B.V.I.
U.S.V.I.
Anguilla
St. Martin
St. Barthelemy
BARBUDA
Saba
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ST. KITTS
NEVIS
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DOMINICA
Martinique
ST. LUCIA
ST. VINCENT
Barbados
THE GRENADINES
GRENADA

PN-ABI-029

COUNTRY ENVIRONMENTAL PROFILE

ST. KITTS and NEVIS

Prepared Under the Aegis Of:

THE CARIBBEAN CONSERVATION ASSOCIATION
St. Michael, Barbados

On Behalf Of:

THE GOVERNMENT OF ST. KITTS and NEVIS
Ministry of Agriculture, Lands
Housing and Development

With the Technical Support Of:

THE ISLAND RESOURCES FOUNDATION
St. Thomas, U.S. Virgin Islands

And

THE ST. CHRISTOPHER HERITAGE SOCIETY
Basseterre, St. Kitts

And

THE NEVIS HISTORICAL AND CONSERVATION SOCIETY
Charlestown, Nevis

Funding Provided By:

THE U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
Regional Development Office/Caribbean
Bridgetown, Barbados

Draft Prepared 1990
Edited and Published 1991

FOREWORD

One of the most serious threats to sustainable economic growth in the Caribbean is the increasing degradation of the region's natural ecosystems and a concurrent deterioration in the quality of life for Caribbean people. The task of reversing this unfortunate trend requires better knowledge and understanding of the region's unique environmental problems and the development of appropriate technologies and public policies to lessen and even prevent negative impacts on our fragile resource base.

In an attempt to provide such a framework, the Caribbean Conservation Association, with funding provided by the United States Agency for International Development and with the technical assistance of the Island Resources Foundation, has produced a series of Country Environmental Profiles for six Eastern Caribbean countries -- Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines.

Even though these documents do not claim to be encyclopedic in their treatment of individual sectors and issues, each Profile represents the most current and comprehensive information base assembled to date on environmental and conservation issues that affect, and are affected by, the development process in the Profile countries.

Each document addresses key environmental problems, constraints, and policy directions as these were identified and fleshed out by a team of researchers and writers, in collaboration with a local coordinating committee. Each Profile also identifies and examines a variety of opportunities and planning tools which may prove useful in meeting environment/development goals in the future. All of this information should play a significant role in informing and influencing ecologically-sound development planning in the region, and should provide a basis for improved decision-making -- both immediate as well as long-term. This may best be accomplished by using the data to define priorities (in view of related benefits and costs), to pursue in-depth analysis of issues, and to undertake necessary follow-on activities in such a way that they are mutually reinforcing. In short, action emanating from the recommendations contained in the Profile might best be undertaken within a comprehensive environmental management framework, rather than from a piecemeal, project-oriented perspective.

The Caribbean Conservation Association is very pleased to be able to make this contribution to development planning in the region.

Calvin A. Howell
Executive Director
Caribbean Conservation Association

(April 1991)

ACKNOWLEDGEMENTS

Overall project management for the St. Kitts-Nevis Country Environmental Profile Project was provided by the Caribbean Conservation Association (CCA) under the direction of Acting Executive Director, Mr. Calvin Howell.

Technical guidance in preparation of the Profile was the responsibility of the Island Resources Foundation (IRF). Dr. Edward L. Towle, President of the Foundation, is the Team Leader for the Profile Project in the Eastern Caribbean; and Judith A. Towle, IRF Vice President, is the Editor of the CEP Report Series.

St. Kitts-Nevis Government liaison for the CEP effort was the Ministry of Agriculture, Lands, Housing and Development, which took the lead in appointing the members of the CEP National Committee (see page ii). Mr. Valdemar Warner, Permanent Secretary for Agriculture, Lands and Housing within the Ministry ably served as chairman of the National Committee.

Local project support for the St. Kitts-Nevis CEP was provided through the offices of two environmental NGOs (non-governmental organizations), both of which executed Memoranda of Understanding with the CCA for coordination and administration of the CEP project. In St. Kitts, the designated NGO was the St. Christopher Heritage Society which provided office and logistical support and other expert assistance to the various members of IRF's in-country technical team. Special appreciation is due to Jacqueline Cramer-Armony, President of the Society, and to Larry Armony, Secretary, for their continued support throughout the project; to Dr. Keith Archibald (a member of the Society and of the CEP National Committee) for his extraordinarily helpful review of draft chapters; and to the office assistant at the Heritage Society, Rodina Griffin, who cheerfully assisted in meeting so many of the project's on-site requirements.

In Nevis, the Nevis Historical and Conservation Society (NHCS) was designated as the executing NGO on behalf of the Profile Project. Early on, the Profile Sub-Committee formed in Nevis, under the auspices of NHCS, elected to take a more direct role in the writing of the CEP report and designated a group of local researchers and writers to assist with this effort (see page iii). Special thanks and appreciation are due to all members of the Nevis Profile working group and, in particular, to Chairman David Robinson, who worked long and diligently to coordinate this important task in Nevis.

Staff at the U.S. Agency for International Development, Caribbean Regional Development Office in Barbados facilitated implementation of the St. Kitts-Nevis Profile Project, in particular, Mission Environmental Officer Rebecca Niec, whose support has been appreciated throughout this effort by both CCA and IRF.

Many organizations, agencies, and individuals in St. Kitts-Nevis provided valuable assistance during the course of the project. To each we extend our gratitude, along with the hope that the Environmental Profile will assist the country in defining and achieving its goals for sustainable development in the decade ahead.

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ACRONYMS USED IN THE ST. KITTS and NEVIS COUNTRY ENVIRONMENTAL PROFILE

BDD	British Development Division
BWI	British West Indies
CAEP	Caribbean Agricultural Extension Project
CANARI	Caribbean Natural Resources Institute (formerly ECNAMP)
CARDATS	Caribbean Agricultural Rural Development Advisory and Training Service
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community
CCA	Caribbean Conservation Association
CDB	Caribbean Development Bank
CEHI	Caribbean Environmental Health Institute
CEP	Country Environmental Profile
CERMES	Center for Resource Management and Environmental Studies (UWI)
CHA	Central Housing Authority
CIDA	Canadian International Development Agency
CIDE	Center for International Development and Environment
CICP	Consortium for International Crop Protection
CITES	Convention on International Trade of Endangered Species of Wild Flora and Fauna
CTO	Caribbean Tourism Organization (formerly Caribbean Tourism Research and Development Center)
CTRC	Caribbean Tourism Research and Development Center (now Caribbean Tourism Organization)
CZM	Coastal Zone Management
DESFIL	Development Strategies for Fragile Lands Project (USAID)
DOS	Directorate of Overseas Surveys
ECCB	Eastern Caribbean Central Bank
ECLAC	Economic Commission for Latin America and the Caribbean (United Nations)
ECNAMP	Eastern Caribbean Natural Area Management Program (renamed 1989 as Caribbean Natural Resources Institute, CANARI)
EE	Environmental Education
EEC	European Economic Community
EEZ	Exclusive Economic Zone
EDF	European Development Fund
EIA	Environmental Impact Assessment
EMU	Environmental Management Unit
FAO	Food and Agriculture Organization of the United Nations
FBDC	Frigate Bay Development Corporation
GDP	Gross Domestic Product
GOSKN	Government of St. Kitts and Nevis (found in the Bibliography under St. Kitts and Nevis Government)
GTZ	German Agency for Technical Co-operation (Deutsches Gessellschaft fur Technische Zusammenarbeit)
ICOD	International Center for Ocean Development (Canada)
IICA	Inter-American Institute for Cooperation on Agriculture
IMO	International Maritime Organization
IPA	Investment Promotion Agency
IRF	Island Resources Foundation

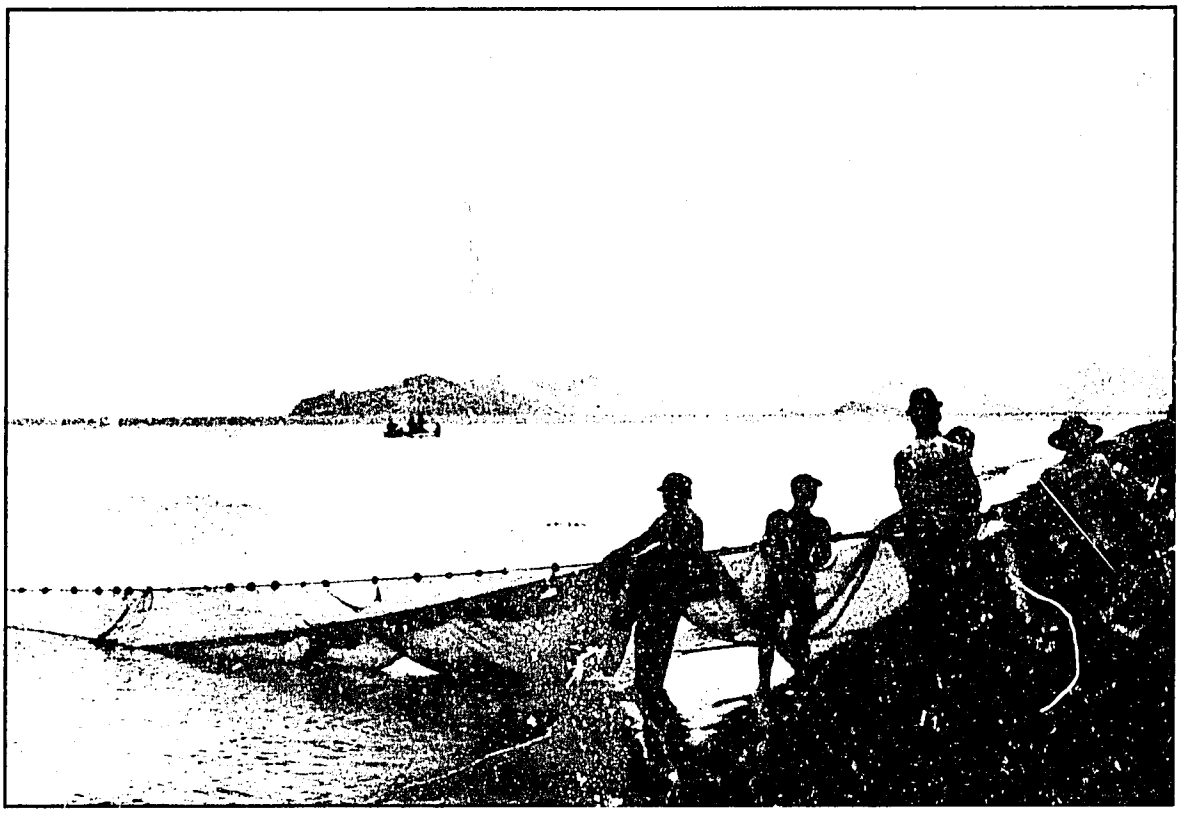
IUCN	International Union for Conservation of Nature and Natural Resources
KPA	Ker, Priestman and Associates
LAC	Latin America and the Caribbean
NACO	National Agricultural Corporation
NCEPA	National Conservation and Environment Protection Act
NEEC	Nevis Environmental Education Committee
NGO	Non-Governmental Organization
NHCS	Nevis Historical and Conservation Society
NHLDC	Nevis Housing and Land Development Corporation
NIA	Nevis Island Administration
OAS	Organization of American States
OECS	Organization of Eastern Caribbean States
OECS-NRMP	Organization of Eastern Caribbean States-Natural Resources Management Project (currently reestablished as Natural Resources Management Unit)
PAHO	Pan American Health Organization
PPU	Physical Planning Unit
SCHS	St. Christopher Heritage Society
SEP	Southeast Peninsula
SEPLD&CB	Southeast Peninsula Land Development and Conservation Board
SKANTEL	St. Kitts and Nevis Telecommunications Ltd.
SKN	St. Kitts and Nevis
SKNED	St. Kitts-Nevis Environment and Development
SSMC	St. Kitts Sugar Manufacturing Corporation
TDC	Trading Development Corporation
TFAP	Tropical Forestry Action Plan
TFR	Total Fertility Rate
TRD	Tropical Research and Development
UK	United Kingdom
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
US	United States
USAID	U.S. Agency for International Development
USAID/RDO/C	U.S. Agency for International Development/ Regional Development Office/Caribbean
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USVI	U.S. Virgin Islands
UWI	University of the West Indies
WHO	World Health Organization
WWF	World Wide Fund for Nature (International)
WWF-US	World Wildlife Fund (U.S.)

Abbreviations Used In The Country Environmental Profile

ac	acre	kn	knot
BOD	biochemical oxygen demand	kV	kilovolt
cm	centimeter	kW	kilowatt
COD	chemical oxygen demand	kWh	kilowatt-hour
EC$	Eastern Caribbean Dollar	lb	pound
ft	foot	m	meter
g	gram	MG	million gallons
gpd	gallons per day	MGD	million gallons per day
gph	gallons per hour	mi	mile
gpm	gallons per minute	ML	millions of liters
ha	hectare	ml	milliliter
Igpd	Imperial gallons per day	mm	millimeter
Igpm	Imperial gallons per minute	MW	megawatt
in	inch	ppm	parts per million
kg	kilogram	US$	American Dollar (US$1.00 = EC$2.67)
km	kilometer		

Conversion Coefficients Between Imperial Measures and Weights And The Metric System

	Imperial	Metric System
LENGTH	1 inch	2.540 centimetres
	0.39370 inch	1 centimetre
	1 yard	0.91440 metre
	1.094 yards	1 metre
	1 mile	1.609 kilometres
	0.6214 mile	1 kilometre
	1 fathom (6 feet)	1.829 metres
AREA	1 square foot	0.093 square metre
	10.6 square feet	1 square metre
	1 acre	0.405 hectare
	2.471 acres	1 hectare
	1 square mile	2.59 square kilometres
	0.386 square mile	1 square kilometre
VOLUME	1 pint	0.568 litre
	1.76 pints	1 litre
	1 gallon	4.546 litres
	0.220 gallon	1 litre
	1 cubic foot	0.028 cubic metre
	35.31 cubic feet	1 cubic metre
WEIGHT	1 pound	0.4536 kilogram
	2.205 pounds	1 kilogram
	1 long ton	1016 kilograms
	1 short ton	907.185 kilograms
	0.9842 long ton	1 tonne (1,000 kilograms)
	1.102322 short ton	1 tonne (1,000 kilograms)
TEMPERATURE	Conversion F to C: subtract 32 and divide by 1.8	Conversion C to F: multiply by 1.8 and add 32



Bringing in the nets, Pinneys Beach, Nevis (1974).

INTRODUCTION

Preparation of Country Environmental Profiles (CEPs) has proven to be an effective means to help ensure that environmental issues are addressed in the development process. Since 1979, the U.S. Agency for International Development (USAID) has supported Environmental Profiles in USAID-assisted countries. Those completed to date have provided:

(1) a description of each country's natural resource base, including a review of the extent and economic importance of natural resources and changes in the quality or productivity of those resources;

(2) a review of the institutions, legislation, policies and programs for environmental planning, economic development and natural resource management;

(3) identification of the major issues, conflicts or problems in natural resource management and opportunities for effective responses.

Profiles have highlighted gaps in the existing information base, suggested new guidelines for the design and funding of development programs, pinpointed weaknesses in regulatory or planning mechanisms, and illustrated the need for changes in policies. Most importantly, the process of carrying out a profile project has in many cases helped establish new working relationships and even consensus among government and non-government bodies concerned with environmental issues and has also served to strengthen local institutions and improve their capacity for incorporating environmental information into development planning.

PROFILES FOR THE EASTERN CARIBBEAN

Country Environmental Profiles have been prepared for several countries in the Wider Caribbean Region, including Panama, Belize, the Dominican Republic, Haiti, and Jamaica. The potential utility of CEPs in the Eastern Caribbean sub-region (essentially the OECS countries) has been a subject of discussion since the early 1980's. The need for the profiling process to begin in those countries was reaffirmed during a seminar on Industry, Environment and Development sponsored by the Caribbean Conservation Association (CCA) and the University of the West Indies in August 1986.

Shortly thereafter, USAID entered into a Cooperative Agreement with CCA for preparation of a series of CEPs for the Eastern Caribbean. It was decided to begin the profile process in the country of St. Lucia as a pilot project, to be followed by profiles for Grenada, Antigua-Barbuda, Dominica, St. Kitts-Nevis, and St. Vincent and the Grenadines.

Early in 1987, CCA and the Island Resources Foundation (IRF), of St. Thomas, U.S. Virgin Islands, entered into an agreement whereby it was determined that IRF would provide technical assistance and support to CCA in the execution of the profile project in the Eastern Caribbean. The Executive Director of the Caribbean Conservation Association is the CEP Project Director, while the President of the Island Resources Foundation serves as CEP Project Manager/Team Leader.

THE ST. KITTS-NEVIS COUNTRY ENVIRONMENTAL PROFILE

Early in 1990 a Memorandum of Understanding (MOU) was signed by CCA and the Government of St. Kitts and Nevis (GOSKN) for the purpose of executing a Country Environmental Profile, with the Ministry of Agriculture, Lands, Housing and Development selected as the counterpart agency for Government. A National CEP Committee was formed as an advisory, technical information, and review body for the CEP Project. The committee is comprised of representatives from GOSKN agencies and private sec-

tor organizations concerned about development and the environment.

At the same time, the St. Christopher Heritage Society (SCHS), a local non-governmental organization, was designated by CCA and GOSKN as the local implementing and coordinating group for the CEP Project in St. Kitts and the Nevis Historical and Conservation Society (NHCS) as the counterpart group in Nevis.

The CEP National Committee was called on to support the project in a variety of ways, most importantly in helping to identify environmental issues, to obtain reference materials, and to coordinate and assist with the in-country review of materials prepared by the CEP technical writing team. A broad spectrum of individuals was selected locally to participate in the review of the Profile, on a chapter-by-chapter basis.

The Nevis sub-committee for the Profile project, formed under the aegis of the Nevis Historical and Conservation Society, elected to take a more direct role in the writing of the CEP report and designated a group of researchers and writers to assist with this effort in Nevis. A coordinating sub-committee of 27 persons was established, and nine individuals were commissioned to take on responsibility for providing material for the Nevis sub-component of the Country Environmental Profile.

The headquarters of the St. Christopher Heritage Society in downtown Basseterre also served as the headquarters of the CEP Project. The staff and members of SCHS were most supportive of the project and greatly facilitated completion of the report within what was a very demanding time frame. During the course of the CEP project, a significant collection of environmental reference materials on St. Kitts-Nevis and the Eastern Caribbean was made available to both counterpart NGOs in St. Kitts and Nevis. These collections will remain in the country and, in the case of the newer St. Christopher Heritage Society, form the nucleus of a new environmental library and, in the case of the older Nevis Historical and Conservation Society, augment the archives/library already established by NHCS, supplementing the more historically-focused collection with natural history materials. Both "information centers" will serve the local communities in St. Kitts and Nevis long after the completion of the Profile Project.

The draft Profile Report was prepared during a three month period, June - August, 1990, with draft chapters circulated to in-country reviewers for comments and input as each was readied by the CEP technical team. The full CEP document, in "draft final" format, was completed in September and disseminated for final review both in St. Kitts-Nevis and to other reviewers in the Caribbean region.

ORGANIZATION OF THE ST. KITTS-NEVIS CEP REPORT

As determined by the CEP Committees in St. Kitts and Nevis and the IRF technical writing team, the Country Environmental Profile has been organized in nine primary sections. Each sector-specific chapter provides the reader with an overview summary of the sector, reviews key environmental problems and issues within the sector, and concludes with recommendations specific to that sector.

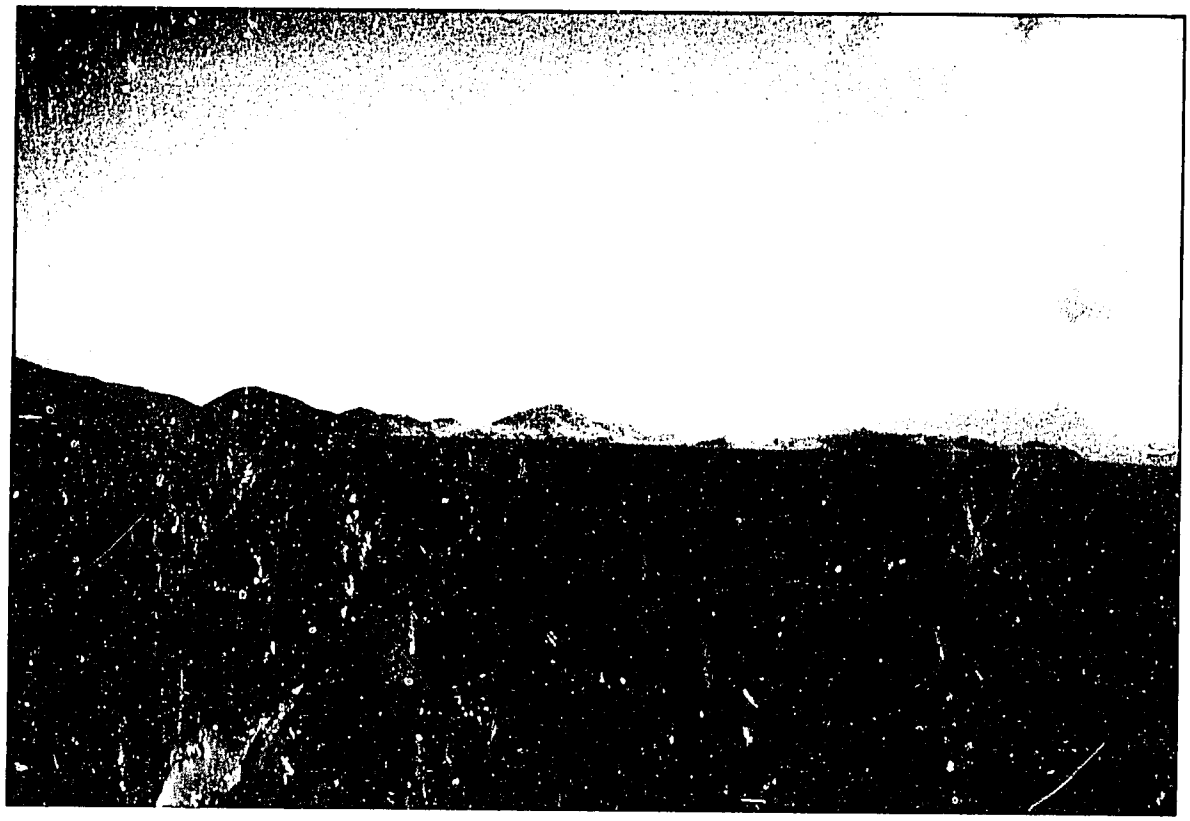
SECTION ONE provides background information on the general environmental setting of the country and briefly reviews historical, economic and demographic features. SECTION TWO is a review of the natural resource base, including a discussion of primary environmental issues within four key resource sectors: forests and watersheds, fresh water resources, biodiversity and wildlife, and coastal and marine resources.

The Profile moves away from an examination of the physical environment to consider key economic sectors which depend on sustainable resource management. First, in SECTION THREE, the Profile looks at agriculture and then tourism in SECTION FOUR.

SECTION FIVE considers issues related to park planning, protected areas management, and the preservation of historical resources. Pollution and environmental health form the focus of SECTION SIX, and the related topics of land use, physical planning, and development control are examined in SECTION SEVEN.

The subject of SECTION EIGHT is the institutional framework for environmental management in St. Kitts-Nevis, including an overview of key agencies and organizations with resource management and development responsibilities. The final chapter, SECTION NINE, provides a summary and synthesis of critical environmental issues, conclusions, and recommendations.

A comprehensive bibliography of source materials dealing with natural resource development and environmental management is found at the end of the Profile. Most references cited deal specifically with St. Kitts-Nevis or with the Eastern Caribbean sub-region. It is the most thorough assemblage of such reference material on St. Kitts-Nevis to be published to date.



In the background, the Southeast Peninsula of St. Kitts, with the island of Nevis rising to the right, as seen from the western side of Basseterre Harbor, near Ft. Thomas.

SECTION 1 INTRODUCTION

1.1 OVERVIEW

1.1.1 Landscape and the Changing Environment

St. Christopher and Nevis are but two of an extended archipelagic clustering of oceanic islands in the Eastern Caribbean known collectively as the Lesser Antilles (Figure 1.1(1)). This biogeographic grouping is notable among scholars and tourists alike for its cultural, environmental and geomorphological diversity. The current environmental profiling exercise, of which this document is the last in a series of six covering the OECS independent countries, has helped define the extent to which differences among the islands in natural and physical resource endowments have shaped and continue to affect human and institutional development.

While all Eastern Caribbean islands share certain valuable natural amenities, such as a favorable climate, a rich cultural heritage, luxuriant coral reefs and a wide selection of colorful and attractive people, flora and fauna, not everything is distributed evenly. Some islands, like Antigua, have insufficient rainfall and a surfeit of droughts; while others, like Dominica, experience an excess of rainfall with associated cloudy weather, landslides and flooding. Only two island states, Grenada and St Lucia, have a good, naturally-protected harbor, while none of these islands escape the danger of hurricane damage.

But risk factors and levels vary greatly. St. Vincent, for example, lives with the ominous threat of a recently active volcano; conversely, Nevis has geothermal springs at the Baths and St. Lucia has the good fortune of newly confirmed geothermal power. Barbados recently found and now exploits subterranean natural gas and oil deposits, while St. Lucia and St. Eustatia have had to settle for the containers, i.e., an oil transshipment bulk terminal (or tank farm) with an elevated risk of oil spills. St. Kitts shares with Nevis the double luxury of having both an adequate supply of groundwater (at least for current needs) and three-fourths of all its land being suitable for agriculture on well-drained fields of less than ten degree slope. This is in contrast to Grenada, St. Vincent and Dominica -- which have to make do with very little flat land since eighty percent of each has slopes steeper than 21 degrees.

Amidst this assembly of diverse island ecosystems that form the northeasterly boundary of the Caribbean basin, St. Kitts (called this as a shortened version of St. Christopher since the eighteenth century) and Nevis (pronounced "nee-vis" except by tourists) have together succeeded in fashioning for themselves a national identity and a public image of uniqueness derived in part from the country's distinctive, dramatic and spacious landscape profile. Each island, one larger, one smaller, is dominated by a single, fairly youthful volcanic cone surrounded by fertile slopes, called glacis, falling away almost uniformly but always gracefully towards the sea in all directions. There is little of the flatness of a Barbados, only a touch of the dryness of an Antigua, and none of the mountainous irregularity of a Grenada, a St. Vincent, a St. Lucia or a Dominica -- with their convoluted interior terrain and maze-like radiating ridges, spurs and deep, isolated valleys, bound together by a narrow coastal strip of densely-populated land which guards the few entries to less accessible hinterland.

By way of contrast, the so-called hinterland of St. Kitts and Nevis is open for all to see, from coastline to mountain top in one continuously graceful sweep, a verdant display of micro-habitat variation and altitudinally-conditioned biodiversity. The whole is comprehensible, center to edge, core to periphery, the inside and the outside are one. Even the central massif is crossed by the old military road at Phillips Level in St. Kitts; while Nevis, two centuries ago, had an upper level, circular road around Nevis Peak at about the 1,000 foot contour level with open, cultivated land above this road. Perhaps this openness, this

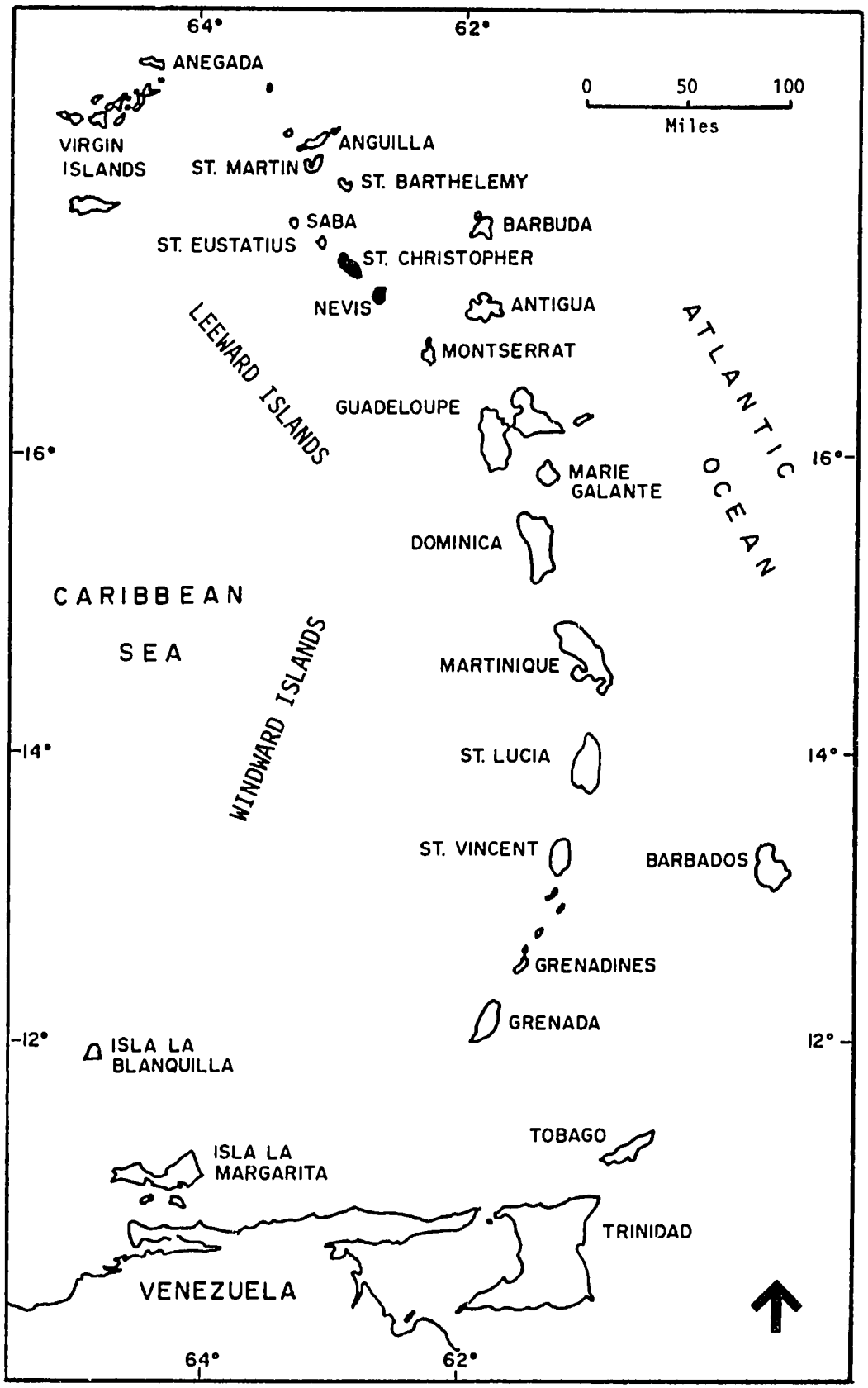


Figure 1.1(1). General map of the Eastern Caribbean, showing the location of St. Kitts and Nevis.

variable display of nature's vegetational splendor in the sunlight and the rain, is why Kittitians and Nevisians take obvious pride in what their separate but almost linked pair of islands looks like, from the air, from land and from the sea. They talk about it, and they are quite aware of its history. They seem to have an innate sense of understanding that the assembled landscape features, both natural and man-made, really do constitute a remarkable resource, part of the national patrimony, and a thing of value that is priceless.

These islanders sense what Alexander Pope was referring to when he said, " . . . in everything, respect the genius of the place" (*Essays on Man*, 1733). And the signs of institutionalized concern are all about the landscape. In St. Kitts, there is the newly established (National) Conservation Commission, a new national park, the new St. Christopher Heritage Society, and the Chamber of Commerce's "Beautiful Basseterre" project with its special concern for urban landscape and vernacular architecture. In Nevis, the Historical and Conservation Society is about to undertake a major environmental research project with external funding, the local Environmental Education Committee was the 1990 recipient of an Eastern Caribbean "Earth Day" award, a restoration initiative for the Baths is in train, and current land zoning initiatives are setting a standard for the country and the region. In sum, concern for maintaining environmental quality, including key landscape features, is growing.

This distinguishing feature, the biogeographical face of the country we call the landscape, was shaped in its present form not just by nature but by the interaction of man and nature over time. In St. Kitts, several centuries of conscientious land husbandry on sugar estates have left an aesthetically pleasing, orderly, well-proportioned rural landscape or "countryside", disproving the universality of the customary argument about the damaging effects of plantation-based monoculture -- or at least confirming a Kittitian exception to the rule. Meanwhile, the long, less satisfactory experience of Nevis with sugar, at least until the 1950's, and since then with free-grazing goats, sheep, cattle, and pigs has scarred and ravaged a vegetation that would have otherwise helped stem wind and water erosion and reduced the impact of sediments transported by run-off to coastal waters and reefs. Yet, on this subject, there are still some modest site-specific lessons to be learned, as will be discussed in the Profile.

In retrospect, the man-landscape dialogue and "development" process in St. Kitts, and to a degree in Nevis, over the past several centuries have evoked a strikingly successful compromise between the disorderly, unplanned, lushness of tropical ecosystems and settlements (both are land-hungry) and the neat, serene and orderly but efficiently liveable, planned and manicured landscapes that are so characteristic of rural English and some European countrysides where the process of conserving, shaping and designing landscape is more a calculated objective and the result of effective land stewardship practices than an accidental by-product. The response of the Nevis landscape to human tenancy differs markedly from the St. Kitts experience.

The two islands are, of course, only separated physically by a modest ocean channel known appropriately as the "Narrows," which is neither wide nor deep but is nonetheless metaphorically profound (see Figure 1.1(2)). This situation is reflected in the unique kind of binary "Federation" under which the two officially operate as one. The shaping of the content and even the format of this Country Environmental Profile owes something to an awareness of the special relationship that exists between the two island systems that function together and separately at the same time. It also reflects concern that different problems may require quite different solutions or that the same problem in different places may also require different resolutions. As a consequence, this document is really two profiles in one, and the reader will note virtually all chapters have two separately presented sections, one on St. Kitts and one on Nevis, followed by a set of recommendations that deal with both island units and the country as a whole.

The decade of the 1990's will see extraordinary changes in both St. Kitts and Nevis and will require equally extraordinary resource management responses by the state.

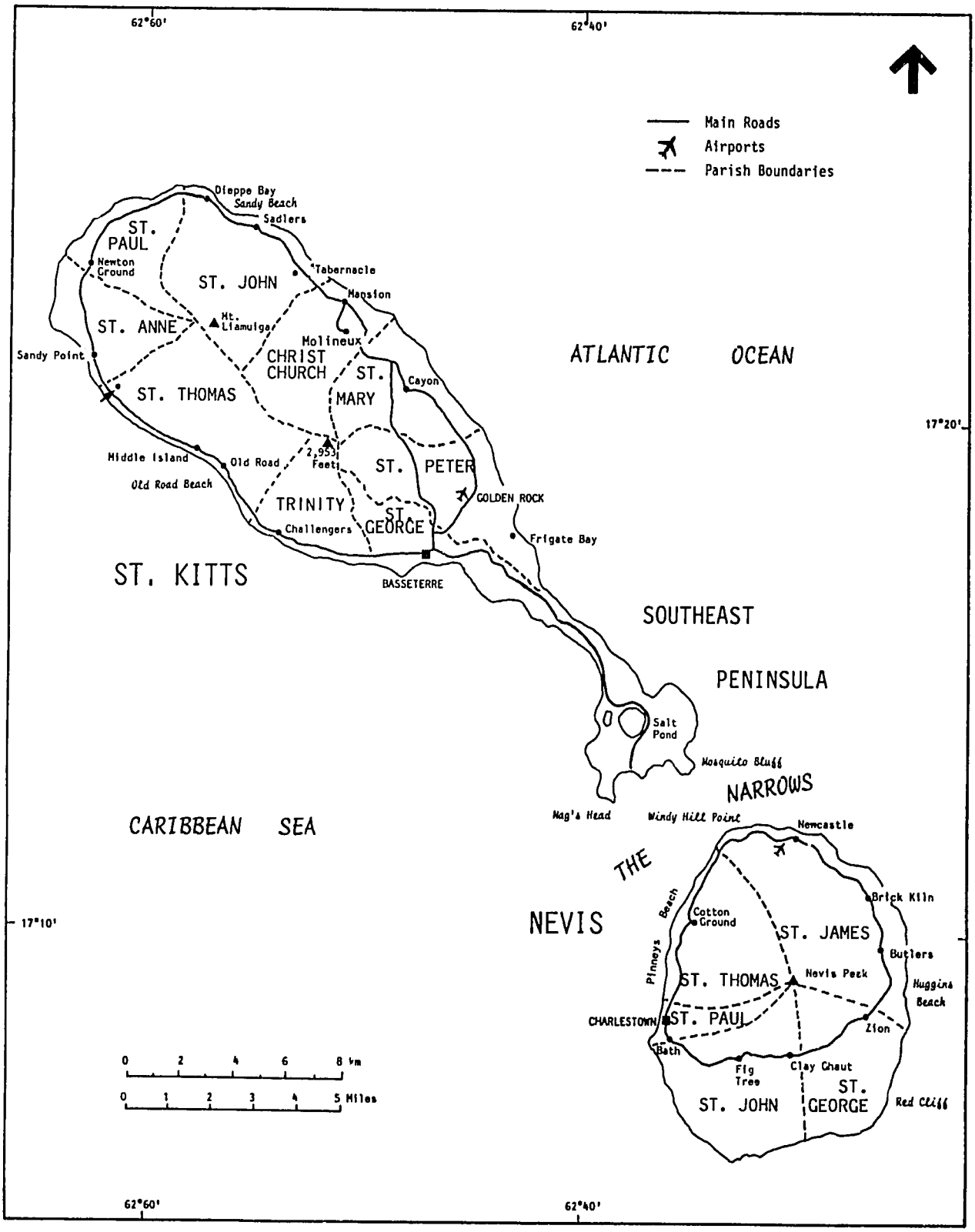


Figure 1.1(2). General location map for the islands of St. Kitts and Nevis.

With annual sugar production in St. Kitts down to 15,000 tons in 1990 (from 50,000 tons in the 1950's), the shift to more diversified agriculture and agro-forestry will accelerate rapidly, as will the risk of massive changes in the configuration of the island's traditionally open, well-husbanded landscape. Simultaneously, manpower and labor costs will become problematic once the 4,000 acre Southeast Peninsula, now open for investment, becomes an expansive construction site filling the decade with its demands for people, services and funds. Furthermore, the specialized environmental management required for this drier more fragile landscape, being reshaped to a standard twice that of Frigate Bay, will place an escalating strain on the state's limited pool of trained technicians and professionals with expertise in environmental specialties and procedures like impact and risk assessment, pollution monitoring, damage mitigation, and ecological restoration.

For Nevis, the changes of the decade have already begun with the development of a new hotel-condominium tourism resort complex at Pinneys Estate. Adjusting to its unprecedented scale and its infrastructural needs will be a major task in its own right -- especially following the unplanned environmental "changes" launched by Hurricane Hugo in September 1989. Since it is quite likely that for the near future Nevis can expect the unexpected in terms of environmental impacts, careful, anticipatory planning is in order for the island.

The dilemma confronting the Kittitian and Nevisian resource and development planner in the 1990's who tries to manage external development pressures while also being responsive to local environmental imperatives is best illustrated by the following couplet from a twentieth century poet concerned about the impact of continentally-based institutions and enterprises on islands:

The tidal wave devours the shore
There are no islands anymore.

(Edna St. Vincent Millay)

All islands face the same combination of opportunity and risk, the same marketing strategies for continentally-generated development theories, the same pressures of exogenous television advertising, the same "high-tech" quick fix for complex local problems, and the same kind of siren song of growth and modernization and material progress. Most will succumb. Some will lose their sense of place. Some will resist. And some will succeed, finding creative alternatives. Some may even lead because they appreciate that the difference between just growth and real development is largely environmental and only sustainable development ensures the viability of the supporting natural resource base. This Environmental Profile, reflecting the concern of the St. Kitts and Nevis CEP National Committee, is about the state of that resource base at the beginning of the decade of the 1990's in this Eastern Caribbean country. What will it be like in the year 2000?

1.1.2 Historical Overview of the Nation

"WHAT'S PAST IS PROLOGUE . . ."

St. Kitts and Nevis were among the Caribbean islands sighted and named by Columbus during his voyage of 1493. At the time, St. Kitts (and possibly Nevis) was inhabited by Carib Indians, the last of several waves of seafaring immigrants from South America who settled the Caribbean islands during the prehistoric period. The first wave of settlers had arrived around 2500 B.C. (Goodwin, 1978a; Armstrong, 1980). About the time of Christ, these hunters and gatherers were succeeded by agriculturalists known as the Arawaks. The Carib Indians, who called St. Kitts "Liamuiga" or fertile island, displaced the Arawaks not long before Columbus' fleet sailed into view.

While Indian population size remains conjectural, recent archaeological investigations indicate that at times it was rather high on St. Kitts, and that land use was very intensive (Goodwin 1980). It is quite likely that several millennia of shifting, slash and burn agriculture by aboriginal horticulturalists destroyed much of the climax forest on St. Kitts,

ST. KITTS "VITAL STATISTICS"

LOCATION	Latitude: 17 degrees 15 minutes North Longitude: 62 degrees 45 minutes West
AREA	176 sq km (68 sq mi); 36.8 km (23 mi) long, roughly oval in shape with a narrow neck of land extending like a handle from the southeastern end
POPULATION	Estimated at 37,000 with census scheduled for 1991 (some projections as high as 40,000); population concentrated in the Greater Basseterre area which may account for over half the total population; population density is 209 persons per sq km (1987)
CAPITAL	Basseterre (approximate population, 18,500, with density of 550 persons per sq km projected for 1990)
HIGHEST POINT	Mount Liamuiga, 1,156 m (3,792 ft)
CLIMATE	Tropical and maritime, heavily influenced by steady northeast trade winds with an average temperature of about 81 degrees F (27 degrees C)
RAINFALL	Annual average is 64 inches (1,625 mm)
PHYSICAL FEATURES	Central mountain range dominated by Mount Liamuiga surrounded by cane-covered slopes, dissected by ghauts, reaching to the sea. The southern branch of the range encloses a spacious fertile valley and the capital of Basseterre. Golden sandy beaches surround the Southeast Peninsula, although most island beaches are of grey to brown volcanic sand.
ECONOMIC ACTIVITIES	Until recently, the only remaining sugar monoculture in the Eastern Caribbean; faced with continuing reductions in sugar market, Government has embarked on a program to diversify the agriculture sector and stimulate development of other sectors, especially tourism and light manufacturing and crafts.
TOURISM	Tourism is gradually replacing agriculture as the major economic sector and is an important source of foreign exchange. Prior to development of Frigate Bay resort area in 1972, tourism focused on small, locally-owned hotels and guest houses. With the recent completion of a road to the Southeast Peninsula, this 4,000 acre area will become the target of major tourism expansion.
AIRPORT	Golden Rock Airport with 8,000 ft of paved runway and night-landing facilities.
MAJOR PORT	The deep water port at Basseterre can accommodate ships of up to 35 ft (10.5 m) draught at its 410 ft (125 m) wharf. It has a 90 ft (27 m) wide roll on/roll off facility.

NEVIS "VITAL STATISTICS"

LOCATION	Latitude: 17 degrees 10 minutes N; Longitude: 62 degrees 35 minutes W 3 km (2 mi) southeast of St. Kitts
AREA	93 sq km (36 sq mi); 12.3 km (7.64 mi) long and 9.6 km (5.96 mi) wide
POPULATION	Estimated at 9,600; most dense around Charlestown (St. Paul's Parisn) and Gingerland (St. George's Parish). Average population density (1980) is 102 per sq km; 37 percent of the population is under 15 years of age and less than 10 percent over 65.
CAPITAL	Charlestown (approximate population, 1,700)
HIGHEST POINT	Nevis Peak, 985 m (3,232 ft)
CLIMATE	Tropical and maritime, heavily influenced by steady northeast trade winds with an average temperature of about 81 degrees F (27 degrees C)
RAINFALL	Annual average is 46 in (1,170 mm)
PHYSICAL FEATURES	Nevis is of volcanic origin and is dominated by a central peak (Nevis Peak) usually embraced by clouds. Deep ghauts (guts) dissect slopes from below the Peak to the sea with no regular stream flow except during heavy rains. There are no bays, inlets or cays of significance, but long stretches of golden, sandy beaches surround much of the island. Growth cover is extensive but not dense, and many wetlands occur along the leeward coast.
ECONOMIC ACTIVITIES	Agriculture, tourism, fisheries, boat building, commercial trading, construction trades and a very small manufacturing sector. There are an estimated 1,129 part- and full-time farmers and 350 part- and full-time fishermen.
AGRICULTURAL PRODUCTION	Vegetable crops, citrus (variety of both with no dominant crop); cattle, sheep, goats, pigs (many free-grazing)
TOURISM	Concentrated along Pinneys Beach area from Charlestown to Newcastle and in the Gingerland area between approximately 800 and 1,000 feet. The total number of rooms is approximately 420 and will increase to 616 with the completion of a large resort in 1991.
AIRPORT	Newcastle on the northern end of the island is the sole air strip with a 2,500 foot runway for 18 seater planes only. Expansion is planned at Newcastle or relocation of air facilities to Indian Castle.
MAJOR PORT	Charlestown, with a 368 ft (112 m) long pier and maximum water depth of 15 ft (4.5 m); there is also a small pier at Newcastle but it is not heavily used. There is a regular ferry service between St. Kitts and Nevis.

and perhaps Nevis also, well before the arrival of Europeans.

The island of Nevis has a prehistory that dates back to at least 2000 B.C. Preceramic people left evidence of their habitation in the finely crafted stone tools found on the island. Flint cutters and stone implements, made from material not available in Nevis, indicate the movement of Amerindian peoples, while recently investigated middens reveal beautifully formed and intricately colored pottery, providing clues to the technical sophistication of these early cultures.

Like St. Kitts, the written history of Nevis begins with the account of the island as recorded by Columbus in 1493. Its name is derived from "Nuestra Senora de las Nieves" which means Our Lady of the Snows and refers to the cloud cover which almost always encircles Nevis Peak. The Caribs, the last Amerindian group to inhabit the island, called it "Oualie" or land of beautiful water.

Although Columbus claimed St. Kitts and Nevis for Spain, the Spanish made no attempt to colonize them, preferring the larger islands of the region. Thus Carib dominion lasted until the early seventeenth century when land-hungry northern Europeans descended upon the Eastern Caribbean. In 1624 a small party of Englishmen led by Thomas Warner landed at St. Kitts and was allowed by Caribs, led by Chief Tegreman, to establish a settlement near their village at Old Road. This became the first permanent European settlement in the Lesser Antilles. A few months later a band of French privateers headed by Pierre Belain, Sieur d'Esnambuc, arrived and was also welcomed by the Caribs. In 1626 the French and English set the stage and tone of their joint conquest of the Eastern Caribbean by massacring and enslaving their hosts.

The French and English divided St. Kitts between them and, fearful of being annihilated by the Spanish, managed a precarious but generally peaceful co-existence for forty years. The English made Old Road their capital, while the French established villages at Basseterre and Dieppe Bay. From these bases, they expanded into the surrounding islands. In 1628 a group of Englishmen led by Anthony Hilton moved to Nevis, where they established a settlement named Jamestown. During the next few years other Englishmen from St. Kitts also colonized Antigua and Montserrat, while parties of Frenchmen conquered Guadeloupe and Martinique. For giving birth to these and other imperial seedlings, St. Kitts became known as the "Mother Colony" of the Eastern Caribbean.

St. Kitts also developed a reputation as one of the most fertile of all Caribbean sugar colonies, although its emergence as a sugar monoculture took almost a century to achieve. The seventeenth century plantation system of St. Kitts and Nevis was characterized by crop diversity, self-sufficiency and small, widely dispersed units of production. Slave laborers were imported from Africa to help clear the forests and till the fields, but prior to 1700 they were only slightly more numerous than Europeans (Dunn, 1972; Sheridan, 1973).

Sugar cultivation was introduced in the 1640's, but only in Nevis -- which had become a regional slave trading center -- did it gain immediate ascendency. Most of Nevis below 2,000 feet in elevation has been cultivated since the late 1600's, and as early as 1687 it was reported that "the clearing of land extended almost to the top of the central mountain" (Sloane, 1707). Development of sugar plantations on St. Kitts was retarded by four decades of intermittent colonial warfare. Between 1666 and 1706 the French and English took turns attacking and seizing each other's territory on St. Kitts, while Nevis was twice overrun and ransacked by French forces. Eventually, the English gained the upper hand, and in 1713 France ceded its portion of St. Kitts to Great Britain. The French lands were distributed in large parcels to aspiring sugar planters and Basseterre became the new capital and chief port.

Expulsion of the French opened the way for rapid expansion of the sugar industry on St. Kitts, and between 1715 and 1735 its diversified agricultural economy gave way to sugar monoculture and to the rapid expansion of plantation slavery (Sheridan, 1973). During this period its population quadrupled, from

5,000 to 21,000 due to massive importations of slave labor. By mid-century, St. Kitts had one of the highest population densities in the Caribbean, with 367 persons per square mile.

The sugar revolution had profound and long reaching consequences for St. Kitts and Nevis. In order to maximize exploitation of environmental and human resources, sugar plantation populations were concentrated into nucleated settlement sites that combined residential and manufacturing functions. Slave laborers cleared away the remnant forest and converted all arable land into cane fields. Marginal land became pasture and provision grounds. The plantations thus totally transformed insular environments into distinctive cultural landscapes that have persisted, with minor modifications, into the present.

By concentrating resources and wealth into the hands of a few landholders and relegating the rural working class to conditions of scarcity, deprivation and powerlessness, the sugar plantations also engendered and perpetuated a complex social structure and set of social relations, attitudes and behaviors that only recently have begun to unravel.

Sugar plantations dominated St. Kitts and Nevis throughout the eighteenth and nineteenth centuries. Fluctuating market conditions after 1820 and labor problems arising from slave emancipation in 1838 brought a century of prosperity to an end, but the plantocracy managed to survive by consolidating landholdings, mechanizing field work, adopting new processing technologies and reducing wage payments. Unable to obtain land of their own, many under-paid ex-slaves elected to emigrate in search of greater economic opportunities and personal freedom, thus giving rise to a migrant tradition and culture that persists into the present. Those who stayed behind settled in village communities on rented estate land, thereby altering somewhat the eighteenth century settlement patterns (Richardson, 1983).

On Nevis, the sugar plantation economy began to disintegrate at the beginning of the twentieth century, when most local planters found it impossible to compete with European beet sugar in the British market. Many planters shifted to the cultivation of Sea Island cotton or to cattle raising. Others parcelled out their land to smallholders. By the 1930's Nevis had a substantial free-holding peasantry which has continued to grow in size and productivity. The last Nevisian sugar mill shut down in 1958, and the last commercial crop was harvested in 1969 (Richardson, 1983). Today most cultivation focuses on vegetables, fruits and some pasturing grasses for animal production.

Over the years, Nevis has made a number of important contributions to the historical development of the region. One of the earliest ventures in tourism was the Bath Hotel, built in 1778 on a site overlooking Charlestown and adjacent to natural hot springs which attracted European travellers for many years. Two men who played important roles in world history -- Alexander Hamilton and Lord Admiral Horatio Nelson -- were linked to Nevis. The first Secretary of the Treasury of the United States, Hamilton was born in Nevis in 1757, and his birthplace has been reconstructed as a museum in Charlestown. Lord Nelson, England's most famous admiral, used Nevis as a base of operations during the mid-1780's, and it was here he subsequently married a Nevisian, Frances Nisbet, in 1787.

In contrast to Nevis, sugar has remained the mainstay of the Kittitian economy, although the plantation system has recently been jettisoned. The industry was saved by the establishment of a central factory in 1912, which made it possible for individual estates to shut down their antiquated mills and factories and concentrate solely on cane cultivation. The 50 or so sugar plantations that remained operational during the twentieth century were linked to the corporately-owned central factory by a narrow gauge railway completed in 1926. In 1975-1976 the St. Kitts Government nationalized the surviving sugar plantations and the central factory, thereby centralizing all operations under state direction. Thus, the sugar industry lives on, although its future prospects hardly look as bright as in decades past.

CONSTITUTIONAL HISTORY

Throughout its brief history, French St. Kitts was administered by an all powerful governor appointed in the Mother Country. In English St. Kitts-Nevis, efforts by local governors and their metropolitan sponsors to establish a similar form of one-man rule met with fierce colonial opposition. As a consequence, a modified form of representative government evolved, consisting of an appointed Governor and Council and an elected Legislative Assembly (Dunn, 1972).

At first St. Kitts and Nevis each had its own government. But in 1660 the federal principle was introduced, whereby the two islands were combined with several others into a single administrative unit known from 1670 onward as the Leeward Islands. Under this arrangement, a Governor-General appointed in England administered the federated Leeward Islands, while individual islands made their own laws and enjoyed limited self-government under the direction of an appointed Lieutenant Governor and Council and an elected Assembly. Local government was by and for the plantocracy, which alone possessed sufficient property to vote and to hold office (Dyde, 1989).

This plutocratic form of representative government lasted just over two centuries. The first major modification occurred in 1866, when the Council and Assembly were merged into a unicameral Legislative Council, with half of its members appointed and half elected. In 1878 the Legislative Council passed a law providing that all of its members be nominated by the Crown. Concurrently, there were changes in the federal arrangement. In 1871 St. Kitts and Nevis, as individual members of the federated Leeward Islands, were organized into Presidencies, each with its own Administrator and Legislative Council. Then, in 1882, Nevis, St. Kitts and Anguilla were combined into a single Presidency.

Representative government was reestablished in 1937, when provision was made for the election of five seats on the Legislative Council, three from St. Kitts and one each from Nevis and Anguilla. High property qualifications limited the vote to less than 200 people, thus assuring continued dominance by the plantocracy. However, qualifications were lowered in 1946, enabling several members of the St. Kitts-Nevis Trades and Labor Union, which had been established in 1940, to gain Council seats.

In 1952 a new Constitution granted universal adult suffrage and created a Legislative Council with a majority of elected members. In the first national election, the St. Kitts-Nevis Labor Party won control of the Council.

The next major advance in self-rule occurred in 1967, when St. Kitts-Nevis-Anguilla became an Associated State within the British Commonwealth. Along with this change of status came full internal self-government and the establishment of a Senate and a fully elected House of Representatives. State administration was vested in a Premier and cabinet drawn from the majority party in the House. While these advances pleased the ruling Labor Party, they prompted Anguilla to secede from the new State, an action that was officially recognized by Great Britain in 1982. During the 1970's, Nevisians, who had long been disenchanted with the Government in St. Kitts, also began to consider secession.

The long rule of the St. Kitts-Nevis Labor Party ended in 1980, when a coalition comprised of the St. Kitts-based Peoples Action Movement (PAM) and the Nevis Reformation Party (NRP) won a narrow electoral victory at the polls. The Coalition worked out a formula for Nevisian self-government that enabled the two islands to become an independent nation in September 1983.

1.2 THE BIOPHYSICAL ENVIRONMENT

1.2.1 Climate

St. Kitts and Nevis. Situated some six degrees south of the Tropic of Cancer with temperature-moderating areas of open ocean to the east, both islands have a tropical marine

climate, heavily influenced by steady northeast trade winds, which produces an environment almost ideal for human comfort. There are only small variations in temperature throughout the year, the average at Basseterre being 27.8 degrees C (79.6 F). Average minimum and maximum temperatures in the Basseterre Valley stand at 22 and 29 degrees C in January, increasing to 25 and 32 degrees C in July (Kennedy and Robbins, 1988). Nevis temperatures and seasonal variations are similar (Darby, *et al.*, 1987). At lower elevations, maxima above 32 degrees C (90 F) and minima below 18 degrees C (65 F) are extremely rare. Only at higher elevations, where the rule of thumb is a one degree Celsius ambient temperature drop per 100 meters in altitude above sea level, do temperatures drop below 17 degrees C (60 F). Halcrow (1966) computed the minimum temperature at the summit of Mt. Liamuiga at 7 degrees C (45 F). However, the near perpetual cloud cover, high humidity and wind chill factor at the peak would tend to make it feel much colder.

The prevailing winds hold fairly steady from the east, swinging seasonally between northeast and southeast with mean speeds ranging from 5.4 mph in November to 9.1 in July. The months with the higher wind speeds are the dry months from January to March. Cloud cover is more common than would be expected, averaging between 40 and 50 percent, which helps account for the relatively low evapo-transpiration rate of around 40 inches per year (Halcrow, 1966).

Free water evaporation rates are about five inches per month or 60 inches per year which explains the general absence of open water empoundments and the preference for tanks and cisterns for water storage. Relative humidity averages 76 percent but ranges from 70 percent in March to 78 percent in September, October, and November. The islands receive an average of nine hours of sunshine per day (KPA, 1987), but the applicability of this figure to Nevis is questionable in the absence of confirming data (suggesting the need for a meteorological station or two on Nevis, with substations for specialized or localized data requirements).

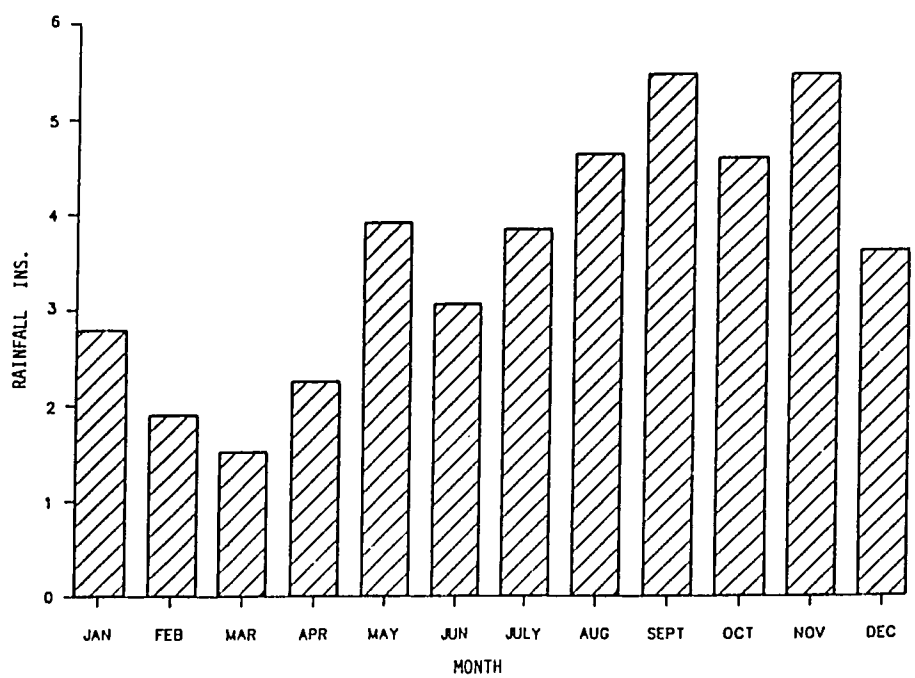


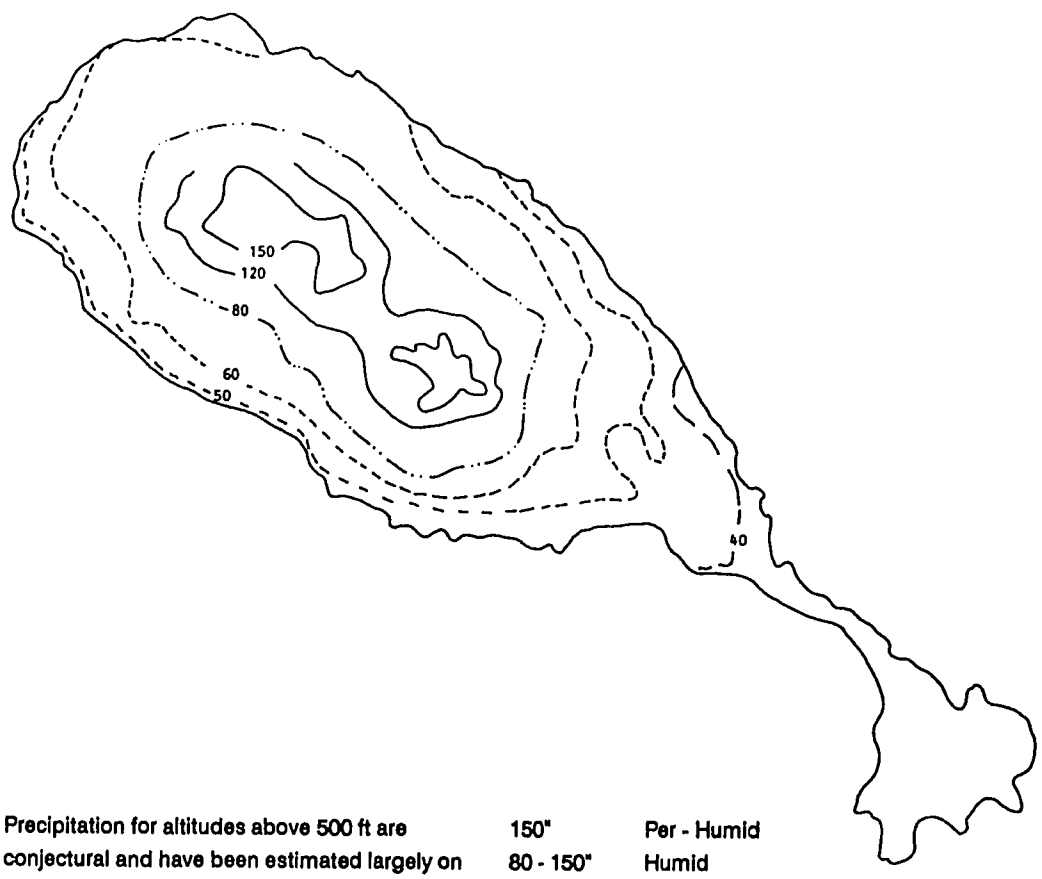
Figure 1.2(1). Typical 30-year average rainfall, Basseterre Sugar Factory gauge, St. Kitts (source: KPA, 1987).

RAINFALL

St. Kitts. Rainfall over the main landmass of St. Kitts is relatively plentiful. With its central mountain range extending from Mt. Liamuiga, at 3,792 feet (1,156 m) elevation to the peak of the South East Range at 2,953 feet (901 m), the uplift effect produces an annual average of 64 inches (1,625 mm). For a summary of thirty years of data from one station, the Basseterre Sugar Factor gauge, see Figure 1.2(1).

Except for the Southeast Peninsula (SEP), rainfall is fairly well distributed throughout the island although there are some seasonal variations, with a wet period from August to November and dry period from mid-January to about April (see Table 2.2(1) in Section 2 for display of mean monthly precipitation figures for the island). The driest year on record recorded 33 inches (832 mm) from a dry area, while the island average for the same year was 45 inches (1,143 mm).

Although the Southeast Peninsula, which is very dry, and the central mountain areas above the 1,000 foot (305 m) contour (where it is wetter) lack good rainfall records, there are still more than 50 gauges around the island (Torres, 1985). For earlier, long-term records, see Halcrow (1966, Table 1 in Appendix 1) which shows the duration of the rainfall records and monthly and annual totals. From these data, and allowing for the fact that 27 percent of the main landmass



NB. Precipitation for altitudes above 500 ft are conjectural and have been estimated largely on the basis of vegetation.

150"	Per - Humid
80 - 150"	Humid
40 - 80"	Sub- Humid
40"	Semi - arid

Figure 1.2(2). Average annual rainfall, St. Kitts, in inches (source: Torres, 1985, based on Lang and Carroll, 1966).

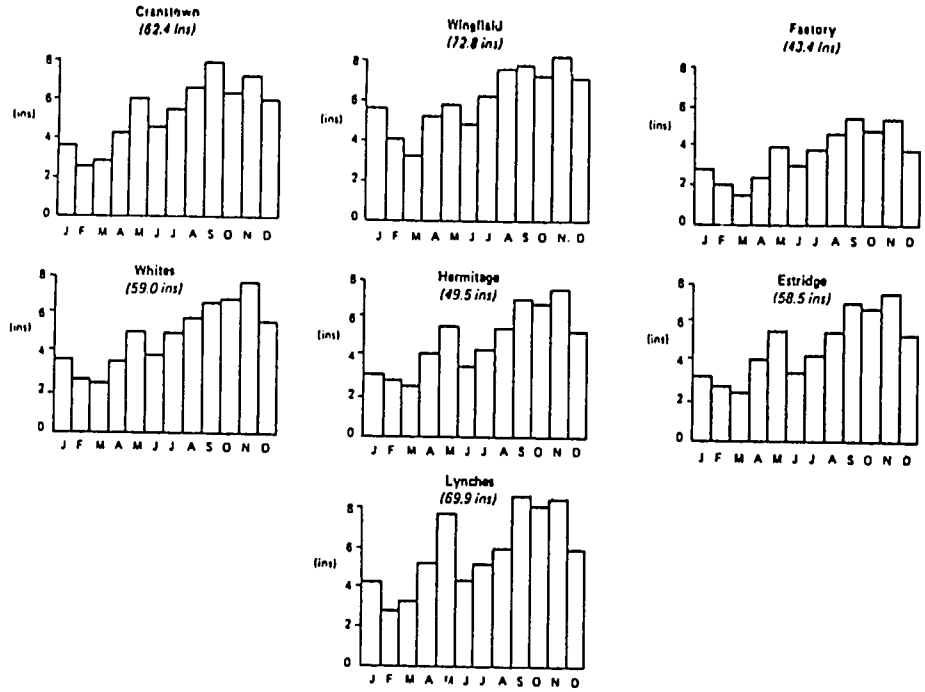


Figure 1.2(3). Average monthly rainfall for St. Kitts from seven rainfall stations (Atkins, 1983).

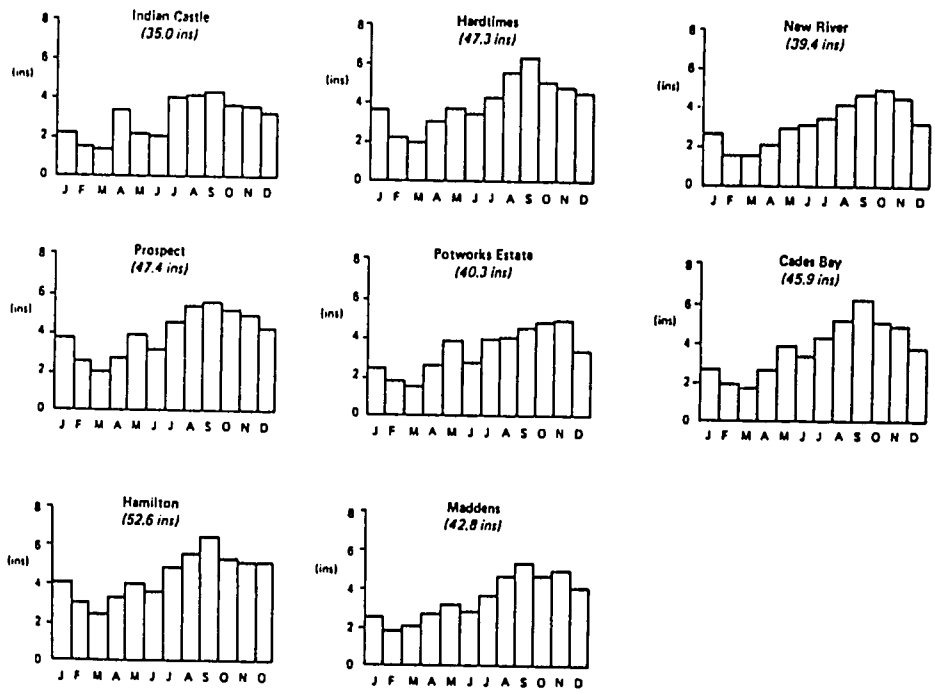


Figure 1.2(4). Average monthly rainfall for Nevis from eight rainfall stations (Atkins, 1983).

(above 1,000 ft/305 m) was ungauged, annual isohyetals were calculated by the Halcrow consulting team in 1966. These data, however, have not been readily accessible as copies of the report are difficult to locate in-country and have not been used widely by various researchers and consultants.

Therefore, as a more readily available substitute, Lang and Carroll's (1966) rainfall isohyetal map (actually a 1962 UWI Soil Survey Department map with no raw data from above the 500 foot contour) has instead been used and re-used over the years. See for example Figure 1.2(2) which is basically a 1985 uncorrected tracing, taken from the old Lang and Carroll (1966) version of the 1962 isohyetal map. (See also Section 2.2 on Freshwater Resources.)

Average monthly rainfall at seven different sugar estate locations on St. Kitts is displayed in Figure 1.2(3). The situation on the Southeast Peninsula is quite different, where precipitation varies from 39 inches (1,000 mm) on the peaks to 34 inches (864 mm) at Cockleshell Bay (Lang and Carroll, 1966 and Jackson, 1981, cited in Towle, *et al.*, 1986a). The remnant dry forest on the Peninsula reflects this relatively dry climate and high evaporation rates. There is some evidence, however, that individual rainstorms can be very intense and cause flash flooding. Roughton (1981) predicted a ten year storm frequency at five inches (127 mm) per hour which, for the Great Salt Pond watersheds that drain into the pond (see Figure 1.2(7)), would have a combined peak discharge of 35.7 cubic meters/sec (1,260 cf/s).

Nevis. Islands like Nevis with one or more high peaks manufacture their own local weather, creating a range of micro-climates which vary greatly with height, location and orientation. Nevis has several projecting masses, with Nevis Peak at 3,232 feet (985 m) the dominant feature, which cause a marked upward deflection of westerly moving, moisture laden air. This rising sea air is cooled by expansion, and the moisture is condensed so that orogenic cloud formations and often heavy precipitation result. A typical feature of central mountain peaks in the Eastern Caribbean islands is a cap of "trade wind clouds" which masks their summit day after day and is only occasionally dissipated in very still or very dry weather.

Rainfall records for Nevis are much more consistent than any other climatic data. Daily rainfall is currently being measured by the Agriculture Department at eight stations, when personnel is available (see Figure 1.2(4) for average monthly rainfall at the eight Nevis rainfall stations and Table 1.2 (1) for mean monthly and annual rainfall data for the island). More than one-half the island receives less than 50 inches (1,270 mm) of rainfall per year, with the average rainfall being 46 inches (1,170 mm), as compared to the average for St. Kitts of 64 inches (1,625 mm). Mean annual rainfall varies from 29.66 inches (753 mm) at New River on the windward side to 51.60 inches (1,310 mm) at Hamilton's Estate on the western slope of Nevis Peak. Rainfall is lowest along the eastern side and increases with altitude. Monthly data show that most rain falls between July and January with a lesser monthly peak occurring in May. However, there is considerable variation from year to year and month to month. While short periods of drought can occur at any time throughout the year, the months of February through April are most susceptible to extended droughts. Isohyetal data is presented in Figure 1.2(5).

1.2.2 Topography and Geology

ST. KITTS

Topography. At 176 square kilometers (68 square miles), St. Kitts is the larger of the two islands comprising the Federation of St. Kitts and Nevis. The entire island is perched midway on a submerged ridge or bank some ten miles wide with a northwest to southeast axis from which both Nevis and neighboring St. Eustatius also arise. The main part of St. Kitts has a rugged backbone dominated by the Northwest Range which includes three linked volcanoes, with the largest (and youngest) of these -- Mt. Liamuiga (Mt. Misery until independence in 1983) -- rising with a pronounced crater to 3,792 ft (1,156 m).

Table 1.2(1). Mean monthly and annual rainfall data for Nevis, to 1985.

DATA TYPE	STATIONS[1]									EVAPO-TRANS.[2]
	1	2	3	4	5	6	7	8	9	
Period of record (yrs.)	23	42	31	36	28	36	42	43	17	
Elevation (ft.)	30	800	200	270	60	50	510	280	725	
Monthly data (in.)										
January	1.70	3.34	2.01	2.40	2.14	2.51	3.84	3.74	2.81	3.75
February	1.23	1.92	1.36	1.49	1.27	1.42	2.29	2.38	1.52	4.10
March	1.19	1.64	1.18	1.42	1.17	1.50	2.28	1.80	1.09	4.40
April	2.48	2.30	1.45	2.35	2.47	2.41	3.06	2.19	2.64	4.62
May	1.67	3.42	2.08	2.57	3.14	3.46	3.88	3.23	2.58	4.74
June	1.26	2.25	1.99	2.17	1.95	2.72	2.76	2.70	1.79	4.70
July	2.75	3.72	2.83	3.69	3.54	3.96	4.56	3.98	2.84	4.65
August	3.42	4.51	3.46	4.46	3.82	5.09	5.21	5.23	3.31	4.58
September	2.92	5.23	3.92	4.76	3.68	5.51	6.09	4.78	4.34	4.28
October	3.72	4.73	4.11	4.20	4.57	5.08	4.62	4.56	5.27	3.92
November	2.50	4.52	3.76	4.49	4.53	4.84	5.02	4.55	6.22	3.61
December	2.55	3.88	2.57	3.08	2.76	3.24	4.57	3.90	3.85	3.54
Annual data (in.)	33.30	45.38	29.66	43.08	39.80	45.98	51.60	43.98	44.83	50.89

Notes: [1]Stations are:
1 Indian Castle
2 Hard Times
3 New River
4 Madders
5 Potworks
6 Cades Bay
7 Hamiltons
8 Prospect
9 Prison Farm (privately operated)

[2]Evapotranspiration < 300 m.

Source: Kennedy and Robins, 1988.

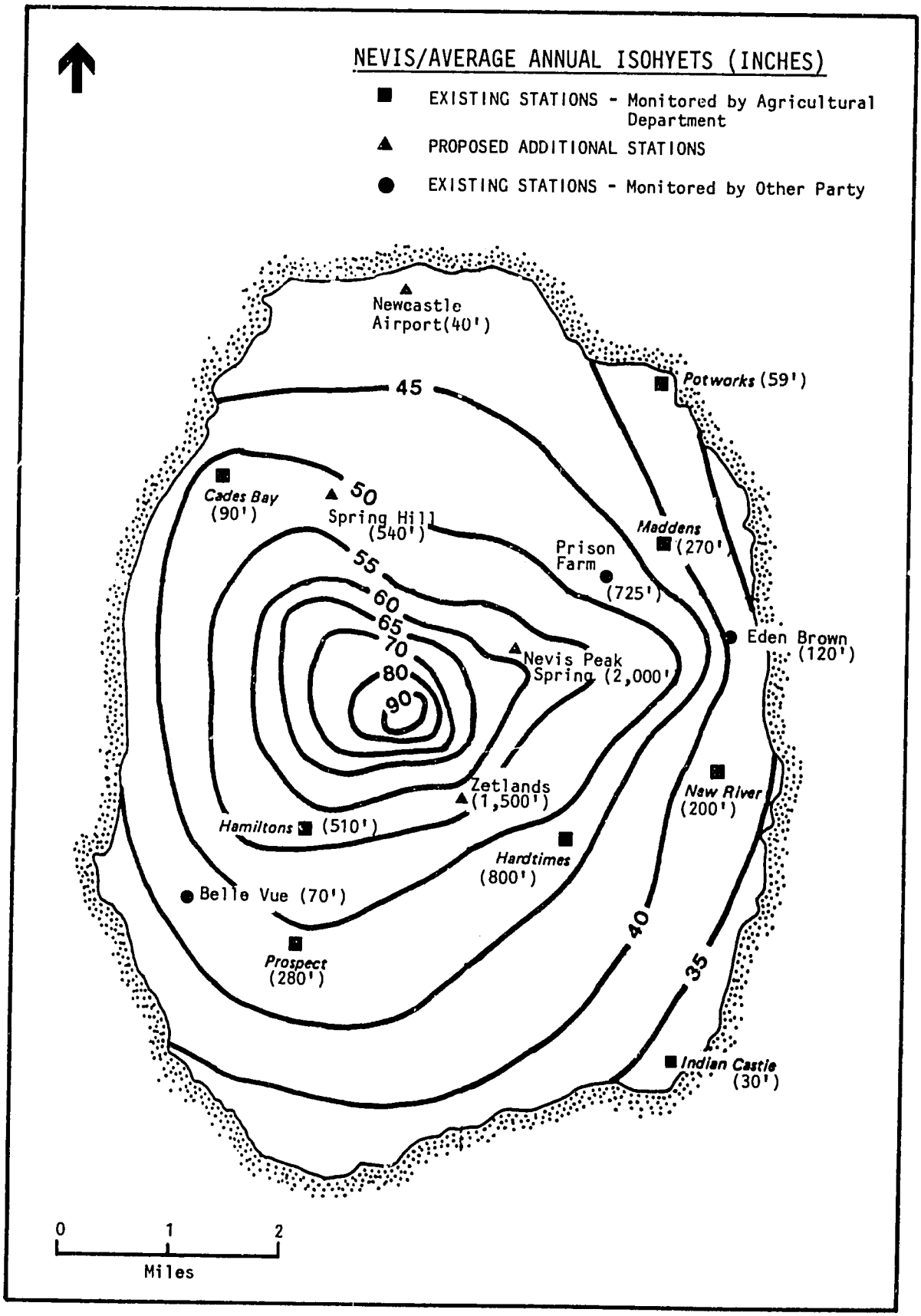


Figure 1.2(5). Nevis average annual isohyets (in inches) and rainfall stations (elevation in feet) (source: Atkins, 1983 and information from the Nevis Agricultural Department).

Southeast of Liamuiga, the now dormant volcanic chain continues with the Central Range and the Southeast Range (dominated by Verchild's Mountain and Camp Crater, respectively) after which the land descends into the Basseterre Valley. The steeper part of St. Kitts' central, mountainous interior is surrounded by an upland forest belt blending downslope into a gradually sloping coastal plain sweeping gracefully seaward, covered primarily by sugar cane with expanding patches of diversified agricultural crops and some pasture land. Minor domes protrude from these lower slopes at Brimstone Hill, Ottley's Mountain, Sandy Point Hill, and Monkey Hill (Figure 1.2(6)).

The coastline of the island's main landmass consists primarily of cliffs, some 50 to 100 feet high. At the foot of these cliffs are narrow beaches comprised of coarse "black" (volcanic) sand and numerous pebbles and boulders. In the northwest, however, the cliffs are lower, and some of the beaches are wider and comprised of yellow sand. Coastal erosion, caused by various factors such as reef damage due to excessive sediment loads, biocide run-off and other land-based sources of pollution, is a continuous and ubiquitous problem for the state and is discussed in Sections 2 (Section 2.4) and 6 of the Profile.

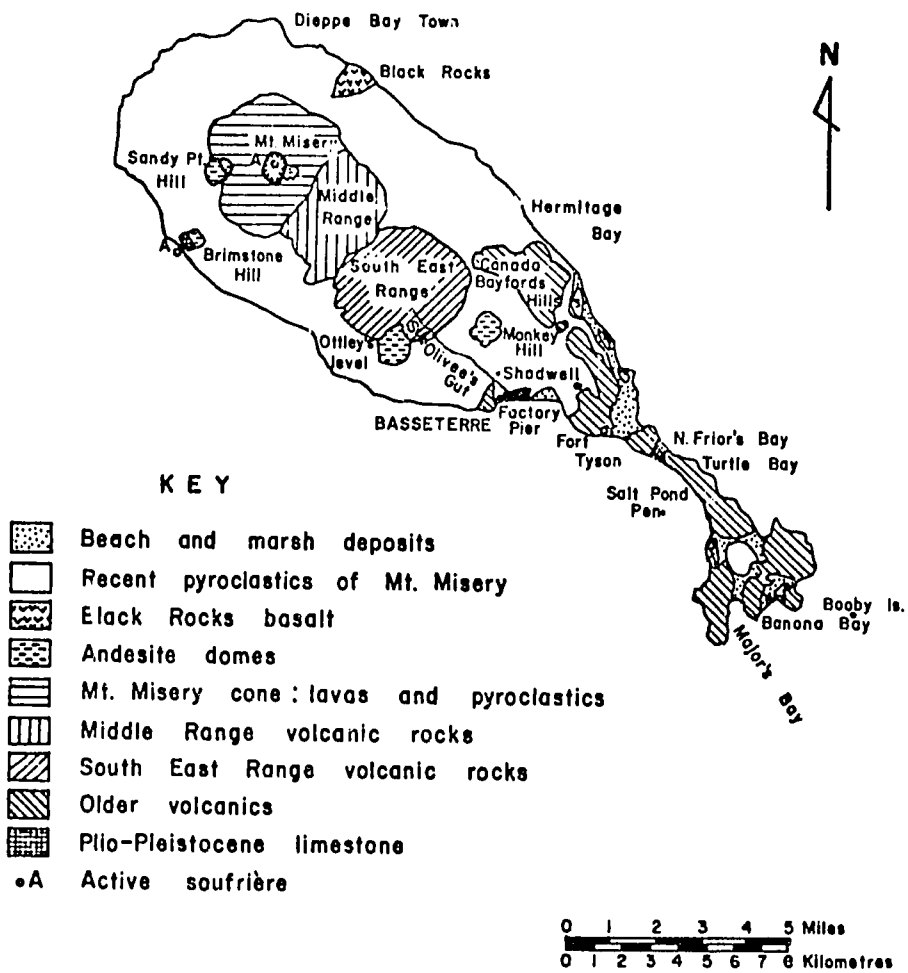


Figure 1.2(6). Generalized geological map of St. Kitts (source: Christmas, 1977, after Martin-Kaye, 1959).

Except at the eastern (Fort Tyson) and western (Fort Thomas) headlands, there are no cliffs along the Basseterre Harbor shoreline nor in the area extending from Cayon to the Atlantic side of Frigate Bay where there is a very long but rugged, high energy beach. Nearby, and pointing off in the direction of Nevis, the rugged Southeast Peninsula contains the island's best swimming beaches except perhaps for the Caribbean side of the Frigate Bay development area.

Only just recently made accessible by a new access road, the Southeast Peninsula (SEP) is actually a cluster of seven older, small rocky islands linked by more recent beach and saline marsh deposits, originally tombolos, now broadened into flat sedimentary plains and marsh land tying the seven islets together. At Frigate Bay they are linked to the base of the older volcanics of the Conaree Hills. All the residual hills on the Peninsula are smoothly rounded with slightly convex peaks, once heavily forested but now covered mostly with dry scrub woodland vegetation -- principally, acacia, agave, and columnar and Turks Head cacti on the hills, with guinea grass on open, burned-over areas and with manchineel, mangrove, seagrape and beach strand vegetation occurring intermittently at the base of the hills along the shoreline or the salt pond margins. Excluding the Frigate Bay area, which is the actual base of the Peninsula and which has 380 hectares (850 acres), the Southeast Peninsula proper embraces over six square miles (1,600 hectares/4,000 acres) and eight saline ponds which vary in size from 160 ha (400 ac) to 1.6 ha (4 ac).

The topography of the Peninsula consists of two quite distinct features: (1) a narrow, isthmus-like, rock spine slightly more than 0.5 km in width and about 4.5 km in length, extending in a southeasterly direction from Timothy Hill at Frigate Bay to Salt Pond Hill (see Figure 1.2(7)) and (2) a larger, roughly triangular area shaped like a grand amphitheater with a cluster of hills surrounding the 440 acre Great Salt Pond which has a watershed catchment area of about 380 ha (940 ac). The highest hill on the Peninsula is St. Anthony's Peak at 319 m (1,047 ft). Lang and Carroll (1966) indicate that it may be the site of a former volcanic crater, but this is not proven.

Geology. The geology of St. Kitts was first described by Earle (1922) and subsequently revised by Martin-Kaye (1959). A simplified presentation of their findings in the form of a geological map is provided as Figure 1.2(8). The island, which remains seismically active, has a core of older (Eocene) volcanic material comprised largely of andesite. This material is exposed in the Canada Hills and Conaree Hills to the north and east, respectively, of Basseterre and in the Southeast Peninsula. Three younger volcanic centers are found along the island's central spine, which were active during the Pleistocene period when they yielded andesitic pyroclastics. The latter are retained as ash, reworked sands and gravels, cobbles, and boulders. Mud flows or lahars are common in the northwest, characterized by a silt or clay grade matrix (Kennedy and Robins, 1988). Mt. Liamuiga is a relatively simple strato-volcano with a deep summit crater about 1,000 yards in diameter. According to Baker (1968) the earliest subaerial eruptions probably occurred about one million years ago and a much larger cone than the present one was built up at that time. The present steep central cone is made up of andesitic and basaltic lava flows, agglomerates and pyroclastics.

Evidence of a basalt flow from Mt. Liamuiga can be seen at Black Rocks and above Profit Estate, and a small area of older limestone can be found on the sides of Brimstone Hill and at Godwin Ghaut above 1,000 feet (KPA, 1987). Recent marsh deposits are present in low areas of the SEP, and some alluvial outwash deposits can be found in ghaut floors by the coast (Kennedy and Robins, 1988).

No obvious geologic faults have been recorded, but several observed lineations may be deeper faults that have been masked by volcanic ejecta (KPA, 1987).

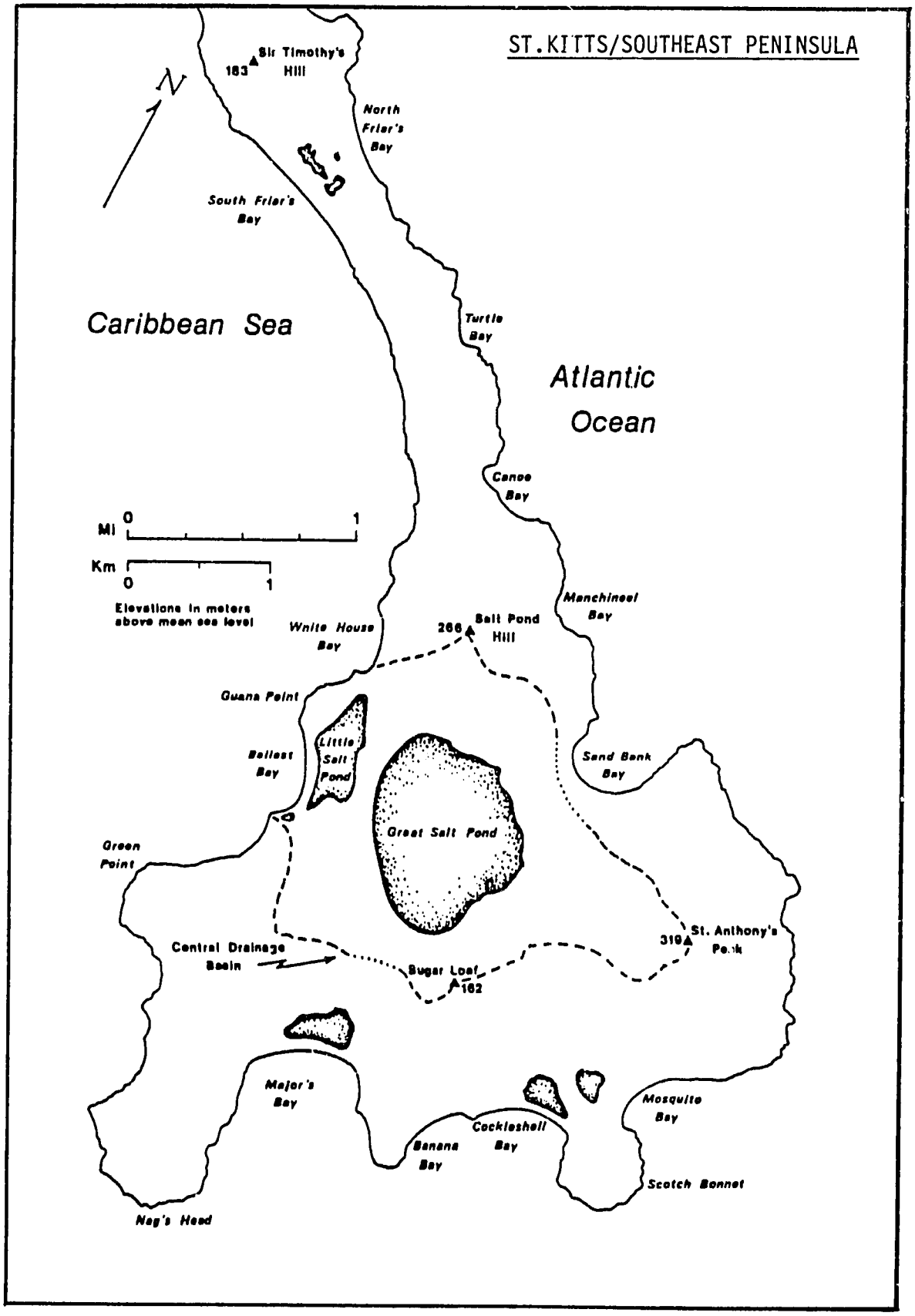


Figure 1.2(7). Location map, Southeast Peninsula, St. Kitts (source: Orme, 1989a).

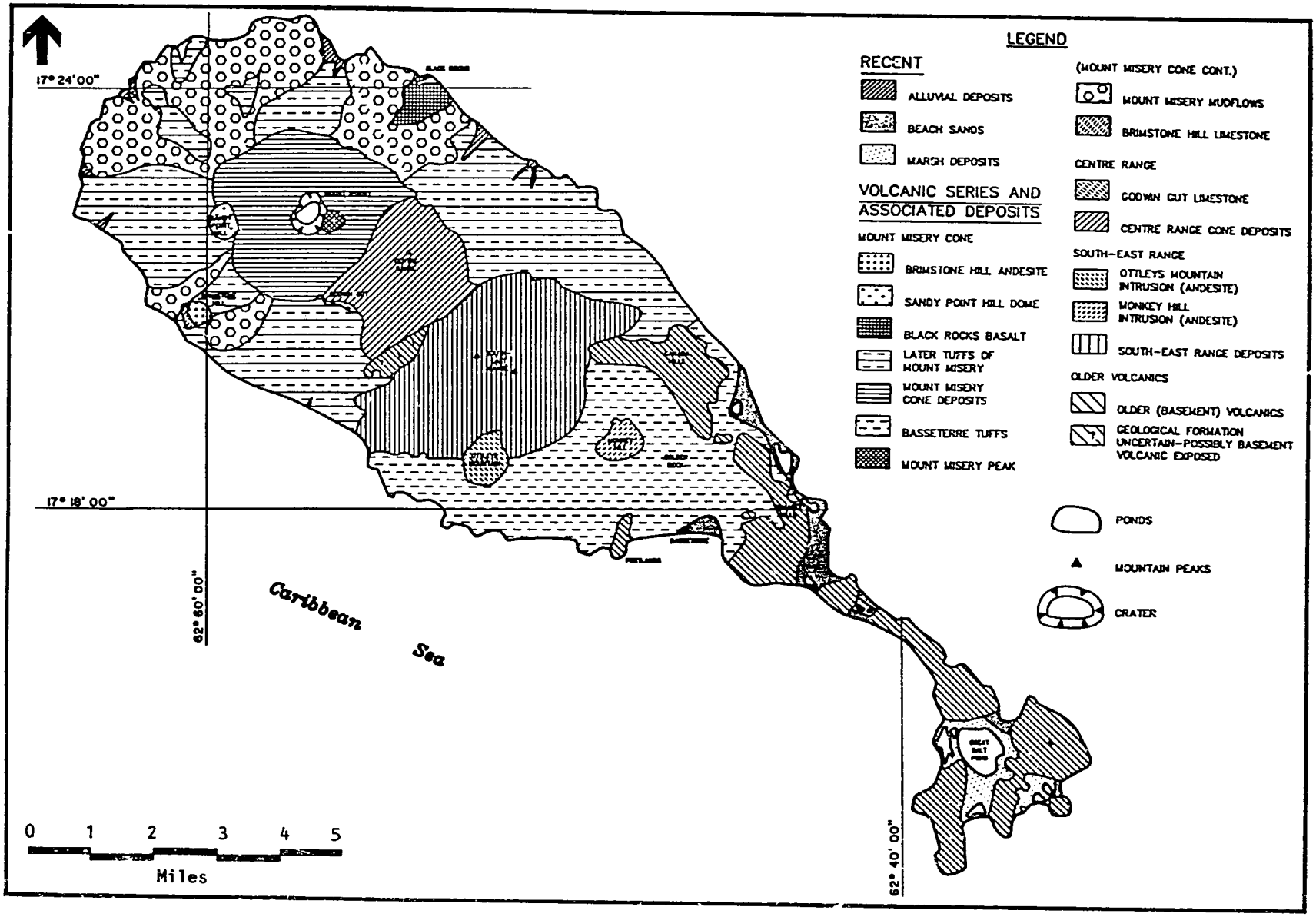


Figure 1.2(8). Geology map of St. Kitts (source: KPA, 1987, based on geological maps produced by Dr. P.H.A. Martin-Kaye and Dr. P.E. Baker).

NEVIS

Topography. At the northern end of the Lesser Antilles archipelago, where Nevis and its sister island are located, the Leeward Islands comprise a double arc, with an older, elementary arc to the east and a younger volcanic arc to the west (Martin-Kaye 1969; Rea and Baker 1980). These are regarded as forming an island arc couplet comparable to that of the Tongas in the Central Pacific (Miyashiro, 1974), even though the Lesser Antilles lack the oceanward trench normally associated with such arcs (Chayes, 1964). Nevis lies on the inner arc, near the southeastern border of the St. Eustatius bank, and comprises some ten distinct volcanic centers. These are strung out along a line trending approximately southeast to northwest, parallel to the trend of the inner, volcanic arc. These centers are flanked by and, in some cases, almost overwhelmed by volcanigenic deposits.

Topographically Nevis is approximately circular and dominated by the central Nevis Peak, some 985 m (3,232 ft) high. (The preliminary data atlas published by ECNAMP in 1980 gives the altitude of the peak incorrectly as 3,596 feet, a figure which had also been routinely taught in the schools.) Nevis Peak is such a dominant feature that, especially when viewed from the west, the peak overshadows other topographic features, giving the island the appearance of a text-book volcano. In plan view, however, Windy Hill (309 m) and Saddle Hill (381 m) at the head and tail of the island, respectively, align with Nevis Peak to form a north-northwest/south-southeast trending spine comparable to the more pronounced spine of St. Kitts (Merrill, 1958). To the east the spine is thickened by the bulge of Butlers Mountain. (578 m). Slopes vary from almost zero near the sea, to over 40 percent in the vicinity of Saddle Hill, Butlers Mountain, Nevis Peak and Windy Hill.

Geology. The thick cloak of volcanigenic sediment, together with the dense carapace of vegetation sported by the island, for many years encouraged geologists to adopt a sketchy approach to Nevisian geology; and for a long time it was assumed that Nevis comprised simply one volcano (Spencer, 1901; Trechmann, 1932; Cleve, 1882). Two factors served to alter this view:

- The application of aerial photography, especially in the 1950's;
- The appointment in the 1950's of a geologist, based in St. Lucia, responsible for geological matters in the Lesser Antillean region.

This geologist, Dr. P.H.A. Martin-Kaye, accumulated considerable data, although only a little of it was published. Among his unpublished works is the first geological map of Nevis (Martin-Kaye, 1961), copies of which were lodged with the Institute of Geological Sciences in the UK (now the British Geological Survey). Although only a sketch map, Martin-Kaye's map remains unchallenged to this day (Kennedy and Robins, 1988; pers. commun., Sylvia Brackell, British Geological Survey, 1990) and has formed the basis for subsequent sketch maps published in Hutton (1965) and Robson and Tomblin (1965), and the more detailed map published in Hutton and Nockolds (1978). (For the convenience of the serious researcher, it is noted that Martin-Kaye's original 1961 map is reproduced as Figure III in Lang and Carroll, 1966.)

Hutton and Nockold's map in turn forms the basis of the geological map displayed in Figure 1.2.(9). However, recent unpublished work (Wilson, 1990) has indicated that the geological boundaries given on previous maps may be subject to revision as field data are gathered. The map presented in Figure 1.2(9) must, therefore, be regarded as a sketch map only. Nevis comprises principally dacites, with andesites at three centers: Cades Bay, Saddle Hill, and the main cone of Nevis Peak (Table 1.2(2)).

Although Nevis is primarily a volcanic island, the oldest rocks are of marine origin. On the southern slopes of Saddle Hill an obscure outcrop of conglomerate yields blocks of recrystallized limestone that contain foraminiferids of mid-Eocene age (Hutton 1965). The next oldest rocks are volcanic, and much younger, being erupted during Pliocene time (Table 1.2(3)). The older volcanics crop

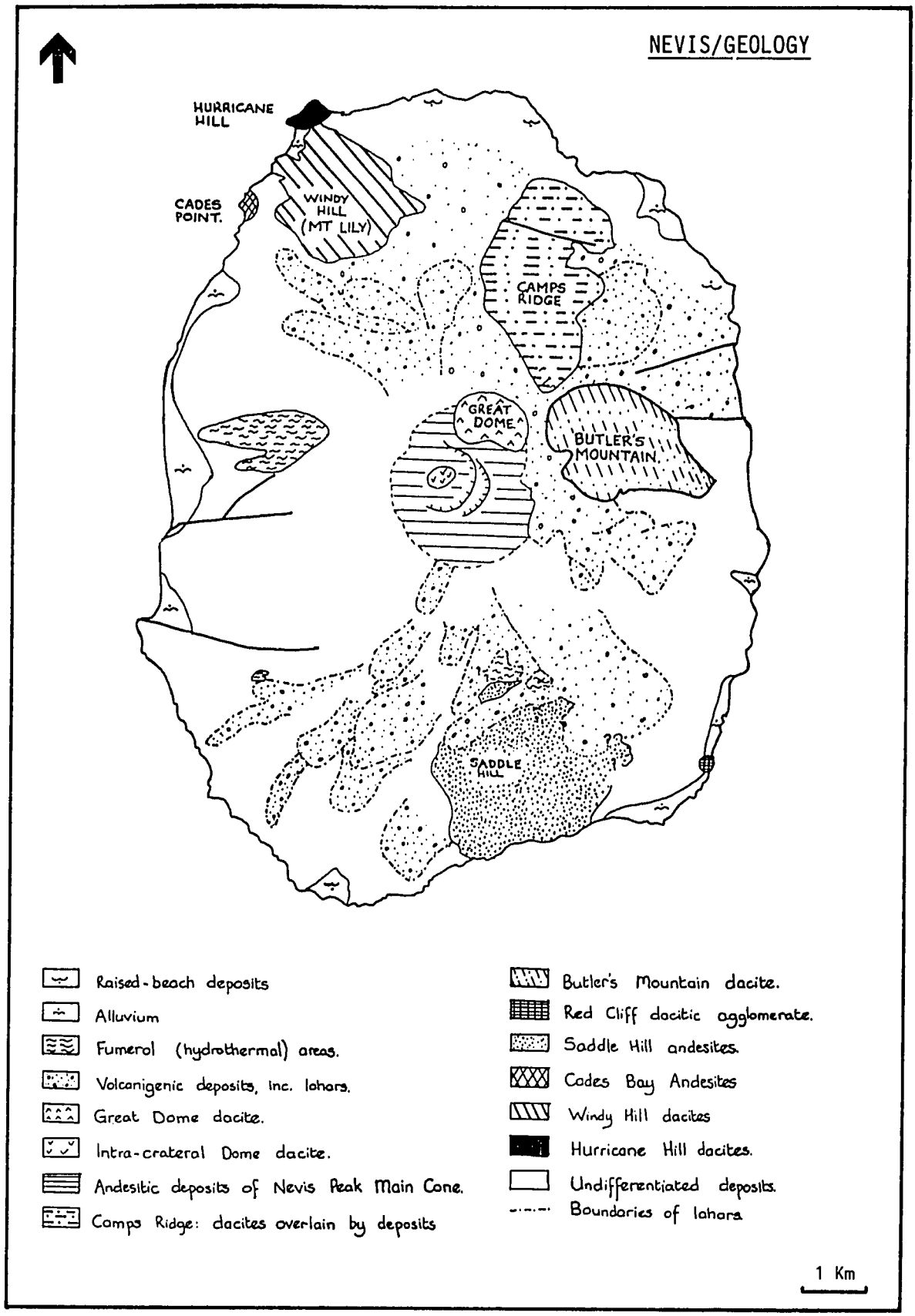


Figure 1.2(9). Geologic map of Nevis (source: Wilson, 1990, adapted from Martin-Kaye, 1961, and Hutton and Nocholds, 1978).

Table 1.2(2). Location and composition of Nevisian volcanics.

LOCALITY	SAMPLE NO. (a)	SiO_2 (%) (b)	
Saddle Hill (c)	10-12	57.90	
Saddle Hill (d)	13-14	58.95	
Main Cone, Nevis Peak	22-25	59.85	ANDESITES
Cades Bay	6- 8	60.27	
Camps Ridge	19-21	61.30	
Red Hill	15	61.60	
Hurricane Hill (e)	1- 2	61.75	
Windy Hill (e)	3- 5	61.80	DACITES
Nevis Peak, older volcanics	33-35	62.40	
Butlers Mountain	16-18	62.60	
Intra-crateral Dove	26	62.90	
Great Dove, Nevis Peak	27-30	63.40	

NOTES:

(a) Data from Hutton and Nocholds, 1978.

(b) Compiled on the basis of Hamilton's (1964) igneous rock classification system in which basalts comprise < 56% silica SiO_2, andesites 56-61% SiO_2, and dacites > 61% SiO_2.

(c) Saddle Hill type andesite.

(d) Station type andesite.

(e) Hutton (1965) and Hutton and Nocholds (1978). Hurricane Hill is incorrectly referred to as Windy Hill, and vice versa. This error is rectified herein.

out on the northwestern coast, while the youngest form Nevis Peak; Saddle Hill to the southeast is of intermediate age (Hutton and Nockolds, 1978). Hutton and Nockolds (1978) were the first to note that the Saddle Hill complex comprises two major igneous rock types, which they designated: (1) the Station type and (2) the Saddle Hill type. Field evidence shows the Saddle Hill type to form the spine of Round Hill, the cores of the lateral cones now forming Mast Hill, and other areas noted in Figure 1.2(10). The so-called Station type is much more widespread, forming aprons to the occurrences of Saddle Hill type. Such a situation can be best explained by eruption of these rocks from a compositionally stratified magma chamber (Rea and Baker, 1980, propose a similar model for the Soufriere Hills complex, Montserrat). According to such a model, while in the magma chamber, the more acid Station type lay on top of the Saddle Hill type. The widespread Station type was the first to be erupted, the more restricted Saddle Hill type being erupted later. During eruption of this volcanic center, there was only limited convective mixing of these magma types. Thus far plutonic blocks, common in other Lesser Antillean volcanoes (Lacroix, 1949; Baker, 1968) have not been recorded from Nevis (Lewis, 1973).

Away from the volcanic centers *per se* -- these frequently having been eroded so deeply that they now expose more or less massive igneous rocks of somewhat intrusive aspect -- Nevis is formed of sediments derived from those centers. The precise nature of these sediments, however, is not clear; for example, Martin-Kaye (1961) recognizes blocky pyroclastic debris, flow deposit and laharic (mud flow) deposits. Hutton and Nockolds (1978) concurred but also recognized ash-and-block flow deposits.

This confusion reflects a more fundamental problem within the discipline regarding the overall classification of volcanic breccias and conglomerates (Fisher, 1958, 1960a/b). This confusion arises because the various types of volcanic deposits grade from

Table 1.2(3). The ages of selected rocks in Nevis.

LOCATION	RADIOMETRIC AGE	STRATIGRAPHIC AGE
Main Cave, Nevis Peak	0.98 +/- 0.1 Ma	Pleistocene
Butlers Mountain Center	1.10 +/- 0.16 Ma	Pleistocene
Saddle Hill Center	1.80 +/- 0.3 Ma	Pliocene/Pleistocene
Hurricane Hill Center	2.7 +/- 0.5 Ma	Pliocene
Cades Bay Center	3.22 +/- 0.16 Ma	Pliocene
Windy Hill Center	3.43 +/- 0.17 Ma	Pliocene
	HIATUS	
Saddle Hill Area: clasts in conglomerate	N/A	Mid-Eocene

Source: Hutton (1965) and Hutton and Nockolds (1978).

one to another. Working on Nevis, Wilson (1990) has developed a tentative model for genesis of selected volcanigenic sediments, drawing his sample from Whitehall Ridge, immediately south of St. George's Farm. In this area there is a gradational series from massive igneous rocks, through autobrecciated material indicative of the tops of lava flows, to an overlying laharic unit. It would thus appear that the laharic material has been derived from reworking of autobrecciated lava. However, the extent this reworking was contemporaneous with the eruption of this volcanic center remains unclear.

1.2.3 Soils

The agricultural soils of St. Kitts and Nevis have been used extensively and intensively for over three hundred continuous years. Although the lowland soils of Nevis, in particular, show the ill effects of this and of other uses, in general the soils of both islands have stood up amazingly well to the long period of cultivation.

This is largely the result of the quality of the locally available parent material provided by recent volcanism in the islands. The fragmented volcanic ejecta (rock and ash) is rich in mineral elements required by plants. The physical qualities, in addition to the chemical qualities, are such that the parent material weathers rapidly into soil. It is known from other studies done in the region (Hardy, 1939) that fresh volcanic ash soils can give rise to truly fertile soil within ten to twenty years after the time of deposition or fresh exposure to weather. Therefore, it can be assumed that, to some degree, the ill effects of soil erosion on the cultivated slopes of St. Kitts, and to a lesser degree on Nevis, have been somewhat offset by the rapid rate of soil formation.

Chemical analysis of the country's soils as early as 1947 (Hardy and Rodrigues) confirmed certain deficiencies (see Table 1.2(4)). Low nitrogen and organic matter figures for the non-forest cane fields tend to confirm the negative impact of long continued cultivation. Although not shown in the table, potash levels were low, averaging only 112 ppm as opposed to a needed 120 ppm minimum. This potash deficiency accounts for the attention of colonial planters to collecting and applying pen manure to their lands and also explains the more recent shift to commercial fertilizers containing potash when working cattle and horses were replaced by tractors.

There are very marked differences between the soils of St. Kitts and the soils of Nevis. This is reflected in equally notable differences in the agriculture of the two

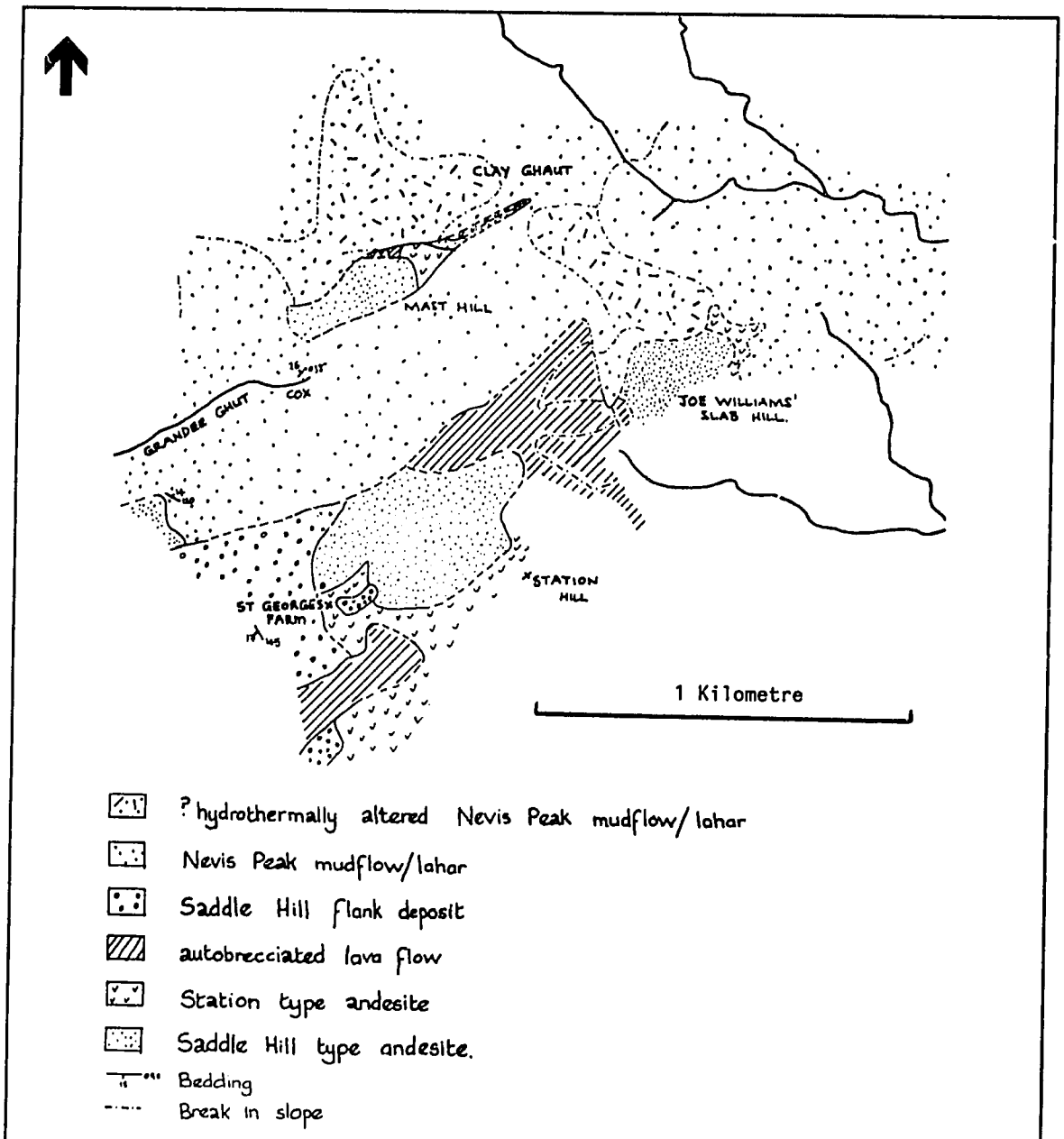


Figure 1.2(10). Geology of the Saddle Hill area, Nevis (source: Wilson, 1990).

islands and the effects that agriculture has had on the landscape and on the environment of each (see also Section 3 on Agriculture). It is noteworthy that the standard St. Kitts and Nevis 1966 *Soil and Land-Use Surveys* by Lang and Carroll, although published together as one document under the aegis of the Imperial College of Tropical Agriculture, were in fact prepared separately by two investigators who wrote individual reports which differ significantly in map detail. Mr. D.M. Lang was responsible for the survey of Nevis and Mr. D.M. Carroll carried out the work on St. Kitts. One of the few things that they had in common was a shared preference for a pedogenetic soil classification system based on the degree of maturity and weathering which made their reports useful as a guide to the nature of the soil types but not very helpful as an inventory of the resource or for soil management and conservation purposes. Under these circumstances, soil issues in the state have tended to remain separated. Following independence under the Federation, two

Table 1.2(4). Chemical analysis of soils in St. Kitts and Nevis.

SOIL TYPE	NITROGEN CONTENT	CARBON/NITROGEN RATIO	ORGANIC MATTER CONTENT
Red-Brown Earth (forest)	0.40%	11.5	7.9%
Sugar Cane Soils	0.11%	10.9	2.3%
Shoal Soil (St. Christopher)	0.12%	10.9	2.3%
Shoal Soil (Nevis)	0.14%	11.8	2.9%

Source: Hardy and Rodrigues, 1947.

separate agencies for agriculture emerged -- one for (and in) St. Kitts and one for (and in) Nevis (for further information, see also Sections 3 and 8 of the Profile).

ST KITTS

Merrill, in his 1958 monograph on the historical geography of St. Kitts and Nevis, identified four primary soil types on the larger island:

Yellow — An ash-based, porous, well-aerated soil that makes the best agricultural soil, for example, the fine ash deposits on the Olivees Range which weather into "yellow earth," the color due to limonite particles.

Brown-Yellow — Good for crops, weathers from small stones, angular boulders, sand (mixed), covers much of the well-watered western slopes and lowlands (except the peninsular), low nitrogen (N) and Potassium (K), low organics, needs animal or chemical fertilizer.

Red-Brown — Soils of the upper slopes, higher in nitrogen and organic matter but leached by high rainfall in areas far too steep for agriculture, under forest cover.

Shoal — Montmorillonitic clay with silica pan, as on the Southeast Peninsular, difficult to farm lowland, similar to Nevis lowland soils.

Subsequently, in 1963, two visiting soil scientists (Lang and Carroll), carried out the necessary field investigations, one on each island as mentioned above, and completed a greatly expanded pedogenetic profile of the soils of both St. Kitts and Nevis, also preparing a new soil map for each island at 1:25,000 scale at the same time (see Lang and Carroll, 1966). They drew heavily upon the earlier work of Hardy and Rodrigues in 1947 and were further assisted in this endeavor by P. Moss and J.K. Coulter of the University of the West Indies.

Although the new classification system involved 33 different soil types, they have been divided and summarized into five main groups as follows (Atkins, 1983):

- Shallow soils over volcanic materials (12%);
- Deep, strongly weathered kaolinitic and allophanic clay and silt soils from volcanic materials with

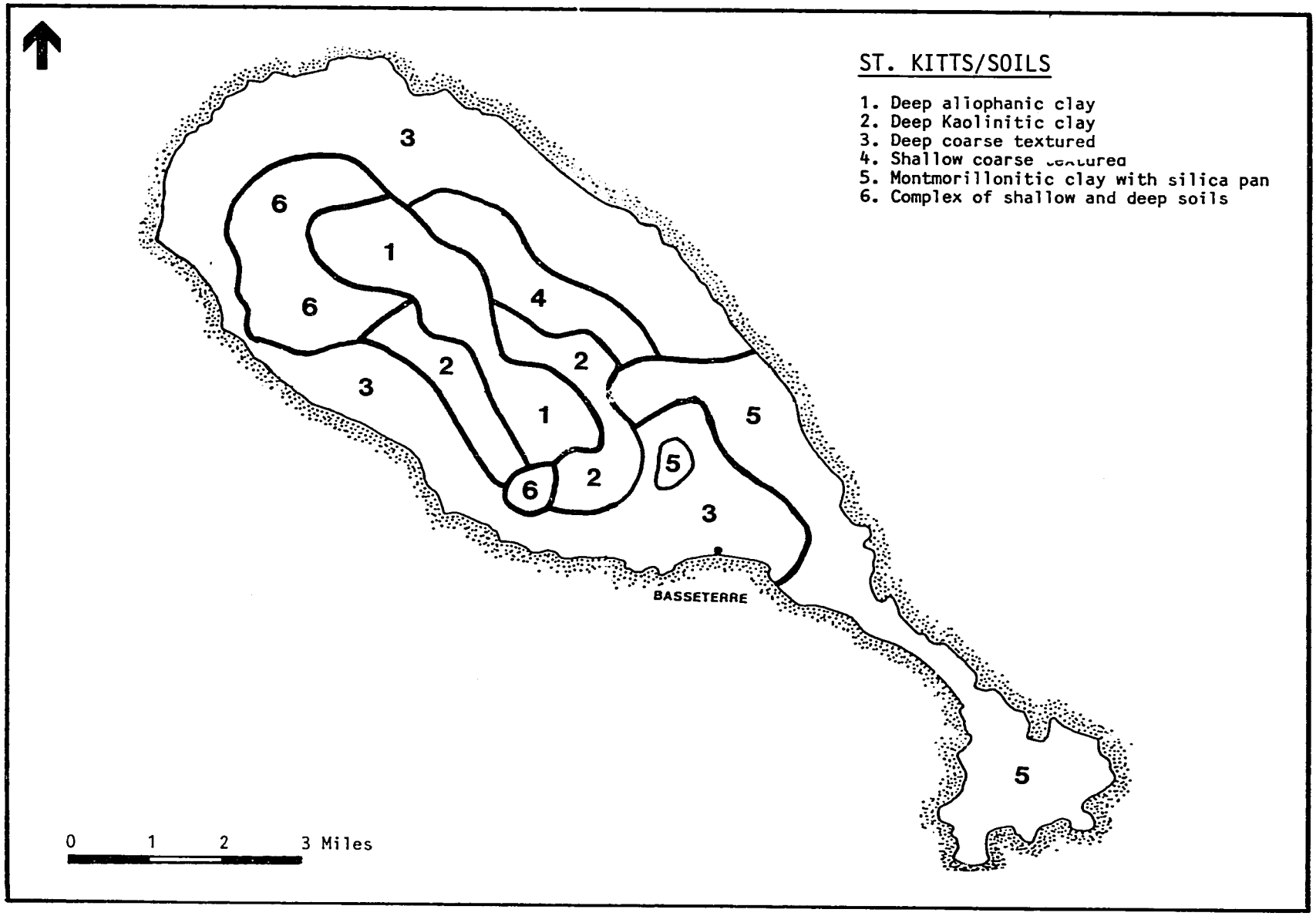


Figure 1.2(11). Soils distribution for the island of St. Kitts (source: Atkins, 1983).

good physical properties (Latosolics) (22%);

- Deep, little weathered, sandy soils from volcanic materials (Protosols, Young soils) (45%)

- Montmorillonitic clay soils, usually shallow and with a silica pan (shoal soils) (19%);

- Alluvial soils (1%) and other (1%).

The distribution of these soils is shown, proportionally above and spatially in Figure 1.2(11).

Since Lang and Carroll's St. Kitts survey and its Nevis counterpart discussed below were part of a larger region-wide initiative to prepare similar soil profiles, slope analyses, and erosion susceptibility maps for all the British West Indian territories, it is now possible for other, more recent researchers to assemble useful comparative tables and information displays that seek to convey more complex relationships. One recent example is presented as Figure 1.2(12). Upon closer inspection, however, it is clear that the figure, although presented in a 1985 report, is in fact based on Lang and Carroll (1966), without appropriate acknowledgment.

NEVIS

As noted above, the first soil survey of Nevis was conducted as recently as the 1940's, when researchers from the Imperial College of Tropical Agriculture in Trinidad produced both a soils map and report (Hardy and Rodrigues, 1947). This work was acknowledged and summarized by Merrill (1958) and later cited by Halcrow (1966), among others. In brief, Nevis had fewer soil types, more problem soils, less good cane soil, and extensive areas where good soil was rendered almost unusable because of a profusion of interlayered rocks, clasts, and boulders.

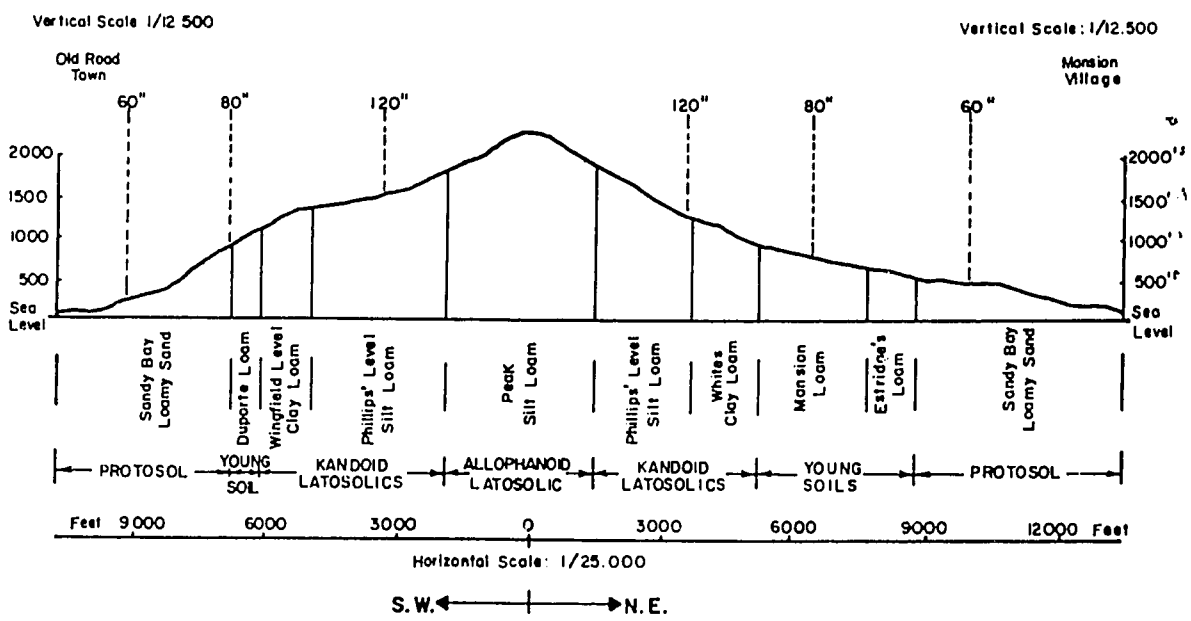
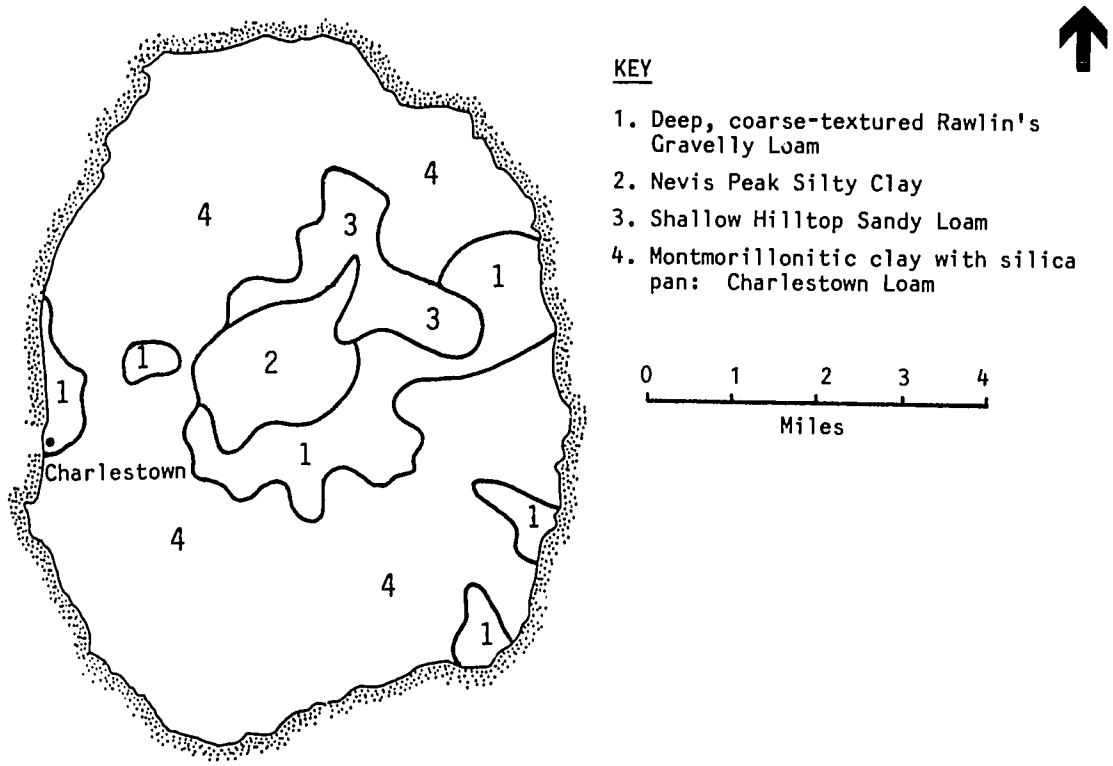


Figure 1.2(12). Relationship between relief and rainfall for St. Kitts soils (source: Torres, 1985, adapted from Lang and Carroll, 1966).



Figures 1.2(13). Soils distribution for the island of Nevis (adapted from Atkins, 1983).

The three primary soils types of Nevis are as follows:

(1) A Red-Brown Earth at the summit of Nevis Peak. This soil is mature, but strongly acidic and of little agricultural importance.

(2) A Brown-Yellow Earth, which encircles the area of the Red-Brown Earth type. This is a good agricultural soil but contains many boulders that limit mechanized methods of cultivation.

(3) A "shoal" soil, which occurs in low-lying areas. Lying on volcanigenic sediments, this soil is loamy but clayey and difficult to cultivate.

The 1947 survey work remained the primary reference for Nevis until 1966, when Lang and Carroll published their findings from the earlier 1963 research referred to in the section on St. Kitts above. Lang and Carroll recognized 24 soil series, of which four are variously subdivided into stony, rocky, and stone-free phases. The soils recognized vary in area from 16 acres, for both the Clay Ghaut clay and the Sulphur Ghaut clay loam and clay, to 7,400 acres for the bouldery phase of the Charlestown clay loam and clay. Individual areas of soils recognized are as small as two acres, and many are smaller than 40 acres.

Comparison of Lang and Carroll (1966) with Hardy and Rodrigues (1947) suggests that the soil types may be related as follows. The Red-Brown Earth of the earlier work corresponds to the Nevis Peak Silty clay and clay loam of the later; the Brown-Yellow Earth and the shoal soil of the earlier survey both correspond to part of the Charlestown clay loam and clay, with the shoal soil qualitatively corresponding to the bouldery phase of the Charlestown series.

Although the Lang and Carroll study (1966) remains generally unchallenged, it has not escaped criticism. Knox (1986) notes that:

- Soil descriptions given are too brief;

- Recommendations for soil management are few and general;

- Distinctions among soils made in the report are still to be demonstrated convincingly in the field.

Knox concludes that an update of previous work is required if Nevis and St. Kitts are to make the most of its soil resources.

Darby, *et al.* (1987) updated the Lang and Carroll maps in 1987 based on further field observations and made extensive recommendations for soil conservation measures. Figure 1.2(13) provides a very general differentiation of soil types on Nevis according to Lang and Carroll's classification system.

1.2.4 Vegetation

Within the climatic belt south of the Tropic of Cancer, moisture-laden trade winds are commonly forced upwards when they confront the land mass of even small tropical islands with prominent central peaks like St. Kitts and Nevis. The cooled moisture in the air precipitates as rain, falling most consistently on the upper slopes. Therefore, island vegetation at higher elevations receives the highest rainfall, and the leeward side of the island customarily receives slightly more rain than the windward side because the air masses and clouds formed at the peak move in a westerly direction under the influence of the prevailing winds. A simplified diagrammatic presentation of this process, drawn from Beard's famous study, *The Natural Vegetation of the Windward and Leeward Islands*, is provided in Figure 1.2(14).

A second factor, additional to rainfall, that influences vegetational distribution within islands like St. Kitts and Nevis is the extraordinary variety of "micro-climates" which can prevail in small island systems. Altitude, temperature, humidity, saltiness of the air, the intensity and incidence of sunshine, wind exposure, and soil type(s) all interact and conspire to create numerous locally site-specific, variable "climates" within each island. This suggests how impossible it is to speak accurately about the "climate" of any one island or even cluster of islands. Beard (1949) exaggerates only a little when he says, "Scarcely a single acre in the islands has exactly the same climate as its neighbour." Anyone who looks closely can see evidence of these variations because they are mirrored by each island's mosaic-like overlay of diverse combinations of natural vegetation. They are the very substance of the habitat side of biodiversity. Without them, the landscape would be less interesting, less colorful, and less productive. It would also be more uniform and therefore more at risk.

The flora of the Lesser Antilles embraces about 2,000 species of flowering plants, of which, according to Beard (1949), 243 are trees (a tree being a woody plant capable of attaining a height of five meters at maturity). Of these 243 species of trees, St. Kitts and Nevis have approximately half or 121 species. Table 1.2(5) shows the distribution among different islands in the Eastern Caribbean.

The present vegetation of St. Kitts and Nevis gives evidence of great disturbance by human activity. In the lowland areas intensive land use has removed all vestiges of the natural vegetation and everywhere -- except in urban Basseterre, Bird Rock, Frigate Bay and on the Southeast Peninsula -- agricultural crops prevail. The mountain peaks are still covered by forest (see Section 2.1), but it is quite unlikely any virgin forest remains intact. Most lower reaches of the forest are secondary growth on previously cleared, once farmed but now abandoned upland marginal cane land or provision grounds. There are few places where charcoal burners have not been; and undisturbed rain forest, not a large area to begin with, is relatively rare on both islands. The distribution of vegetation, as depicted by Beard more than forty years ago, is shown as Figure 1.2(15).

ST. KITTS

The so-called travel literature of the seventeenth, eighteenth and nineteenth centuries contains a wide assortment of descriptive accounts of the vegetation of St. Kitts

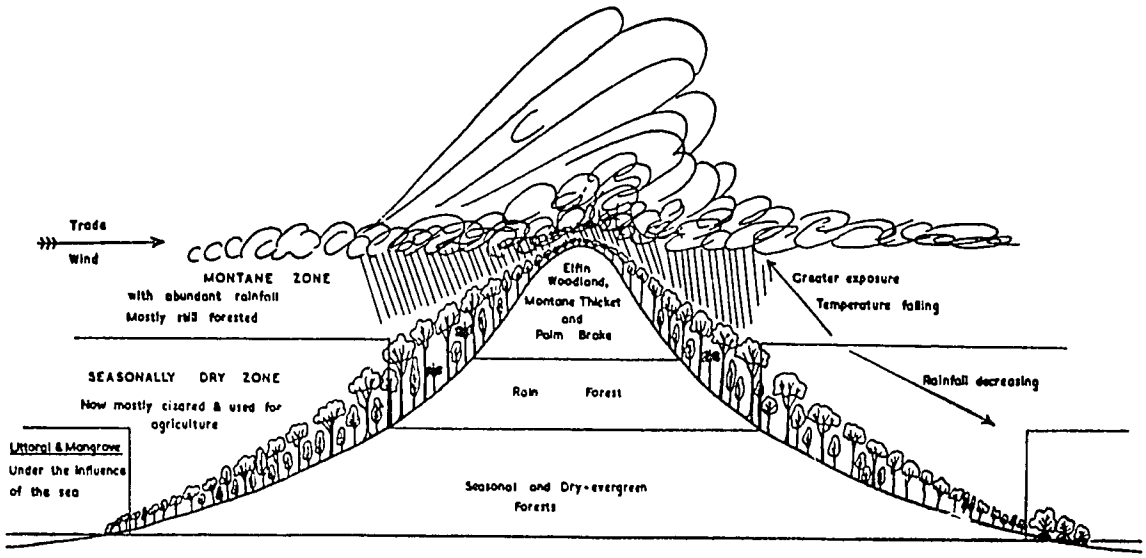


Figure 1.2(14). An idealized transect through a moist Caribbean island in the Lesser Antilles (source: Beard, 1949).

Table 1.2(5). Tree species distribution by island in the Eastern Caribbean.

Island	Total No. of Tree Species	Percent of Tree Flora	No. of Endemics
St. Kitts-Nevis	121	50	13
Montserrat	132	54	17
Guadeloupe	193	78	43
Dominica	167	68	42
Martinique	181	74	47
St. Lucia	151	62	35
St. Vincent	151	62	29
Grenada	120	49	15

Source: Beard, 1949.

(and Nevis as well). St. Christopher was described by one of the original settlers as being all "... overgrown with palmetos, cottontrees, lignum vitae and divers other sorts but none like any in Christendom" (Churchill, 1744-46).

But human occupation had its price, and the forests were not only cleared for cane but also were regularly used as a source of fuel in the production of sugar. As a result, before the end of the seventeenth century, planters on St.

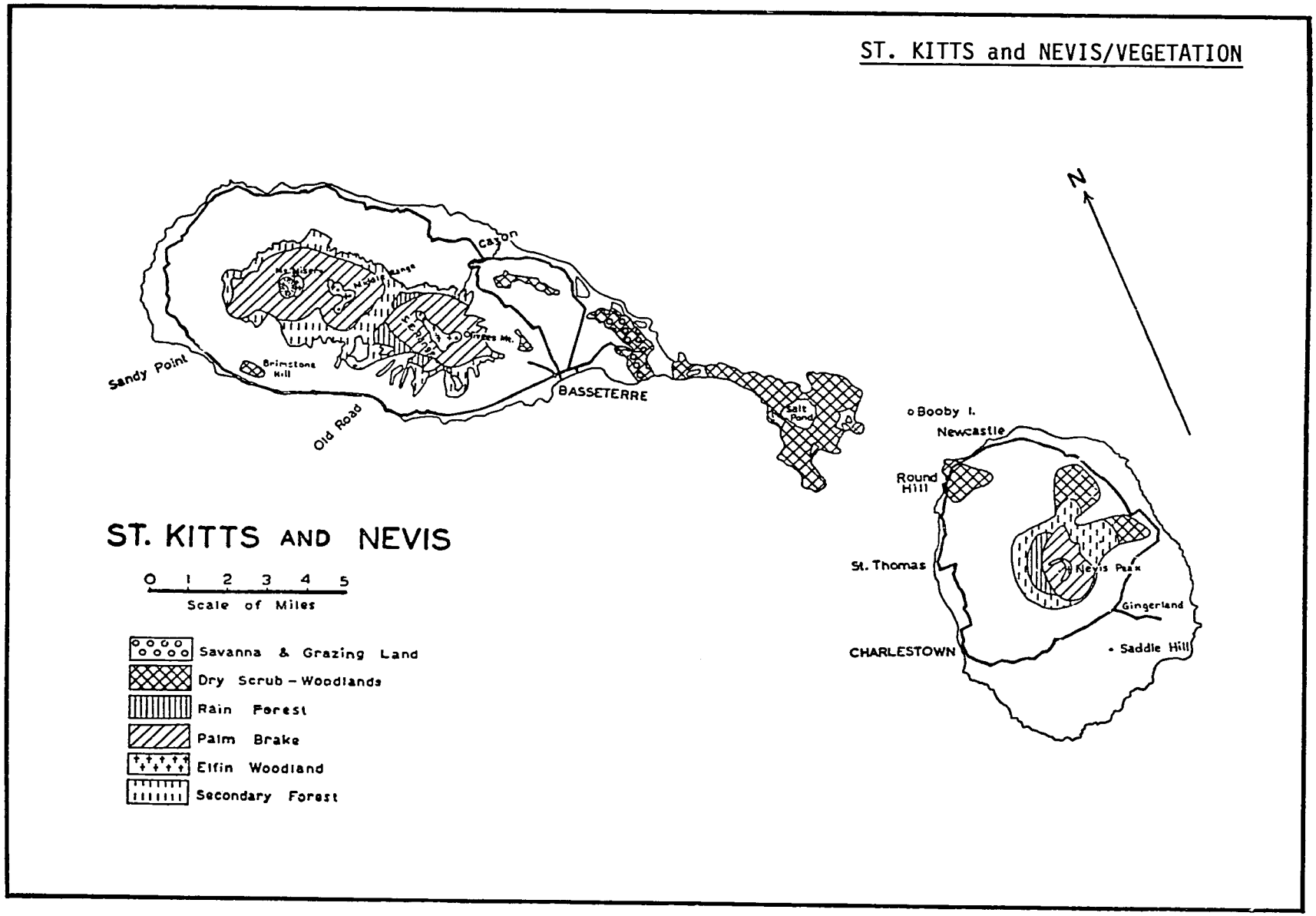


Figure 1.2(15). Beard's vegetation map of St. Kitts and Nevis (source: Beard, 1949).

Kitts were complaining to visitors about the shortage of timber (Merrill, 1958).

Two hundred years later, at the beginning of this century, Dr. N.L. Britton, Director in Chief of the New York Botanic Gardens, visited St. Kitts and undertook a local survey, reporting on it in the Garden's *Journal* of 1901 just two years prior to passage of St. Kitts' milestone "Forestry Act". Britton's report later was to become a key segment of the very popular 1920 St. Kitts-Nevis *Handbook* written by Katherine Burdon, wife of the Government Administrator at the time. Burdon's useful book included, beyond vegetation, a wide variety of information on health, geology, flora, fauna, agriculture, and climate and was a creditable predecessor to this current Profile being written some seventy years later. Based on Britton's field work, the *Handbook* identified five major vegetation types, occupying distinctive zones, which had obviously been affected by several hundred years of colonial occupation:

(1) **Littoral Vegetative Belt.** A halophytic (salt tolerant) shoreline zone composed of such species as seagrape (*Coccoloba uvifera*) and three mangrove species (*Rhizophora mangle*, *Avicennia nitida*, and *Laguncularia racemosa*).

(2) **Xerophytic Vegetative Belt.** Dry vegetation occupying low rocky hills and principally composed of cacti (*Cereus* and *Opuntia* spp.), *Plumeria alba*, *Acacia farnesiana*, and species of *Rauwolfia* and *Euphorbia*.

(3) **Cultivated Belt.** Composed of agricultural crops, such as sugar cane and introduced weed species.

(4) **Mesophytic Flora.** A forested zone at mid-elevations, characterized by a variety of forest trees.

(5) **Mountain Summit Vegetation.** The windswept zone along ridge lines and associated windward slopes.

Britton's work included preparation of a list of interesting and useful trees and shrubs. A total of 77 species were included in that list (Burdon, 1920).

Some forty years later, as World War Two was distracting some, other public servants in the Caribbean were not so easily diverted from their appointed ways. First, the Assistant Conservator of Forests for Trinidad and Tobago, J.C. Cater, made a brief visit to St. Kitts in the early 1940's in conjunction with an evaluation of the forestry practices and associated issues in the Leeward Islands. Cater's recommendations for a regional research effort led to the most significant assessment of the vegetation of St. Kitts (and Nevis) ever undertaken. Under the aegis of the Colonial Forest Service. J.S. Beard, as part of a larger regional survey that had begun in 1943, visited St. Kitts and Nevis in 1946 for necessary field work and mapping. His classification scheme lists five major forest type remnants in St. Kitts of the original vegetative cover (see Figure 1.2(15)). Additional to Beard, there is a sixth type composed of secondary forest resulting from abandonment of agricultural land. Beard identified these five forest associations:

(1) **Rain Forest,** of which Beard says, "Only two relatively small areas of first-class undamaged rain forest were located in St. Kitts, the one lying in the head-waters of the Wingfield River and the other above Mansion Estate." Where relatively undisturbed, gommier (*Dacryodes excelsa*) was the principal species, with an understory of regenerating gommier, and palms (see Figure 1.2(16)). Where disturbance was in evidence, which Beard attributes to hurricanes, there is less gommier in the overstory. Palms were reported to compose 55 percent of the stems counted in Beard's sample plot, at the disturbed Mansion Estate site. (see Figure 1.2.(17)).

(2) **Dry Evergreen Forest.** Beard identified this as secondary forest occupying lands below the rain forest. Twenty-one species were enumerated by Beard and included many intolerant, pioneer species.

(3) **Palm Brake.** This type was found above elevations ranging from 1,200 to 1,800 feet. Beard reported, "The forest is dominated by palms (always the mountain cabbage, *Euterpe globosa*) which form over 60 percent of the total crop." Tree ferns (15

KEY TO CODE LETTERS

Ca. Cyathea arborea Sm.
Cl. Clusia sp.
D. Dacryodes excelsa Vahl
Ha. Hedyosmum arborescens Sw.
L. Lauraceae (miscellaneous)
Mi. Miconia spp.
Mr. Marila racemosa Sw.

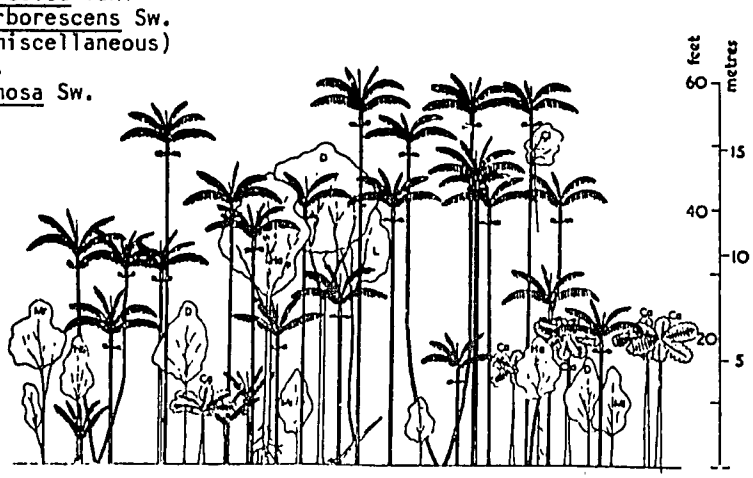


Figure 1.2(16). Profile diagram of palm brake, measured above Wingfield, St. Kitts, by Beard; all the palms are Euterpe globosa (source: Beard, 1949).

percent) and small trees (25 percent) made up the balance of the stems in Beard's sample. Approximately 10 tree species were shown to grow in association with palms, and Beard reported 800 stems per acre.

(4) Elfin Woodland. This is the tropical alpine meadow reported by Cater. Beard indicates this type occurring above 2,000 feet elevation. He describes it as "a low, gnarled tangled growth, usually about 12 feet high, loaded with moss and epiphytes and matted with lianes." Beard identified about 10 woody plants in this type.

(5) Dry Scrub Woodland. Beard suggests this is principally isolated to the Southeast Peninsula and has been heavily impacted by past use. Beard identified 39 species and indicates this to have been originally a deciduous seasonal forest.

In the vicinity of the summit of Mt. Misery (Liamuiga), Beard reported a pioneer community characteristic of volcanic ejecta and observed also in Martinique, Guadeloupe, St. Vincent and Dominica. In St. Kitts, this vegetation, composed of mosses, lichens, ferns and dwarf woody plants, covers the peak. Beard suggested this unique vegetation is a sub-climax type resulting from development on volcanic material where soil is lacking.

A distinguishing feature noted by Beard in describing the vegetation of St. Kitts was the surprising lack of well developed rain forest. This he attributes to periodic stand damage from passing hurricanes which cause breakage and subsequent forking of larger specimen trees. The resulting uneven forest canopy allows additional light to penetrate and encourages growth in adventitious or second growth species which may not be part of the climax forest type. A profile diagram of the damaged rain forest at Mansion Estate is provided as Figure 1.2(17). Beard contrasts the disturbed Mansion Estate plot with a more developed plot at Wingfield, referred to previously, and concludes that hurricanes play a major role in controlling composition and complexity of forest vegetation and that periodic disruption is variable due to storm direction and intensity. The effect of storms is undoubtedly an impact which continually molds the forest cover and maintains much of the forest in a pre-climax condition.

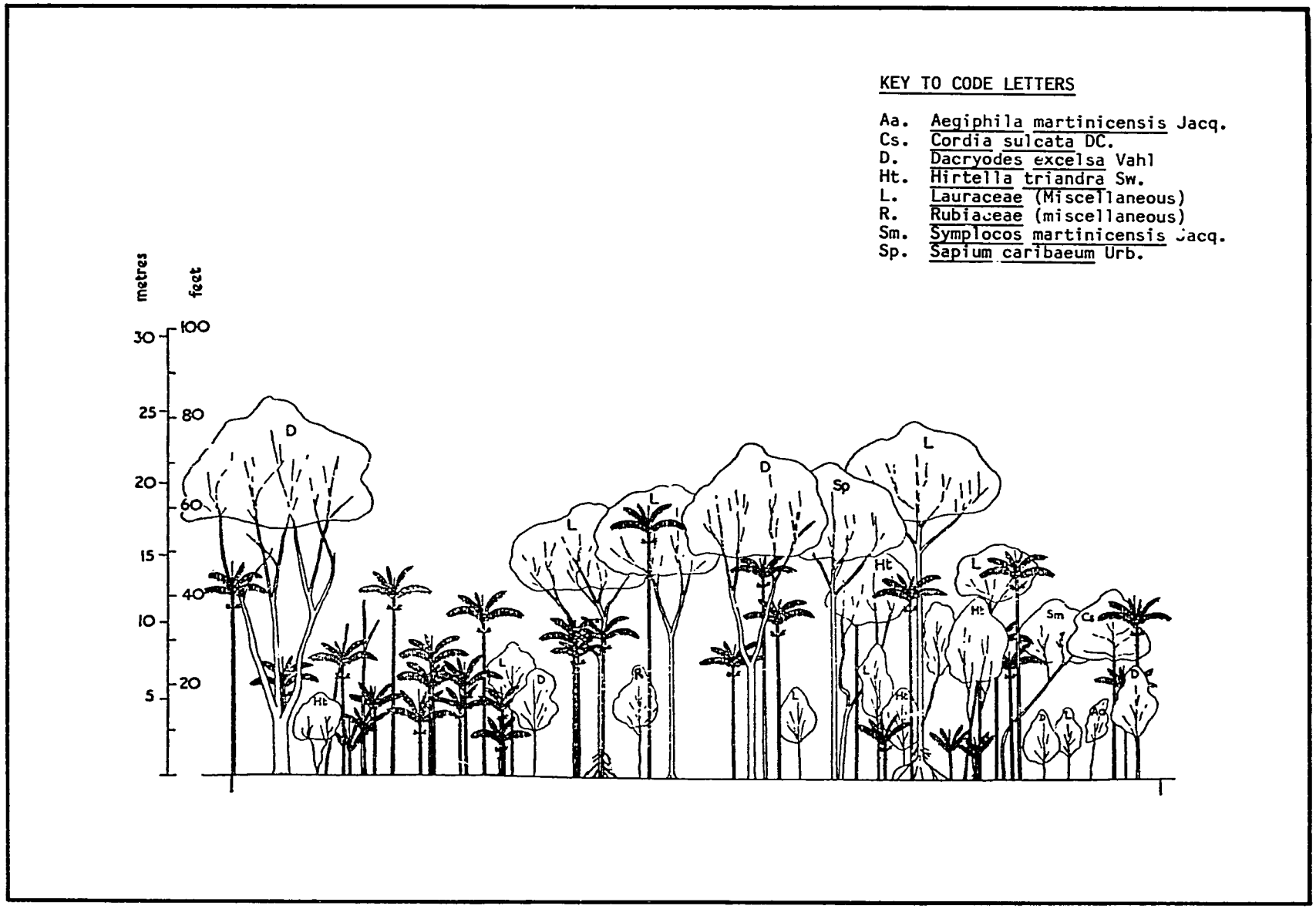


Figure 1.2(17). Profile diagram of ruinate rain forest in St. Kitts, measured at Mansion Estate (source: Beard, 1949).

NEVIS

The vegetative zones of Nevis follow the pattern typical of small, volcanic Caribbean islands (see Figure 1.2(14)). Beard's 1949 vegetation report (see above) on St. Kitts-Nevis included a distinct, separate section on Nevis, in which he took note of the extensive secondary scrub woodlands and thornbush amidst the cultivated acreage in the lowlands. He further observed:

> Good high forest is only seen on the north-western face of the main mountain above Jessup's, where protection from the prevailing wind has enabled a good stand of rain forest to develop. At the head of the Stapleton River on the north-east there is also some high forest but it is somewhat ruinate. Elsewhere on the mountains the slopes are so steep and exposed that the belt of low secondary woodland adjoining cultivated lands at the foot is very quickly succeeded by palm brake which continues right up to the summit. (Beard, 1949).

Nevis has, according to the Beard system of classification, six vegetation zones (Figure 1.2(15)). They are: rain forest, dry evergreen forest, montane thicket, palm brake, elfin woodland and dry scrub woodland. To be technically correct, three additional lesser zones should be included: mangrove swamp, littoral woodland and dry zone flora (Figure 1.2(18)). Although the dry evergreen forest and the dry zone flora are products of the same climatic conditions, they differ in that the latter consists of secondary forest regenerating from abandoned agricultural land, whereas the former is natural vegetation. The rest of the zones differ due to varying moisture conditions, wind exposure and/or topography.

(1) Rain Forest and Humid Forest. The only substantial stand of tall forest is on the northwestern side of the mountain above Jessups. Abundant rainfall and protection from the prevailing winds allow the trees to grow to a considerable height and form a dense canopy. The dominant species are the mountain cabbage palm (*Euterpe globosa*), gumlin (*Dacryodes excelsa*), and burrwood (*Slonea truncata*).

The humid forest zone surrounds the mountain and resembles the rain forest in species content. However, due to the steepness of the slope and high wind exposure, the trees are smaller and do not form a dense canopy. This allows for a more luxuriant herbaceous ground vegetation to form. Redwood (*Coccolobis diversifolia*) is more prominent here possibly due to the drier conditions.

In both the humid and rain forest zones, the species diversity is low (approximately 25 distinct species). However, this feature is not uncommon in the Lesser Antilles (Beard, 1949).

(2) Elfin Woodland. The summit of Nevis Peak is covered with low, gnarled, tangled growth. This forest is usually under three meters high and laden with moss and epiphytes and matted with lianas.

Woody plants are very low growing due to very high wind exposure, and herbaceous plants are quite common. The most common plant is a bromeliad which appears to be an undescribed species of Guzmania. Orchids, mosses, ferns, anoids and grasses are also abundant (Beard, 1949).

(3) Montane Thicket. Beard (1949) discovered only a thin belt of montane thicket on Nevis, located just above the rain forest on the west side of the mountain. This area is dominated by weedee (*Podocarpus coriceus*) and mountain cabbage palm. This pole stage forest contains no large trees except for an occasional large weedee, usually bent and gnarled.

(4) Palm Brake. Palm brake is a band of montane forest located on very steep slopes or in areas exposed to high winds. This zone is dominated by mountain cabbage palm, and the rest of the forest consists of tree ferns (*Cyathea arborea*) and small trees.

On Nevis, palm brake occurs on the mountain slopes above 550 m on the eastern and southern slopes and above 700 m on the northern and western slopes; this band

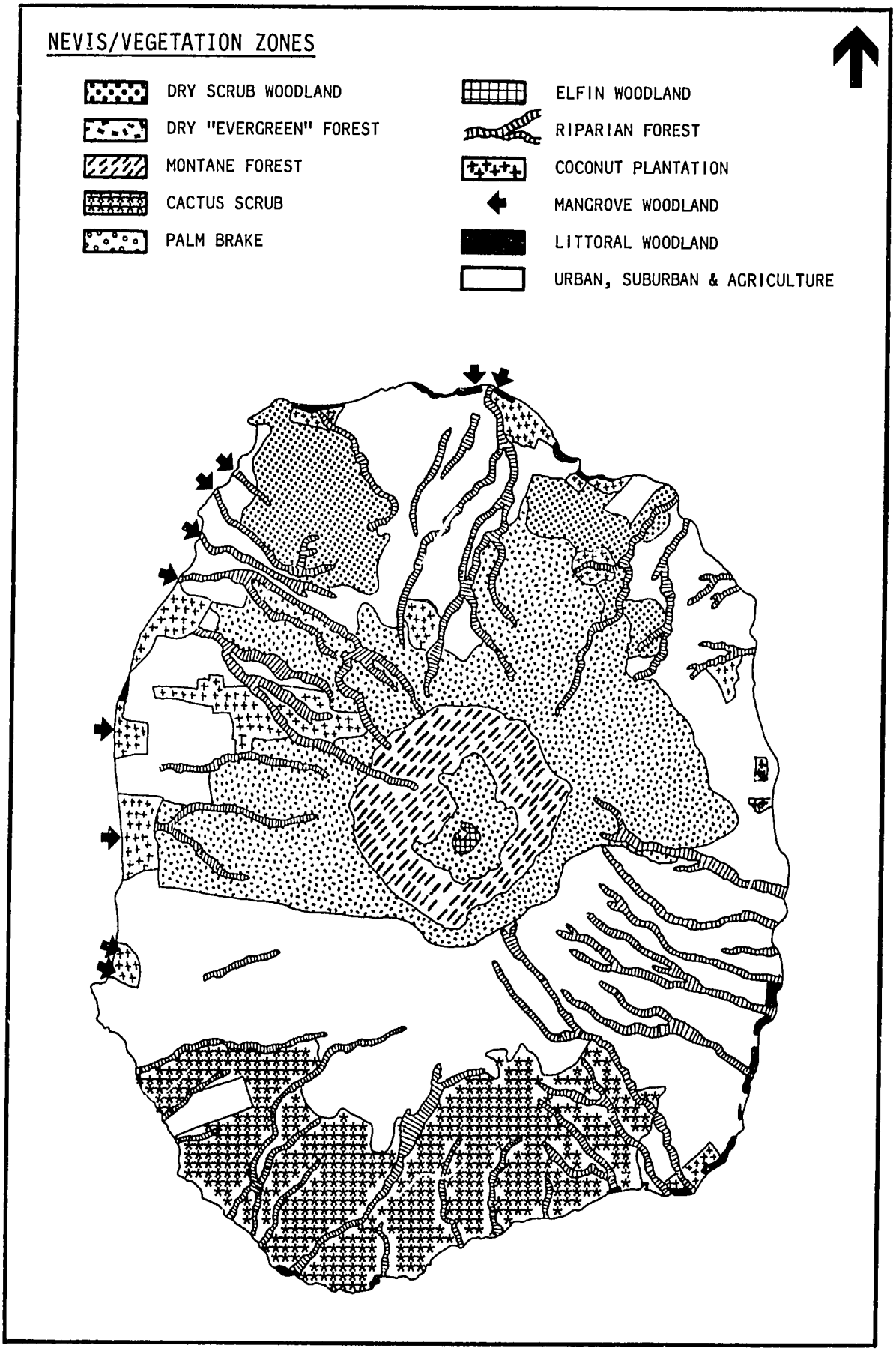


Figure 1.2(18). Vegetation zones for Nevis (source: Rodriques, 1990b).

extends almost to the summit where it is replaced by elfin woodland. In some places slopes are so steep that even palms cannot persist, and they give way to patches of tree ferns (Beard. 1949). The limiting factor in tree growth here may be wind exposure. Palms and tree ferns are dominant because their trunks are flexible and can bend with heavy winds. Other more rigid trees must remain small or be blown over.

(5) Dry Scrub Woodlands. The low hills of Nevis (e.g., Round Hill and Saddle Hill) consist of a patchy, scrub woodland. The prominent trees are various species of Acacia and Cassia. Also present are century plant (*Agave americana*), Prickly Pear Cactus (*Opuntia rubescens*), and Pope's Head or Barrel Cactus (*Euphorbia pulcherrima*) (Merrill, 1958). Most of the southern coast of the island from the Bath Plain to Indian Castle consists of cactus scrub woodland.

(6) Dry Evergreen Forest. The lower slopes of Nevis Peak that extend north and east are covered with an evergreen forest of small trees. The most prominent trees are white cedar (*Tabebuia heterophylla*), black mast (*Diosyros ebenaster*) and loblolly (*Pisonia fragrans*) (Beard, 1949).

(7) Mangrove Woodlands. A series of white mangrove stands (*Laguncularia racemosa*) surround fresh or brackish water lagoons on the western and northern coastal regions of the island. Good stands of white mangroves still exist at Newcastle Bay, Pinneys Estate and the mouth of the Bath Stream (Rodrigues, 1990b).

(8) Littoral Woodland. A thin belt of coastal vegetation exists on most of the unaltered areas of the Nevis coastline. Due to ocean spray exposure, these plants are usually resistant to salty conditions. A vital function of this vegetation zone is to prevent wave erosion, for sand and soil are held in place by the plants (Rodrigues, 1990b).

(9) Dry Zone Flora. This zone has the greatest diversity in species and covers the most land (approximately 75 percent of the total landmass in Nevis). This entire zone is the result of past land clearing for agricultural purposes, and thus very little of the original vegetation still exists (Robinson, 1988). However, in recent years, much of this land has been abandoned and is now reverting back to wildlands consisting of bushy pioneer forest.

The dominant species are logwood (*Haematoxylum camechianum*), wild tamarind (*Leucaena leucocephala*), loblolly, acacia, genip and clammy cherry (*Cordia collococca*). Many agricultural and ornamental species have also become wild and can now be considered part of the natural vegetation.

N.B. Tables listing the species for all of the above vegetation groupings are available from the Nevis Historical and Conservation Society. Tables show both scientific and common names (when a common name is available).

1.3 DEMOGRAPHICS AND HUMAN RESOURCES

INTRODUCTION

The 1980 census enumerated a population of 33,881 in St. Kitts and 9,428 in Nevis; both islands recorded a decrease in population over the 1970 census (see Table 1.3(1)). The 1991 census questionnaire is being pre-tested over a two week period beginning August 13, 1990, and a census day is officially scheduled for May 12, 1991.

The most notable demographic feature about St. Kitts and Nevis over the past 100 years (Table 1.3(1)) has been the remarkable stability of the population, a trend maintained because of a strong migration tradition which has served as a kind of population safety valve (for an account of the population history of SKN see Richardson, 1983 and Bouvier, 1984). When the population of the country is disaggregated by island, substantially greater proportional loss is evident in Nevis after 1946, through internal migration to St. Kitts and emigration. St. Kitts experienced population losses during 1901-1921 and again

Table 1.3(1). Population and growth rates, St. Kitts and Nevis, 1844-1980.

CENSUS YEAR	ST. KITTS Population	ST. KITTS Avg. Annual Growth Rate (%)	NEVIS Population	NEVIS Avg. Annual (Growth Rate (%)
1844	23,177	-	9,571	-
1861	24,440	0.31	9,822	0.15
1871	28,169	1.42	11,703	1.75
1881	29,137	0.34	11,864	0.14
1891	30,876	0.58	13,087	0.98
1901	29,782	-0.36	12,774	-0.24
1911	26,283	-1.25	12,945	0.13
1921	22,415	-1.59	11,569	-1.12
1946	29,818	1.14	11,388	-0.06
1960	38,113	1.75	12,770	0.08
1970	34,077	-1.12	11,250	-1.27
1980	33,881	-0.06	9,428	-1.77

Sources: UK Government, West Indian Census (Part F), 1946.
CARICOM/ECLAC, 1985 (1980-1981 Population Census of SKN).

during 1960-1980, two periods in its history when there was considerable emigration.

Given the fragile nature of insular Caribbean environments and their finite land area and absorptive capacity, the question of future population growth and distribution should be one of the top priorities for policy makers in the 1990's. In the face of declining opportunities for emigration and increasing return migration and some immigration, GOSKN needs to formulate a population policy that takes into consideration future manpower needs which will be generated by proposed tourism development and related construction in both islands.

This policy should consider ways to attract home Kittitians and Nevisians living abroad and should also evaluate the long-term effects of importing agricultural and other labor from the Windward Islands and elsewhere in the region (Trinidad, Guyana, Dominican Republic and Haiti).

POPULATION SIZE

Table 1.3(2) shows the estimated mid-year population for St. Kitts and Nevis for selected years from 1970-1987. These estimates were derived by balancing and re-estimating the data derived from GOSKN's Statistics Division and McElroy and deAlbuquerque, 1988a. Absolute declines in the population of St. Kitts occurred between 1971 and 1976 and in Nevis between 1970 and 1980, indicative of the fact that during this period emigration exceeded natural increase. In the 1980's, there have been perceptible increases in the population of St. Kitts-Nevis as emigration has slowed. Based on research during the period 1989-1990, one investigator has estimated that the rate of population growth increased significantly during 1988-1990 (natural increase was augmented by return migration and some immigration) and has projected that the 1991 census should enumerate a population of between 37,000 and 39,000 in St. Kitts (K. deAlbuquerque,

Table 1.3(2). Selected demographic indicators.[1]

INDICATOR	1970	1974	1976	1980	1984	1987
Est. mid-year population (SK/N)[2]	44,884	43,682	42,881	43,709	45,210	47,105
St. Kitts	33,744	33,286	32,933	33,881	35,219	36,789
Nevis	11,140	10,356	9,948	9,428	9,991	10,316
Pop. density St. Kitts (per sq km)	125.3	123.6	122.2	125.8	130.7	136.6
Crude birth rate (per 1000)[3]	24.8	25.6	29.6	26.4	24.1	21.8
Crude death rate (per 1000)[3]	9.2	11.4	10.7	11.1	10.7	10.6
Rate of natural increase (%)	1.56	1.42	1.89	1.53	1.34	1.12
Est. population growth (%)	-	-.92	-.92	1.30	.07	1.8
Total fertility rate (%)	-	-	-	3.9	3.0	2.9
Births to teenage mothers as a % of all births	-	-	-	30.3	-	-
Infant mortality rate	48.4	57.7	33.3	53.0	27.8	22.2
Arrivals from the USVI	8,357	9,540	7,775	8,798	7,457	-
Departures to the USVI	8,947	9,445	7,332	9,175	7,827	-
Difference	-590	95	443	-377	-370	-
Total arrivals (1000s)	29.9	33.5	34.8	50.4	59.1	92.3
Total departures (1000s)	30.8	33.8	34.9	50.8	59.2	92.9
Difference	-0.9	-0.3	-0.1	-0.4	-0.1	-0.6

Notes: 1 Unless specified, all data refer to St. Kitts and Nevis.
2 Mid-year estimates have been smoothed and revised by the author.
3 Birth and death rates were not computed from revised mid-year population estimates.

Source: Statistics Division, GOSKN; McElroy and deAlbuquerque, 1988a.

unpublished report prepared for CEP project, 1990). Some observers suggest that a 1991 population of 40,000 for St. Kitts is not unrealistic.

Two attempts (Bouvier, 1984 and ECLAC, n.d.) have been made to project the population of SKN to 2030 and 2015, respectively. Unfortunately, both projections are of dubious reliability since their assumptions regarding fertility, and especially migration, now appear to be incorrect. For example, under the ECLAC medium projection, the total fertility rate (TFR) was projected to decline to replacement level (2.1) by the year 2000 (a plausible, but conservative assumption, given current trends in the TFR), while net migration was assumed to be minus 400 persons a year, an assumption that is quite erroneous given what is actually happening in the twin-island state.

POPULATION DENSITY AND DISTRIBUTION

St. Kitts' population density of 209 persons per square kilometer (1987) is average by OECS standards. When population densities are disaggregated by parish (Table 1.3(3)), densities range from a low of 90 persons per square kilometer in St. Thomas to nearly 550 persons in Basseterre (1990 estimates).

Table 1.3(3). Population distribution of St. Kitts by parish, 1921-1980.

Parish/Town	YEAR 1921	1946	1960	1970	1980	PERCENT CHANGE 1921-60	1960-70	1970-80
Basseterre	7,736	12,194	15,579	12,771	14,161	101.4	-18.0	10.9
St. George remainder	175	663	614	1,079	122	250.9	75.7	-88.7
St. Paul	1,380	1,761	2,278	2,071	2,080	65.1	-9.1	0.4
St. Ann	2,644	2,913	3,648	3,300	3,145	38.0	-9.5	-4.7
St. Thomas	2,056	2,177	2,529	2,195	2,255	23.0	-13.2	2.7
Trinity	846	877	1,184	1,066	1,161	40.0	-10.0	8.9
Christ Church	1,531	1,999	2,248	2,091	1,989	46.8	-7.0	-4.9
St. John	3,194	3,240	4,152	3,401	3,163	30.0	-18.1	-7.0
St. Mary	1,781	2,326	3,575	3,381	3,308	100.7	-5.4	-2.2
St. Peter	1,072	1,698	2,306	2,389	2,497	115.1	3.6	4.5
TOTALS	22,415	29,818	38,113	33,744	33,881	-	-	-

Sources: UK Government, West Indian Census (Part F), 1946.
CARICOM/ECLAC, 1985 (1980-1981 Population Census of SKN).

Table 1.3(3) also displays changes in the population distribution between 1921 and 1980. In 1960, 41 percent of the population of St. Kitts resided in Basseterre. By 1970 this figure stood at 38 percent and by 1980 it had risen 6 percentage points to 42 percent. Between 1960 and 1970 the town of Basseterre saw its population decline by some 18 percent, but in the decade of the 1970's, Basseterre's population grew by 10.9 percent (see Figure 1.3(1)). Thomas (1989) assumes the same 10.9 percent growth in the population of Basseterre between 1980 and 1990 and estimates that the Greater Basseterre area, covering 32.5 square kilometers, will account for 52 percent of the total population of St. Kitts in 1990. This figure is bound to increase significantly by the year 2000 given current development plans for the Greater Basseterre area (e.g., Bird Rock extension Phase II, several low income housing projects, a new middle-income housing project, and several new industrial and commercial developments).

With projected increases in the population, particularly in the Basseterre/Greater Basseterre area, densities will rise, and issues related to urbanization/suburbanization will require significant planning attention. Unlike the densely populated islands of Barbados, Bermuda, St. Maarten, St. Thomas, and New Providence, where mass tourism has severely compounded density related problems, St. Kitts is fortunate in having developments like Frigate Bay and the Southeast Peninsula which, because of their relative distance from the main populated areas, should effectively minimize the density related impact of large numbers of tourists.

The island of Nevis registered a population of approximately 9,428 persons in 1980 (Table 1.3(1)), giving it an average population density of 102 persons per square km (total land area calculated at 93.5 sq km) (see Table 1.3(4)). The settlement pattern in Nevis is linear and dispersed. Charlestown is the largest settlement, although other parishes have larger populations but smaller settlements due to land ownership patterns and the

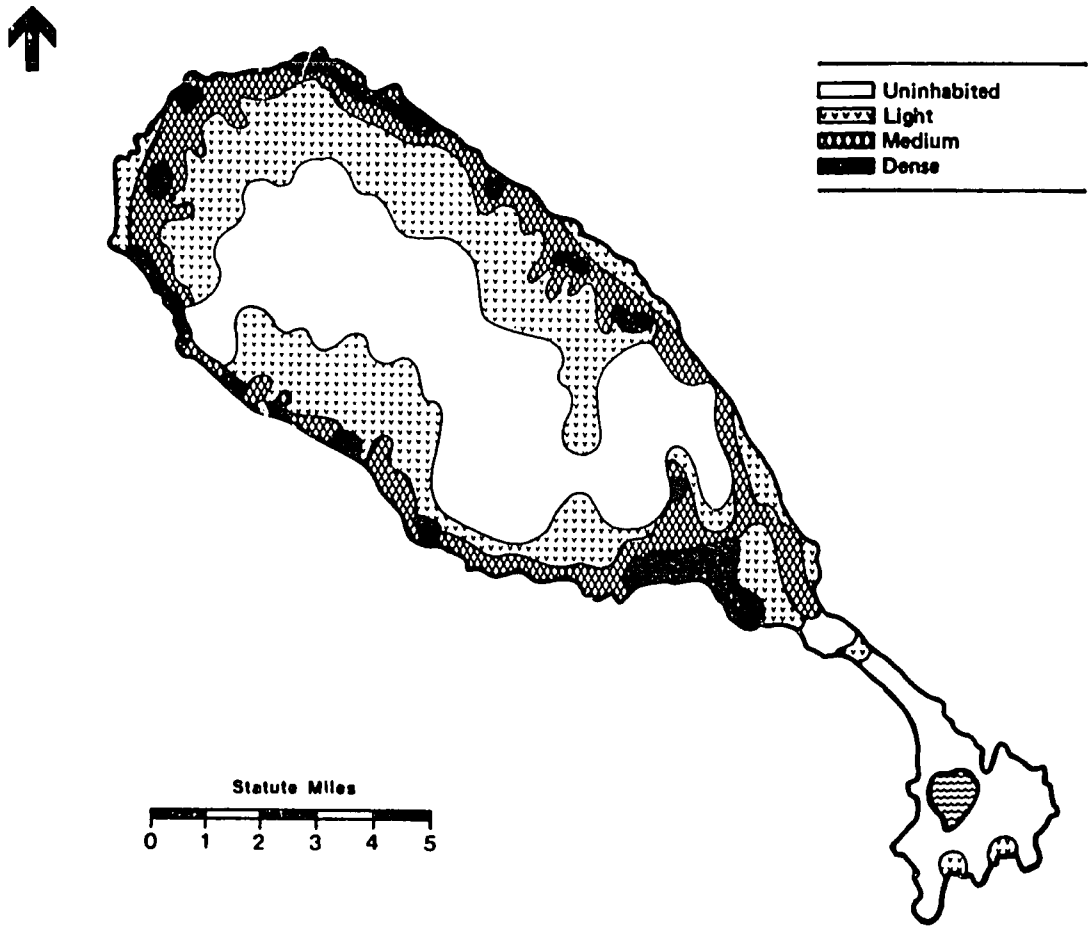


Figure 1.3(1). St. Kitts population density (ECNAMP, 1980b, based on 1975 data).

generally dispersed settlement pattern. This dispersion reflects the dissolution of the plantation system and the establishment of independent farms (see Figure 1.3(2)).

FERTILITY

Table 1.3(2) shows remarkable stability in the crude birth rate between 1970 and 1987, although there is some evidence that birth rates are beginning to decline. The TFR has shown considerable decline since 1980 and is currently estimated at 2.6 (Population Reference Bureau, 1990). With the continuing entry of women into the labor force, and if the experience of Antigua is any guide, the TFR should decline to replacement level, or below, by 2000. In the short term, declining fertility should be more than offset by declining mortality and increasing return migration.

MORTALITY

Like birth rates, crude death rates have remained relatively stable over the last two decades. With general improvements in the standard of living and health care, mortality rates should decline fairly rapidly during the 1990's to somewhere between five and six per 1,000 population. Indeed, health care services in St. Kitts-Nevis compare favorably to that of other OECS territories like Antigua, Dominica, St. Lucia, which traditionally have had much lower infant and general mortality rates.

Table 1.3(4). 1980 population density by parish, Nevis.

Parish	Land Area (sq km)	Population	Density
St. Paul	3.5	1,243	355
St. John	21.5	2,224	104
St. George	18.5	2,295	124
St. Thomas	18.1	1,975	109
St. James	31.1	1,691	54

Source: CARICOM/ECLAC, 1985.

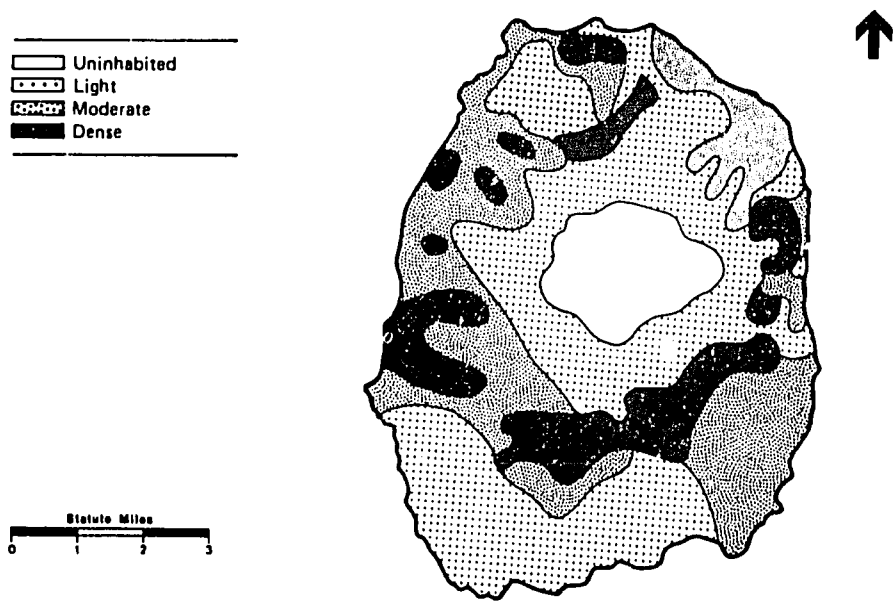


Figure 1.3(2). Nevis population density (ECNAMP, 1980a, based on 1975 data).

The infant mortality rate in St. Kitts-Nevis (higher in St. Kitts than in Nevis) is high in comparison to other OECS countries and poses a particularly vexing problem to health care professionals in the twin-island state. In a study undertaken on the status of women and children in SKN, Chevannes (1989) recommended improvements in nutrition and health care of children and a coordinated national health education campaign aimed at young expectant mothers. It is expected that in the 1990's, infant and child mortality in the country will be brought more into line with the OECS average (about 20 per 1,000 live births).

MIGRATION

Like most Eastern Caribbean societies, St. Kitts-Nevis has had a long migration tradition, with islanders migrating to the

Bermuda dockyards in the early 1900's, to the United States and the cane fields of the Dominican Republic during the period 1900-1930 (1924 for the United States), to the United Kingdom, Aruba and Curacao in the 1950's, and to the U.S. Virgin Islands (USVI), the United States, and Canada in the 1960's and 1970's (Richardson, 1983; McElroy and deAlbuquerque, 1988a and 1988b). Emigration to the U.S. Virgin Islands declined significantly after 1973 (McElroy and deAlbuquerque, 1988a); yet the U.S. Virgin Islands remained the most popular destination for emigrants through the 1970's and early 1980's (see Table 1.3(2) for estimated migration to the USVI). The 1980 census in the USVI identified a total of 6,539 persons who had been born in St. Kitts-Nevis, this group constituting the largest single group of Eastern Caribbean immigrants to this American territory. As many of these persons reach retirement and near retirement in the 1990's, they should begin to return to the country in increasingly large numbers.

Table 1.3(5) shows estimates of net migration for various intercensal periods for 1980-1987. It is clear from the data that the 1960's was the decade of greatest emigration, that during the 1970's the number of emigrants was reduced to half, and that in the 1980's emigration slowed down to barely 173 persons a year. These net migration estimates should be accepted advisedly since they are subject to coverage and registration errors. The 1980-1987 estimates should be interpreted even more cautiously since they are based on 1987 estimates of the population.

Table 1.3(5). Components of population change in St. Kitts and Nevis, 1921-1987.

Island/Components	1921-46	1946-60	1960-70	1970-80	1980-1987
St. Kitts/Nevis					
Intercensal change	7,848	10,450	-5,556	-8,848	3,796
Registered births	24,844	-	17,542	11,737	8,763
Registered deaths	16,797	-	5,442	4,907	3,762
Natural increase	8,047	19,307 [1]	12,100	6,830	5,001
Implied net migration	-199	-8,857	-17,656	-8,848	-1,205
St. Kitts					
Intercensal change	8,029	-	-4,036	-196	-
Registered births	17,332	-	12,676	9,535	-
Registered deaths	12,620	-	3,965	3,889	-
Natural increase	4,712	-	8,711	5,646	-
Implied net migration	3,317	-	12,747	-5,842	-
Nevis					
Intercensal change	-181	-	-1,520	-1,822	-
Registered births	7,512	-	3,453	2,202	-
Registered deaths	4,177	-	1,017	1,018	-
Natural increase	3,335	-	2,436	1,184	-
Implied net migration	-3,516	-	-3,956	-3,006	-

NOTE: [1] Includes Anguilla.

Sources: UK Government, 1946; CARICOM/ECLAC, 1985; Statistics Division, GOSKN.

As suggested above, all indirect evidence points to positive net migration after 1986 with a significant number of islanders returning from the UK and the USVI and to a lesser extent from the United States and Canada. In addition, there has been some return migration from the Dominican Republic and also some immigration of persons from the Dominican Republic and the UK who can claim citizenship because one or both their parents had been born in St. Kitts-Nevis. As the economy of the country continues to expand, it will create a demand for a wide range of occupational skills not available locally, and while this demand can be met initially by returning Kittitians and Nevisians living abroad, eventually St. Kitts-Nevis will complete the migration transition from a labor-exporting to labor-importing society (see McElroy and deAlbuquerque, 1988b).

Like many Leeward Islands, St. Kitts-Nevis is also attracting a steady stream of North American retirees, with Nevis historically the preferred destination of these retirees. Added to this group are a growing number of North American and European entrepreneurs, professionals and technicians, drawn primarily by opportunities in the expanding tourism sector, resulting in a small but economically significant nucleus of white expatriates in the country.

AGE AND SEX STRUCTURE

Figure 1.3(3) shows the age-sex pyramids for St. Kitts-Nevis in 1960, 1970 and 1980. For all three census periods, the pyramids show noticeable "waisting," the result of heavy emigration. This waisting is most apparent among the 20-44 year old age group (especially in 1970), the age group that is most likely to be depleted through emigration. In the 1980 pyramid the waisting is less severe, particularly among the 20-29 year old age group, which obviously experienced markedly reduced opportunities for emigration in the 1970's. Some return migration during the period 1970-1980 is also discernible in the older age groups (60 and above), which by 1980 had almost doubled in size. Sex differentials in emigration are also apparent in the characteristically lower male share of the working-age groups (20-49) during all three census periods.

Slight declines in the birth rate and drastically reduced emigration have combined to reduce the dependency ratio in both St. Kitts and Nevis. (The "dependency ratio" is defined as that proportion of the population under 15 and over 64, per each 100 persons aged 15-64.) In 1970 the total dependency ratio in St. Kitts was 124, by 1980 it had declined to 86, and by 1987 it was estimated at 77. Projected increases in life expectancy and in return migration should predictably result in increases in the aged dependency ratio, while the youth dependency ratio should fall with declining fertility.

EDUCATION

Table 1.3(6) shows that public school enrollment has declined substantially in the 1980's (a similar, but less marked, decline is observed in private school enrollment), largely because of the shrinking pool of school-aged children. Enrollment declines are not equally spread throughout the school system, with rural primary schools experiencing greater declines, while in some urban schools overcrowding is common. Staff-pupil ratios in St. Kitts-Nevis compare quite favorably with other OECS countries -- with a staff-pupil ratio in 1987 of 24 at the primary level and 15 at the secondary. Educational performance is generally good, with students obtaining better pass percentages in the Caribbean Examination Council's (and other external) examinations than their counterparts in Antigua, St. Lucia and Grenada.

LABOR FORCE AND EMPLOYMENT

Statistics on the labor force show a 22 percent decline in the total labor force during 1980-87 (Table 1.3(6)). This decline is perplexing -- given the expansion in the country's economy, the increasing entry of women into the labor force, greater labor force participation rate and declining unemployment; and it raises questions concerning the validity of labor force statistics. The statistics nevertheless do reveal a trend towards increasing

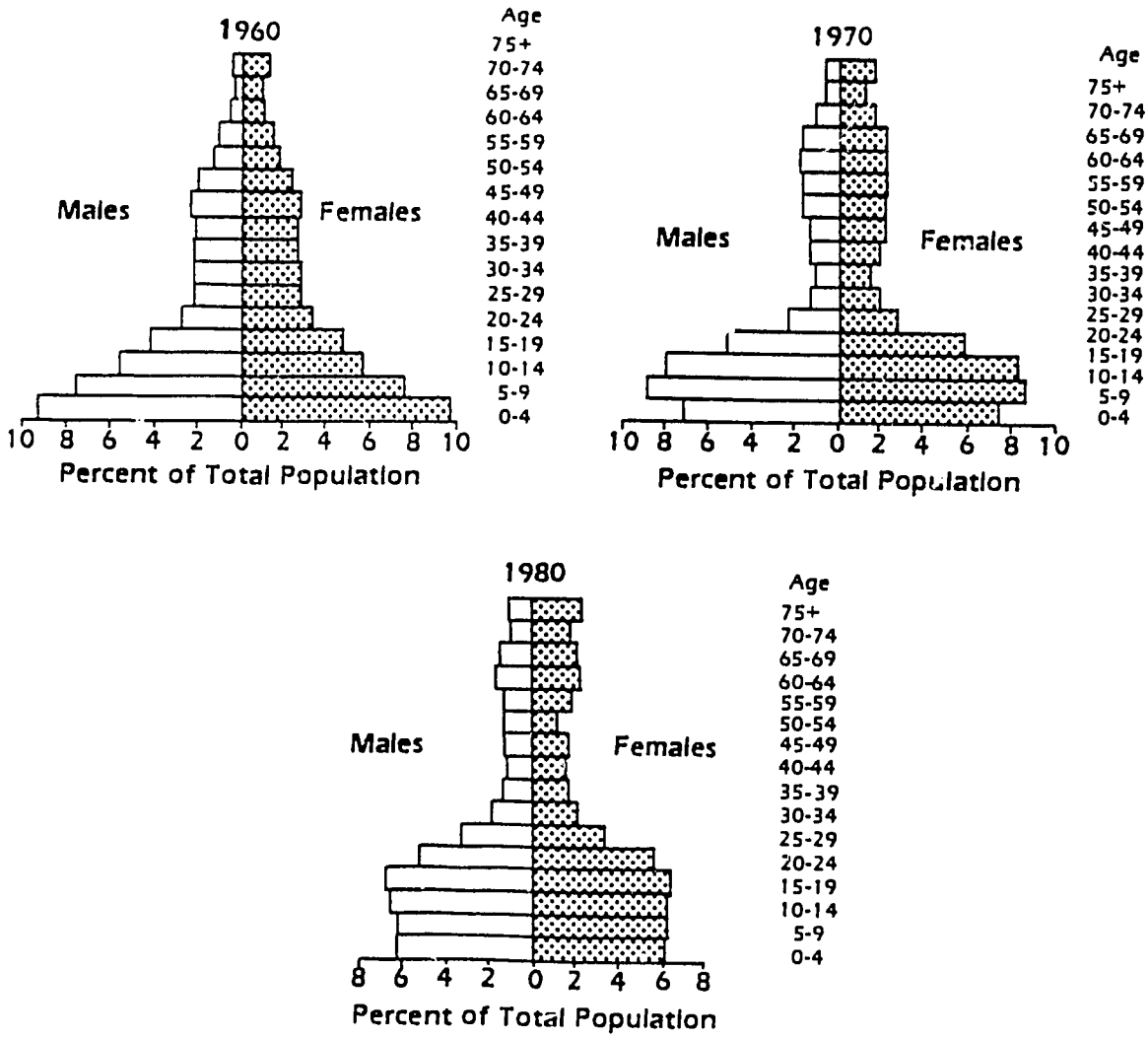


Figure 1.3(3). Age-sex pyramids, St. Kitts-Nevis, 1960, 1970, and 1980.

female labor force participation. In fact, given current trends in manufacturing (women workers overwhelmingly dominate the electro-assembly and garment industries) and hotel employment and declining employment in agriculture and the sugar industry, the dominance of women in the labor force should be a noticeable factor in the 1990's.

Most of the projected demand for service workers in the tourist industry in the 1990's can be met locally. However, as labor continues to be competed away from the agricultural sector, shortages of agricultural labor will have to be made up by the importation of workers form the Windward Islands. Vincentian cane cutters were imported to help with the 1990 sugar harvest, but despite the use of imported laborers and the widespread use of mechanical harvesters, a significant portion of the sugar crop was left unharvested. The gradual phase-out of sugar in the 1990's should free up a significant amount of labor, but if agricultural wages remain low, these

Table 1.3(6). Selected socio-economic indicators, 1975-1987.

INDICATOR	1975	1980	1982	1984	1986	1987
Population per physician	-	-	2,039	2,055	2,103	2,141
Population per dentist	-	-	8,972	9,042	9,254	9,421
Population per hospital bed	-	-	181	182	179	190
School enrollment (all levels)*	13,544	11,363	11,265	10,934	10,717	10,572
Total labor force	-	7,219	6,295	6,281	6,230	5,629
Percent women in labor force	-	39.9	40.4	42.7	46.7	48.1
Property crime rate (per 100,000)	-	1,617	1,769	1,856	2,213	2,070
Violent crime rate (per 100,000)	-	755	651	553	659	679
Total stayover visitors (1000s)	-	31.0	34.6	39.9	56.8	66.7
Cruise ship visitors (1000s)	6.2	5.8	11.1	34.1	27.0	31.4
Total no. of hotel beds	550	878	825	895	1,003	1,046
No. of telephone subscribers	-	-	1,900	1,900	3,000	4,200
Total no. of licensed vehicles	2,856	3,359	3,783	4,178	4,502	4,853

NOTE: * Does not include private schools.

Sources: GOSKN Statistics Division, Planning Unit; Investigation Division, Royal SKN Police Force.

former sugar workers will be competed away from agriculture to better paying jobs in other sectors of the economy.

THE MODERNIZATION OF SOCIETY

By all measures (rural electrification, electricity consumption, number of telephone subscribers, building construction, bank deposits, tourism receipts, real per capita GDP, etc.), Kittitian/Nevisian society has undergone a remarkable transformation in the 1980's, the result of moving toward a more diversified economy in both islands. With improvements in the standard of living/purchasing power and liquidity in the banking system, an unprecedented number of islanders have been able to finance new home construction and purchase automobiles and a whole range of consumer durables. Indeed, so great has demand been for some modern services/conveniences, that supply has been unable to meet demand. This is most evident in the area of telephones. Although the number of telephone subscribers increased by the phenomenal rate of 289 percent during the period 1980-87 (Table 1.3(6)), SKANTEL has a long list of persons waiting for telephone service.

Since much of this remarkable transformation is the result of tourism development and related construction, GOSKN has hinged its future development plans on the expansion of the tourism industry (the manufacturing sector is relatively stagnant and shows little promise of significant growth in the 1990's). Even though the infrastructure for the Southeast Peninsula in St. Kitts (Government's most ambitious tourism development project) is already in place, development of the Peninsula must be managed wisely to minimize the kinds of environmental, infrastructural and social impact so visible in mass tourist destinations like St. Maarten and St. Thomas. Already, at least one major development (the Four Seasons Hotel in Nevis) is having an adverse impact on the water supply on Nevis (see Section 2.2 of the Profile).

The environmental consequences of the modernization of the country's society and economy are everywhere visible. New home construction has led to an unprecedented demand for sand, and given the cost of imported sand, beach sand mining is a daily occurrence in many areas, e.g., at Sandy Point (the Fig Tree area) and at Conaree in St. Kitts. Litter is much more visible in town areas of both islands and in various rural communities, the result of increasing dependence on imported foods, drinks and other items that come in disposable containers and packaging (see also Section 6 of the Profile). With a brewery and soft drink bottling plant in St. Kitts, which produces a wide range of alcoholic and non-alcoholic drinks, there appears to be little reason to import alcoholic and soft drinks in disposable bottles and cans.

As noted in Section 1.1, the awareness of the environment as a social issue has been late in coming to St. Kitts-Nevis, but through the efforts of the St. Christopher Heritage Society and building on the work of the Nevis Historical and Conservation Society, along with some more recent planning efforts by Government (e.g., for the SEP), environmental concerns should increasingly find their way into the development planning arena in the 1990's.

1.4 NATIONAL ECONOMY AND DEVELOPMENT TRENDS

St. Kitts and Nevis were colonized by Great Britain primarily for sugar and Sea Island cotton export. From colonial times to the present, sugar in particular has dominated the economic landscape. Following sugar's peak in the 1880's, the economy stagnated and the population steadily declined as workers emigrated to other islands, the United States, Britain, and more recently the U.S. Virgin Islands (Richardson, 1983). The present population has been relatively stationary since 1980 and is approximately the same as it was nearly a century ago in 1891 (see Section 1.3 on Demographics).

The structure of today's economy is marked by three major features. (NB. There are limited data available which distinguish between economic activity in St. Kitts and in Nevis, and unfortunately marked differences in the economic output of each island may be lost or suppressed when both data sets are combined.) First, the economy continues to be heavily dependent on foreign dollars that stream into the two-island Federation from five different sources:

- export sales,
- tourist spending,
- wages remitted from off-island workers,
- foreign investors, and
- foreign government and bank loans primarily for infrastructure.

Very crude calculations indicate that, on the average, one foreign dollar injected into the economy from these sources creates slightly more than one dollar in SKN Gross Domestic Product (GDP).

Second, the economy is dominated by St. Kitts, the seat of government, location of the deep water port, and center of tourist, sugar, and manufacturing activity. This larger island contains two-thirds of the total land area and three-fourths of the population and accounts for over 85 percent of all visitors. The smaller island of Nevis is characterized by small-holder agriculture, livestock grazing, fishing and relatively small-scale tourism. Government services are also an important part of the Nevis economy and GOSKN is a significant employer. Remittances sent home by Nevisians working abroad have traditionally been important to the local economy, although not reflected in standard financial accounts. There is some evidence that these money receipts may now be declining.

Third, the economy has for some time been diversifying away from traditional sugar and cotton exports toward tourism, construction, light manufacturing and local

Table 1.4(1). St. Kitts-Nevis GDP at factor cost by economic activity in current prices, percent distribution.

INDICATOR	1977	1988	Change
GDP (EC$ millions)	70.9	263.2	192.3
Percent shares			
Agriculture	22.1	10.2	-11.9
Manufacturing	17.6	11.5	-6.1
Construction	9.3	11.8	2.5
Hotels/Restaurants	2.0	9.4	7.4
Government	16.6	20.8	4.2
Other[1]	32.4	36.3	3.9
TOTAL	100.0	100.0	-
Per Capita GDP in constant (1977) prices	1,638	3,400[2]	1,762
Total Stayover Tourists (1000s)	26.3	69.6	43.3
Number of Hotel Rooms	395	854	459

NOTES: [1] Includes primarily transport, banking/realty, retail trade and other services.
[2] Computed by deflating GDP by the 1977 price index for 1988 (121.57) and dividing by the estimated population of 44,000.

Sources: GOSKN, 1984, 1989b.

agriculture (McElroy and deAlbuquerque, 1988b). Table 1.4(1) takes two recent snapshots for 1977 and 1988 that mark this transition. The figures indicate the continued decline in sugar and cotton production since the GDP shares of agriculture and manufacturing (historically sugar processing has represented roughly half of all manufacturing) fell a combined 18 percentage points. The most rapidly expanding sector was hotel and restaurant activity and related tourist sectors such as construction and other services (transport, banking/realty, etc.). It was a decade of major change as the number of visitors, the number of hotel rooms, and the level of per capita GDP all more than doubled.

RECENT DEVELOPMENTS

Recent performance indicates the economy is stabilizing and developing a resilience to unfavorable external shocks. For example, of the 1,340 jobs lost in sugar fields and factory work during the period between 1981-1987, in part as a result of sharp declines in U.S. sugar import quotas, over 40 percent or 550 new jobs were directly created in the two new export sectors of tourism and manufacturing (GOSKN, 1989b). New manufac-

turing jobs contributed three-fourths of this total. Other major employment gains are attributed primarily to domestic agriculture, new private and public construction, and expanded government services. As a result of this increasing capacity to adjust, the standard of living continues to rise. Between 1981 and 1988, the number of telephone subscribers more than tripled, tourism receipts tripled, bank deposits doubled, and the proportion of housing made of concrete and of wood and concrete combined rose 50 percent.

The strength of the new export sectors plus ongoing commercial, residential and infrastructure construction (like the Southeast Peninsula access road in St. Kitts) have also enabled SKN to weather major financial storms. The early 1980's witnessed worldwide recession, falling private investment, annual fiscal deficits, high interest rates and sharply rising local and foreign government borrowing (McElroy and deAlbuquerque, 1990). Between 1981 and 1985, the average annual excess of Government expenditures over revenues was above four percent of GDP. Since 1986, however, rising fiscal surpluses have been achieved by improved tax collections, new revenue measures and reduced expenditure growth. Local inflation has been slowed considerably. Provisional data indicate that these positive fiscal trends have continued through 1988 and 1989 (ECCB, 1989). No other Caribbean countries except Dominica and Jamaica have accomplished such a favorable fiscal turn-around over the decade (World Bank, 1988a).

These fiscal improvements have enabled SKN to augment domestic resources for further diversification in two ways. First, the islands' capacity for external borrowing has risen. Current foreign capital requirements for the 1988-90 period to finance tourist infrastructure and related utilities in the Frigate Bay resort area and the Southeast Peninsula are among the highest in the Caribbean, averaging EC$890 on a per capita yearly basis (World Bank, 1988a). Second, increasing funds from foreign borrowing and strong tourism spending have allowed SKN to finance expensive infrastructure imports, building materials and machinery for residential construction, and food and gift items for tourist consumption.

AGRICULTURE

A variety of specific policies have been initiated during the 1980's to foster diversification in the targeted sectors of agriculture, manufacturing and tourism (GOSKN, 1987c/d). Two agricultural goals have received the most attention: stabilizing the surviving sugar industry on a reduced scale and diversifying into small-holder domestic food crops and fishing. The data indicate new strategies are needed to reverse long-term declines in the number of farms and acreage in farms (see Table 1.4(2)).

These falling trends have accelerated since 1975 as tourism has intensified. During the six years between 1981-1987, sugar production fell by one-fifth, sugar employment fell by one-third, and cotton output declined over 50 percent (see Table 1.4(2)). Despite the very recent success of white potatoes, most domestic food crop production also fell steadily. These decreases occurred when labor shortages intensified in sugar as the divergence between acres cultivated versus acres harvested rose. By 1987 over one-fourth of the potential crop was left standing. In addition to weak foreign demand conditions, sugar continues to be plagued by dry weather and labor shortages caused by steady emigration and wage competition from the expanding sectors. During the 1980's, hotel and/or manufacturing employees and construction workers earned two and three times more, respectively, than cane field workers (CARICOM, 1984).

In Nevis, agriculture is still a relatively important source of employment; in 1986 the sector employed 300 people and provided 30 percent of the island's domestic vegetable requirement. Sea Island cotton, the island's most important export crop, provides some of the best quality lint in the world. Production declined drastically from 3,000 acres during the 1950's to only 38 acres by 1980 (GOSKN, 1987d). Rehabilitation efforts during the last decade saw 124 acres planted in 1985-1986, but the 1989 harvest was again

Table 1.4(2). Selected agricultural indicators, St. Kitts-Nevis.

INDICATOR	SELECTED YEARS		
	1961	1975	1985
Number of farms	4,855	3,525	2,800
Acreage in farms	50,504	41,909	16,100
	1981	1987	
Sugar employment	3,927	2,587	
Cotton (tons)	34.5	16.6	
Sugar cane (1,000s tons)	338	271	
Sugar cultivated (1,000s acres)	10.1	11.1	
Sugar harvested (1,000s acres)	10.1	8.2	
Food crop production (1,000s lbs)			
Avocados	60	340	
Bananas	302	235	
Breadfruits	375	233	
Cabbages	73	47	
Carrots	29	83	
Coconuts (number)	120	156	
Peanuts	447	72	
Pumpkins	229	147	
Sweet peppers	19	27	
Tomatoes	52	135	
Sweet potatoes	694	580	
Yams	232	52	

Sources: ECLAC, 1988; GOSKN, 1989b.

down to 50 acres and expected to drop further in 1990.

Wage imbalances plus seasonal factors have also negatively affected small-scale fishing and domestic agriculture. The cane-cutting season in St. Kitts is routinely associated with reduced fishing effort during the period when the most commercially lucrative migratory species (dolphins and tuna) are abundant. Such labor problems compound other constraints: in the case of farming, poor soil (in Nevis), inadequate farm size, land tenure and conservation practices, small local markets and damage from foraging animals; in the case of fishing, inadequate capitalization and storage facilities, outmoded techniques, and depletion of nearshore lobster and conch beds.

Government efforts underway to address these problems include the provision of long-term leases of Government land for small farmers, new feeder roads, seasonal irrigation, concessional loans and services/inputs, market forecasting and surveillance for specific crops, duty-free importation of equipment, temporary curbs on foreign

food imports, restrictions on local lobster/conch fishing, aquaculture, and various research (local animal feed) and extension (tick eradication) activities.

MANUFACTURING

Since the country contains no known commercially viable mineral deposits, non-sugar industrial development has been confined to manufacturing for the local market and enclave-type processing for export. This latter refers to the finishing (textiles) and assembling (electronics) of imported raw materials and parts by local labor. Despite intense international competition, enclave manufacturing has thus far been a modest but successful diversification venture. According to Table 1.4(3), during the past decade the non-sugar manufacturing share of GDP rose over 20 percent to an estimated 7.5 percent in 1988. Over the same period, the value of exports and selected manufacturing employment rose more than two-thirds. The output of non-alcoholic beverages and construction related products like concrete blocks and furniture outpaced enclave production (Table 1.4(3)). Throughout the decade output patterns have been volatile because of demand fluctuations in both CARICOM and foreign markets.

In Nevis, the industrial sector is very small. The island's business sector is comprised primarily of managers of small branches of Kittitian firms and the owners of small tourist establishments. A limited airport runway and inadequate draft at the port in Charlestown hinder extensive expansion of manufacturing in Nevis.

Table 1.4(3). Selected indicators of manufacturing performance, 1979-1988.

INDICATOR	1979	1988	% Change 1979-88
Manufactures (% of GDP)	6.2	7.5	21.0
Value of manufacturer exports (EC$)	44.3	76.6	72.9
Selected employment[1]	1,157	1,936	67.3
Selected production			
Non-alcoholic beverages (1,000s gal)	547	843	54.1
Alcoholic beverages (1,000s gal)	291	327	12.4
Concrete blocks (1,000s)	1,058	1,873[2]	77.0
Shoes (1,000s pairs)	49	factories closed	-
Industrial gases (1,000s lbs)	218	104	-52.3

Notes: [1] Includes garment, shoe, electronics and beverage workers.
[2] 1987.

Sources: World Bank, 1985 (for 1979 data); GOSKN, 1989b (for 1988 data).

Sustaining future gains in the sector in St. Kitts-Nevis will depend on how well a number of constraints are addressed: limited infrastructure, high transport costs, marketing problems, inadequate linkages with other local industries, and the poor "quality, availability, and [high] cost of labour . . . . " (CDB, 1989). In response, several programs outlined in the National Development Plan have already been initiated. To supplement the U.S. AID-funded Eastern Caribbean Investment Promotion Service, GOSKN is establishing its own Investment Incentive Corporation with professional staffing (1) to attract off-island investment, (2) to better screen serious, bona fide investors, and (3) to provide "one-stop" investor servicing. The Federation is also creating new industrial parks and factory shells and expanding the skilled labor force through job training and vocational education to support a new strategy of targeting higher-value garment and electronic firms and data processing.

The outlook for small local building-related manufacturing is promising. The National Development Plan projects the GDP contribution of construction activity to soon double because of the priority placed on infrastructure, utility expansion, and public and private residential construction. The rate of new/replacement housing starts is expected to double over mid-1980 levels. In addition, Government is planning direct sponsorship of a number of indigenous manufacturing enterprises in meat processing, footwear, and honey processing for export.

TOURISM

Tourism has sustained the diversification effort well, and -- once the impact of Hurricane Hugo (1989) is behind the country -- it should continue to outperform all other sectors. Visitors increased only one percent overall in 1989 because of the storm-induced decline in the fourth quarter following Hugo. Between 1984-88, however, stay-overs grew at an annual average rate of 15 percent per year. Over 40 percent were from the U.S. while 20 percent were from Canada and Europe, and 25 percent (mainly returning SKN workers and students) came from the Caribbean. During the same 1984-1988 years, total visitor expenditure more than doubled, increasing over 20 percent per year, making SKN one of the region's growth leaders. Cruise traffic fluctuated because of shifting routes and the bankruptcy of one ship firm that formerly accounted for a quarter of SKN cruise passengers (*Caribbean Update*, 1989). Room capacity also doubled over the four years, and the value added to GDP by the hotel/restaurant subsector alone tripled (CTO, 1989).

Presently, the most favorable developments in the sector include an increasing share of visitors using hotels (61 percent), strong increases in long-staying Canadian and European tourists, and completion of the Southeast Peninsula access road at the end of 1989. The development of this pristine area is expected to "augment capacity and enhance the quality of the tourism product" (GOSKN, 1987c). Construction of two large (250 rooms) hotels is expected to begin soon on the Peninsula (*Caribbean Update*, 1990) and to generate significant new revenues. If these properties materialize and complement the large resorts nearing completion at Pinneys Beach and Fort Charles in Nevis, total room capacity could double in the next few years.

The long-term success of diversification clearly lies with tourism and its potential linkages with domestic agriculture. The sustainability of tourism depends on whether the country can continue to distinguish itself from its Caribbean competition. In great part this will depend upon: (1) whether the planned large hotel developments in St. Kitts and in Nevis materialize; (2) whether they result in a unique high quality, high income, repeat visitor experience; and (3) how they impact the present balanced mix of North American, European, and West Indian visitors who presently enjoy a relatively small-scale hotel structure and a natural island tourism style (McElroy and deAlbuquerque, 1989). The 1990's will be a critical decade in the Federation's transition to up-scale international tourism prominence because several major infrastructure and development projects will be established that will affect the country's delicate insular environment.

THE "GREENING" OF ECONOMICS

In the area of environmental management, the role of economics traditionally has been diagnostic, scene-setting, and related to the identification of dollars to pay for expensive infrastructure programs. Most of the prescriptive elements of environmental policies are usually dealt with within natural resource sectors such as agriculture or forestry. But that's now changing. As the *Economist* magazine (5 May, 1990) recently noted, "Environmental policies that take no heed of economics will backfire; but so will economic policies that ignore the environment." This statement is just as valid for Eastern Caribbean countries like St. Kitts-Nevis as it is elsewhere in the world.

Progressive environmental policies are most likely to achieve their goals in a cost-effective manner if they use economic mechanisms such as taxes and control of pricing for non-market goods. Regulations and direct subsidies are demonstrably less effective than economic tools which control prices to consumers.

It is important for governments to eliminate subsidies for the exploitation of scarce natural resources. Although this is easy to say, it sometimes clashes strongly with fundamental political issues, such as government-financed housing schemes where a subsidy is used to support the conversion of prime agricultural land into housing tracts. Another traditional subsidy often associated with negative environmental consequences is the construction of farm-to-market roads. In contrast, however, taxes on scarce natural resources and energy can serve the dual goals of revenue generation and ensuring that the prices of such goods more fully reflect the full costs to society.

There are many opportunities for GOSKN to explore the elimination of environmentally-harmful "subsidies" or the adoption of creative fiscal disincentives to protect the environment. For example:

- Establishing grazing fees to reduce excessive devegetation;

- Raising the fee for local sand (or, conversely, reducing the tariff on imported aggregate) to better regulate and control local sand mining;

- Charging higher stumpage fees for lumber and fuelwood extraction from local forests;

- Establishing license fees for commercial fishing to reduce depletion of nearshore fisheries;

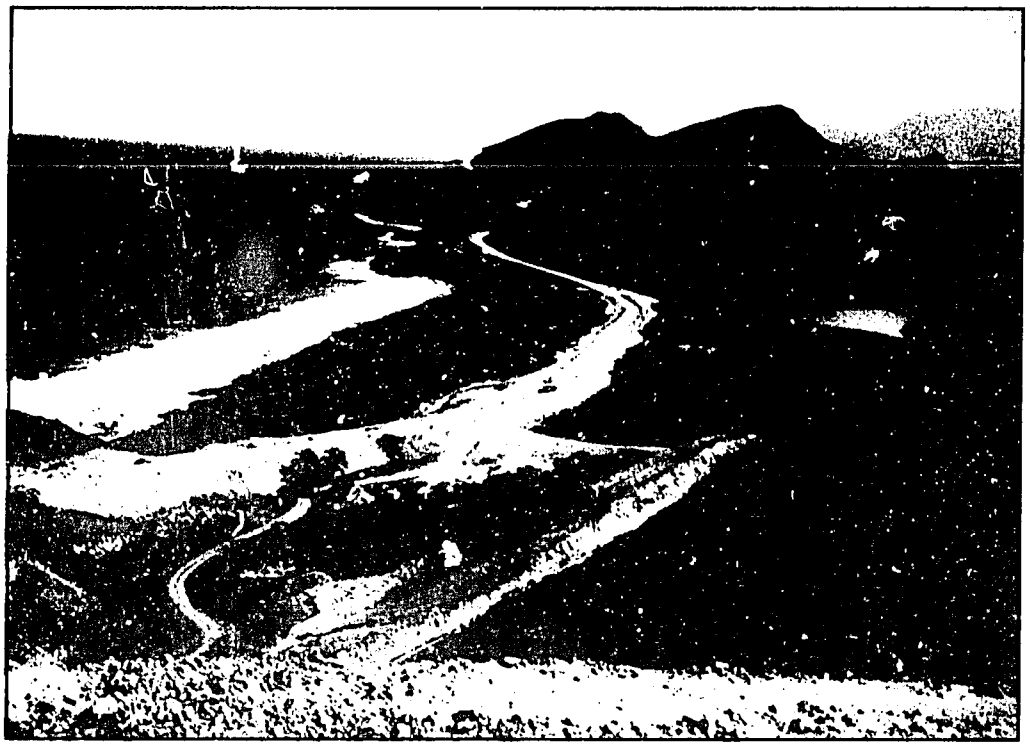
- Raising water distribution charges and setting user fees where there are none;

- Designing tax abatement schemes that incorporate environmental penalties and rewards, e.g., reducing incentives for firms seriously violating pollution control standards or providing subsidies to firms that create environmental enhancements;

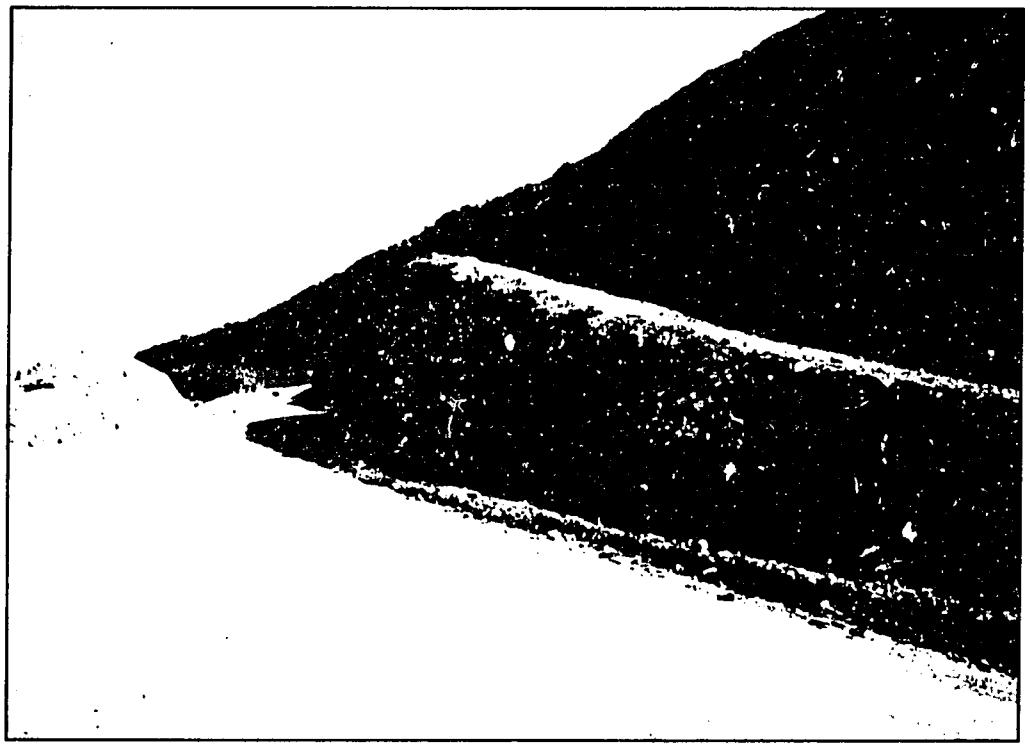
- Similarly, providing tax benefits for hoteliers and manufacturers who excel in purchasing local products and inputs.

It is important for St. Kitts-Nevis and other Eastern Caribbean governments to explore additional ways for economics and the environment to work together creatively.

Efforts must be made to guarantee that the overall speed of tourism development does not deplete the labor force and undermine diversification into agriculture and industry. Likewise, some examination of wage imbalances is warranted so that tourism and construction do not continue to attract labor away from these same sectors. In Nevis, the unemployment level is very low, and the labor force often has to be augmented with imported laborers. In the tourism sector, very few Nevisians are qualified at present to hold many of the managerial posts associated with the industry.



The Southeast Peninsula Road, under construction, as it passes south through the North Friar's Bay area and rises into the hills of Salt Pond Estate. Friar's Bay, with both Atlantic and Caribbean beaches, is likely to be developed early as a major tourism site. Protecting the two salt ponds at South Friar's Bay on the Caribbean side warrants special attention by development planners.



A major engineering achievement for St. Kitts, the Southeast Peninsula Highway may require special efforts to eliminate erosion and rock slides on the steep slopes where the road has been cut into hillsides as shown above.

SECTION 2 THE NATURAL RESOURCE BASE

2.1 FOREST RESOURCES

2.1.1 Overview

ST. KITTS

In between the dozens of deep drainage ghauts which radiate outward in all directions from the elevated center of St. Kitts, trapezoidal cane fields gracefully reach inward and upward toward the thick, deep-green panoply of tropical trees, vines, ferns and plants that make up the heavily-forested core of the island. Dominated by Mt. Liamuiga (3,792 ft/1,156 m), the elongated steep-sided ridge consisting of the Northwest, Central and Southeast Ranges (see Figure 1.2(6)) remain to this day mostly inaccessible and undeveloped. The irregular very steep terrain has, historically speaking, had very little regular intensive use, contrasting dramatically with three hundred years of intensive agricultural use of adjacent surrounding slopes, used traditionally for sugar cane.

However, throughout the colonial era and since independence, the forested core and especially its peripheral edge, have provided downslope communities with a wide variety of useful goods and services such as building materials, fuelwood, natural medicines, wild fruits, and a habitat for game species and other wildlife. By far, however, the most important service provided by the forest is as a reliable source of domestic water for the entire island. In a most orderly sequence, the forest catches the rainfall, stores the water, arranges for its distribution islandwide and releases it over time at various locations.

EXTENT AND NATURE OF THE FOREST

According to Mills (1988), it is generally accepted that about 37 percent of the land area of St. Kitts is covered by forest vegetation (16,000 acres). A land use break-down of the island can be found in Table 2.1(1). Additionally, the relationship between maximum elevation and percent of total area forested in St. Kitts, in comparison to other islands in the Eastern Caribbean, is displayed in Figure 2.1(1).

Nearly all of the forested areas, except for the Southeast Peninsula, are owned by the Government. The St. Kitts forest/woodland cover of 6,500 ha can be classified as:

- Rain and Cloud Forest 2,300 ha
- Moist Forest 2,100 ha
- Dry forest 2,100 ha.

Table 2.1(1). Land use in St. Kitts.

Land Use Type	Acres	Percent
Agriculture	24,420	56.1
Forest	16,000	36.8
Urban	2,600	6.0
Other Use	500	1.1

Source: McKenzie (1987c).

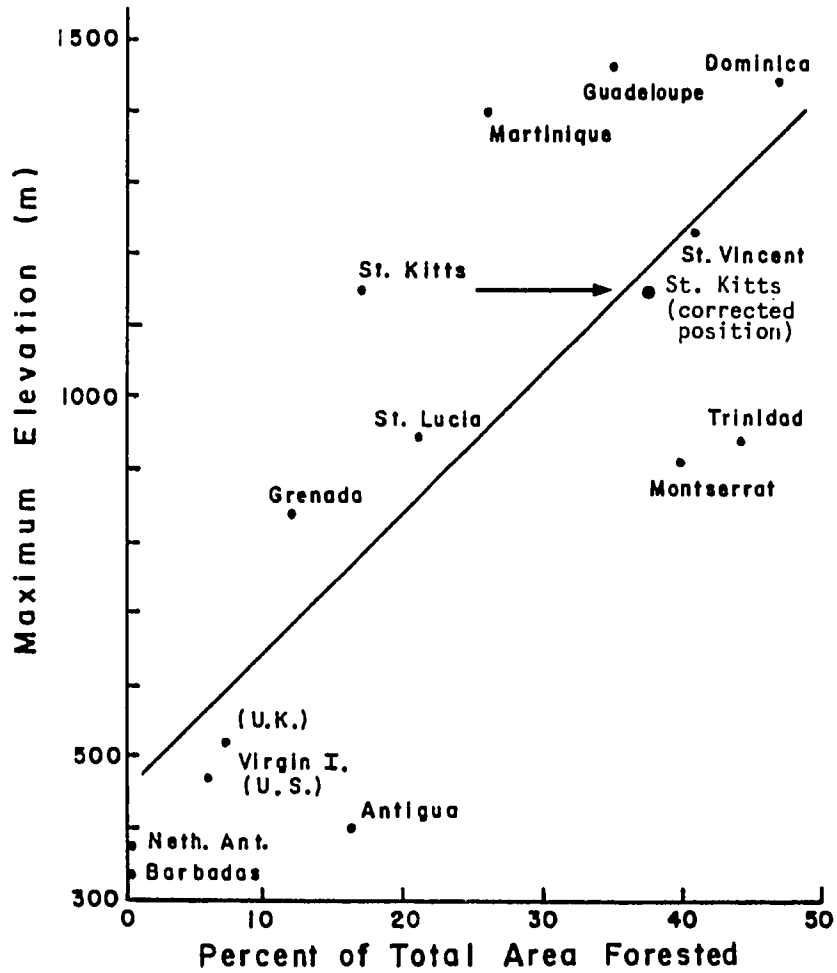


Figure 2.1(1). Relationship between maximum elevation and percent total area forested in St. Kitts, in comparison to other Eastern Caribbean islands (source: Lugo, 1986). This figure is based on Lugo's Table 1 which used an incorrect acreage figure of 16.7% for St. Kitts. The correct figure is 37% (Mills, 1988). The above figure shows both the former (incorrect) plot for St. Kitts and the corrected position.

The species composition of the different types of forest and woodland is still very much like that described by Beard (1949) in his study of West Indian vegetation and as summarized in Section 1.2.4 of the Profile (see also Tables 2.1(2-6)). There is, however, no recent forest resource assessment of St. Kitts (or Nevis either). At least six different consulting reports and studies completed over the last decade have each suggested that a forest inventory should be undertaken and be used to develop an improved management strategy for the resource. See, for example, Skerritt and Evelyn (1982), CDB (1983), UNDP/FAO (1984), McKenzie (1987a and 1987b), and Chalmers (1990).

Table 2.1(2). Common forest trees of St. Kitts-Nevis: rain forest group.

Local Name	Scientific Name
Gumlin	*Dacryodes excelsa*
Mountain Cabbage	*Euterpe globosa*
Yellow Bay Sweetwood	*Beilschmiedea pendula*
Guana Sweetwood	*Aniba bracteata*
Wild Plum [Tom Tar]	*Simarouba amara*
Pigeon Berry	*Hirtella triandra*
Burrwood	*Sloanea truncata*
Snakewood	*Ormosia monosperma*
Wild Coffee	*Faramea occidentalis*
Black mahoe [Black Bark]	*Guatteria caribaea*
Birdlime	*Sapium caribacum*
Fiddlewood	*Vitex divaricata*
Bull Tongue [Honeyberry]	*Marila racemosa*
Gunstock	*Guazuma ulmifolia*
White Fig [Wild Fig]	*Ficus americana*
Greenheart	*Drypetes piriformis*
[Weedee]	*Podocarpus* coriaceus
[Pan Mango]	*Micropholis* chrysophylloides
[Choky Apple]	*Pouteria multiflora*
[Yellow Sandars]	*Buchenavia capita*
[Wild Pepper]	*Hedyosmum* arborescens
[Trumpet]	*Cecropia peltata*
[Milky Tree]	*Sapium caribeaum*
[Redwood]	*Coccoloba* diversifolia
[Spanish Ash]	*Inga laurina*
[Tree Fern]	*Cyathea arborea*
[Blue Box]	*Ilex sideroxyloides*
[Whitewood]	*Symplocos* martinicensis

Sources:

(1) Items not in brackets reported for St. Kitts in Skerritt and Evelyn, 1982 (based on Beard, 1949).

(2) Items in brackets additionally reported for Nevis (R. Young, CEP Project Team).

N.B. Some items listed may be present on both islands.

CURRENT STATUS AND ENVIRONMENTAL CHANGES

Cater (1944) and Beard (1949) both remarked on the fact that there was evidence of continuing and progressive abandonment of agricultural land on previously cleared areas in the upper, steeper slopes of the island as cane production was slowly consolidated on better sites. More recent mechanization and the need to focus production on the most productive land have resulted in further abandonment. Some areas have reverted to secondary forest or have been utilized for grazing (Mills, 1988). Others are used for charcoal, principally because of their accessibility via abandoned but still passable trails used to retrieve the finished, bagged charcoal. As much as 3,500 acres are estimated by one OAS consultant to be pioneer forest which has resulted

Table 2.1(3). Common forest trees of St. Kitts-Nevis: elfin woodland.

Local Name	Scientific Name
	Freziera undulata
	Charianthus coccineus
	Didymopanax attenuatum
Wild Pepper	*Hedyosmum aborescens*
[Weedee]	*Podocarpus coriaceus*
	Weinmannia pinnata
	Rapanea ferruginea
Mountain Cabbage Palm	*Euterpe globosa*
Strangler Fig	*Clusia rosea*
Blue Box	*Ilex sideroxyloides*
	Phoebe sp.

Sources:

(1) Items not in brackets reported for St. Kitts in Skerritt and Evelyn, 1982 (based on Beard, 1949).

(2) Items in brackets additionally reported for Nevis (R. Young, CEP Project Team).

N.B. Some items listed may be present on both islands.

from abandonment of agricultural land (Prins, 1987). Labor shortages in the sugar industry (mostly of cane cutters at harvest time) and the concomitant shift to mechanized harvesting have accelerated this process of acreage reduction of land in cane. The mechanical harvesters simply cannot function efficiently -- sometimes not at all -- on the upper, steeper slopes where the fields also tend to be smaller and more irregular in shape. As a result the upland forested areas of St. Kitts (and Nevis too, see below) are no longer declining but appear to be increasing through secondary growth.

It is, however, legitimate to inquire about the capacity of the new growth areas to provide certain environmental "services". Some experts (for example, Arendt, 1985) have cautioned against the assumption that pioneer scrub forest is good for wildlife, making up for other lost habitat acreage. Unfortunately, some species are very selective, adapted to one or another kind of more mature forest food supplies of insects, seeds, and berries. Other skeptical ecologists warn against assuming the renewed scrub forest zones will provide watershed soil stabilization and renewal (when the soils have been badly damaged by prior misuse). On the positive side, there is some agreement about the role of scrub forest in improved water infiltration and also regarding its buffer zone function for other habitats needing protection. This is especially the case with surviving small areas of rain forest or any specific habitat unique enough to draw attention to itself, thereby inviting an excess of human visitors and impacts, however inadvertent.

REGULATION AND CONTROL

Traditionally, the Government of St. Kitts-Nevis has had a relatively limited role in the management of forested areas. They fell principally within the purview of the sugar estates, which looked after them because they were the sole source of *each* estate's water supply. Not only was responsibility decentralized but so was concern; and, as a result, the estate management format tended to be a surrogate for an informal watershed management process. Management and protection of

Table 2.1(4). Common forest trees of St. Kitts-Nevis: dry evergreen forest.

Local Name	Scientific Name
White Cedar	*Tabebuia pallida* ?
[White Cedar]	*Tabebuia heterophylla* ?
Black Mast	*Diospyros ebenaster*
Loblolly	*Pisonia fragrans*
Mahoe	*Daphnopsis caribaea*
Sweetwood	*Lauraceae* spp.
[Sweetwood]	*Aniba bracteata*
Prickle, yellow	*Fagara martinicensis*
Prickle, white	*Fagara monophylla*
Monkey goblet	*Clusia rosea*
[Strangler Fig]	*Clusia rosea*
Small-leaf	*Myrtaceae* spp.
Spanish Ash	*Inga laurina*
Gum Tree	*Bursera simaruba*
Galba	*Calophyllum antillamim*
Wild Plum	*Simarouba amara*
Wild Grape	*Coccolobis diversifolia*
[Redwood]	*Coccoloba diversifolia*
Locust	*Hymenaea courbaril*
Red Cedar	*Cedrela mexicana*
Dogwood	*Lonchocarpus* latifolius
Bitter Ash	*Picrasma antillana*
Gunstock	*Guazuma ulmfolia*
Pigeonberry	*Hirtella triandra*

Sources:

(1) Items not in brackets reported for St. Kitts in Skerritt and Evelyn, 1982 (based on Beard, 1949).

(2) Items in brackets additionally reported for Nevis (R. Young, CEP Project Team).

N.B. Some items listed may be present on both islands.

upland forests were activities that commanded some level of *investment* of money and effort by owners and some level of planning, work and supervision by resident estate managers. Therefore, for a long time, it appeared that forests were self-managing resources and required nothing from Government. But times changed, and the market place intervened in the form of pressures which encouraged each estate to expand cane production through internal efficiencies and by opening up new cane production areas. There was no place to go but uphill.

The process of clearing forested upper-level estate land for cane culture, for "new" provision grounds or for fuelwood harvesting or charcoal production apparently reached its zenith about the end of the nineteenth century. After a not inconsiderable public outcry, mostly based on concern for the effects of excessive deforestation on the water supply and ghaut erosion from increased run-

Table 2.1(5). Common forest trees of St. Kitts-Nevis: palm brake group.

Local Name	Scientific Name
Bull Tongue	*Marila racemorsa*
Pigeonberry	*Hirtella triandra*
Blue Box [White Birch ?]	*Ilex sideroxyloides*
Gumlin	*Dacryodes excelsa*
Burrwood	*Sloanea* spp.
Sweetwood	*Beilschmiedea pendula*
Birdlime	*Saplum caribaeum*
Tree Fern or Durmandraw	*Cyathea arborea*
[Mountain Cabbage Palm]	*Euterpe globosa*

Sources:

(1) Items not in brackets reported for St. Kitts in Skerritt and Evelyn, 1982 (based on Beard, 1949).

(2) Items in brackets additionally reported for Nevis (R. Young, CEP Project Team).

N.B. Some items listed may be present on both islands.

off and downslope flooding, a formal strategy was initiated by estate managers and developed by Government to control tree cutting and limit shifting cultivation.

In 1904 this took the form of a new Forest Ordinance, the first for St. Kitts-Nevis and the first for the Caribbean. A Forestry Board composed of planters with lands extending into the forested mountains was established to control cutting of vegetation. Beard (1949) observed during his assessment of forests in the 1940's, "The effect of this ordinance, which has been consistently well enforced, has been to create a large central block of forest which is now mostly well-advanced second growth."

The record shows estate owners and managers working cooperatively with the Board to implement the regulations and reforest degraded areas. But, with the gradual decline in and dissolution of the estate system culminating in the nationalization of estate lands, a void slowly developed concerning forest protection and management.

Skerritt and Evelyn (1982) contrast the functional operation of the Forest Board before and after Government acquisition of the sugar estates in 1974. They concluded the Government take-over resulted in "a sudden and rapid deterioration in active management of the forests by the Forestry Board."

After 1974, the Board failed to meet, no summonses were served to illegal cutters, and the issuance of charcoal permits was left to forest guards (there is no record of any licences being issued even though there was considerable evidence of coal-burning) (Skerritt and Evelyn, 1982). In 1976, the Board was abolished and its responsibilities shifted to the Chief Agricultural Officer (Lausche, 1986). This was not a real solution.

Ten years later, under the stimulus of developing a new national environmental strategy to deal with the anticipated impacts of development on the Southeast Peninsula, the Government of St. Kitts-Nevis proceeded to design a new national approach to resource management in the state. The resulting product -- the National Conservation and Environmental Protection Act (1987) -- is a broadly-based piece of legislation designed to protect, preserve and administer a wide range of natural resources. The overall implications

Table 2.1(6). Common forest trees of St. Kitts-Nevis: dry scrub woodland.

Local Name	Scientific Name
Gum Tree	*Bursera simaruba*
Loblolly	*Pisonia fragrans*
Dogwood	*Lonchocarpus latifolius*
White Cedar	*Tabebuia pallida*
	Plumeria alba
	Randia nitis
	Croton flavens
	Capparis flexuosa
	Acacia sp.
	Prosopis chilensis
	Coccolobis puhescens
	Triphasia trifolia
	Nectandra membranacea

Sources: Skerritt and Evelyn, 1982 (based on Beard, 1949) and R. Young, CEP Project Team.
N.B. Some items listed may not be present on both islands.

and detail of the full scope of this comprehensive act are reviewed in Section 5 on Parks and Protected Areas and Section 8 on the Institutional Framework. However, the principal parts of the law as it relates to forestry can be outlined as follows:

- Establishment of Protected Areas. Lands, including private property, can be set aside for a variety of purposes, including national parks, nature reserves, botanic gardens, and historic and scenic areas, and can include marine as well as terrestrial environments.

- Administration of Protected Areas. The Minister for Development, or an appointee, is responsible for management, administration, restoration and conservation.

- A National Conservation Commission is to be formed under the Act, and management plans are to be prepared for protected areas.

- Forestry, Soil and Water Conservation. Timber is not to be cut or felled without permit; forest reserves are to be established, and grazing is to be prohibited within reserves.

- Regulations are to be prepared for the utilization of forest resources, so as to maximize productivity.

- Reforestation is to be promoted, as is timber stand improvement, forest protection, forest management, and research.

- Charcoal production is to be regulated, and export of charcoal controlled.

- Procedures and exemptions for cutting and felling trees are to be determined.

- Soil conservation with special reference to protection of ghauts is identified as a priority, and management and protection measures are to be enforced.

- Watershed conservation is to be employed to insure an uninterrupted supply of water for domestic, agricultural, and industrial uses.

The absence of regulations will undoubtedly prevent the immediate implementation of this extraordinarily comprehensive piece of environmental legislation, and these in turn await guidance from the newly-established Conservation Commission which just began deliberations in 1990. The Commission, however, will not suffer for lack of an agenda in the forestry sector as there have been several useful summaries circulated within the state in the past decade. These include:

(1) A thoughtful, independent assessment by Skerritt and Evelyn was prepared in 1982 as a formal paper for presentation to the Caribbean Conservation Association, then having its annual general meeting in Nevis. Key concerns are outlined in a summary section entitled "The Need For Management".

(2) In 1983, the Caribbean Development Bank (CDB), with the assistance of the Deutsche Forstinventur Service GmbH (DFS), undertook a regional forestry sector study which included St. Kitts. These findings identified environmental concerns comparable to those suggested by Skerritt and Evelyn the year before. These were summarized as:

- An urgent need to identify land which, because of slope, location, infertility, or other reasons, should be permanently retained under tree cover;

- A lack of a formally approved forest policy resulting in significant gaps such as controls on illegal grazing;

- A forest administration lacking a sufficient number of adequately-trained professionals and ill-equipped to perform the range of duties required;

- Exploitation of forests for fuelwood, fence posts and timber which was damaging public land; little incentive for private land owners to improve their forested property;

- The existence of large areas of former agricultural land lying idle or going to bush;

- A lack of trained personnel for reforestation, which made any proposed plantation forestry program a risky undertaking;

- A completely uncontrolled and primitive system of charcoal production.

The CDB/DFS report also made note of the existence on paper of Forest Reserves, first created in 1904 and identified as forest areas above an elevation of 1,500 feet (Skerritt and Evelyn, 1982). The boundaries of the Forest Reserves are not surveyed or marked on the ground, and the CDB/DFS study recommended clear demarcation of the reserves.

Other studies of the forestry sector and its needs occurring at about the same time include the OAS study of the Forestry Division (Prins, 1987) and a very recent St. Kitts component to the FAO Tropical Forestry Action Plan (TFAP) by Chalmers (1990).

NEVIS

Early seventeenth century visitors to Nevis like Captain John Smith and Sir Henry Bolt remarked that forests and "woods" extended all the way to the sea in almost all parts of the island. But by 1707, Hans Sloane reported that Nevis had cleared its forests al-

most to the top of the central mountain, presumably to provide fuel for the sugar cane industry and to make land available for orchards and grazing. A bit of exaggeration is suspected in both accounts, but old maps of the island clearly indicate an upper island road at about the one thousand foot contour, portions of which still exist as trails today.

As large estates began to collapse in the late nineteenth century and population density decreased, abandoned land in Nevis started to revert to a wild state. This natural forest regeneration continues in some places, now a hundred years old, and almost half the total land area of the island is covered with forest or woodland, much of it owned by the Government.

Production forestry has never been a prominent industry in Nevis. At one time, cedar shingles were produced, and in the 1940's Nevis supplied St. Kitts with large amounts of charcoal. Today, activities are limited to periodic charcoal burning (the charcoal production that does occur employs the pit method), some harvesting of bamboo and screwpine for furniture and crafts, and the felling of small trees for use in fish traps, fencing, and construction poles. Remaining forest areas are not suitable for saw timber production due to extreme slopes, erosion hazard, slow growth rates and small tree diameters.

Fruit (banana, mango, genip, papaya, breadfruit) is harvested from naturally regenerated trees as well as domestically propagated ones. Cacao and Castilloa rubber trees were planted in the early twentieth century as an economic venture but were not viable. There are currently no agroforestry or artificial reforestation projects in Nevis. Many lands that were formerly cleared for agricultural production are now abandoned and are naturally reverting back to wild forest.

Watershed management in Nevis has been viewed as applying primarily to Nevis Peak, the source of the island's potable surface water (see also Section 2.2 of the Profile). This, of course, involves a slightly specialized, Nevisian adaptation or use of the watershed concept to cover the entire cluster of upper watersheds around the peak as a management zone instead of the more customary true "watershed" associated with a single watercourse, whether a normally dry ghaut or a flowing stream. There is a precedent for this perspective. The Forestry Ordinance of 1904 declared all forested lands generally above 1,000 feet in elevation crown lands, largely out of recognition of the vital role they play in water conservation. As a consequence, the practice of "forestry" in Nevis has in fact consisted almost exclusively of watershed protection measures. The now-disestablished Forestry Board was required to have among its members one representative from the Agricultural Department and one representative from the Water Department, and the foresters were primarily responsible for ensuring that no activities threatened the water conservation function of forested areas.

2.1.2 Problems and Issues

ST. KITTS

FOREST MANAGEMENT ON ABANDONED CANE LANDS

Although there is no clear definition of acreage involved, there appears to be between 2,500 and 3,500 acres of land which were previously in sugar cane production. Farquharson (1986) in his study of farming models for agricultural diversification reports about 3,000 acres of former cane land available for alternative agricultural activities, but since much of this land never should have been cleared for agriculture in the first place, some care should be exercised to exclude non-suitable land from possible production-oriented farm or agro-farm land re-distribution or re-settlement programs. Prins (1987) argues that a good portion of the approximately 5,000 acres currently in use for cash vegetable crop production, hillside provision grounds, grazing land, or otherwise fallow areas are, in fact, former cane-crop lands. One resource manager in St. Kitts (pers. commun., H. Mills, Forest Officer, 1990) suggests a smaller acreage, i.e., perhaps 2,500 acres of land, is in

a condition suitable for alternative uses. In any event, specific guidelines for de-selection and conversion to some type of land-banking, marginal land reserve or land/soil restoration program need to be developed.

Farquharson (1986) proposes a number of farming models for upper slope areas. These are principally classified as small cash crop vegetable production, fruit crop and livestock farming. The importance of protecting and utilizing these lands in a forest plantation management program is emphasized by recent activities undertaken as part of the OAS Natural Resource Management Planning Project for St. Kitts. The identification, propagation and outplanting of suitable forest species in multi-purpose plantations was a major focus of project activities. The establishment of demonstration plantations in conjunction with soil conservation activities were planned outputs, although plantations proposed at soil conservation project sites such as Sir Gillies Ghaut and Lavington's Estate were not established. This kind of work should continue on a greatly expanded scale.

The importance of the natural forest for watershed protection is paramount. Likewise, the importance of retaining both abandoned cane lands which are in a fallow status and forests which contain early successional species to control and maintain water flow needs to be emphasized, and appropriate management practices need to be implemented. These lands have potential for productive forest plantations for a variety of wood products in local demand. Research should be focused on identifying silvicultural techniques capable of establishing useful species at exposed sites. Agroforestry has a well defined role to play on upper sites, where farmers' needs and requirements for environmental protection can be merged.

FOREST MANAGEMENT ON THE SOUTHEAST PENINSULA

Realizing the potential threat to the unique environment of the Southeast Peninsula (SEP), and in response to an antecedent full-scale environmental assessment report (Towle, *et al.*, 1986a), the Southeast Peninsula Development and Conservation Board organized preparation of sectorial management plans for the Peninsula's terrestrial and marine environment. The Forestry Resources Management Plan (Buchter, 1989) includes identification and description of each unique vegetation type and its contribution to the overall environment of the Peninsula. Barrier dune, littoral forest, sea blast areas, a xerophytic association, tropical dry forest, and the guinea grass type are represented.

Of particular concern on the Peninsula is the fire hazard that occurs during the dry season in guinea grass, an introduced vegetation type. Annual burning in these areas maintains the grass cover and prevents regeneration of more complex and stable natural vegetation. The guinea grass, which was originally introduced as cattle forage, is expanding in area annually as a result of progressive burning into forested areas.

The Forestry Resources Management Plan outlines the critical relationship between vegetation and erosion on the Peninsula. Disruption to the natural vegetative cover in this area of low rainfall requires many years for full recovery. The impact of poorly-planned construction on the natural cover will be essentially permanent, and siltation resulting from increased run-off from construction sites could adversely affect marine resources.

Reserve status is therefore recommended in some special treatment areas on the Peninsula. These include ghauts, especially St. Anthony's Peak ghaut, areas of sea-blast vegetation, barrier dunes, and the littoral forest areas. Negotiation for preservation of these areas with SEP land owners is recommended and justified on the basis of resource conservation as well as aesthetic appeal.

As plans for major development projects are proposed for the Peninsula, emphasis should be placed on a thorough review and implementation of the development guidelines contained within the SEP Forestry Resources Management Plan. Recommendations are specified for protection of trees and shrubs, the integrity of the ghauts, roadway design criteria to protect vegetation, fire con-

trol, landscaping, and the impact of animals. The need to pay particular attention to appropriate landscaping of buildings and roadways is emphasized by Buchter (1989) and other planners (Towle, *et al.*, 1986a).

WETLAND FORESTS

The wetland resources of St. Kitts were identified by Henry Mills (GOSKN Forestry Officer) in his paper prepared for the Fifth Caribbean Foresters Meeting in Trinidad in 1990. Wetlands are also considered within the scope of the FAO Tropical Forest Action Plan (TFAP). A preliminary list of TFAP issues in St. Kitts (Chalmers, 1990) identifies Greatheeds Fond, located less than three miles from Basseterre, as a significant wetland threatened by pollution from the adjoining refuse dump. On the basis of a preparatory mission undertaken in advance of a more detailed study of tropical forest concerns, Chalmers suggests, "This [Greatheeds Pond] has excellent potential for development as a wildlife sanctuary . . . ." Chalmers recommends that an assessment should be made rapidly to determine other mangrove areas in the Federation requiring protection.

URBAN FORESTRY INITIATIVE

The importance of trees, shrubs and other vegetation in urban areas cannot be overemphasized. The benefits of these plants go beyond their obvious aesthetic value and include serving as noise barriers, removing air-borne pollutants and adding oxygen to the environment, and providing shade and wildlife habitat. The need for these benefits is important in St. Kitts-Nevis as urban development continues and as additional facilities for tourist accommodation are built. Well-planned landscaping and rehabilitation of natural vegetation on development sites should be required as part of the development permitting process. Planting new trees and caring for existing trees should also be addressed in older neighborhoods.

An urban forestry initiative would help to focus attention on the loss of trees and shrubs in the urbanized or more developed environments of the country. Improvements to the urban forest can include street tree planting, park and cemetery planting, and protection of natural areas and should involve both private and public property. Initiating an urban forestry program, with perhaps an inventory assessment, planting schemes, and other improvements (including support for establishment of a new botanical garden), will help to raise public awareness and generate interest in a comprehensive urban forestry effort. Education programs on the benefits of trees and shrubs and on the need to focus attention on organizing the natural environment through landscape planning and landscape architecture can be accomplished with the assistance of local media and in conjunction with the Ministry of Education for programs focusing on school grounds. Guidelines for landscaping aimed at developers of individual or multi-unit housing projects could be prepared, and a list of recommended plant material and sources could be compiled with help from local experts.

A successful urban forestry program will require a cooperative effort by Government and the private sector. In this regard, the pioneering efforts of the Basseterre Beautification Committee and other organizations and clubs need to be recognized.

FOREST RESERVES

Protecting the land from the effects of destructive erosive forces and protecting the supply of freshwater are the primary functions of the natural forest. In order to insure that these benefits continue uninterrupted, the status of forest reserves should be formalized, and measures should be set in place to improve their management.

The composition, condition, area, and resources of the upland forest are poorly defined. The extent to which these areas are presently used, by whom, and for what purposes has not been evaluated or documented on a consistent basis. The extent to which the forest supplies firewood and wood for charcoal is essentially unknown. A long-term management plan for the forest reserves is needed, which would include defining areas

where different uses can occur and areas where protection forest is to be emphasized.

The boundaries of the forest reserves need to be established. Survey of boundary lines and demarcation in the field should proceed following a forest inventory and establishment of the legal framework to ensure control and regulation of the land. The National Conservation and Environment Protection Act (1987) would appear to be an appropriate legislative vehicle for insuring proper protection and management of forest preserves.

ECO-TOURISM

Several tour operators and guides use the natural forest for nature excursions, and recreational trips into the forest have become popular with island visitors. The impact of increasing numbers of people and the vulnerability of locations visited on a regular basis need to be assessed. In addition to formalizing routes frequently used, further development in the eco-tourism sector might include rehabilitation and improvements to the cross-island trail. This historic trail is an old road connecting the villages of Old Road and Molineux, via Phillips Level. Development of facilities such as interpretive signs, side paths to significant natural features, and resting stations and shelters are trail amenities which could be of interest to local residents and tourists alike. Additionally, such a trail has potential as a focus for a continuing environmental education program suitable for a broad cross section of the resident and non-resident populations.

FOREST INVENTORY

It has been more than 50 years since Beard's assessment of the natural forest (Beard, 1949). At Wingfield and Mansion Estates, Beard established one acre quadrats which were inventoried in some detail as to species composition and stocking (see Section 1.2.4 of the CEP). There is no evidence of other more extensive or detailed examinations of the forest resource since Beard's work. Detailed knowledge is of prime importance in view of the susceptibility of the resource to change, e.g., storm damage. Instituting a method of monitoring change which results from natural occurrences such as hurricanes and the effects of human disturbances needs to be addressed. As a first step, the forest resource should be inventoried, to include mapping the forest by type, noting slope percent, exposure to the frequent path of major storms, and a variety of other topographic details. Forest composition, volume of timber-producing species, forest products, age class, access, and other features of the forest should also be collected in a field cruise based on random sample points distributed over the forested portion of the island. Analysis of field data would provide essential information for the preparation of a full forest management plan and clear designation of forest reserves. Intensity of proposed forest use could be identified by management unit and might include areas suitable for multi-purpose use, e.g., timber production, and areas which will not sustain major human impact.

NEVIS

The major problem with forestry on Nevis is the absence of an overall forest management and protection program. Legislation has been in place for some time to regulate certain activities and to protect lands above 1,000 feet, but it has not been actively enforced. There are no trained foresters on Nevis as vacant positions were never filled when the last forest guards died in the 1970's, and a forestry program has never been developed. Forested crown lands are under the jurisdiction of the Ministry of Agriculture, but the Department is so understaffed at present that no time can be devoted to forestry. The Forestry Board in Nevis, as in St. Kitts, became defunct in the late 1970's, and although a Forestry Division was established under the Ministry of Agriculture, Lands, Housing and Development in St. Kitts in 1987, Nevis does not have an active forestry unit.

An obstacle to any forestry program is the paucity of information about Nevis' forest resources. Very little study has been done on the vegetation in recent years, and Beard's

1949 descriptions are in need of updating in Nevis as well as St. Kitts. A new study of the island's vegetative zones could serve as a guide for future development programs and provide the necessary baseline data for any forestry program.

The upper elevation forests on Nevis are largely intact, protected from agricultural encroachment by their steep slopes and monkey populations, but the lower elevation areas are subject to overgrazing and erosion. At the height of charcoal production in the 1940's, the Leeward side of the island between 700 and 1,200 feet was heavily exploited. (Charcoal was exported from Nevis because regulations against the felling of timber were stricter on St. Kitts.) Charcoal production regulated by the issuing of permits is called for under the Nevis Forestry Regulations of 1940, but this law is not enforced, making it impossible to estimate the amount of wood felled for this purpose. The 1980 population census (CARICOM/ECLAC, 1985) indicated that 57 percent of the population used charcoal or wood for cooking fuel. Given the increase in gas stoves on Nevis in the last ten years, it can be assumed that this percentage has dropped substantially.

One threat to the higher elevation areas is not agricultural encroachment as is common in St. Lucia, St. Vincent and Grenada but rather residential encroachment. Cooler breezes and spectacular vistas attract mainly non-Nevisians to these areas to build homes. As beachfront property becomes limited, more developments such as the one planned for Pinneys Estate -- which utilize a small length of beach but extend a much greater distance back up the flanks of Nevis Peak (in the case of the Pinneys development right up to 1,000 feet) -- may be proposed.

The Agricultural Department's lack of oversight concerning forest resources can lead to several problems. Unmonitored, introduced exotic species can establish dominance over the island's natural vegetation and in some instances cause the extinction of vulnerable native species. Introduced species that have already become pests include Mexican Creeper (*Antigonon leptopus*), Acacia (*Acacia* sp.) and Logwood (*Haematoxylon campechianum*). As more hotel resort complexes are built, non-native species may be brought in for landscaping. There have been no reforestation or agroforestry projects in Nevis, and little research on the tree species that would be most suitable for managed fence post or charcoal production, or any other use, has been carried out.

Years of lax enforcement of the Forestry Regulations have caused the Government to lose some control over the indiscriminate felling of timber. In a recent incident, a few mahogany trees near the Charlestown Secondary School were cut for furniture production before the teachers could alert the Ministry of Agriculture.

NEVIS WATERSHED MANAGEMENT

Problems associated with watershed management in Nevis are closely tied to those related to the management of forest resources. Under the Watercourses and Waterworks Act of 1956 and Regulations of 1973, the Government has the authority to prohibit cultivation and livestock grazing within thirty feet of a watercourse but is given no specific guidance on enforcement procedures for offences. In addition, the penalties for violation are too low to be a practical deterrent (Lausche, 1986). An added complication in watershed management is the imprecise distribution of oversight between two Government agencies, the Water Department and the Agricultural Department. It is unclear exactly which responsibilities fall to each Department. Legislation linking forest, soil and water conservation and erosion mitigation, which would be an effective way to integrate the watershed management activities of the two Departments, does not exist.

LEGISLATIVE AND ADMINISTRATIVE ISSUES

As indicated in Section 2.1 above, the National Conservation and Environment Protection Act (NCEPA) of 1987 has a distinct Forestry, Soil and Water Conservation section which authorizes the establishment of forest management schemes including the

designation of forest reserves, the prohibition of livestock grazing in certain areas, the promotion of reforestation, timber stand improvement, multiple use forests and forest research. In consultation with the Conservation Commission, the Minister is to formulate regulations for soil conservation and to work with the Water Board to develop water resources to prevent and reduce soil erosion. The effect of these policies remains to be seen as no regulations have been developed to date. Prior to enactment of the NCEPA, Nevis had drafted a Land Development Ordinance (1984) which was designed to reduce or prevent soil erosion, develop forest reserves and protect ghauts and other water supplies, but it was never institutionalized. Modifications to this draft Ordinance might provide a step in the direction of the needed NCEPA regulations for the island of Nevis.

The Nevis Island Administration (NIA) has expressed interest in conferring special status on some forested areas in Nevis. The NCEPA outlines the procedure for setting aside such protected areas, and the proposed zoning map for Nevis identifies Nevis Peak, Butlers Mountain Round Hill, Hurricane Hill and Saddle Hill as "prospective" national parks.

2.1.3 Policy Recommendations

For perhaps four hundred years the Government of St. Kitts and Nevis, in its various jurisdictional and administrative forms, has been more or less preoccupied with three sequential tasks:

First, clearing the forest from the best, most accessible land to make room for privately-owned agricultural estates growing sugar cane to produce sugar for export.

Second, encouraging more forest clearing (of steeper lands) to enable the expansion of cane acreage and sugar production by the estates and their owners.

Third, once markets, prices and estate management became marginal after World War Two and near collapse by the 1970's, taking responsibility for continuing the cane-based agriculture and the sugar-based industry, assuming full management control of the estates and the entire production system -- an enormous and formidable undertaking for a small Government in a small country.

What is noteworthy now, and in retrospect, is that during the first three centuries and in carrying out the first two tasks, "forests," as such, were generally seen either as an obstruction and a nuisance or as a source of fuelwood, a *by-product* of land-clearing activities. If anything, they were viewed with some hostility because it was to the forest that runaway slaves retreated. When, later, slavery was abolished and all potential cane land had been cleared for cultivation, attitudes towards the forest softened or at least became more neutral.

By the time of the third task -- i.e., Government assumption of management responsibilities for the sugar industry in all its complexity, sugar estates included -- forests were simply not perceived as important. They were seen only as peripheral and mostly irrelevant to the task at hand -- conceptually distant from the real world of unemployment, declining sugar prices, estate management problems, and the business of learning how to run a Government, since national independence came along not long after. All of this leads to several conclusions which should inform any attempt to shape forestry-focused action recommendations.

Firstly, forests have not, as a matter of public policy or public concern, ever figured largely in the history or development planning of St. Kitts and Nevis. Over the years, forest resources have generally been taken for granted -- because they were isolated, distant, reliable producers of water, home for wildlife, never demanding much from the public treasury for repair or management. The exception to this situation was passage of the innovative Forest Ordinance in 1904.

However, times have changed; and the drive for expanded diversification in agriculture, as well as in employment, Government revenues and business opportunities, should lead to a serious reassessment of the unrealized potential of the country's approximately 25,000 acres of forest. Perhaps the time has come, after two decades of consultants, one after another suggesting the need for a forestry policy, to redefine and expand the role of the forests within the country's larger national development planning strategy.

At the very least, there is some evidence that the casualness of the past regarding the forest resources of St. Kitts and Nevis should, at least fairly soon, become a thing of the past. The patterns of risk to all living, renewable resources like a forest are changing -- e.g., new biocides, expanded harvesting of wood and water, threats from settlements and even the risk of lost opportunities -- and each suggests the need to periodically assess priorities. There is, admittedly, no crisis of the forest. But the time for good planning and precautionary action is here. Agenda items for consideration follow.

FORESTRY RESOURCE ASSESSMENT

An updated forest resource inventory and assessment should be launched as soon as possible and should include, among other tasks, an identification of reforestation areas, fuelwood plantation sites, potential wildlife reserves or protected areas, tourist amenities, problem watersheds, training sites, and potential recreation sites (e.g., campgrounds).

FORESTRY POLICY DEVELOPMENT

Following the development of regulations by the Conservation Commission pursuant to the NCEPA (or as *ad interim* policies until such guidelines are available), a comprehensive forest resources policy and plan needs to be prepared, with associated regulations covering production forestry, agro-forestry, social forestry, urban forestry, wildlife habitat, watersheds, forest reserves, and fuelwood production and other plantation development on forested lands. Additionally, the forestry policy and plan should probably lay out guidelines for the restoration/recovery of abandoned cane lands and for erosion control and mitigation. The idea of a special unit within the Forestry Division for ghaut forestry may warrant review.

AGRO-FORESTRY AS DIVERSIFICATION

As a facet of the larger national agricultural diversification strategy, sub-elements should focus on expanded and accelerated implementation of a program of agro-forestry. Attention needs to be given to such issues as: longer term land leases, monkey control, tick control, grazing control, institutional support systems, fence post pressure treatment facilities, and lumber import substitution programs.

NATURE TOURISM AND FOREST RECREATION LEADERSHIP

In some cooperative format, the Forestry Division should take the lead in conceptualizing and shaping a nature tourism and domestic recreational facility development plan, including a hiking trail system, provision of shelters, and implementation of an educational program (drawing on the models now underway in St. Lucia, Grenada, Montserrat, and the U.S. Virgin Islands).

WETLAND WILDLIFE RESERVES

A resource inventory, including mapping the location and extent of the remaining wetlands (both St. Kitts and Nevis), is a critical requirement which should be undertaken as soon as possible. It would appear that the legal structure for protection of wetlands is included within the 1987 National Conservation and Environment Protection Law.

As a model for other wetlands, the present plan for the establishment of a wildlife sanctuary for Greatheeds Pond at Conaree, for which a funding proposal is awaiting approval from ICOD, should be started as soon as possible, perhaps in cooperation with the St. Christopher Heritage Society. Pond mon-

itoring should not await word on the ICOD funding. Separate, internal or external funding should be identified for ongoing monitoring regimes.

SPECIFIC CONSIDERATIONS FOR NEVIS

In addition to the above recommendations which apply generally to both St. Kitts and Nevis, specific consideration should be given to certain requirements in Nevis. Before any serious forestry program or projects can be properly developed for this island, a Division of Forestry must be instituted within the Nevis Agricultural Department and at least one trained forester employed to manage such a division. Standards for identifying, selecting and ranking prospective "areas of special concern" or forest reserves should be one of the foremost responsibilities of the Nevis Division of Forestry. Earlier efforts to declare Nevis Peak and other forested upland areas as national parks could and should be included in this process. Regulations for the implementation of Part VII of the National Conservation and Environment Protection Act are a badly needed next step to enable Nevis to move ahead with a forestry protection program. Additionally, the proposed Nevis Forestry Division should work with the Nevis Water Department to employ effective watershed management strategies.

Natural reforestation is occurring on many abandoned lands, so a large-scale, artificial reforestation campaign would not be the best use of available resources, except perhaps for seriously damaged or eroded sites in key watersheds. Small-scale projects could include managed mini-plantations using fast-growing fuelwood species such as Leucaena for charcoal or those specially planted for fence post production or agro-forestry projects which inter-crop fruit or fodder trees with vegetable crops. Tree planting initiatives for erosion control within, on the sides and on the upper edge of eroding ghauts and as wind breaks in fields would be highly effective in stemming one aspect of Nevis' soil loss problem. Lower cost fencing is needed to mount the first phase of a strategy to reduce overgrazing on the island. An expanded nursery output of Gliroidia, which can be planted as a living fence, would also help.

Finally as recreational and scientific use of Nevis Peak increases, the collection of plant specimens and hiking access should be monitored.

2.2 FRESHWATER RESOURCES

2.2.1 Overview

ST. KITTS

BACKGROUND INFORMATION

Upon arriving in St. Kitts in 1493, the chronicler of Columbus' second voyage noted the presence of "verdant forests and sparkling streams. . ." (Matheson, 1985). At present, almost 500 years later, "verdant forests" have been displaced up to elevations between 800 and 1,400 feet (Prins, 1987), and no "sparkling streams" can be found below 400 feet, except after heavy rainfall (Oelsner, 1986). But, unlike most islands in the Caribbean, the area of forest on St. Kitts has expanded in recent decades, due to the abandonment of sugar cultivation on steeper lands following mechanization of the industry. Given the importance of vegetation to water cycling, storage, and recharge, this trend will have a favorable impact on the island's freshwater resources. An estimated 3,500 acres, some 22 percent of the total area of forest (16,000 ac), consists of new pioneer succession or secondary growth (Prins, 1987).

Numerous studies of water resources on both St. Kitts and Nevis have been undertaken over the last quarter century, beginning with that of Sir William Halcrow and Partners (Halcrow, 1966). Torres (1985) provides a brief description of each of these research efforts.

Partly as a result of the considerable research that has been conducted, relatively substantive data on rainfall and water resources are available. In fact, some 50 rain gauges are present on St. Kitts (Torres 1985), but none are located within the rain forest; thus, as indicated in Section 1.2.1, rainfall patterns for these areas have been estimated on the basis of vegetation. The estimated average mean monthly precipitation for the island of St. Kitts is 64 inches as shown in Table 2.2(1). Average evapotranspiration has been estimated at 45 inches (Torres 1985).

Water from the island's elevated mountain core drains to the sea via river valleys or ghauts (guts) which usually are dry along all or most of their stretches. Only the relatively large Wingfield and Cayon Rivers flow almost to the sea for much of the wettest part of the year. Many of the streams are spring-fed, and normally flow to about the 250 meter contour before disappearing underground. Intakes for the public water supply intercept the surface flow either right at the spring or at a slightly lower elevation (Kennedy and Robbins, 1988).

Water is drawn into the public supply from five streams (see Table 2.2(2)). Together these supply about 85 percent of the island's needs (Oelsner, 1986), but, as outlined below, attention is turning to expanding the contribution of groundwater resources to satisfy future demand.

The water is produced and distributed through three main systems. These are:

1) The Wingfield, Frankland and Stonefort/Basseterre System (WFS/Basseterre System), which services Basseterre, Frigate Bay (the main tourist area) and all the leeward communities to Dieppe Bay -- a total of about 70 percent of the island's population;

2) The Phillips and Lodge System, supplying the area from Lodge to Dieppe Bay; and

3) The Greenhill or Cayon System, servicing Cayon, Keys, Brighton, Stapleton, Monkey Hill, New Road and the Sugar Factory (Oelsner, 1986).

Three levels of service are available, as listed below, with each serving the proportion of population indicated in parentheses

Table 2.2(1). Mean monthly precipitation for the island of St. Kitts.

MONTH	PRECIPITATION (%)	PRECIPITATION (inches)
January	5.63	3.60
February	4.97	3.18
March	4.55	2.91
April	7.05	4.51
May	10.48	6.71
June	5.99	3.83
July	8.13	5.20
August	8.84	5.66
September	11.53	7.38
October	10.97	7.02
November	12.81	8.20
December	9.23	5.91

Source: Torres, 1985

Table 2.2(2). Stream water statistics for the island of St. Kitts.

SOURCE	FLOW (gph) Average	FLOW (gph) Minimum
Wingfield	34,473	19,759
Phillips	7,497	2,119
Lodge	864	202
Franklands	20,421	2,476
Stonefort	2,080	500

Source: Torres, 1985.

(pers. commun., A. Rawlins, Water Department Manager, 1990):

- public standpipes (35%);
- yard standpipes (10%);
- private (e.g.. home, business) connections (55%).

The spring intakes, as well as the electrical supply for ground water pumping, are susceptible to hurricane damage, and thus the entire system is considered to be in a very

vulnerable position. The only mitigation measure recommended to date has been stand-by emergency pumping which could yield at least six gallons/person/day after distribution system losses (Oelsner, 1986). Imported generators and pumps for emergency situations were recently received by the Water Department (pers. commun., A. Rawlins, Water Department Manager, 1990).

At present, there is only one treatment plant, at La Guerite, where sediment settling and chlorination is carried out on the surface water which feeds into the plant. This treated water is supplied to Basseterre proper; the water supplied to the remainder of the island is not treated (pers. commun., A. Rawlins, Water Department Manager, 1990).

Very few roof catchments and cisterns are used on the island at present, but all new homes in the Frigate Bay area are required to install these systems. In the past, the emphasis on decentralized water supplies and self sufficiency was much greater.

The impoundment of water on St. Kitts is achieved through the use of storage tanks located in numerous communities. The largest of these is the La Guerite Reservoir, which has served Basseterre since early in this century. No stream reservoirs have been developed, i.e., through dam construction.

At present, three 300,000 imperial gallon tanks, fed by wells in the Basseterre Valley, store water for Frigate Bay (pers. commun., W. Liburd, Managing Director, FBDC, 1990). Two additional tanks, each with a capacity of 500,000 gallons, are proposed for Frigate Bay; the same is proposed for the Southeast Peninsula. Designs have been approved, but no final project approval or funding has as yet been secured (pers. commun., A. Rawlins, Water Department Manager, 1990).

The supply and delivery of water, along with electricity, have received increasing attention in recent years. These utilities are regarded as essential in view of increasing demands from the country's economic diversification program and more general expansion in the lead growth sectors of industry, tourism, and both sugar and non-sugar agriculture (e.g., for irrigation). As outlined in the National Development Plan (GOSKN, 1987c), the focus has been not only on enhancing the physical integrity of the public utilities system but also on administrative structures, namely, upgrading and increasing technical, managerial and administrative personnel, while giving special consideration to the development of improved organizational structures. The Water Department (within the Ministry of Communications, Works and Public Utilities) is charged with water supply and distribution on St. Kitts and Nevis, while the Ministry of Health is responsible for the monitoring of water quality. As outlined in Section 2.2.3, a variety of institutional, as well as legislative, adjustments have been recommended by consultants to clarify control and management of water resources and to improve water quality monitoring.

THE ISLAND WATER SUPPLY BALANCE

An analysis of the water sector was carried out for St. Kitts and Nevis in 1987 by Ker, Priestman and Associates, under the sponsorship of CIDA (KPA, 1987). The analysis looked into a variety of factors relevant to water resources management and planning, such as per capita consumption, population growth and distribution, industrial development, and tourism. The current and future water supply balance for each island was calculated.

On St. Kitts, population was estimated to increase at 0.5 percent annually beyond the 1980 census year. The number of tourists during the peak period was estimated at 600 (in 1987), but increasing to 3,000 by 2010, because of planned resort development on the Southeast Peninsula (KPA, 1988).

It is noted that domestic demand does not vary significantly between the wet and dry seasons. But since the main tourist season occurs in the winter, demand for water from this sector becomes most intense during the driest months of the year (December to March).

Table 2.2(3) summarizes data on the supply, demands and losses for the St. Kitts water system for the years 1987 and 2010. The well yields indicated assume 24 hour/day pumping in 1987 (necessary to provide sufficient water), but decreased to a preferred 16 hour/day regime in 2010. Yields from the surface sources assume a 24 hour supply but with minimum average monthly flows. Supply figures in the table are based on new production wells being inoperative in 1987 but supplying water in 2010. Design demands correspond to the peak demand season, which coincides (due to tourism) with the period of lowest surface water supply (KPA, 1988).

The summarized analysis (Table 2.2(3)) revealed that none of the water systems currently have sufficient supply to meet existing demand, the overall deficit on the island being an estimated 675,000 Igpd. But with the commissioning of new production wells, ample water is projected by the year 2010 (KPA, 1988).

The main industrial user on the island is the sugar factory operated by St. Kitts Sugar Manufacturing Corporation (SSMC), followed by the brewery and the bottling company. SSMC maintains its own water supply for the factory consisting of a surface water source and two wells. The company also has two additional wells that were drilled for irrigation purposes (pers. commun., A. Rawlins, Water Department Manager, 1990). All other industries on the island are dry and thus do not use much water. No plans exist to try to attract additional industries that use substantial amounts of water, but the island probably could accommodate some (pers. commun., A. Knight, CIC Executive Director, 1990).

With respect to the anticipated expansion in consumption by the tourism sector, it should be noted that a 10 inch water main has already been installed to the end of the Southeast Peninsula; it was constructed concurrently with the road into the area and was completed in December, 1989 (pers. commun., A. Rawlins, Water Department Manager, 1990).

Beginning in the mid-1970's attention turned to irrigation, primarily as a result of the interest of NACO, the National Agricultural Corporation (now SSMC). SSMC is the country's managing and marketing agency for the sugar industry. Various investigators have concluded that irrigation for the industry is viable, but some feel additional groundwater studies and drilling are required. Another concern has been the island's lack of experience with irrigation and with the problems inherent to it (Torres, 1985).

At present, very little irrigation is in use on St. Kitts for agricultural purposes (i.e., not including the golf courses). SSMC was involved in a pilot irrigation scheme in the early 1980's, but presently uses no irrigation systems other than for propagation (pers. commun., R. Klenzman, SSMC Agronomist, 1990). The Taiwan-sponsored agricultural project at Needsmust Estate, northeast of Basseterre, maintains the largest area of irrigated agricultural land on the island, but this consists of only three acres of vegetables under sprinkler-irrigated cultivation. The project's water is drawn from a well that remains under the control of the SSMC. Thus, while the supply is considered adequate, the management at the estate reportedly has no control over scheduling the supply of water to its field. At times, there is excess flow, resulting in flooding (pers. commun., C. Evelyn, Needsmust Estate Manager, 1990).

GROUNDWATER RESOURCES

Until the early 1970's, groundwater on St. Kitts was "virtually a virgin resource" as the island's needs were satisfied entirely by surface water from springs and streams (Christmas, 1977). Attention has turned increasingly to the island's groundwater resources as a source of supply, necessitated, according to Oelsner (1986), by a growing water deficit and because surface water resources are fully developed. Stanley (1985) points out, however, that surface water sources could provide the island with all of its water, but that these sources are susceptible to hurricane damage. Thus, it is largely on reliability grounds, these consultants claim, that groundwater sources are being developed. In any case, "springs" (i.e., surface water base flow), rather than groundwater, continue

Table 2.2(3). Water supply (both surface and groundwater sources), demands, and losses in St. Kitts for 1987 and 2010.

UNIT	QUANTITY	RATE (lgpd)	DAILY (lgpd)	TOTAL (lgpd)	BALANCE (lgpd)
1987 STATUS					
Residents, Rural	18,456	30	553,680		
Residents, Urban	16,628	60	997,680		
Tourists	600	150	90,000		
Golf Course Irrigation			300,000		
Cattle	6,000	15	90,000		
Sheep and Goats	16,500	2	33,000		
Total Consumption				2,064,360	
Total Losses				884,726	
Total Production Required				2,949,086	
Total Supply				2,273,760	
Total Surplus (Deficit)					(675,326)
2010 STATUS					
Residents, Rural	20,700	40	828,000		
Residents, Urban	18,650	60	1,119,000		
Tourists	3,000	150	450,000		
Golf Course Irrigation			300,000		
Cattle	6,000	15	90,000		
Sheep and Goats	16,500	2	33,000		
Total Consumption				2,820,000	
Total Losses				705,000	
Total Production Required				3,525,000	
Total Supply				3,641,280	
Total Surplus (Deficit)					116,280

Source: Ker, Priestman and Associates, 1988.

to dominate the St. Kitts system, accounting for about 85 percent of the total supply in 1986 (Oelsner, 1986).

As confirmed by the CIDA-sponsored Exploratory Drilling Project (see sidebar), the coastal aquifer, containing seven

THE ST. KITTS-NEVIS EXPLORATORY DRILLING PROJECT

Throughout most of the 1980's, a relatively comprehensive drilling project was undertaken on both St. Kitts and Nevis, under the sponsorship of CIDA (KPA, 1988). The project had three main purposes, namely:

(1) To Locate sources of groundwater and determine availability and quality of groundwater at the sites drilled.

(2) To locate, design and construct production wells to meet the unsatisfied potable water demand.

(3) To assess if further carefully-planned drilling, including high contour exploratory drilling, is likely to delineate further significant sources of groundwater.

In relation to objective no. 1, some 29 test holes were drilled, and most were pumped to determine yield and to obtain a sample for quality analysis. In general, the availability and quality of groundwater are good on St. Kitts. Eleven additional production wells were identified which can supply 1.6 million gallons per day (MGD) of potable water, through a 16 hour/day pumping regime.

The second project purpose was addressed through the construction of seven 8-inch production wells and the redevelopment of four others.

The third stated purpose led to a hydrogeology study including an assessment of the island's groundwater resource potential.

Specific details of the project are described in KPA (1988); among many other features, it included determining aquifer boundaries, predicting the effects of pumping on the water table, and on recharge, discharge, springs, and stream-flow.

Wells were drilled at elevations ranging from 68 to 525 feet above mean sea level and to depths ranging from 77 feet to 510 feet below the surface. The strata encountered consisted of interlayered volcanic rock (lava rock) and epiclastic volcanics (sand, gravel, and rock fragments). In all but one well, the aquifer consisted of an epiclastic volcanic layer located near and below sea level (KPA, 1988).

Some 12 of 20 *completed* test holes showed a measure of success. Low aquifer transmissivity is the main factor contributing to unsuccessful wells. Successful test holes are those at which a 50 imperial gallon per minute (igpm) well could be constructed. Several factors control the permeability or transmissivity of St. Kitts' geologic units, including grain size (a major factor), degree of sorting, degree of compaction, and cementation (KPA, 1988).

The primary conclusion of the overall drilling study was that "St. Kitts possesses a good groundwater resource for a small Caribbean island, with the capacity to meet present and projected future domestic demand, in conjunction with the surface sources." (KPA, 1988).

major groundwater basins, is the location of the island's best-yielding present and future wells (see Figure 2.2(1)). The aquifer materials belong to two main geologic deposits -- the Basseterre Tuffs and the Later Tuffs of Mount Misery (now called Mount Liamuiga).

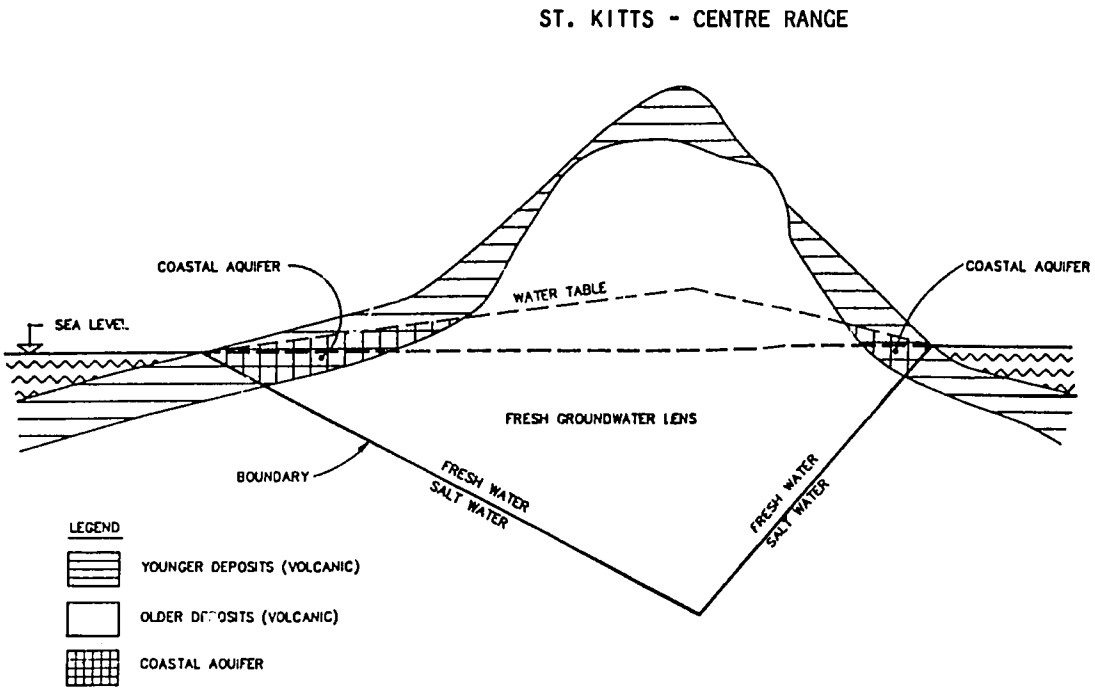


Figure 2.2(1). Generalized geologic cross-section showing groundwater storage areas, St. Kitts (source: KPA Ltd., 1988).

The aquifer occurs where these two deposits exist within a zone approximately between sea level and 50 feet below mean sea level (msl). The main untapped reserve is located beneath the north flank of Mt. Liamuiga, between Sandy Point and Sadlers (KPA, 1988).

Because of its high recharge rates and high transmissivity, the coastal aquifer is a favorable unit for wells. An estimated 20 percent of all rainfall on the island becomes groundwater flow; this is less, however, than previously estimated (KPA, 1988). Some 11.75 million gallons per day (MGD) is the estimated total amount of water that ultimately can be tapped by tube wells (KPA, 1988), again less than previously claimed, e.g., by Halcrow (1966) and Oelsner (1986). Of this total, 1.4 MGD currently can be extracted, and sites for withdrawing an additional 2.7 MGD have been identified. Sites for extracting a portion of the remainder of 7.65 MGD also have been located through the drilling project (KPA, 1988).

It is estimated that once the new production wells have been commissioned and the overall distribution system upgraded, the island will have a potable water supply surplus of 1.3 to 2.1 MGD (KPA, 1988).

NEVIS

BACKGROUND INFORMATION

Nevis is somewhat drier than its sister island of St. Kitts; this is primarily a function of the lower elevation of its central mountain. Annual rainfall varies from approximately 900 mm (35 in) in the drier, coastal regions of the southeast to 2,540 mm (100 in) at Nevis Peak, the highest point on the island (see also Section 1.2.1). Average annual rainfall, based on at least 20 years of record, is 1,170 mm (46

in). Over half of the island, however, receives less than 1,300 mm (50 in) per annum (Atkins, 1983). Rain gauges are located at eight stations around the island, and daily rainfall data are normally collected by the Agricultural Department. However, the Department is presently short-staffed and unable to collect information from three of the gauges. Rainfall records date back to 1888 but are not continuous for the entire period. Of the eight stations on Nevis, three (Prospect, Hamilton and Hardtimes) have 40 years of continuous data (Pemberton, 1985). Rainfall data are accurate for the lower elevations of Nevis, but because there are no rain gauges above 300 m, rainfall patterns for these areas (like St. Kitts) have been estimated on the basis of vegetation types and extrapolation from data collected at lower elevations.

Annual rainfall decreased 15 percent from 1975 to 1985, and some climatologists believe that Nevis, like other Caribbean islands, experiences a 60 year rainfall cycle and is currently at the bottom end of the cycle. Rainfall averages are expected to remain low through the mid-1990's, when this pattern will begin to reverse. A pronounced wet season from June through December and a comparatively dry season from January to May affect all areas of the island but the top 200 m of Nevis Peak.

Halcrow (1983) developed a rough water balance for Nevis based on 105.3 million cubic meters of precipitation per year (see Figure 2.2(2)). The evapotranspiration and run-off rates were analytically derived and were not based on actual field data since hydrological information has never been collected on Nevis. Presumably more accurate groundwater storage and recharge rates based on actual hydrogeologic observations were calculated by Ker, Priestman and Associates (1986). Observed recharge was very close to hydrologists' standard assumption of 20 percent of annual rainfall. On Nevis, this works out to be 240 mm (10 in) per year. UNESCO recently prepared a hydrogeological atlas of Nevis (unpublished as of mid-1990) which will add to this earlier work.

Water drains in a radial pattern from Nevis Peak to the ocean. This pattern is only

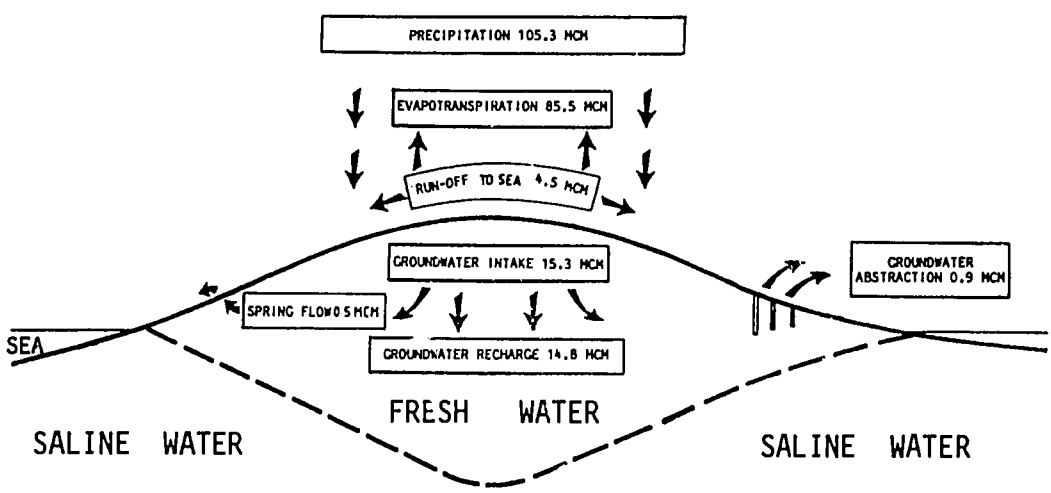


Figure 2.2(2). Annual water balance for Nevis (source: Halcrow, 1983).

disrupted by the smaller volcanic cones of Hurricane, Saddle and Round Hills. The drainage ghauts are relatively straight and cut deep, steep sided ravines into the flanks of the Peak. Almost all of these ghauts are ephemeral. Only Bath and Camps Rivers actually flow to the sea, but the sources of both these watercourses are springs less than 1.6 km (1 m) from the shore. The remaining ghauts flow three to four times a year. No data on stream flow, peak discharge, or sediment loads exist for any ghauts on Nevis. Darby (1987) estimated peak discharges for different sized drainage areas based on a 24-hour intense storm, but no storm run-off profiles have been developed for any of the ghauts.

Seventy five percent of Nevis' land area is covered by very shallow clay soils underlain by a silica pan that severely limits infiltration. A significant portion of groundwater recharge is believed to occur along the more permeable ghaut beds (pers. com., B. Kennedy, BDD Resident Advisor to and Acting Director of the Nevis Water Department, 1990) For this reason, it would be extremely valuable to measure the quantity and duration of flow in at least the larger ghauts.

Nevis draws mainly on rain and groundwater for its water supply because no lakes or ponds and virtually no rivers (only intermittent streams) exist. Until recently surface water, in the form of high elevation springs (carrying run-off water from the Peak) constituted the major source of freshwater for domestic, agricultural and industrial purposes. As indicated in the sub-section on St. Kitts, an extensive well drilling program for both St. Kitts and Nevis has been completed by Ker, Priestman and Associates for CIDA in an attempt to augment the surface supply with groundwater resources. Three coastal aquifers were identified and several test wells will soon be put into operation. Figure 2.2(3) shows the aerial extent of the coastal aquifers, and Figure 2.2(4) depicts a cross section of the island's larger freshwater aquifer. Many Nevisians supplement their public water supply with rainwater collected in cisterns, and some rely solely on this method for their domestic water supply.

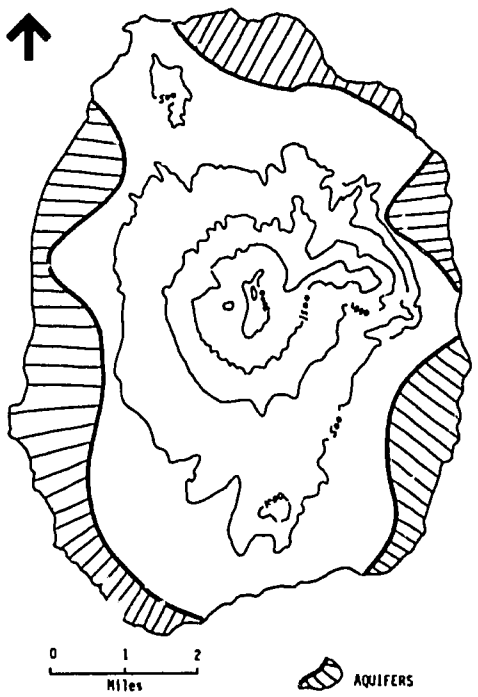


Figure 2.2(3). Aerial extent of coastal aquifers, Nevis (source: KPA, 1986).

KEY CATCHMENT AREAS AND WELLHEADS

Nevis' domestic, agricultural and industrial water needs are met by a combination of surface, rain and groundwater sources. Groundwater constitutes approximately 80 percent of the public piped supply and surface water the remaining 20 percent. It is uncertain what portion of the supply roof catchments contribute.

Nevis is not divided into watershed units for the purpose of water resource management, possibly because the island's small size facilitates its treatment as one macro-watershed. The water supply system is divided into eleven zones for purposes of demand estimates (Table 2.2(4)), but four distribution networks service the entire island. The Nevis Peak-New River system supplies the southern half of the island, the Maddens system the northeastern portion and the Camps Spring-Jessup system the northwestern section. Charlestown has its own wells which

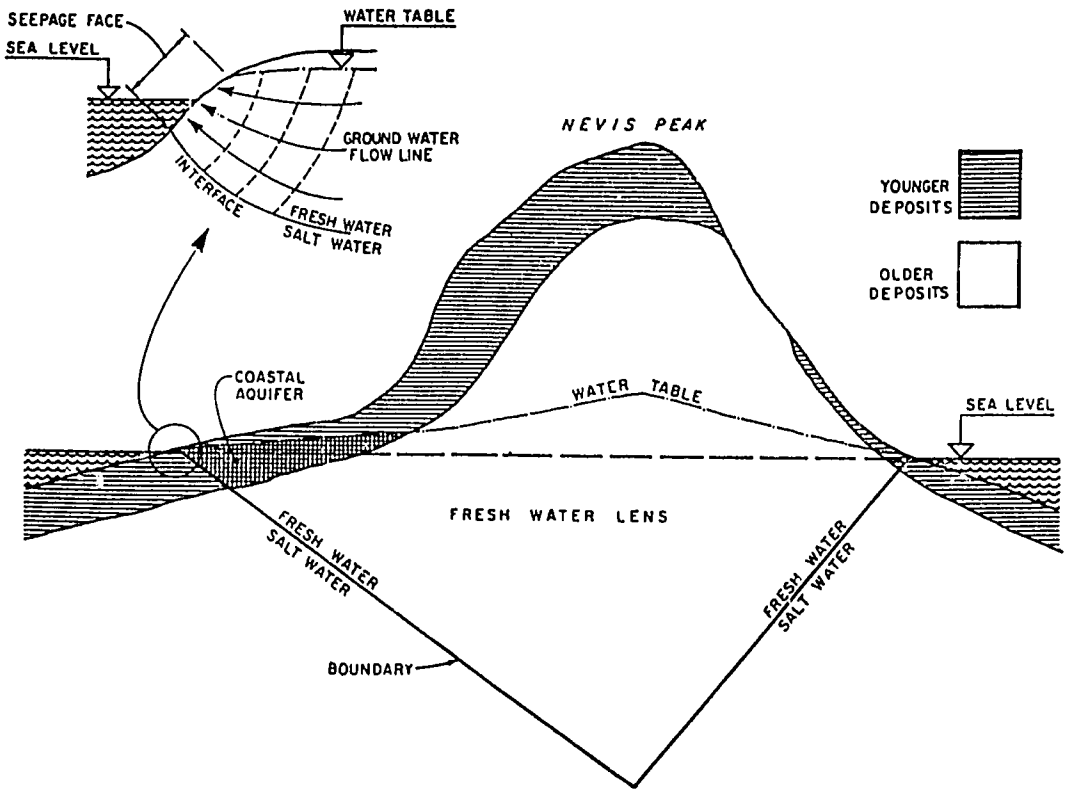


Figure 2.2(4). Generalized geologic cross-section showing groundwater storage areas, Nevis (source: KPA Ltd., 1986).

Table 2.2(4). Nevis domestic water demand by zone.

ZONE	POPULATION	DEMAND AT 65 gpd
Newcastle	250	16,250
Westbury	95	6,175
Cotton Ground-Jessups	1,247	81,055
Charlestown	2,392	155,480
Morning Star	1,010	65,650
Stoney Hill	1,767	114,855
Hardtimes	1,241	80,665
Butlers	344	22,360
Brick Kiln	362	23,530
Camps	407	26,455
Mt. Lily	333	21,645
Total Population:	9,448	Total Demand: 614,120

Source: Data from the Nevis Water Department, 1990.

serve this population center. Catchment areas surrounding these water sources are illustrated in Figure 2.2(5). (Catchment area refers to the sub-watershed area upslope from a water supply.) Most of the springs produce variable flows throughout the year, and some do not flow at all during the dry season.

In addition to the Charlestown wells, the surface water supply is supplemented by wells at Zion and Maddens, and five more should be commissioned within the next year. Spring and well water is held in covered tanks and reservoirs at several points along the distribution network (Hurricane Hugo took roofs off some of the reservoirs in September, 1989, and three are still missing). All springs, wells and storage tanks comprising the public water supply system are illustrated in Figure 2.2(6). New River Spring and a few low yield boreholes are used for agricultural purposes only. Table 2.2(5) lists all of the current and planned water sources by distribution system.

WATER SUPPLY AND DEMAND

With all wells pumping 24 hours a day, the drinking water supply on Nevis is presently 721,440 Imperial gallons per day (Igpd). Based on the Water Department's population figure of 9,448, this supply should be adequate to meet the domestic demand. In reality all the pumps are not operational for 24 hours, and significant shortfalls occur. The amount of water can also vary from the dry season to the wet season. During the dry season of 1985, for example, particularly acute water shortages were experienced (Pemberton, 1985). Using 1985 population estimates Ker, Priestman and Associates (1986) calculated a domestic water supply deficit of 243,000 gallons per day (gpd) and proposed that this shortfall be made up by the commissioning of five production wells. These wells will raise the total water supply to just over one million Imperial gallons per day by late 1990, and for the first time Nevis will have a surplus, rather than a deficit, of water.

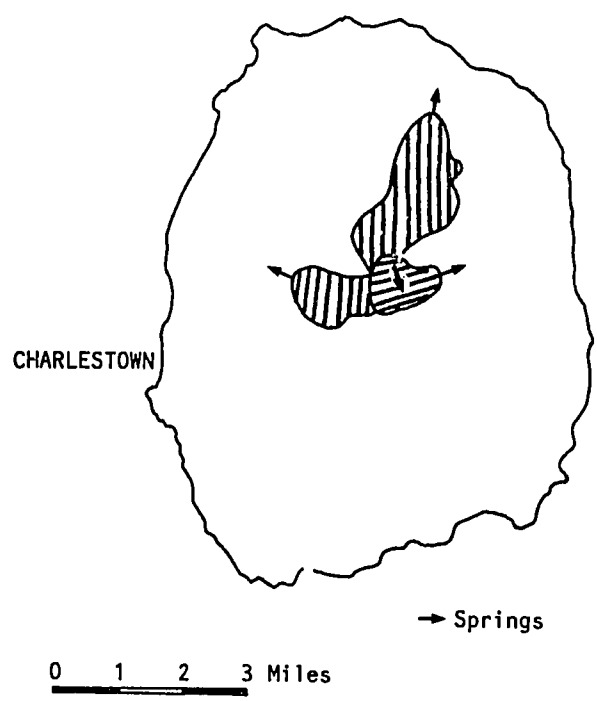


Figure 2.2(5). Key catchment areas of Nevis (source: adapted from ECNAMP, 1980a).

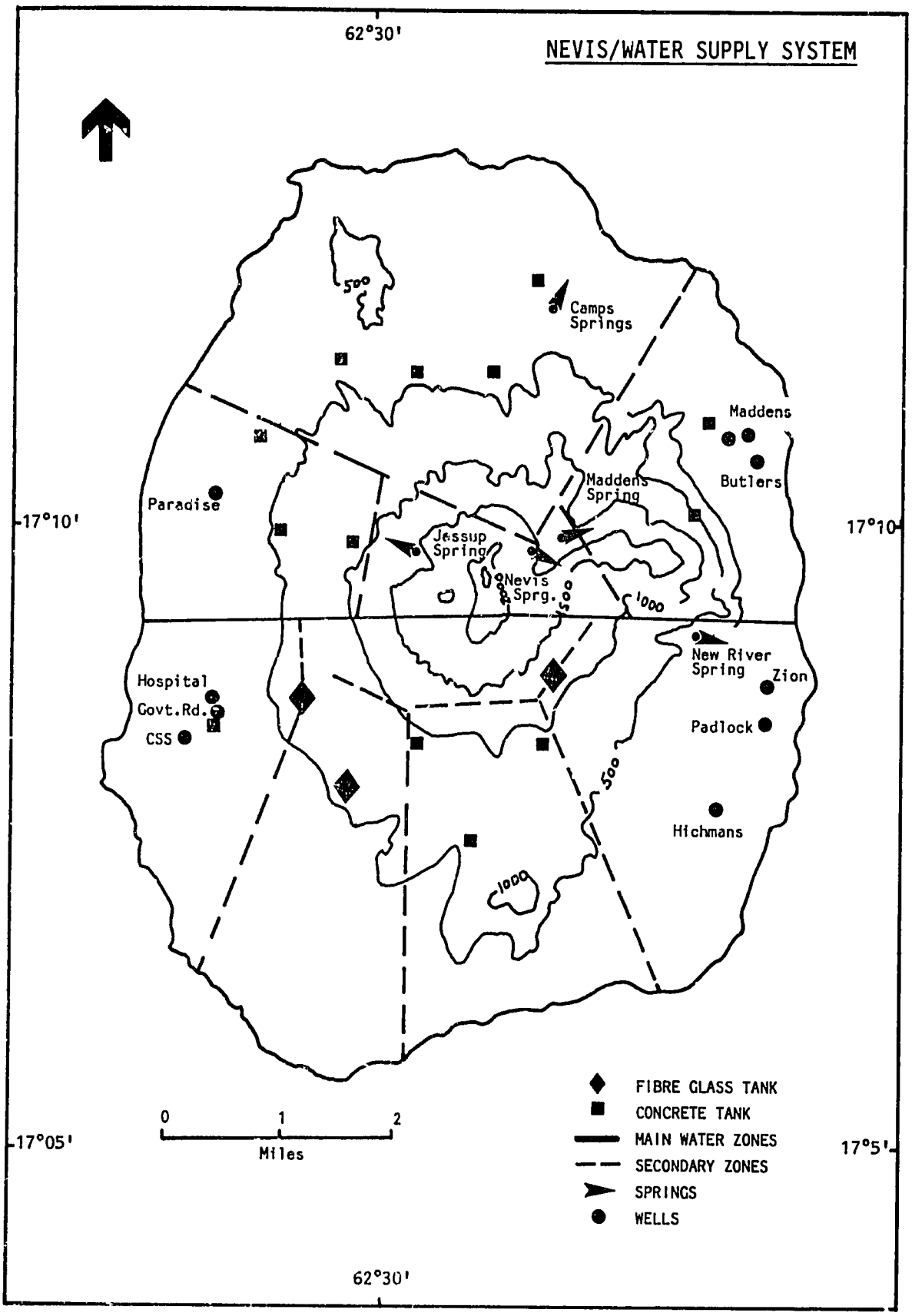


Figure 2.2(6). Nevis water supply system (source: adapted from Hobson, 1990 and pers. commun., B. Kennedy, BDD Resident Advisor to and Acting Director of the Nevis Water Department, 1990).

Table 2.2(5). Nevis' water supply system, current and projected.

SYSTEM	PERIOD	GPM	GPD	
Maddens System				
Maddens Spring	Current	13	18,720	
Maddens' Well #1		125	180,000	
		Current Total	198,720	
Maddens' Well #2	By 1991	50	72,000	
Butler's Well		70	100,800	
		1991 Total	371,520	
Camp's Spring-Jessup System				
Camp's Spring	Current	50	72,000	
Jessup's Spring		3	4,320	
		Current Total	76,320	
Paradise Well	By 1991	25	36,000	
		1991 Total	112,320	
Nevis Peak-New River System				
Nevis Peak Spring	Current	40	57,600	
Zion Well		150	216,000	
		Current Total	273,600	
Padlock Well	By 1991	80	115,200	
*Hichman's Well		48	69,120	
			388,800	(*457,920)
Charlestown System				
CSS Well	Current	50	72,000	
Government Road Well		70	100,800	
		Current Total	172,800	
Hospital Well	By 1991	45	64,800	
		1991 Total	237,600	
	Current Supply for Entire Island		721,440	
	1991 Projected Supply for Entire Island		1,110,240	

Note: *Undetermined operation date.

Source: Nevis Water Department, 1990.

The estimates Ker, Priestman and Associates made were based on per capita consumption rates of 60 gpd for Nevisians and 100 gpd for tourists. Nevis Water Department meter readings from January to June 1989 show an average per capita consumption of 55 gpd. The rural average, however, is 65 gpd, and the Department bases its demand estimates on this figure, allowing 100-200 gpd for tourists. Using the higher consumption rates, there will still be a surplus of water after 1990.

The 1980-81 population census revealed that approximately 49 percent of the population on Nevis obtained its water from public standpipes or tanks, 24 percent had public water piped into their yard or dwelling and 24 percent utilized a private source. (These figures were based on less than 30 percent of the population, and therefore may be slightly inaccurate.) Current figures are not available, although it is probable that the percentage of the population with public piped water has risen substantially. It is interesting to note that in a recent study Hobson (1990) found that of 123 households without public piped water, the percentages of those using public standpipes and tanks versus private catchments were very close to those calculated in the 1980-81 census.

The Water Department is in the process of installing water meters in every building that receives public piped water. As of June 1990, the Department had 794 domestic, 17 non-domestic and 21 hotel meters functioning (pers. commun., B. Kennedy, BDD Advisor to Nevis Water Department, June 1990). Water is metered at a cost of EC$10.00 per 1,000 gallons for domestic users and EC$20.00 per 1,000 gallons for non-domestic consumers.

The Water Department estimates that leakage in the water supply system may be as high as 25 percent of production (pers. commun., B. Kennedy, BDD Advisor to Nevis Water Department, July 1990). Prior to 1988, when all of the water mains in Charlestown were replaced, water losses were as high as 50 percent.

WATER MANAGEMENT AND LEGISLATION

Several departments in the Nevis Island Administration are charged with water management responsibilities. Public water supply is managed by the Water Department within the Ministry of Communications, Works and Public Utilities, the Agricultural Department oversees all irrigation projects, and the Health Department is responsible for water quality monitoring. The Water Department maintains a map of the public water distribution system, and the Agricultural Department keeps records of water allocated for irrigation or stock watering purposes.

No regular water quality testing is done for any of the drinking water sources. Water is crudely filtered at each intake and chlorine is added to some of the reservoirs, but not on a regularly scheduled basis. Nevis does not at present have a laboratory capable of comprehensive water quality analysis, although the Water Department is in the process of setting up such a facility and is currently training a Nevisian to work in the lab. The Alexandra Hospital can also test for bacteriological contamination, pH and suspended solids but is too under-staffed to assume such responsibilities.

Water resource management falls under the Watercourses and Waterworks Act of 1956 and the Watercourses and Waterworks Regulations of 1973 (see Section 2.2.2). A major weakness in Nevis' water legislation is that no provisions exist for the management of sewage disposal. Wilkinson (1989) suggested that this function be incorporated in the activities of the Water Department.

2.2.2 Problems and Issues

ST. KITTS

WATER POLLUTION

Only the water supplied to Basseterre proper is treated (at La Guerite), with sedi-

mentation, filtration, and chlorination. Water distributed elsewhere on the island commonly shows excessively high readings of coliforms, suggesting bacteriological, but not pathogenic, contamination (Chavannes, 1989). In May 1989, for example, every tap water sample taken on the island, except those provided with water from the La Guerite treatment plant, did not meet WHO standards for both fecal and coliform bacteria (pers. commun., T. Mills, Chief Public Health Inspector, 1990).

Gastroenteritis and diarrhea are relatively significant health problems on the island, but it is unclear whether they are caused by contaminated water *per se* or by a variety of sanitation-related problems. The records of the J.N. France General Hospital reveal that gastro/diarrhea was the third leading cause of total pediatric admissions between 1984 and 1988, after respiratory tract and viral infections and injuries. Out of a total of 2,151 admitted children between the ages of 0 and 14, some 428 or 20 percent were accounted for by gastro/diarrhea (Chavannes, 1989).

The incidence of gastro appears to be distributed unevenly, both spatially and seasonally. Christ Church Parish, for example, on the northeast side of the island, has the highest incidence of the disease, followed by St. George Parish where it is about equal to that of the capital, Basseterre. On a seasonal basis, gastro rises steadily until May, peaks in June, and falls steadily to its lowest level in December. According to Chavannes (1989), this seasonal variation seems to be related to the mango season, and therefore, as noted above, the particular role of contaminated drinking water is unclear.

The source of water contamination also is unclear, due to very limited research efforts. The major aquifers appear to be pollution free at present, but most potable water on the island is derived from surface sources. It may be that, at times, these sources have high bacterial levels due to natural causes. The Chief Public Health Inspector (pers. commun., T. Mills, 1990) suspects contamination may result from storage tanks or from the numerous leaks in the distribution system. At times of low flow through saturated ground, pipe leaks would allow surrounding water to be drawn into the system, water which may be contaminated, e.g., with sewage.

The aquifers of the major well fields presently appear to be pollution free. Quality samples taken from all production wells and most test holes, showed that all but one (from test hole #21 at Buckleys) were suitable for drinking. As a result of the depth of the water table and the nature of the overlying soils, the St. Kitts aquifers are considered relatively resistant to pollution from surface sources (KPA, 1988). However, to maintain the aquifers in this condition over the long term, an active monitoring effort will be required.

The Basseterre Valley aquifer, for example, which currently provides the island with a major portion of its acceptable potable water, already is under development stress, given its location beneath the growing center of St. Kitts' residential, commercial, and industrial activity. Potential pollution risks were identified by KPA in 1988:

- automobile showrooms, using industrial solvents;
- auto service stations, disposing waste oils and solvents, and with underground fuel tanks;
- the SSMC sugar processing factory, which discharges "high-strength" liquid waste to the sea via a concrete-lined trench;
- photo processing laboratory, which discharges used chemicals;
- numerous homes with "soak-away" sewage disposal (i.e., cess pools);
- schools using "soak-aways" for sewage and possibly laboratory chemicals;
- airport, with "soak-aways" and possibly spillages of jet fuel and fire fighting chemicals.

More than half the homes in Basseterre use pit privies (pers. commun., T.

Mills, Chief Public Health Inspector, 1990) with essentially no treatment of human wastes. Given the town's location at the edge of the sea, this fact may be more of a coastal pollution problem than one of groundwater contamination, but it could also contribute to water supply contamination because of leaks in the distribution network.

Further information on pollution and environmental health is provided in Section 6 of the Profile.

WATER SYSTEM LEAKAGE AND WASTAGE

A study of the water sector by Stanley International determined that "there is a large amount of unaccounted for water . . . ." In fact the difference between the amount produced and that actually consumed amounts to some 780,000 gallons per day or 39 percent of the amount produced. This is equivalent to 11 gallons per connection per hour. These consultants concluded also that by introducing a purposeful leak detection and repair program, no major new source and distribution work would be necessary for the next five years (Stanley, 1985). Rawlins (pers. commun., Water Department Manager, 1990) feels the 39 percent figure may be an overestimate. In any case, the leakage problem has yet to be addressed in any serious way. Essentially this aspect of water system operation and maintenance has been neglected, primarily due to budgetary limitations. But it is unclear as to why funding agencies providing support for the water sector (e.g., CIDA) have seemingly put less weight on this problem than they have on expanding groundwater production.

Another concern is the need for more extensive water metering as a means of promoting water conservation by consumers. In 1985, an estimated 3,000 domestic consumers, out of a total of 4,938, were metered; of 247 commercial water users, 111 were metered; all 10 industrial consumers were metered, while none of the 60 Government consumers were metered (Stanley, 1986). At present, only new water connections made by the Water Department, approximately 250 per year, are installed with meters (pers. commun., A. Rawlins, Water Department Manager, 1990).

LACK OF WATER MASTER PLAN

The considerable attention to water resources (particularly groundwater) development on St. Kitts has gone forward in the absence of an overall master plan for water or even an economic analysis to determine the optimal ratio of surface to groundwater exploitation. The approach adopted in St. Kitts has been to develop ground and surface sources to provide for a higher level of supply reliability in the face of emergency situations such as hurricanes. Stanley (1985) has pointed out that while reliability of supply is an important concern and groundwater development is therefore a constructive objective, "no economic analysis has been done to determine the precise ratio of surface water to groundwater which should take place." This is important in view of the higher overall costs of groundwater exploitation -- i.e., both capital and recurring pumping costs are involved while, because of gravity flow, surface water use primarily involves capital expenditure.

Furthermore, there probably is room for expansions in the use of surface water resources. Stanley (1985) suggests that the size of intake pipes be increased as a means to limit reliance on groundwater during the dry season and thereby save on pumping costs. However, potential impacts on aquatic life (e.g., freshwater shrimp) need also to be considered in assessing any possible expansion of surface water utilization.

Since, as noted above, there is a very high degree of leakage in the distribution system, as much as 39 or 40 percent (Stanley, 1985; Oelsner, 1986), the costs of rehabilitating the present system have to be weighed against those of developing additional production sources, but the degree to which such analyses have been done appears to be quite limited. These and other issues would best be addressed through development of a Water Master Plan.

NEVIS

CONDITION OF CATCHMENT AREAS

Unlike many Eastern Caribbean islands, the upland forest resources of Nevis have not yet been encroached upon by agricultural squatters. The main threats to the upper Nevis Peak watershed areas are charcoal burning and the construction of homes (primarily by non-Nevisians) up the lower flanks of the mountain. The higher springs (Nevis Peak and Maddens) are generally well protected by vegetative cover but have experienced accelerated siltation due to defoliation and landslides caused by Hurricane Hugo in 1989. The areas surrounding Camps and Jessup Springs are still undeveloped, with no threat to the water sources at the present time. Many of the older, concrete reservoirs have problems with siltation and seepage. Earth tremors crack the masonry, and water also seeps through the permeable substrate (Pemberton, 1985; pers. commun., B. Kennedy, BDD Advisor to Nevis Water Department, July 1990).

Many of the island's storage tanks are capped, but the springs are open to contamination by foraging monkeys, birds and domestic livestock. Some Nevisians collect their water supply from public tanks, which may expose these sources to contamination.

WATER QUALITY

Surface water supplies have rarely been tested on Nevis. The Water Department has placed a higher priority on water quantity and has concentrated its efforts to date on providing a 24-hour supply to the entire population. All of the CIDA wells were tested for chloride, certain metals, nitrogen and coliform. Zion Well, Charlestown Secondary School Well, Government Road Well and Jessup and Camps Springs were also tested at the same time and found to be of safe quality for the parameters analyzed. The Water Department has a portable DelAqua water testing kit, but analysis is difficult because other necessary lab equipment is not available (pers. commun., B. Kennedy, BDD Advisor to Nevis Water Department, July 1990). Even if testing were done, the country lacks specific drinking water quality standards for measurement -- although the Water Departments in St. Kitts and Nevis use WHO standards as their guidelines. Protocols for sampling and analysis procedures are also needed.

Water is crudely filtered at each intake (with a large mesh screen), and chlorine is sometimes added to the reservoirs. Chloramines, a class of carcinogenic compounds, can be formed if water rich in organic substances (not well-filtered) is chlorinated. It is not known if this is a problem in Nevis.

Although the quality of rainwater versus the public water supply is not known, many Nevisians prefer the taste of "light" rain water to "heavy" public water. It is common for Nevisian households to use cisterns or other rainwater collectors for drinking water and the public supply for other purposes (Hobson, 1990). Some islanders without piped water also prefer to build cisterns because they believe them to be cheaper than the public water supply (Hobson, 1990).

Major pollution threats to water quality, which are discussed in more detail in Section 6, include: fertilizers and biocides (pesticides and herbicides), waste oil, pathogenic bacteria from inadequate septic systems, and leachate from solid waste disposal sites (both authorized and unauthorized). The freshwater lens on Nevis is very shallow, particularly as it approaches the coastline. Infiltration trenches allow water to be safely skimmed off the top of the aquifer in these areas, where drilling a well is much more likely to result in saline intrusion of the freshwater. Although there are currently no plans to use infiltration trenches for potable water, if Nevis must rely on these shallow trenches for drinking water in the future, great care will have to be exercised because they are extremely vulnerable to contamination by agricultural chemicals.

The incidence of water-borne disease, especially gastroenteritis, has not fluctuated much over the past five years (pers. comm., C. Fahie, Senior Public Health Inspector, July 1990 and M. Tyson, R.N., Matron, Alexandra

Hospital, August 1990); it is not the leading cause of pediatric admissions to the hospital. Records of visits to health facilities are not maintained by disease type, and, therefore, it is not possible to ascertain the number of actual cases. As is the case in St. Kitts, it is also unclear whether the incidences of gastroenteritis are caused by contamination of the water supply or are sanitation related. It would be good practice to monitor the water supply to ensure that sewage contaminated water does not leak into the pipes during periods of low pressure. The aquifer appears to be pollution free at this point in time, but wellhead protection will become more and more critical as the CIDA test wells are commissioned.

WATER SUPPLY AND DEMAND

Although the water supply system has improved markedly in the last 5 years, several parts of the island of Nevis still do not consistently receive a 24 hour supply of water, and/or the water pressure is frequently quite low. Water shortages continue to be a problem during the dry season, which coincides with the height of the tourist season, placing even higher demands on the diminished supply. Exploitation of groundwater sources should ameliorate this condition in the future.

Water distribution is closely tied to the generation of electricity in Nevis. Often times pumps cannot run due to shortages of electricity or are burned out by power surges. In addition, due to financial constraints, backlogs of spare parts are not kept on the island in the event of pump breakdowns. This considerably delays the time required to bring malfunctioning pumps back on line.

Over the years, several aid assistance agencies (BDD, EEC, CIDA and USAID) have funded projects to replace old water mains or establish new pipeline systems, build reservoirs and storage tanks, and drill and commission wells. In mid-1990, five water projects aimed at increasing the water supply on Nevis were planned and/or underway:

1) Construction of reservoirs at Mt. Lily and Maddens (BDD);

2) Construction of a pipeline system to supply the northern part of the island with the water from these reservoirs (EEC);

3) Commissioning of six new production wells (CIDA);

4) Extension of water mains into areas that will be sold for residential development (sections of Hardtimes and Hamilton are being developed now) (NIA);

5) Development of a source and distribution system to supply the new Four Seasons Hotel (NIA)

For years planners believed that water resources were quite scarce on Nevis. With the location and development of groundwater sources, water now appears to be more abundant than previously projected. Distribution is currently the limiting factor in providing an adequate supply to the population. However, as several other Caribbean nations have discovered, exploitation of groundwater resources on a small island must be done with extreme caution. The balance between fresh and saline water is delicate and, once tipped, is difficult to restore. Nevis' three coastal aquifers are particularly vulnerable to saline intrusion, as the water table does not extend much above sea level. Several of the CIDA test wells were either initially or subsequently contaminated with chlorides. Ker, Priestman and Associates recommend that water levels in all wells be maintained at 0.3 to 0.5 m (1 to 1.5 ft) above sea level. If drawdown below sea level occurs, the aquifer can be polluted for years or even decades (KPA, 1986).

The Ker, Priestman and Associates Report (1986) estimated that 25 percent of Nevis' groundwater recharge, or 3 MGD, (versus 2.3 MGD estimated by Halcrow in 1966) can be safely extracted. At present, approximately 0.6 MGD is pumped with one MGD expected to be tapped within the next year, leaving two MGD for future development.

The Nevis Island Administration (NIA) is actively promoting expansion of the tourist industry in Nevis, which will place great demands on the island's already taxed water distribution system. Very careful planning will be necessary to ensure that this use will not result in saline intrusion of Nevis' aquifer. Hoteliers should be required to take measures to conserve water, and developments should be designed so that they do not disrupt natural flow and infiltration patterns. The Water Department's ongoing meter installation program will also aid in water conservation and provide more accurate estimations of consumption patterns.

POLICY MATTERS AND LEGISLATION

The Nevis Water Department shares administrative authority in the area of water resource management with the Agriculture and Health Departments; unfortunately, Agriculture's water development projects are not always integrated with those of the Water Department. There is no legislation concerning groundwater rights, making it difficult to control and account for all extractions from the island's aquifer. It is unclear which agency is responsible for water quality monitoring in ghauts, natural ponds and lagoons, and coastal waters.

AN EXAMPLE OF THE TOURIST INDUSTRY'S IMPACT ON THE INFRASTRUCTURE OF A SMALL ISLAND

A large hotel complex currently under construction on Nevis provides an excellent example of the impact of large-scale tourist facilities on the resources of a small island. An 18-hole championship golf course is one of the hotel's featured attractions and requires 300,000 gallons of water per day to maintain. Owners estimate that the 196 room hotel will need an additional 60,000 to 80,000 gallons per day bringing the total demand to 380,000 gallons of water per day. This is twice the amount of water consumed in Charlestown each day, the island's most concentrated population center.

The hoteliers have innovatively designed their package sewage treatment plant so that the treated effluent will supply 50,000 gallons of irrigation water to the golf course per day. The NIA is responsible for providing the remaining 250,000 gallons. To accomplish this, the Nevis Water Department recently completed an 800 foot infiltration trench just south of the hotel complex. The trench is drawing non-potable (slightly brackish) water off the freshwater lens which is 18 inches above sea level at this point. Because the trench is so close to the sea, pump operators must be extremely careful not to draw the water surface down below sea level.

The 80,000 gallons needed by the hotel must be potable water and will be supplied through the island's existing water system. It will most likely be drawn off the Camps Spring-Jessup and Madden's water supply system networks. Hotel planners have not included cisterns in their design, which could provide additional water, although they will construct a desalination plant capable of producing 60,000 gallons of water per day to be used as a backup supply in the event of a break down in the public supply system.

The hotel will not open until 1991, but the golf course is now receiving close to 300,000 gallons of water per day which is applied to the fairways with an aerial sprinkler system. Residents of Charlestown have been somewhat perplexed to see these sprinklers in operation when little or no water is available for domestic use in the adjacent port. Unless Nevisians are assured that the hotel is paying a price commensurate with the cost of supplying this valuable resource, an adversarial relationship between the hotel and the local community could develop.

The Watercourses and Waterworks Act of 1956 was extensively reviewed by Wilkinson (1989) and found to be obsolete. Wilkinson provided a comprehensive list of recommendations for improvement; key suggestions called for better delineation of ownership and control over water resources, consolidated water and sewerage oversight, and the development of a Water Supply and Wastewater Master Plan to anticipate future development.

The Water Department also suffers from funding constraints which have limited the programs, improvements, and expansion of the water supply system (GOSKN, 1987d and pers. comm., B. Kennedy, BDD Advisor to Nevis Water Department, June 1990). If the tourist, agricultural and industrial sectors are to expand, then the necessary funding must be allocated to develop an efficient water supply infrastructure designed with the flexibility to sustain the resource through anticipated future development.

2.2.3 Policy Recommendations

Demands on water resources will continue to increase as the country seeks to further diversify its economy through expansions in tourism, manufacturing, and non-sugar agriculture. The CIDA-sponsored drilling program, focused primarily in the Basseterre Valley of St. Kitts, has developed wells which, when commissioned, will meet the needs of that island (including those of its industrial and tourism sectors) into the next century. However, with a growing reliance on groundwater in St. Kitts as well as Nevis, and in light of potential contamination problems, it is clear that attention must now be directed to analyzing and correcting existing potable water quality problems in both St. Kitts and Nevis and to ensuring that future supplies (i.e., the aquifers) remain safe. In general, a master plan for future water (and sewage) management is advisable, as are new measures to address the problem of excess leakage from the water supply system and distribution issues. Realistically, however, the chronic shortage of funds will make it very difficult for the Water Department to actively pursue many of these objectives, and, therefore, an economic analysis to confirm that water is charged at a rate equal to its production cost is also advisable.

Finally, in order to make more informed decisions about allocations of surface and groundwater resources, baseline hydrological data need to be collected on stream flow rates and duration. In Nevis, for example, it has been recommended that -- because ghaut flows vary from extreme high to extreme low stages -- automatic flume gauges are the most appropriate instruments for such measurements. Data collection sites proposed are in the Maddens and Coconut Walk areas and Camps River (pers. commun., B. Kennedy, BDD Advisor to Nevis Water Department, 1990). Rain gauges could be located above 300 m to confirm extrapolated annual rainfall data for the Nevis Peak area; Zetlands Plantation (at 460 m) and Nevis Peak Springs (at 600 m) are also suggested sites because of their relative accessibility. Water Department personnel could monitor a gauge at Nevis Peak Springs and the Agricultural Department or a private citizen at Zetlands. A citizen network to help with monitoring activities could be employed, the Nevis Historical and Conservation Society being one NGO which could be called upon for assistance.

WATER POLLUTION ISSUES

Stanley (1985) recommended that sedimentation, filtration, and sterilization treatment be provided for all surface water sources to reduce the incidence of enteric illness. For groundwater, only chlorination is suggested. As a first step, and as soon as possible, apparatus should be installed to dose the water with hypochlorite solution in intake chambers. This, it is reported, will be a comparatively cheap treatment measure and highly effective, except perhaps when the water is turbid (Stanley, 1985). However, if the contamination is occurring during storage prior to distribution, this suggestion will not be as effective. Ultimately, the source of contamination problems will need to be studied in more detail.

Drinking water quality standards should be officially adopted. For example, the WHO International Standards for Drinking Water, presently used as a guideline by the Water Department, could be revised as appropriate for St. Kitts and Nevis and then formally adopted. Protocols for sampling and analysis procedures are also required. Each island should have its own water quality monitoring facilities to test for bacteriological contaminants as well as for agrochemical pollution.

Because of the risks of groundwater pollution, a comprehensive water monitoring and protection plan should be formulated and implemented. The disposal of industrial liquid wastes, oil products and other products that can produce harmful leachates should be strictly controlled in key areas that recharge well fields. Properly designed and built septic systems should not pose a risk to well fields, but such systems should not be sited within 100 feet of a pumping well (KPA, 1988).

A monitoring and protection plan will help ensure that the country's groundwater resources provide a safe source of drinking water for Kittitians, Nevisians, and visiting tourists. The risk of contamination through industrial, agrochemical and sewage pollution is very real, and the costs for advanced forms of water treatment are very high. In view of the fact that economically important tourist areas like Frigate Bay and the Southeast Peninsula in St. Kitts will receive all of their water from well sources, the issue of groundwater protection is one which is clearly linked to national development strategies.

MINIMIZING LEAKAGE AND WASTAGE

A large portion of water produced is assumed to be lost through leaks in the distribution network. As noted by Stanley (1985), "Stopping the leaks makes that much more water available for public use without an increase in public works." A program of leak detection and repair should therefore be initiated. Pipe replacements are clearly necessary in many locations, but continuing repair work needs to be treated as an ongoing maintenance requirement since leaks from old water mains are a recurring phenomenon.

A CIDA-sponsored study on leakage is about to be initiated. Two districts in Basseterre will be examined through a comparison of results from meter readings at source and at the receiving end. PAHO also is assisting with leak detection, in part, by supplying metering instruments for this purpose. At present, about EC$5,000 per year is spent by the Water Department on leak detection (pers. commun., A. Rawlins, Water Department Manager, 1990).

As noted elsewhere in this section of the Profile, only a small proportion of water connections in the country are metered. Stanley (1985) recommended that as a priority, all commercial premises as well as all Government offices should be metered. With respect to household connections, these consultants suggested that a complete conversion be made to metered connections over a five year period, while all new industrial consumers should continue to be installed with meters. Additionally, all production sources should be metered in a phased program over two to three years (Stanley, 1985). These measures would help promote water conservation as well as provide for better data collection for the Water Department, an essential component of effective water management.

DEVELOPMENT OF A WATER MASTER PLAN

As emphasized by Oelsner (1986), pursuant to his OAS-sponsored review of water supply options, the development of a Master Plan for water resources will enhance optimal management of the sector in the future. Stanley (1985) also pointed out that development of a Master Plan was the single most important engineering function that could be carried out in St. Kitts and Nevis. In fact, these consultants suggested that almost no component of the EC$6 million capital works program they recommended should be implemented until a Master Plan had been formulated and several other high priority

items, including leak and waste reduction and water treatment, were addressed.

Given the inherent pollution risks to groundwater resources that result from a wide variety of land-based activities, the formulation of a Master Plan should give consideration to minimizing the use of well fields that are considered at greatest risk. Probably of even greater importance is the need to implement a land use strategy that restricts or precludes certain classes of land use (e.g., industrial and agricultural) that are incompatible with water resource protection requirements in critical areas. For example, in Nevis, strategies need to protect key catchment areas, such as Nevis Peak, from encroachment by charcoal burning and home building, while the island's ghauts need protection as a large proportion of groundwater recharge occurs along these permeable streambeds.

ENSURING SAFE GROUNDWATER YIELD

The fresh groundwater lens beneath the islands of St. Kitts and Nevis is in dynamic equilibrium with the saline ocean water which surrounds and underlies it. Pumping affects this equilibrium, causing a reaction at the freshwater/seawater interface.

A critical factor in groundwater management is therefore the need to ensure that the amount of water pumped from a given basin is not excessive in order (1) to ensure that the resource is not depleted over time (i.e., by pumping water from the basin at a faster rate than the rate at which it is recharged); (2) to avoid well drawdown interference (i.e., effects on nearby wells); and (3) to avoid seawater contamination. The "safe yield" of a basin is calculated by multiplying rainfall volume by estimated infiltration and recoverable ratios. The safe yields of St.

Table 2.2(6). The estimated "safe" yield, existing well capacity, and the amount of surplus water available for seven major groundwater basins in St. Kitts.

Basin Location	Estimated Yield (Igpm)	(1000's)	Total Well Capacity (Igpm)	Surplus (Igpm)
Basseterre Valley	2,067		1,845	222
Cayon	341		24	317
Lodge/Tabernacle	1,054		340	714
Profit/Sir Gillies *	2,875		349	2,466
Con Phipps/Wingfield	1,221		142	1,079
Stonefort	333		150	183
West Farm/Buckleys	331		Nil	331
Totals	8,162		2,850 (4.1 Mgd)	5,312 (7.67 Mgd)

* St. Paul's well can produce 89 Igpm but has a 20 Igpm pump installed.

Source: Ker, Priestman and Associates Ltd., 1988.

Kitts' seven major groundwater basins have been calculated by KPA (1988) and are shown in Table 2.2(6) along with existing well capacity and the amount of surplus water available. As displayed in the table, the Basseterre Valley basin appears close to maximum capacity, as well capacity (potential pumping) is approaching estimated (safe) yield. No additional high capacity production wells, apart from those identified by KPA (1987), should be developed in the basin.

The effects of groundwater pumping at all production well sites identified by KPA (1988) have been considered to ensure that recommended production rates maintain the freshwater/saltwater boundary below the bottom of the wells. Well spacing has been set to minimize drawdown interference. Effects on high elevation springs, stream flow, groundwater recharge, and discharge to the ocean also have been analyzed and have been deemed of minor concern.

However, discharge to the ocean from the Basseterre Valley basin will be affected more than from the other basins. Some 60 percent of the recharge will continue to flow to the sea, an amount considered acceptable, but careful monitoring of the water levels has been suggested (KPA, 1988). Well pumping water levels and rates recommended by KPA (1988) for each well must be maintained to ensure that changes in groundwater quality (i.e., salinity) remain minor.

INSTITUTIONAL, LEGISLATIVE AND FINANCIAL REQUIREMENTS

The primary legislation pertaining to water resources is the 1956 Watercourses and Waterworks Ordinance. Several consultants (Stanley, 1985; Oelsner, 1986; Wilkinson, 1989) have highlighted problems with this legislation and pointed to a number of areas in the ordinance which are unclear, e.g., with respect to authority, duties and responsibilities under the existing law.

In view of these weaknesses, as well as others that pertain to extant legislation on pollution control, recommendations have been made calling for a revised and updated Water Code and a new institutional framework, i.e., in the form of an autonomous Board to administer the legislation, including responsibilities for sewage collection, treatment and disposal. Stanley (1985) provides details on some of these recommendations, for example, on the organization and management structure for the proposed Board.

A related recommendation in the Stanley International report of 1985 calls for creation of a new tariff structure. Water Department revenues are substantially lower than production/operating costs, i.e., on the basis of 1982 data, costs were calculated to be 13.8 cents per 100 gallons, while revenues amounted to only about 5 cents per 100 gallons. Furthermore, these costs were deemed to be some 10 cents lower than they would have been if full maintenance costs and annual depreciation had been included in the analysis (Stanley, 1985). In actual fact, therefore, revenue increases of over 350 percent would be necessary to cover the *full* costs of production/operation, i.e., 23.8 cents per 100 gallons. However, the last price increase by the Water Department, in 1986, amounted to only 25 percent (pers. commun., A. Rawlins, Water Department Manager, 1990), and therefore a very significant financial shortfall continues to limit what the Department can realistically achieve.

2.3 BIODIVERSITY AND WILDLIFE RESOURCES

2.3.1 Overview

INTRODUCTION

At one time, geological speaking, St. Kitts and Nevis had more wildlife species than they do now. Fossil evidence suggests that during the post-Pleistocene interglacial period, lower sea levels provided for much larger areas of coastal savannah-plains-scrub environment with greater opportunities and more room for a broader spectrum of local species. Land bridges between some of the now separate islands and islets in the region would also have increased the effective gross area of some land masses and had a similar positive effect on species diversity. But when the glaciers melted for the last time and sea levels returned more or less to their present levels, some coastal lowlands and low-lying entire islands were submerged beneath the surface of the sea, slowly drowning some specialized habitats and eliminating those few species unable to adapt to the changes.

Human settlement, although benign in the pre-Columbian period, eventually saw indigenous Arawaks replaced by more aggressive Caribs who were, in turn, replaced by even more aggressive Europeans. The result for both St. Kitts and Nevis was the wholesale clearing of vegetation, extensive landscape changes, estate development for cane cultivation, and civil works that modified or eliminated a variety of habitat types and their associated resident wildlife.

The coming of the Europeans also saw the introduction of mostly exotic animal species -- like cats, dogs, rats, pigs and the mongoose -- and had a significant impact on many native wildlife species, especially ground-dwelling birds, beach-nesting sea turtles, large tasty amphibians, slow-moving agouti, and an edible local iguana. The end result of these changes is now evident. Ground birds are now scarce, the sea turtle is now endangered, and the mountain chicken, agouti, and iguana are now all extinct. It is not unfair to say that wildlife protection has not been pursued very assertively as a matter of policy in either St. Kitts or Nevis.

WILDLIFE RESOURCES AND BIODIVERSITY

Fortunately, there has been a buffering effect for wildlife in the form of one or more undeveloped areas which furnished a *de facto* zone of modest protection for most important wildlife. In St. Kitts this was comprised of the central montane spine (from Liamuiga to Olivees) and the remote dry woodland of the formerly isolated Southeast Peninsula (SEP) with its extraordinary cluster of various types of wetlands, cliffs, hills and beaches. These two large areas, totalling perhaps 15,000 acres, have until very recently functioned as an unfunded, unofficial, informal, unnamed and mostly unvisited wildlife protection zone. For several decades they have provided an almost surrogate system of wildlife reserves, which has enabled the country to delay development and implementation of a more formal, professional, wildlife protection and management program.

But the Southeast Peninsula has just been opened by a new highway, and the Phillips Level Road (across the mountain from Old Road to Molineux) will probably not be far behind. When the "land rush" starts, and in the absence of any national wildlife policy, agency, officer or agenda -- except for the activities of concerned individuals and NGOs -- it is unlikely that *timely* attention will be given to wildlife concerns *unless* a donor agency is involved and presses the issue. The operative word in the last sentence is "timely," meaning in this case "in advance" since wildlife and habitats are like Humpty Dumpty, not easily reassembled once broken.

In the case of Nevis, only the combination of the buffering value of Nevis Peak

(which is almost as high and as large as Liamuiga in St. Kitts) and a scale advantage resulting from lower population densities have moderated what has otherwise been a serious wildlife system loss (see Section 2.3.2 below). As it is, inferior clay soils, reduced water flows in watersheds and ghauts, and feral livestock impacts on vegetation all have tended to reduce habitat diversity and therefore limit niche options for wildlife. Campbell Evelyn, a former estate manager known for his personal interest in environmental affairs, summed it up in an interview for this Profile when he said, "One often forgotten value of the forests is the habitats and food that they provide for [wild] animal life."

In the meanwhile, centuries of intensive agriculture have made inroads on native plant communities at lower elevations which have only marginally recovered. On -- and especially off -- the former estates, poor farming practices and careless, often excessive, use of biocides have a great potential for further degrading upland habitats and damaging the downslope marine environments which are important to local fishermen and tourism alike.

It is significant that the new candidates for threatened species status in several of the Eastern Caribbean states, St. Kitts and Nevis included, are once common species such as marine turtles, lobster, conch, and wilk (or whelk, the West Indian top shell). The continued practice of taking female turtles or lobster is slowly but surely depleting these stocks.

Biological diversity includes two related concepts, genetic diversity and ecological diversity. Genetic diversity is the amount of genetic variability among individuals in a single interbreeding group or the number of population strains, breeds, races, or subspecies. Ecological diversity (species richness) is the number of species in a community of organisms. Both kinds of diversity are fundamental to the functioning of ecological systems in St. Kitts and Nevis.

ST. KITTS

This sub-section of Section 2.3 provides a brief status report on the wildlife of St. Kitts, terrestrial or aquatic (fresh water or marine), looking at both vertebrate and invertebrate species, except that marine invertebrates such as conch (*Strombus gigas*) and lobster (*Panulirus argus*) are more appropriately covered in Section 2.4 (Marine/Coastal Resources) of the Profile. Marine vertebrates such as turtles are considered here principally because their economic value is overshadowed by their ecological role and status as rare and endangered animals requiring more aggressive protection and management.

Terrestrial animals such as birds, mammals, reptiles and amphibians have been discussed previously by Jackson (1981), Arendt (1985) and Towle, *et al.* (1986a). Marine turtles have been extensively covered by Eckert (1989) and Rainey (in Towle, *et al.*, 1986a). Marine birds (seabirds) and waterbirds (ducks and shorebirds) have not been adequately discussed in previous studies, with the exception of Arendt (1985) and Norton (1989), but are treated more fully here. (See Figure 2.3(1).)

Wildlife generally is separated into three special management classes -- resident, introduced or migratory. Resident wildlife are those species which breed in habitats of the island. These species are in general more important than the other two types. For example, marine turtles use the expansive beaches of the Southeast Peninsula, Deippe Bay, and Belle Tete on St. Kitts (and others on Nevis) to dig nests and lay eggs and also feed in nearshore seagrass and reef areas; however, they also migrate elsewhere on an annual basis. Some avian species follow a similar pattern, on a daily or seasonal schedule.

Migratory wildlife for the most part includes species which breed on other islands in the Caribbean or its bordering continental areas and use the habitats of St. Kitts during the period when northern temperate weather forces them to seek alternative winter season food and shelter. Migratory species can include birds, whales, certain fish, butterfly species and bats. Some species may spend the

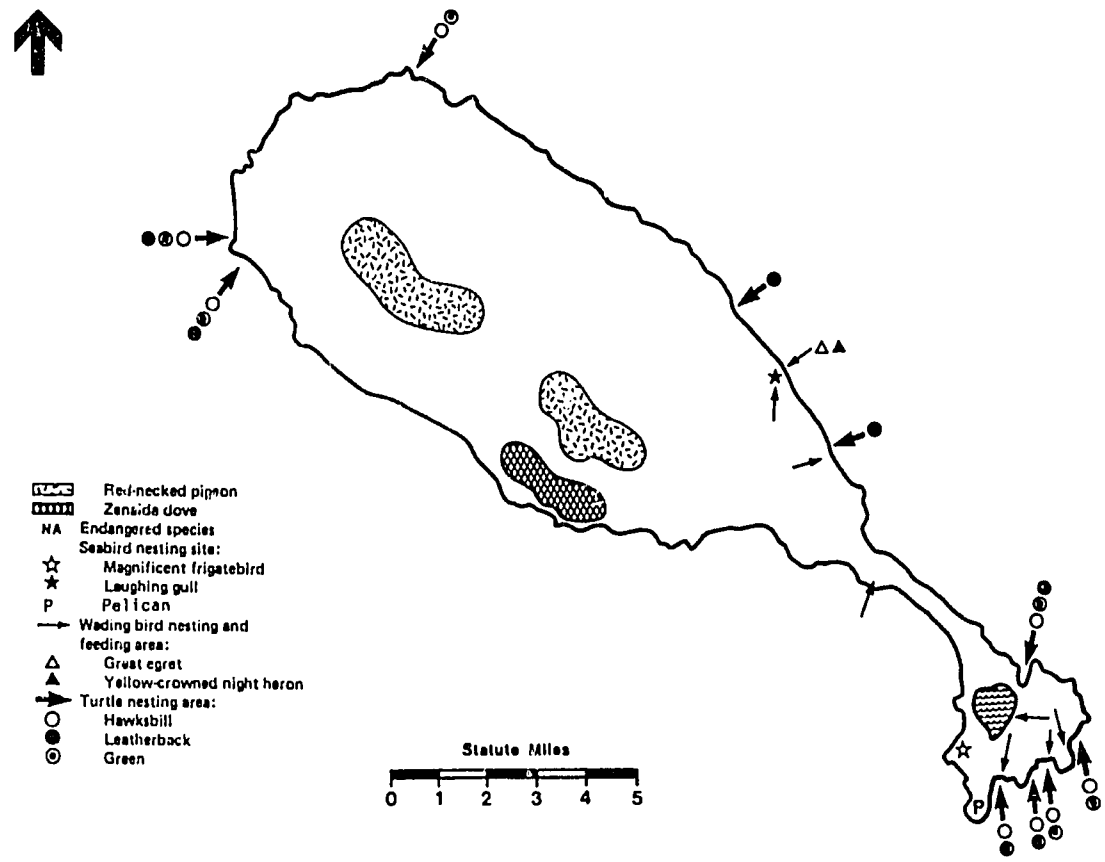


Figure 2.3(1). Endangered and locally important species, St. Kitts (source: ECNAMP, 1980b).

entire winter period in the area of the Southeast Peninsula, for example, while others are temporary inhabitants in the spring on their way north to resume breeding activities.

Introduced wildlife includes marine toads, mongoose, rats, mice, (feral) cats and dogs and monkeys, for example, which negatively impact native and certain migratory species. The status of resident and introduced land animals has been addressed in previous studies (Arendt, 1985; Young, 1989). Species lists have been developed (Tables 2.3(1-5). These are indicative of the diversity of fauna dependent upon wetland systems and montane wildlife habitats of St. Kitts.

There are few specialized habitats that are important to both resident and migratory wildlife. Remnants (or extensions) of the surviving rain forest may occur at lower altitudes (below 1,000 feet), particularly in ghaut areas immediately downslope from the mountains. These forested corridors extend along the natural drainage pathways even to the sea, and consequently many forest bird species may be found therein (Morris and Lemon, 1982).

At the lower edge of the forest (800-1,500 feet) where the land had been under cultivation for a long period of time, a relatively new low dry evergreen forest of small trees (50-60 feet in height) is found. The flora also differs in this belt from the rain forest above. Constant cutting of timber for fuel and clearing for planting has resulted in a variety of transition types from open pasture with native and introduced grasses to closed forest dominated by Spanish Oak (*Inga laurina*) or Locust (*Hymenae courbaril*). In damp protected micro-habitats, the Sierra Palm (*Aerista monticola*) abounds, and there are also occasional pure stands of the common Tree Fern

(*Cyathea arborea*). In each case, the habitat can serve a slightly different set of species or wildlife community. The physical separation of one habitat or association from another quite different one may be only a matter of 100 meters. For example deeper ghauts on the lee of the island may support a few tree ferns to as low as 250 feet above sea level.

Agricultural areas exist from the coastal plains to elevations from 800 to 1,400 feet. Cropping includes sugar cane as the major crop with small plots of vegetable and root crops scattered between and above the sugar plantations. Some of these areas, including windbreaks, provide ideal habitat for many insect-eating birds that make life more tolerable for humans in nearby villages and residential areas.

The coastal belt of St. Kitts contains perhaps the most important habitat group as far as migratory and marine avian species are concerned -- namely, the wetlands. On the southern part of the windward coast at Conaree, immediately below the Canada Hills, is Greatheeds Pond, the best St. Kitts example of a mangrove swamp that serves as an important avian habitat. In 1982 Morris and Lemon reported that the future of the Pond was in doubt. Seven years later the island's Forestry Officer, in a paper to the Caribbean Association of Foresters, reiterated this concern adding, "... the mangrove still continues to be cut for charcoal production. The adjacent landfill [Conaree] poses a serious threat by encroachment; toxic leachates into the pond may be the major element causing a large-scale of fish mortality . . . [and] construction of a large masonry plant adjacent to the pond will exacerbate the situation." A proposal to turn the pond into a coastal wildlife reserve is now pending with CCA and ICOD.

Other important wetland habitats, brackish and fresh water, of the coastal belt are located at Friar's Bay, Frigate Bay, and the pond system of the Southeast Peninsula where large numbers of migrant and resident waterbirds may congregate. Few islands in the Lesser Antilles have large pond systems such as those found at the SEP, St. Kitts. Indeed, St. Kitts may be unique in having one very large pond which attracts great numbers of shorebirds and also having a series of small satellite ponds where birds may find various foods as each pond goes through a production cycle in accordance with fresh water recharge and nutrient loading. Small ponds of the SEP, including Little Salt Pond and those at Mosquito and Cockleshell Bays, and Majors Bay, are open and afford little cover from avian predators. The exception is the red mangrove swamp at Friar's Bay where there is cover for moorhens and ducks for nesting and feeding. Ponds that do not appear to be feeding sites for shorebirds, gulls, and ducks do, however, provide roosting sites.

Recent studies (Towle, *et al.*, 1986a; Brown, 1989b; Eckert, 1989; Norton, 1989; Young, 1989; Wilcox, 1989a and 1989b) have focused on various aspects of the terrestrial and marine wildlife resources of St. Kitts and the Southeast Peninsula. There is little point in summarizing this extensive documentation here as the reports are all still available from the Office of the Southeast Peninsula Land Development and Conservation Board.

Terrestrial. Scorpion, Ground Spider, Centipede, and Millipede are among the most recognizable of the island's invertebrates. There are four types of land crabs; *Cardisoma guanhumi* and *Gecarcinus ruricola* are two of commercial or subsistence value.

Aquatic. Mountain Mullet (*Agonostomus monticola*) are found in ephemeral pools or streams after a prolonged period of rain and may attain a substantial size (one foot). Mudfish (*Gobiidae*) are also found in mountain streams and pools under the same conditions described above.

Reptiles. St. Kitts has three lizards (*Ameiva erythrocephala*, *Anolis b. bimaculatus* and *Anolis wattsi schwartzi*); four geckos (*Hemidactylus maboui*, *Sphaerodactylus sabanus*, *S. sputator* and *Thecodactylus rapicauda*); and two snakes (*Alsophis rufiventris* and *Typhlops monastus geotomus*). Burdon (1920) reports that a shiny, bronze lizard (*Mabouia mabuia*), not recorded by subsequent investigators, was becoming scarce. It is now believed to be extinct.

Table 2.3(1). Species of special concern, as listed by IUCN and the U.S. Fish and Wildlife Service International.

Organism	Status	Source
Invertebrates		
Black Corals (*Antipatharians*)	CT	IUCN
Caribbean Spiny Lobster (*Panulirus argus*)	CT	IUCN
Fishes: None Listed		
Amphibians: None Listed		
Reptiles		
Green Turtle (*Chelonia mydas*)	E	IUCN
Hawksbill Turtle (*Eretmochelys imbricata*)	E	IUCN
Loggerhead Turtle (*Caretta caretta*)	T	USFWS
	V	IUCN
Leatherback Turtle (*Dermochelys coriacea*)	E	IUCN
Birds		
Brown Pelican (*Pelecanus occidentalis*)	T	USFWS
Piping Plover (*Charadrius melodius*)	E	USFWS
Roseate Tern (*Sterna dougallii dougallii*)	T	USFWS
Peregrine Falcon (*Falco peregrinus*)	E	USFWS
Mammals		
Blue Whale (*Balaenoptera musculus*)	E	IUCN
Finback Whale (*Balaenoptera physalus*)	E	IUCN
Humpback Whale (*Megaptera novaeangliae*)	E	IUCN
Sperm Whale (*Physeter catadon*)	E	USFWS

KEY Listed by IUCN: E = Endangered; V = Vulnerable; CT = Commercially Threatened
Listed by USFWS: E = Endangered; T = Threatened

Source: IUCN, 1989; USFWS, 1990.

There are three marine turtles, Green, Hawksbill and Leatherback, resident in St. Kitts. They have been recorded nesting at beaches of the Caribbean coast and the Southeast Peninsula. All are considered threatened with extinction because of poaching and human disturbances to nesting habitat. The Leatherback is critically threatened because of poaching and plastics in the sea which the turtle mistakenly consumes.

Amphibians. *Eleutherodactylus johnstonei* and *Leptodactylus fallax* are the principal native amphibians (Table 2.3(5)) of St. Kitts. A large edible frog (*L. fallax*), known locally as crapaud or Mountain Chicken, was apparently native to St. Kitts (Burdon, 1920),

Table 2.3(2). Resident waterbirds observed at the Southeast Peninsula, St. Kitts.

Species	Total Number Recorded
Family - *PELECANIFORMES*	
*Magnificent Frigatebird	15
**Brown Pelican	25
Family - *CICONIFORMES*	
Yellow-crowned Night-Heron (*Nyctanassa violaces*)	6
Family - *LARIDAE*	
Laughing Gull (*Larus atricilla*)	20
Royal Tern (*Sterna maxima*)	20
**Roseate Tern (*Sterna dougallii*)	12
*Least Tern (*Sterna antillarum*)	12
Family - *CHARADRIIDAE*	
Snowy Plover (*Charadrius alexandrinus*)	4
Wilson's Plover (*Charadrius wilsonia*)	11
Family - *HAEMATOPODIDAE*	
American Oystercatcher (*Haematopus palliatus*)	2
Family - *RECURVIROSTRIDAE*	
Black-necked Stilt (*Himantopus mexicanus*)	295
Family - *SCOLOPACIDAE*	
*Willet (*Catoptrophorus semipalmatus*)	12
Total observed	434

* Species of concern
** Threatened species

Source: Norton, 1989.

but became extirpated through habitat modification, over-exploitation for food or by the mongoose. It is reported to have been reintroduced without success. The small piping frog (*E. johnstonei*) is endemic to St. Kitts and is primarily found in moist forests or similar habitats in bromiliads. The Marine Toad (*Bufo marinus*) was introduced, as in many of the other islands of the West Indies, as a biological control for rats and mice. It is a large toad with toxic warts around the head which can cause death for dogs and cats when bitten.

Mammals. Native mammals are few. The most common are bats of which at least five regional endemics are resident: Fruit Bat (*Ardops nichollsi*), Cave Bat (*Brachyphyllum cavernarum*), and three insectivores (*Myotis dominicensis*, *Artibeus jamaicensis*, and *Monophyllus plethodon*). The Fishing Bat (*Noctilio lepoinus*) and a common insectivore (*Molossus molossus*) are also found. Migrant mammals include the Humpback Whale (*Megaptera novangliea*), Sperm Whale (*Physter catadon*), and other cetaceans, e.g., Bottle-nosed (*Tursiops truncatus*), Rough-toothed (*Steno bredanensis*) and Spinner (*Stenella longirostris*) Dolphins, which may appear periodically on the St. Christopher marine platform.

Table 2.3(3). Migratory waterbirds observed at the Southeast Peninsula, St. Kitts (September 22-24, 1988).

Species	Total Number Recorded
Family - *ARDEIDAE*	
Great Blue Heron *(Ardea herodius)*	1
Family -*CHARADRIIDAE*	
Black-bellied Plover *(Pluvialis squatarola)*	33
Lesser Golden-Plover *(Pluvialis dominica)*	1
Semipalmated Plover *(Charadrius semipalmatus)*	78
**Piping Plover *(Charadrius melodus)*	1
Family - *SCOLOPACIDAE*	
Greater Yellowlegs *(Tringa melanoleuca)*	34
Lesser Yellowlegs *(Tringa flavipes)*	354
Spotted Sandpiper *(Actitis macularia)*	16
Whimbrel *(Numenius phaeopus)*	8
Black-tailed Godwit *(Limosa limosa)*	1
Ruddy Turnstone *(Arenaria interpres)*	48
Red Knot *(Calidris canutus)*	15
Sanderling *(Calidris alba)*	6
Semipalmated Sandpiper *(Calidris pusilla)*	820
Western Sandpiper *(Calidris mauri)*	108
Least Sandpiper *(Calidris minutilla)*	245
White-rumped Sandpiper *(Calidris fusciollis)*	1
Pectoral Sanpiper *(Calidris melanotos)*	6
Stilt Sanpiper *(Calidris himantopus)*	168
Short-billed Dowitcher *(Limnadromus griseus)*	44
Long-billed Dowitcher *(Limnadromus scolapaceus)*	1
Total observed	1989

** Endangered species

Source: Norton, 1989.

Agouti (*Dasprocta leporina* or *albida*), thought to be an aboriginal introduction throughout the Lesser Antilles, was once common according to Burdon (1920) but has apparently been decimated by hunters and the depredations of the mongoose (*Herpestes auropunctatus*), introduced to St. Kitts in 1884 from Jamaica. The African Green or Vervet Monkey (*Cercopithecus aethiops*) was apparently introduced some 300 years ago by the French as a pet, escaped and multiplied during the period of the French wars with the English. Its survival was dependent upon adaptation to native flora and fauna. Florida White-tailed Deer (*Odocoileus virginianus*) were introduced from Puerto Rico in 1931 to St. Kitts by Phillip Todd of Lodge Estate as a game species. When the herd reached seven animals, it was released at Frigate Bay. Its survival success in St. Kitts has been marginal but not without negative impacts on agriculture. Other introduced mammals include the ubiquitous rodents *Rattus rattus*, *Rattus norvegicus* and *Mus musculus*.

Resident Bird Species. Resident bird species have been recorded by Burdon (1920), Danforth (1936), Morris and Lemon (1982), and Arendt (1985). Of particular interest is the status of the St. Kitts race of the Puerto Rican Bullfinch (*Loxigilla violacea grandis*). It was reported to be extinct as a result of hurricanes and constant predation pressure from the green monkey at Mt. Liamuiga. The Carib Grackle (*Quiscalus lugubris*) brought

DEFINITION OF TERMS

Waterbirds - Any of a group of species that use water resources for feeding.

Shorebirds - Aquatic species adapted to feeding at the edge of or in the shallow waters of ponds, streams, sloughs, or ocean shores by probing in the mud or soil.

from Barbados (Burdon, 1920) is the first avian introduction recorded on St. Kitts.

Resident waterbirds of the SEP are listed in Table 2.3(2). Few areas in the lesser Antilles provide the type of expansive mudflat or saltpan habitat required by resident Antillean shorebird species. In particular, Snowy Plover and Willet were observed to have found nesting habitat at the SEP during 1988 (Norton, 1989).

Threatened resident seabirds of St. Kitts include the Brown Pelican and Roseate Tern listed for the Caribbean (USFWS, 1990). Local species of concern include the Magnificent Frigatebird (*Fregata magnificens*) and the Least Tern (*Sterna antillarum*) which are resident on the SEP.

Migratory Birds. Two major factors contribute to the diversity and abundance of migratory bird species seen in St. Kitts during the fall to late spring period. The principal element is weather, and the other is available habitat. Migrant shorebird species diversity in the region may result from "fall-out" from tropical storms or hurricanes, which pass through the Eastern Caribbean from late August through September, the period when most north temperate zone migrants are flying south. Weather, which forces migratory birds to leave their nesting grounds in the far north, also provides necessary freshwater along the migratory flyway in the Lesser Antilles. Freshwater on the SEP during fall months is provided by large, low pressure systems and great quantities of recharge to ponds. Freshwater and abundant sunlight in shallow ponds set off blooms of phyto- and zooplankton upon which shorebirds sustain themselves during the fall and winter and again in spring.

The diversity of shorebird species observed, particularly on the SEP, can be exceptional. Twenty-five species were recorded during two days of field investigation in mid-September 1988 (Norton, 1989). Prior to this, only fourteen species had been recorded on St. Kitts from 1936 (Danforth, 1936). Migratory waterbirds are listed in Table 2.3(3).

The diversity of the waterbirds observed at these ponds is a strong indication that food resources are available for a wide variety of species. The pond system of the SEP appears to be a resource of international importance based on the diversity and abundance of species recorded (Norton, 1989).

NEVIS

The first listing of natural resources for Nevis was a 1745 publication by the Reverend William Smith entitled *A Natural History of Nevis*, which describes the flora, fauna, sea life, geology and other aspects of colonial life during early settlement and provides insights into wildlife populations at that time. More recent descriptions of Nevis plant and animal communities have been provided by Beard (1949), Westermann (1952), and Merrill (1958).

Even more recently, Robinson (1988) assembled both historical and current information on the natural resources of Nevis. This document, completed by the Nevis Historical and Conservation Society as a project for OAS, was based in part on field work by Young, *et al.* (1988) as one component of an active program of biological research being conducted by field teams from Vanier College, Montreal, on the island of Nevis. Under this program student reports have been prepared on flora (Rodrigues, 1990a and 1990b), avifauna (Esser, 1990), monkeys (Bermingham, 1990), and marine life (Beaulieu, 1990; Denoncourt, 1990). In

Table 2.3(4). Avifauna observed in St. Kitts (March 26 - April 29, 1982).

COMMON NAME	SCIENTIFIC NAME	CODE
Seabirds		
Brown Pelican	Pelecanus occidentalis	RO
Brown Booby	Sula leucogaster	RO
Magnificent Frigatebird	Fregata magnificens	RO
Laughing Gull	Larus atricilla	RO
Sooty Tern	Sterna fuscata	UN
Least Tern	Sterna albifrons	RO
Roseate Tern	Sterna dougalli	UN
Royal Tern	Thalasseus maximus	UN
Brown Noddy	Anous stolidus	UN
Shorebirds		
Great Blue Heron	Ardea herodias	MO
Little Blue Heron	Florida caerulea	RO
Green Heron	Butorides virescens	UN
Yellow-crowned Night Heron	Nyctanassa violacea	RO
Snowy Egret	Egretta thula	UO
Cattle Egret	Bulbulcas ibis	RO
Common Gallinule	Gallinula chloropsus	RO
Caribbean Coot	Fulica caribaea	UN
Lesser Yellowlegs	Tringa flavipes	UO
Greater Yellowlegs	Tringa melanoleuca	UO
Common Stilt	Himantopus himantopus	RO
Ruddy Turnstone	Arenaria interpres	UO
Willet	Catoptrophorus semipalmatus	MN
Black-bellied Plover	Squatarola squatarola	MN
Thick-billed Plover	Charadrius wilsonia	RO
Snowy Plover	Charadrius alexandrinus	RO
Rufous-naped Plover	Pagolla wilsonia	MN
Semipalmated Plover	Charadrius semipalmatus	UO
Sanderling	Crocethia alba	UO
Semipalmated Sandpiper	Calidris pusilla	UO
Spotted Sandpiper	Actitis melanoleuca	UO
Least Sandpiper	Calidris minutilla	MN
Lesser Scaup	Aythya affinis	MN
Blue-winged Teal	Anas discolors	MN

[continued ...]

DESCRIPTIVE CODE:

- RO Species observed by Morris and Lemon (1982); presumed to be year-round resident breeding on St. Kitts.
- MO Species observed by Morris and Lemon (1982); presumed to be migrant or transient.
- UO Species observed by Morris and Lemon (1982); status unknown.
- RN Species not observed by Morris and Lemon (1982), but on basis of published accounts presumed to be a resident.
- MN Species not observed by Morris and Lemon (1982), but on basis of published accounts presumed to be a migrant.
- UN Species not observed by Morris and Lemon (1982), but previously reported; current status unknown.

Table 2.3(4) (continued). Avifauna observed in St. Kitts (March 26 - April 29, 1982).

COMMON NAME	SCIENTIFIC NAME	CODE
Terrestrial Birds		
Tree Duck	Dendrocygna spp.)	MN
Rock Dove	Columba livia	RO
Red-necked Pigeon	Columba squamosa	RO
Zenaida Dove	Zenaida aurita	RO
Ground Dove	Columbina passerina	RO
Bridled Quail Dove	Geotrygon mustacea	RN
White-crowned Pigeon	Columba leucocephala	UN
Peregrine Falcon	Falco peregrinus	MN
Kestrel	Falco sparverius	RO
Red-tailed Hawk	Buteo jamaicensis	RO
Osprey	Pandion haliaetus	MN
Yellow Warbler	Dendroica petechia	RO
Black-whiskered Vireo	Vireo altiloquus	RO
Black-and-white Warbler	Mniotilta varia	MN
Parula Warbler	Parula americana	MO
Prairie Warbler	Dendroica discolor	MN
Hooded Warbler	Wilsonia citrina	MN
American Redstart	Setophaga ruticilla	MN
Veery	Catharus fuscenscens	MN
Northern Waterthrush	Seiurus novaboracensis	MN
Louisiana Waterthrush	Seiurus motacilla	MN
Scarlet Tanager	Piranga olivacea	MN
Northern Oriole	Icterus galbula	MO
Belted Kingfisher	Megaceryle alcyon	MO
Lesser Antillean Bullfinch	Loxigilla noctis	RO
Black-faced Grassquit	Tiaris bicolor	RO
Caribbean Elaenia	Elaenia martinica	RO
Stolid Flycatcher	Myiarchus stolidus	RO
Grey Kingbird	Tyrannus dominicensis	RO
Bannanaquit	Coereba flaveola	RO
Lesser Antillean Pewee	Contopus latirostris	RO
Pearly-eyed Trasher	Margarops fuscatus	RO
Scaly-breasted Thrasher	Margarops fuscus	RN
Trembler	Cinclocerthia ruficauda	RN
Antillean Crested Hummingbird	Orthorhyncus cristatus	RO
Purple-throated Carib	Eulampis jugularis	RO
Green-throated Carib	Sericotes holosericeus	RN
Purple Martin	Progne subis	RO
Cliff Swallow	Petrochelidon pyrrhonota	MN
Barn Swallow	Hirundo rustica	MN
Collared Swift	Streptoprocne zonaris	MN
Black Swift	Cypseloides niger	UN
Guinea Fowl	Numida meleagris	UO
Peacock	Pavo sp.	UN

Source: Morris and Lemon, 1982.

IN THE AFTERMATH OF HUGO

On the evening of September 16, 1989, Hurricane Hugo began its path of destruction through Nevis, and by the time the storm had passed, the island looked very different. Nevis Peak was brown -- leaves, vines, flowers and fruits had been stripped from trees, and rock-slides left deep scars on the sides of the Peak. Ravines flowed with water, trees and various debris collected along their routes. Water lines from collecting reservoirs were broken, and large trees were uprooted everywhere.

Hardest hit were the animals whose lives depend upon the forest. Thrashers descended on cat and dog food left for domestic pets, hummingbirds sat exhausted on garden walls waiting for sugary treats, and monkeys descended to lower ravines in order to raid orchards and gardens.

Debris was everywhere, and over the next few months thousands of little white and yellow butterflies were evidence of the massive organic decomposition that was taking place. Various forms of fungus were also much more prevalent than in pre-hurricane times.

With the loss of vegetation in the ravines, soil erosion increased as did the volume of water flowing to the coastal lagoons. Bath Bog continued to fill and empty on a weekly basis, and severe flooding occurred in the Cades Estate area several months later.

Coconut palms along the coast, particularly in the Bath Bog and Cotton Ground areas, were devastated. Older, taller trees often were uprooted or had their tops snapped off. Beaches suffered sand loss, and seagrass beds were smothered with sedimentation from mountain ravine run-off. On the windward coast, large amounts of sand accumulated and filled inland ponds near Red Cliff. Elkhorn coral near Cades Bay was broken to pieces, and in other areas coral was damaged from increased siltation and changes in water salinity.

addition, environmental impact assessments (EIAs) have been carried out by Young and Scully (1990) and Young, *et al.* (1990) for local development projects planned for environmentally sensitive areas. This current surge of field activity and documentation of the natural resources of Nevis coincides with larger natural events like global warming and the passage of Hurricane Hugo over the Eastern Caribbean in 1989. While the effects of the former are still under scientific debate, the results of the latter are all too obvious to Nevisians (see sidebar).

Plants. The flora of Nevis is typical of small Caribbean islands of volcanic origin, and the vegetation zones are well described by Beard (1949) (see also Section 1.2.4 of the Profile). Cloud forest or elfin woodland forms at the upper elevations where constant humidity, strong winds and regular rainfall dictate the pattern of growth and which species can survive.

There are transitions through montane thicket, palm brake, moist evergreen and dry tropical forest on the mountain slopes. Trees on steep banks often display enormous buttressed root systems; and in regions where lianas, bromiliads and ferns are abundant, there is a resemblance to the tropical rain forests encountered in larger islands and continental areas.

The secondary woodlands on Nevis cover the largest area of land of all zones, primarily due to past agricultural practices where large tracts of land were cleared and subsequently abandoned. Throughout these

Table. 2.3(5). Reptiles and amphibians recorded from St. Kitts.

Name	Status
REPTILES:	
Lizards	
Iguana rhinolopna	E
Ameiva erythrocephala (ground lizard)	Ab
Anolis bimaculatus bimaculatus (lizard)	C
Anolis wattsi schwartzi (lizard)	Ab
Mabouia mabuia	E
Geckos	
Hermidactylus mabouia (So. woodslave)	U
Sphaerodactylus sabanus	C
Sphaerodactylus sputator	Ab
Thecadactylus rapicauda (giant woodslave)	U
Snakes	
Alsophis rufiventris (black snake)	Ab
Typhlops manastus geotomus (worm snake)	Ab
Sea Turtles	
Chelonia mydas (green turtle)	R
Eretmochelys imbricata (hawksbill)	R
Dermochelys coriacea (leatherback)	R
AMPHIBIANS:	
Toads	
Bufo marinus (giant toad) (introduced)	Ab
Frogs and Toads	
Leptodactylus fallax (mountain chicken) (extinct)	Ab
Eleutherodactylus johnstonei (tree frog)	Ab

Key: Ab = Absent from samples; C = Common; E = Extinct; I = Introduced; R = Rare; U = Uncommon

Source: Modified from Arendt, 1985.

regenerating woodlands, remnants of past fruit orchards can be found as evidenced by trees like mango, avocado, guava, soursop and various citrus like lemon, lime, sour orange and grapefruit.

Lowland and coastal areas feature combinations of acacia, wild tamarind, kapok, almond, mangrove, manchineel and seagrape. Another vegetation zone that is encountered at several locations around Nevis can best be described as cactus-scrubland with xerophytic plants like aloe vera, wild physic nut, acacia and various cacti able to survive under extremely arid conditions.

One of the greatest difficulties in identifying the flora of various regions is the large number of trees, shrubs and other plants which were brought to Nevis over the centuries following initial settlement by Europeans. These include fruit trees like the Breadfruit which were imported from the South Pacific to ornamentals like the African Tulip Tree, Australian Pine, Royal Palm, Indian Rubber Tree and a host of others from virtually every continent. A useful series of publications on the flora of the Lesser Antilles can be found in Howard (1974).

Invertebrates. A complete listing for terrestrial invertebrates in Nevis is not presently available, but some work has been accomplished for species that are of some importance or prominence, or pose a hazard. These include the poisonous centipede (*Scolopendra Dromorpha*) and the wolf spiders (*Lycosidae*), donkey spiders (*Theraphosidae*) and scorpions (*Scorpionida*). Freshwater, terrestrial and marine crabs identified to date include the Caribbean Crayfish (*Macrobrachium acanthurus*), which has been discovered in a fresh water stream at the 1,200 foot level above Tower Hill Estate; Caribbean Mud Fiddler Crabs (*Uca rapax*), which are common near fresh water lagoons; the Great Land Crab (*Cardisoma guanhumi*); Ghost Crab (*Ocypode guadrata*); Land Hermit Crab (*Icoenabita clypeatus*), also called Soldier Crab; Sally Lightfoot Crab (*Grapsus grapsus*); and the Lesser Blue Crab (*Callinectes similis*), which is quite common in the shallow waters along Long Haul Bay beaches.

Bee keeping has more recently become a viable agricultural activity in Nevis. First introduced by Europeans during the early settlement of Nevis, honey bees (*Apis mellifera*) slowly adapted to Caribbean flora. By the twentieth century honey cutters were able to make a modest living from the wild nests.

Fishes. Fresh water fish are abundant in both the coastal lagoons and mountain streams of Nevis, but identification by species is not available at this time. Marine fishes and invertebrates are those typical of the Lesser Antillean Region and have played a prominent role in fishing activities around Nevis for centuries.

FROM HONEY CUTTERS TO BEE KEEPERS

Long before modern methods of beekeeping came into practice, Nevis honeycutters would go into ravines, forests, cliffs, abandoned buildings and sundry other places in search of wild honeybee hives. Although the honeybee is not indigenous to Nevis, or the West Indies for that matter, attempts to start hives by European settlers in the eighteenth and nineteenth centuries resulted in many escapes or "swarms" which colonized in the wild. Since bees prefer dark, inaccessible cavities in trees and rocks, finding the nest and extracting the honey were time-consuming and often hazardous endeavors by the few men willing to make the effort. Traditional honeycutters would use crude veils called "masks" and had "smokers" that were fashioned from tin cans. Knives and cutlasses were used to remove the wild nests and occasionally a portion would be left behind to allow the bees a chance to re-establish themselves.

The honey industry on Nevis began in earnest in the fall of 1987 with the arrival of a British volunteer from Voluntary Service Overseas (VSO) who had previous experience with modern beekeeping practices. A local group of bee keepers and cutters organized to form the Nevis Beekeepers Cooperative, and financial assistance was obtained from the British and USAID for the purchase of necessary materials and equipment. Today there are 22 active members of the cooperative and over 70 bee hives in operation around the island, and honey is sold to the general public in a variety of retail and specialty outlets.

Amphibians. Two amphibian species have been identified on Nevis (Young, *et al.*, 1988): the Giant or Marine Toad (*Bufo marinus*), which was introduced to the Caribbean in an attempt to control cane beetles, and the miniscule Brown Tree Frog (*Eleutherodactylus johnstonei*), which is often referred to locally as a "cricket". Merrill (1958) makes reference to the large edible frog known as the "mountain chicken" (*Leptodactylus fallax*), but these have not been found on Nevis for decades. They were hunted aggressively for food by man, and the mongoose also aided in their extinction.

Reptiles. Terrestrial reptiles reported on Nevis by Young, *et al.*, (1988) include two geckos (*Hemidactylus maboia* and *Sphaerodactylus sabanus*); two climbing lizards, the green anole (*Anolis binaculatus*) and the smaller brown anole (*Anolis wattsi*); one ground lizard (*Ameiva erythrocephala*); and a blind snake (*Typhlops monastus*), which resembles an earth worm. Three marine reptiles, all sea turtles, are also frequently sighted and heavily fished in the waters around Nevis. They include the Green (*Chelonia mydas*), Hawksbill (*Eretmochelys imbricata*) and Leatherback (*Dermochelys coriacea*).

All marine turtles are listed as endangered or threatened by IUCN, with the Hawksbill being the most critically endangered species (see Table 2.3(1)). Natural factors such as storm damage to nesting beaches, disease and predation have always taken a toll, but the actions of man have had the greatest impact on sea turtle populations. The eggs of all species are eaten, juvenile and adult Green Turtles are killed for their meat, and Hawksbills are hunted for their colored shell which is valued for jewelry.

Besides direct slaughter, other threats to the survival of turtles are destruction of nesting beaches by sand mining and development; bright lighting along the shoreline which disturbs nesting females and causes disorientation of the young at hatching; predation on hatchlings by domestic animals such as dogs and pigs; floating tar balls and plastic bags that cause injury or death when ingested; and floating monofilament fishing line in which the turtles become entangled. In the case of the Hawksbill, the increasing damage to coral reefs from siltation, pollution and dredging affects the survival of populations since this species feeds on the invertebrates associated with coral reefs and also depends on reefs for shelter at all stages of its life cycle.

Three species of sea turtles, the Green, Hawksbill and Leatherback, are reported to nest on Nevis beaches (Lynch, 1979) with the beaches along the north shore, and particularly Hurricane Beach, identified as primary nesting sites. Green turtles have been frequently sighted (Young, *et al*, 1988) feeding along the southern coast of Nevis, and hawksbills are reported in the area adjacent to Cades Bay. Although there is a closed season for turtle fishing (June 1 to September 30), fishermen disregard this regulation and enforcement is non-existent. As in other Eastern Caribbean islands, sea turtle stocks in Nevis are considered to be depleted by fisheries personnel, and most fishermen report that turtles are harder to find and generally smaller in size.

Birds. Hilder (1989) has provided a listing of resident and migratory birds for Nevis. Almost seventy species are documented as well as information on sighting locations. Esser (1990) provided information on avifauna distribution in several select habitats of Nevis including coastal, secondary woodland and tropical forest. Seven members of the heron-egret family are particularly abundant on Nevis and provide an excellent opportunity for avid bird watchers to enjoy many hours of exploration through coastal freshwater habitats.

Mammals. Native terrestrial mammals such as the agouti (*Dasyprocta albida*) are no longer reported on Nevis. Instead they have been replaced by the roof rat (*Rattus rattus*) which is an excellent climber, the Norway rat (*Rattus norvegicus*), and the common house mouse (*Mus muscoulus*). Two species of bat have been identified on Nevis: the Jamaican fruit bat (*Artibeus jamaicensis*) and the common house bat (*Molossus molossus*) which is insectivorous.

Two introduced mammals have made a nuisance in Nevis and elsewhere in the Caribbean. They are the Small Indian Mongoose (*Herpestes auropunctatus*) and the African Green Monkey (*Cercopithecus aethiops*). It is commonly believed by Nevisians that the mongoose was imported to rid the island of snakes, but it is more likely that the presence of the mongoose was to control rats which were ravaging the cane sugar supplies. The mongoose do indeed reduce the rodent populations to tolerable levels, but they also prey on domestic and wild birds as well as other small animals. They are often regarded as serious threats to the survival of native wildlife.

The situation for the African Green Monkey or Vervet is somewhat more controversial. Regarded by locals as a serious crop pest and eaten by Kittitians, these monkeys are also a favorite with visitors to the islands and they have the potential to spawn a very lucrative guided-tour industry in several locations, such as the Southeast Peninsula in St. Kitts (Young, 1989) and the Golden Rock Estate area in Nevis (Bermingham, 1990). The African Green Monkey is a relatively large, Old World primate that is widespread throughout Africa and was brought to the Caribbean over 300 years ago (McGuire, 1974). Their populations in St. Kitts have been estimated to be around five to seven thousand by scientific studies (Poirier, 1972; McGuire, 1974; Young and Morden, 1988), although local reports claim there are as many as thirty or forty thousand monkeys. From preliminary investigations on Nevis, one researcher (pers. commun., R. Young, Vanier College, 1990) estimates that there are about 2,000 monkeys residing in approximately 100 troops mostly located in ravines around the island's central mountain.

African Green Monkeys are primarily fruit and leaf eaters although they have been observed to eat small insects from time to time (McGuire, 1974). There are no recorded instances where they have killed, eaten or even disturbed other wildlife such as nesting birds or small mammals; and, in fact, they are often reported to live in close association with other animals (McGuire, 1974). Their populations have been kept somewhat in check by a very active trapping and export business in St. Kitts, and every year thousands of monkeys are captured in St. Kitts and Nevis for export to biomedical labs in the United States, Canada and Europe.

Several domestic animals have become a significant wildlife problem on Nevis with the potential to cause considerable damage. Stray dogs pose a threat to wild animals and to humans through the spread of diseases; while feral sheep, goats, donkeys and pigs have the potential to overgraze fragile regions of cactus scrubland. At the present time, no effort is made to control their numbers or restrict their activities.

2.3.2 Problems and Issues

(1) Predator Control. Wildlife management or maintenance of biodiversity in St. Kitts-Nevis does not at present include any continuous predator control program. Introduced species, such as mongoose and feral cats and dogs, can have a serious negative effect on native species populations and survival.

(2) Loss of Native Forest. The primary negative impact of development on wildlife is habitat reduction via the conversion of forested wildlands to other habitat types and land uses. Home range requirements and minimum viable population sizes for most species are as yet poorly known. The small land masses of both St. Kitts and Nevis means that any future system of parks and protected areas will consist of small, probably isolated "islands" of more-or-less "natural" habitat surrounded by a matrix of more intensive land uses. If maintained largely as *native vegetation*, such reserves could perhaps include sufficient area to protect smaller species of wildlife which may require that particular type of habitat, but this is very much a matter of individual species characteristics.

The importance of *native* forest for wildlife needs to be underscored. Regeneration of forests which favor exotic or pioneering forms of vegetation will be of more limited value in promoting biodiversity. A program of

selective reforestation and natural avian dispersal of native plant species may prove to be more beneficial to the recovery of biodiversity than passive regeneration of forests.

Many so-called marginal lands or former agricultural lands now reverting to scrub (in both St. Kitts and Nevis) are often considered of minimal economic importance primarily because they cannot be profitably developed for agricultural production. However, such lands have value which extends beyond economic productivity; most significantly, such lands can be developed as wildlife habitat and for watershed protection. It is, therefore, important that Government include such non-traditional, non-economic considerations in its assessment of and judgments about the capabilities and usefulness of marginal lands or former agricultural lands. From a biodiversity perspective, these lands could have considerable national value and require the development of appropriate management strategies.

(3) **Endangered Species.** The absence of an endangered species recovery plan for the country, customarily a primary segment of the working agenda of a wildlife officer (which SKN does not have), leaves all threatened and endangered species at risk. Furthermore, with the prospective changes in the status of the Southeast Peninsula, St. Kitts' endemic flora and fauna must be considered threatened (or endangered) by definition.

The Brown Pelican (locally called the booby) is listed as threatened in the Caribbean. It is also the National Bird of St. Kitts-Nevis. The Roseate Tern, which has been recorded with juvenile birds at White House Bay on the SEP, is also listed as threatened in the Caribbean and is presumed (pers. observ., R. Norton, CEP Project Team, 1990) to have nested in the region of the SEP.

Identification of wildlife species and their relative abundance, distribution, and ecological roles is critical to the development of more comprehensive resource management programs for endangered and threatened species. Some limited work has been initiated under the auspices of the Nevis Historical and Conservation Society, which has developed working partnerships with external visiting scientists.

(4) **Impacts of Agrochemicals on Wildlife.** Pesticide importations are not being monitored in accordance with the Pesticides Act of 1973, and there is virtually no residue monitoring in either wildlife feeding areas or from wildlife specimen tissues. CEHI and FAO/UNESCO have provided technical assistance and equipment for upgrading the analytical capabilities of GOSKN, but these are either underutilized or non-functional. Therefore, the effects of agrochemicals on wildlife and the terrestrial and marine ecosystems of St. Kitts-Nevis remain undocumented and largely unknown.

Even if standard toxicological data were available, such data by themselves are frequently not sufficient to predict the consequences of releasing toxic synthetic compounds in an ecosystem. Quantitative evaluation of the effects of agrochemicals requires a fairly detailed ecological picture which is rarely available for tropical vertebrates and which is exceedingly labor-intensive to acquire. Furthermore, the consequences for wildlife populations of exposure to sublethal levels of one or more pesticides or herbicides, often in combination with additional environmental stresses (e.g., habitat reduction or a severe dry season), cannot yet be predicted even at the single-species level.

Nevertheless, some broad statements in reference to vertebrate wildlife can be made. Birds are generally more sensitive to biocides than mammals, perhaps in part because mammals have better detoxification systems. Fish are frequently, but not consistently, more sensitive than warm-blooded vertebrates. There is also a general developmental hierarchy of sensitivity within each species. Vertebrate embryos, eggs and larvae are often more sensitive to toxicants than adults because they are less protected from the surrounding environment, have limited means for detoxifying absorbed substances, and are less able to move away from noxious substances.

(5) Convention on International Trade in Threatened and Endangered Species of Wild Fauna and Flora (CITES). International trade is a major threat to the survival of many wildlife species in the region. Many Caribbean countries permit commercial export of wildlife, including species listed as endangered by IUCN. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) attempts to regulate wildlife and trade through a worldwide system of import and export controls for listed species. CITES offers only imperfect protection to endangered species since a member country is obligated only to ensure that products from listed species do not enter international trade; hunting and killing of such species for local trade is not prohibited. Moreover, any country is allowed to enter "reservations" at the time of ratification which allow it to continue its international trade in species which it so designates.

The Government of St Kitts and Nevis is not a signatory of CITES. Membership would offer the country access to a wealth of materials, training and expertise on species conservation and wildlife trade regulation.

(6) National Conservation and Environment Protection Act. Several sections of the new National Conservation and Environment Protection Act (NCEPA) of 1987 pertain to wildlife and the maintenance of biodiversity.

First, the Act provides for the establishment of "protected areas" and specifically indicates several broad purposes or objectives justifying the setting aside of such areas, including:

(1) To preserve biological diversity of wild flora and fauna species that may be endemic, threatened, or of special concern and the land and marine habitats upon which the survival of these species depend;

(2) To protect selected examples of representative or unique biological communities, both on land and in marine areas, and their physical environment.

Management plans are to be prepared for each designated protected area by the Conservation Commission, which was set up under the law to administer the provisions of the legislation. The NCEPA also states that the Minister (of Development) may appoint special wildlife officers to assist in carrying out the responsibilities called for under the Act.

Finally "wild animals" and "wild birds," as enumerated in the Third Schedule to the Act, are "protected". However, the legislation is not specific as to how "protection" is to be provided, monitored and enforced, nor does it specify which agency of Government is charged with wildlife protection responsibilities.

Regulations to this important legislation await guidance from the now functional Conservation Commission; without regulations in place, the provisions for wildlife protection and biodiversity enhancement as provided in the NCEPA will lack sufficient specificity and authority to fulfill the intent of the lawmakers.

At present, there are no wildlife sanctuaries or protected wildlife areas in the state -- nor are there any wildlife officers or resource management programs for wildlife. In Nevis, a series of unofficial environmental study areas have been set up by the Nevis Historical and Conservation Society, including the Bath Bog/Gallows Bay region, mountain forest above the Hamilton Mill and Golden Rock Estates, Cades Bay, Bath plain, Stockpen Estate, Pinneys Estate and marine sites along the northern coast (see Figure 2.3(2)). Documentation of plant and animal species and descriptions of habitat features for these areas are available from the NHCS, and future plans call for continuous monitoring of the sites and perhaps gradual expansion to other areas.

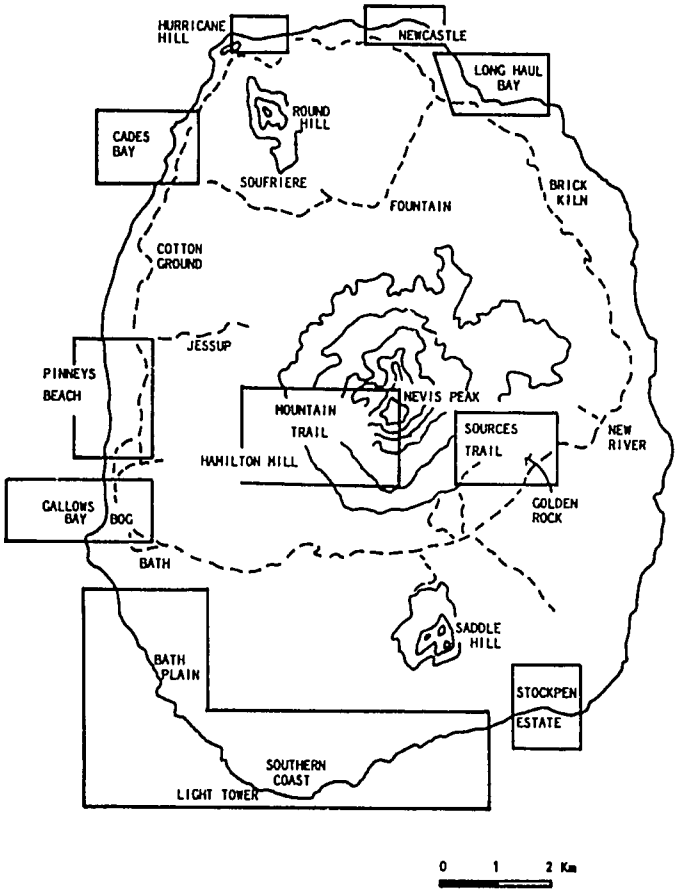


Figure 2.3(2). Environmental study areas, Nevis (source: Nevis Historical and Conservation Society).

2.3.3 Policy Recommendations

(1) Land Use Decision-making. In order to improve and inform the land use decisions of the Southeast Peninsula Board, the Frigate Bay Development Corporation, the St. Kitts Sugar Manufacturing Corporation, the Central Housing and Planning Authority, and other duly authorized planning agencies and bodies of Government, relative to the impact of land use decisions on wildlife and wildlife habitat, a professionally trained wildlife officer is needed to provide special counsel to Government as well as to carry out project planning, oversight and monitoring functions in the wildlife sector. The proposed Wildlife Officer ideally would function almost like an ombudsman for wildlife and could become part of the technical support staff or secretariat of the Conservation Commission.

(2) Protected Areas and Nature Tourism. Nature tourism, also called ecotourism, is a booming industry worldwide, and more and more countries are demonstrating how an ecotourism approach can enhance local conservation efforts by linking resource protection strategies to the generation of foreign exchange earnings. Nature tourism may be one method -- perhaps the most effective one -- of preserving some of the natural resources of St. Kitts-Nevis while at the same time expanding the country's overall economic base. Furthermore, ecotourism can provide an excellent opportunity for the private sector and NGOs to work with Government in developing appropriate wildlife/nature reserve management programs. In short, if biodiversity and tourism are equally important to the development of the country, then these otherwise diverse goals could be compatible.

For example, St. Kitts has rain forest habitat to the north where West Indian endemic birds may be observed any time of the year. Additionally, the dry forest regime of the SEP affords accessible pond habitat for wildlife observers who want to experience somewhat different tropical island fauna. At Nag's Head, there are two important seabird rookeries which occupy the southwest promontory. Arendt (1985) found nesting Brown Pelicans and Magnificent Frigatebirds. Both species are important to local fishermen for locating schools of fish.

(3) Biocides. No information exists on the potential hazards of large amounts of biocides to wildlife populations in St. Kitts-Nevis. A long-term record-keeping capability should be developed by an appropriate GOSKN agency for recording pollutant impacts on wildlife by means of a simple database. Descriptive information, even if unconfirmed by site visits, would provide a perspective on the frequency and distribution of events. Members of NGOs in both St. Kitts and Nevis could be called upon to assist with monitoring and data collection. Other recommendations on this subject can be found in Section 6.3 of the Pollution Control chapter.

(4) Research. Natural resource data in St. Kitts-Nevis are very limited, including inadequate baseline data, which makes assessment of biological diversity very difficult. To maintain biodiversity in the face of increasing demands on wildlife habitat for development requires at least a semi-quantitative knowledge of what is needed to maintain species or communities. Again, for many of these research efforts, the assistance of local NGOs (as is already the case in Nevis) could be significant in collecting data and providing support for already over-burdened Government staffs.

For example, a status survey of the Agouti and of the St. Kitts race of the Puerto Rican Bullfinch should be undertaken to determine if these species have become extinct. The plant ecology of the elfin forest of Mt. Liamuiga should be studied because many more endemic plants and animals may be found. Groundwater hydrology and nutrient levels should be monitored as a means of ensuring the health of pond and reef systems.

As a result of local research efforts, educational programs for schools could be developed to promote interest in the island's wildlife.

(5) Legislation. The National Conservation and Environment Protection Act is quite comprehensive and adequate to achieve substantial objectives for the conservation and protection of natural and historical resources in St. Kitts and Nevis. However, what is critically required at this point is the preparation, enactment and enforcement of specific regulations which make the provisions of the law fully operational. Additionally, an amendment to the Act should be considered to require preparation of formal, standardized Environmental Impact Assessments for all major development projects (public or private sector), and such EIAs should assess the impact of proposed development on wildlife habitat.

(6) International Conventions. The Government of St. Kitts-Nevis should become a signatory of CITES.

2.4 COASTAL AND MARINE RESOURCES

2.4.1 Overview

ST. KITTS

PHYSICAL FEATURES

St. Kitts rests upon an 80 km x 16 km submarine ridge that it shares with Nevis and St. Eustatius. The coastal shelf is generally narrow but widens slightly along an axis passing through the Narrows between St. Kitts and Nevis. This underwater bank and its relationship to others nearby (especially Saba and Redonda) are shown in Figure 2.4(1). The portion of the coastal shelf within St. Kitts and Nevis territory has a total area of 595 sq km or about twice the total land area of the pair. Ocean currents set predominantly to the northwest (see Figure 2.4(2)), and Cambers (1983) presents further details on the close inshore current patterns of St. Kitts as evidenced by littoral drift vectors at nineteen coastal locations around the island (Figure 2.4(3)). Velocities, diurnal tide-current reversals, and island wake effect gyres and other anomalies have apparently never been studied, measured or mapped. Towle, *et. al.* (1986a) reports on transects and stations run by M. Goodwin as part of the Southeast Peninsula (SEP) access road environmental assessment report. Maximum currents *measured* off the SEP were less than 0.25 m/sec (0.5 kn). Wilcox (1989) provides useful descriptive updates and mapped benthic data for Peninsula waters on the Caribbean side.

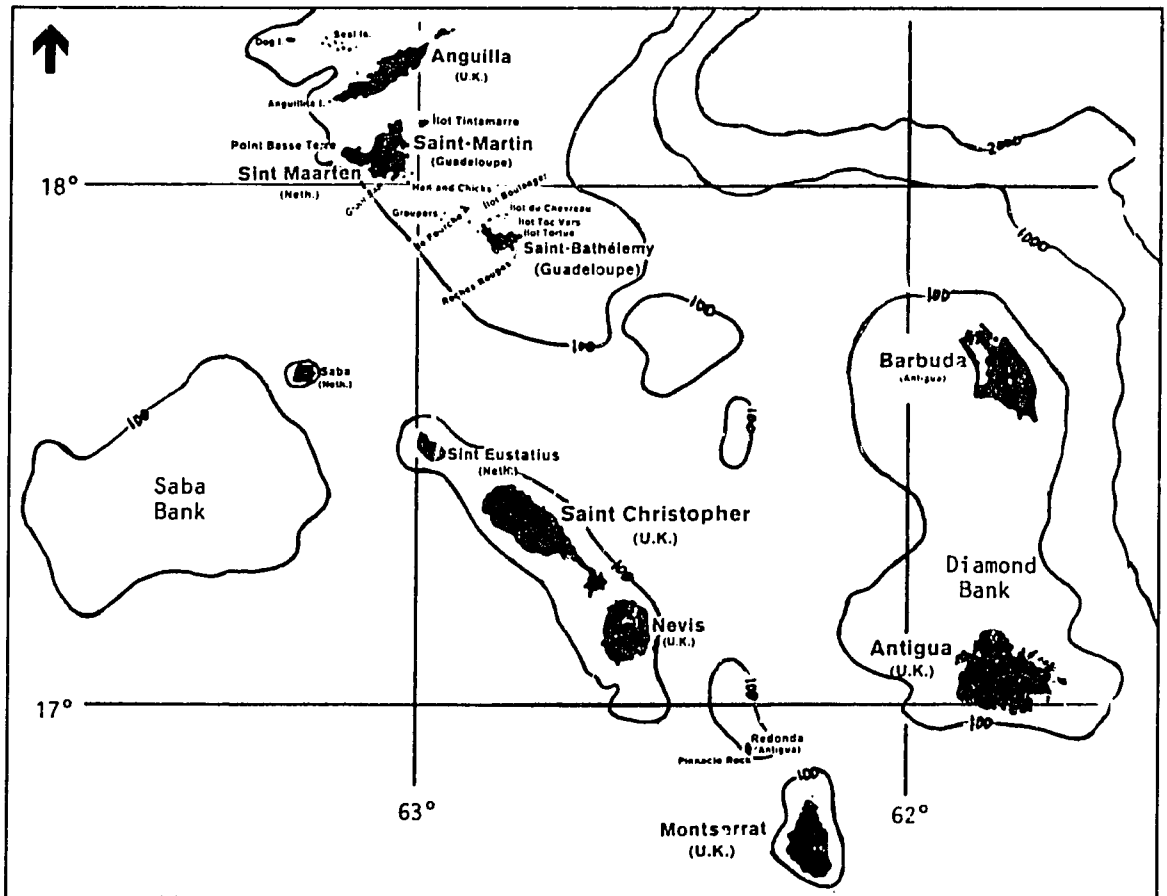


Figure 2.4(1). The St. Christopher-Nevis coastal shelf in relation to neighboring shelves (100 fathom isobath).

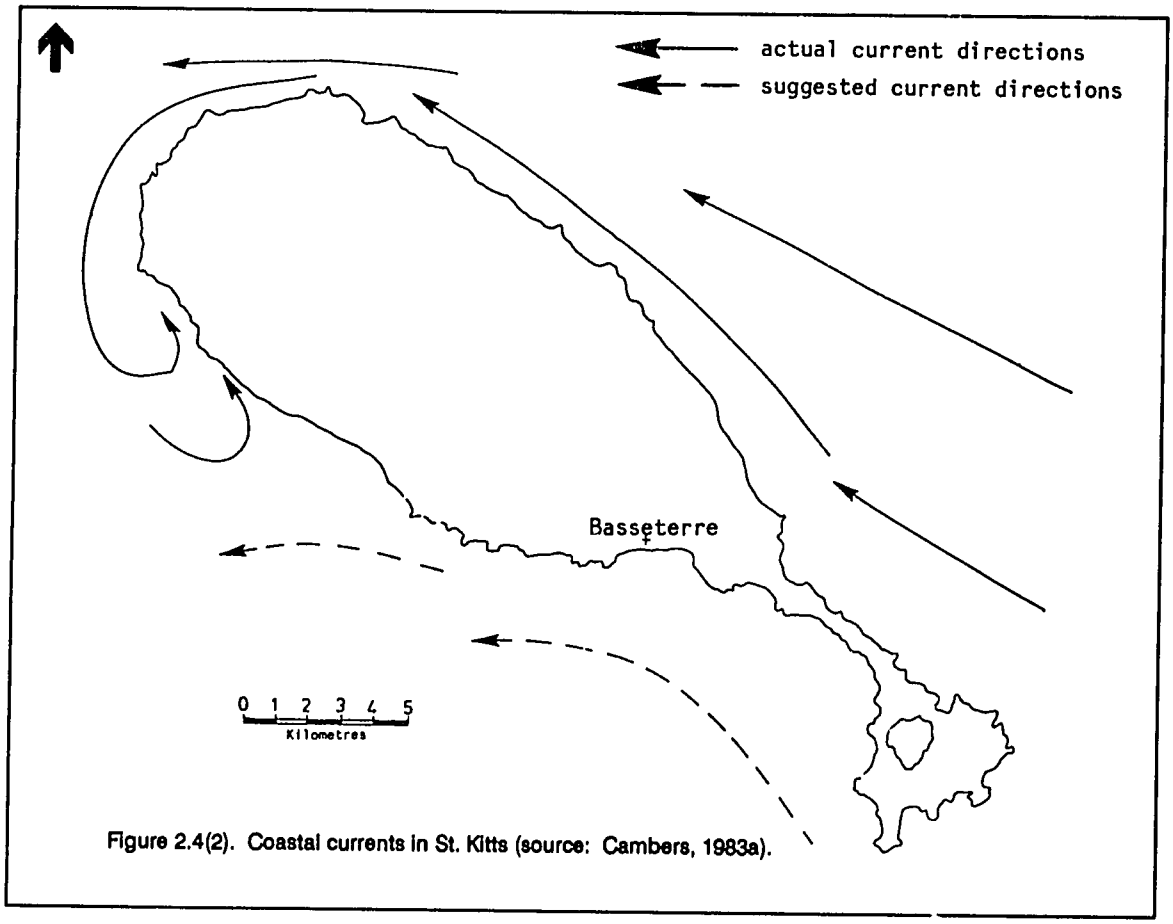


Figure 2.4(2). Coastal currents in St. Kitts (source: Cambers, 1983a).

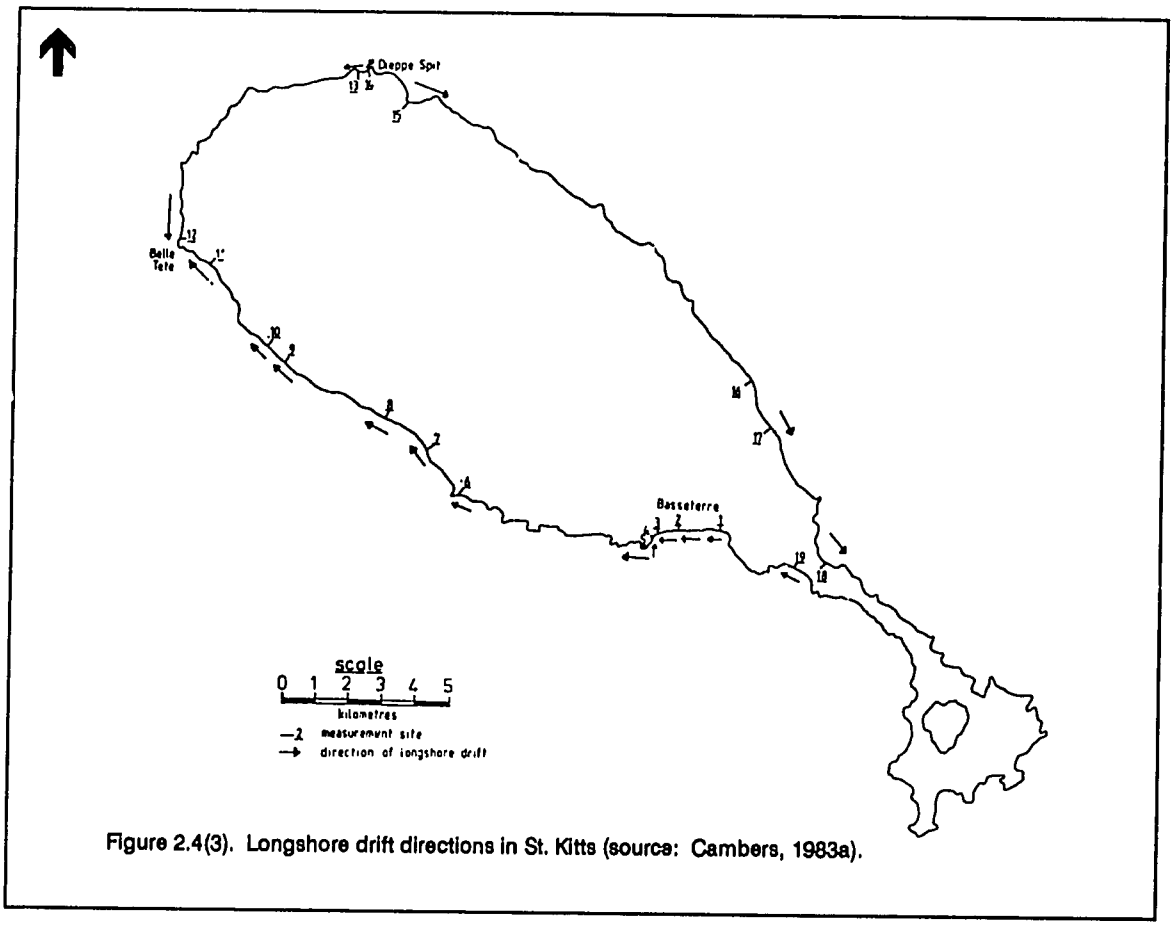


Figure 2.4(3). Longshore drift directions in St. Kitts (source: Cambers, 1983a).

Coralline and shell sand beaches occur at Frigate Bay, (South and North) and on the SEP at Friar's Bay, Canoe Bay, Turtle Bay, Sand Bank Bay, Mosquito Bay, Majors Bay, Cockleshell Bay, and Banana Bay. Beaches at Sandy Point, Dieppe Bay, and Conaree have mixed terrigenous and marine sand, while those in other locations consist of a variety of mostly volcanic material ranging from black sand to cobbles, rocks and boulders. Beach dynamics and geomorphology are addressed in Deane, *et al.* (Vol. III, 1973); Cambers (1983a); and Orme (1989). Upland areas are drained by ghauts (guts) that carry substantial quantities of coarse erosional sand to the coast (see Figure 2.4.(3)). Ghaut sand mining, and related coastal management issues, have recently been addressed in detail by Cambers (1988b) for OAS and the Government of St. Kitts-Nevis. (See also below discussion of the recent sand mining task force established to deal with the findings of the Cambers [1988b] study.)

CRITICAL HABITATS

Coral reef and seagrass habitats occur primarily along the southwest coast between Nag's Head and the southern end of Basseterre Bay, on the northwest coast between Sandy Point and Dieppe Bay, on the east coast between Conaree and Friar's Bay and on the southeast coast adjacent to the Narrows. Reef systems were recently reviewed by Wells (1988) in an IUCN/UNEP coral reef directory (see Figure 2.4(4)).

Most coral habitats are relatively small with less species diversity than is typical of similar habitats elsewhere in the Eastern Caribbean. Many of these reefs appear to have been significantly affected by sedimentation, but the time sequence and source of this stress remain undetermined. Deep reefs off Sandy Point and Guana Point, and in the Narrows (e.g., Monkey Shoal) are an exception, however, with species diversity and living cover typical of healthy Caribbean reefs. Seagrass communities are typically co-dominated by turtle grass (*Thalassia testudinum*) and manatee grass (*Syringodium filiforme*), often in combination with calcaereous algae. Major coral and seagrass habitats near the SEP are identified in Towle, *et al.* (1985), Towle, *et al.* (1986a) and Wilcox (1989). Similar surveys have not been conducted for the remainder of St. Kitts' coast, nor have the reef assessments or baseline surveys been done for most of the coastline.

Marine habitats in the vicinity of the SEP are likely to be more diverse and extensive because of lower sediment loading associated with a drier landscape and relatively undisturbed landscape. Conch and spiny lobsters are generally more abundant in the vicinity of the SEP than in other areas of the St. Kitts coast, and considerable reproductive activity in both species has been observed in the SEP area. Because prevailing currents tend to carry the larvae of these species to the northwest, spiny lobster and conch populations in this area may consequently be important to maintaining these stocks along the entire coast of St. Kitts. The DESFIL study team (Brown, 1989b) concludes that "... the marine environment of the Southeast Peninsula is the single most important commercial fishing and recreational diving area within the nation." It is reiterated, however, that except for the Southeast Peninsula area, the remainder of the coastline and shelf area of the country is unsurveyed and unevaluated.

Both coral reef and seagrass communities provide habitat for commercially important fish species, although these species have been severely depleted by intense nearshore trap fishing activity and coastal pollution. Spiny lobster and queen conch also depend upon both habitats at certain periods in their life cycles. Seagrasses in shallow water provide shelter for juveniles of both species. As lobsters mature, they gradually move into deeper waters where larger shelters are found in reef habitats. Adult conchs may remain in shallow water to graze the surface of seagrasses or may move onto sand or rubble plains in deeper water. Heavy fishing pressure has virtually eliminated adult conch from shallow water grassbeds. All coastal species, grasses, fish, lobsters, and conch may also be suffering from reduced populations as a consequence of declining coastal water quality caused by increased sediment loads, sewage, agrochemical run-off and industrial

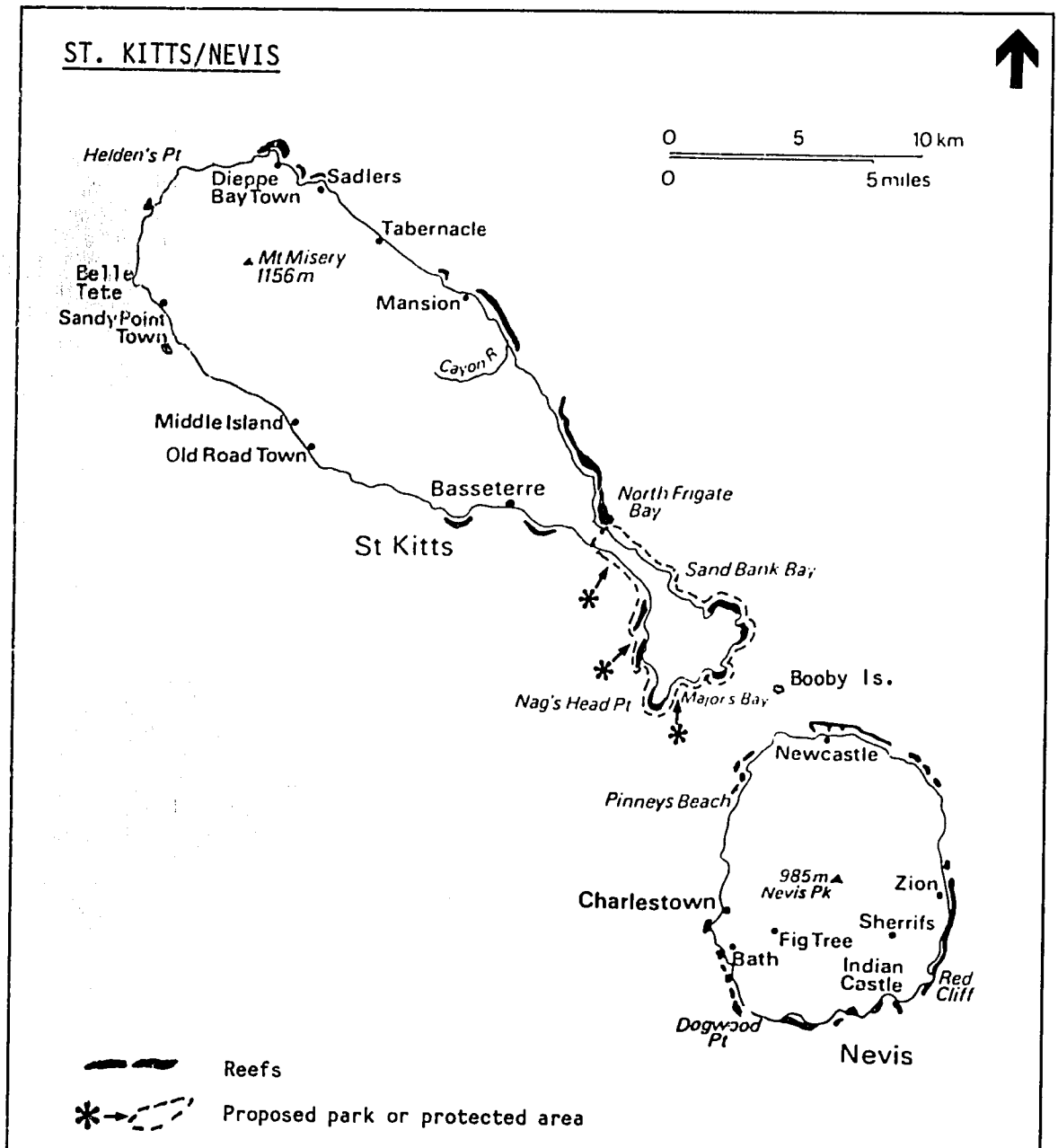


Figure 2.4(4). Important coral reef areas of St. Kitts-Nevis (adapted from Wells, 1988).

effluents, and other land-based sources of marine pollution (see also Section 6).

Mangroves are not abundant. The most extensive stand occurs in the vicinity of Greatheeds Pond and reportedly is "severely stressed by solid waste dumping and the operation of an aggregate block making plant (CIDE, 1988). Mangroves can also be found at Friar's Bay and at several other salt pond sites on the Southeast Peninsula.

MARINE WILDLIFE

Hawksbill (*Eretmochelys imbricata*) and green (*Chelonia mydas*) sea turtles forage and shelter in coral reef and seagrass habitats around the entire coast. These species, as well as the leatherback turtle (*Dermochelys coriacea*), also depend upon beaches for nesting. Loggerhead (*Caretta caretta*) turtles are occasionally seen but are not typical of the area. The latter species is considered vulnerable; the rest are endangered. Eckert (1989)

reports that beaches on the Atlantic coast of the SEP appear to be most important as nesting sites, while coral and seagrass habitats on the Caribbean coast are the most significant forage sites. (See Section 2.3 on Wildlife for more information on sea turtles, also Figure 2.3(1).)

Bottlenose dolphins (*Tursiops truncatus*) and several other unidentified cetacean species are commonly seen around the entire coast. Humpback whales (*Megaptera novaeangliae*) are occasionally reported in the vicinity of the Narrows, primarily during winter months.

Norton (1989) and Towle, *et al.* (1986a) list 16 sea- and shorebirds seen in the vicinity of the SEP. Of these, two -- the brown pelican (*Pelecanus occidentalias*) and roseate tern (*Sterna dougallii*) -- are considered threatened, and three -- magnificent frigatebird (*Fregata magnificens*), least tern (*Sterna antillarum*), and willet (*Catoptrophorus semipalmatus*) -- are species of concern. Salt ponds on the SEP, and in other parts of St. Kitts, are critical habitats for many resident and migratory bird species (see also Section 2.3 of the Profile).

FISHERIES

The fisheries sector of St. Kitts has been reviewed by Vidaeus (1970), Dalhousie Ocean Studies Program (1983), Olsen (1984), Anderson, *et al.* (1985), Goodwin, *et al.* (1985), and Barrett, *et al.* (1988). Annual landings are reported to be on the order of 420 metric tons per year, but adequate data have not been collected to verify this estimate. The majority of the catch consists of demersal fishes captured with hand lines or Antillean Z-traps. Small schooling pelagic fishes are harvested with seines operated from beaches or offshore from boats carrying a four- to five-man crew. Larger pelagic species are harvested seasonally by hand lines. Spiny lobsters (*Panulirus argus*) are fished primarily by traps, occasionally supplemented by scuba diving. Queen conch (*Strombus gigas*) are captured by diving, most frequently with scuba equipment. Increased fishing effort targeted toward spiny lobster and conch in recent years has severely depleted stocks to the extent that Basseterre fishermen travel as far as Dieppe Bay and the Statia Channel area to secure a reasonable catch.

Most of the 179 vessel fishing fleet (GOSKN, 1987a), of which about 100 are active, consists mostly of carvel-planked, open wooden boats less than five m long, powered by outboard engines. Twelve landing sites are distributed around the non-peninsula portion of St. Kitts. New Town, Irish Town, Old Road, Sandy Point, and Dieppe Bay are considered to be the major sites and account for 67 percent of the total fleet (see Figure 2.4(5)).

The majority of fishermen are part-time, and to minimize time spent at sea as well as reduce cost and risk, they tend to concentrate their efforts in nearshore areas. As a result, traditional fishing sites (primarily reef areas) are severely overfished. The seasonal occurrence of migratory pelagic fishes in St. Kitts waters coincides with the operational season of the sugar industry. Therefore, part-time fishermen who work in the sugar industry are unable to take advantage of pelagic stocks that are generally considered to offer the only significant opportunity for increased harvest.

COASTAL RESOURCE MANAGEMENT AND DEVELOPMENT

Coastal resource development activities have been directed toward maritime transportation, fisheries and sand mining, or are related to tourism. During the 1970's the shipping terminal in Basseterre Bay for the sugar factory was expanded to include a deepwater port facility that now has a 400 foot pier with an associated Ro-Ro facility and secure storage area for containerized cargo. Planning for a substantial expansion effort is currently underway, but neither the present port nor the proposed extension has a management plan for the disposal of solid waste or toxic materials. The present on-site trash pile at the rear of the port property has outlived its usefulness and lacks any aesthetic appeal as regards visiting cruise ship passengers. Usage in 1989 was on the order of 600 vessels carrying general cargo and 198 cruise ships (36,000

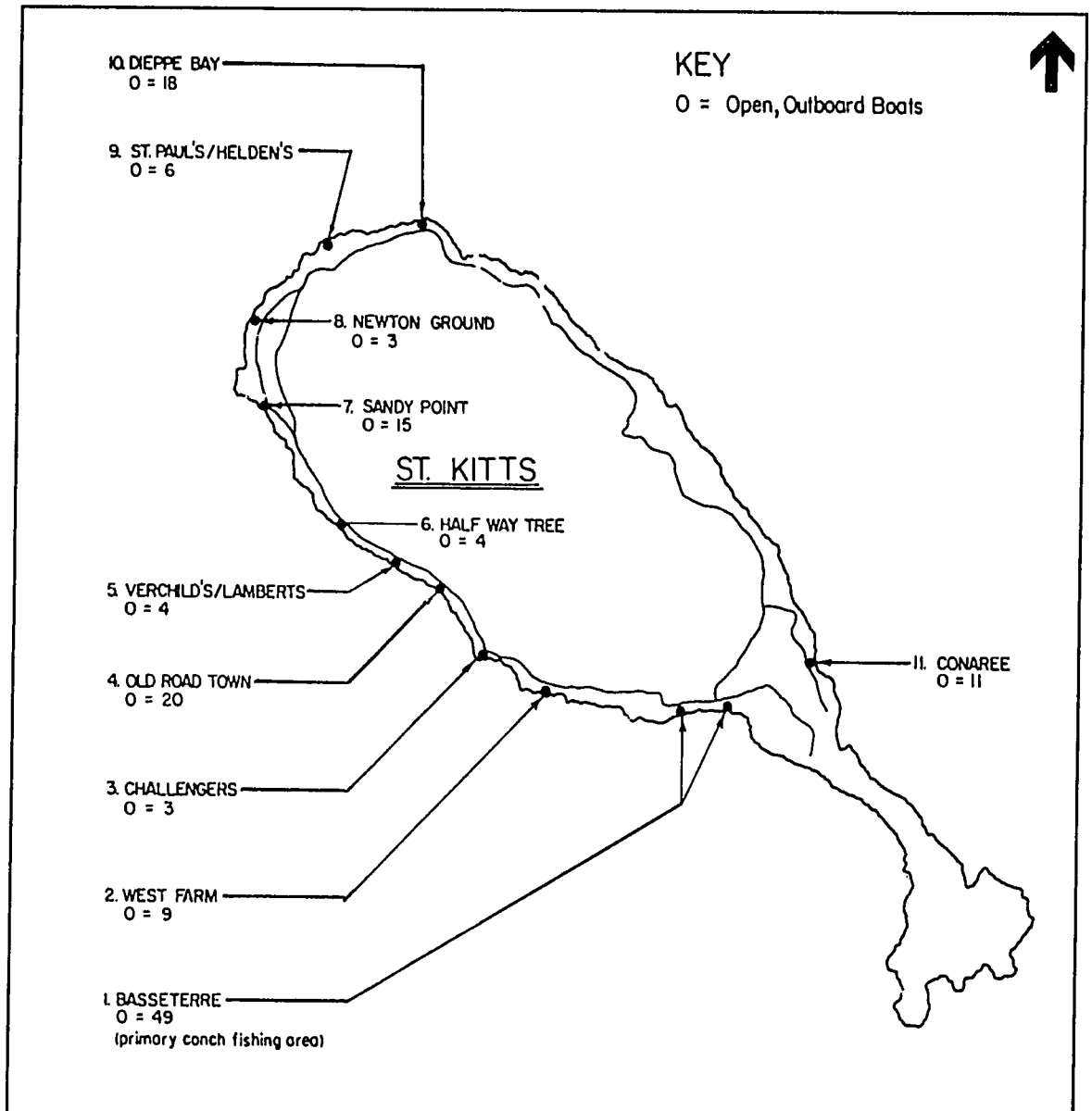


Figure 2.4(5). Fish landing areas in St. Kitts (source: Mahon and Rosenberg, 1988).

passengers). Throughput tonnage for the port for 1989 was 167,000 tons of which 52,000 was containerized, and only 35,000 tons were exports (of which 20,000 tons were sugar).

The major fishery development proposal in recent years focuses heavily upon funding shore-based infrastructure, including gear shelters, cold storage, ice and marketing, and boat and engine maintenance facilities. Fewer resources are targeted toward improving the efficiency and capabilities of the fishing fleet, although a demonstration project to introduce an improved fishing vessel and alternative gear was started as a joint effort between Government and the St. Kitts-Nevis Foundation for National Development. Fisheries Division staff with some external technical assistance have conducted a variety of management-oriented projects (Goodwin, *et al.*, 1984; Goodwin, 1986; Goodwin, *et al.*, 1986; Wilkins, *et al.*, 1986; Wilkins, *et al.*, 1987; and Wilkins and Goodwin, 1989). However, much more formal emphasis is placed on harvesting and marketing than on fisheries

production and improvement of the resource base.

Significant coastal development related to tourism began with the establishment of the Frigate Bay Development Corporation in 1972 (see also Section 4, Tourism). Construction of hotels, a golf course, and service facilities in this area have taken place without comprehensive guidelines for coastal resource management. Consequently, while considerable attention has been directed toward development of this 850 acre area, there has not been an equivalent effort to control the reported periodic discharge of sewage into the Frigate Bay pond system; the use of nearby dune, berm and beach sand for construction; the wholesale removal of dune vegetation; tourist spear fishing in nearshore reefs; or the application of various chemicals to the golf course; nor has the impact of such activities been monitored. In effect, the role and input of coastal resources to the Frigate Bay project remain unevaluated and have been taken for granted.

Considerable effort has been directed toward environmental management issues associated with development of the Southeast Peninsula (SEP), primarily with support and impetus from the U.S. Agency for International Development. The Southeast Peninsula Land Development and Conservation Board, created by statute in 1986, has been augmented by a variety of technical consultancies that have produced extensive natural resource planning documents (e.g., Towle, *et al.*, 1986a and 1986b; Brown, 1989; Orme, 1989; Morris, 1989). These reports reflect substantial effort to accommodate the need to protect and enhance the natural resource base while engaged in economic development. In many cases, innovative approaches are suggested that would avoid much of the degradation and provide compensatory measures for the unavoidable damage or losses previously associated with such development. Some of the proposed tasks and activities include the following:

- implementation of fisheries and beach management regulations;
- establishment of a national marine park reserve around a major portion of the Peninsula (proposed boundaries vary);
- careful regulation of marina development with full EIAs required;
- funding for fisheries research and education;
- development of guidelines to integrate marina and boating activities with use patterns of artisanal fishermen;
- protection of sea turtles, rookeries, salt ponds;
- establishment of construction waste disposal sites;
- establishment of wastewater treatment facilities;
- regulations for permissible housing and hotel unit densities, linked to available wastewater treatment facilities;
- requirement for project drainage systems to contain run-off at project sites;
- establishment of a 100 m setback from mean high water for all major buildings.

Many of these recommendations could be applied to the entire coastal zone of St. Kitts, but at the present time there is no constituency or specific branch of Government taking the lead in dealing with the issue. This was not always the case. In early 1987 the Planning Unit sought and obtained the support of the OECS Natural Resource Management Project (now called a "Unit") to plan and implement a new, experimental coastal resource management program for the country. The project document laid out a ten part agenda with a focus on getting the newly established Conservation Commission on stream, on solving the sand mining problem,

on setting criteria for project evaluation, and on putting an environmental impact assessment framework in place. The Planning Unit was to have direct responsibility for the project. A very creative planning workshop was held in Nevis in July (OECS, 1987), and by January of 1988 a formal, very impressive and very detailed four year "Plan of Operations for the Coastal Resources Management Project" was published and circulated by the OECS-NRMP office (OECS, 1988a). Unfortunately, the project was deferred despite the fact that the forward looking National Conservation and Environment Protection Act (NCEPA) mandates the preparation of a coastal zone management plan to regulate developmental activities. What is, in retrospect, most perplexing is that the OECS-NRMP effort was to have assisted with the planning and drafting of the regulations needed for implementation of the NCEPA. Despite these delays, the basic work plan for the OECS project is still sound and warrants reactivation.

SAND RESOURCES AND SAND MINING

For purposes of domestic recreation and tourism development, coastal or beach sand is an important amenity when it is in the proper place -- namely, *on the beach*. But sand is worth up to EC$50 per cubic yard in some Eastern Caribbean islands *off the beach* and is therefore also the basis of a local sand mining industry (i.e., as a harvestable commodity for sale locally and regionally). At the same time, as a vital input for concrete, sand is important to the construction industry, in the building of roads, and for use by the do-it-yourself housebuilder. Finally, sand is very important *en masse*, *in situ*, and *au naturelle* to coastal landowners as a barrier against storm waves and for preventing excessive run-up, overwash and inland flooding. A quiet beach can absorb a lot of repetitious, pounding storm wave energy that would otherwise cause serious damage.

The supply of construction sand has been a nagging problem for a long time in St. Kitts. The lower slopes of the island, used heavily for cane cultivation, are drained by a series of streams which cut deep ravine-like channels into the soft volcanic ash deposits. These normally dry ghauts, as they are called locally, are mined at the lower end for sand which, of course, reduces the supply of sand reaching the beaches in the coastal zone.

Streambed sand is normally preferred for block-making and for mixed concrete, and the unregulated, "free" supply of this sand has enabled St. Kitts to export building blocks to adjacent islands. Beach sand, however, is the preferred sand locally for plastering, waterproofing and stucco work, and in some cases is more accessible to the small user. The linkage between continuous sand removal from both the ghauts and the beach-dune systems and a continuing and worsening problem of erosion in both locations has not escaped the attention of both policy makers and environmental scientists. Documentation by a coastal engineer from the University of the West Indies in Trinidad, (Deane, *et al.*, 1973) was followed by a more intensive review by Cambers (1983a) and then a further, even more detailed study on the ghaut sand resource problem in 1988, also by Cambers, whose work was in this latter instance supported by the OAS (Cambers, 1988b). Erosion-prone sites investigated by Cambers prior to the 1983 report are presented in Figure 2.4(3) and listed in Table 2.4(1), which also shows the shoreline losses observed between 1968 and 1983.

The Cambers (1988b) report recommendations, as they related to preferred ghaut sand mining locations, are shown in Figure 2.4(6). The report additionally suggested that " . . . future supplies of fine [beach] sand should be obtained from Belle Tete and Sir Timothy Hill dunes." Site supervision and a fee of EC$20 per load, the same as for ghaut sand, were also recommended.

In early 1989, Camber's findings and suggested management options were taken up for study by a specially appointed Cabinet committee chaired by the Director of Planning. The report of the task force on sand mining was completed and submitted on 13 September, 1989. It has not yet been released but appears to have been favorably received. Perhaps the two decade old problem of unregulated, excessive indiscriminate sand

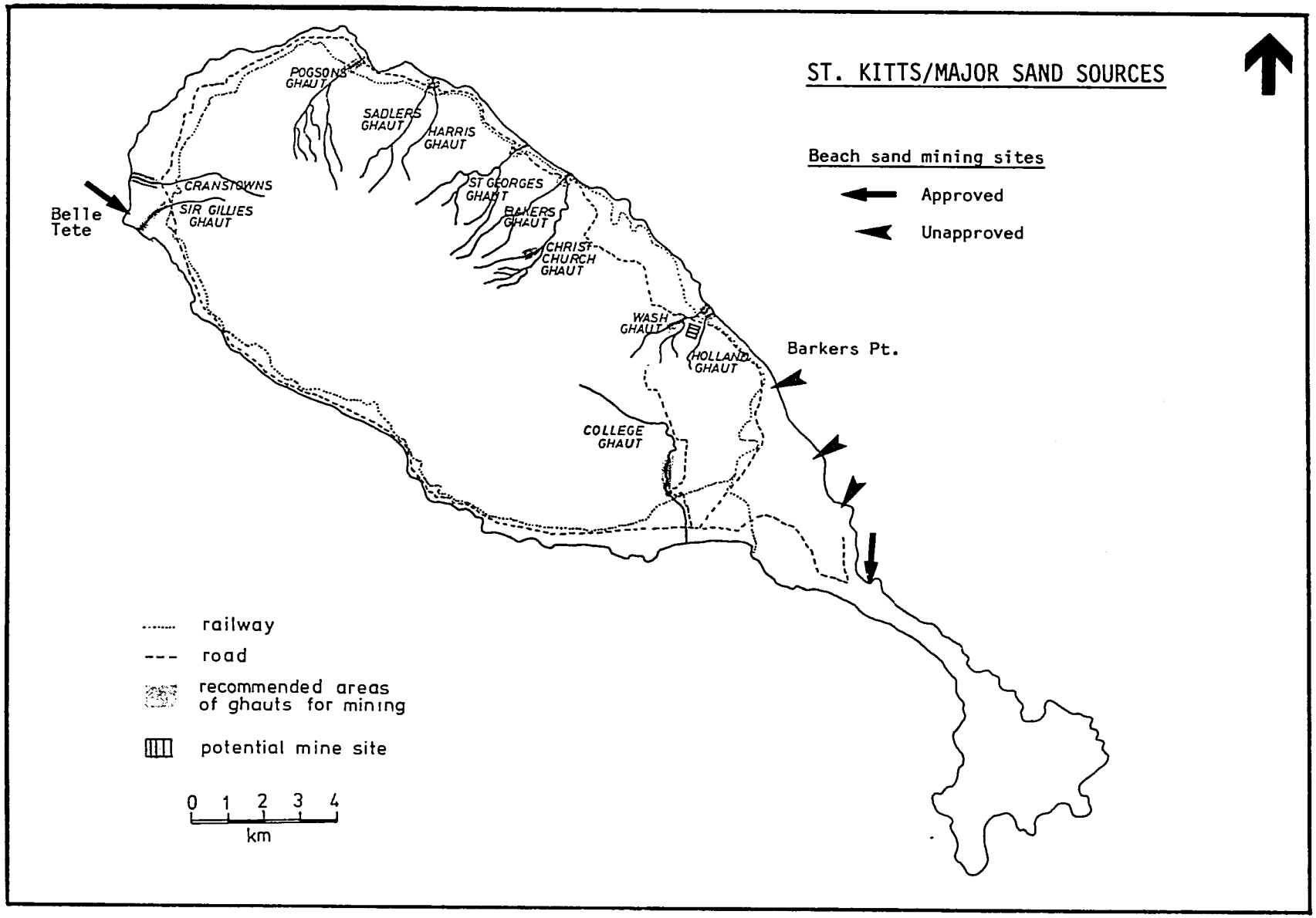


Figure 2.4(6). Major sand sources in St. Kitts (source: Cambers, 1988b).

Table 2.4(1). St. Kitts coastal erosion and wave data: 1968 to 1983 (see also Figure 2.4(3)).

SITE NO.	SITE NAME	EROSION 1968 - 1983	WAVE PERIOD (sec.)	WAVE LENGTH (m)	WAVE DIRECTION (°)
1	Basseterre Bay East	- 7 m	6.2	60.0	203
2	Basseterre Bay Central	- 2 m	8.0	99.8	172
3	Basseterre Bay West	- 10 m	6.4	63.9	136
4	Ocean Terrace Inn	+ 8 m (artificial)	4.4	30.2	108
5	Fort Thomas	NM	NM	NM	NM
6	Challengers	NM	6.5	65.9	157
7	Old Road Bay	0	6.6	68.0	218
8	Verchilds	- 10 m	4.8	35.9	183
9	Half Way Tree	- 6 m	6.2	60.0	212
10	South of Brimstone Hill	- 6 m	6.0	56.2	214
11	Pump Bay	- 15 m	6.5	65.9	208
11A	South of Belle Tete	- 20 m			
12	Belle Tete	NM	8.8	120.8	338
13	Dieppe Bay West	0	10.0	156.0	108
14	Dieppe Bay Spit	- 14 m	10.0	156.0	308
15	Sandy Bay	+ 10 m	7.6	90.1	052
16	Barkers Point	NM	5.9	54.3	075
17	Conaree	- 3 m	5.5	47.2	077
18	Frigate Bay N	NM	5.0	39.0	067
19	Frigate Bay S	NM	6.0	56.2	198

NM = No Measurement
Source: Cambers, 1983a.

mining in St. Kitts' coastal zone is close to resolution in a way that protects both the environment and the industries dependent on a regular supply of sand for whatever purpose.

LEGISLATION

Several pieces of legislation relate to and have an impact on the use, management, and development of coastal and marine resources in St. Kitts-Nevis.

(1) The Building Ordinance (No. 42, 1978) provides for regulations concerning construction, siting, layout, design, drainage, and sanitation that could be used to regulate sewage and run-off pollution from land-based sources.

(2) Beach Control Ordinance (Chapter 281, 1961) vested in the Crown all rights in or over the foreshore, sea floor, and adjacent land for a distance of 50 yards beyond the landward limit of the foreshore or high water mark. The ordinance was repealed by the National Conservation and Environment Protection Act of 1987, but since regulations have not been enacted relative to the 1987 legislation, there is some uncertainly about the control and managment of these resources at the present time.

(3) The Maritime Areas Act (No. 3, 1984) establishes the low water mark as a baseline for defining the territorial sea, contiguous zone, and the exclusive economic zone or EEZ (12, 24, and 200 nautical miles seaward of the baseline, respectively). The Act also provides for regulations to control sanitation and pollution and to protect and preserve the marine environment.

(4) The Fisheries Act (No. 4, 1984) requires the Chief Fisheries Officer to prepare a plan for the development and management of fisheries; it provides for the establishment of a fisheries advisory committee, for the licensing of foreign and domestic fishing vessels and fish processing establishments, for regional cooperation, for the designation of local fisheries management areas and of organizations representing local fishermen as Local Fisheries Management Authorities, for the leasing of land, foreshore, and sea bed for aquaculture, and for the declaration of marine reserves; it also authorizes fisheries research, prohibits the use of explosives or chemicals for fishing, and designates authorized persons for enforcement.

(5) The Southeast Peninsula Land Development and Conservation Act (1986) established the Southeast Peninsula Land Development and Conservation Board to prepare, evaluate, and monitor development schemes for the Peninsula and to prepare a management plan and proposals dealing with land use, transport facilities, preservation of resources, recreation, tourism, waste disposal, power plants, living resources, human settlements, agriculture, industry, coastal conservation, and any other developmental matter specified by the Minister (of Development).

The National Conservation and Environment Protection Act (No. 5, 1987) -- with respect to the marine and coastal environment -- provides for the establishment of protected areas, requires preparation of management plans for protected areas by a designated Conservation Commission, establishes public right to access and recreational use of all beaches, requires the preparation and implementation of a coastal zone management plan to regulate development activities in the coastal zone, prohibits unauthorized sand mining and removal of beach vegetation, and prohibits waste disposal within the coastal zone. The Conservation Commission, established as the administrative agent under the Act, has only recently begun its deliberations, and implementation of this importation legislation awaits enactment of accompanying rules and regulations.

NEVIS

PHYSICAL FEATURES

Shoreline features of Nevis include a reasonable balance of sandy beaches, fresh water lagoons, rocky shores and massive sea cliffs, but the island lacks a good natural harbor (see Figure 2.4(7)). The most prominent sandy beach is a 4 km section of the coastline that stretches north from Charlestown to Cades Bay, called Pinneys Beach. It is composed of both coral fragments and terrestrial soils which gives it a yellow appearance and is typical of a number of beaches found along the leeward coast (west and north sections) of the island. South of Charlestown there is a black sand beach at Gallows Bay formed from volcanic materials. Beaches like this one are more likely to be found on the windward coasts of Nevis and are generally less extensive.

Another feature associated with the leeward coastline of Nevis is its system of fresh water lagoons. These may be the result of either mountain ravine run-off, as is the case for the Pinneys Estate lagoons, or underground springs as evidenced at Nelson Springs in Cotton Ground. Some lagoons may "flush" their contents into the ocean on a regular

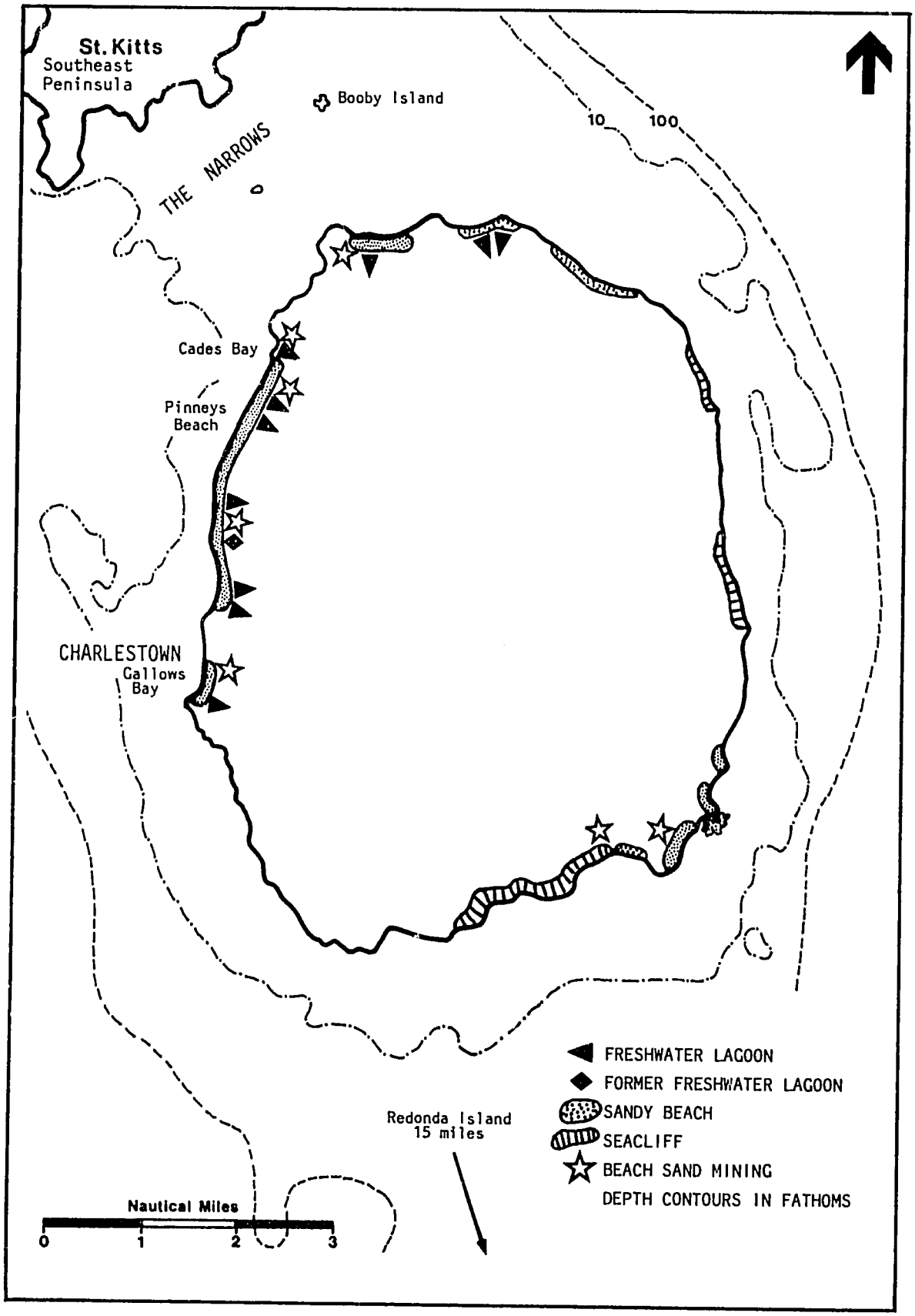


Figure 2.4(7). Coastal features of Nevis.

basis like the Bath Bog lagoon system, while others appear to remain in a relatively stagnant condition until major rain storms occur. Some will also receive periodic input of salt water which results in the development of a brackish zone.

Rocky shores are often associated with an impressive array of marine life from algae and snails to juvenile fishes of all description. Sea cliffs will result where strong wave energy undercuts rock ledge and erodes soil from agglomerate and unconsolidated rock. These rugged habitats can be found on the southern and eastern coasts of Nevis.

Offshore marine features of Nevis include extensive seagrass beds and patches of well developed coral reefs (see Figure 2.4(4)). The coastal shelf is relatively large and extends northwest across "The Narrows" to the Southeast Peninsula of St. Kitts and southeast toward the island of Redonda, some 15 miles away. The north equatorial current strikes Nevis from the southeast (see Figure 2.4(8)) and produces secondary currents which collide in the Fort Charles area along the west coast of Nevis. These currents and the longshore drift will determine to some extent the patterns of sand deposition on beaches as well as the transport of any material discarded into the sea.

COASTAL HABITATS

Three coastal habitats -- freshwater lagoons, coral reefs, and seagrass beds -- are of critical importance to the nearshore tropical marine ecosystems of Nevis. There are many direct and indirect links between the productivity of these habitats and the health of inshore fisheries. All of these linked ecosystems are presently being stressed by a variety

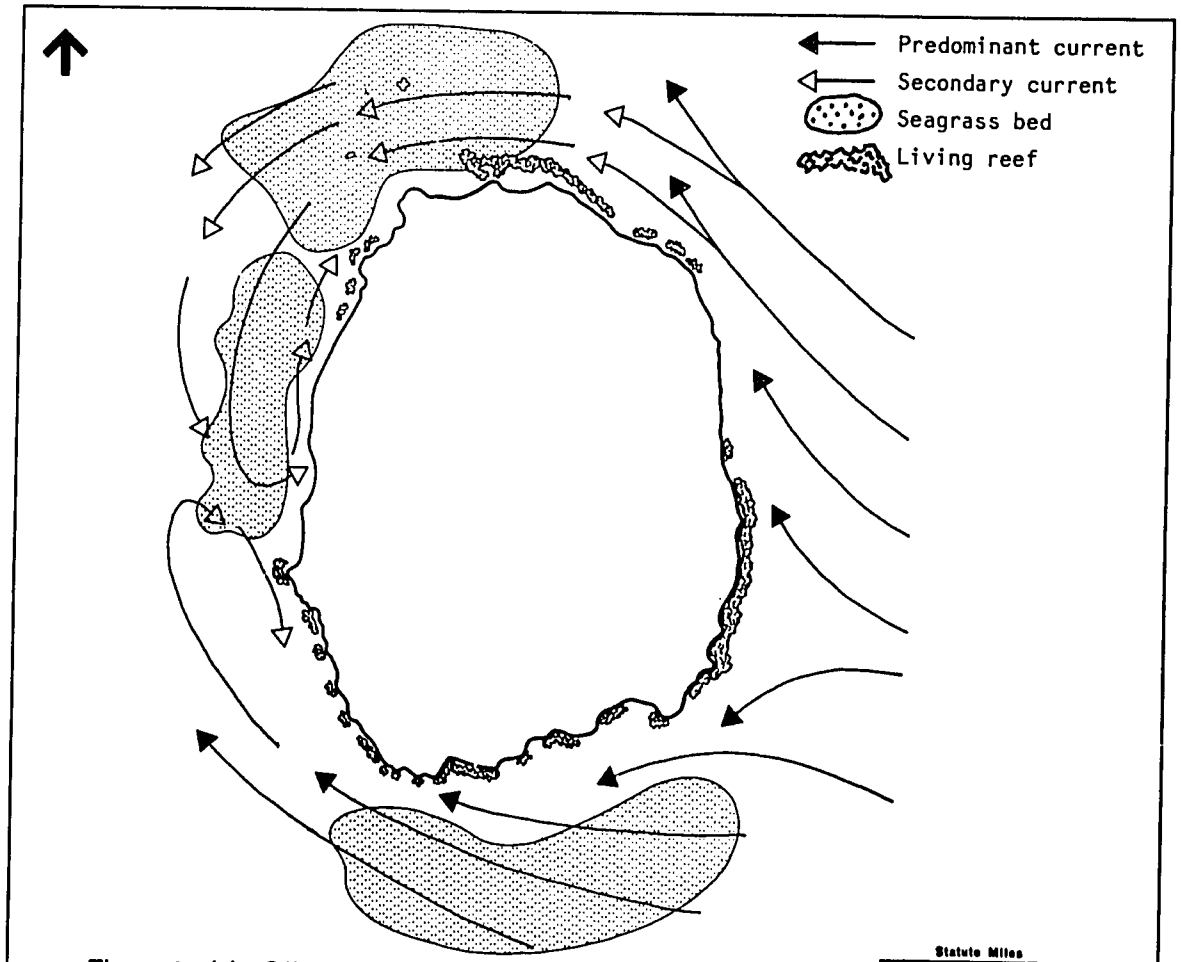


Figure 2.4(8). Offshore marine features of Nevis.

of externalities. Excessive sediments and agrochemicals in run-off waters can alter food chains and reduce water quality. The draining and filling of coastal lagoons may upset the flow of nutrients from the terrestrial ecosystem into the adjacent coral reef and seagrass system. Landfill of lagoonal habitats may eliminate important nursery areas for fishes, crustaceans and avian species.

FISHERIES

Fishing is to Nevis what agriculture is to St. Kitts, and Nevisian fishermen continue to work the coastal shelf around Nevis and the Southeast Peninsula of St. Kitts (see Figure 2.4(9)) in much the same manner as they have been doing for centuries. The use of bottom traps or "pots" is the most common method of fishing (see Table 2.4(2)) reported by Nevisians. Other techniques include hand lining, beach seinings, Ballahoo netting, trammel netting for turtles, occasional trolling for migratory species and SCUBA diving for lobster and conch. At the present time on Nevis, there are an estimated 350 full- and part-time fishermen operating about 100 boats averaging 3 or 4 trips per week. Charlestown fishermen tend to go out to sea on a daily basis, while those from Jessups average three to four days per week and Gingerland fishermen as few as two times a week. The Nevis Fishermen's Marketing and Supply Co-operative Society lists 190 members for 1990 which is a substantial number for an island the size of Nevis.

Although there is no precise method to document fish harvest, some estimates for total annual catch (Table 2.4(3)) and export records (Table 2.4(4)) are available. Local

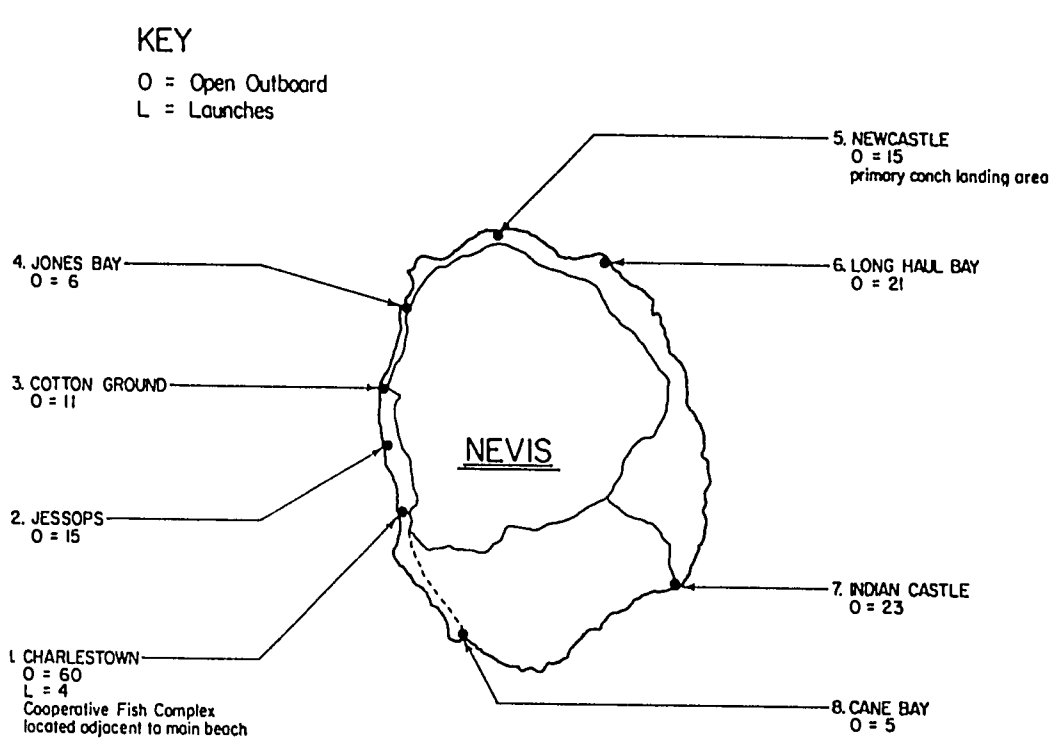


Figure 2.4(9). Fish landing areas in Nevis (source: Mahon and Rosenberg, 1988).

Table 2.4 (2). Fishing methods for Nevis and St. Kitts by percentage use.

	POT FISHING	HAND LINE	DIVING	NET	OTHER
NEVIS	70.5	20.8	6.0	1.3	1.4
ST. KITTS	20.1	59.1	14.1	4.6	2.1

Source: GOSKN, 1987a.

Table 2.4(3). Total annual fish catch estimates for Nevis in metric tonnes (mt).

Year	Fish	Lobster	Conch	Other
1984	455.4	16.8	70.9	2.3
1987	176.1	49.1	143.6	10.0

NOTES:
(1) The annual totals for 1987 are projected from reports of weekly catch in pounds.
(2) "Other" category includes turtle, sea moss, whelk and other marine species for the 1987 data, but turtle only for the 1984 information.

Source: Information for 1984 from Goodwin, et al., 1985 and for 1987 from GOSKN, 1987a.

Table 2.4(4). Fish export records for Nevis (in pounds).

Year	Fish	Lobster	Conch
1987	14,508	11,858	161,935
1989	19,921	7,843	182,066

Source: Data obtained from GOSKN documents prepared by the Nevis Department of Agriculture in its yearly reviews.

consumption on Nevis greatly exceeds export levels with the possible exception of conch. In spite of the reasonably large coastal shelf around Nevis and St. Kitts, it is generally acknowledged that nearshore fishing grounds are overexploited, particularly on the Leeward side. Using lobster as an example, data provided by Ansyln in a 1982 report to the Caribbean Conservation Association indicated that 24,000 lbs of lobster were exported from Nevis in 1974 but that only 18,000 lbs were exported in 1979. Data for the 1980's shown in Table 2.4.(4) continue to reflect a decline in exports, but, in the absence of actual landing data and local sales figures, it is unclear whether or not lower exports reflect reduced stocks or increased local demand by restaurants and hotels. What is apparent, however, is the absence of conch from most of the nearshore seagrass beds, and this exploitation is noted in the Goodwin, *et al.* (1985) fisheries sector assessment for selected Caribbean islands, including St. Kitts and Nevis. When local fishermen report that they must travel greater distances from shore, dive in deeper water, spend more hours fishing and still land smaller catches, it is obvious that local stocks are being severely depleted. As tourism increases in Nevis, there will be an even greater demand for "luxury" species such as lobster, conch, parrotfish and snappers. (See also Figure 2.4(10).)

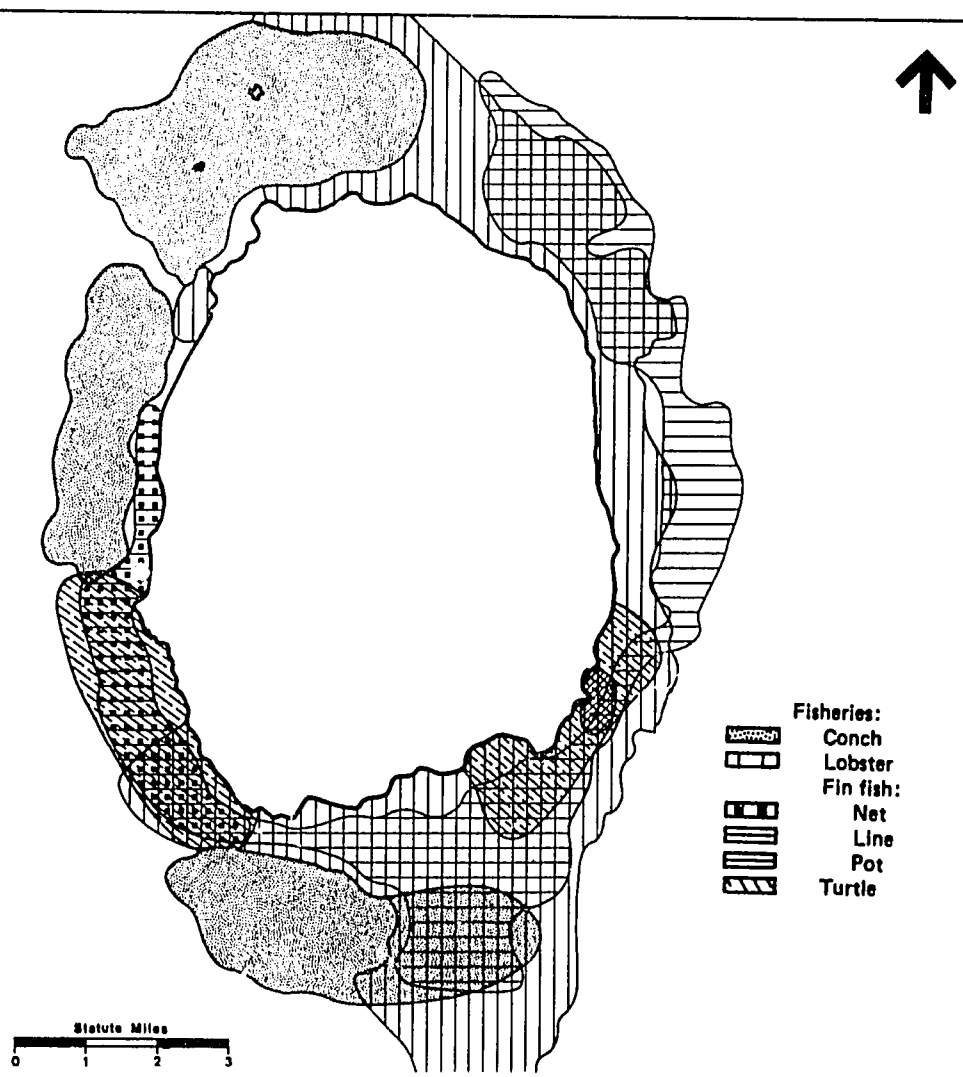


Figure 2.4(10). Principal Nevis fishing areas (adapted from ECNAMP, 1980a).

2.4.2 Problems and Issues

THE DILEMMA OF PLANNING AND GROWTH MANAGEMENT

The coastlines of St. Kitts and Nevis are suffering from the same growth and development problems as the other OECS countries -- namely, overfishing, erosion, damaged habitats like mangroves, freshwater lagoons and salt ponds, deteriorating coastal water quality, excessive dredging or mining of coastal sand, excessive waste and trash from recreational users, lost or almost lost critical species, and, lastly (and perhaps most importantly), the continuous loss of experienced, young professionals from the very same coastal zone who are needed to plan, monitor, manage and protect the coastal environments which are at risk. The central problem is one of leadership linked to a perception failure. Environmental scientists and environmental protagonists and coastal zone specialists of all stripes have failed to be convincing, persuasive, or effective in their specific and general arguments regarding the benefits of or risks to coastal/marine environments. The coastal zone has too many believers and not enough defenders and certainly not enough publicists. As a result, too few community leaders and very few political leaders perceive the losses or the problems within the coastal zone as serious.

Even in those cases when an issue is brought to the forefront of the political agenda, Governments of the Eastern Caribbean confront a monumental staffing problem in dealing effectively with issues which cannot be solved in the short-run. Alternative solutions are needed, and the application of imagination, risk-taking, and ingenuity *can* lead to environmentally-sound solutions for meeting development requirements.

Most coastal zone problems in St. Kitts-Nevis have been well-documented for some time, e.g., overfishing or coastal erosion exacerbated by sand mining. Fisheries laws have been in existence for many years protecting breeding activities of spiny lobsters and sea turtles. Development strategies to reduce overexploitation and improve the economic performance of the fishing industry have been repeatedly suggested by numerous consultants. Recommendations for offshore marina development (Orme, 1989c) and appropriate sewage disposal on the SEP through constructed wetlands (Morris, 1989) are indicative of the availability of technically-sound approaches to development requirements that are also sensitive to natural resource management needs.

Nevertheless, the longer-term management goals of the environmentalist/planner are too often summarily dismissed as being incompatible with private sector and governmental development objectives. It is noteworthy that the National Conservation and Environment Protection Act is administered by the Minister of Development. It could be expected that this merging of responsibilities will result in a more significant integration of development efforts with natural resource management activities. It could, on the other hand, reduce Government's commitment to resource management and conservation activities if these are perceived to be antagonistic to economic progress. Usually good leadership can help demarcate a zone of compromise.

Much of the resource management planning that has taken place in recent years has been driven by external development assistance agencies. Although many civil servants are concerned and dedicated to the principle of environmental management, there does not appear to be a clearly articulated and supported policy for comprehensive coastal resource management in St. Kitts-Nevis as a whole, despite the lessons to be learned from extensive attention to planning for the Southeast Peninsula.

St. Kitts-Nevis is in the enviable position of being able to consider many coastal resource management problems as "potentials" and consequently has the opportunity to avoid many of the adverse impacts that have attended poorly managed development in other areas. Comprehensive coastal zone management planning can provide a mechanism or framework for addressing the issues discussed in the following sub-sections and for avoiding future resource degradation while achieving

economic development; but such planning is of little use without commitment to implementation.

WATER QUALITY AND HABITAT LOSS

Major water pollution issues are discussed in Section 6 of the Profile. Primary concerns in the coastal zone in St. Kitts are focused (1) on a few sites where observable degradation has occurred (e.g., Basseterre Bay due to sugar factory waste and domestically-derived liquid effluents; the Sandy Point-Old Road area due to solid waste disposal on shore) and (2) on potential impacts from construction and increased activity on the Southeast Peninsula. The potential impact of SEP construction on water quality is primarily increased sediment loading due to land clearing and accelerated run-off. On the coast of the SEP, this impact is apt to be coupled with increased bacterial and nutrient loading from sewage produced by hotels and pleasure boats. In Nevis, a source of concern is the release of periodic lubricating oil by the municipal electrical plant into a drainage canal that flows directly into the Bath Bog wetland (see also Section 6.2 of the CEP Pollution chapter).

Another area of concern in Nevis is the loss of freshwater lagoons. Wetlands are often regarded as wastelands by developers, areas to be drained, dredged or filled. The freshwater lagoons of Nevis are a unique and valuable natural resource with a high biological value as well as excellent economic potential through ecotourism development. Already one lagoon, located in Clark's Estate, has been eliminated with the construction of a resort hotel. Two others are threatened with the development plan currently proposed for Pinneys Estate (Young and Scully, 1990). Such habitat losses may be unnecessary, for it is often possible through good project design to protect the integrity of the wetland drainage basin, proceed with development of adjacent land, and even incorporate features of freshwater lagoons within tourism development projects as a "natural area" which can be a most effective tourist attraction.

MANAGEMENT OF PHYSICAL RESOURCES

St. Kitts. Cambers (1988b) describes a plan to provide much of the sand needed for construction through management of ghauts. Only a five-year supply of the beach and dune sand traditionally used for plastering and waterproofing was estimated to be available from sources that would not compromise beach and dune conservation. Dunes at Belle Tete and Frigate Bay were subsequently recommended as a sand source; regulations should restrict mining to areas behind the seaward dune and be carefully supervised.

None of the ghauts recommended for mining are on the SEP, however, where almost 40 percent of the estimated demand for sand in St. Kitts will be concentrated. These circumstances will generate considerable temptation to use the more accessible sand dunes on the SEP for construction in that area (note, however, that Towle, *et al.* [1986b] state that dunes at Sand Bank Bay could be used as a source of construction sand). Cambers also notes that previous efforts to control illegal sand mining were thwarted by an unwillingness to prosecute offenders; protection of beach resources in the face of anticipated development will require more substantial commitment by GOSKN.

Nevis. Results from beaches surveyed every three months since August 1988, show that sections experiencing serious erosion problems are Gallows Bay, Pinneys Beach, Mosquito Bay and the north coast of the island (Cambers, 1988a). Data exist for one site at Pinneys Beach which indicate that between 1983 and 1989, the high water mark retreated inland 19 meters which represents an erosion rate of three meters per year (Cambers, 1989).

Sand dunes also play an important part in maintaining a stable beach system. Conservation practices should include vegetation which stabilizes the dune and reduces sand losses due to wind erosion. The physical removal of strand vegetation should be avoided by beachfront developers, and if public access through vegetated areas is essential, it is best done on raised wooden walk-ways.

MANAGEMENT OF LIVING MARINE RESOURCES

A variety of development and management strategies have been proposed for specific fishery resources, but plans for comprehensive management of living marine resources are lacking. Wilcox (1989a) recommends establishing a marine park/reserve around the entire perimeter of the SEP and defines broad objectives for such a reserve. But there is little guidance for the implementation of specific management activities needed to achieve these objectives or to how they can be practically integrated with other development activities and fiscal realities. A more fundamental problem is that successful functioning of the park/reserve is not explicitly linked with sound management in other portions of the coastal zone; yet water quality and habitat availability in adjacent areas will have direct impact within the proposed reserve boundaries.

The need for a comprehensive approach to managing living resources will become increasingly acute as these same resources are subjected to more diverse uses throughout the country. Nearshore habitats offer opportunities for economic, recreational, and aesthetic benefits to artisanal fishermen, sport fishermen, snorkelers and scuba divers; but each group uses the resources in different ways. Conflicts have already been observed between seine fishermen and visiting yachts in the Southeast Peninsula of St. Kitts -- at Majors Bay, White House Bay, Ballast Bay, and Shitern Bay. Wilcox and Walters (1989) report interference with trap fishing activities by sport divers in the vicinity of Sandy Point and describe probable conflicts with fishermen that might result from marina construction on the SEP.

A comprehensive marine resource management strategy, for both St. Kitts and Nevis, is needed to address problems of overexploitation, use allocation, and protection of endangered species.

2.4.3 Policy Recommendations

(1) CZM Program. A comprehensive coastal zone management program should be implemented to provide overall guidance for specific development and management activities. The National Conservation and Environment Protection Act of 1987 calls for the preparation and implementation of a coastal zone management plan "to regulate developmental activities in [the] coastal zone and to make necessary Regulations." The National Conservation Commission needs to give early attention to this legislative requirement, perhaps with the assistance of OECS/NRMP.

Oversight authority for a CZM program should reside in one agency, although responsibility for specific components may have to be an inter-departmental undertaking. Particular emphasis should be placed on formalizing a requirement for the preparation of Environmental Impact Assessments for all major development activities in the coastal zone.

The components of a St. Kitts-Nevis CZM program should include consideration of strategies which address, among others, the following issues: water quality for multiple uses (i.e., fisheries habitat, human contact, and waste disposal); coordinated management of the country's wetlands; port development; increased recreational opportunities; and coordinated and broad-based participation in coastal resource management. The emphasis should not be on regulation alone, as experience suggests that a program emphasizing education, incentives, technical assistance, cost-sharing, and cooperation will be more effective than a proliferation of rules and penalties. Major elements of this type of program include development of a system characterization (inventories), priority problem definition, action plans, and financial strategy.

(2) Constituency Building. A dedicated effort should be undertaken to build a constituency for coastal resource management that can improve the political feasibility of implementing Fishery Regulations and the National Conservation and Environment Protection Act. The focus should be on how to get

the most from available opportunities, how to accommodate the desired mix of uses while avoiding the negative impacts of resource degradation, and how to improve access by Kittitians/Nevisians to various resource use opportunities.

Key elements of a constituency-building program are:

- Experienced staff skilled in public communications, with adequate time and resources to operate the program;

- At least one communications tool to explain the general program, typically a slide show, although consideration could be given to the most appropriate tool for the general public in St. Kitts-Nevis;

- Means for regularly communicating with the public, usually a newsletter, through neighborhood meetings, radio programs, etc.;

- A mechanism through which concerned and interested individuals can regularly participate in some aspects of CZ management, such as beach clean-up days, family field trips, or cultural shows.

- A formally acknowledged role for the program, which could best be accomplished under provisions of the NCEPA.

(3) Coastal Zone Infrastructure. Provision should be made for essential infrastructure (especially sewage and solid waste management) in advance of major development in the coastal zone. This should be presented to development assistance agencies as a matter of top priority that is critical to the well-being of Kittitians/Nevisians as well as to the development of a viable tourist industry. At least partial recovery of capital costs could be achieved through user fees, especially for new developments that place high demands on such services.

(4) Sand Mining. Recommendations which have been made to control and regulate sand extraction activities in the state should be fully implemented. Areas which are designated to be set aside for no further sand mining activities should be closely monitored so that resource degradation does not worsen and these areas are allowed to recover. The two areas from which sand can be legally extracted in St. Kitts -- Belle Tete and the dunes at Timothy Hill -- should likewise be monitored and controlled. A program similar to that being put in place for St. Kitts needs to be reviewed by the Nevis Island Administration.

Once the principle of a *regulated* sand mining program, with an accompanying fee system, has been put in place and accepted, the present fee schedule should be modified to reflect actual volume removed, i.e., payment on the basis of cubic yardage, thus more effectively applying the "user pays" principle for the use of a common property resource. In general, sand pricing by Government should move toward a market price, as opposed to a subsidized price, in part so that the sand monitoring program can pay its own way and is not a further drain on the public treasury.

(5) Pollution Control. The extent of sediment loading and runoff-borne, non-point source pollution should be assessed. Steps need to be taken to control upland erosion and sources of sediment loading (such as construction sites) which impact on the marine environment. Consideration should be given to implementing best management practices as developed to deal with these problems in other areas.

(6) Fisheries recommendations. Because individual fishery stocks are relatively limited, fisheries development activities should concentrate upon supplying domestic seafood demands and providing a variety of options for local fishermen (e.g., demersal fishing, pelagic fishing, aquaculture). Fishery stocks and habitats should be managed for multiple use, with all major user groups participating in the management process. Fish aggregating devices, for example, could be used as a low-cost means for improving efficiency of the artisanal pelagic fishery as well as to provide opportunities for sportfishing.

Artificial habitats have promise for improving artisanal fishery yields as well as for reducing fishing pressure on natural reefs, thereby improving the recreational experience for sport divers.

(7) EIA Requirement. As already indicated in Recommendation No. 1 above, an Environmental Impact Assessment -- as part of a more general planning and land use optimization process -- should be required for all large coastal development projects. The cumulative effects of such projects need to be assessed rather than a case-by-case analysis of each project in semi-isolation. One option might be to strengthen the Physical Planning Unit and designate it as the GOSKN lead agency responsible for impact assessment in the country. In any event, a standard EIA evaluation process should be established, under guidelines to be developed by the National Conservation Commission, and should include an opportunity for input in review and evaluation procedures by other GOSKN agencies.

(8) Coastal Set-backs. Consideration of a coastal setback requirement of at least 50 to 100 m for development activities should be reviewed by the Conservation Commission. The setback requirement needs to be appropriate to the geophysical features of individual sites and to risk factors present. Removal of beach dune vegetation should be prohibited, and revegetation of beaches cleared in the past should be accelerated to stabilize beaches at risk.

(9) Harmonization of Development Objectives and Resource Management Priorities. Development policy should emphasize activities that achieve development objectives as well as address resource management needs and issues. An excellent example is found in the case of the proposed creation of one or more marinas on the Southeast Peninsula by dredging salt ponds. Such ponds typically serve as settling basins that prevent runoff-borne sediment from reaching nearshore habitats (particularly seagrass beds and coral reefs). Marina construction, it has been feared, would reduce this function, and the consequent sediment load derived from run-off would be exacerbated by that resulting from dredging. The consequent deterioration of nearshore habitats would adversely impact local fishermen as well as recreational divers.

Orme (1989c) concludes that Little Salt Pond offers the best potential site for onshore marina development as it provides the requisite protected space and could be developed with minimal impact to other nearby salt ponds, beaches, reef habitats, and fisheries. Majors Bay ranks as a second choice but is considerably less desirable because of more difficult seaward access, the likelihood of congestion if other development plans are carried out, the need for extensive engineering to prevent offshore pollution, and the probability of significant adverse impacts on nearshore resources. Previously proposed marina construction at Cockleshell Bay and South Friar's Bay would entail serious problems and few advantages.

Orme's report offers an innovative alternative to all these sites in the form of an "offshore" marina formed by a 200 - 300 m breakwater at White House Bay. Perhaps the most significant advantage of this approach is that it would avoid dredging and associated impacts on adjacent marine resources (in this connection, it should be remembered that marinas in salt ponds are likely to require periodic maintenance dredging to remove runoff-borne sediment, and impacts are more likely to be chronic than of a single event character). Water quality within the type of marina proposed by Orme would be much easier to maintain because of improved circulation. The breakwater, in fact, could be designed to provide supplemental habitat for marine species useful to tourism (e.g., reef fishes of interest to snorkelers) as well as commercial fishermen (e.g., spiny lobsters).

Structured environmental education activities in St. Kitts and Nevis are of relatively recent origin and have been spearheaded primarily by environmental NGOs. Pictured are participants in a recent village-level environmental competition in Nevis.

SECTION 3 AGRICULTURE

3.1 OVERVIEW

ST. KITTS

HISTORICAL CONTEXT

For over 300 years sugar cane has been grown intensively on the deep volcanic soils of St. Kitts. Cane was first introduced prior to the arrival of English settlers by native Carib Indians. The first reference to its planting was 1639, and the industry was well established by 1659 (BWI Sugar Assoc., 1961). The continuing dialogue with sugar production makes St. Kitts unique among its island neighbors, not only by virtue of its landscape dominated by rich fields of cane, but by the impact which sugar has had on the island's society. In spite of a changing economy, which now includes an expanding tourism sector, and even with the need to further diversify agriculture (which already includes livestock, tree crops, root crops and legumes), sugar is likely to remain a significant part of St. Kitts for many years to come.

Agriculture has been the economic mainstay of St. Kitts since the very first settlers cleared small patches of land for subsistence crops in 1623. Tobacco, cotton and ginger were important export crops during the first half of the century, but the politics of empire-building saw these crops give way to sugar by the second half of that century. In 1678 one local planter, Christopher Jeaffreson, wrote that the conversations of the day ". . . turned on the ruling price of sugar [and] the damage done by the last hurricane . . . " (Jeaffreson, 1878). To a degree, the comment still applies to Kittitian society three centuries later. The patterns of agricultural settlement may have changed, but sugar cane has been grown in St. Kitts continuously since that time.

St. Kitts was an important colony during the seventeenth century, in part because settlement was rapid; once the indigenous Indians were eliminated (see Section 1.1), the island quickly became both productive and profitable. A map of the island was published in England in 1660 based on an actual survey by one Andrew Norwood, Surveyor General. Most of the holdings, while numerous, were small and settlement extended into the dry peninsula of the southeast (see Figure 3.1(1)). Not long after this, when sugar and plantation style agriculture were introduced, the pattern of agricultural settlement began to change, as can be seen in the sequence of maps also shown in Figure 3.1(1).

The following century was a period of social and economic stability and brought with it the full development of sugar plantation agriculture to St. Kitts, with the "estate" emerging as the primary production unit (Merrill, 1958). The out-migration of small farmers and land owners continued unabated as small farmers and small farm units were slowly forced out or consolidated into the estate system. In 1716 the island governor wrote, " . . . what has weakened these Islands most has chiefly been occasioned by rich men buying out the poor of their little settlements and by this means they have been in time driven off the Islands" (Pitman, 1917). By the end of the century, windmills had replaced cattle mills, nearly every estate sported a "great house," field and domestic laborers and many tradesmen were African slaves, and everywhere sugar was king.

However, by the beginning of the nineteenth century, competition from other colonies and social pressure to end the slave trade resulted in a long and slow decline in the sugar industry. The process was accelerated by first Mauritius (in 1825) and then British India being given access to the British market for sugar on an equal footing with the British West Indian islands. This was a devastating turn of events for Caribbean producers, who had simultaneously enjoyed a protected market for sugar and free trade with the United States in plantation stores and food, including salt fish. As Britain moved further toward a free trade position, the price

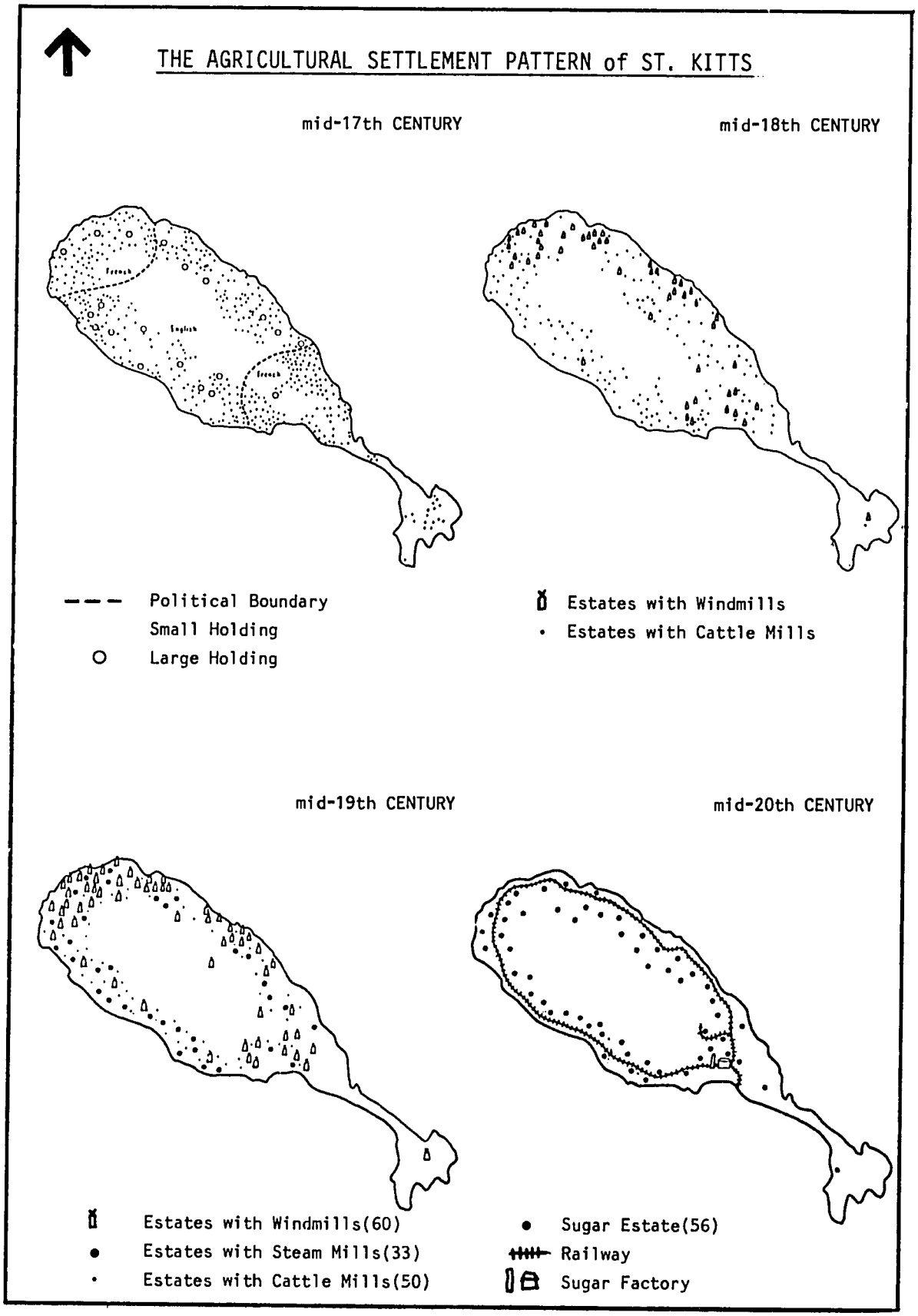


Figure 3.1(1). Agricultural settlement patterns of St. Kitts in the mid-17th, mid-18th, mid-19th, and mid-20th centuries (source: Merrill, 1958).

of sugar slowly came down, to the dismay of West Indian planters and land owners.

By the end of the century, in 1897, a Royal Commission recommended that in order to increase efficiency and to compete with lowered world prices, the processing of cane, previously done at each individual estate which produced only unrefined "muscovado" sugar, should be consolidated at a central sugar-processing facility. After rather extended debate which consumed the better part of the succeeding fourteen years, a new modern sugar factory was built in the Basseterre Valley east of Taylor's Range in 1911 and was brought into operation by 1912. Its effects were immediate, and within just eight years the last individual estate mill had ceased operation. A new era had begun.

The estate system continued, however, but with some continuing amalgamation. When a British civil servant named Cater passed through St. Kitts in 1943 investigating forestry issues, he reported finding 66 large estates encompassing 32,500 acres, which, he said " . . . generally run from the sea to the main ridge of the mountains." The mountainous forest land was " . . . privately owned and managed as part of the agricultural estates" (Cater, 1944). But between 1944 and 1965 the number of estates would drop to 42, and a steady decline in both world sugar prices and productivity and an increase in labor costs would ultimately result in Government takeover and acquisition of all sugar estates in 1974. The industry is now run as the St. Kitts Sugar Manufacturing Corporation (SSMC), a Government-owned entity.

Other crops were grown in the plantation system along with sugar. Sea Island cotton was introduced from the Carolinas in North America in 1905, and by 1920 2,000 acres were in cotton production in St. Kitts. Vegetables and root crops have been grown since colonial times on a subsistence level on marginal land and on small patches of higher ground above fields of sugar cane. Cater (1944) reports 200 to 300 acres of coconuts existed during the 1940's. Just a year following Carter's survey trip in 1943, the Government established a dairy farm at Bayfords; and livestock, including sheep, had long been associated with the Southeast Peninsula, Vambelle and other locations in St. Kitts.

By 1987 one source estimated that non-sugar extensive farming use accounted for about 4,800 acres (USAID, 1987). Of this amount, perhaps 2,000 acres were used for food crop production, mainly short-term cash crops (annuals) in pure stands and intercropped with perishables. The remainder was used for livestock (including four large cattle farms ranging from 100 to 500 acres), with considerable acreage in fallow or temporarily abandoned fields not yet gone to scrub. There were, in 1986, an estimated 900 full- and part-time farmers utilizing from 0.5 to 5 acres each for non-cane endeavors (USAID, 1987).

But all this activity took place within the context of vast, productive sugar cane fields that continued to dominate the landscape. Over the 300 year period since the introduction of cane in St. Kitts, no crop has had as much impact or generated as much revenue or employed as many people or shaped a society so extensively as has sugar cane. In spite of the less than promising economic picture for sugar at the present time, it remains the paramount agricultural crop in St. Kitts.

CURRENT SITUATION

Sugar production peaked in the 1950's to a level of over 50,000 long tons per annum, from a total of 14,000 acres, with an additional 2,000 acres under cultivation (Kelly, 1990). Following severe damage by Hurricane Hugo in 1989 and as a result of labor shortages which continue to plague the industry, an all-time low of about 15,000 long tons was harvested in 1990 (see Table 3.1(1)).

According to Kelly (1990), 70 percent of sugar crop land is on middle and upper slopes exceeding 10 percent grade. In spite of the sloping land, soils have been conserved, and cane yields have averaged 32 tons per acre over a four decade period. Kelly (1990) predicts that with increased mechanization the production of sugar cane will continue well into the twenty-first century with an area under cane of 10,000 acres, from which 8,500 acres will be reaped annually.

Table 3.1(1). Performance of the sugar industry, 1960-1990.

Year	Acres Reaped	Tons Cane Ground	Tons 96° Sugar (TS) Produced	TC:TS	Avg Tons Cane/ Acre	Avg Tons Sugar/ Acre
1955	14,214	401,921	49,356	8.14	8.28	3.47
1960	13,830	432,900	50,179	8.63	31.30	3.59
1970	9,700	325,679	27,163	11.99	33.56	2.80
1980	10,445	351,543	34,748	10.12	34.18	3.33
1981	10,027	337,515	32,357	10.43	33.66	3.23
1982	9,948	349,599	35,955	9.72	35.14	3.61
1983	10,159	276,207	27,762	9.95	27.19	2.73
1984	10,359	298,315	30,954	9.64	28.91	3.00
1985	10,157	263,098	26,893	9.79	25.90	2.65
1986	9,654	260,367	28,491	9.14	26.96	2.95
1987	8,213	258,659	25,256	10.24	31.49	3.07
1988	7,862	270,825	25,531	10.61	34.45	3.25
1989	8,905	252,296	24,767	10.18	28.20	2.74
1990	8,200	-	15,178	-	-	-

Source: SSMC data.

Agricultural Diversification. One of the most noteworthy early attempts at implementing an agricultural diversification policy took place in St. Kitts in the 1970's, as a joint strategy of the Department of Agriculture, the Sugar Industry Rescue Operation (SIRO), and its successor body, the National Agricultural Corporation (NACO). Indeed, when Government acquired the island's sugar lands in the early 1970's, a component of this strategy was to integrate non-sugar production into agricultural planning. Efforts at diversification at this time included: significant gains in peanut production, 50 acres of white potato production (using two locally-tested white potato varieties), a 50 acre fruit orchard at Wingfield (citrus, mango, avocado), a 20 acre stand of coffee at Molineux Estate, 25 acres in pineapple production, and 20 acres of bananas at Wingfield (pers. commun., K. Martin, former Chief Agricultural Officer, 1990).

More recently, according to the Director of Agriculture, Archibald (1989), "The world market price for sugar fell dramatically some years ago due to competition from other types of sugars, including beet sugar, and the development of sweeteners such as high fructose corn syrup . . . with the result that the sugar industry is now heavily dependent on the quotas in the preferential markets provided by the United States of America and the European Economic Community." As a result of this difficult economic situation faced by the sugar industry, Government has formally adopted a new policy of agricultural diversification. This policy is outlined in the National Development Plan, (1986-1990) as follows:

(1) to increase food production in order to improve the nutritional status of the community;

(2) to increase net foreign exchange earnings through agricultural production for import substitution and export;

(3) to generate employment opportunities and increase income; and

(4) to increase food reserves, thereby improving local capability to cope with disaster emergency.

Implementation strategies associated with program objectives include:

(a) a land distribution initiative, with long-term lease arrangements to help solve the long-standing land use and land tenure impasse;

(b) a spread of programs to expand vegetable and root crops, including irrigation;

(c) tree crop and agro-forestry programs;

(d) livestock, fisheries, soil conservation, forestry and watershed management programs, and a package of marketing incentives.

Additional components include provision of credit, extension services, institutional strengthening, training and technical assistance. About 100 farms, with a total size of almost 1,100 acres, have been proposed, including tree and arable crop settlements, sheep, goat, and beef operations, small dairy farms, a communal pasture, and one large forage farm. The total cost of the St. Kitts (and Nevis) Agricultural Diversification Program is estimated at US$15.2 million. It is projected that 1,848 farmers and fishermen will benefit from the diversification program (Petty, 1989).

This is by no means the entire picture, for the Ministry of Agriculture seems to be well aware of the fact that the diversification process has too much promise as a risk-spreading strategy to see it restricted to just agricultural production. Therefore, a parallel diversification process is underway *within* the sugar industry itself, and new methods are being identified to use old products, namely, cane juice and molasses.. A new rum distillery has been constructed, adjacent to the sugar factory, by the Rothschild Group of France, which converts sugar cane juice, rather than fermented molasses, directly into a high quality rum called "CSR" (Cane Spirit Rothschild) for export and for direct sale within the local tourism industry. (There are some problems associated with distillery waste discharges which are discussed in Section 6 on Pollution Control.) Separately, a new processing plant has been constructed just east of the airport near Conaree to produce gelled (canned) alcohol from molasses. A scheme has been proposed to convert its organic wastes into a bio-fertilizer. In this latter case, there is some continuing skepticism about the viability of the waste recycling scheme and some concern about adverse environmental impacts of other possible waste discharges.

The real focus, however, of the diversification strategy is on developing a rational solution to a difficult dilemma resulting from two known factors. First, the Government owns most of the desirable agricultural land (largely in, or formerly in, cane); secondly, there were, according to the 1987 Agricultural Census, about 3,000 small farms in St. Kitts, most of them less than three acres and only two percent larger than five acres. The problem is how to " . . . enable farmers to develop larger farms and expand food production significantly, especially to meet the increasing demand for food by an expanding tourism industry" (Archibald, 1989). This matter is complicated by a clear Government preference to not sell its land and therefore a GOSKN reliance upon traditional lease arrangements. But the impact of insecure tenure arrangements on small leaseholders may inhibit their incentive to make improvements to the land base which could reduce erosion and enhance soil fertility, drainage, and long-term productivity. The environment is consequently adversely affected. One way around this problem is to employ longer-term leases which the Government, after some serious, site-specific, land use planning, is apparently about to do.

Regardless of some constraints associated with agricultural policy, there are indications that the effort to increase the supply of locally-produced vegetables within the diversification effort is meeting with some success. An initial objective under the diversification

program is to achieve continuous vegetable production to meet domestic demand for the first six months of each year. Thomas (1989) points out that production has been highly dependent on a few commercial farmers, possibly a result of the unavailability of land with secure tenure and the dependence on rainfall for irrigation.

The vegetables selected to have potential for import substitution include: carrots, cabbage, onions, white potatoes, sweet peppers, and tomatoes. Cucumbers, pumpkins and watermelons are also potentially within the domestic supply category (see Tables 3.1(l) and 3.1(2)). In spite of early success in growing vegetables, "the present system of

Table 3.1(2). Vegetables imported with potential for local production (lbs.)

	1982	1983	1984
Carrots	73,320	64,980	76,697
Cabbages	121,000	122,580	118,255
Onions	414,000	426,850	545,332
White Potatoes	854,000	880,620	975,692
Sweet Peppers	13,290	10,850	13,651
Tomatoes	80,650	87,740	85,803

Source: Thomas, 1989.

Table 3.1(3). Estimated vegetable production needed to meet domestic demand.

	MONTHLY NEEDED (in lbs)	AREA NEEDED (ac/mo.)	TOTAL (ac/yr)
Carrots	12,000	1.20	14.4
Cabbages	15,000	1.25	15.0
Cucumbers	10,000	0.07	8.4
Onions	46,000	4.60	27.6
White Potatoes	83,000	8.30	49.8
Pumpkins	10,000	0.70	8.4
Sweet Peppers	3,000	0.30	3.6
Tomatoes	16,000	1.10	13.2
Watermelons	10,000	0.70	8.4
		18.85	148.8

Source: Thomas, 1989.

production during the first six months of the year is characterized by short periods of adequate to surplus production, followed by weeks of shortfall [and therefore] . . . the proposed new approach to the intensification of vegetable production in St. Kitts aims to extend the period of production by scheduling planting among selected farmers" (Thomas, 1989).

The current proposal for even more produce self-sufficiency involves bringing more farmers into commercial production, particularly from areas in higher rainfall zones. Farmers with access to irrigation water would also be encouraged to produce food crops. The Department of Agriculture plans to assist farmers with marketing, crop forecasting, and phasing of planting to minimize gluts and shortages. Vegetable production to meet domestic demand for at least the first six months of the year is also dependent upon ensuring access to land. The placement of farmers on land with longer-term leases has also been proposed (Thomas, 1989).

NEVIS

Nevis, like St. Kitts, was colonized by European agriculturalists in the early seventeenth century, who quickly cleared the natural vegetation of the island, initially for cane fields and later to furnish fuelwood for sugar production boilers. At the zenith of sugar production in Nevis, 10,000 of the island's 23,000 acres were planted in cane. Sugar remained the principal crop until the mid-1800's when the plantocracy system began to collapse. Following Emancipation in 1838, Nevisian farmers continued to grow cane through a share cropping system, but that system proved unproductive. The island simply could not support large-scale, mechanized sugar processing, and cotton and food crops gradually replaced sugar. The last sugar mill ceased operation on Nevis in 1958, and the final commercial sugar harvest was in 1969.

Despite Emancipation in 1838, land remained in the control of the planter class. With the only available land above the estates too steep to cultivate, a great many Nevisians emigrated to other islands, beginning a pattern that is still central to Nevisian society. Much of the land was held in large estates in the early 1900's, but beginning in the 1920's small parcels were gradually sold off until the majority of the Nevisian population owned a small plot. Some of the estate land was abandoned to scrub, which supported burgeoning free-grazing stock populations (Weisburd, 1984).

Cotton growers encountered many of the same problems experienced by sugar producers, and although Nevis Sea Island cotton is purported to be among the finest in the world, lint never became a viable, sustained export. The biggest cotton crop in recent decades (157,000 lbs.) was harvested in 1975-1976. Since that time, cotton production has fluctuated in both acreage planted and amount reaped. In 1979-1980 production dropped to 8,000 lbs. and by 1982-1983 had risen back to 55,000 lbs. In the mid-1980's the Japanese contracted to buy all of Nevis' cotton exports for a very favorable price. Despite this guaranteed market and considerable effort on the part of the Agricultural Department and CARDI to revitalize the industry, cotton production continues to decline. Figure 3.1(1) shows acreage under cotton cultivation from 1975 to 1985. Fifty acres of cotton were planted in 1989 yielding 20,310 lbs., and the 1990 crop is projected to be even smaller (Nevis Agricultural Department Records, 1989).

At present, vegetables and ground provisions are cultivated by the greatest number of Nevisian farmers. As recently as the 1960's, Nevis was considered the breadbasket of the Federation and sent meat, milk and vegetables to St. Kitts. But in recent years food imports have far outstripped exports, and since St. Kitts is more diversified, most Nevisian crops are now grown for private consumption or sold in the local market.

Agricultural production is hindered on Nevis by several social, economic and environmental factors. The soil is composed of heavy clays with limited water infiltration and in some instances can only be worked immediately after a rain. The land is extremely stony and bouldery, making only a few

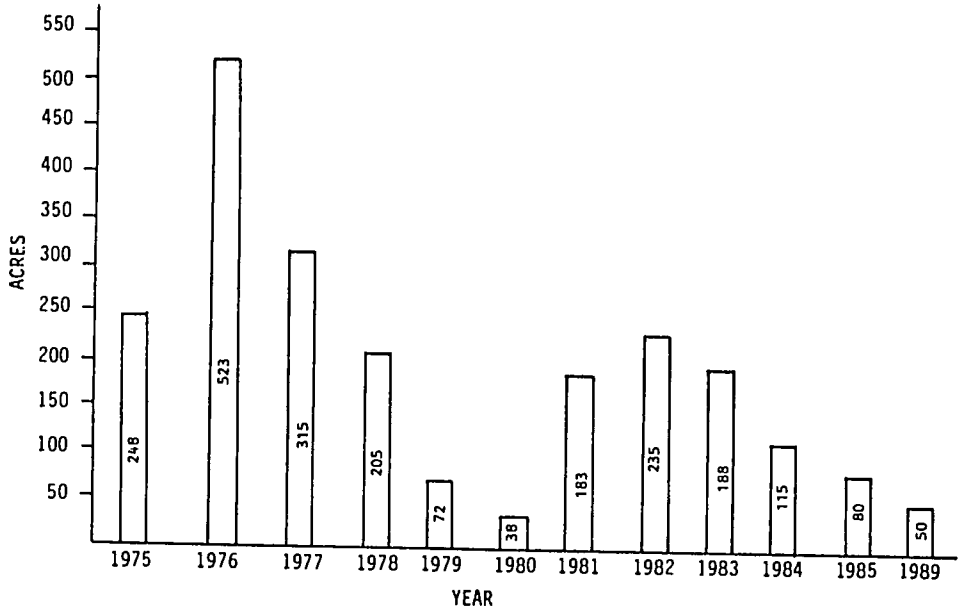


Figure 3.1(2). Acreage under cotton cultivation on Nevis, 1975-1985 (source: Lowery, 1982, and Griffin, 1986).

isolated areas amenable to small-scale mechanization. Low rainfall averages and extended periods of drought make moisture the most critical limiting factor. Due to historical overgrazing and poor farming practices, soil fertility has decreased significantly. Lack of cold storage facilities and reliable transportation further hinders export activities. As a final obstacle, fewer and fewer young people are attracted to farming as their opportunities for education and migration increase. In 1970 the inter-island ferry, the *Christena*, sank on its way back to Nevis from St. Kitts. Scores of Nevis' best farmers (returning from the market in St. Kitts) were killed in the accident, and some Nevisians claim that the agricultural sector still has not recovered from this loss (Chavannes, 1989, and pers. commun., S. Powell, Acting Director, Nevis Agricultural Department, 1990).

It is very difficult to determine agriculture's contribution to Nevis' GDP because most figures are combined with those for St. Kitts. However, based on these aggregate statistics, it is reasonable to assume that agricultural revenues comprise less than 20 percent of the island's GDP. In 1987 it was estimated that only eight percent of the population was employed in the agricultural sector (GOSKN, 1987a). This figure, however, only reflects full-time farmers, and many more people engage in agriculture on a part-time basis. Nevertheless, this represents a six percent drop since 1980 when, according to the Agricultural Census, 14 percent of the population worked in agriculture.

The most serious challenge for the Nevis Department of Agriculture, and one that it has set as a priority, is to increase local production to effect import substitution and fill the demand from the growing tourist industry in order to thwart even higher importation rates. Food importation is not a new phenomenon for Nevis, but dates back to plantation days when all arable lands were devoted solely to sugar cane, and most food items were shipped in. In the 1970's the Nevis Island Government tried to force local cultivation of produce by prohibiting the importation of white potatoes, peas, beans and other food crops that could be grown locally (Olwig, 1985). This attempt was unsuccessful, however, since imports remain higher than local production.

LAND CAPABILITY

Soil and agronomy experts have contradictory opinions on the agricultural potential of Nevis soils. Darby, *et al.* (1987) claim that much of the land has retained reasonable productive capacity, whereas a World Bank study (Hochlaf, 1984) reports that soil fertility is low over much of the island due to loss of topsoil. Both sources stress that future productivity is predicated on proper soil and water conservation practices.

Lang and Carroll (1966) completed the first official soil survey of Nevis and determined that 26 percent of its land area was of high quality agricultural land and 45 percent of moderate quality. A more recent study conducted by the World Bank (Hochlaf, 1984) concluded that 7.9 percent of the island is good agricultural land, 56.4 percent fair agricultural land, 15.2 percent land suitable for pasture and 16.2 percent suitable only for forestry. The Soil Conservation Planning Guide and Handbook (Darby, *et al.*, 1987) probably contains the most detailed information on land capability, as it rates each soil type over a range of slope classes. The major land capability groupings are further subdivided by erosion, excess water, soil and climatic limitations.

Loss of soil due to past erosion and potential for future losses are the most critical elements in determining land capability on Nevis. Percent slope of the land is an important influence on an area's susceptibility to erosion; slope categories in Nevis are illustrated in Figure 3.1(3). Most of the lands currently in production have slopes less than 10

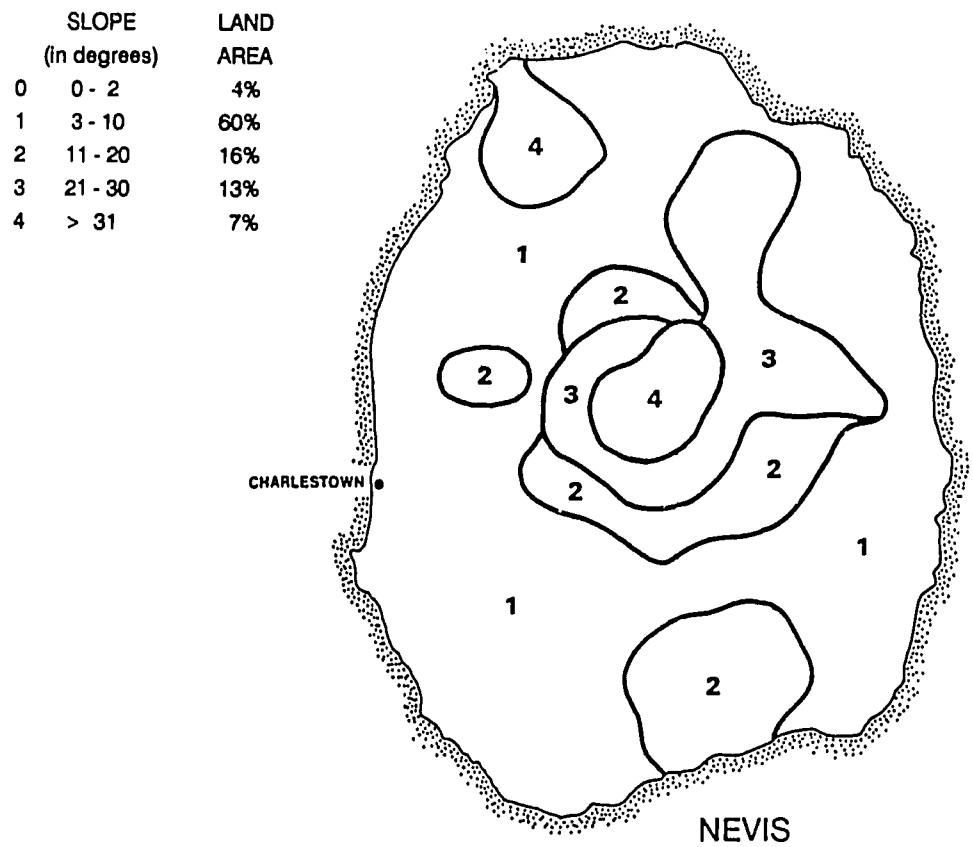


Figure 3.1(3). Slope categories and percent of land area in each category for the island of Nevis (source: Atkins, 1983).

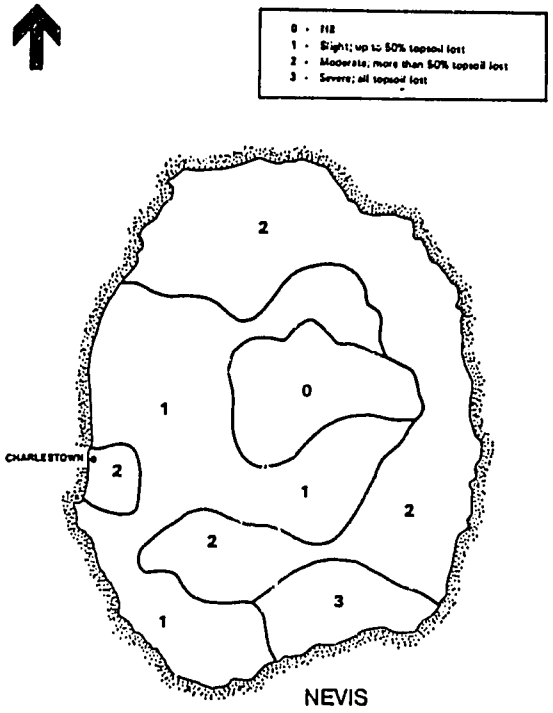


Figure 3.1(4). Soil loss, Nevis (source: Atkins, 1983).

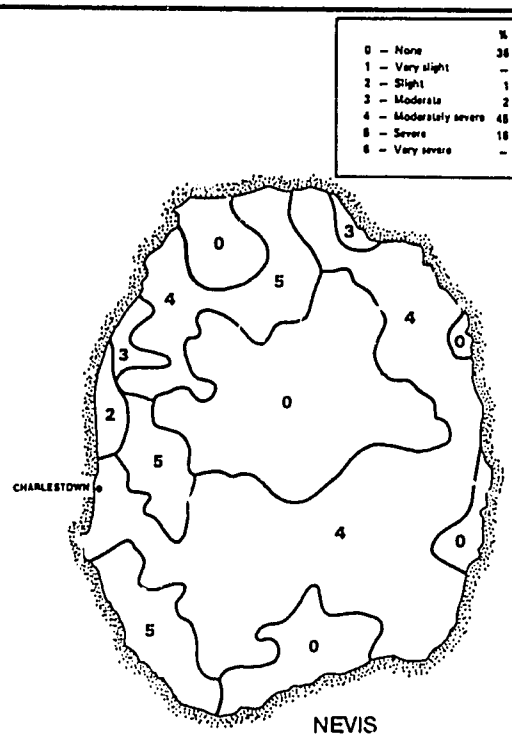


Figure 3.1(5). Potential accelerated erosion hazard, Nevis (source: Atkins, 1983).

degree, but cultivation does occur in isolated cases on slopes of up to 15 degrees. A large proportion of Nevis' agricultural lowlands is characterized as already moderately to severely eroded (Figure 3.1(4)). Maps of potential erosion risk and existing ground cover were overlain by Atkins (1983) to predict areas prone to accelerated erosion rates (Figure 3.1(5)). In formulating an agricultural development plan for the island, it is essential that intended land uses be compatible with land capability. The Nevis preliminary zoning plan prepared by a BDD consultant identifies land with high, medium and marginal potential for agricultural production (Corker, 1988). Planners will have to make careful choices based on proper alternative uses within the context of a general land use plan (Darby, *et al.*, 1987).

LAND USE PATTERNS AND FARMING SYSTEMS

The agricultural system on Nevis is one of mixed cultivation, carried out primarily on small farms. Pure stands of export-destined monocrops are rarely seen. Typical farming systems can be characterized as household/commercial or household/subsistence (Weisburd, 1984). In 1987, 85 percent of all agricultural holdings were under three acres (GOSKN, 1987a).

It is difficult to estimate land use changes because regular records of agricultural acreage are not maintained. Based on comparisons of aerial photographs from the 1940's and 1980's, and the records that are available, it appears that the amount of land in agricultural production has been declining. Table 3.1(4) displays the land use in 1975.

Livestock rearing is the dominant agricultural activity in Nevis. A variety of food crops including more traditional staples such as cassava, sweet potato and yams are grown, as well as numerous European vegetables. Several varieties of fruit are produced and consumed locally. No products other than meat are commercially processed, although the Government hopes to stimulate this type of enterprise in the future. Vegetable

Table 3.1(4) Land use in Nevis, 1975.

LAND USE	PERCENTAGE
Forest	10%
Woodland/Scrub	8%
Agricultural Land	31%
Grazing Pasture Land	41%
Other Land	10%

Source: Atkins, 1983

Table 3.1(5). Nevis vegetable production (lbs.), 1986-1989.

CROP	1986-87	1987-88	1988-89
Sweet Potato	8,000	9,000	10,000
Cabbage	15,000	20,000	18,000
Cauliflower	300	250	350
Lettuce (heads)	7,000	12,000	10,000
Tomato	8,000	6,700	12,000
Egg Plant	1,200	1,000	1,200
Sweet Pepper	7,000	6,000	9,000
Squash	5,000	5,000	6,000
Cucumber	6,000	6,500	10,000
Watermelon	8,000	15,000	13,000
Cantaloupe	850	2,000	4,000
Peanuts	10,000	12,000	10,000
Yams	30,000	47,000	50,000
Carrot	20,000	25,600	35,000
Pigeon Pea	800	600	1,200
Tannia	3,000	3,500	3,500
Parsley	200	200	250
Onion	2,500	2,500	4,000
Dasheen	1,500	1,000	1,000
Christophene	1,000	1,100	900
Ginger	900	1,000	1,200
White Potato	-	2,200	9,500
Pawpaw	4,000	4,000	4,500
Pineapple	400	450	450

Source: Nevis Agricultural Department Records, 1990.

production for the past three years is detailed in Table 3.1(5).

CROPS

Ground Provisions. Peanuts and cotton are the highest income-earning crops, followed by sweet potatoes and yams. White potato, carrot, beet, cassava, dasheen and tannia are also produced in smaller amounts. In the past Nevis exported yams to neighboring islands, and the Agricultural Department is mounting a campaign to recoup this market share. Some yams were sold to St. Kitts and Montserrat last year, but traditionally low sweet potato and yam yields (Lowery, 1985) will have to be overcome before these products make a significant contribution to export earnings. At the same time, white potato production is being emphasized because this is the crop for which the highest percentage of domestic demand (69 percent) is filled by imports.

Vegetables and Legumes. Vegetables are cultivated on small plots, typically from 0.75 to 2 acres by commercial producers and 0.5 to 0.75 acres by subsistence growers. Usually portions of the plots are planted with cotton and/or peanuts and the balance in yams, sweet potatoes and vegetables (Weisburd, 1984). Because Nevisian tastes have shifted towards higher consumption of European vegetables, the Department of Agriculture has been promoting better farming techniques for these crops and boasted a 54 percent increase in vegetable production in 1989 (Nevis Agricultural Department Records, 1989).

Fruit Tree Crops. Except for coconuts, fruit trees are generally planted on small houseplots along with vegetable crops. Hurricane Hugo in 1989 damaged or destroyed perhaps 90 percent of the island's fruit trees. Copra production is being discouraged by the Agricultural Department, and fresh nut production is being encouraged instead (pers. commun., S. Powell, Acting Director, Nevis Agricultural Department, 1990).

LIVESTOCK AND POULTRY

Sheep and goats figure quite prominently in Nevis' landscape, particularly in the southern half of the island. Although Nevis has half the land area of St. Kitts, it supports over twice as many goats and sheep. Many households, even in the center of Charlestown, raise a pig or two, a few head of goats or sheep, and several chickens for supplemental income or private consumption. In 1989, the Federation was reportedly only self sufficient in eggs (Chavannes, 1989). In rural areas the animals roam freely, exerting heavy grazing pressure on the sparse vegetation and damaging crops. Donkeys, once commonly used for transportation, now range freely throughout the Bath Plain to Indian Castle area in wild herds. Cattle, pigs and sheep are raised on Government estates at Indian Castle and Maddens.

The cattle population suffered a dramatic decline over the last two decades as a result of a tick borne dermatophilosis infestation. Table 3.1(6) shows the changes in livestock populations from 1975 to 1987. Lack of forage is a serious problem, especially during the dry season and owners commonly cut and haul fodder for their livestock.

An abattoir was built by CIDA and BDD in 1985 to slaughter and process meat. (Problems with this facility's effluent are discussed in Section 6 of the Profile.) Roughly 3.000 animals were slaughtered each year from 1983 to 1985, and 2,000 in 1989. Live animals are routinely sold to St. Kitts, Anguilla, St. Barths, St. Eustatius and St. Martin. Table 3.1(7) lists animals slaughtered and exported live for selected years.

OTHER AGRICULTURAL ACTIVITIES

In addition to these agricultural production systems, beekeeping and aquaculture are also practiced in Nevis. There are approximately 70 operational hives and honey is extracted at a central beehouse and sold in many island shops. The OAS funded a *Tilapia* sp. aquaculture project in 1989. An old sugar mill on Fothergill's Estate was modified to create a 13,000 gallon tank which currently

Table 3.1(6). Livestock populations, island of Nevis.

LIVESTOCK	1975	1985	1987
Cattle	2,418	900	720
Sheep	7,687	12,000	5,165
Goats	5,869	9,000	3,521
Pigs	1,903	2,000	1,409
TOTALS	17,877	23,900	10,815

Sources: Barrett, 1987; GOSKN, 1987a.

Table 3.1(7). Animals slaughtered and exported live for selected years, island of Nevis.

LIVESTOCK	SLAUGHTERED		EXPORTED			
	1985	1989	1983	1984	1985	1989
Cattle		207				26
Sheep		622				1,545
Goats		504				524
Pigs		704				510
TOTALS	2,937	2,037	3,000	3,000	3,000	2,605

Source: Nevis Agricultural Department Records, 1989.

houses 300 juvenile fish that will be used as breeding stock. The first fish are projected to be harvested for consumption in mid-1991.

There are six agricultural cooperative societies on Nevis (including a beekeepers co-operative) and one fishermen's cooperative. The societies organized for the purpose of marketing their goods and apply directly for small grants to fund their projects.

LAND TENURE

Land became accessible to many Nevisians when sugar and then cotton production ceased and plantations were liquidated in the early 1900's. Although a high percentage of the population owns land (an estimated 70 percent in 1983), the holdings are very small, usually less than five acres and are becoming increasingly fragmented. The total share of agricultural lands controlled by these smallholders has decreased, as more acreage has been consolidated in the hands of

a few landowners. Land held in parcels of 50 acres or more increased by 60 percent from 1961 to 1975. By 1975, 3 percent of the landowners controlled 82 percent of the land (Weisburd, 1984). Data from the 1987 Agricultural Census appear to indicate that landownership is not as concentrated as it was in 1975 (GOSKN, 1987a).

Reliable, up-to-date statistics on agricultural land tenure are not available, but the Agricultural Census of 1975, the 1980 CARDI Baseline Survey and the 1987 Agricultural Census indicate that the percentage of land holdings that were rented as opposed to owned remained stable during this period, with roughly 70 percent of the holdings wholly owned and 30 percent rented (Table 3.1(8)). Thus, land tenure problems in Nevis appear not to be ownership status, but rather the small size of the parcels held.

The NIA purchased 15 estates in the 1930's, 1940's and 1950's for a total of 5,375 acres (Table 3.1(9)). Government holdings comprise 30 percent of the island's agricultural land (Atkins, 1983) and are reputedly some of the most fertile. A good proportion of these estates remain in scrub and unimproved pasture. It is common for farmers to own one home plot and lease one or two more from the Government on an annual basis. Of the 5,375 acres owned by the Government, 29 percent were on lease purchase or annual rental in 1980 (Ferguson, 1980).

The Government has redistributed its land to some degree but has only sold plots of relatively small sizes, making it difficult for a

Table 3.1(9). Land tenure patterns, Nevis.

OWNERSHIP	1975		1980*		1987
	% of farms	% of land area	% of parcels	% of farms	% of land area
Wholly owned	61.7	82.8	26.9	63.7	78.7
Cash rented	17.7	7.5	68.9	26.3	12.3
Share rented	-	-	0.6	-	-
Rented for service	-	-	-	0.9	0.4
Rented for produce	-	-	-	1.0	2.3
Rent free	1.6	1.3	-	5.8	2.5
Mixed tenure	18.8	8.3	-	-	-
Other forms of tenure	0.2	0.1	0.6	2.3	3.8
Family land	-	-	3.0	-	-
TOTALS	100.0	100.0	100.0	100.0	100.0
Absolute Numbers	1,843 farms	17,927 acres	167 parcels	1,887 farms	5,906 acres

Note: *The discrepancy in the proportion of owned versus rented farms in the 1980 data is somewhat of an enigma and may be the result of the small sample size. 167 represents the total number of parcels, not the number of farms as do the other two years.

Sources: Adapted from Atkins, 1983 (1975 Agricultural Census and 1980 CARDI Baseline Survey) and GOSKN, 1987a.

Table 3.1(9). Government-owned estates on Nevis.

Estate Name	Year Acquired	Total Acres	Annual Rental	Agric. Dept. use	Improved Pasture	Scrub/unimp. Pasture	Forest
Low Ground	1951	493	248[1]	-	-	245	-
Hamilton	1933	580	433[2]	-	-	147	-
Prospect	1940	236	135	16[3]	-	85	-
Hard Times	1939	192	135	-	-	-	57
Fothergille	1955	228	17	15	-	196	-
New River and	1938	790	200	-	100[4]	-	490
The Valley	1944	-	-	-	-	-	-
Indian Castle	1959	470	-	-	320[5]	150	-
Eden Brown	1956	303	50	-	-	253	-
Dos D'An	1939	193	-	-	-	-	193
Maddens	1945	1,024	112	-	400[6]	512	-
Potwork	1955	179	-	76[3]	103[7]	-	-
Nisbett	1942	259	90	-	-	169	-
Cades Bay	1939	184	112[8]	-	-	72	-
Spring Hill	1939	97	-	45[6]	-	52	-
Stock Pen	1968	247		No information provided			
TOTALS		5,475	1,532	152	923	1,881	740

Notes: [1]Area in lease purchase.
[2]Area in lease purchase and annual rental combined.
[3]Nursery.
[4]Pasture used for communal grazing.
[5]Pasture used for 184 head of government cattle.
[6]Pasture used for government cattle.
[7]Improved pasture and scrub combined.
[8]Rental to the Nevis Farmers Cooperative Society for crops and livestock.

Source: Adapted from Adams, et al., 1983.

single farmer to amass enough acreage to qualify for adequate bank financing to start commercial production or to ensure that the enterprise will be profitable. The Nevis Housing and Land Development Corporation (a Government statutory body) is now responsible for management of Government land, and conflicts between agricultural and residential or commercial use have in some cases led to a loss of agricultural land (pers. commun., S. Powell, Acting Director, Nevis Agricultural Department, 1990). The Director of Agriculture sits on the Housing and Land Development Corporation Board but is not a voting member. Because of the prevalence of subsistence farming, household producers and the agricultural extension service would both benefit from greater interaction.

3.2 PROBLEMS AND ISSUES

ST. KITTS

SOIL EROSION AND RELATED ISSUES

One of the key impediments to increased agricultural production in St. Kitts is the potential for continued loss of topsoil. Erosion of the land involves dislodgement and transport of lighter and generally finer surface soil materials. The effect of the erosion process in the short term is to decrease soil fertility and in the long term to render the land useless for supporting agricultural crops. An indication of this effect on agricultural lands in St. Kitts is the reduction in yields on upper elevation fields by as much as fifty percent in a ten year period (USAID, 1987). Furthermore, fertile topsoil is being lost in St Kitts at a relatively high rate.

Top soil loss is mostly due to sheet and rill erosion where thin layers of soil are removed almost indiscernibly by each succeeding rainfall. This surface run-off then deepens and widens the smaller ravine bordering the fields and leads to downstream gully or ghaut (gut) erosion which is very difficult to deal with. Steep slopes have greater risk in this regard (see Figure 3.2(1)).

Although sugar cane is no longer a highly profitable crop, it does have some distinct ecological advantages in a tropical environment (Bralts and Southgate, 1985). Sugar cane is an effective cover when planted in dense stands, and therefore soils in St. Kitts have generally remained deep and productive because of the uninterrupted propagation of cane over the past 300 or more years. Severe erosion has resulted in several Caribbean areas as a result of discontinued cane production and substitution of alternative crops less capable of holding soil (Bralts and Southgate, 1985). As the diversification process accelerates in St. Kitts and more lands are taken out of cane production, the risk of increased erosion will rise. Atkins (1983) has mapped potential erosion risk for St. Kitts (see Figure 3.2(2)).

In the Bralts and Southgate report to USAID in 1985, mention is also made of increased risk of erosion due to possibly expanded irrigation practices. This is most likely to occur on commercial farms, probably operated by more progressive farmers interested in maximizing production. The report suggests, "The institution of irrigation is another erosive action which also must be thoughtfully planned to avoid serious environmental damage" (Bralts and Southgate, 1985).

It has been recommended (Darby, *et al.*, 1987) that specific alternative uses for land withdrawn from cane production be identified in the context of a general land use plan. Such alternative uses would be appropriate for the site conditions and operational practices that protect the soil from erosive action. The Darby report indicates, "Cane has provided an excellent cover for the soil, which is not completely exposed except during re-planting once every several years. Only the steeper slopes have suffered damaging soil loss. However, as St. Kitts now seeks to diversify its agriculture and plant new crops, soil conservation practices must be applied on nearly all lands to preserve the resource base. Decisions regarding the 'mix' among sugar cane, other crops, and alternative land uses, must be made in the context of an overall resource management plan" (Darby, *et al.*, 1987).

The projected increase in food crop production will come from an expansion in the acreage planted in vegetables, root crops and fruit. Vegetables and root crops are usually managed on a clean tillage system, with one to three crops per year. Crop land is often left in an unstable, erosive condition, especially during periods when heaviest rainfall is expected. It can be assumed that an expansion in domestic food crop production will increase the total land area exposed to erosion and that there will be a corresponding increase in overall erosion.

As the predicted expansion of agriculture continues within the diversification effort, better road access to farm land will be required. Expansion of secondary roads, and roads within settlement areas, will allow

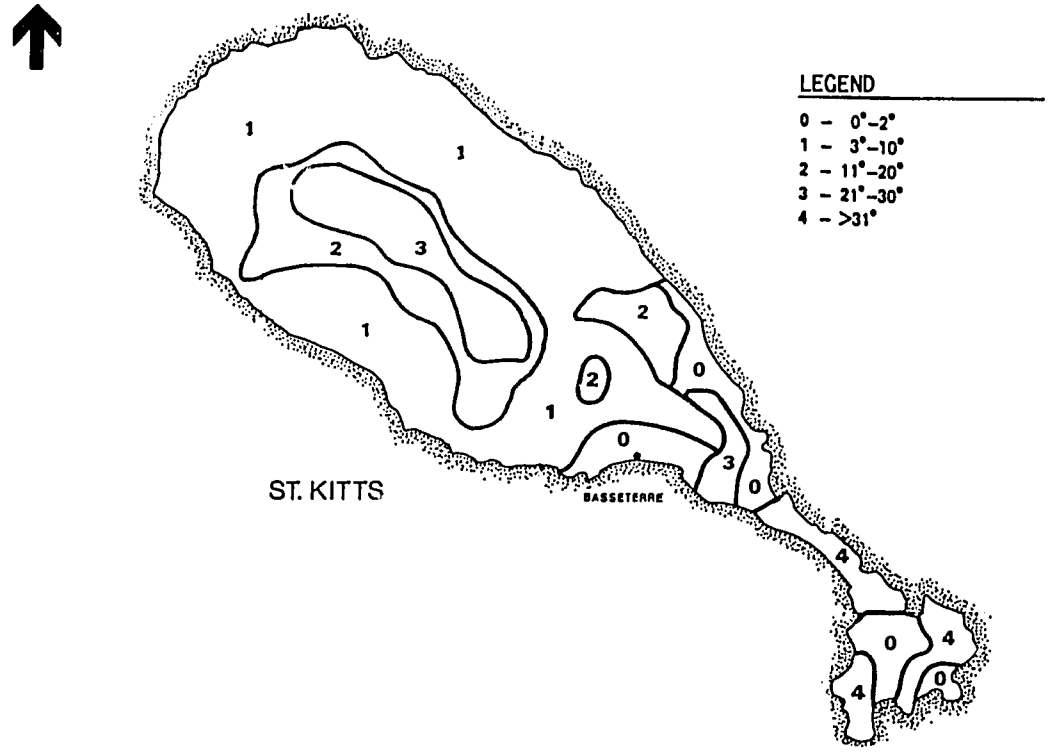


Figure 3.2(1) Slope categories and distribution for the island of St. Kitts (Atkins, 1983).

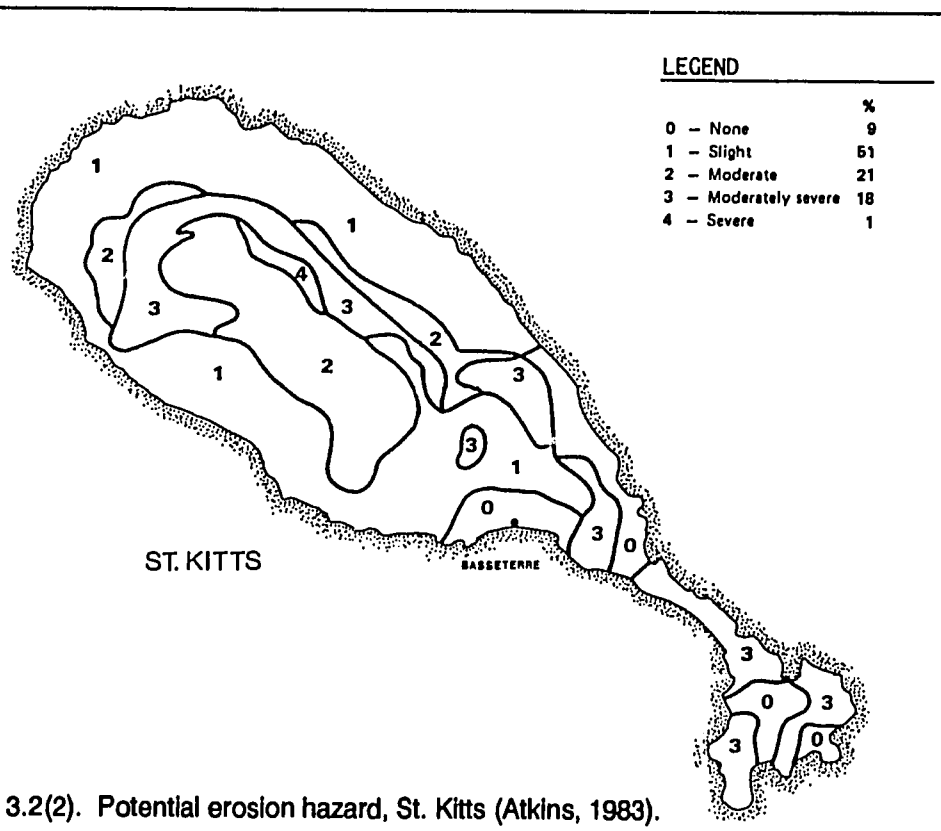


Figure 3.2(2). Potential erosion hazard, St. Kitts (Atkins, 1983).

tractor access and shipment of produce by truck. But the expanded road network could also introduce additional non-point sources of pollution, primarily in the form of silt from unpaved roads, and could accelerate erosion hazard.

To assist in the overall process of agricultural diversification and to specifically aid in the identification of protective practices to control current and projected soil erosion, the USAID-supported Soil Conservation Project has prepared a practical guide and handbook for St. Kitts and Nevis (Darby, *et al.*, 1987). The manual covers a series of broad topics, including an introduction to soil conservation in St. Kitts and Nevis, causes of soil erosion, and principles of soil conservation. The identification of appropriate land use options, the implementation of a soil conservation program, and a series of practical measures to control erosion are covered in the manual.

The Organization of American States proposed two schemes designed to improve crop production and soil conservation, within an agroforestry context. Both applications focused on poor cropland located on slopes representative of small-scale agriculture in St. Kitts. A system of conversion of such cropland to improved pasture with selected trees is outlined by OAS (McKenzie, 1987b), and a system of conversion to stable gardens with various trees was also proposed. The stable garden model has application to steeply sloping land up to a 50 percent grade. Specific agroforestry plantings were also recommended as part of the OAS Forestry Development and Resource Management Planning Project. These proposed plantings include windbreaks, fencing, pasture shade, alley farming, and inter-cropping. A conservation belt planting, representing a model for Sir Gillies Ghaut, was also proposed.

Agroforestry can benefit small-scale and commercial growers by creating environments for stable and sustainable production. The variety of plants within an agroforestry system can serve to buffer environmental impacts created by weather and destructive pests. In concept, agroforestry also serves to improve the microclimate for plant growth and increase the overall quality and variety of produce possible from a given area of land. In spite of the traditional nature and application of some agroforestry systems, it is a relatively untested and applied practice in St. Kitts. Many farmers question the relevance of incorporating trees into the production of provisions and are therefore skeptical of investing time and labor in such practices, particularly in view of the time involved before trees yield benefits. Furthermore, since many of St. Kitts' small-scale farmers are landless, few may be initially interested in agroforestry investments on land where clear title is in question and tenure may be not be guaranteed.

Chalmers (1990), in his preliminary report for FAO on development of a Tropical Forestry Action Plan for nine CARICOM countries, also makes note of the potential for agroprocessing of fruits, in the form of jams, jellies, juices, and flavorings, the production of which can be increased once agroforestry projects are well established. The processing of such produce can also provide a major role for women.

A major limitation to agroforestry and traditional agriculture production in St. Kitts is the overpopulation of monkeys (African Green Monkey, *Cercopithecus aethiops*). An estimated population of between 5,000-7,000 is thought to inhabit St. Kitts (Young and Morden, 1988), with many monkeys at mid and upper elevations where agroforestry is most applicable.

The overall effort to control and reduce soil erosion will also benefit from proposed legislation currently in draft form to provide 35 year leases to farmers. The legislation is designed to encourage farmers to return to the land and to induce young people to pursue a career in farming. It is hoped the lease incentive will expand the diversification process by creating a relative sense of security and will additionally stimulate pride in and stewardship of the land among leaseholders which, in turn, may enhance interest in and commitment to soil conservation practices.

AGROCHEMICALS

The impact of agrochemical use in St. Kitts is also discussed in Section 6 of the Profile (Pollution Control). As agricultural diversification expands and as the production of cane intensifies on smaller acreages, and as producers come under greater economic pressure for efficiency, the potential for risks from agrochemical use is increased. A list of biocides currently imported and used in St. Kitts is listed in Table 6.1(2) of Section 6, which also deals with the primary environmental management and pollution issues related to their use.

Herbicides, including 2,4D, are used widely to control weed invasion in cane fields. Research into effective and safer herbicides is underway by the St. Kitts Sugar Manufacturing Corporation (Kelly, 1990). A variety of pesticides is used by vegetable and root crop farmers, particularly those engaged in commercial production utilizing more modern farming methods. More traditional agriculture, however, now practiced mostly by older farmers, utilizes minimal inputs of agrochemicals. In spite of abuses in chemical application and lack of protective devices, the small acreage now involved poses a minimal risk of environmental damage at the present time. As this acreage expands as a consequence of the diversification program, it will be incumbent upon both GOSKN and the commercial agriculturalists to monitor the impact of any expanded use of biocides. By-products of agricultural processing, including the cane field discharge of stillage from ethanol processing, do not appear to currently impact the environment but should be watched closely. However, as overall agricultural production increases, and tree crop production expands with associated use of pesticides, the need for greater control and regulation of pesticides will be essential.

Within the last decade, the demand and use of a wide range of pesticides, especially insecticides, have increased dramatically among 30 or more small, commercial vegetable growers who are each farming 5 to 25 acres of land intensively. Among the many pesticides in use, toxicities range from toxic to highly toxic. There is growing concern that for the first time in the history of food production in St. Kitts, the quantity of pesticides being used per unit area of land farmed has markedly increased and is likely to become even more concentrated in the years ahead. There is also suspicion that safe harvest periods are not being observed and that, therefore, there may be pesticide residues on the produce being consumed. At present, there is no way of determining how widespread this problem may be (pers. commun., C. Kelly, SSMC, October 1990).

A baseline study on pesticide use and safety was conducted by the Government's Integrated Pest Control Unit (IPCU) in 1989. Based on the results, a number of training sessions for farmers have been planned, the first such session conducted in September 1990 by the IPCU at CARDI's St. Kitts research station. In addition, IPCU staff visit farmers weekly to provide advice on integrated pest management techniques which are specific to pests identified on each farm visited. The IPCU has also distributed to farmers and posted in key locations pictograms for use in decanting insecticides, as well as guidelines for the safe and effective use of pesticides and for emergency measures in cases of pesticide poisoning. The Unit also works with pesticide distributors and retailers to help ensure proper labeling of containers and use of appropriate safety measures in storing and transporting pesticides (pers. commun., C. Kelly, SSMC, October 1990).

The Pesticides Act of 1973 needs to be effectively implemented and regulations updated to reflect new chemicals introduced, levels of safe tolerance, and modern application methods. Until recently (see preceding paragraph), there was no formal or informal training offered to farmers in pesticide use, application equipment, or safe storage requirements for pesticides. Integrated pest management (IPM) research is underway under the aegis of the SSMC, and efforts to introduce farmers to IPM practices for local crops need to be expanded. The monitoring of pesticide use and periodic testing of groundwater from a variety of sources should be expanded (see also Recommendations in Section 6).

NEVIS

Traditionally appraisals of Nevis' agricultural sector have identified constraints to production such as unstable markets, insecure land tenure and insufficient farm labor which are economic or social in nature. Aspects of farming in Nevis which have an effect on the physical environment (which, not coincidentally, also present the most severe constraints to production) include: erosion caused by livestock overgrazing and poor farming techniques, the use of agricultural chemicals, and irrigation practices.

EROSION

Erosion is probably the most serious environmental problem in Nevis in terms of land area affected, severity of resource loss and duration of the problem. In many ways, Nevis' farmers are contending with environmental problems that were created decades, even centuries ago. Much of the erosion in the lower elevations is a relict of the sugar and cotton days, but continues today as a result of livestock overgrazing and, less often, farming techniques that do not adequately protect the soil. Seventy percent of Nevis' agricultural land has a moderately severe risk of accelerated erosion, meaning that virtually any agricultural activity must incorporate measures to prevent soil loss. Fertility can plummet as much as 50 percent with the first inch of topsoil removed (Atkins, 1983). Soil regenerates very slowly in dry lowland areas where shallow soils predominate, as in Nevis. No actual measurements have been taken on a regular basis, so current average soil loss rates are not available. Over the past two centuries desertification has actually been occurring on Nevis, with many areas reverting to acacia-thorn scrub or acacia-cactus scrub (Chalmers, 1983).

Erosion due to livestock overgrazing is particularly acute in the southern portion of the island where large numbers of feral goats, sheep and donkeys roam. In some parts of this region, animal trails quickly become minor gullies after heavy rains and ghauts are cutting widening paths through the unprotected soil. The Nevis Department of Agriculture has tried to persuade livestock owners to make pasture improvements with very little success (Weisburd, 1984). Insecure tenure also dissuades farmers from making improvements that require capital expenditures, including fencing. It should be noted, parenthetically, that other economic and social factors (e.g., the part-time nature of farm work and the prevalence of subsistence rather than commercial production) probably limit agricultural investments more generally than insecure land tenure. As the system now functions, livestock owners do not incur any expense other than the initial purchase and investment in the animals. The stock are let out to roam freely during the day and return to the yard at night.

The Agricultural Department has pilot grazing improvement projects on its estates and practices pasture rotation. The Department has also persuaded some farmers to develop fodder banks, but this effort suffered a setback during Hurricane Hugo in 1989. Adopting these practices islandwide would improve the nutritional status of the animals (the indigenous forage is quite low in nutrients) and serve to check further soil loss.

Current deteriorated land conditions often lead external consultants to somewhat casually recommend increased livestock production rather than crop cultivation in the areas unsuitable for horticulture. This is paramount to solving one problem with another more damaging one. Only with properly controlled grazing access and other soil conservation measures can animal husbandry be ecologically sustainable on Nevis.

Darby, *et al.* (1987) developed an excellent technical manual on soil and water conservation techniques tailored specifically to Nevis that should be referred to by all agricultural professionals. Wind erosion is as severe as water erosion in some parts of the island (particularly the windward side), and windbreaks should be included in cropping schemes. The Cades Bay agricultural production area suffers some of the worst erosion. In this case debris in the ghauts blocks the channel during heavy flow, and water is diverted onto the fields where it washes the topsoil away. This problem might be mitigated

by maintaining a wider vegetative buffer along the ghauts.

AGRICULTURAL CHEMICALS

Biocide and chemical fertilizer use is also discussed in Section 6 (Pollution Control) of the Profile. Generally, Nevisian farmers use smaller amounts of fertilizers and pesticides than their counterparts on neighboring islands. Table 3.2(1) lists pounds of fertilizers, pesticides and herbicides applied to Nevisian crops in 1987. (Refer to Table 6.1(3) for a description of chemicals imported in 1989.) This may be due in part because there is no overriding emphasis on any one export monocrop which tends to require higher inputs. The mixed vegetable cultivation that dominates Nevisian agriculture is certainly a more dynamic and flexible system and may even function as planned companion planting does to repel insects.

Nevisian farmers have traditionally weeded their plots manually rather than using herbicides. CARDI and other agricultural development institutions have been researching the use of herbicides with different crops. In one recent experiment herbicide inputs amounted to 25 percent of the cost of production. CARDI also investigates non-chemical means of weed control. As well as being environmentally benign, farmers may be more receptive to these non-chemical techniques. It is frequently noted that cotton farmers do not request the Government's spraying service to combat bollworms even though it is very cost effective. In addition, Agricultural officers report that farmers are averse to using pesticides (pers. commun., S. Powell, Acting Director, Nevis Agricultural Department, 1990). Interestingly, in a survey of household farmers, Nevisians interviewed cited too many chemicals as a negative characteristic of imported vegetables (Weisburd, 1984).

Insecticides are more widely used than other biocides and are applied most frequently to European crops. As reported in a recent study (Hammerton, 1987), farmers attributed the major loss of crops to insects, followed by weeds and rodents. The same study discovered that two-thirds of the farmers surveyed used fertilizers, a significant increase from 1980 when chemical fertilizers were reportedly used very infrequently (Ferguson, 1980). This finding, however, conflicts with results reported in the 1987 Agricultural Census, making it difficult to determine which information is most accurate. Farmers most often apply PKN 15:15:15 and less frequently 20:20:20. Other fertilizers include murate of potash and sulphate of ammonia. Household producers in particular, use manure as an organic fertilizer.

Table 3.2(1). Agrochemical use in 1987, island of Nevis.

Chemical	% of holdings using chemical	Acreage treated	lbs. applied
Chemical fertilizer	6	145	-
Organic manure fertilizer	36	135	-
Pesticides	11	73	839
Herbicides	2	12	177

Source: GOSKN, 1987a.

Under the present institutional framework, there are some risks in the promotion of pesticide use. Even if the international aid agencies are careful about the toxicity and persistence of the biocides they advocate, once externally-funded or sponsored projects are completed, the lack of pesticide regulations in the country may make it possible for farmers who have become dependent on agrochemicals to gain access to more lethal substances. The Agricultural Department collects monthly records of pesticide sales from the St. Kitts-Nevis Development Bank and TDC (a primary distributor of pesticides in the country), but this is primarily done so that the Department can inform farmers about the availability of chemicals. The NIA sold agricultural chemicals at subsidized rates directly to farmers in the early 1980's. All sales were then shifted to the private sector, and pesticides are no longer subsidized. The Agricultural Department and CARDI will however provide donated chemicals to farmers at no cost, and Government spraying services are subsidized. Incentives to use biocides -- in the form of subsidies for chemicals, sprayers and the Government spraying services -- should be carefully evaluated before being offered and should be discontinued if they are deemed environmentally detrimental. If the current shortage of farm labor continues, it may precipitate more intensive use of herbicides and insecticides to reduce the person hours normally devoted to manual weeding and pest control.

IRRIGATION

Irrigation is not widely practiced in Nevis because the costs of exploiting surface water sources have been quite prohibitive. Checkdams and storage tanks to provide water for stock are very common, however. With the exploration of groundwater sources, it is now much more feasible to use low-yielding boreholes for irrigation purposes.

There are presently five irrigation projects in Nevis. In 1983 the BDD initiated a project on ten acres of terraced land at New River using water from New River Springs. CARDATS/CARDI has been overseeing an irrigation project at Cades Bay, and most recently the Water Department assisted the Department of Agriculture in developing an infiltration trench to irrigate land at Nisbett Plantation. The Agricultural Department is currently conducting a drip irrigation demonstration project at Cades Bay. The New River project was originally designed as a flood irrigation system, but high erosion rates were occurring, and it is being upgraded to a drip system as well. Maddens and Potworks Estates are also irrigated, but water is leaking out of the catchment areas, which need to be resealed with clay.

As groundwater sources are exploited, the same cautionary notes that were discussed in Section 2.2 of the Profile (Water Resources) apply. All wells should be very carefully monitored to prevent saline water from intruding into the aquifer. Other precautions must also be taken when irrigating land with high erosion potential. If not properly designed so that moisture is never brought above field capacity, irrigation will result in greatly accelerated erosion. Any future irrigation projects in Nevis must be very carefully designed and well maintained in order not to cause more harm than good. Finally, as Nevis irrigates more land, greater attention will have to be paid to the condition of lower elevation watersheds, as well as source flows if water yields are to be maintained.

3.3 POLICY RECOMMENDATIONS

(1) Soil and Water Conservation Practices. Measures to limit soil erosion by the application of contour plowing, strip cropping, protective mulches, and other practices need to be actively encouraged by GOSKN. Demonstration of these techniques and periodic technical training sessions for food crop farmers should be implemented by the Department of Agriculture as diversification production expands.

Resources already available, such as the Soil Conservation Planning Guide and Handbook, should be required for resource planning at the policy-making level of Gov-

ernment and on a practical level by resource managers in the field. Simple demonstration of some of the conservation practices explained in the Manual could be helpful to Kittitian and Nevisian agriculturalists.

Consideration might be given to (1) development of integrated soil and water conservation legislation for the country and (2) establishment of a Soil and Water Conservation Advisory Board whose membership could cut across ministerial and departmental lines.

A concerted effort should be made to properly design future agricultural roads to minimize erosion hazard and create safe and stable thoroughfares. Paving is unlikely to be economically viable for many farm roads, but such roads should utilize ditches, culverts and waterbars as needed to control erosion and run-off.

Irrigation systems should be carefully designed so that they do not accelerate erosion processes. Improving catchment areas used for irrigation water would be an effective way to integrate watershed management with agricultural practices.

(2) **Agroforestry.** Application of agroforestry practices is recommended as one method to more effectively control erosion. Traditionally, lands considered unsuitable for cane production in St. Kitts have been used, with or without the authority of estate managers, for the growing of provisions. This arrangement has been in place for several hundred years. Lands used for subsistence production were located on upper slopes above the cane crops or in drainage ghauts, adjacent to cane land. The practice continues at the present time and may be one of the principal sources of soil erosion. Lang and Carroll (1966) made special note of the fact that the "worst erosion on St. Kitts may be seen in the young soils or latosolics in the upper glacis above the limits of cane cultivation where the forest has been cleared for the ground provisions." The introduction and subsequent expanded application of agroforestry systems -- designed to meet the production needs of small farmers -- is recommended to control soil erosion in upland areas and elsewhere.

Agroforestry should be demonstrated in conjunction with GOSKN efforts to provide long-term leases of agricultural lands and suitable plots for small-scale agriculture. Research should be undertaken to identify agroforestry systems most applicable to the country. These systems might include forage banks, windbreaks, living fences, and intercropping with fruit trees. In support of such an effort, the FAO Tropical Forest Action Plan has identified agroforestry as a priority. The applicability of agroforestry in Nevis within livestock production systems has also been recommended (Chalmers, 1990).

(3) **Use of Agrochemicals** (see Section 6.3 for additional recommendations regarding biocides). The Departments of Agriculture (St. Kitts and Nevis) need to monitor biocide use more closely, and the experimental introduction of integrated pest management practices for local crops should be pursued.

Instituting a small demonstration project for the organic production of vegetables and root crops would introduce farmers to the benefits of non-chemical farming and would serve to compare production systems. This could be carried out in conjunction with agroforestry interventions on the same site and using inter-cropping practices. Small-scale, "custom-grown" vegetables and fruits would initially appeal to tourist visitors already accustomed to consuming organic produce and would generate higher prices for producers.

(4) **Land Use Planning.** Decisions regarding alternative uses for agricultural lands should be considered within the context of a general land use plan for St. Kitts-Nevis. High quality agricultural land is relatively scarce in Nevis, and once withdrawn from agriculture for other land uses, it is lost forever. In St. Kitts, decisions regarding land to be withdrawn from cane production should be undertaken within the larger framework of an overall resource management plan for rural areas and should be based on site-specific conditions, on an appropriate "mix" of cropping patterns, and on the use of operational practices that protect the soil from erosive action.

The many successful small hotels and inns of St. Kitts-Nevis attract guests by offering low-key, high-quality, personalized service within historic settings (pictured is a small hotel in Nevis). Compared to many other types of tourism facilities, such accommodations have a high rate of return visitors, a high percentage of long-term guests and a high rate of expenditure per guest.

SECTION 4 TOURISM

4.1 OVERVIEW

The Government of St. Kitts-Nevis has made major commitments to the development of tourism in the state. Tourism's performance in recent years in foreign exchange earnings and job creation has generated considerable confidence in the sector at a time when the dominant sector, agriculture, is on the decline. In his 1990 Budget Address, the Prime Minister acknowledged that tourism had recently surpassed sugar as the primary foreign exchange earner. He further pointed out that while there had been a decline in the number of cruise ship visitors in 1989, the continued increase in visitors by air had more than compensated for the loss of cruise passengers. Total visitor arrivals for the half-year period January to June of 1989, according to the Prime Minister, amounted to 36,962, an increase of 7.5 percent over the corresponding period in 1988 (GOSKN, 1989c). (See Table 4.1(1) below for full 1989 figures.)

In the early 1970's, Government commenced planning for the Frigate Bay Development Project in St. Kitts and set the stage for the transformation of the tourism sector in that island. Prior to this, and for some time after, tourism in St. Kitts (and Nevis) revolved primarily around small, locally-owned hotels and guest houses. Sixty-three percent of the rooms in the country were locally owned in 1976 (Charles and Marshall, 1990).

All this changed in 1972. In that year, Government established a statutory corporate body, the Frigate Bay Development Corporation, which was solely owned by GOSKN and was set up to direct development of 850 acres of Government land located at the Frigate Bay Estate in St. Kitts. In the original Frigate Bay development plan, land was categorized and allocated for five different types of use, resulting in the following general classifications: 220 acres for residential land; 285 acres for commercial land (hotels and condominiums primarily); a 180-acre golf course; 30 acres for services; and 135 acres set aside as "green areas" and for other uses (Towle, *et al.*, 1985).

Seventeen years after the commencement of the Frigate Bay Development Project, an access road to the Southeast Peninsula (SEP) of St. Kitts was completed with primary financial assistance provided by the U.S. Agency for International Development. This penetration highway opened up for tourism development 4,000 acres, an area roughly one-fifth the size of St. Kitts which includes the most attractive beach areas on the island. The cost of the SEP road and infrastructure project was spread among three donors: EC$22 million from USAID, EC$4 million from CIDA, and EC$5.5 million from BDD, plus an additional USAID grant-supported planning and environmental protection component at approximately EC$2.5 million. The total EC$34 million investment is expected to attract significant private sector financing and the development of from 2,000 hotel rooms (low projection) to a possible maximum of 8,000 rooms as identified by one of several land use planning studies completed for the SEP.

With major hotel expansion also occurring in Nevis (see below), tourism is destined to become the dominant economic sector in the country. Since tourism development will also expand the market for local agricultural produce, the growth of the sector should help to increase sales and earnings for domestic agriculture. Thus, in all sectors, a generally optimistic outlook for the future is held within the country. However, the management of tourism growth as currently projected will provide a considerable challenge to the country since, at present, the Government's planning and regulatory agencies lack adequate staff, budget and experience with which to effectively cope with the anticipated expansion *unless* it is carefully phased. An additional problem lies in the fact that the labor force is far too small to meet the demands for

Table 4.1(1). Visitor arrivals, St. Kitts-Nevis, 1981-1989 ('000).

	1981	1982	1983	1984	1985	1986	1987	1988	1989
STAY-OVER ARRIVALS	35.5	34.5	34.3	39.8	46.1	55.1	64.6	69.6	72.1
CRUISE PASSENGERS AND YACHTS	10.9	11.1	22.8	34.1	31.1	27.0	31.4	53.6	36.6
TOTALS	46.4	45.4	57.1	73.9	77.2	82.1	96.0	123.2	108.7

Source: Statistics Division, Planning Unit, Ministry of Agriculture, Lands, Housing and Development.

construction and service jobs required in a greatly enlarged tourism sector. The experience of other Caribbean countries indicates that unmanaged tourism growth carries with it demographic, social and environmental problems that may inadvertently erode the quality of life in St. Kitts-Nevis.

PAST PERFORMANCE

Visitor Arrivals. Between 1981 and 1983 there was a slight negative growth in stay-over arrivals to St. Kitts-Nevis. Steady and appreciable growth occurred between 1984 and 1989. The 1989 figure of 72,100 stay-over visitors is double the 1981 figure of 35,500 (Table 4.1(1)). Growth in cruise and yacht passenger arrivals is less reliable, tending to periodic reversals from one year to the next.

Table 4.1(1) shows that cruise and yacht passengers doubled between 1982 and 1983, increased another 50 percent between 1983 and 1984 and then declined for the next two years. A 71 percent increase occurred between 1987 and 1988 only to decline by 31.7 percent in 1989. Even then, the 1989 cruise and yacht passenger arrival figure of 36,600 was more than three times the number for 1981.

St. Kitts-Nevis is neither a major cruise ship nor yachting destination. Its share of cruise passenger visits in 1987 was a meager 0.6 percent of the regional total of 5.6 million visitors. In 1981, its share was a meager 0.3 percent of 3.4 million. Neither island presently has the facilities and allied services to attract cruise ships or yachts in significantly greater numbers. It is difficult to maintain steady growth under these circumstances, but the St. Kitts-Nevis Government is taking some steps to try to improve services. For example, a new shopping mall, with associated duty-free shops, restaurants and other amenities, is being developed as a tourist center on the Bayfront in downtown Basseterre; anticipated opening is the spring of 1991. Until the center and other island attractions are more fully established, however, cruise passenger visits can be expected to continue a pattern of fluctuation in the near future.

Tourism Expenditure. Estimates of average daily expenditure by five categories of tourists, i.e, cruise ship, excursionist, hotel, private home and business, were developed for St. Kitts-Nevis for 1978 to 1984 (see Table 4.1(2)). During the period, daily average expenditure increased for all categories a minimum of 66 percent. Cruise ship expenditure remains the lowest, being one-fifth of business

Table 4.1(2). Total annual expenditures by type of visitor (US$ millions).

	1980	1981	1982	1983	1984
Cruise Ship	0.06	0.13	0.14	0.32	0.37
Excursionists	0.04	0.03	0.03	0.03	0.03
Hotel	4.27	5.47	6.28	5.14	6.15
Private House	2.37	2.91	3.37	4.10	4.96
Business	1.28	1.31	1.13	1.51	1.81
TOTALS	8.02	9.85	10.95	11.10	13.32

Source: Towle, et al., 1986b, as reported by World Bank, 1985.

Table 4.1(3). Hotel occupancy and departure tax, 1984-1988 (EC$ millions).

	1984	1985	1986	1987	1988
Hotel Occupancy Tax	0.688	1.057	1.594	2.021	2.148
Departure Tax	--	--	--	8.604	8.942

Source: Statistics Division, Planning Unit, Ministry of Agriculture, Lands, Housing and Development.

expenditure which for 1984 was US$88.2 per day.

Total expenditures for the five categories, 1980-1984, are displayed in Table 4.1(2). Cruise ship expenditure as a percentage of total tourist expenditure increased from 0.7 percent in 1980 to 2.7 percent in 1984. Hotel visitor expenditure is in excess of 50 percent of total expenditure for most years. These figures were compiled in the absence of detailed surveys and therefore should be used with a degree of caution. They are nevertheless instructive for future policy decisions on investment and promotion in respect of any of the categories.

Tourism Tax Revenues. Government revenue from tourism is generated from a variety of sources, e.g., hotel occupancy tax, airport departure tax, condominium fees, taxi and car rental license fees, stamp duty on land sales. The hotel occupancy and departure taxes are levied directly on the visitor and

therefore are fairly reliable indicators of economic performance, although total figures cited for the latter also include taxes paid by residents leaving the state.

Table 4.1(3) displays information on hotel occupancy tax revenue and on the collection of departure taxes. These data appear volatile and reflect more than changes in arrival and departure figures because, between 1985 and 1988, GOSKN undertook a campaign: (1) to document uncollected or poorly-collected taxes and fees, (2) to improve record keeping on the payment of taxes and fees, and (3) to collect the full amounts due. Hotel-supplied occupancy data (from some establishments) during the period 1985-87 proved less than reliable. Arrival data tend to be more accurate but are difficult to disaggregate.

Spatial Development Trends. St. Kitts currently has a total of 1,112 hotel rooms, condominiums and other facilities to accommodate visitors (see next sub-section for figures on Nevis). The breakdown by type of facility is as follows (data supplied by Ministry of Tourism and Labor):

Apartments	316
Condominiums	103
Cottages	9
Villas and Inns	167
Hotels	517

Before the development of the Frigate Bay tourist resort area, most of the rooms in St. Kitts were located in Basseterre, the capital. In both islands, but more so in Nevis, a number of the plantation houses have been converted into hotels (see also Section 5). Most, if not all, of the plantation houses are located away from the immediate coastline. A significant and deliberate shift to the development of beach lands for tourism occurred first at Frigate Bay, starting in 1972, and more recently at the Southeast Peninsula in St. Kitts and at Pinneys Beach in Nevis (see also sub-section on Nevis).

As indicated above, the SEP comprises 4,000 acres and has some of the best beaches in St. Kitts. Its tourism development potential is relatively large. Table 4.1(4) lists projects that have been proposed for the SEP with defined components. The projections signal the making of a major resort area, the influence of which can be expected to further encourage the expansion of Basseterre towards Frigate Bay and the SEP itself. The SEP land use management plans earmark space for a commercial center in the Great Salt Pond area, but Government has so far made no intervention to make this happen.

It is difficult to determine what would constitute an environmentally-safe ceiling for room density at the SEP. A Land Use Management Plan prepared by Island Resources Foundation (Towle, *et al.*, 1986b) indicated that 1,250 hotel rooms could be considered an environmentally acceptable target. That plan, however, was more concerned with the rate of growth than with the total number of rooms. Starnes, *et al.* (1989a), in a revised Land Use Plan prepared as a part of the USAID-funded DESFIL project for the Peninsula, projected a *maximum* of 8,500 hotel rooms on approximately 1,400 acres of recommended buildable space. However, with residential and other uses competing for buildable acreage, hotel room construction has been *targeted* by the DESFIL plan at approximately 4,000.

In either case, the SEP is expected to emerge as a major resort district, with the likelihood of having the majority of rooms in St. Kitts, if not in the country.

NEVIS

Tourism in Nevis has deep roots in its historical past. There are numerous recordings of Amerindians and early explorers who stayed on in Nevis to take full advantage of the island's healing and soothing Bath Spring. The Bath Hotel (Nevis' only officially designated historic landmark) was build in 1778, its first tourist destination and attraction. Some 200 years later, in the 1980's, a much stronger wave of tourism took hold in Nevis and has more recently culminated in the development of a major resort project at Pinneys Beach -- the Four Seasons Resort, an almost 200-room complex now scheduled to open in February of 1991.

Table 4.1(4). Proposed developments, Southeast Peninsula, St. Kitts.

Project	Land (acres)	No. of Rooms	Facilities Condos/ Units	Marina Berths
Banana/Cockleshell Bay				
Resort Hotel	12.4	-	217-275	-
Hotel/Conv. Center	153.5	250	-	-
Salt Pond				
Casino and Marina	158	812	425	130
Friars Bay				
Comprehensive Resort	257.6	500-700	-	-
Whitehouse Bay/ Sand Bank Bay				
Resort Development	381	1,555	1,650	-
TOTALS	962.5	3,317	2,350	130

Source: Mohammed, 1990.

Tourism statistics for Nevis are closely linked to those of St. Kitts; most are combined with no aggregate breakdown for Nevis. Yet there are distinctions which separate the style of tourism in Nevis from that of St. Kitts. For example, as stated in the Nevis Island Administration's official tourism development policy:

> *Nevis has traditionally catered to the upmarket tourist specializing in small, cottage type hotels. It therefore provides a pleasant contrast to the mass tourist oriented destinations in the Caribbean. Government will encourage a combination of large and small hotels, but emphasis will remain on chalet style buildings with a maximum of two storeys.*

Tourism development in Nevis has traditionally been small-scale with (prior to development of the Four Seasons Resort at Pinneys Beach) an average of 20 rooms available in ten major hotels (for a total of 200 rooms). With the addition of small guest houses and other rooms, the total number of beds has been approximately 420 (Wirt, 1986) (see Table 4.1(5) for a list of hotels and their present capacity). Until commencement of the Four Seasons Resort, no hotel or other resort had more than 54 rooms, and, except for two, all were located in cooler, upland areas.

There are three important differences in the scale and style of tourism that set Nevis apart from many other Caribbean destinations. In the first place (although this characteristic is not as marked a contrast with other tourism markets), it possesses considerable natural amenities, including Pinneys Beach and to a lesser degree Mosquito Bay and Newcastle and Nisbett beaches, which are along the protected Leeward coasts with mostly calm waters.

Table 4.1(5). Major hotels and capacity and price structure for winter and summer, double room rates, Nevis.

HOTEL	ROOMS	WINTER RATE	SUMMER RATE
Croney's Old Manor	10	US$150.00 EP	US$ 90.00 EP
Golden Rock Estate	15	US$175.00 EP	US$ 90.00 EP
Hermitage Plantation	11	US$195.00	US$130.00
Montpelier Plantation	16	US$310.00 MAP	US$190.00
Mt. Nevis Hotel	32	US$210.00	US$120.00
Nisbett Plantation Inn	38	US$385.00 MAP	US$250.00
Oualie Beach Club	5	US$132.00	US$105.00
Pinneys Beach Hotel	54	US$100.00	US$ 60.00
Rest Haven Inn	43	US$100.00	US$ 80.00
Zetland Plantation (temporarily closed)	16	US$200.00	US$135.00
Four Seasons Resort (to open February 1991)	196	US$350.00	

EP = European Plan; MAP = Modified American Plan

Secondly, as a stated policy in the Nevis Development Plan, the promotion of culture- or nature-based tourism has been targeted as a marketing objective. Its manifestation can be seen in the number of hotels reconstructed on old plantation sites (most using traditional Nevisian or Caribbean style architecture) and by the type of repeat visitor attracted to the island, i.e., tourists who want to hike, visit historic sites or just be part of the relatively unspoiled landscape afforded by Nevis. This propensity for ecotourism and the type of visitor drawn by its promotion is graphically demonstrated by the subscription records of the Nevis Historical and Conservation Society which show approximately 60 percent of its membership being non-resident, but frequently-returning island visitors, most of whom visit Nevis annually and participate in Society programs at that time. Furthermore, almost all tourism operations on the island have been "low-key" and because of their relatively small size have generally had less negative impact on the environment.

The last distinguishing characteristic of Nevisian tourism is the dominance of an "up-scale" clientele which, despite the limited number of rooms available to date, has nevertheless generated significant tourism revenues for the island (see Table 4.1(5) for price structure of hotels). The local tourism operators, who advertise collectively as "The Inns of Nevis," cater to this philosophy and have generally sought to achieve desired tourism goals by generating more dollars per room (with fewer guests) rather than fewer dollars per room (with more guests). This approach has created a high proportion of repeat visitors, many of whom stay for long periods or who have purchased homes (approximately 200). Unfortunately, there are few statistics available to document the benefits accrued to the island in its pursuit of this style of "up-scale" tourism where, in effect, "less is more" (i.e., the number of tourists is less but the revenue per room or operation is more).

There are several additional factors which have limited the appeal of a mass tourism approach in Nevis. The small airport

facility can only accommodate airplanes of about 18 seats or smaller with regular service by only one carrier, which has prompted establishment of several chartering companies affordable primarily by wealthier visitors. Scheduled commercial flights are few (approximately five per day), which limits numbers arriving and leaving. There has been, until recently, just one regular ferry service (Government-operated) to and from St. Kitts with an average of two scheduled runs per day, Monday through Wednesday plus Friday and Saturday. No service was available on Thursdays and Sundays. This limited service has discouraged many potential visitors from coming to Nevis. There is now a private boat run by a local hotel which runs Thursdays and Sundays and other days approximately one hour after the Government-operated ferry service. This should improve the number of day tourist visits, particularly during the December - April season.

Cruise ship and private boat visitation to Nevis has traditionally had little affect on the economy. In 1987, there were regular visits by a medium-sized cruise ship (approximately 210 passengers) every two weeks and another (120 passengers) weekly, but these operations continued for only a few months. There are year round weekly visits by windjammer sailing vessels, but the average per capita expenditure from these visitors is small, and there is no stay-over potential (pers. commun., Nevis Tourism Office and NHCS Sales Records, 1990). The biggest hindrance to more cruise ship visits in Nevis is the lack of a deep water harbor landing site or dock, which means all visitors must come ashore via small passenger launches. There are no established marinas on Nevis. There are, however, several coves along Pinneys Beach which provide shelter for boats, but no facilities are available for gas or food except at Charlestown. A planned marina at Fort Charles now appears moribund.

The Four Seasons Hotel, which is scheduled to open in early 1991, will substantially alter the tourism picture in Nevis. The owners are projecting an employment level of approximately 500 persons when it is fully operational (Stauss, 1989). This tourist facility of 196 rooms will double the occupancy space available at major hotels in Nevis and will definitely be an "up-scale" facility with daily per person room rates of US$350 (Table 4.1(5)). The 350 acre resort, which comprises about 11 percent of Nevis' land area, will eventually include an 18-hole championship golf course, health spas and access to over a quarter of a mile of beach frontage. Several other major hotel sites are being offered by the NIA along the Pinneys Beach corridor, but no plans have yet been accepted.

4.2 PROBLEMS AND ISSUES

INSTITUTIONAL STRUCTURE FOR MANAGING TOURISM

It is becoming more obvious that tourism must be properly planned and managed and not just described and marketed. The basis for most tourism is the natural and historical/cultural resources of the country. If the quality of these resources is seriously undermined, then St. Kitts-Nevis in the long run will become less attractive as a destination -- *and* less attractive for residents as well. This vital link between tourism and the environment must be maintained, using flexible institutional mechanisms which can both protect and develop natural and cultural attractions while ensuring that touristic facilities and users are compatible with the character and scale of the resource base and also profitable to developers and to the country. It is no small or simple task. But it is more than mere advertising. It will, if properly done, require management skills of the first order.

Links between tourism and agriculture, as well as between tourism and other sectors, could be strengthened to reduce leakage in foreign exchange. The basic elements from which more economically-beneficial linkages between agriculture and tourism could be derived are present, i.e., (i) arable lands to expand the production of vegetables for use in hotels and restaurants and (ii) a rapidly expanding tourist market. What is lacking are the appropriate institutional mechanisms to remove constraints that forestall effective, mutually-supportive connec-

tions between the two sectors. Such constraints include the quality of agricultural produce, undependable supply of produce, and high prices.

Other institutional weaknesses in the tourism sector result partly from:

(1) the lack of formal and informal consultative and collaborating mechanisms between agencies whose functions impact tourism;

(2) legal instruments that either restrict or fragment tourism management functions among agencies; and

(3) the lack of a mechanism to jointly plan (when appropriate) selected common marketing approaches for St. Kitts and Nevis.

Agencies with tourism functions in the state are listed in Table 4.2(1).

Table 4.2(1). St. Kitts-Nevis agencies with tourism functions.

AGENCY	FUNCTION
Ministry of Tourism and Labor	Tourism planning
St. Kitts Tourist Department	Tourism marketing, St. Kitts
Nevis Tourist Department	Tourism marketing, Nevis
Frigate Bay Development Corporation	Planning, development control and administration of the Frigate Bay Resort area
SEP Land Development and Conservation Board	Planning, development control and monitoring of development on the Southeast Peninsula
Physical Planning Unit	Statewide physical and land use planning
Central Marketing Corporation	Marketing of agricultural produce
Port Authority	Management of cruise ship docking activity
Ministry of Agriculture, Lands, Housing and Development	Policy and planning of tourism development
St. Kitts-Nevis Chamber of Industry and Commerce	Representation of private sector interest in tourism
Brimstone Hill Fortress National Park Society	Management of Brimstone Hill Fortification as a national park and tourist attraction
Investment Promotion Agency	Investment promotion for St. Kitts-Nevis, including tourism

Present land use planning and development control policy and practices illustrate the second point above. The Frigate Bay Development Corporation manages land use and development at the Frigate Bay resort area in accordance with a master plan. The enabling legislation in effect established a separate development and planning jurisdiction for Frigate Bay by giving to the Corporation authority to establish its own development guidelines. Land use and development control at the Southeast Peninsula are the responsibility of the SEP Land Development and Conservation Board (SEPLD&CB), which has established a different and more demanding, comprehensive and rigorous set of guidelines. While tourism projects for these two areas are subjected to a review process which, particularly in the case of the SEP, calls for consideration of environmental impacts in evaluating potential projects, effective procedures to ensure environmentally-compatible tourism development for the rest of the country do not exist; for example, there is no requirement at present that major tourism projects submit an Environmental Impact Assessment to Government prior to review of development applications. It should be noted, however, that although it is not widely known, GOSKN has for some time utilized an internal, *ad hoc*, interdisciplinary technical committee for project review and environmental compatibility/impact assessment screening.

The decentralization of responsibilities for the management of the land use aspects of tourism development (see Table 4.2(1)) is not likely to be cost-effective for the country and, furthermore, does not permit easy consolidation and sharing of technical expertise and management skills. The operation of three separate development control regimes, i.e., one each for Frigate Bay, the SEP, and the rest of the country, creates a financial burden and presents a problem in identifying appropriate technical skills to meet staffing requirements. Each calls for its own in-house technical capacity to evaluate and monitor tourism projects for both spatial and environmental harmony. Budgetary constraints and the difficulties in finding suitably qualified staff will unfortunately hinder the effective management of tourism land use by any of the development control regimes. In particular, the SEPLD&CB is facing budgetary problems, and while its development guidelines provide for an integrated comprehensive development control process for the Peninsula, its future effectiveness is nevertheless uncertain (Mohammed, 1990).

Institutional cohesiveness is also lacking in tourism investment promotion and in the marketing of the St. Kitts-Nevis destination. The Frigate Bay Development Corporation has done a commendable job in selling tourism development lots, but it took eighteen years to reach its present capacity. The investment performance of the SEP could also be quite sluggish. Investment promotion is fragmented among the several landowners of the SEP, some of whom may see no real urgency to develop their property. There is no formal or informal mechanism to foster cooperation between landowners in promoting investment or in the development of the SEP. Government's initiative in promoting investment of the area is inhibited by the fact that it does not own any land on the Peninsula and by the lack of a clearly defined instrument of GOSKN/landowner partnership for investment promotion.

St. Kitts and Nevis have separate Tourism Departments but share one budget for overseas promotion. Separate Departments seem more a product of circumstances than design. Thus, areas of cooperation have not been clearly defined. Each pursues its own initiative primarily in the interest of its own island. St. Kitts will employ a Product Development Officer in early 1991, who will manage the new tourist Shopping Mall in Basseterre and is expected to assist in the development of other tourist attractions solely in St. Kitts (pers. commun., L Richards, Permanent Secretary, Ministry of Tourism, 1990). Nevis, in turn, is pursuing its own attractions program. It is considering the development of Hamilton Estate into shops, restaurants and condominiums to attract and accommodate tourists.

In fact, it may be said that tourism investment policies and planning are being pursued along insular lines. Formalized mechanisms for ongoing participation of various interest groups in the evolution of tourism pol-

icy and in tourism planning is either lacking or inoperative. One observer has noted that a Committee created to advise the St. Kitts Tourist Department has not met in about two years (pers. commun., R. Skerritt, General Manager, Delisle Walwyn and Co. Ltd, 1990). The Permanent Secretary of the Ministry of Tourism (pers. commun., L. Richards, 1990) supports the creation of a Tourist Board to replace the Tourism Department. One advantage of having a Board is that it provides a vehicle for consultation between the public and private sectors in tourism policy and planning.

IMPLICATIONS OF TOURISM DEVELOPMENT POLICY

From the perspective of the amount of public spending committed to tourism infrastructure, it is clear that the industry is expected to provide the major thrust for the development of St. Kitts-Nevis in the near future. Infrastructure spending on the SEP project is at least EC$34 million, financed mainly from external grants and borrowing. The recovery of public investment is going to be slow, particularly if, according to Mohammed (1990), taxation on land transactions and annual land-related taxation are to be the major means of direct retrieval of the state's investment. This position overlooks the powerful revenue generating capacity of the room occupancy tax which becomes operational as hotel rooms come on stream. It has previously been estimated (Towle, *et al.*, 1986b) that even with a low-growth scenario (i.e., 1,250 plus rooms), the occupancy tax plus the airport departure tax from new SEP visitors will be sufficient to amortize the initial road costs (electricity and water costs should be self-amortized through SEP utility surcharges). The continuing uncertainty regarding the ability of GOSKN to service tourism-inspired debts from tourism revenue in the future -- caused in part by the slow and methodical SEP Board review procedures for hotel development schemes, which appears to delay the immediate receipt of project revenues -- is a small price to pay for not allowing ill-conceived or hastily-selected projects to set the standards or style for future SEP development.

The implications of Government's present tourism development policies require close scrutiny. Tax exemption for hotels over 200 rooms means that by far the majority of rooms in St. Kitts-Nevis in future years will come from large facilities. The policy places the small investor at a disadvantage and hints at the difficulties that the SEPLD&CB will experience in trying to keep development within the scale prescribed by land use planning efforts.

The fact that one of the projects put before the SEPLD&CB for review has in excess of 3,000 rooms indicates that questions of scale have not been carefully addressed. From an environmental point of view, one of the most critical infrastructure requirements for the SEP, i.e., sewage waste disposal, is still to be effectively resolved. Individualized treatment and disposal systems may suffice in the short term but will become problematic as more properties are constructed. The issue also raises several important questions. Can improved systems be made part of the permitting process by raising design standards and forcing the developer to bear the costs? Is the idea of a municipal or central facility inappropriate since there is no good reason for taxpayers to subsidize hotel development beyond and above the existing tax exemptions for large projects? How can a group of private developers be persuaded to cooperate on financing, building and operating a central sewage treatment system? Or could it be run as a profit-making venture by charging processing fees to each user hotel?

At the very least, GOSKN policymakers need to plan sufficiently well so as to avoid having to fund and operate a municipal facility for a group of wealthy landowners and corporations. This would not be very defensible from the taxpaying public point of view.

Major social impacts from current tourism policies can be expected. On the one hand, development of the SEP, the completion of Frigate Bay expansion, and substantially expanded tourism development in Nevis and other areas of the country will carry St. Kitts-Nevis well past the stage of full employment of its labor force. On the other hand, given the small size of the St. Kitts-Nevis labor

force, labor shortages are inevitable. Based on the experiences of other Caribbean islands with strong tourist economies, migrant labor will be needed to complement the local labor force. The resultant population increase will carry with it increased demands on infrastructure, schools and other services.

NEVIS

The Nevis Island Administration has expressed concern over several important issues related to tourism development in Nevis: the low occupancy rate (average 30 percent) for tourist facilities on the island, limited infrastructure for further development (i.e., utilities, port and airport facilities), foreign exchange leakage, requirements for additional training of islanders in the tourism sector, and the need for improved promotion/marketing schemes and statistical data (GOSKN, 1987d).

Alternatively, public and private sector cooperation in promoting the unique Nevisian "style" of tourism are considered by many to be a social and environmental benefit for the island. The fact that the tourist industry is growing at a slow, projected three percent annually (GOSKN, 1987d), has provided time for concerns about the pace of tourism development to be aired locally. Yet, perhaps one of the most frequently overlooked factors about tourism lies in the erratic and unpredictable nature of the sector. An example of this was provided in the aftermath of Hurricane Hugo in 1989 which crippled the tourism market in Nevis, throwing all previous projections off and effectively closing at least three hotels for the 1989-90 season. There is a question now whether two of the three will try to rebuild as they are for sale, and another projected hotel in the process of construction has gone bankrupt, partly due to hurricane damage.

INFRASTRUCTURE

Infrastructure concerns are presently occupying the attention of the NIA as the pace of tourism development has sharply accelerated within the last year. The 196-room Four Seasons Hotel is projected to open in 1991, and at least two other hotels are planning additions. This along with a strong private-sector building program is straining the electrical and water services of the island. The problem is whether an adequate level of new services can be put in place so that the general population is not affected by the type of shortages so common only a few years ago.

An airport development plan is now under consideration using the existing Newcastle facility. However, concerns have been voiced about such an upgrade, for example:

- The proposed path of the airstrip would cut through and endanger Nevis' oldest historic site, a redoubt built about 1650 and very possibly one of the oldest surviving structures of its type in the Caribbean;

- The lengthened airstrip would come within several hundred feet of the village of Newcastle, creating a potential safety hazard and adding to the noise pollution of the area.

The financing for this project requires completion of an EIA which has not yet been publicly announced.

The port facility in Charlestown is a primary bottle neck in the island's infrastructure system. The existing 368 foot (112 meters) pier is the only adequate boat landing site in Nevis. It is used by all types of ships, and most usually must wait before docking which discourages many pleasure craft and larger cruise ships from using the facility. The NIA has provided for expansion of the pier facilities, estimating the cost at EC$13,250,000 (GOSKN, 1987d); however, to date no funding has been identified and no work started.

TRAINING NEEDS

Anticipated increased room occupancy rates in the near future will ensure year-round employment for a greater number of Nevisians in the tourism sector. However, in

order to meet these requirements, additional training is needed, not only for semi-skilled tourism jobs; opportunities for middle management-level training also need to be created, particularly for the island's young people. Most training to date has been done off-island. The Hotel Training Facility at the St. Kitts-Nevis Technical College is currently upgrading its training in tourism-related skills development, and Nevis has also broken ground for construction of a new vocational school which will include tourism courses in its curriculum.

4.3 POLICY RECOMMENDATIONS

INSTITUTIONAL REFORM

A forum providing for creative dialogue between varied public and private sector interests would be useful in establishing a clear vision of the style and scale of tourism to be pursued by St. Kitts-Nevis in the future. Such a forum could also strengthen the review and evaluation process regarding major decisions made in the tourism sector. Additionally, recommendations for shaping policy and strategic planning for tourism could emerge from the discussions.

Other initiatives should seek to:

(1) Establish public and private sector working groups or committees to define sub-strategies of national tourism planning.

(2) Improve promotion and marketing through the restructuring of the agencies responsible for this function. One alternative could be the creation of a Tourist Board, whose composition would provide for formalized consultation and cooperation between the public and private sectors, which the Tourism Departments do not seem to provide on a consistent basis. This may be desirable in principle, but the relatively complex system of Government in the Federation suggests the need for thorough analysis of the range of alternatives available for institutional restructuring in this area.

(3) Explore ways for the Investment Promotion Agency to work closely with SEP landowners in promoting investment on the SEP and with small business developers in the local tourism sector.

(4) Extend the life of the SEPLD&CB and the regulatory functions in land management and environmental monitoring currently entrusted to the Board.

ATTRACTIONS DEVELOPMENT

A destination becomes inherently more marketable when tourists are provided with a wide choice of natural and cultural/historic heritage attractions. The potential list of attractions for promoting St. Kitts-Nevis and for generating income is only partially being tapped. The Ministry of Tourism should seek to coordinate a comprehensive program for the development, use and management of attractions as a vital element of tourism marketing and as a means to increase tourist expenditure (see also Section 5 of the Profile).

Ecotourism (or nature tourism) promotion for both islands should also be expanded. Nevis has already built a clientele of return visitors who are, in part, drawn to the island because of its natural features. Similar opportunities could be created in St. Kitts by emphasizing nature excursions and recreational trips into forested areas, e.g., rain forests to the north and dry forest and aquatic regimes on the Southeast Peninsula (see also Section 2.1 on Forest Resources and Section 2.3 on Wildlife). The ecotourism amenities of both islands need to be more fully addressed in the country's tourism marketing and promotional literature.

Underwater attractions can also be important. It is noteworthy that neighboring St. Eustatius is about to launch a full-scale inventory of coastal and marine resources likely to be of interest to tourists. A shipwreck in-

ventory is to be included. Secondly, the project includes a marketing plan to attract tourist SCUBA divers and snorkelers and a marine park plan -- all with a view to diversifying the tourism base to include visitors with a special interest in marine environments. The emphasis is on managing the resource.

Since St. Kitts and Nevis share the same underwater platform with St. Eustatius, perhaps the country should not let its neighbor get too much of a head start. In the meanwhile, St. Maarten, another neighboring island, is sending tourists by boat to dive on a gorgeous, unspoiled reef just off Sandy Point in St. Kitts. Perhaps a marine and coastal resource management plan could address the issue of what the country should do to protect the reef from visitor damage, to monitor its use, and to earn income from utilization of the resource, in part to cover costs of protection and monitoring. The matter of an appropriate license should also be reviewed.

Additional elements currently missing in the St. Kitts-Nevis touristic amenities framework and needing attention include:

- a group of museums and restored historic sites;
- active linkages with sports/health enthusiasts (e.g., hiking, biking);
- research-based tourism, e.g., scientific visitors;
- campground tourism;
- active NGO participation in tourism planning and in interpreting the country to visitors.

MAINTAIN DIVERSITY

An overall national emphasis on diversification should not be diverted by too heavy a reliance on a narrowly-defined tourism industry as an economic panacea. For some time, the economy of St. Kitts-Nevis has been diversifying away from traditional sugar exports toward tourism, light manufacturing and local agriculture in St. Kitts. In Nevis, the mix has been on local agricultural production, improvements in the fishing sector, and a more modest increase in industrialization along with tourism development. Both of these approaches are certainly defensible and practical. A more balanced economy will certainly help the country to weather crises more effectively, e.g., worldwide recessions or natural disasters such as the dislocations associated with Hurricane Hugo in 1989. But the principle of diversification can be applied to the tourism sector itself. On a small scale, there is room in the state for a continuation of a risk-spreading mix of touristic enterprises. Whether by plan or happenstance, the country's emerging mix is not just diversified but decentralized -- each prototype (i.e., Frigate Bay, "The Inns of Nevis," the Southeast Peninsula, rural guest houses) suited to its own location where each "style" can establish its own adjacent amenity set and its own customized activities agenda and quality controls.

USE OF LOCAL INPUTS

As St. Kitts-Nevis continues to expand in the tourism sector, it will be more difficult to maintain the current level of local resource utilization. In other words, as the number of tourists increases, there will be a tendency to increase the marginal purchase of imported goods and services to support them. For example, the issue will not be how to increase the sales of local produce; it is likely to become one of how to avoid reducing such purchases. Resource managers from both the private and public sectors should meet from time to time with leaders of the tourism industry to identify those sectors which should be "abandoned" to imports and those where better planning can actually increase the local content of the tourist product.

In another context, by vigorous recruitment of overseas resident Kittitians and Nevisians, it may be possible to hold a larger portion of middle and upper management positions in the tourism industry for local "repatriates", a reverse brain drain which can have multiple advantages from the viewpoint of public policy. To some extent this is occurring, but with active recruiting it could become more of a reality.

Brimstone Hill, St. Kitts -- a great expanse of walls, arches, buildings and paved areas -- was the crowning achievement of the British defense system for the island. This monumental fortress constitutes one of the most impressive military landmarks in the New World. It is the country's only officially-designated national park and also an important tourist attraction.

SECTION 5 HISTORICAL RESOURCES, NATIONAL PARKS AND PROTECTED AREAS

5.1 OVERVIEW

5.1.1 Historical Resources

The people of St. Kitts-Nevis possess a deep sense of their historical development and of the role their country has played in the unfolding drama of Caribbean history and culture. It is a source of considerable pride that their nation is recognized as the "Mother Colony" or "Cradle" of the Eastern Caribbean. Their pride and sensitivity is awakened and nurtured by the abundant physical evidence of the past that surrounds them and infuses their daily lives. The past is present not only in myriad historic buildings and sites but in the very landscape that has been fashioned by some 5,000 years of continuous human interaction with the natural environment.

Unfortunately, this sense of national pride has not yet led to widespread recognition of the inherent qualities of indigenous historical and cultural resources or produced a unified program for their preservation, management and enhancement. This inertia, however, should not be mistaken for indifference. Rather it derives partly from familiarity and partly from a social and educational system that has failed to adequately instill appreciation of local history, creativity and uniqueness.

It also proceeds from the fact that until very recently historical endowments were threatened by little more than natural deterioration and the forces of nature. However, as the pace of socio-economic change quickens, as the scale and scope of development widens, and as awareness of national identity becomes more firmly rooted and understood, there has arisen an emerging concern and growing consensus that the historical/cultural heritage must be incorporated into development planning and management programs before it is irrevocably lost.

While there have already been some grave losses, there have also been some impressive accomplishments, most notably the restoration of Brimstone Hill and its designation as a National Park. Conversion of several plantation sites into small hotels and inns has demonstrated that preservation can generate economic returns. Within the past decade broad-based preservation organizations have been established, and preservation legislation has been enacted. Local firms are becoming aware that preservation can be good business. While the impact of these initiatives is only now beginning to be felt and much remains to be done before positive results can be claimed, the future appears to be bright. What is needed at this juncture is the will and determination to use the resources of the present to preserve those of the past.

RESOURCE BASE

The country of St. Kitts and Nevis is richly endowed with a diversity of widely distributed cultural resources. They consist of prehistoric and historic archaeological sites, plantation settlement sites, churches, schools, fortifications, and historic towns and villages. Several of these landmarks, including Brimstone Hill, the Great Pond and Sugar Factory archaeological sites, Old Road Town, and Fountain Estate in St. Kitts and the Bath Hotel in Nevis, are regionally as well as locally important.

A comprehensive survey and assessment of all historic and archaeological properties does not exist. A partial descriptive inventory of historic sites was compiled in 1974 by Island Resources Foundation on behalf of the Caribbean Conservation Association (Tyson and Tyson, 1974). Hobson (1987) carried out a survey of Nevis historical landmarks on behalf of the Nevis Historical and Conservation Society (NHCS). Additionally, documentation and/or reports on historic sites in Nevis are maintained in the Archives of Nevis History at NHCS. The Hobson (1987) inven-

tory includes approximately 100 individual site reports with survey forms and is currently being computerized by NHCS. Twenty-six of these historic sites have been marked with signs, and a brochure -- *Nevis Walking and Riding Tour* -- is available for use by the public.

Several, but far from all, prehistoric archaeological sites have been documented by archaeologists (e.g., Branch, 1907; Hoffman, 1973; Allaire, 1974; Goodwin, 1978, 1980; Armstrong, 1980; Wilson, 1984, 1985, 1989; Nicholson, 1985). A few historical archaeological sites in the Southeast Peninsula have been recorded by Nicholson (1985), while Marx (1971) has made an incomplete tabulation of shipwrecks.

It is imperative that a comprehensive and officially-recognized inventory of the nation's historical and archaeological sites be completed as soon as possible. Nevis has make a good start in this direction already. A national inventory or "register" should not only locate and identify all known sites but should evaluate and rank them according to significance, condition, preservation needs and reuse potential. Without such a planning tool, informed management decisions cannot be made, and protective provisions of the National Conservation and Environment Protection Act of 1987 (NCEPA) cannot be brought into full force.

Plantations. Plantation settlement complexes are the most ubiquitous group of historic sites found within St. Kitts-Nevis. The D.O.S. 1979 map for St. Kitts-Nevis depicts approximately 100 plantation settlements with structural remains on both islands. Undoubtedly many other sites, with less visible ruins, escaped the attention of the mapmakers.

All of the mapped sites were associated with sugar production and so contain a complex of structures, including plantation houses, factories, mills (wind and steam) and (sometimes) worker housing. Some, mainly those on Nevis, also cultivated cotton or became stock estates. Many complexes, as well as their individual structures, are remarkably intact. This is particularly true on St. Kitts, where the plantations remained operational until quite recently. Several planters' houses are still inhabited, and a few buildings are being used as storage depots. Machinery for processing sugar and cotton can still be found at some sites.

The majority of plantation sites are privately owned. Of these, a handful are still being operated for agricultural purposes by owners or tenants. Others serve as private residences. Several have been partially restored and converted into small, luxury hotels/inns, which are being operated very successfully in both Nevis and St. Kitts. In Nevis, at least a dozen wind mills and many great houses and sugar production structures have been restored or reconstructed. At least one site (Romneys in St. Kitts) is utilized as a small batik factory. Another (Morning Star in Nevis) houses a small museum. However, only one (Golden Rock in Nevis) is being used to interpret the sugar industry to residents and tourists.

Government gained possession of several plantation sites when it acquired the sugar lands on St. Kitts in 1974. Most of these settlements are currently occupied by equipment and managers of the Sugar Manufacturing Corporation. A few seem to have been abandoned altogether. Whether occupied or abandoned, the government-owned properties are poorly maintained. Many buildings are roofless and falling into ruin. Moreover, some structures, including mill towers and chimneys, are being dismantled by islanders seeking cut stone for reuse elsewhere. Government seemingly does little or nothing to discourage this regrettable practice.

While it might be argued that employment of plantation sites as storage depots and construction quarries does contribute to the national development process, this usage hardly constitutes the best and most productive utilization of these valuable resources. Many sites can and should be converted into small hotels and inns. Others could become factory shells. Some could be adapted to meet the housing shortage, thereby discouraging movement from the countryside to, for example, Basseterre and Sandy Point. Lastly, a few could become recreational and educational sites. Certainly, one on each island

HISTORIC INNS OF ST. KITTS-NEVIS:
A Strategy For Economic Development Through Preservation

While St. Kitts-Nevis is faced with accelerating deterioration and loss of many of its historic plantation sites, members of its business community are demonstrating how these complexes can be saved through adaptive reuse as small hotels and inns. Their positive example of economic development through preservation suggests one attractive national strategy for saving and recycling these assets into the new economic order.

Currently there are about a dozen historic inns operating in St. Kitts and Nevis, and the number is growing. These resorts attract guests by offering low-key, high quality, personalized service within historic settings. Compared to many other hotels, they have a high rate of return visitors, a high percentage of long-term guests and a high rate of expenditure per guest. The local Hotel Association recognizes that hotels of this scale and character are among the most profitable in the region, as well as most suitable to Caribbean culture and environment (Walwyn, 1989).

All of the SKN owners interviewed during the course of the CEP project were very enthusiastic about their current rate of return and future prospects. All believed there was considerable room for expansion of this component of the tourist industry, and all advocated greater Government involvement in promoting this highly successful form of heritage tourism.

Government could encourage this positive trend, which up to now has depended almost exclusively on private sector initiative, by selling or leasing suitable plantation sites for development as historic inns, by providing economic incentives (such as property and excise tax exemptions) for rehabilitation projects, and by actively marketing the historic inns and historic sites generally in its tourism advertising campaigns.

According to one tourism expert (Beekhuis, 1985), historic sites and historic charm are two of the five main tourist attractions of St. Kitts-Nevis. Government should do everything possible to capitalize on these valuable resources.

needs to be carefully restored in order to interpret the central role of the sugar plantations in shaping the history and culture of the nation.

It has long been recognized that Fountain Plantation on St. Kitts, the former residence of the French Governor de Poincy, could become a major attraction for residents and visitors alike. One expert (Buisseret, 1983) proclaimed it the most neglected historic asset in the Caribbean and recommended its immediate restoration. The Ministry of Tourism and the OAS have prepared a conservation and enhancement plan for the site (OAS/GOSKN, 1990) that merits prompt implementation.

The preservation and imaginative reuse of plantation sites can contribute significantly to meeting many of the current economic, social and educational development goals of St. Kitts-Nevis, as stated in the current Development Plans for both islands. Moreover, these benefits can be achieved with limited public expenditure, while encouraging private sector investment and job creation. However, given the rate of structural loss and deterioration, a strategy needs to be devised and implemented as soon as possible, or valuable assets will be forfeited and costs will escalate.

Fortifications. Two centuries of incessant warfare led to the construction and

reconstruction of numerous fortifications on St. Kitts-Nevis, nearly all of which were located on promontories along the leeward coastlines. The crowning achievement of this insular defense system was, of course, the monumental fortress at Brimstone Hill, which constitutes, along with Henri Christophe's Citadel in Haiti, the most impressive military landmark in the Caribbean and one of the most impressive in the New World. This fortress, which has been nominated as a World Heritage Site, is managed by the Brimstone Hill Fortress National Park Society and is the country's only National Park.

The restoration of Brimstone Hill as a scenic and educational attraction for both residents and tourists is a marvelous example of how historic resources can contribute to the economic and cultural development of the nation. Unfortunately, other lesser military sites do not receive the attention they deserve, and several are in danger of disappearing completely.

Excluding Brimstone Hill, there are eleven extant coastal fortifications in St. Kitts and two primary sites in Nevis, all of which are state-owned. Two of these, Charles Fort in St. Kitts and Fort Charles in Nevis, are true forts. The others are little more than coastal batteries. In St. Kitts, except for Charles Fort (which has been used as a leper asylum), all of these sites are in varying states of ruin. Charles Fort and the surviving structures at Fort Thomas are maintained by Government, but the remainder are sadly neglected. Most are being eroded and undermined by the sea and vandalized by stone hunters. Few are accessible to residents or visitors.

In Nevis, the most important military site is Fort Charles, located just outside of Charlestown. Management of the Fort, which is primarily of local rather than regional importance, has been vested in the NHCS which, until 1987, kept the site clean and open to the public. In 1987, the Fort was leased by the Nevis Island Administration (NIA) to a private contractor for a hotel development. That project subsequently went bankrupt, and therefore the fate of the Fort is once more in question. It is no longer accessible to the public as the potential developer put fencing around the structure before abandoning the project.

A second military site in Nevis, Saddle Hill fortification, is inaccessible by vehicles and can only be approached after a mile hike through the bush. There are 16 other military sites that have been identified and mapped on the island.

All of these sites, in both Nevis and St. Kitts, possess historical interest, as well as scenic, recreational and educational values, which could be tapped by minimum expenditures on access trails, clean-up, stabilization and posting of interpretative markers.

Churches. The deeply religious character of the people of St. Kitts-Nevis is reflected in the many historic churches found in the towns and rural villages of the country. These places of worship have never been fully recorded. Tyson and Tyson (1974) list six on St. Kitts and two on Nevis, but others have been documented elsewhere (e.g., Manchester, 1972; Innis, 1985; and Hobson, 1987), including ten church sites in Nevis which the Nevis Historical and Conservation Society has recommended on its list of proposed protected sites for that island.

All surviving historic churches date from the nineteenth or early twentieth centuries, although a few have been built upon eighteenth century foundations. The Anglican churches have historic cemeteries containing many eighteenth and nineteenth century gravestones. Several churches are still attended and consequently are kept in a reasonably good state of repair by their congregations. Others are in need of maintenance. A few, like the Methodist Church at Palmetto Point, have fallen into ruin.

Historic Towns and Villages. The towns and villages of St. Kitts-Nevis possess great charm and historic interest due to their distinctive West Indian architecture. Although ravaged by fires, hurricanes and other disasters, Charlestown, Sandy Point, Old Road, Dieppe Bay and especially Basseterre still contain several historic buildings dating

THE SUCCESS STORY OF BRIMSTONE HILL *

For decades following abandonment of the Brimstone Hill fortification by the British in 1852, the site was only used for occasional excursions by local people; while some road clearing and cutting did take place from time to time, the magnificent site gradually fell into a state of considerable disrepair.

The Society for the Restoration of Brimstone Hill was formed in 1965 and was granted a lease by Government for a 21 year period at a nominal rental fee. Government also provided a modest annual grant and after 1980 refunded to the Society all entrance fees collected by the group. Over the years, an active partnership between Government (which owned the site) and the Society (which managed and developed the fortification) emerged, and it was this harmonious relationship between the public and private sectors which in large measure made the achievements at Brimstone Hill possible.

Development of the site proceeded on a year-by-year, project-by-project basis, with some early funding available simply because the Society was ready at an opportune time with a sound project idea -- for example, restoration work at the Prince of Wales Bastion in the early 1970's was supported by the Caribbean Conservation Association, the first such grant to be made by the CCA. Over the years, the Society gained a reputation as an organization able to stretch dollars to achieve objectives -- e.g., use of prison laborers to double the work force provided by the Public Works Department for land clearing and the establishment of a training program with the local technical college whose classes in building trades used Brimstone as a training site. "Prudent expenditure of limited resources," says former Society President, D. Lloyd Matheson, "enlarged the impact of available dollars and enhanced Brimstone's credibility with funders."

While focusing on preservation of the historical integrity of the site, no building or series of buildings at Brimstone Hill were restored for the sake of preservation alone. Practical, contemporary uses for restored building sites were carefully identified over the years, while a closer integration of Brimstone Hill into the community life of St. Kitts always was a primary objective.

By 1986, when the Society's lease with Government for use of the fortification had expired, Brimstone Hill had been declared a national park; by that time, the imposing fortress had not only emerged as the country's number one tourist attraction but, equally important, Brimstone's role as the country's leading national historical monument had been restored.

* Extracted from J. Towle (ed.), The Uses of Historical Resources in Eastern Caribbean Island Development: Report of A Workshop Held at Brimstone Hill, St. Kitts, October 21-23, 1983.

from the late nineteenth and early twentieth centuries. However, it is the many vernacular buildings found throughout these towns and many rural villages, like Middle Island Village, that define their special character and attractiveness.

Unfortunately modern intrusions have begun to mar the traditional ambiance of these communities. In recent years a number of lovely wooden buildings have been torn down and replaced by poorly scaled, inappropriately designed, block buildings that are conspicuously incompatible with their historic

surroundings. Existing "zoning" laws and building codes do not provide adequate controls and are seldom enforced. Government, which owns several downtown properties in Basseterre, has been one of the foremost offenders. Given the growing movement of rural families into Basseterre and mounting property values, these destructive trends will continue and accelerate unless positive regulatory action is forthcoming.

Concern that Basseterre will shortly lose its distinctive architectural heritage if the pace of modernization continues unabated has led the Chamber of Industry and Commerce to establish the Basseterre Beautification Committee, whose purpose is to preserve and enhance the historic character of the town. To date, the Committee has promoted the beautification of Independence Square; initiated a public education campaign to foster appreciation of Basseterre's architectural heritage; and persuaded several businesses to make improvements or construct new buildings that are compatible with surrounding structures. Moreover, some businesses have begun to voluntarily construct new buildings that incorporate traditional West Indian design elements.

Charlestown in Nevis contains a high proportion of colonial two-story structures, most built following a fire in 1873. However, some date to the early nineteenth century and are of stone construction. Newcastle, a smaller town, contains a number of interesting buildings of an obviously grander style than most others in Nevis and reflects a period of prosperity when Newcastle was a major shipping port of Nevis (Hobson, 1987).

The only officially designated historic site in Nevis is the Bath Hotel, located just outside of Charlestown, which is included by reference in the National Conservation and Environment Protection Act. In 1987, a feasibility study for the site was funded by CDB (Gillespie, Steele and Associates, 1987) which outlines a plan for its restoration and use as a health spa.

Over and above specific restoration activities for single sites such as that proposed for the Bath Hotel, there is a need for the establishment of historic districts or zones and more effective building controls, if the historic and traditional qualities of Basseterre, Charlestown and other urban areas are to be effectively preserved.

Archaeological Sites. Human occupation of St. Kitts-Nevis commenced some 5000 years ago and has been more or less continuous ever since. Most of the surviving physical evidence of this long settlement history lies buried beneath insular soil and surrounding waters. These archaeological remains can be sub-divided into three types of sites: 1) prehistoric, 2) historic, and 3) shipwrecks. Their number and distribution is unknown, as they have been only partially surveyed and recorded. Several of these sites have regional as well as national importance, and consequently the people of St. Kitts-Nevis have a special responsibility for their preservation.

Prehistoric Archaeological Sites. Over 25 prehistoric sites on St. Kitts-Nevis have so far been documented by archaeologists (Branch, 1907; Hoffman, 1973; Allaire, 1974; Goodwin, 1978, 1980; Armstrong, 1980; Wilson, 1984, 1985, 1988, 1989; Nicholson, 1986). Most of these are located on St. Kitts, where they are widely distributed. The oldest sites have been radio-carbon dated to 3000 B.C.

At least three of the known sites in St. Kitts are regionally significant. Two of them, the Archaic sites at Sugar Factory Pier and the Great Salt Pond in the Southeast Peninsula, are among the oldest known sites in the Antilles (Goodwin 1978; Armstrong 1980). The site located between Old Road and Bloody Point is one of the few clearly documented settlements of the Antillean Caribs and the home of Chief Tegreman, the first identifiable Kittitian. All three sites, along with others in the vicinity of Basseterre, have been seriously damaged and are in danger of being completely destroyed by encroaching, government-sponsored development.

Only a few prehistoric sites have been scientifically excavated and reported. In St.

Kitts, some of the recovered artifacts have been turned over to the Brimstone Hill Society, which stores and displays them at its Museum in Fort George. The museum also has artifacts that have been found throughout the island by local residents. Many other artifacts have been taken out of the nation by treasure hunters as well as professional archaeologists. The collection at Brimstone Hill is in need of curation and conservation (pers. commun., D.L. Matheson, former President, Society for the Restoration of Brimstone Hill, 1990).

Prehistoric archaeological sites in Nevis have been inventoried and reported on by Wilson (1984, 1985, 1988, 1989). Figure 5.1(1) and Table 5.1(i) document Wilson's work. Excavations of two sites were performed in 1985, 1986 and 1987. Artifacts have been curated by the NHCS and used in exhibitions at its museum. Some radio-carbon dating has also been done.

Historic Archaeological Sites. St. Kitts and Nevis are dotted with the archaeological remains of some 1,400 historic settlement sites that were abandoned and fell into ruin prior to 1900. Nicholson (1985) has located and dated eight of these in the Southeast Peninsula. Systematic, sub-surface testing would most certainly reveal many others there and elsewhere. Of such sites, the most important are those of the seventeenth century English and French settlers, which can contribute immeasurably to our otherwise rudimentary understanding of early colonial history and culture in the region.

The single most significant historic archaeological site is undoubtedly Old Road Village in St. Kitts, which contains ruins and artifacts associated with the first permanent European settlement in the Lesser Antilles. The De Poincy Chateau is another important site.

Shipwrecks and Other Submerged Sites. There is no complete count of shipwrecks in the waters surrounding St. Kitts-Nevis, but the number is substantial. The most informative source (Marx, 1971) found documentation of over 400 marine disasters between 1629 and 1823. Using this figure as a basis, it can be conservatively estimated that there have been no less than 600 shipwrecks within national boundaries. A few of these have been found and randomly salvaged by divers, but most await discovery. These wreck sites represent veritable time capsules, whose scientific excavation can add immeasurably to our knowledge of the maritime heritage of the nation and region.

In addition, much of the town of Jamestown (Nevis), including its fort, sank into the sea during an earthquake in 1680 (Marx, 1971). Due to sea level rise, many prehistoric sites are now under water.

MUSEUMS

The only museum in St. Kitts is housed within Fort George at Brimstone Hill. Maintained by the Brimstone Hill Society, its collection consists largely of historic artifacts found around Brimstone Hill, prehistoric artifacts, military uniforms and copies of historic maps, prints and documents. Much of the collection is on display.

The island of Nevis has two museums open to the public. The Nelson Museum at Morning Star is a private collection which opened in 1962 and has on display over 500 artifacts concerning Lord Horatio Nelson. In March of 1990, the Nevis Historical and Conservation Society was formally presented with the Nelson collection and broke ground for a new museum building to house what is believed to the largest collection of Nelson memorabilia in the Western Hemisphere. The facility is projected to open in early 1991.

The island's second museum, the Museum of Nevis History at Alexander Hamilton's birthplace in Charlestown, was opened in 1983. The building is a reconstructed two story Georgian-style structure owned by the Nevis Island Administration. The ground floor contains the museum, NHCS offices and the Archives of Nevis History managed by the Society. The upper floor is the Nevis House of Assembly. NIA provides the museum facilities rent-free, while NHCS helps to maintain the building.

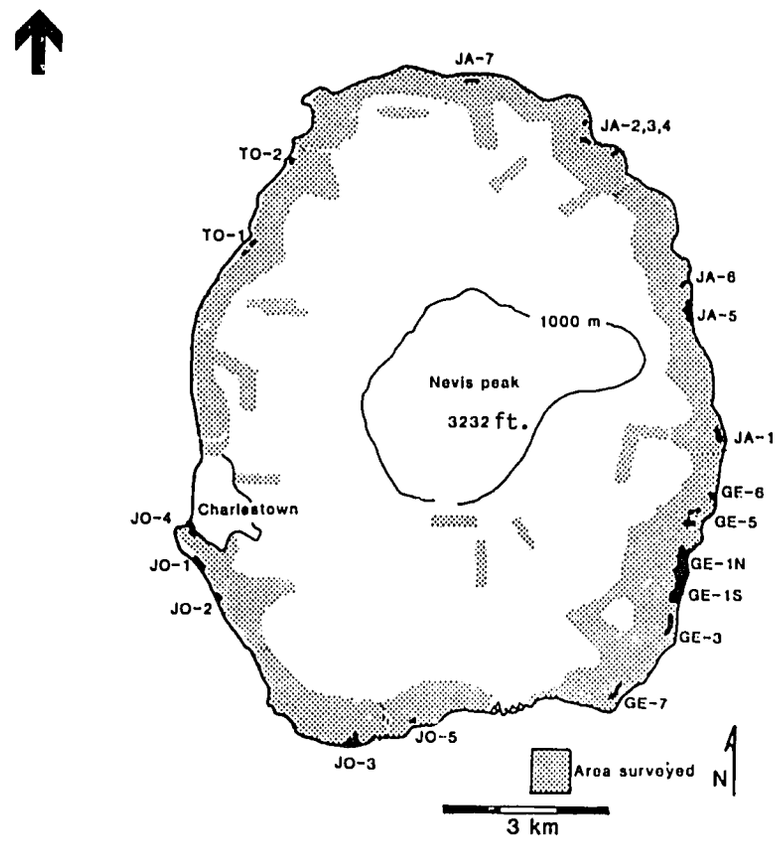


Figure 5.1(1). Surveyed Amerindian sites of Nevis (source: Wilson, 1989).

Table 5.1(1). Prehistoric sites on Nevis. (Period 1 is aceramic, Period 2 is Saladoid, and Period 3 is Ostinoid; measurements are in meters.)

Period	*Code*	*Name*	*Quad east*	*Quad north*	*Area (sq m)*	*Length*	*Width*	*Depth*	*Volume (cu m)*	*Distance from coast*	*Elevation*
1	JA-7	Nisbetts	338	1903	270	30	9	0.25	67.5	100	10
	GE-6	Hichmans' Shell Heap	342	1895	250	25	10	0.40	100	5	8
2	GE-5	Hichmans'	342	1895	8800	110	80	0.50	4400	100	30
	GE-1N	Indian Castle N	341	1894	300	30	10	0.25	75	8	15
	GE-1S	Indian Castle S	341	1894	68750	550	125	0.60	41250	0	10
3	JA-5	Butlers	341	1898	8400	120	70	0.40	3360	10	5
	JA-1	Cocoanut Walk	342	1896	5500	110	50	0.40	3850	30	15
	GE-3	IC2	341	1893	3750	125	30	0.30	687.5	30	8
	JA-6	Tittle Ghut	341	1899	3200	80	40	0.40	1280	25	15
	GE-7	Indian Castle Estate	340	1892	2450	70	35	0.40	980	25	8
	JO-2	Bath Plain 2	333	1893	1200	40	30	0.70	840	5	5
	JO-1	Bath Plain 1	332	1894	1000	50	20	0.60	600	5	5
	JA-2	Hick's Cove	341	1901	750	30	25	0.25	187.5	10	15
	JO-5	Whitehall	338	1891	750	30	25	0.10	75	15	15
	JA-3	Hick's Cove	340	1901	625	25	25	0.25	156.25	10	10
	JO-3	Lighthouse	335	1890	600	30	20	0.70	420	5	5
	JA-8	Newcastle	337	1903	450	30	15	0.25	112.5	30	10
	TO-2	Cade's Bay	335	1900	300	30	10	0.25	75	5	5
	JA-4	Hick's Cove	340	1901	250	25	10	0.25	62.5	30	10
	TO-1	Nelson Springs	333	1899	250	25	10	0.40	100	10	10
	JO-4	Bath Stream mouth	332	1894	150	15	10	0.40	60	0	5

Source: Wilson, 1989.

NHCS hopes to eventually build a new Museum of Nevis History and Pre-history on the land now being developed for the Nelson Museum. That museum complex is located in Belle Vue next to Government House.

GOSKN recently offered land on Independence Square to the Chamber of Industry and Commerce for the purpose of establishing a museum in Basseterre. The St. Christopher Heritage Society has also become involved in these discussions. The private sector would have to raise construction funds and would be responsible for museum administration and artifact acquisition. Other potential museum sites, including the Treasury Building on the waterfront, are also under consideration.

5.1.2 Natural Resources

At the present time, St. Kitts and Nevis have no formally designated natural parks or protected areas, complete with designated and surveyed boundaries, established goals and objectives, management plans, and management team.

There are, however, various lists and even studies of prospective, recommended sites -- some habitat-focused, some wildlife-focused, and a few -- mostly from Nevis -- that deal with the protection of landscape features or what is sometimes referred to as the visual component of environmental quality control.

A selected list of natural areas or environmental features which have been recommended for protected area status is presented as Table 5.1(2) and Figure 5.1(2). Clearly, there are other possible candidates awaiting identification in a formal and standardized national inventory and assessment, which has yet to carried out in the country.

An example of the present level of *ad hoc* site assessment which is indicative of parks and protected area planning in the State to date is the recent preparation of a marine park plan for the Newcastle area by the Nevis Historical and Conservation Society (prepared under a grant from UNDP). It is now being studied by both the NIA and private investors prior to submission to the National Conservation Commission for consideration as a designated protected area. A marine park site at Cades Bay was also called for as part of a zoning proposal developed for the NIA (Corker, 1988a). Recent research indicates that the Newcastle site is superior in the variety of fish and other sea life present; additionally, the Cades Bay site may be threatened by development proposals for a ferry service and hotel.

Considering the country as a whole, the best examples of all ecological community types need to be demarcated and set aside as protected areas, with proper management regimes. The present generation would be derelict in its responsibilities to its children and to future generations of Kittitians and Nevisians if it deprived them of the opportunity to view, to learn and to benefit from a healthy environment as reflected in all its present richness, diversity, beauty and subtlety.

Generally, once an official inventory and assessment is completed and selected areas and sites have been demarcated with appropriate management plans in place, the resultant institutional framework is designated a "parks and protected areas system". Such systems (which may include both natural and historical/cultural features) are actually a set of multi-purpose management strategies. They contribute to the quality of life of both inhabitants and visitors because this combination of strategies guarantees:

- the productivity of commercial species and non-commercial species that have economic significance and that depend on and contribute to a high level of biological diversity and quality environment;

- the protection of endangered species and the life support systems of other wildlife species;

Table 5.1(2). Proposed protected areas for selected natural resources, St. Kitts-Nevis.

AREA	REASON FOR PROTECTION
ST. KITTS	
- MT. LIAMIGUA CENTRAL RANGE "NATIONAL PARK" *(Carter, 1944; ECNAMP, 1980b)*	Forest and habitat protection; soil, water, and species conservation; recreation
- GUANA ISLAND "MARINE RESERVE" *(Towle, et al., 1986a)*	Habitat protection; high productivity
- NAGSHEAD "WILDLIFE RESERVE", including Green Point *(Towle, et al., 1986a)*	Species protection (Magnificent Frigate Bird, Brown Pelican)
- BLACK ROCKS "NATURAL MONUMENT" *(OAS)*	Unique lava phenomena; public education
- SOUTHEAST PENINSULA "MARINE PARK" *(Wilcox, 1989a; Walters, 1990)*	Reef protection; recreation
- GREATHEEDS POND *(Ministry of Agriculture)*	Primary freshwater pond in St. Kitts; extensively used by migratory waterfowl and shorebirds
- SANDY POINT REEF "MARINE RECREATION AREA" (or marine reserve)	Reef protection; recreation
- SOUTHEAST PENINSULA SALT PONDS "AVIAN SANCTUARY" *(Towle, et al., 1986a)*	Species protection; ecotourism
NEVIS	
- NEVIS PEAK "NATIONAL PARK" *(NHCS)*	Forest and habitat protection; soil, water, and species conservation; recreation
- GALLOWS BAY BOG *(NHCS)*	Wetland habitat; species protection
- SADDLE HILL *(NHCS)*	Historic and scenic value
- ROUND HILL/HURRICANE HILL *(NHCS)*	Bird habitat
- HURRICANE BAY "RESERVE" *(NHCS)*	Turtle nesting
- CADES BAY "MARINE PARK" *(Corker, 1988a)*	Reef habitat; Amerindian site; recreation
- NEW CASTLE "MARINE PARK" *(NHCS)*	Reef protection; recreation

NOTES:

1) The source of the recommendation is shown in parentheses.
2) Additional "protected area" recommendations have been made by the NHCS and submitted to the National Conservation Commission; they are also on file at NHCS headquarters in Charlestown.

- retention of unaltered functional examples of the country's natural heritage;
- continued economic development for those sectors that use the landscape (e.g., agriculture, tourism);

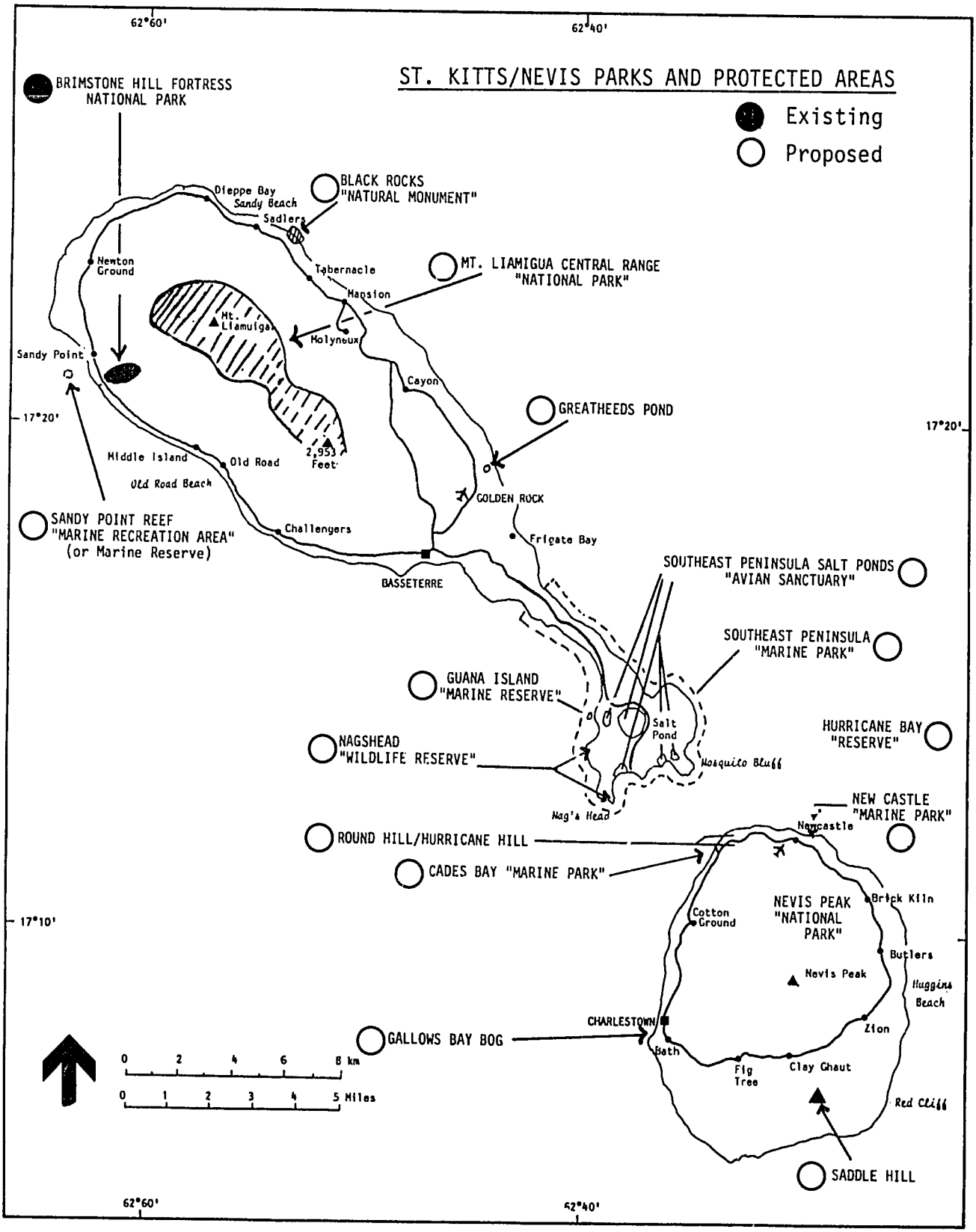


Figure 5.1(2). Parks and protected areas, St. Kitts and Nevis.

opportunities for future study and interpretation of the country's natural and cultural heritage.

Development of a management framework is discussed in the next sub-section.

5.1.3 Parks and Protected Areas System

HISTORICAL RESOURCES

The National Conservation and Environment Act of 1987 (NCEPA) is the basic mechanism for protecting and managing the nation's natural and cultural resources. This far-reaching and generally enlightened law authorizes:

1) Protected area status and management for "designated" historic and archaeological sites;

2) Fines for the removal and export of artifacts (including those within territorial waters) without an official license;

3) Development controls and rehabilitation incentives for "listed" buildings;

4) The issuance of regulations for preventing the deterioration of historic sites, buildings and monuments;

5) Incentives for restoration of historic buildings;

6) Requirements for licenses, bonds, salvage plans, and evidence of scientific competence for certain activities cited in the legislation;

7) Penalties for damaging any historic building or site.

These powers are vested in the Minister of Agriculture, Lands, Housing and Development, who is to act in consultation with, and with the recommendations of, an independent Conservation Commission also established under the Act.

Historic and archaeological sites designated as protected areas can be managed (in accordance with a site-specific management plan) as either a "National Park" or an "Historic Site". While not expressly stated, a site or set of sites could also be managed as part of a "nature reserve", "scenic site", "botanic garden", "marine reserve" or "area of special concern".

The Conservation Commission, established under the legislation (see also Section 8), is authorized to designate sites as protected areas and prepare management plans. Site administration may be by the Conservation Commission or by a "competent authority" designated by the Minister. Other arrangements are also possible, a good example of which is the ongoing relationship between NHCS and the NIA which provides for the residency and building custodial care of Hamilton House by the Society.

To date only two sites have been designated as protected areas and they are both historical resources: Brimstone Hill as a National Park, administered by the Brimstone Hill Society and the Bath Hotel in Nevis as a Historic Site, with no designated administration under the Act. The St. Christopher Heritage Society and the Nevis Historical and Conservation Society have developed lists of sites meriting designation under the provisions of the NCEPA, but no action has yet been taken on these preliminary recommendations. At some point, probably on request from the Commission, the two NGOs will launch projects to upgrade their inventories to a professional standard with more formal classifications, vetting, documentation, and ranking procedures regarding importance, risk analysis, and comparative costs for protection, stabilization, and restoration strategies spelled out in a well-ordered planning report with suggested management and funding schemes and schedules.

In a similar vein, no action has been taken by the Conservation Commission with

THE NATIONAL CONSERVATION AND ENVIRONMENT PROTECTION ACT (1987)

The National Conservation and Environment Protection Act (No. 5 of 1987):

- provides for the selection and establishment of protected areas (national parks, nature reserves, botanic gardens, historic sites, or areas of special concern)
- creates a Conservation Commission to advise the Minister of Development on conservation matters and the administration of protected areas, and to function as a corporate body in respect to property held in trust
- requires preparation of management plans for protected areas
- establishes Brimstone Hill Fortress National Park and Bath Hotel Historical Site
- establishes public right to access and recreational use of all beaches
- requires the preparation and implementation of a coastal zone management plan to regulate development activities in the coastal zone
- prohibits unauthorized sand mining and removal of beach vegetation
- prohibits waste disposal within the coastal zone
- provides for establishment of soil conservation regulations
- declares ghauts to be areas of special concern
- provides for the establishment of forest reserves and necessary regulations to protect them
- provides for the protection of designated wild animals and birds
- prohibits unauthorized search and recovery of antiquities
- promotes conservation in the Federation as a part of long-term development planning.

respect to a list of "special buildings" within Basseterre requiring protection developed by the Beautiful Basseterre Committee. Lists of special buildings in other towns and villages have not been prepared.

NCEPA does provide immediate, albeit limited, protection for terrestrial and submerged archaeological sites by stipulating that removal of any artifact requires a license. While this provision does regulate "search", "excavation" and "salvage", seemingly it does not prohibit demolition or damage to sites by development or other earth-change activities, which constitute the most serious threat to archaeological sites. Such protection would ex-

ist if the terms "excavation" and "digs" were to be broadly interpreted.

In short, the protective and management provisions of NCEPA relating to historic properties are more potential than real at this time. Moreover, there is a need to clarify its application to the SEP and Frigate Bay development projects that are governed by different legislation, regulations and authorities. The development regulations and guidelines established by the Frigate Bay Development Corporation provide no explicit protection for cultural resources.

Protection of historic and archaeological sites is not among the goals and objectives of the Land Use Management Plan for the SEP prepared under the DESFIL project (Starnes, *et al.*, 1989a); nor are such sites even mentioned by this plan, despite the fact that 15 sites, many of them of high local and regional significance, were located and reported on in the Environmental Assessment Report prepared by IRF in 1986 (Towle, *et al.*, 1986a). Cultural resources are the only major set of resources within the SEP for which there is no management plan. This presumably was an oversight, for the SEP development guidelines "Handbook" does specify that "significant archaeological sites shall be identified and protected from destruction, or their destruction shall be mitigated by data recovery," but it fails to specify by whom or how this objective is to be accomplished (Starnes, *et al.*, 1989b). The "Handbook" does not explicitly pass this responsibility on to the developer or make cultural resource assessment part of application submissions.

The failure to provide adequate protection for the multiple, non-renewable cultural resources within the SEP should concern not only the people of St. Kitts-Nevis, whose cultural patrimony is being placed at risk, but also USAID (which provided primary funding for the SEP road-building project). USAID has a statutory responsibility under United States law to give these resources due consideration and protection in accordance with the provisions of the U.S. National Environmental Protection Act and national historic preservation legislation.

NATURAL AREAS

Most approaches to launching a system of national parks and protected areas for St. Kitts-Nevis have been developed in the fairly recent past, a response to the donor-influenced resource planning and environmental assessment models deployed in the design and development phases of the Southeast Peninsula Road Project.

The country already has a legal framework which accepts the principle behind and the idea of a system of national parks and protected areas. The concept satisfies both the objectives for marine reserves under the Fisheries Act of 1984 and the objectives of the NCEPA of 1987. The latter legislation specifically provides that protected areas be set aside under Part II (Section 4(a) through 4(d)), which spells out the following objectives and classes of sites:

(a) to preserve biological diversity of wild flora and fauna species that may be endemic, threatened, or of special concern and the land and marine habitats upon which the survival of these species depend;

(b) to protect selected examples of representative or unique biological communities, both on land and in marine areas, and their physical environments;

(c) to sustain natural areas important for protection and maintenance of life-support systems (air, water) and basic ecological processes including water recharge and soil regeneration;

(d) to protect selected natural sites of scenic beauty or of special scientific, ecological, historical or educational value, including sites that are already degraded and need protection for restoration or sites that may become degraded if not protected.

Provisions are also made in NCEPA for the Commission to regulate specimen

taking and removal; to control, maintain and develop botanic gardens and beaches, with supporting facilities; and to develop management plans for protected areas based on ". . . the best available scientific information [and including] the long-term goals of the protected area and the associated conservation and restoration, research, education, and recreational objectives of the area . . . ."

The immediate significance of the NCEPA for St. Kitts-Nevis is that it provides a framework for the recognition, establishment and protection of both natural and cultural areas, sites and features.

INSTITUTIONAL SUPPORT

Awareness of the value and vulnerability of the nation's cultural and natural patrimony has been growing within St. Kitts-Nevis since the achievement of independence. This has resulted in three positive developments:

1) Enactment of legislation providing a rational framework for protecting and managing cultural resources;

2) The formation of private sector organizations with broad preservation goals; and

3) Several preservation initiatives by the local business community.

Thus, the basic components for enlightened protection and management of cultural and natural resources within the national development process are in place. The challenge before local preservationists is to creatively blend these ingredients into a successful recipe that will appeal to the Kittitian/Nevisian community and will strengthen its ability to manage growth and development in accordance with traditional values and national concerns.

Constructive institutional responses to these community needs regarding protection of the national heritage are summarized below.

The **Society for the Restoration of Brimstone Hill** was the oldest preservation organization in St. Kitts-Nevis, established in 1965 with the sole objective of restoring and developing the Brimstone Hill fortification as a national monument. Under a 21-year lease from Government, the Society managed the Brimstone Hill site until it was established as the Brimstone Hill Fortress National Park under the National Conservation and Environment Protection Act (No. 5, 1987).

The Society (renamed in the 1987 legislation as the **Brimstone Hill Fortress National Park Society**) is a company incorporated under the Companies Act (Cap. 335). Under the NCEPA, management and administration of the Brimstone Hill Fortress National Park was vested in the Society, thus continuing a working partnership between the Society and Government which first began during the mid-1960's.

The Society has the authority to make and enforce regulations for the management of the Park, to collect and retain admission fees, and to employ personnel and expertise from governmental, non-governmental and international organizations in the execution of its management responsibilities at Brimstone Hill.

The **Nevis Historical and Conservation Society** (NHCS) is a decade old NGO with a current membership of over 400 and an annual budget in excess of EC$100,000. The Society's broad objectives focus on preservation, conservation and educational programs related to the island's cultural and natural environment. In its ten years of activity, the Society has established a museum on Nevis' natural and cultural history, a research archives and a library; it publishes a quarterly newsletter, has a permanent staff of five, and has managed a number of environmental and historical projects, some of which were externally funded (e.g., OAS, UNEP, USAID, and a new project to be supported by WWF-US).

The Society maintains a good working relationship with the Government Administration in Nevis, and through an informal agreement, it serves in an advisory capacity to the NIA for the management of Government-

owned historical, archaeological and cultural resources in Nevis. NIA has given Government consultant designation to the Society's two curators, provides use of Hamilton House to NHCS for use as a museum, library and offices, and has furnished land for the Society's new museum complex at Belle Vue.

A newer, counterpart organization to NHCS was established in mid-1989 on the island of St. Kitts -- the **St. Christopher Heritage Society** (SCHS). With the broad overall goal of safeguarding and preserving the island's national heritage, SCHS has made commendable progress in a short period of time. A Society headquarters office and library/documentation center have been set up in downtown Basseterre, and a publication, entitled *Heritage*, has been produced. The Society's first major project has been to assist with the preparation of this Country Environmental Profile, but plans are underway for its involvement in the establishment of a museum in Basseterre, as well as other programmatic activities.

5.2 PROBLEMS AND ISSUES

5.2.1 Historical Resource Management

(1) Accelerating loss of archaeological sites and artifacts. The persistence of historical land use and settlement patterns, as well as a relatively low level of tourism, have hitherto helped protect this rich archaeological heritage in St. Kitts-Nevis. However, expansion of tourism, housing, urban sprawl, industry and roads into new areas now places much of it at risk. Recently, public housing and industrial parks around Basseterre have virtually obliterated two important prehistoric sites. The new Southeast Peninsula Road has cut through an early eighteenth century settlement and burial site. Urbanization at Old Road Town threatens to destroy archaeological remains of the Carib settlement and the original English village. The loss of this site would be a regional as well as a national catastrophe. In Nevis, where archaeological sites have been informally "vested" in the NHCS, the Society has been little more than a watchdog since it lacks legal authority.

(2) Deterioration and dismantling of plantation settlements, fortifications and other rural historic sites. For example, as noted in Section 5.1.1, the taking of facing stones and other building material from Government-owned historic structures has become common practice and has been permitted to continue without prosecution. Many sites have lost much if not all of their intrinsic historical/architectural value because of these activities.

(3) Intensifying destruction or modification of historic and vernacular buildings in historic towns and villages, to the extent that some communities are losing their traditional architectural character and charm. This trend will continue in view of accelerating development, the movement of more persons to town and urban areas, and the lack of design guidelines in the building code which recognize that traditional and unique architectural features must be taken into account in the development application and approval process.

(4) The lack of a holistic national plan for the incorporation of the country's cultural patrimony and living culture into its national development process. Similar plans have been developed with UNESCO assistance for Jamaica, Guyana and other Caribbean countries.

(5) Deficiencies of existing resource planning and management mechanisms. The country lacks a comprehensive, systematic, and official inventory of extant historical/archaeological sites which assesses their current condition and ownership status, and evaluates their potential for national development. This is an essential planning tool in order to ensure rational decision-making.

St. Kitts-Nevis is one of the few countries in the English-speaking Eastern Caribbean that has enacted a comprehensive law providing various mechanisms for the protection, sound management and enhancement of its cultural patrimony. The problem is that several important steps remain to be

taken before the 1987 law can be fully implemented and enforced. Specifically:

(a) Significant archaeological and historic sites need to be designated as "protected areas" as soon as possible, and a generic management plan needs to be prepared for these (as historic and/or archaeological sites). Many sites can be designated on the basis of existing information. Others can be designated once the comprehensive inventory has been completed.

(b) Special and historic buildings within all towns and villages need to be identified and listed as soon as possible.

(c) Public notice needs to be given regularly to residents, and particularly tourists, about the prohibitions on the search for and removal of antiquities.

The NCEPA also does not specifically address key issues such as the establishment of historic preservation districts or "zones" within towns and villages; the need to have cultural resource surveys conducted in advance of major development projects; and the need to provide economic incentives for the restoration or rehabilitation of plantation and other sites.

With passage of the NCEPA, the relationship of the Nevis Island Administration and the Nevis Historical and Conservation Society needs to be reassessed and perhaps formalized. Until passage of the NCEPA, the NIA informally permitted the Society to manage and protect historical/cultural sites owned by Government and, with NIA's approval, to establish policies and priorities for the use of such sites. With enactment of the new Conservation and Environment Protection Act, this informal relationship needs more formal and standardized guidelines defining the role of the Society in resource protection and management in Nevis.

Finally, historical and archaeological sites are not being adequately protected or managed within Frigate Bay and the Southeast Peninsula in St. Kitts. The applicability of NCEPA to these areas needs to be clarified (perhaps with a test case or two), and specific regulations and development guidelines need to be established.

5.2.2 Managing Natural Resources: Parks, Reserves and Protected Areas

The question is often asked among concerned planners and environmentalists in both St. Kitts and Nevis: how do we start a park system? Since the Brimstone Hill Fortress is already an established national park under the NCEPA, the correct question should be: how do we add a natural areas component to a national park system that began with a focus on an historic site? This is an interesting reversal of the Dominica case where the first site in the system -- the Morne Trois Piton National Park -- is a forested montane park and the Park Service is now going through the difficult task of adding an historic site -- the Cabrits (similar to but much smaller than Brimstone Hill) -- to the system. The management requirements are quite different.

Brimstone Hill, for all its success, is still a first step. Furthermore, as national planning proceeds for more diversification in agriculture, industry and tourism, the issue of what environmental resources to protect in the process will become ever more pressing.

As a facet of the environmental planning initiatives for the Southeast Peninsula, Brown and Norton (1989) state that "... environmental protection at the planning level is not enough .... It is imperative to begin the task of developing a nationwide parks and protected areas system." Even though there has been a significant amount of time and money invested in a preliminary parks and protected areas system for the Southeast Peninsula in St. Kitts and Brown and Norton (1989) try hard to suggest that the proposed SEP scheme is a good model for the entire country, this possibility should not distract attention from the need to -- *as a first step* --

define such a system for the country as a whole, so that informed choices can be made about what really ought to go first for which set of reasons. This task will lead to a better allocation of skills, funding, and institutional commitment and will provide a more orderly national site protection and acquisition plan, one designed to acquire sites and negotiate easements *before* other development drives up land prices in areas requiring protection.

Under the direction of the Southeast Peninsula Land Development and Conservation Board, the SEP technical support staff has developed several park planning documents -- both terrestrial and marine -- and some specialized studies dealing with wildlife, forest cover, and vegetation. There is little doubt that the SEP is closer to being ready for the first nomination as a second national park area following the statutory designation of Brimstone Hill, than any other area in the country. Unfortunately, there is as yet no "map" for procedural pathways to make this happen.

There are other stumbling blocks as well. As discussed in Lausche (1986), Bourne (1989), and Towle, *et al.* (1986b), it is apparent that, despite recent, well-conceived legislative initiatives, development of a truly comprehensive and well-managed parks and protected areas system will be at risk if the need for significant institutional strengthening and development is not addressed, *on a continuing basis*, in the near future. A regime of institution-building tasks will need to involve several GOSKN departments, several statutory bodies, and several NGOs, but it will be essential to the success of the overall strategy (see also Section 8.5 of the Institutional Framework chapter).

GOSKN has in hand (Livingston, 1989) a draft implementation plan for the NCEPA, for the development of the Conservation Commission's technical support system, and for establishing procedures for dealing with the delegation of responsibilities and tasks among the various participants. Once these tasks are accomplished, the matter of building a national system of parks and protected areas will fall in place and become more obvious.

LANDSCAPE AS A PROTECTED RESOURCE

An unspoiled or pleasing landscape for a local home owner is a resource of some economic importance. Unfortunately, in periods of rapid development and growth, these same landscape features tend to be taken for granted and rarely are they thought of as a resource in their own right. Yet, even a cursory inspection of a dozen or so tourist brochures makes it very clear that landscape is not unimportant to that industry. Most repeat business or return tourism is based on "images". While beautiful tropical scenery alone, whether in a park or more generally dispersed, is not always enough to attract tourists, who tend to have other options, the absence of it is likely to send them to another destination the second time around. There are numerous examples in the Eastern Caribbean of poorly-designed, ill-sited and worse maintained developments done by the very people who are attempting to capitalize on the landscape resources so important in attracting and sustaining tourism in the first place.

In the case of St. Kitts and Nevis, a question might be asked about where the "landscape" fits into the scheme of things. Should it be protected in some way? There are provisions in the NCEPA for doing so. In theory landscape is a renewable resource, but in actuality this is only true if the scenery and its component parts are used wisely and well, according to sound conservation management principles.

5.3 POLICY RECOMMENDATIONS

5.3.1 Historical Resources

* Historic and archaeological sites that have been recommended by local NGOs as protected areas should immediately be considered for protected area status by the Conservation Commission. A generic management plan for this type of protected area needs to be developed and put into place.

Thereafter, site specific management plans should be developed.

* Landmark buildings in Basseterre and Charlestown that have been recommended by NGOs should be immediately considered for listing by the Conservation Commission. Landmark buildings outside of Basseterre and Charlestown need to be identified, assessed and listed. Consideration needs to be given to establishing historic districts or "zones" in Basseterre, Charlestown, Old Road and other appropriate town places. Consideration should be given to adoption of a Government policy which encourages adaptive use and restoration strategies by the employment of economic and other incentives and to the adoption of design controls for new construction in designated "historic districts," perhaps along the lines of the recently released OAS recommendations for St. John's, Antigua (OAS, 1989).

* A comprehensive and detailed national inventory and assessment of historic and archaeological sites should be commissioned as soon as possible.

* Government should develop a management plan for all buildings and plantation sites under its ownership. This should include a handbook of development guidelines for plantation sites.

* Government should prepare a cultural tourism plan, that would identify resources, needs, opportunities and strategies for taking full advantage of the nation's cultural assets.

* A legal analysis should be undertaken to determine how the NCEPA can be interpreted or amended to provide for: (1) cultural resource surveys for all major development projects; (2) the establishment of historic districts or zones within towns and villages; and (3) economic incentives for plantation site development and historic districts.

* Development management plans and guidelines for the Southeast Peninsula and Frigate Bay need to be revised to provide for meaningful protection of historic and archaeological sites. Here and elsewhere in the country, developers should be required to pay for a cultural resource survey by professional archaeologists of the entire area to be developed. These surveys, which should be submitted to the Minister and the Conservation Commission early in the planning process, should clearly identify the location of all resources, assess their significance, and recommend measures for mitigating (through salvage archaeology) any unavoidable impacts. Such surveys should also be required for all major development projects undertaken by Government.

Site survey and assessment responsibilities might be delegated to the St. Christopher Heritage Society and to the Nevis Historical and Conservation Society. However, since these organizations do not have trained archaeologists within their membership, and since there is no trained archaeologist residing in the country, provision could be made to provide a few individuals within each organization with a short training course, so that they could undertake preliminary site surveys, monitor earth-change activities and engage in salvage archaeology under professional supervision.

Government might approach a regional body, such as OAS or CCA, to provide a qualified archaeologist to help with survey and recovery needs.

* Government should ask USAID to provide funding to: (1) conduct a comprehensive, Phase 1 Cultural Resource Survey of the entire Southeast Peninsula; (2) conduct salvage archaeology for sites that have been impacted by the new road; (3) stabilize the Fleming Estate Windmill, which has been destabilized by road construction; and (4) prepare a management plan for cultural resources within the SEP.

* Government should ask UNESCO for assistance in the preparation of a National Cultural Development Plan.

* Government should prohibit the removal of cut stone from all historic buildings and ruins, with appropriate enforcement measures taken.

5.3.2 Parks and Protected Areas System

* A parks and protected areas plan is needed to ensure that all critical natural and cultural resources receive adequate protection and that management is carried out in an *integrated* fashion. The Conservation Commission should give early attention to the development of a comprehensive plan which approaches the subject of parks and protected areas from a national perspective and which includes identification of appropriate mechanisms for coordinating management responsibilities within a national system. Allocation of manpower resources for enforcement and management activities should be made on the basis of priorities established in the plan.

* The Conservation Commission must also give attention to preparing guidelines which accomplish the following:

- establish its priorities for protected area designation;
- develop a process for selection and acquisition of protected area sites;
- determine a phasing-in schedule to bring new sites within the system;
- establish management guidelines for each protected area class or category, including identification of non-compatible uses which will not be permitted within designated protected areas;
- provide for enforcement procedures;
- designate a central management authority to oversee the system;
- determine mechanisms for inter-agency and inter-departmental cooperation;
- define a role for appropriate NGOs such as the Nevis Historical and Conservation Society and the St. Christopher Heritage Society.

SECTION 6 POLLUTION CONTROL AND ENVIRONMENTAL HEALTH

6.1 OVERVIEW

The environmental problems identified by the *Evaluation Report on the Caribbean Environmental Health Institute* (CARICOM/UNEP/PAHO, 1986, cited in Brewster, 1988) as requiring urgent attention in the region have counterparts that should be addressed in St. Kitts and Nevis. Areas of concern include:

- solid waste management;
- sewage and industrial waste collection, treatment and disposal;
- monitoring of chemical pollution of ground and surface water sources;
- marine and coastal pollution monitoring; and
- drinking water quality monitoring and control.

St. Kitts and Nevis, as is the case with other small islands, must address the probability that near-site impacts on land of pollutants will be extended and amplified because most pollutants from residential, agricultural, and industrial sources are transported to the coast via streams and watercourses, by leaching and infiltration through the soil, by direct (piped) discharges into the sea, and through non-point sources along coastlines (Archer, 1987).

ST. KITTS

SOLID WASTE

The solid waste of St. Kitts has grown significantly in both volume and composition in recent years. Changes include larger amounts of man-made materials such as synthetic fibers, plastics, rubber, and various glass and metalware (Frank, 1990). Solid waste is collected a minimum of once a week in Basseterre and in the rural areas of St. Kitts using the trucks and personnel of the Public Health Department in the Ministry of Health, which has responsibility for disposal.

It is estimated that approximately 20 tons of solid waste are generated in Basseterre daily (Frank, 1990). In addition to the metal bins used for disposal in Basseterre, numerous oil drums (44 gallons) are placed along the streets and alleys of the capital for disposal of solid waste. Regulations to Public Health legislation require each dwelling to provide proper storage containers not to exceed four cubic feet (pers. commun., C. Pencheon, Vice Pres., SCHS, 1990).

The Department has ten trucks that serve as collection vehicles for the island, eight for the Basseterre area and two trucks for the rural areas (pers. commun., T. Mills, Chief Public Health Inspector, 1990). The Public Health Department has initiated a waste collection schedule to improve collection efficiency. Additionally, the Department has installed more than 30 communal, hydraulic bins in problem locations to reduce the problems of flies and scattering of wastes by loose domestic animals (Frank, 1990). Waste collection by Government carries no direct charges for citizens.

Most solid wastes in St. Kitts are disposed at the Conaree dump immediately to the east of the airport runway. Disposal also occurs at Sadlers in the north and at Belle Tete near Sandy Point (Figure 6.1(1)). Approximately 30 tons of refuse are dumped at Conaree on a daily basis, and eight tons at Belle Tete and four tons at Sadlers on a weekly basis (pers. commun., C. Pencheon, Vice Pres., SCHS, 1990). The open dumping along the shore that was practiced at Guinea Bay west on the coast (Archer, 1984) is no longer permitted (pers. commun., T. Mills, Chief Public Health Inspector, 1990). However, solid wastes are disposed of improperly in many unofficial locations, frequently in ghauts (guts) and along roadsides. Except for the reuse of soda and beer bottles,

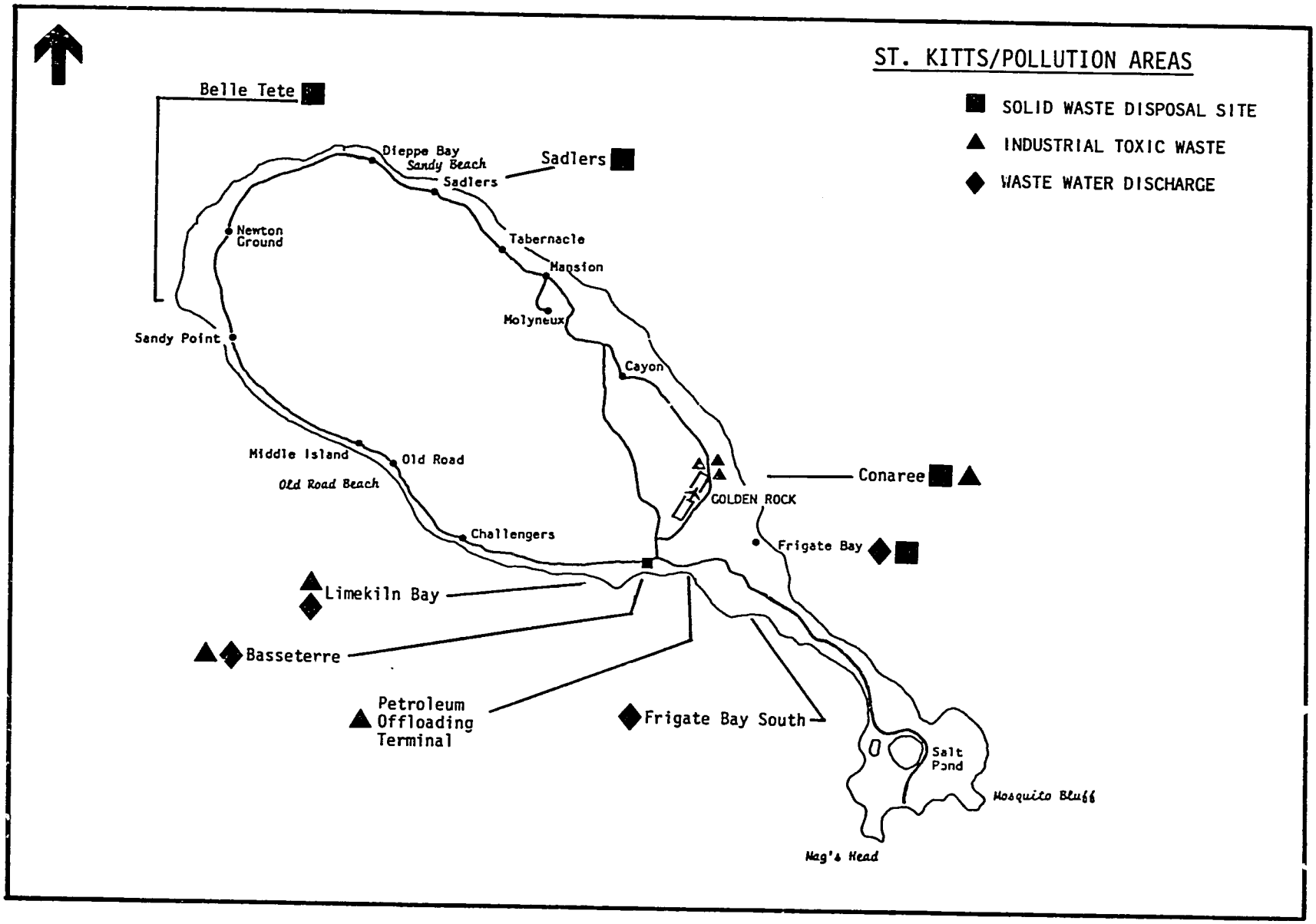


Figure 6.1(1). Location of selected pollution problem areas in St. Kitts.

there is no official program for recycling of materials in St. Kitts, even though common litter contains a number of recyclable materials.

The Conaree site, a five acre area on Crown lands that serves as the principal solid waste disposal site on St. Kitts, is operated as an open dump where burning is practiced. It receives a variety of wastes which can be classified into four principal categories: sugar cane bagasse, construction rubbish, landscape rubbish, and commercial and residential wastes including paper and kitchen waste (Brown, 1989).

In the Frigate Bay residential areas owners are required to place waste in containers, and garbage trucks take away waste once per week to the Conaree disposal site. Commercial operations in this area are expected to dispose of their own waste (Towle, *et. al*, 1985). The consultants for development projects on the Southeast Peninsula (SEP) recommended that solid waste generated on the Peninsula be trucked to the Conaree dump for disposal to reduce problems associated with removal of the anticipated volumes of waste on the Peninsula (Morris, 1989).

The Litter Abatement Act (No. 8, 1989) recently passed by the National Assembly addresses a wide range of litter prevention issues and prescribes penalties to discourage littering. It focuses on most common forms of littering in public places -- from sweet and cigarette wrappings to derelict vehicles and construction materials dumping. The Act also includes provisions for litter wardens. Implementation of the Act, which went into effect in September 1990, will be the responsibility of the Public Health Department.

A Cabinet-appointed Committee on Sand Mining and Construction Waste (chaired by the Director of Planning) was established in response to an OAS-funded study on sand mining (Cambers, 1988). Its mandate was to regularize sand mining through a permit system, with fee schedules and monitoring procedures, to be implemented by SSMC (regulation of sand extraction in ghauts) and the Department of Public Works (regulation of beach sand mining). The Committee was also to address the issue of informal/unauthorized dump sites and to provide strategies to restrict use of ghauts for solid waste disposal. Independent monitoring for procedures recommended by the Committee was to be provided by the appointment of a Conservation Officer. In September 1989, the Committee had completed its deliberations and delivered a report to Cabinet; a new conservation officer was appointed in December of that year. The waste disposal aspects of the Committee's report (e.g., implementation strategies) are currently under review.

SEWAGE AND OTHER DOMESTIC LIQUID WASTES

Sewage is disposed of in one of three ways in St. Kitts: septic and absorption pits, pit latrines, and treatment plants. The first two are used by private households, the last by major institutions such as the Hospital in Basseterre and the large hotels (Betz, 1989; Chavannes, 1989). Fifty-five percent of private households in St. Kitts have water closets, while thirty-five percent utilize pit latrines of the traditional type (Chavannes, 1989). Approximately half of the homes in Basseterre use pit latrines which essentially involve no treatment of the waste (pers. commun., T. Mills, Chief Public Health Inspector, 1990).

The Department of Public Health has specified use of a two-chamber septic tank design sized at 40 gpd/person for St. Kitts that appears to be adequate for the island, with the exception of areas on the Southeast Peninsula where soil conditions are different from those of the remainder of the island (Morris, 1989). The SKN Government is presently seeking funds to address strategies recommended in a UNESCO study that would result in replacement of septic tanks, soak-away pits, and associated drainage fields in the Basseterre Valley with a sewage treatment plant (pers. commun., E. Petty, Director of Planning, 1990). Additionally, new development projects are now required to put in sewage treatment facilities as part of their infrastructure.

In the Frigate Bay area sewage disposal in residential sections is accomplished by the use of holding tanks which overflow to

soak-away pits. Presently there are three package plants handling the sewage generated at the hotels in the area (pers. commun., W. Liburd, FBDC, 1990). The plants discharge partially treated sewage into a complex eight pond system (two natural and six artificial) that eventually allows a diluted secondary effluent (mostly from Frigate Bay South) to flow into the sea. There is some question about periodic malfunctioning of this system, and there is little evidence of a monitoring regime regarding operating efficiencies and the chemical make-up of effluents. The present mixed sewerage system for the Frigate Bay area is scheduled to be replaced by a new system, with major funding from CIDA, designed to satisfy demand beyond the year 2000 (pers. commun., W. Liburd, FBDC, 1990). The central sewage plant is presently at the engineering design stage. After approval by CIDA and GOSKN, the project is expected to be completed within three years (pers. commun., W. Liburd, FBDC, 1990).

Gray water (sullage), which can often be odorous, runs in open drains and culverts from Basseterre across the beach into Basseterre Bay. Various industries in the Basseterre area also have outfalls that empty high nutrient and chemically-laden effluents into Basseterre Bay (see also sub-section on industrial wastes below). Recently, limited monitoring of the coastal waters of Basseterre has been conducted by the Department of Public Health (pers. commun., T. Mills, Chief Public Health Inspector, 1990). Two GOSKN staff persons (one from Public Health and one from the Water Department) were trained by the Caribbean Environmental Health Institute (CEHI) to measure selected physical parameters and bacterial levels (mostly coliforms) of coastal seawater, as well as to monitor the presence of oil pollution on beaches (pers. commun., N. Singh, Director of CEHI, 1990). No measurements were made for toxic organic compounds, nutrient levels, or heavy metals.

Draft legislation dealing with watercourses and sewage disposal has been drafted, the implementation of which would establish a Sewage and Water Authority for the country. This act is designed to institutionally address sewage and water issues in St. Kitts and Nevis (pers. commun., D. Mendis, Legal Advisor to GOSKN, 1990).

INDUSTRIAL WASTES

Generally, waste products from industry are transported to the Conaree disposal site, or they flow into or are thrown into the coastal waters of St. Kitts. One study (Archer 1984) indicated that approximately 90 percent of the waste water released from industry flows to the sea through pipes and drains. Waste products from sugar cane and molasses production, soft drinks, dairy products, margarine, distillery, abattoir, brewery and power plants all enter the coastal environment and contribute to stressful conditions experienced by marine ecosystems in the coastal waters.

Archer (1984) reported the high Biochemical Oxygen Demand (BOD) waste from sugar production as being a major contributor to the pollution of Basseterre Bay and the loss of coral reef structures in the vicinity of the harbor. The cement drain used by the St. Kitts Sugar Manufacturing Corporation (SSMC) is also used by the CSR Distillery, and effluent from this area has been analyzed by the Department of Public Health as part of its coastal monitoring program (pers. commun., T. Mills, Chief Public Health Inspector, 1990). The water in Basseterre Bay near the SSMC outfall was shown to have high BOD producing wastes with high suspended particulate matter content and high levels of bacteria (assayed as coliforms). This outfall has also been reported to exude black, oily water that smells as though it has distillery by-products ("dunder") mixed into it (pers. commun., R. Walters, TRD Environmental Specialist for SEP Project; pers. observation, CEP Research Team). The oil reportedly is waste oil from the electricity plant which also uses the same drain as the sugar factory and the distillery. Recently, samples of coastal water that may have chromates from textile dying ventures have been sent off island for analysis because fish kills were observed nearshore (pers. commun., K. Archibald, Director of Agriculture, 1990).

Pollution from caustic solutions from the soft drink factories, waste water and efflu-

ent from the sewage package plant at the hospital, and high BOD wastes from the brewery operations have been cited as causes of heavy pollution to Limekiln Bay (Figure 6.1(1)). The discharges are heavy enough to discolor the inshore waters of the Bay. Livestock processing waste can cause marine pollution problems from high BOD and COD when waste products are dumped at sea (see Archer, 1984). However, St. Kitts' new abattoir at Buckleys, opened in 1989, reportedly disposes of its wastes at the Conaree disposal site. A recently built ethanol production plant in the Conaree area produces jelled alcohol from molasses. The process and its by-products may pose some pollution risk, especially from the plant's effluent, a high nutrient dunder or stillage. At present, however, the plant operates only intermittently, apparently as a result of an irregular supply of molasses. If and when the plant becomes fully operational and stays on line for any length of time, a more intensive effluent monitoring strategy will be required since present drainage from the site passes in open drains east along the road in the direction of the Conaree dump and Greatheeds Pond. In the same vicinity, the smoke from the burning at the Conaree disposal site and the smoke from the shortened stacks of the sugar factory both contribute to heavy localized air pollution.

AGROCHEMICALS

Agriculture is becoming progressively dependent on inputs such as fertilizers, herbicides and pesticides as farmers attempt to increase productivity and diversity (see Table 6.1(1) and Table 6.1(2)). Although the use of pesticides and herbicides (collectively called biocides) in St. Kitts has been reported by one source to be common (DeGeorges, 1989b), hard data on the actual levels of usage are not easily compiled. The majority of the biocides used on St. Kitts are imported by GOSKN for the Departments of Agriculture and Public Health and by TDC (Trading Development Company), which supplies the SSMC with approximately half of its volume of herbicides. A 1985 study by CARDI found three varieties of fungicides, 31 varieties of herbicides and 23 varieties of insecticides in use on St. Kitts (cited in Betz, 1989). In 1989 GOSKN and TDC made available eight different

Table 6.1(1). Biocide use in St. Kitts and Nevis, by holdings.

	TOTAL NO. OF HOLDINGS	HOLDINGS USING BIOCIDES NO.	HOLDINGS USING BIOCIDES ACREAGE	QUANTITY USED (POUNDS)
PESTICIDE USE				
ST. KITTS	2,195	267	372	1,701
NEVIS	1,207	136	73	839
TOTAL: ST. KITTS/NEVIS	3,402	403	445	2,540
HERBICIDE USE				
ST. KITTS	2,195	64	75	485
NEVIS	1,207	21	12	177
TOTAL: ST. KITTS/NEVIS	3,402	85	88	662

Source: GOSKN, 1987a.

fungicides, 16 different herbicides, and 15 insecticides to the public.

The Department of Agriculture sells chemicals to farmers for use on crops and livestock (Table 6.1(2)) The amounts are purported to be modest (pers. commun., J. Thomas, Agronomist, Dept. of Agriculture, 1990). Although there is no official list of banned chemicals for St. Kitts, USEPA recommendations on appropriate biocide choices are used as a guide for extension work with farmers (pers. commun., K. Archibald, Director of Agriculture; DeGeorges, 1989b). Agricultural Extension agents conduct informal training of farm workers, but there is apparently no formal certification program (DeGeorges, 1989b).

Sugar cane is the major agricultural output of St. Kitts (see Section 3 of the Profile), and the SSMC reports that it uses limited insecticides on the crop, concentrating mostly on herbicides applied as sprays. Proportionally, herbicide use by the SSMC ranks as the highest use of biocides in St. Kitts (Table 6.1(2)). Thomas (1980) indicates that herbicide use has been high for a number of years. Reportedly, workers at SSMC are given training on the use of pesticides (pers. commun., C. Kelly, Agronomist, SSMC, 1990).

GOSKN has enacted legislation for pesticide regulation (Pesticides Act, No. 20 of 1973). The Act provides a framework for drafting regulations, the organization and role of a Pesticides Board, the assignment of inspectors, and a delineation of offenses and penalties. The only regulations in place at the present time are the Pesticides (Labelling and Storage of Containers) Regulations (SRO No. 18 of 1975). Following the passage of this legislation, the Ministry of Agriculture circulated for information and guidance a list of pesticides of very high mammalian toxicity and advised against the importation of such pesticides into SKN. The list included Parathion, Endrin, T.E.P.P., Aldrin, Dieldrin, Phosdrin, Antak, Bidrin, Dinoseb, Calcium arsenate, Furadan, Lannate, Lindane, Systox, D.D.T., and D.D.V.P. (Stevens, 1980).

The Pesticides Board, which has not been functional for a number of years, is presently being revitalized (pers. commun., K. Archibald, Director of Agriculture, 1990). According to the enabling legislation, the Board, to be chaired by the Chief Agricultural Officer, is empowered to make decisions concerning importation, sale and distribution of pesticides.

Presently, there is no monitoring of agrochemicals in the environment or in agricultural products carried out in St. Kitts (pers. commun., K. Archibald, Director of Agriculture), nor are farm workers and potable water assessed for pesticide residues. In addition to training GOSKN personnel in coastal monitoring techniques, the Caribbean Environmental Health Institute (CEHI) in St. Lucia has provided approximately US$10,000 worth of wet/soils laboratory equipment to St. Kitts (pers. commun. N. Singh, Director, CEHI, 1990). The equipment is presently stored in the old sugar cane laboratory. Recommendations have been made to renovate the lab and combine the CEHI equipment with appropriate equipment from the Department of Agriculture to create a central environmental lab for the country (Towle, *et al*, 1986; DeGeorges, 1989b).

OIL POLLUTION

Oil and other petroleum products are brought to St. Kitts by tanker to the Shell depot or the new Texaco depot just south of Basseterre. Location of the petroleum offloading terminal for Shell, the largest importer, is shown in Figure 6.1(1). The Shell facility is supplied by relatively small tankers that are moored offshore and run floating hoses to the manifolds. The oil tankers at the St. Kitts terminal in recent years had a capacity range of 8,700 increasing to 37,000 barrels (pers. commun., D. Phillips, Shell Acting Operations Supervisor, 1990).

Shell provides safety and clean-up equipment on tankers that carry persistent oils only. The manifolds where vessels secure their hoses were reported to be directly over the water, posing a potential pollution problem if leakage occurred (Spitzer, 1984). Shell reports it has protected the system with

Table 6.1(2). Agrochemicals used in St. Kitts.

	Brand/Generic Name	Levels Used By SSMC in 1990
	HERBICIDES	
*	Ssulox 40	28,000 liters
*	Actril DS	12,000 liters
*	Oxytril	520 liters
#	Gesapax 500 FW	24,000 liters
#	Gesapax combi	8,000 liters
#	Gesaprin	1,000 liters
#	Gesagard	600 kg
#	Dalapon	9,000 kg
* +	Fusilade	
+	Prowl	
* +	Round-up	
# *	Gramoxone	500 liters
*	Eptan	
*	Daconate 6	
*	Dectial	
*	Trimec	
*	Weed Ex	
*	Multiple Zero	
	FERTILIZERS	
#	18-8-18	1,515,000 kg
#	Ammonium sulphate	1,050,000 kg
#	NPK 15-15-15	40 tons

	INSECTICIDES		FUNGICIDES
* +	Decis	+ *	Diathane
* +	Diazinon 60 EC	*	Cuprosan
+	Karate	+	Peltar
* +	Malathion	+ *	Benlate
* +	Dipel WP	+	Trimitox Forte
* +	Sevin		
# *	Orthene		
*	Actellic		

KEY: * = Imported by TDC; + = Sold by Dept. of Agriculture; # = Imported by SSMC.

interceptors on land and drip pans at hookup sites on the tankers (pers. commun., D. Phillips, Acting Operations Supervisor, 1990). There is no equipment on St. Kitts to handle the clean-up of an oil spill or accident; assistance would have to be sought from Antigua or Barbados, which raises serious questions about the delay in the country's response capabilities while waiting for equipment to be mobilized and shipped from elsewhere. Shell does have a contingency plan that indicates personnel contacts and procedures for getting equipment to St. Kitts to begin a clean-up process in the event of a

spill (pers. commun., D. Phillips, Acting Operations Supervisor, 1990).

At present there is no system for the collection and proper disposal of waste oil on St. Kitts. The electricity plant is the largest single consumer, using approximately 80 percent of the total diesel throughput on St. Kitts (Spitzer, 1984). Shell supplied the plant with 600 barrels of lubricating oil in 1989. Much of the reported pollution at the electricity plant is from waste lubricating oils resulting in oil saturated soil and oil draining into ditches and the soil (Spitzer, 1984). It is reported that some waste lubricating oil finds its way into the drainage ditch that takes effluent from the electricity plant, the sugar factory and the distillery to Basseterre Bay (pers. commun., C. Kelly, SSMC, 1990; pers. observation, CEP Research Team, 1990). Additionally, oil is collected in 40 gallon drums and is trucked to Conaree dump for disposal (Spitzer, 1984; pers. commun., P. Huggins, Electricity Department, 1990).

Waste oil and grease from garages are dumped into storm drains and on the ground. This material combines with oil from street surface run-off and is washed into drains, ghauts and coastal waters during heavy rains. The potential for underground leakage from storage tanks at older gasoline stations into the water table, which has been reported as a problem throughout the Caribbean and elsewhere, has not been investigated in St. Kitts (see also Section 2.2 of the Profile).

The occurrence of petroleum tar on beaches is common throughout the region, and the problem has been monitored by the CARIPOL (the CARIbbean POLlution Program of UNEP) (Atwood, *et al.*, 1987/1988). Windward coasts of Caribbean islands are the most likely to be contaminated with tar, indicating that the source of much of the pollutant is upwind and beyond the control of individual governments. CARIPOL monitoring data have shown that when beach tar values reach 10 grams per meter of shore front, persons using beach areas commonly report tar on their feet. When levels are close to 100 grams per meter, beaches become virtually unusable for tourism and most recreational activities in general. St. Kitts did not participate in this study, but the Department of Public Health has started a limited program of monitoring tar on beaches in St. Kitts (pers. commun., N. Singh, Director, CEHI, 1990 and T. Mills, Chief Public Health Inspector, 1990). Data were not available at the time of the CEP project in St. Kitts, but many do not believe that this is yet a problem in the country.

A draft Marine Pollution Prevention Bill (1988) designed to give St. Kitts and Nevis an effective legal instrument for the prevention, reduction, and control of marine pollution is presently being reviewed for implementation by GOSKN (pers. commun., D. Mendis, Legal Adviser to GOSKN, 1990). The Bill covers the responsible agency, jurisdiction of the State, administrative penalties, reporting procedures and penalties, and authorizations for the appropriate officials involved in clean-up actions.

SOIL EROSION

A pollutant has been defined as a resource in the wrong place, and soil erosion is a classic example of this. The highly porous, free-draining sandy loams existing on the steep slopes of St. Kitts are susceptible to wind and sheet erosion which, when carried by run-off to the sea, can result in the pollution of coastal waters (see also Section 1.2.3 of the Profile). Factors contributing to soil erosion in St. Kitts are the looseness or compactness of the soil and subsoil profile, the marked absence of bedrock, and traditional land use practices (Mills, 1989).

Fertile topsoil is being lost in St. Kitts at a high rate. Topsoil loss is due to sheet and rill erosion, where thin layers of soil are removed by each rainfall in an almost indiscernible manner in the field due to the slow pervasive process involved. Excessive surface run-off is causing the deepening and widening of ravines bordering cropland. The result has been the loss of significant portions of land after each major storm, e.g., a gully can cut fifty linear feet into prime agricultural land during a single storm event.

Gully or ghaut erosion results from excessive run-off concentrating into larger

channels. As the gully bottom deepens, a sudden drop or headcut develops in the channel. Successive flows cause a further deepening and advancing of the headcut stream. The gullies formed by this process number 100 throughout the island, with 39 of them considered to be major problems (USAID, 1987).

In St. Kitts, most construction sand is supplied by ghauts. Management of the mining of the ghauts is necessary to maintain a sustainable supply of sand (Cambers, circa 1988), and to assist in this effort, the Forestry Division of the Department of Agriculture has developed a program to establish fast-growing trees to stabilize ghaut sides.

During the rainy season refuse dumped into neighborhood ghauts, along with top soil removed by erosion, is transported by swollen ghaut streams to the sea, resulting in damage and partial destruction of corals due to siltation. Some portion of the refuse is often washed up on beaches.

The new access road to the Southeast Peninsula of St. Kitts is a 10 km penetration road built as a joint project between GOSKN and USAID for the purpose of stimulating economic development in the area. The road has created significant areas of bare earth from cut-and-fill activities on very steep slopes that are prone to erosion and sedimentation. Erosion and sedimentation reduction monitoring and mitigation recommendations are being addressed under the SEP project. For example, the Department of Agriculture undertook a program of reforestation along the SEP highway, and this program has resulted in considerable stabilization of the area's roadsides.

PUBLIC HEALTH

As also noted in Section 2.2 of the CEP, environmentally-related and waterborne diseases, such as gastroenteritis and diarrhea, are considered significant health problems in St. Kitts. However, no clear correlation with any particular environmental pollutant or condition has been identified, even though a number of sanitation-related problems are possible contributing factors (Chavannes, 1989). In 1986, district nurses indicated environmental health hazards were the result of refuse dumping in ghauts, lack of well-managed areas for solid waste disposal, lack of pit latrines in some densely-built areas, and the general state of disrepair of public conveniences. The results were cases of gastroenteritis and skin rashes or boils in small children who played near or in areas where refuse was discarded (Wirt, 1986).

A Department of Health Program has recently begun to deploy a truck with "fogging" equipment to apply Malathion insecticide in urban areas. Additionally, larvicides are used in breeding areas of mosquitoes and sand flies (pers. commun., T. Mills, Chief Public Health Officer, 1990). St. Kitts continues to suffer from the presence of *Aedes aegypti*, the vector of yellow fever and dengue, *Culex fatigans* and *C. quinquifaciatus*, vectors of filariasis, and *Aedes taeniorhynchus*, a salt marsh mosquito with a very painful bite (Stevens, 1980; pers. commun., T. Mills, Chief Public Health Inspector, 1990).

NEVIS

Nevis has not experienced the degree of environmental degradation that has accompanied rapid growth in many of the other Leeward Islands. The population of Nevis has been declining for the past 20 years, unlike other developing nations where rising population rates often overwhelm other problems, particularly environmental ones. There is very little industrial activity on Nevis, and the tourism sector is just beginning to expand in scale. Unlike Basseterre, Frigate Bay and the Southeast Peninsula in St. Kitts, which are having to confront costly upgrades of sewage disposal systems, present population densities on Nevis have not yet warranted more extensive use of treatment plants for sewage and other wastewater.

SOLID WASTE

The current solid waste collection and disposal system in Nevis is not optimal

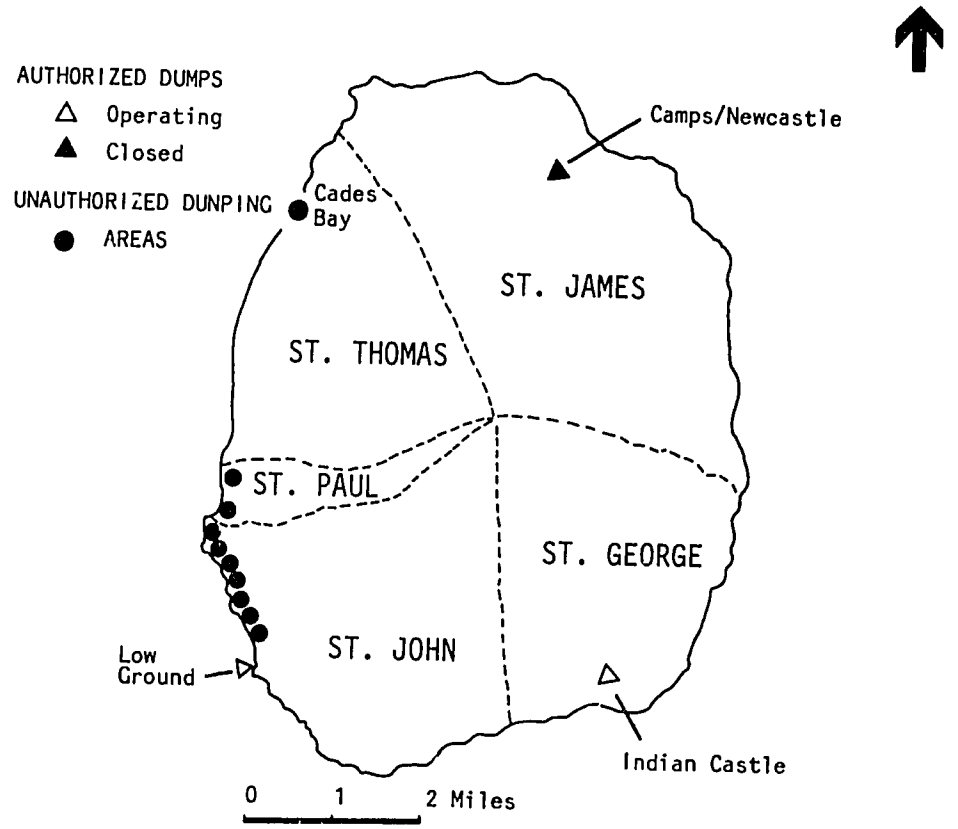


Figure 6.1(2). Solid waste sites for the Island of Nevis (source: pers. commun., C. Fahie, Senior Public Health Inspector, Nevis).

from an environmental or public health standpoint. The Health Department is responsible for the management of solid waste but lacks the financial resources to adequately address the full spectrum of issues associated with a properly functioning waste collection and disposal system. As a result, refuse is indiscriminately disposed of in many areas that then become *de facto* (but illegal) dumps, or it is simply discarded in streets, ghauts, ravines and other public places.

There are two official disposal sites on the island (Figure 6.1.(2)). A one acre site at Low Ground Estate on the southwestern coast of Nevis serves St. Paul Parish (including Charlestown), St. Thomas Parish and parts of St. James Parish. On the southeastern side of the island, a 0.25 acre site at Indian Castle Estate collects waste from St. John, St. George and part of St. James Parishes. Originally intended as a temporary disposal site when the Low Ground access road was impassable, Indian Castle continues to operate because the Camps/Newcastle site in the northern section of the island was recently closed to allow for residential development in the immediate area. Disposal methods employed at the active site are crude tipping from the collection trucks, open burning, and, when a bulldozer is available, burial and compaction.

A private contractor collects refuse every day in Charlestown's business district and at least once a week in outlying areas. Two Government trucks are scheduled to pick up refuse from all other parts of the island at least once a week. Throughout the island people hand carry their trash to various deposit points and in the process create illegal dump sites, including one in the center of Charlestown. Plastic and paper refuse usually lines the channelized ghauts in town, and even

street cleaners will throw the refuse they collect into unauthorized areas.

SEWAGE AND OTHER DOMESTIC LIQUID WASTES

Sewage disposal on Nevis consists primarily of pit or dry conservancy systems and water closet/septic tank combinations. The Four Seasons Hotel, slated to open in February of 1991, will be the first facility on the island to construct and operate a package sewage treatment plant. Almost all of the ghauts on Nevis are intermittent, so they are rarely used to convey sewage. Any direct disposal would be to freshwater lagoons or the sea. Statutory regulations for domestic sewage disposal and septic tank design standards have not been written. Public Health officers, although permitted by law, are only infrequently consulted during the planning and inspection phases of construction and development projects.

The 1980-81 population census estimated that 66 percent of Nevis' population used pit toilets, one percent connected water closets, 23 percent unconnected water closets and four percent had no toilet at all. (The remaining five percent did not state the type used.) More recent figures are not available and will not be collected until the next population census is conducted in 1991.

Other domestic liquid wastes are either discharged into concrete-lined ghauts and drains which flow into the harbor in the coastal areas of Charlestown or into soak-aways in other parts of the island. The effects of these effluents and presumed leachates on Charlestown Harbor and adjacent shorelines are undocumented.

In many places thin, hard volcanic soils limit percolation and therefore prevent the proper installation and functioning of soak-aways and septic tanks. Other low-lying areas, particularly the western coast of the island along Pinney's Beach and parts of Newcastle to the north, have high groundwater tables which also preclude natural filtration of sewage and wastewater through the soil. Accelerated, large-scale infrastructural tourist development presently underway landward of the highly desirable Pinney's Beach runs the risk of contaminating adjacent coastal and lagoon water bodies if waste disposal is not carefully managed.

AGRICULTURAL CHEMICAL USE

From the little information available, it appears that fewer fertilizers and biocides are applied in Nevis than on many of the larger islands in the Eastern Caribbean (pers. commun., S. Powell, Acting Director, Nevis Agricultural Department, 1990 and J. Lowery, former Nevis CARDI Country Team Leader, 1990). The release of agricultural chemicals into the environment is certainly not the problem it has become in some of the banana-producing OECS countries. However, central statistics on biocide imports are not collected, making it very difficult to quantify the actual amounts used. DeGeorges (1989b) inventoried biocide importations in the Eastern Caribbean but unfortunately did not obtain specific information about St. Kitts and Nevis. Only two private retailers, TDC and the St. Kitts-Nevis Development Bank, import and sell biocides on Nevis. If the records are accurate, the figures are very low. Many private plantation owners and agricultural development agencies such as CARDI import their own agricultural chemicals directly, making it even more difficult to get accurate estimates of the amounts entering the island. CARDI also sells some chemicals directly to its target farmers. Table 6.1.(3) provides a qualitative (and quantitative where possible) listing of biocide imports. Gramoxone super (paraquat) is the only USEPA restricted pesticide used in Nevis, although Diathane (Mancozeb) has been cancelled in St. Lucia, Grenada, Antigua and Dominica.

Homeowner applications of insecticides to control mosquitoes, ants and cockroaches may constitute a high percentage of biocide use on the island, but this has never been studied. Most shops and restaurants also frequently spray their premises with insecticides.

Table 3.1(3). Selected list of agrochemicals imported to Nevis from June 1989 to June 1990.

NAME OF AGROCHEMICAL	QUANTITIES
Name of Insecticide	
Karate	60 liters
Actellic	24 liters
Diazinon	20 gallons
Ambush	3 liters
Malathion	20 gallons
Dipel	12 pounds
Sevin	600 pounds
Orthen	12 pounds
Smarol	15 pounds
Torpedo	10 gallons
Name of Herbicides	
Gramoxone	36 liters
Fusilade	12 liters
Name of Fungicides	
Diathane	20 pounds
Kocide	20 pounds

Source: Figures from TDC, Nevis, 1990.

OIL POLLUTION

Oil and other petroleum products are brought to Nevis by tankers and off-loaded at buoys in Charlestown Harbor and Low Ground. Shell and Delta are the distributors for the island, and both of these companies import and store diesel fuel and gasoline. Oil tankers coming into Nevis have an average capacity of 2,000 tons.

No major oil spills have occurred off Nevis, and the island does not have an oil spill contingency plan. Both Shell and Delta require their tankers to carry chemical dispersants, but the closest spill containment and clean-up equipment is in Antigua or Barbados. No system exists for the collection and disposal of waste oil.

INDUSTRIAL WASTE

The industrial sector is not highly developed on Nevis and consists of an electronic parts manufacturer, a concrete factory, a pottery works, a floor tile producer, an abattoir and several small garment and furniture making shops. A soft drink bottling factory permanently ceased operation several years ago. The Nevis National Development Plan 1987-1991 projects considerable investment and growth in light industries as a goal for 1991. The NIA would like to see expansion of the manufacturing sector to bolster employ-

ment and bring additional revenues to the island. None of the effluents and other wastes from these operations have ever been quantitatively sampled. The most visible industrial pollutant is wastewater from the abattoir which is high in pathogenic bacteria and biological oxygen demand (BOD) (Vlugman, 1988).

SOIL EROSION

Nevis' landscape has undergone serious soil erosion for the past two centuries. Agricultural lands and coastal features (beaches and rocky head lands) have experienced some degree of erosion which can lead to sediment pollution in coastal and inland waters (see also Section 2.4 of the Profile).

PUBLIC HEALTH

As is the case in St. Kitts, data on the incidence of water- or sewage-related diseases are difficult to analyze, in part because health records have been irregularly maintained due to logistical and administrative problems. (Steps to institute a medical reporting system are currently being taken, so this information should be accessible in the future.) Gastroenteritis is still common among children during particularly wet or dry spells (pers. commun., P. Dias, M.D., Medical Health Officer, Alexandra Hospital, 1990), but the number of cases has not varied significantly in the past five years (pers. commun., C. Fahie, Senior Public Health Inspector, 1990 and M. Tyson, R.N., Matron, Alexandra Hospital, 1990). The cases that are reported could either be related to poor sanitation or contamination of the water supply. There have only been a few isolated cases of typhoid and infectious hepatitis in the last two decades.

The Public Health Department routinely uses insecticides to control mosquito populations. Health workers mix Malathion-57 with diesel fuel and spray the "thermal fog" from a pick-up truck in all inhabited areas of the island and apply larvicides to stagnant water collections island-wide. Prior to Hurricane Hugo in 1989, a serious source reduction campaign was initiated throughout the island, with a strong educational component. The project was quite successful in reducing mosquito breeding areas, and fogging did not begin in earnest until June, following heavy rain showers. Health officials have sufficient evidence to believe that Dengue fever is present on Nevis, but no cases have been clinically confirmed due to difficulties in sending samples to off-island laboratories for testing (pers. commun., P. Dias, M.D., Medical Health Officer, 1990). Clinical evidence suggests that Dengue is not endemic to Nevis, but rather that the island has been part of the pandemic spread of this disease.

6.2 PROBLEMS AND ISSUES

ST. KITTS

SOLID WASTE DISPOSAL

Solid waste disposal is a serious environmental problem in St. Kitts. Presently, official and unofficial means of disposing of refuse have undesirable impacts on the natural environment and the citizens of the island.

The location and operation of the major refuse disposal site at Conaree are of concern for a number of reasons. This dump site, which serves Basseterre, the surrounding suburbs, Frigate Bay and probably the SEP area when it is developed, is very visible in its location at the end of the airport runway and along the side of the highway. Additionally, since it is not a sanitary landfill and open burning is done regularly, visibility is decreased by wind-driven air pollution from smoke.

The Conaree dump site is situated on the southern border of Greatheeds Pond, a proposed protected area and the primary freshwater pond on the island. It is completely surrounded by a thick shield of mangroves, contains fish and crabs, and is extensively used by migratory waterfowl and shorebirds. Actually, the pond is threatened on several fronts, including threats from industrial development on its western perimeter

and loss of protection from adjacent sand dunes on its eastern border (Mills, 1989).

The Public Health Department is in the process of identifying alternative sites where sanitary landfills could be organized even though it is expected that the disposal sites at Conaree, Sadlers, and Belle Tete would be able to handle the refuse of St. Kitts for many additional years (Thomson and Madoo, 1989). Improved control of the Conaree site can be secured by putting in place adequate roads and fencing. A seawall would reduce the uncontrolled loss of material from the Belle Tete site during storms and high seas. Additionally, a number of pieces of large equipment are needed by the Public Health Department in order to upgrade dump sites to sanitary landfills (whether existing or new sites), including a compactor, a bulldozer and an excavating machine (pers. commun., T. Mills, Chief Public Health Inspector, 1990).

A more widespread, yet growing solid waste problem in St. Kitts is the existence of unofficial disposal sites (Frank, 1990; pers. commun., T. Mills, Chief Public Health Inspector, 1990). These sites can be observed in neighborhood ghauts, in cane fields, on unoccupied overgrown lots, on stretches of shoreline (e.g., off Fort Thomas, Camps and Old Road Bay), and along lonely sections of roadways. The Frigate Bay public areas presently face this problem (pers. commun., W. Liburd, FBDC, 1990), and it is a future concern for the SEP area as well (Towle, *et al.*, 1986). As the country continues to modernize, the availability of more disposable consumer products is likely to exacerbate the problem.

Manpower shortages, underproduction, and equipment abuse in the solid waste collection unit are compounded by the local stigma that Kittitian society attaches to the job of solid waste collection (Frank, 1990). The need for public awareness and cooperation in the area of solid waste disposal becomes apparent when refuse is placed beside, instead of into, empty bins provided by the Public Health Department.

Implementation of the new Litter Abatement Act was effected in September of 1990. The Act will only be effective in reducing littering if the system that is put in place is well organized, has sufficient human resources and equipment, and includes an appropriately designed public education component. The long-term environmental, public and economic health of St. Kitts will be impacted by the success or failure of efforts to control solid waste.

TREATMENT AND DISPOSAL OF LIQUID WASTES

It is becoming increasingly urgent to identify methods which ensure domestic effluents (including gray water) and industrial effluents receive proper treatment and disposal. The systems in place in St. Kitts to handle sewage, gray water, and liquid industrial wastes may be permitting large amounts of bacteria and viruses, nutrients, chemicals, and particulate organic matter to enter the coastal waters of the island on a fairly consistent basis. Although nutrients are a natural part of the marine environment, large or higher than normal quantities tend to stimulate the growth of algae and bacteria to the point where such growth becomes aggressive and destructive to benthic marine organisms. Increased turbidity of coastal waters due to dense populations of microalgae and high levels of suspended particulate matter create conditions of restricted light and reduced dissolved oxygen concentrations which negatively impact the growth and health of corals and fish in the area. Human health may be endangered when recreational waters contain pathogenic bacteria and viruses that can survive for hours in the marine environment.

The town of Basseterre is showing signs of soil saturation with septic tank effluent polluting the land and the inshore marine areas (Archer, 1988). In the flat coastal areas where groundwater is high and development and population density are on the increase, public health problems will occur where the volume of effluents exceeds that which the soil can absorb. Health concerns arise in some areas where subsurface sewage effluent, especially from overloaded soak-aways and other septic systems, drains into the nearby embayments and shorelines. Recent marine water quality studies initiated by CEHI have found

coliform counts of up to 5,000 per ml. in marine water on the Basseterre Bay shorefront, indicative of the direct discharge of sewage effluents of unknown sources and dimensions. Some effluent may arrive through concrete storm drains at the lower end of ghauts (Archer, 1988).

Now that the basic planning for a Frigate Bay sewerage treatment strategy has been completed, it is time for GOSKN to direct its attention to a far more difficult problem, namely, the design and installation of a sewerage system for Basseterre and its environs. It has been recommended that a feasibility study be done to design an appropriate system for Basseterre, Ponds Pasture, and New Town areas (Archer, 1988; DeGeorges, 1988). It is anticipated that external funding will be sought to finance a plan to address liquid waste disposal in an effective and environmentally sensitive manner, for such a system, in a heavily populated area like Basseterre, will be costly (pers. commun., T. Mills, Chief Public Health Inspector).

The final selection of a wastewater treatment system for any area of St. Kitts, including the Southeast Peninsula, will require execution of an Environmental Impact Assessment if GOSKN wishes to ensure that the system chosen will provide the best environmental protection for its investment. The assessment should look at a series of alternatives, including various treatment levels, and compare a variety of disposal methods. Final decisions regarding liquid waste treatment and disposal for specific areas would then be based on an analysis that had considered economic, technical and environmental parameters.

Industrial waste contributes to pollution of Basseterre Bay and other coastal waters such as at Limekiln Bay. Although there is no evidence of significant levels of toxic effluent being discharged into the coastal waters of St. Kitts, discoloration and high turbidity levels are observable in inshore waters receiving discharges from the brewery, the distillery, the sugar factory and food processing plants. These effluents tend to be high in particulate matter, for example sugar cane ash, and high in nutrients as in the stillage from the brewery and distillery. Although not necessarily toxic, these pollutants contribute to the reduction of dissolved oxygen in localized areas, stressing corals, fishes and other animals and in extreme cases resulting in fishkills and other forms of destruction. The ash and grit discharged in the sugar factory effluent have built up a mat of carbonaceous material over the years which reportedly destroyed most of the reef formation within one kilometer of the Basseterre coastline (Archer, 1984). This condition is compounded by the waste oil from the electricity plant that enters Basseterre Bay through a drain at the bay front. Consequently, household waste water and industrial discharges enter and mix in the waters of Basseterre Bay and Limekiln Bay where people swim, creating an unknown health risk to the population.

It has been suggested (Archer, 1984) that the brewery could install pre-treatment facilities to reduce the level of nutrients and particulate matter entering the inshore area of Limekiln Bay. Also, the hospital, which discharges waste water into the same bay, should have an outfall further out to sea where better dilution and dispersion can occur, thereby reducing the health threat to bathers. This type of system has been used in areas where there is some concern that package sewage treatment plants may malfunction periodically.

The minimal levels of monitoring of the coastal waters of St. Kitts that have been done indicate Basseterre Bay is one area where further study should be conducted on a routine basis. Contacts made with CEHI to train personnel and provide laboratory facilities have resulted in the training of two persons and the purchase of some laboratory equipment. However, staff recruitment and the need to identify local funding for a fully equipped and operational central environmental laboratory have slowed down the implementation of this program in the country.

OIL POLLUTION

Although St. Kitts and Nevis participated in development of a Subregional Oil Pollution Contingency Plan at a Meeting of Experts held in St. Lucia in 1984, the country

has not yet prepared an oil spill contingency plan for any port or other coastal area. In terms of probability, the greatest threat of a large marine pollution incident comes from small coastal tank ships and the bunker fuel of cargo and cruise ships that operate in the country's waters. Nevertheless, it is also possible for St. Kitts and Nevis to be the victim of catastrophic pollution from transiting marine traffic in regional waters. One obvious result of a spill which deposits a heavy coating of oil on tourist beaches would very likely be a reduction in revenues from the tourist industry for a period of time, dependent on the extent of environmental deterioration.

St. Kitts-Nevis would have a reasonable legislative foundation for addressing the prevention, reduction and control of incidents in coastal waters involving oil and other marine pollutants if the draft Marine Pollution Prevention Bill of 1988 was made law. The bill gives broad jurisdiction to the State to act through national and international law. Additionally, officials are authorized to initiate clean-up activities for land or offshore-based incidents and to make the polluter liable for clean-up and for restoration costs. However, even with enactment of this legislation, it would still be necessary to develop a contingency plan that addresses the procedures, personnel, training, and equipment needs associated with responding to various types of pollution incidents, especially oil. It has been recommended (Spitzer, 1984) that the Government formally recognize the Subregional Plan to provide a means for working and communicating with other nations in the region during major pollution incidents. The Government has been asked to submit the St. Kitts and Nevis "National Annex" of the Subregional Plan to the Secretariat (IMO).

SOIL EROSION

Devegetation of steep slopes and the sides of ghauts in St. Kitts appears to be the major contributor to soil erosion and sedimentation. The removal of vegetation in ghauts to facilitate sand mining has reached proportions that merit regulation of the activity in order to reduce the risks to presently healthy coral communities along the coast. The Cabinet-appointed Committee on Sand Mining and Construction Waste represents one attempt by GOSKN to address this problem (see Section 6.1). Additional information on sand mining can also be found in Section 2.4 of the Profile.

The fate of sediments that enter coastal waters from the land is dependent on factors such as particle size, currents, and wave energy. Larger particles of sand and clays between 3.38 mm and .030 mm will most likely be suspended for limited periods before settling on seabed organisms. Particles less than 0.149 mm can create long-term stress for reef ecosystems due to their ability to resuspend in the water column during turbulence. Calmer areas of the coast with low wave energy and minimal currents would be susceptible to high siltation and smothered seagrass beds and corals if land-based soil erosion is high.

Suspended sediments reduce the penetration of sunlight, reducing growth and health in organisms that require light for biochemical processes such as photosynthesis. Suspended sediments can also reduce levels of dissolved oxygen, causing further stress to seagrass and reef species. If suspended particles smother organisms when they settle, anaerobic conditions may result, leading to the release of hydrogen sulfide with its associated toxicity and offensive odor.

GOSKN has proposed to reduce soil erosion by working towards ghaut stabilization and promoting techniques such as contour farming and terracing. A handbook outlining a comprehensive soil conservation program and well water conservation has been produced by Government.

NEVIS

SOLID WASTE COLLECTION AND DISPOSAL

Both the Low Ground and Indian Castle solid waste disposal sites lie directly above coastal aquifers, and the Low Ground

site is within meters of the coast. They are, however, situated in the driest area of the island which may limit the formation of leachate. Coastal erosion has been so severe at the Low Ground site that refuse is now literally falling into the sea, and the access road has had to be rerouted twice. The Indian Castle landfill, designed as a temporary facility, is only .25 acres in extent, and if the refuse can be consolidated regularly, the Health Department expects it to be operational for three to four more years. The Low Ground site is on Government land and can be expanded if necessary. The Department projects its life expectancy at ten years, but problems with access and erosion do not make this likely. The current boom in the construction industry, which generates a substantial amount of bulky waste, and the disposal of derelict vehicles in municipal landfills will limit their life spans.

Both sites are very exposed, and high winds during portions of the year blow unconsolidated paper and plastic refuse out of the disposal area and in some instances directly into the sea. The dirt road to the Low Ground site hugs the shore for a considerable distance and becomes virtually impassable when it is wet. When they cannot drive all the way to the landfill, people often dump their refuse at any point along the edge of the sea. Refuse has been washing up on the leeward beaches, possibly travelling from these illegal dumps south of Fort Charles and/or the Low Ground facility itself.

Health officials estimate that 2-2.5 lbs. (0.9-1.1 kg.) of solid waste is generated per person per day, or roughly 10 metric tons per day for the entire population (pers. commun., C. Fahie, Senior Public Health Inspector, Nevis, 1990). Tourist facilities generally produce even more waste per capita. The Health Department has produced an excellent video about refuse disposal which is shown on local cable television and places high priority and effort on public education programs.

Proper management of the solid waste sites is compromised in large part by lack of funding for proper equipment and maintenance. Government garbage trucks are old and require chronic repairs. When the trucks are unable to make their regularly scheduled pickups, refuse piles up and is dispersed by the wind and stray animals. This problem is particularly acute in Bath Village, a lower income suburb of Charlestown, where garbage is strewn over large areas. Given the estimated waste generation rates, it is clear that three trucks are not sufficient to transport all of the island's refuse. The disposal areas are not fenced, and bulldozers are not always available to grade the sites. Vlugman (1988) recommended that one professionally designed and properly maintained sanitary landfill be operated for the entire island and suggested that the Indian Castle site be upgraded. This site is bounded on two sides by ghauts and is not amenable to large-scale expansion.

It is debatable whether one sanitary landfill is the best solution for Nevis, despite the island's small size. Given the topography of the island, which limits transportation to a ring road encircling the central peak, having only one disposal area could create logistical problems. The trucks now in operation have such low capacities that several trips between heavily-settled residential areas and the disposal site are necessary. The farther the land fill, the more inefficient the system becomes. The roads on Nevis cannot safely accommodate larger trucks, and it is therefore important that any plans for solid waste disposal include logistical as well as environmental concerns. Regardless of the number of disposal sites, the key is that they be properly constructed and professionally operated. The Health Department has unsuccessfully lobbied for this type of upgraded facility for waste disposal.

No attempt is made to separate batteries and other hazardous materials from the waste stream; they are disposed of in the open landfills with all other refuse. Until recently, most of the bottles on Nevis were returnable, but more exotic drinks and imported beer now arrive in non-returnable containers. Plastic packaging and grocery sacks are also becoming more ubiquitous.

Medical waste is incinerated at the one hospital on the island, and the ash is spread on site. Other solid waste is sent to the municipal landfill. Orderlies are responsible for separating infectious waste from non-

hazardous materials, and in some cases this is not done as carefully as it should and inappropriate waste is directed to the landfill rather than the incinerator (pers. commun., P. Dias, M.D., Medical Health Officer, 1990). Blood products and other liquids are poured down the drain which leads to the soak-away.

Statutory rules and orders governing the disposal of refuse are powerful on paper (Public Health Collection and Disposal of Refuse Regulations, 1978 and the Litter Abatement Act of 1989), but have not been enforced (the Litter Abatement Act went into effect in September 1990). If implemented, the fines levied would be a strong disincentive for improper disposal of household or commercial waste. The new Litter Abatement Act requires that commercial operators arrange for private disposal of their wastes. The Four Seasons Hotel Management may purchase their own vehicle to haul their refuse to the dump, for example, or contract this service out to a local entrepreneur. No tippage fee is collected at the landfills to generate revenues for management or upgrading of the sites.

Until the refuse collection and disposal system is more efficient and reliable, Nevisians will continue to dispose of their garbage by burning it (including tires) or carrying it to unauthorized dump sites. The problem is exacerbated by the high cost of trash bins and their propensity to rust. For some time the Health Department was able to provide drums at no cost, but now islanders must purchase their own. Metal cans must be replaced as often as three to four times a year (pers. commun., C. Fahie, Senior Public Health Inspector, Nevis, 1990).

TREATMENT AND DISPOSAL OF SEWAGE AND LIQUID WASTES

Although the NIA conducts no systematic testing for coliform bacteria in drinking, fresh or coastal waters, current methods of sewage disposal do not appear to have exceeded the assimilative capacities of the soil and water. However, any increases in population density pose the threat of bacteriological contamination of drinking and natural water supplies.

Development of tourist facilities, such as large hotels and residential complexes, will require special provisions for the treatment and disposal of sewage and gray water. The NIA should take a pro-active role in developing protocols and standards for these facilities, drawing on the experiences of other Caribbean nations. Under the current administrative system, no technical experts in the Water or Health Departments are provided the opportunity to review sewage and wastewater plans for development projects. As development along the coast continues, optimal solutions for the final deposition of sludge and liquid wastes should be identified early in the planning process. If ocean disposal is chosen, careful assessments of the bathymetry and coastal currents of the nearshore area are critical in designing sewer outfalls. Tertiary treatment "package" plants require skilled operators, easy access to spare parts, and close Government oversight and inspection. Designs that work well in temperate climates are not always compatible with tropical environments and should be carefully evaluated before construction. Measures to ensure that coastal waters remain unpolluted are vital to the economic well being of Nevis' fishing and tourist industries.

A piped sewerage system is not necessary or practical for the port of Charlestown at this time (pers. commun., B. Kennedy, BDD Advisor to the Nevis Water Department, 1990); however, the storm drainage system would benefit from innovative designs to improve flow patterns and ease of maintenance (pers. commun., C. Fahie, Senior Public Health Inspector, Nevis, 1990). When choosing domestic sewage disposal systems, it should be realized that septic tanks are not a panacea for areas without sewerage systems. They are relatively expensive, have severe limitations when used on steep slopes and will not effectively reduce nutrient pollution in areas of high population density.

The Nevis Historical and Conservation Society (NHCS) is coordinating a UNDP project to map and appraise coral reefs and grassbeds along the western and northern coasts of Nevis. Based on preliminary observations, the investigators do not believe that land-derived pollutants are affecting the in-

tegrity of these marine communities, but additional research is needed to confirm this observation. Test kits were supplied to St. Kitts-Nevis by the Caribbean Environmental Health Institute (CEHI) to measure coliform levels in Charlestown Harbor. St. Kitts irregularly collects and analyzes water samples from Basseterre Harbor for coliform, oil and BOD content, but the program has not been expanded to include Nevis. If samples were collected in Nevis, they could be sent to St. Kitts for analysis via the Government ferry. Monitoring storm sewer outfalls in Charlestown would also provide some information on nutrient and pollutant loading in the harbor. For example, the only laundromat on the island is located on the northern edge of Charlestown and discharges its washwater into a public drain that leads directly into the harbor; yet nothing is known about the concentration of material in this wastewater (pers. commun., C. Fahie, Senior Public Health Inspector, Nevis, 1990).

Another critical area to protect from water-borne pollutants is Newcastle-Longhaul Bay. The reef system is most developed in this section of the island, making it an important fish feeding and breeding ground and the most suitable location for a marine park. Land use in the area is not presently a cause for concern, but hotel and airport expansions should be reviewed with potential impacts on offshore environments in mind. Drainage patterns from the airport's runways should be carefully designed so that nearby waters are not polluted by this run-off.

As with tourist arrivals, the number of yachts anchoring off Nevis has been increasing steadily. The greatest numbers are found in Charlestown Harbor and off Pinney's Beach, a four mile strip of sand heralded as one of the island's finest tourist attractions. Provisions should be made to ensure that vessels do not discharge sewage into these areas. Simple dye studies could determine whether or not this practice poses an immediate risk to bathers.

Another point source of sewage pollution that is often overlooked is livestock impoundments. Several areas in the southeastern portion of the island support very high density livestock populations. The Government farm at Indian Castle bags some manure for use as fertilizer, but the impact of these facilities on the environment may warrant some attention.

AGRICULTURAL CHEMICALS

Fertilizers. Chemical fertilizers are not widely used in Nevis. Nonetheless, nutrient loading has not been studied, and, therefore, the effects of the amounts that are used are unknown. Freshwater lagoons fringing the western and northern coasts would be ideal water bodies to test and monitor nitrate and ammonia concentrations. Nitrogen (ammonia) levels in the wells and springs tested by CIDA in 1986 were well below those considered a health hazard.

Biocides. Farmers in Nevis have traditionally used fewer biocides than their counterparts in other Caribbean islands, but the precise quantities used are not known. Drinking water and agricultural products are not tested for biocide residues, nor are any human tissues. No facilities on Nevis are capable of performing pesticide analyses.

A growing cause for concern is the use of fertilizers and biocides on hotel grounds, ornamental plantations and the newly constructed, championship 18-hole golf course. The best way to control indiscriminate use of agricultural chemicals is to tighten and enforce regulations governing the importation of these substances and to inform the public about the environmental and health hazards they pose.

Revitalization of the island's cotton industry is listed as a priority for the agricultural sector in the Nevis National Development Plan, 1987-1991. Numerous sources recount the severe erosion and loss of soil fertility caused by this crop. Heavy chemical inputs are then necessary in subsequent growing seasons. The Nevis Development Plan also suggests that cut flower exports would be a profitable and viable industry for the island. In other areas of the world (Colombia for example), the cut flower industry has proven

problematic because it requires an excessive amount of pesticides.

The use of biocides poses a problem unique to small islands like Nevis. Tolerance to herbicides, pesticides, insecticides, and fungicides can develop more rapidly than in areas with greater land mass because populations of target organisms are so small. In addition, high rates of run-off and erosion in many agricultural areas of smaller islands result in chemicals being washed into the sea, with much reduced benefits to the crops.

OIL POLLUTION

No oil or toxic material spill contingency plan has been devised for Charlestown Harbor or any other coastal area of Nevis. Any spill that deposits oil on the island's most frequented beaches could have a damaging effect on tourist revenues for years and limit recreational activities for local citizens. Bathers note an oily smell and taste in the water near the Charlestown pier, and oil slicks are sometimes apparent in the immediate area. Coral reefs encircling the island are also very vulnerable to oil spills.

Natural and human (e.g., sand mining) activities have scoured sand from Gallows Bay in front of the Shell oil tanks. The tanks, which are very close to sea level, may now be subject to damage during a hurricane or tidal surge which could result in leakage. A spill did occur at the Shell facility in 1988, and the oil spread into an adjacent wetland area. The company built a rock and earth retaining wall around the tanks to prevent any future incidents. Two years later the contaminated area is completely revegetated, but oil is still occasionally found in the sand seaward of the storage tanks (pers. commun., R. Young, Vanier College, 1990). Fuel is piped through an underwater line to the Delta tanks at Low Ground, and another pipe carries the diesel from the tanks to the electricity plant 1.2 miles (2 km) away. Both of these pipelines were tested under high pressure before they were used to convey fuel, and the offshore pipeline is checked for leaks once every two months (pers. commun., Mr. Parry, Manager, Delta Petroleum, Ltd., 1990). However, these lines are vulnerable to damage during any seismic activity. Flexible hoses carry fuel from tankers moored offshore to the Shell tanks.

Of more immediate concern is the land disposal of waste oil from the two electricity plants and service stations. There is no system for the collection and safe disposal of used oil on Nevis. This is alarming given the dramatic increase in automobiles on the island within the last five years (61 percent from 1984 to 1989) and the addition of at least two engines to the electricity plants. Waste oil from garages and the generators is disposed of in storm drains or poured directly on the ground where it washes into ghauts and coastal waters during heavy rains. Possible leakage from the island's gasoline station storage tanks has not been investigated, although this has been identified as a problem in other Caribbean countries.

SOIL EROSION

The impact of sedimentation on marine and freshwater resources on Nevis is largely unknown (see also Section 2.4 of the Profile). Coastal habitats (seagrass beds, coral reefs, and rocky outcrops) sustained considerable damage in Hurricane Hugo (1989), mainly from siltation. Much of this sediment was derived from beach sand that was scoured during the storm, but the problem may well have been exacerbated by the transport of exposed soil from unprotected inland areas.

Sediment loading has never been measured in any of the natural lagoons on Nevis, but man-made reservoirs and water catchments require chronic maintenance to keep the outlets silt free. Current land use practices, particularly agricultural ones, subject the thin volcanic soils to wind and water erosion. As the construction industry grows and the scale of building increases, associated earth-moving activities may also lead to accelerated erosion and higher sediment loading of nearby waters.

WASTE OIL DISPOSAL PROBLEM IN NEVIS

Nevis has had electricity for 30 years and although the current is weak or non-existent at times, almost all residences and businesses now benefit from electrical lighting and other appliances. For these 30 years, however, there has been no environmentally-sound method for disposal of the lubricating oil used in each generator set at the power plant. The waste products from burning diesel fuel powering the generator are discharged to the air as exhaust. However, lubricating oil must be changed regularly. This used SAE 30 or 40 weight motor oil is simply poured on the ground at the Prospect Power Station and into a storm drain that flows directly into an extensive bog area in Charlestown.

Each generator set must have its oil changed every 1,500 operating hours, or approximately six times a year. With every change, an average of three drums (165 gallons) of waste oil is produced. Assuming that all the generators were operating full time (which is not actually the case due to breakdowns), almost 40,000 gallons of oil have been discharged since electricity was introduced to Nevis.

The Bogs is one of the most expansive open spaces left in densely populated Charlestown and serves as a rich feeding ground for many bird species, including egrets, herons and gallinules, as well as a buffer for inland areas (e.g., Main Street) during tidal surges and strong wave action. Since 1969, when the first generator was commissioned at the Charlestown plant, approximately 28,000 gallons of oil have been discharged into this wetland. The oil has settled along the main channel and down three parallel side channels and is at least half an inch thick in some places. The thick black ooze covers tree trunks and other vegetation despoiling the lush, natural beauty of the waterway. The lagoon is intermittently flushed with salt water so it is likely that some of the oil has been released into Gallows Bay.

Presuming that at least three of the five generator sets function at all times, roughly 3,000 gallons of waste oil will be created each year. Another generator is slated to begin operation in 1991, which will increase this amount. These estimates and projections do not include the waste oil from automobile engines which is also routinely disposed of on the ground behind repair shops.

A solution to this problem must be identified before the Bogs becomes so polluted that it no longer sustains life, or the Gallows Bay beach is no longer usable as a swimming area, or the freshwater aquifer is contaminated with this persistent substance. The acquisition of a small oil reprocessing unit may be feasible. If not, a regional approach to the problem, which undoubtedly faces all of the Caribbean islands, should be explored.

PUBLIC HEALTH

The USEPA lists malathion as one of the least toxic insecticides on the market. However, fogging should be done with great care in populated areas where roof/cistern water collection systems are used. Insecticides of any type are not intended for direct human consumption. This particular form of application requires a very fine mist to be effective, and, therefore, fogging equipment must be well maintained.

6.3 POLICY RECOMMENDATIONS

GENERAL

Financing. None of the issues addressed in this chapter of the Profile have simple, low cost, quick and easy solutions. The governmental initiatives and public and private partnerships needed to effectively address waste streams, pollution loading, and ecosystem and public health risks will take an extraordinary combination of good science, good politics, good government, and good sense. In the decade of the 1990's, with countries like St. Kitts-Nevis and others in the Eastern Caribbean experiencing new levels of imported toxins and chemicals, new kinds of material technology (e.g., packaging), and unprecedented volumes of what was once called trash and garbage, it is almost certain that the financing for needed waste management and pollution control measures is perhaps the most critical element in any action agenda. Therefore, the development of new and innovative means of raising revenues is necessary to reduce the burden on the public sector.

Pollution control and waste management are customarily seen as a drain on the Government treasury. However, given the high costs of modern technology and the high volumes of waste generated in consumer-oriented economies, pollution control and waste management can be turned into revenue-generating activities by the simple procedure of establishing prices for many facets of waste disposal. Once this is done, segments of the process can be privatized.

Possible options that need to be examined for incorporation into a national waste management plan or strategy for St. Kitts-Nevis include:

- charging a levy to all hotels for waste collection and treatment services;
- selling franchises to *private* waste collectors for designated collection areas (with different fee schedules for urban, rural, industrial areas);
- charging all industrial and commercial users for waste collection and disposal (including tippage fees at all waste disposal sites);
- billing polluters for clean-up and restoration costs;
- setting industrial pollution discharge fees (based on waste flow rates and the nature of the pollutant discharged);
- setting and collecting penalties for illegal waste disposal and for permit violations; and
- legislating incentives for recycling and then licensing collection franchises for various waste stream items with local use or intrinsic export value potential.

Pollution "Literacy" Campaign. A campaign -- targeted to decision-makers, businesses and the general population -- is needed to raise awareness about pollution issues and their *costs* to the community and the economy over time. One of the best opportunities for educating the public on pollution issues, as with all environmental education initiatives, is through the schools and youth groups. A serious effort to educate the public and promote new behavior will require a well-conceived and supported campaign. Information about pollution control regulations must be widely disseminated, and violators must be prosecuted.

National Pollution Assessment. The quantitative and systemic aspects of environmental pollution in St. Kitts-Nevis are not sufficiently well documented to permit easy development of remedial or regulatory measures. It would therefore be appropriate to identify funding and/or assistance to carry out a national pollution assessment. Such an effort should establish the basic dimensions of waste streams, identifying and quantifying sources and causative agents, volumes, flow rates, destinations, impacts, and projections, covering:

- point (i.e., industry) and non-point (i.e., agriculture) sources;

- pesticides, herbicides, and agro-chemical inputs;

- industrial chemicals (e.g., imports, storage, use, risk, disposal, impacts);

- interaction, i.e., aggregates and additive effects; and

- bio-accumulation effects over time.

The national "pollution profile" could use the workbook methodology laid out in WHO Publication No. 62, "Rapid Assessment of Sources of Air, Water and Land Pollution," as a preliminary framework (this manual was used by Archer, 1984).

SOLID WASTE

A Solid Waste Management Plan, which supports national growth and land use goals, should be prepared covering a minimum period of twenty years. The most attractive short-term option for solid waste disposal in both St. Kitts and Nevis, from an economic viewpoint, is likely to be a properly operated sanitary landfill. However, strategies to reduce the quantity of solid waste and to promote a variety of recycling options also need to be explored -- ideally as a collaboration between Government and the retail trade sector in order to ensure that such schemes are organized on economically defensible grounds.

Solid waste disposal sites which are appropriate for sanitary landfill activities and which will not have negative impacts on surrounding human or natural environments (such as mangrove forests and salt ponds) need to be identified and acquired. In St. Kitts, funding should be sought to upgrade the design of the Conaree site to a sanitary landfill until an alternative site can be located and Conaree closed as a disposal site. In Nevis, consideration needs to be given to whether upgrading of one site as a single sanitary landfill for the island will be adequate, given the topographic and logistical considerations discussed in Section 6.2 of this chapter.

The Health Departments in both St. Kitts and Nevis require funding for equipment to operate disposal sites more effectively, including permanent access to earth moving equipment to bury and consolidate waste at dump sites.

Consideration should be given to privatizing the collection of refuse, with these responsibilities turned over to private companies authorized to charge fees for their services. The Health Departments could oversee the issuance of licenses and set performance standards for such companies.

LIQUID WASTE

The most cost-effective *and* ecologically-sound sewage disposal and treatment method needs to be identified for the major population center in St. Kitts. Taking into consideration existing technological and financial constraints, the most feasible option is likely to be preliminary treatment combined with a long outfall which discharges into deep water in an area of strong currents. This option is particularly suitable for St. Kitts because there is deep water fairly close to shore. Disposal systems should be designed to be easily upgraded to a higher level of treatment should this prove to be necessary later.

Industries discharging wastes into the coastal waters of St. Kitts should be required to identify and provide pre-treatment systems to reduce the negative impact of their effluents on marine ecosystems. Additionally, attention should be given to the special problems of the urban waterfront of Basseterre Bay because of the emerging conflict between the new tourism facility and the negative effects of continuing untreated industrial waste streams and residential sewage discharges.

A long-term water quality and marine biological monitoring program for St. Kitts-Nevis should be implemented by the Department of Health in order to gather baseline data and identify areas requiring remedial ac-

tion. Laboratory and personnel capabilities will have to be upgraded, and national standards and criteria for water quality are needed.

OIL POLLUTION

An Oil and Hazardous Materials Spill Contingency Plan should be written and implemented. Available data identifying important areas that are vulnerable to oil pollution should be developed into a Sensitive Area/Response Resource Inventory to supplement the Contingency Plan. Legislation is needed to require proper disposal of waste oil and hazardous materials, and facilities to accomplish this need to be provided.

AGROCHEMICALS

The Pesticides Board needs to be reactivated as an operational body and needs to exercise its authority for monitoring and regulating the importation, sale and distribution of biocides in the country. Among other responsibilities, the Board should develop a list of approved biocides, excluding some as absolutely banned or setting use requirements for those restricted. USEPA's pesticides list (or some other suitable agency's classification system) should be used for establishing a basis for the country's approved list. The Board should be responsible for requiring distributors of biocides to report quantities sold and major users to report quantities applied to crops or used for other purposes.

Consideration should be given to creating a central environmental laboratory facility for the country (including pesticide monitoring functions), combining the equipment and capabilities of the Departments of Health and Agriculture. Technicians should be trained in the extraction of biocide residues from samples (e.g., produce, meat, fish, human blood/urine or environmental samples such as water and sediment). The need for establishing a pesticide evaluation capability in the form of an operational pesticide monitoring laboratory has been remarked on by several consultants, and external aid assistance might be sought to help accomplish this objective.

Agricultural extension agents and representatives of farmers organizations should be trained to certify farmers and other users in the safe use and application of biocides. Pest control operators who spray buildings and the environment to control insects, as well as pesticide control inspectors, should also receive training in the safe use of pesticides.

INSTITUTIONAL CONSIDERATIONS

At some point in time, it will probably be necessary for St. Kitts-Nevis to follow the example of other Caribbean countries by merging responsibilities for water and sewage control in a single agency or statutory body.

Public health legislation and water legislation need to be updated and strengthened by the inclusion of national standards and criteria for water quality, pollution control, and waste management. Consideration must be given to the country's existing institutional capabilities and technical/fiscal resources in designating pollution control standards and oversight/regulatory responsibilities.

SECTION 7 LAND USE, PLANNING, AND DEVELOPMENT CONTROL

7.1 OVERVIEW

ST. KITTS

At the present time St. Kitts does not possess an officially approved, comprehensive land use plan; nor does an associated map for the entire country exist.

However, a master plan has long been in use for the Frigate Bay Development Project, as well as a variety of planning studies, resource maps and building guidelines. As yet no master plan exists for the Southeast Peninsula's adjacent 4,000 acres, now proposed for major tourism development. In fact, both of these drier areas, totalling nearly 5,000 acres, stand as good examples (one nearly completed and the other just beginning) of what, in the jargon of professional planners, are called "planned areas" or "planned unit" developments, replete with a battery of antecedent study documents, drawings and plans covering everything from utilities to soil conservation to building and design standards. In sum, the tourism infrastructure base of St. Kitts, most of which is concentrated between the Conaree Hills and "The Narrows" passage between St. Kitts and Nevis, has a solid and respectable planning foundation.

The rest of the country, however, lacks similar, equally comprehensive land use and development planning documentation and generally escapes the development review process. Housing project enclaves in both Basseterre and many of the outlying villages are exceptions, as they have been properly planned and developed by the Central Housing and Planning Authority. Secondly, private sector subdivisions and residential development as well as industrial siting schemes are reviewed both formally and informally by the Physical Planning Unit and that process appears in most instances to have worked satisfactorily.

The main problem that exists in land use planning and development control (for both St. Kitts and Nevis) is the inability of the Government to coordinate physical planning efforts on an islandwide basis and with national goals and objectives, while at the same time mitigating negative environmental impacts and resource depletion. An example of this problem (and there are others) is the proximity of the cement block plant in St. Kitts to both a supply of now illegal beach sand and to a proposed wildlife reserve at Greatheeds Pond. While there is some logic in focusing planning initiatives on key problem areas or sectors, it appears that this has been accomplished at the expense of the remainder of the State. Marginal staffing and funding for planning activities only explain part of this oversight.

CURRENT LAND USE PATTERNS

Historically, mono-crop agriculture dominated the landscape of St. Kitts. Although somewhat diminished in intensity, this phenomenon continues today with the island still involved in a large way with continued production of sugar cane. Most of the land, from sea level to the 1,000 foot contour, is devoted to agricultural crop production. Table 7.1(1) reviews recent land use distribution patterns in St. Kitts based on St. Kitts Planning Unit data from 1982, the most recent official statistics available (see also Figure 7.1(1)). The table shows that sugar cane occupies approximately 12,000 acres or 27.6 percent of the land area (N.B. SSMC reports that this is now down to 10,000 acres). Food crop lands are estimated to occupy approximately 2,000 acres or 4.6 percent of total land acreage. The St. Kitts Planning Unit also estimates that there are 3,000 acres of unused agricultural lands (although see Section 3 on Agriculture for evidence of changes). Therefore, if private and unused agricultural lands are factored into the land use equation, agriculture would account for approximately 19,000 acres or 43.7 percent of the land area of the island. Some slightly different figures

Table 7.1(1). Present land use in St. Kitts.

Sugar Cane	12,000 acres	27.6%
Food Crop Land	2,000 acres	4.6%
Forest	11,000 acres	25.3%
Woodlands	5,000 acres	11.5%
Private Agricultural Lands	2,000 acres	4.6%
Unused Agricultural Lands	3,000 acres	6.9%
Non-agricultural Lands	3,000 acres	6.9%
Built-up Areas	3,000 acres	6.9%
Other Land Uses	2,520 acres	5.6%
	43,520 acres	

Source: St. Kitts Planning Unit data (1982).

are included in Tables 2.1(1) and 3.1(1) of the CEP. Differences are not fundamental at the strategic and environmental planning level, although inconsistency is always bothersome.

The topography of St. Kitts is unique because the high slopes (20 degrees and above) of the island's central mountain range are covered with an intense growth of forest, including Evergreen, Montane and Semi-Deciduous trees with Elfin Woodland-Cloud Forest at the highest elevations. Forest cover of all kinds, including the vegetative types of the marginal lands, accounts for approximately 11,000 acres or 27.3 percent of the land area of St. Kitts. These agricultural and forested lands, when combined, account for roughly 71 percent of the island's total land area.

Scrub woodlands are another dominant landscape feature of St. Kitts. This vegetation type is found in the drier parts of the island and mainly on the Southeast Peninsula (SEP). The low hills of the Peninsula may at one time have been covered with low forest, and this vegetation type still exists in some areas at the tip of the SEP. However, years of clear cutting for firewood and charcoal, grazing animals, and frequent burning of the area as a maintenance mechanism have resulted in characteristic dry savannah and scrub woodlands. Altogether, it is estimated that 5,000 acres or 11.5 percent of the total land area of St. Kitts consists of scrubland varieties, including acacia, cacti, and low growing manchineel. See also Section 1.2.4 and Section 2.1.1 of the Profile.

Based on figures supplied by the St. Kitts Planning Unit, land classified as "Non-Agricultural Lands, Built-up Areas, and Other Lands" accounts for 8,250 acres or 17.5 percent of the island's total land area. Most of these general land-use categories are part of the urban mix of greater Basseterre and the ring of rural villages and townships that dot the coastal road of this island. Much of the island is also utilized for infrastructural development including roads, a railroad system, airport facilities, power plants, industrial estates, residential and commercial developments, quarrying, institutional buildings, parks, and recreational facilities.

LOSS OF AGRICULTURAL LAND TO URBANIZATION

One activity, apart from the urban sprawl brought on by the rapid growth of Basseterre, that is in direct competition with

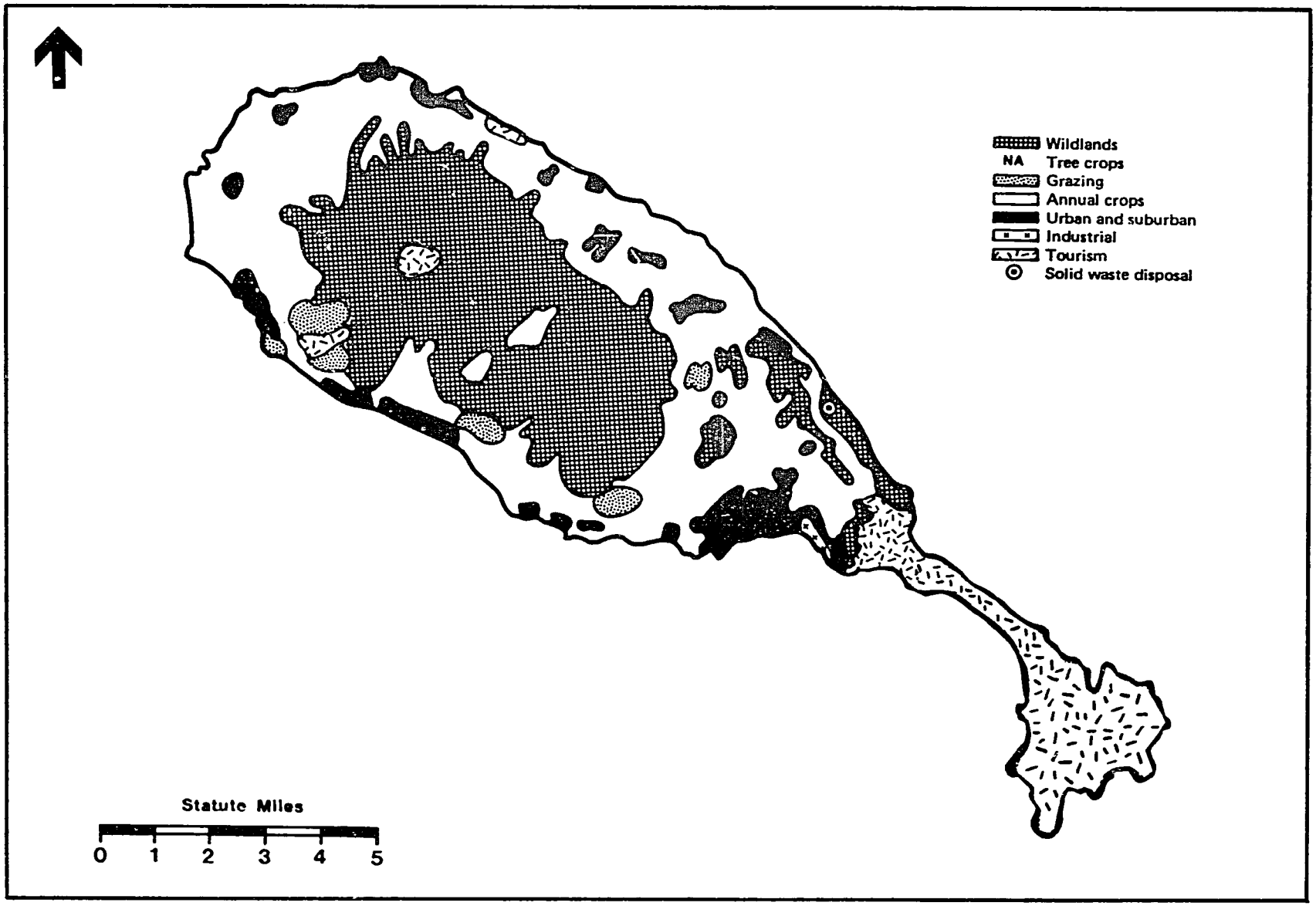


Figure 7.1(1). Present land use, St. Kitts (source: adapted from ECNAMP, 1980b).

agriculture and accounts for the loss of hundreds of acres of usually prime agricultural land, is housing. During the 1950's the Central Housing and Planning Authority was involved in establishing new housing areas with the objective of upgrading settlement conditions and eliminating slum conditions. Projects such as Lodge, Molineux, Sadlers, Cayon and Mansion were built, causing some loss of agricultural land. Private developers, with the approval of the Physical Planning Unit, followed suit with further loss of agricultural land. Each decade saw the loss of additional land as is shown in Table 7.1(2) (Williams, 1983).

HUMAN SETTLEMENT PATTERNS

St. Kitts has a better than average natural endowment, and most resources are well distributed in ways favorable to human occupation and use, given contemporary technologies, i.e., its mountains are not spread throughout the island as is the case in Grenada, St. Lucia and Dominica where potentially prime land areas are intersected with rugged topographies, thereby limiting infrastructural development. The soils of St. Kitts are also of good quality and are distributed in a continuous ring around the island making them accessible with one ring-road and one parallel, narrow gauge rail system. When a relatively benign rainfall regime is added to good soil conditions, the island of St. Kitts can be said to compare quite favorably to others in the Eastern Caribbean.

Table 7.1(3) is useful in establishing one aspect of St. Kitts-Nevis' "favored" status among the OECS group. A comparison of the percentage of land tied up in unharvestable forest on *steep slopes* (i.e., over 21 degrees) reveals that such lands occupy over 70 percent of Grenada, St. Vincent and Dominica and over 50 percent of St. Lucia. St. Kitts and Nevis are both under 20 percent. But the 20 percent is not insignificant, and the montane area is high enough to generate an adequate supply of rain-fed groundwater without the seasonal problem of variables found in rivers and streams, with incumbent high evaporation rates from exposed water surfaces like reservoirs.

Historically, these geographic preconditions and the common-sense practice in rural areas of living within walking distance of the fields have produced rural settlement patterns in St. Kitts where villages are located at distances of between two to three miles from each other (Thompson and Madoo, 1989). These settlements, which range in size from 200 to 3,000 people, run the risk at present of being left without an economic base because of the decline of sugar cane, a homogeneous crop which tends to generate a relatively even distribution of population. Tourism activity, construction and small-scale agriculture are now employing more and more persons from these settlements previously dominated by sugar.

As more diverse agricultural production continues to modify this settlement pattern, the Government will have to consider its agricultural diversification policy in more detail to minimize unwanted, adverse social impacts. Other diversification efforts will have similar effects. For example, notwithstanding the detailed documentation on the ecological impacts of a proposed "Planned Unit" Development for the Southeast Peninsula (Towle, *et al*, 1986a), the agglomeration and pull-effects of development at such a scale will have a significant impact on existing rural settlement patterns in relation to the greater Basseterre area. Some villages and townships may not grow at all and even lose population, while greater Basseterre increases in size as a result of urban sprawl and the demands of accommodation created by rapid and uncontrolled urbanization.

According to Williams (1983), many rural settlements are still showing growth with the exception of Key, Mansion, Tabernacle, Dieppe Bay and Sadlers. In looking at the aggregate or net effect, however, Thompson and Madoo (1989) suggested that the overall demographic projections already show an "impressive" change in population distribution between rural settlements and the Basseterre area particularly if account is taken of the fact that between 1970 and 1980 there was a slight general reduction in St. Kitts' total population. Even with an almost stagnant general population, the greater Basseterre area grew by 10 percent in only ten years. If, therefore,

Table 7.1(2). Loss of agricultural land to urbanization, St. Kitts.

DECADE	HOUSING AREAS	ACREAGE
1950-1960	Greenlands, Bird Rock, Cayon Project, Sadlers Projects, Molineux Project, Mansion Project, Trinity	65
1960-1970	Pond Site, New Pond Site, Pond's Pasture, College Housing, Lamberts, Wades Gardens	110
1970-1980	College Housing Extension, Bird Rock Extension, Harbor View, Suncrest	45
1980-1990	Estimated	80 +
	TOTAL LAND LOST BETWEEN 1950 TO 1990	300

Source: Adapted from Williams, 1983

other conditions stay about the same, for the period 1980-1990, the greater Basseterre area could acquire up to 52 percent of the island's population.

DEVELOPMENT TRENDS

In accordance with its policy to diversify the economy, GOSKN has embarked on a three-tiered approach to diversification in the agricultural, industrial, and tourism sectors (see also Section 1.4 of the Profile).

Current agricultural diversification efforts (which also include some standard upgrade initiatives) have drawn some criticism for moving too slowly in the face of rising local demand, evidenced by rising imports of vegetable crops which could be produced locally, thereby saving foreign exchange by providing substitutes for imports. Mostly this is theory and valid as a concept only in the longer run. Primarily the problem lies in the complexity of agricultural diversification which involves more than switching crops. Mostly the longer time frame and moderate pace of change is more influenced by socio-economic factors than agronomic or technical ones. Education and relocation factors plus the need for farmers to gain experience with new tools, soils, seeds, crops, and pests, and with new fellow workers, new locations, new self-directed farming techniques, even new planting schedules all take time to learn. If the learning process then gets out of synch with shorter-term changes in market demands for new crops, it is wrong-headed to direct the blame at diversification as the culprit or explanation.

As previously stated, 90 percent of the arable land in St. Kitts is still owned by the Government, and mono-crop agriculture predominates. The subject of land tenure is an old and sensitive one with Government (and with many of the international donor agencies). There is simply no easy solution any more than there is a substitute for good planning, which is one of the reasons changes in tenure have taken so long. However, effective

Table 7.1(3). Approximate percentage of land by slope classes for each CEP country.

Slope Class	Grenada	St. Vincent	St. Lucia	Dominica	Antigua	St. Kitts	Nevis
< 2°	2	2	7	1	5	9	4
2° - 10°	8	5	15	1	65	60	60
11° - 20°	19	10	28	12	20	15	16
21° - 30°	45	17	34	22	9	10	13
> 31°	26	66	16	64	1	6	7

Source: Atkins, 1983.

mechanisms for distributing land, whether by lease-purchase arrangements, leasing, or outright sales have been slow in coming. Such delays may well have had an adverse effect on the GOSKN's diversification program; but the alternative, namely a hastily, ill matched, high risk resettlement event followed by failure and foreclosure for the farmer in case after case, *would have been much worse.*

On the other hand, the Government of St. Kitts-Nevis cannot afford indefinite delays in settling on suitable lease terms and the support package for perhaps a hundred or so farmers in the first round of decisions regarding redistribution of land. A new and different reason to accelerate agricultural diversification activity is already in the making -- namely, a substantial increase in tourism development. Failure to realize this objective of opening up new on-farm employment opportunity could trigger a rural to urban migration, thereby imposing serious hardships on the greater Basseterre area to accommodate an influx of discouraged ex-farmers in search of jobs in the commercial and tourist sectors in the urban area.

This rural to urban migration pattern could be further exacerbated by the Government's decision to encourage the expansion of existing and new industrial estates in the greater Basseterre area (GBA) . In a recent survey by Thompson and Madoo (1989) regarding industry siting from 1983 to 1985, it was reported that:

- of 11 firms in the garment sector, six were in the GBA;
- of 16 firms in miscellaneous industries, nine were in the GBA
- of 14 firms in the electronics industry, 13 were in the GBA.

In terms of overall formal employment, this trend is estimated to guarantee the greater Basseterre area a 60 percent slice of the overall employment in St. Kitts in the near future. In addition to these data, it must be recognized that the development of the Southeast Peninsula is expected to generate at least 2,000 new tourism jobs, which when added to the direct expenditures of tourists will definitely reinforce current trends in employment within the greater Basseterre area. This phenomenon will, in conjunction with improved transportation services, undoubtedly hasten the urban sprawl effects of Basseterre and the obvious demand pressures of rapid and uncontrolled urbanization. This means that unless there is a more vigorous development of the current diversification policies, the rural sector's capability to counterbalance the attraction of Basseterre and its environs will be limited indeed.

The planned development at Frigate Bay occupies 850 acres of land. In addition, the proposed development of the 4,000 acre Southeast Peninsula promises to be a formidable task for the Government, to ensure balanced growth and development of the Peninsula in order to realize its tourism growth objectives, while maintaining the unique environmental integrity of the area. Again, development activity on such an imposing scale (considering the size of the resources of St. Kitts) promises to be a demanding job for GOSKN in terms of its ability to allocate infrastructural resources in a coordinated and equitable manner throughout the remainder of the country. This is currently an on-going GOSKN program and should remain a high priority item on the agenda.

DEVELOPMENT CONTROLS

Development control as it is currently practiced in St. Kitts-Nevis is mostly decentralized in nature, lacking a mechanism for coordination and integration on an islandwide basis. The principal planning legislation is the Town and Country Planning Ordinance (Cap. 269, 1949). However, there are no regulations for implementing the ordinance. With respect to development control, the Land Development (Control) Ordinance (No. 15, 1966) stipulates that the development of any land requires permission from the Minister This legislation also has no implementing regulations, but this may have been unimportant since in a small country like St. Kitts and Nevis, any large or significant project is ultimately cabinet-level business. The 1966 law indicates the kinds of developments to which the requirement specifically applies. These include: housing estates, hotels, apartment buildings, industries and factories, and beach facilities. The planning legislation follows the pattern of the colonial-based laws found in many Commonwealth countries. It calls for the preparation and adoption of legally-enforceable zoning plans called "schemes", including compensation for loss of property value as a result of the scheme. In practice this land use planning aspect of the legislation has not been implemented although it would seem to be increasingly relevant as demand requirements for land increases (Lausche, 1986). Presently, the principal use of the legislation is for control of building construction and other urban developments including roads, community facilities, amenities and public services.

The Ministry of Agriculture, Lands, Housing and Development has responsibility for land use planning and development control in the country. However, responsibility for implementing this legislation in St. Kitts is divided between the Central Housing and Planning Authority and the Planning Unit within the Ministry, although it is not clear from the legislation how these agencies divide responsibilities (see also Section 8.3 of the Institutional Framework chapter).

Growth pressures on land (especially agricultural and forested areas) and on water resources in St. Kitts continue to mount causing considerable discussion and an occasional call for action in the planning arena. According to some, it would seem a relatively easy task for the Government to prepare a National Land Use Plan for Government lands and then include natural resource related conditions or covenants in rental leases or deeds of sale. Such terms might restrict land uses to those that are appropriate for land characteristics such as slope, rainfall, soils and altitude. Since these lands cover so much of the country, the impact could be substantial in advancing natural resource management practices without the common problems of compensation.

THE SOUTHEAST PENINSULA: A SPECIAL CASE?

One region of St. Kitts, the Southeast Peninsula, is almost exclusively in private ownership. Recent interest in developing the Peninsula has grown, especially from the tourist sector. A U.S. Agency for International Development (USAID) sponsored project was successful in building a road the length of the Peninsula in the late 1980's. In order to meet the projected growth demands of the SEP, while preserving the environmental quality and balance of the area, the Government enacted the Southeast Peninsula Land Development and Conservation Act in

1986. It is expected that this Act will provide for the development, conservation and management of the Peninsula through the establishment of a Land Development and Conservation Board with specific powers and functions. These include:

(1) To evaluate residential, commercial, industrial and other development schemes; and

(2) to make recommendations concerning:

- allotment, reservation and zoning of land for different purposes;
- control of pollution and maintenance of the environmental quality of the Southeast Peninsula including coastal conservation;
- development and implementation of an environmental protection plan;
- preparation of schemes to develop lands in accordance with the Land Development Control Act of 1966.

The Board was also given the authority to carry out sectorial studies of the SEP and monitor development schemes. Furthermore, the Board was given direct responsibility to prepare a SEP comprehensive land use management plan. In all cases the Board is required to recommend schemes and submit a comprehensive land use management plan for approval to the Minster (of Development). The SEP Land Development and Conservation Act effectively created a separate planning district in St. Kitts for the Peninsula.

The SEP experience has certain similarities to the earlier Frigate Bay Development Project. The Government of St. Kitts-Nevis purchased 850 acres of land in the 1950's, and the preparation of a master plan for the area began in the early 1970's. A semi-autonomous board, the Frigate Bay Development Corporation (FBDC), was established by Ordinance in 1972 and was vested with the previously acquired Frigate Bay estate lands for the purpose of undertaking and encouraging the development of Frigate Bay. The FBDC is a statutory corporate body owned solely by the Government.

In the original 1972 Frigate Bay Development Plan, the land was categorized and allocated for five different types of use, based on a site capability analysis and other factors. The similarity of the prior development structure to the latter 1986 SEP development approach is that the FBDC also operates like a separate *de jure* planning district in St. Kitts. Together, these two districts possess no formal mechanisms for facilitating integrated planning with the rest of the State.

However, there are also many differences between the two. First, each reports to a different Ministry; second, the land of the SEP is privately owned, whereas the land at Frigate Bay is owned solely by the Government; and third, the requirements of the international donor agency funding the road-building project for the SEP provided for the preparation of various comprehensive and sectorial studies of the Peninsula prior to the construction of an access road.

Largely as a follow-up to the SEP planning initiatives, the Government of St. Kitts-Nevis adopted a National Conservation and Environment Protection Act (NCEPA) in 1987. This comprehensive environmental and resource management prototype is a significant first step in the direction of improved resource management in the country; however, comprehensive accompanying regulations are still needed to implement and enforce this Act effectively (see also Sections 5 and 8 of the Profile for more detailed information on the NCEPA).

NEVIS

LAND USE PLANNING AND DEVELOPMENT CONTROL

There is no detailed map of current land use information available for Nevis as a whole. A generalized land use map was pro-

vided in the ECNAMP data atlas in 1980 (ECNAMP, 1980a). See Figure 7.1(2).

What is available is a preliminary zoning map of the island which was prepared and reported on in 1988 (Corker, 1988a). In this proposed zoning scheme, the island was divided into major land use types which were further subdivided in land use classes as follows:

Urban Development:
- Charlestown
- Charlestown conservation area
- Medium density housing
- Low density housing
- Industrial sites
- Airport and port
- Hotel and tourism sites

Agricultural Land:
- High quality
- Medium quality
- Marginal

Reserve Land:
- National Park (Nevis Peak)
- Marine Park (Cades Bay)
- Conservation areas
  - The Bogs
  - Round Hill
  - Hurricane Hill
  - Nelson Springs
  - Saddle Hill
- Historic and environment sites.

This zoning proposal has not yet been approved by the Nevis Island Administration, but it is currently undergoing review.

Effective development control in Nevis has been limited by the absence of an officially approved physical planning scheme, which means that decision-making is done on a project-by-project basis and in an uncoordinated, *ad hoc* manner without adequate guidelines to direct the process. Planning is made even more difficult because ownership claims cannot always be substantiated.

Lausche (1986) points out that differing historical perspectives in St. Kitts and Nevis have resulted in somewhat contrasting approaches to planning. She maintains that since a greater portion of land in Nevis is in private ownership (the Government in St. Kitts controlling the vast majority of rural agricultural lands), there may be a need for a more active Government role to guide the patterns of development in Nevis. Perhaps in recognition of this factor, a draft Nevis Land Development Ordinance was prepared in 1984 which includes the prevention of soil erosion, the development of forest reserves, and the protection of streams and other water supplies among the purposes which can be mapped for land use control. Lausche (1986) applauds the forward-looking approach of the Ordinance, which reflects an awareness of basic natural resource management issues as a component in land use planning. It might be noted that the same could be said for Corker's (1988a) preliminary zoning report and map for Nevis. Although not legally adopted, these documents tend to be used as administrative guidelines.

Planning functions in Nevis, as in St. Kitts, have been integrated into one Planning Unit, which is located within the Ministry of Planning. The Planning Unit incorporates economic planning, physical planning and statistical functions. The Town and Country Planning Board in Nevis has become increasingly inactive over the years, and no meeting was held during the last year.

Development control, which is a loosely-structured and poorly-defined process in the island, rests generally with the Planning Unit, the Nevis Building Board (for review of building applications), and the Nevis Housing and Land Development Corporation, charged with implementation of Government policy for state-owned lands. There is no legal authority in Nevis to handle the full spectrum of centralized development control responsibilities.

Currently, no legal requirement or institutional capacity for carrying out formal environmental impact assessments, even for major projects, exists in Nevis (or in the country). Recommendations by the Nevis Historical and Conservation Society (NHCS) and the Nevis Environmental Education Committee (NEEC) have attempted to alert the NIA to the urgency of implementing such

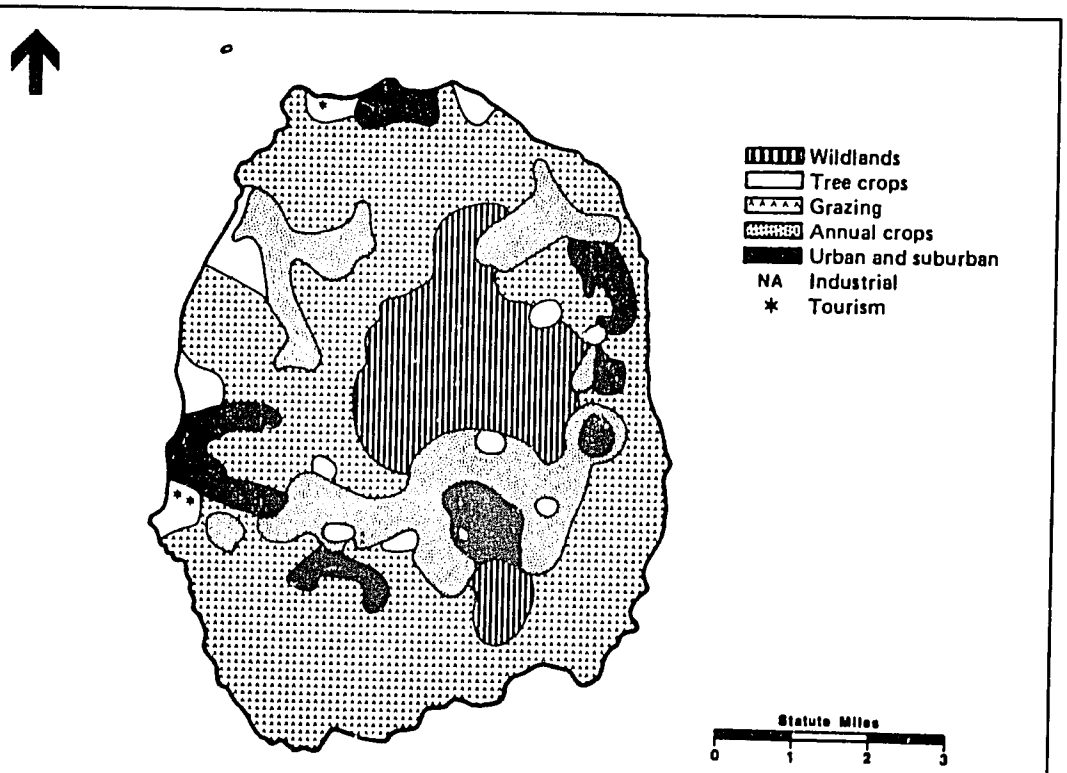


Figure 7.1(2). Generalized land use map for Nevis. (source: ECNAMP, 1980a).

requirements. Information collected by the NHCS and NEEC provides guidelines regarding recommended content for development applications, including general standards for plot cover, setbacks from roads and coastal zones, sewage disposal, interference with wetlands, and building construction requirements. As an unofficial advisor to the Nevis Government for environmental matters, the NHCS has prepared several environmental review reports for proposed development activities.

7.2 PROBLEMS AND ISSUES

The Government of St. Kitts-Nevis is faced with the unique situation of having three separate and independent planning "districts" in St. Kitts -- and, in effect, another one in Nevis.

In the first place, as previously noted, the FDBC, by law, has jurisdiction to plan, permit and implement private or public sector development projects for the 850 acre tract of land at Frigate Bay, subject to the approval of the Minister who holds the portfolio for tourism. A second "planning district," controlled by the Southeast Peninsula Board, has the power to plan and implement a comprehensive development scheme for the entire Peninsula, subject to the approval of the Minister who holds the portfolio for development. The third planning district covers planning and development control in the remainder of the island (except, see below, regarding the SSMC) and falls within the jurisdiction of the Physical Planning Unit, operating under the Land Development (Control) Ordinance of 1966 and responsible to the Minister of Agriculture, Lands, Housing and Development. However, *within* the Ministry, responsibility for implementing this legislation in St. Kitts appears to be divided between the Central Housing and Planning Authority and the Planning Unit.

Additionally, it could be argued that there is yet another informal planning area or "district". To the extent that the St. Kitts Sugar

Manufacturing Corporation plans for, schedules, and influences most land resource allocation decisions within the vast areas of Government-owned agricultural land under its jurisdiction, the SSMC functions as a *de facto* planning unit. Any planning functions undertaken by SSMC are of course subject to review and approval within the Ministry of Agriculture. Whether they (or the decisions of the FBDC or the SEP Board) receive the same kind of comprehensive review process they would get from a more formalized external vetting process is another issue. What does not happen when vetting procedures are internalized (as they are in SKN) is that the very valuable process of information exchange among technocrats and other interested parties is easily overlooked.

While this decentralized system of planning and development control has worked reasonably well, perhaps because it is customized to the St. Kitts-Nevis case, it does leave the separate planning "districts" with very fundamental institutional limitations and even weaknesses since no agency can optimize the benefits to be gained from an integrated land use planning approach -- including a centralized, well-equipped library, map center, land information system and the luxury of an experienced, stable professional staff.

Furthermore, the fragmentation of the planning process can weaken monitoring and forecasting functions, leading to surprise problems arising in any of the planning districts or regimes. Fragmentation of planning activities can also limit the timely application of a coordinated national response to large problems that cannot be addressed fairly or efficiently on a local scale or a piecemeal basis.

For example, already there are indications of what planners call "agglomeration effects" in the greater Basseterre area with related demand pressures for low cost housing (Thompson and Madoo, 1989). As the "pull effects" of this area on the rural sector are increased, so will the demand pressures for housing, infrastructure, institutional services, health and welfare and a range of other social needs. The lack of an integrated planning capability will in turn seriously restrict the Government's ability to engage in long-term, comprehensive planning.

Finally, the programs and procedures of the Physical Planning Unit and the entire planning process that exists for the remainder of the country need to be institutionalized. Draft revisions to the Town and Country Planning Act and draft regulations to this Act have been around long enough to almost qualify as an historical document. While of more recent origin, the same is true of the draft Nevis Land Development Ordinance of 1984.

At present, however, the process remains informal at best and works primarily because of the good intentions, the competence and commitment of the officials involved in the planning and review process. On the other hand, one aspect of the process does work well, albeit quietly; and this is the "review committee," to use its shortened name, or, more formally, the Inter-ministerial Review Committee. This group is a fundamental part of the development planning process in St. Kitts; yet it does not exist under statute. It is a working committee comprised of the technical heads of relevant ministerial agencies, including the Director of the Planning Unit (Committee Chair) and Director of the Central Housing Authority (Committee Vice Chair). Other Agencies represented are: Public Health, Public Works, Electricity, Police, Water, and the Building Board. There is an informal proposal review procedure that works approximately as follows:

(1) The review committee accepts development proposals directly from applicants or through the Central Planning Unit.

(2) Recommendations are made and sent to the Minister of Agriculture, Lands, Housing, and Development.

(3) The Minister makes a decision to approve, deny, or recommend changes, and returns the document to the committee.

(4) The committee informs the applicant of the Minister's decision. If the decision is a denial, the Minister is obligated, within a specified period of time, to show cause for denial of the proposal to the applicant.

POTENTIAL CONFLICTS

There are several areas of potential overlap between the SEP Act of 1986 and National Conservation and Environment Protection Act of 1987 with regard to development control of the Southeast Peninsula. However, it is fortunate that the Minister who holds the portfolio for development is responsible (through the SEP Board and the Conservation Commission, respectively) for the implementation of these two Acts and can use his authority to prevent a duplication of effort or possible jurisdictional conflicts in the management of the Southeast Peninsula.

It is also instructive to note that the recently approved SEP Land Use Management Plan and the SEP "Development Guidelines" do not clearly identify priorities for the SEP. They do not, in effect, capture a clear and concise version of the SEP Board's vision of the future, even though they establish essential constraints on development. A matrix of constraints, however, will neither generate the insight that developers need nor influence support for the Board's position on development issues. As a result, the Board must use every opportunity to influence the character of development on the Peninsula or this will be determined by external pressures.

7.3 POLICY RECOMMENDATIONS

(1) Reform of the Planning Unit. The institutional structure and legal authority of the Planning Unit should be revised to allow it to function in a more integrated and efficient manner -- i.e., as a true "Central" Planning Unit. This should involve the assumption of more formalized development review and development control responsibilities by the Planning Unit. In addition, the adoption of regulations to implement existing planning and development control legislation should be a high priority. Supplemental follow-on tasks include:

(a) Development of an expanded and improved land use database, including an updated and approved land use map and physical development plan for the entire country, which incorporates the existing sectorial plans for Frigate Bay and the Southeast Peninsula.

(b) Development of formal zoning restrictions and subdivision regulations based on an approved physical development plan (a draft preliminary zoning map already exists for Nevis).

(c) Establishment of a procedure requiring the preparation of environmental impact assessments for all major development projects, whether public or private sector.

(2) Provide for Integrated Planning. There needs to be a rationalization of land use planning efforts in St. Kitts-Nevis that will facilitate an integrated approach to planning on an islandwide basis. The real cost of development projects needs to include a process of internalizing environmental costs (e.g., the principle of "the resource user and/or the polluter pays"), especially in the case of larger tourism projects such as those at the SEP and Frigate Bay in St. Kitts and at Pinneys Beach in Nevis.

(3) Integration of Planning Functions. There is an increasing need for an integration between the formulation of economic policy and physical planning on a national scale, particularly because of the spatial and physical limitations of land in the country. This integration task can be greatly facilitated by encouraging citizen participation in the project design or concept review phase of major development activities. This could include a public notice procedure where the project planning and decision-making process is open to input from NGOs and members of the community.

(4) Legislative Reform. Legislation needs to be revised and regulations provided to reinforce the lead position of the Planning Unit in land use planning and development control issues in St. Kitts and Nevis.

SECTION 8 INSTITUTIONAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT

8.1 GOVERNMENT ORGANIZATION

St. Kitts and Nevis is a sovereign democratic state within the British Commonwealth of Nations with a federal system of government. A major step in the organization of the current Government occurred more than one hundred years ago when, in 1871, St. Kitts and Nevis, as individual members of the federated Leeward Islands of Great Britain, were organized into "Presidencies," each with its own Administrator and Legislative Council. In 1882, Nevis, St. Kitts and Anguilla were combined into a single Presidency.

In February 1967, the islands became a State in Association with the United Kingdom, a status which provided for full internal self-government. However, Anguilla seceded three months later and reverted to direct British colonial rule. The Anguilla Consequential Provisions Order (1982) formally acknowledged the separation of Anguilla from the State, which is now known as St. Kitts and Nevis or, alternatively, is called St. Christopher and Nevis or the Federation of St. Kitts and Nevis or the Federation of St. Christopher and Nevis. The St. Kitts and Nevis Constitution Order of 1983 terminated the status of Association with the United Kingdom and provided for the establishment of a fully sovereign and democratic state in that same year.

Under the new Constitution, the Governor-General is Her Majesty's Representative in the state, and, except where otherwise provided, the Governor-General is required to act in accordance with the advice of the Prime Minister under the general authority of the Cabinet. The Cabinet consists of the Prime Minister, the other Ministers, and, at any time his office is a Public Office, the Attorney General *ex officio*. The Governor-General appoints as Prime Minister a member of the House of Assembly who appears likely to command a majority in that House. The other Ministers are appointed from among the members of the House on the advice of the Prime Minister.

Legislative power is vested in Parliament which comprises the House of Assembly with 11 representatives, chosen from single-member constituencies on the basis of universal suffrage, and three members who are appointed (two on the advice of the Prime Minister and one on the advice of the Leader of the Opposition); if one of the appointed members is the Attorney General, then there are four nominees. Executive power is vested in the Cabinet.

The Federal Government is presently organized as follows:

- Prime Minister's Office
- Ministry of Finance, Foreign Affairs and Home Affairs
- Deputy Prime Minister's Office and Ministry of Tourism and Labor
- Ministry of Education, Youth and Community Affairs, Communications, Works, and Public Utilities
- Ministry of Agriculture, Lands, Housing and Development
- Ministry of Trade and Industry
- Ministry of Health and Women's Affairs.

NEVIS

The island of Nevis has its own legislature and administration and may also return members (currently three elected representatives) to the Federal House of Assembly in St. Kitts. Nevisian parliamentarians are therefore

able to hold dual ministerial portfolios, one in the federal administration and the other in the Nevis local administration. The Governor-General appoints a Deputy Governor General for the island of Nevis.

There is a Nevis Island Assembly whose members are elected one from each of five electoral districts, plus at least three appointed members, but appointees are not to exceed two-thirds of the total number of representatives. One-third of the appointed members are selected by the Leader of the Opposition and the others by the Premier.

The Nevis Island Administration (NIA) is led by the Premier who is appointed by the Deputy Governor General. The Deputy Governor General, acting upon the advice of the Premier, also appoints ministers of Government from among members of the Assembly. These ministers, along with the Premier, form the Nevis Cabinet.

The NIA, in accordance with the provisions of relevant laws, is responsible for the following areas: airports and seaports, education, extraction and processing of minerals, fisheries, health and welfare, labor, Government lands and buildings, and the licensing of imports and exports.

The Nevis Island Administration is presently organized as follows:

- Premier's Office (including Planning, Education, Health, Trade and Industry)
- Ministry of Finance
- Ministry of Agriculture, Tourism, Lands, and Housing
- Ministry of Communications, Works, Public Utilities and Posts
- Legal Department.

LEGISLATIVE FOUNDATION OF ENVIRONMENTAL MANAGEMENT

The evolution of an administrative framework for environmental management in St. Kitts-Nevis can be traced by reviewing the legislative history of the country. The authority to regulate activities which protect and manage the environment is dispersed among the laws and ordinances listed in Table 8.1(1). This listing was compiled primarily by an OECS-NRMP consultant (Lausche, 1986), who completed a similar review of resource management legislation in other OECS countries.

8.2 HISTORICAL DEVELOPMENT OF ENVIRONMENTAL MANAGEMENT POLICIES

Most major policies dealing with the management of the environment in St. Kitts and Nevis have occurred in the decade of the 1980's, highlighted by the passage of the National Conservation and Environment Protection Act of 1987.

This does not preclude the fact that environmental legislation came to St. Kitts-Nevis relatively early by Caribbean standards. In 1904 one of the first forestry ordinances in the region established a board to control and manage the use of forests in the state. Regulations to control burning in forests and charcoal production were added to this initial ordinance in 1924 for St. Kitts and 1940 for Nevis. This piece of legislation primarily benefited the sugar industry and plantation owners who recognized the importance of watershed protection and management to the well-being of the sugar industry (see also Section 2.1.1 of the Profile).

Other early pieces of legislation, primarily initiated by British governors and externally-written, prototypic laws, focused on: Fumigation of Pests (1907), Wild Bird Protection (1913), Protection of Animals (1935), and Rules for Agricultural Small Holdings (1937). Despite these early protective measures, no real progress in comprehensive

Table 8.1(1). Primary resource management legislation in St. Kitts-Nevis, based on and updated from Lausche, 1986.

PLANNING/ DEVELOPMENT	Town and Country Planning Ordinance (Cap. 264, 1949) Land Development (Control) Ordinance (No. 15, 1966) Southeast Peninsula Land Development and Conservation Act (1986)
AGRICULTURE	National Agricultural Corporation Act (No. 27, 1975) St. Kitts Sugar Manufacturing Corporation Act (No. 38, 1976) St. Kitts Sugar Manufacturing Corporation (Amendment) Act (1986) Pesticides Act (No. 20 of 1973)
FORESTS	Forestry Ordinance (Cap. 92, 1904) Forestry (Saint Christopher) Regulations (1924) Forestry (Fuel Supply) Saint Christopher) Regulations (SRO No. 28, 1927) Forestry (Nevis) Regulations (SRO No. 13, 1940)
WATER	Watercourses and Waterworks Act (Cap. 185, 1956) Watercourse and Waterworks Regulations (SRO No. 33, 1973)
TOURISM	Frigate Bay Development Corporation Act (No. 13, 1972)
BEACHES	Beach Control Ordinance (Cap. 281, 1961)
PROTECTED AREAS	Public Parks Regulation Ordinance (Cap. 304, 1944) Warner Park Regulations (SRO No. 9, 1945) Grove Park Regulations (SRO No. 6, 1947) Grove Park Rules (SRO No. 31, 1964) Brimstone Hill Regulations (SRO No. 52, 1978) (made under Government Lands Regulations Ordinance [Cap. 126], Sec. 3) Fisheries Act (No. 4, 1984) (marine reserves provisions) National Conservation and Environment Protection Act (No. 5, 1987)
WILDLIFE	Wild Birds Protection Ordinance (Cap. 113, 1913) Fisheries Act (No. 4, 1984) (species conservation provisions) Fisheries Regulations (1986)
WASTE MANAGEMENT	Public Health Act (No. 22, 1969) Public Health (Nuisances) Regulations (SRO No. 19, 1974) Public Health (Collection) and Disposal of Refuge Act (No. 39, 1978) Litter (Abatement) Act (1989)

environmental protection occurred until the mid-1940's.

It could be assumed that external affairs during most of the first half of the twentieth century -- with two world wars sandwiched between a devastating depression and changing socio-economic patterns -- diverted attention from full implementation and enforcement of such "environmental" laws as did exist. By the last years of the Second World War, however, with attention focused

back home, several new pieces of legislation were enacted: a Public Park Regulation Ordinance in 1944, a Cotton Act in 1947, a Turtle Protection Ordinance in 1948 (later repealed by the 1984 Fisheries Act) and -- perhaps the most important environmental management legislation up to that date -- the Town and Country Planning Ordinance of 1949.

The next two decades brought a steady stream of protective policies into effect. Many of these were focused on public health or related issues, e.g., the Watercourses and Waterworks Act in 1956, with accompanying regulations adopted in 1973, and the Public Health Act in 1969. A Beach Control Ordinance (1961) and the Land Development (Control) Act (1966) were in part a recognition of the need to manage development activities in general and, in specific, those activities which exploited an important island resource, i.e., beach sand. Unfortunately, many of these legislative initiatives lacked regulations, and their effectiveness was substantially limited.

The 1980's can be termed the decade which brought to the forefront real consideration of environmental policy concerns. With the advent of independence in 1983, a series of consultant activities was carried out in the state, designed in part to advise the newly independent Government on legislation and programs that would strengthen its ability to protect and manage resources and to plan and control development. Some of these externally-funded studies and resultant reports focused on specific environmental issues, for example, coastal erosion, fisheries management, land development and zoning, and agricultural diversification.

A new Fisheries Act that included species conservation and marine reserve provisions was implemented in 1984. However, the most significant new piece of environmental legislation is the National Conservation and Environment Protection Act (NCEPA) passed in 1987. This Act came about as a result of negotiations between GOSKN and USAID for the construction of a penetration road into the Southeast Peninsula of St. Kitts. One of the requirements for USAID assistance was that GOSKN examine the environmental implications of the SEP project, which, by extension, resulted in a comprehensive review of environmental policy in general. The resultant legislation -- the NCEPA -- is potentially one of the strongest environmental laws in the Caribbean, with broad definitions, rules and penalties covering both the natural and human environment. It took approximately three years for the NCEPA to become law, and even now it lacks adequate regulations for implementation.

In short, it might be said that while the institutional foundation for environmental management in St. Kitts-Nevis has been established in the last two decades, many challenges still lie ahead. Several important pieces of legislation such as the Public Health Act of 1969 still require regulations, and they, therefore, are more a guideline than enforceable policy. Furthermore, the new NCEPA established a Conservation Commission with vested powers to assist the Minister in implementing the provisions of the Act. But, as also discussed in Section 5 of the Profile, the future of effective resource protection and environmental management strategies in St. Kitts-Nevis may well depend on GOSKN commitment to full implementation of this legislation and full support for the authority of the Commission.

The promise of the NCEPA initiative, nevertheless, is very real. Equally promising have been the recent efforts of two important environmental NGOs -- the decade-old Nevis Historical and Conservation Society and the newer St. Christopher Heritage Society -- both groups building on the over two-decade long record of the Brimstone Hill Society which oversaw the successful restoration and development of the country's most important historical landmark and national monument. Thus, the decade of the 1990's opens in St. Kitts-Nevis with much hope and promise, with the beginnings of a strong institutional framework already in place upon which to build system reform and strengthen resource conservation and management practices.

8.3 GOVERNMENT INSTITUTIONS CONCERNED WITH ENVIRONMENTAL MANAGEMENT

Responsibility for the environment in St. Kitts-Nevis is shared by several Government departments, and the allocation of these responsibilities is reviewed in the sub-sections which follow. Some of the discussion is drawn from Bourne (1989), who completed an institutional analysis of GOSKN agencies involved in natural resource management on behalf of OAS and OECS-NRMP.

Although environmental responsibilities are not the exclusive concern of any single GOSKN agency, the Ministry of Agriculture, Lands, Housing and Development (herein referred to as the Ministry of Agriculture) is indisputably the entity with the widest responsibilities for management of the environment. It should be noted that a ministry was established in 1984 precisely for the management and protection of the environment (Ministry of Natural Resources and the Environment), but it remains dysfunctional due to the lack of an administrative structure and implementation resources. Of necessity, therefore, the Ministry of Agriculture has the *de facto* primary responsibility for environmental management since it includes, within its mandate, agriculture (the largest user of land), housing (the second largest), physical planning and development, fisheries, forestry and wildlife.

It needs to be noted that in Nevis the Department of Agriculture (which includes fisheries and forestry responsibilities) falls under the Ministry of Agriculture, *Tourism*, Lands and Housing (Tourism is a separate Ministry in St. Kitts). The Agricultural Department in Nevis makes up over three-quarters of the Ministry's personnel. Planning responsibilities in Nevis do not fall under the Ministry of Agriculture (and Development) as they do in St. Kitts. In Nevis, the Planning Unit is a sub-division of the Premier's Ministry.

PLANNING AND DEVELOPMENT CONTROL AGENCIES

The institutional matrix within which the planning and development of land is carried out in St. Kitts is very complex (see also Section 7 of the Profile). Ultimate responsibility resides with the Ministry of Agriculture, Lands, Housing and Development, but under this umbrella there are several departments and statutory bodies with sometimes overlapping responsibilities or not clearly defined areas of authority.

The **Central Housing and Planning Authority** (often referred to simply as the Central Housing Authority or CHA) is the oldest existing agency dealing with the dual functions of planning and development control. It is a statutory body established under the 1949 Town and Country Planning Ordinance. The Government's **Land Survey Department** is a part of the Authority.

As stated, planning and development control functions are not clearly defined. At present, the Central Housing Authority in St. Kitts functions somewhat like a development control body but with an emphasis on the control of building construction. Building applications are submitted for review to the St. Kitts **Building Board**, sometimes referred to as the State Board. The Chief Technical Officer of the CHA was once Chairman of this Board, but this is no longer the case. The functions of the CHA now relate largely to implementing the Government's housing program, approving and monitoring building construction , and land survey work (Bourne, 1989).

The Government's Planning Unit in St. Kitts is a combination of three units or sections -- Economic Planning, Statistics and Physical Planning. The **Physical Planning Unit** (PPU) shares responsibility for implementation of planning legislation (Town and Country Planning Ordinance of 1949) and development control legislation (Land Development [Control] Ordinance of 1966) with the Central Housing Authority, although it is not entirely clear how these agencies divide responsibilities (Lausche, 1986). According to Bourne (1989), the PPU sees its role as devel-

oping land use strategies, evaluating development proposals (private and public sector), providing advice to Government, monitoring projects for compliance, providing technical support to developers, and preparing guidelines.

The Physical Planning staff in St. Kitts is relatively small, consisting of a physical planning officer, an assistant physical planning officer, and a physical planning assistant. The PPU has no authority to prepare a national land use or physical development plan (although the original Town and Country Planning Ordinance of 1949 calls for preparation of legally-enforceable zoning plans, called "schemes"). Development planning that has been accomplished by the Planning Unit is basically economic planning with some physical planning input. Some attempts have been made to incorporate Environmental Impact Assessment (EIA) into the development planning application process.

The **Planning Unit** in Nevis is a subdivision of the Premier's Ministry, and, like its counterpart in St. Kitts, it comprises three sub-units -- economic planning, statistics and physical planning. The Unit shares offices with the Nevis Housing and Land Development Corporation (see below) and assists it with a variety of projects.

In the area of development control, there is a **Building Board** consisting of a Chairman and seven members who review building applications. A building inspector, technical officer and a sanitation officer help to support the Board, which operates under building regulations which have not been updated since 1946 (Bourne, 1989).

The **Nevis Housing and Land Development Corporation** (NHLDC) is charged with the administration and implementation of the Government's housing policy; it appears to be very much the counterpart of the Central Housing Authority in St. Kitts. NHLDC serves in an advisory capacity to Government and makes projections regarding housing requirements in Nevis. Reportedly, the NIA intends to use the NHLDC for assistance in establishing zoning guidelines, for the identification of new housing areas, and for the administration of a lands program to provide building lots to first-time home owners through the sale and development of Government estate lands.

RESOURCE DEVELOPMENT AGENCIES

Responsibility for the development of the Southeast Peninsula (SEP) rests with the **Southeast Peninsula Land Development and Conservation Board**, a semi-autonomous Government authority created by the SEP Conservation and Development Act of 1986 (see also Sections 4 and 7 of the CEP). That legislation provides for the rational development, conservation and management of the 4,000 acre Peninsula and creates a five-member governing Board. The Board has the authority to (Walters, 1988):

- Evaluate development schemes for the Peninsula;
- Make recommendations concerning the zoning of SEP land; and
- Monitor and regulate development activities in order to maintain environmental quality.

In carrying out its legislative mandate, the Board can draw on the expertise of persons from within Government and can also co-opt the services of persons not in public service to assist in developing recommendations and guidelines for the Peninsula.

The role of the Board is primarily advisory in nature, and its proposals have encountered little opposition to date. However, the Board remains relatively untested at this point as full-fledged development of the Peninsula area has not yet begun, and there are some local concerns about how effective the Board will be in exerting environmental quality control as the pace of SEP development accelerates.

The **St. Kitts Sugar Manufacturing Corporation** (SSMC) is a statutory corporation (under the Ministry of Agriculture) which was established in 1986 to manage the sugar

estate lands acquired by nationalization, as well as the sugar factory and railroad. It took over the responsibilities of the dissolved National Agricultural Corporation (NACO), which was first established in 1975 following nationalization of the sugar industry. SSMC's resource management functions are considerable (given the amount of land under its jurisdiction) and include management of estate water systems and the approximately 100 ghauts on the island; thus, the SSMC should be viewed not only as development agency but, additionally, as a major resource planner in the state. With approximately 3,000 laborers in the sugar industry, which in turn is entirely under the jurisdiction of SSMC, the Corporation is also a major employer.

The **Frigate Bay Development Corporation** is a statutory corporate body established under an Act of the same name in 1972. It is solely owned by the Government which set up the Corporation for the purpose of undertaking and encouraging the development of Frigate Bay, an 850 acre privately-owned estate purchased by the Government in the late 1950's (see also Section 4, Tourism). The Corporation falls under the Ministry of Tourism and Labor, and the Minister appoints the members of the Board which consists of a Chairman, Vice Chairman and not more than seven other members.

The enabling legislation in effect established a separate development and planning jurisdiction for Frigate Bay by exempting the Corporation from building and development control regulations which applied elsewhere in St. Kitts (for example, the Corporation established its own guidelines to control and regulate construction and development activities within its jurisdiction). One study which looked at how well the Corporation was managing the environment at Frigate Bay -- particularly in view of the considerable flexibility awarded the Corporation under the 1972 legislation -- concluded that, despite a basically sound conceptual design and a comparatively orderly (although slower than anticipated) growth rate, the Frigate Bay Corporation had in many ways failed to take appropriate action which addressed early warning signs of serious environmental stress at the development. The authors concluded that no one was in charge of environmental change and impact or of monitoring environmental system interaction, maintenance, and enhancement (Towle, *et al.*, 1985). Many of the same institutional issues -- *vis a vis* environmental management -- identified in the 1985 study are still unresolved today.

RESOURCE MANAGEMENT

The principal role of the **Fisheries Division** (Ministry of Agriculture) is to provide an institutional framework for the management, planning, development and conservation of fisheries. The staff is small, basically a two-person unit in St. Kitts, although it has been augmented from time to time with U.S. Peace Corps Volunteers and other external technical experts; the Chief Agricultural Officer is designated the Chief Fisheries Officer (Bourne, 1989). Personnel have had no professional training except for periodic short-term courses (Mills, 1988). The Division in Nevis has only one Fisheries Officer to carry out duties which include fisheries cooperative market inspection, enforcement of legal regulations for the industry, and providing technical assistance to fishermen.

The Fisheries Act of 1984 provides for the establishment of fishing priority areas and marine reserves, but no reserves have been declared under this legislation. It is unclear what the role of the Fisheries Division would be in the management of marine reserves -- particularly since the NCEPA (1987) gives the Conservation Commission authority to designate resource managers for protected areas -- nor is it clear what the working relationship of the Division will be with the SEP Board for the management and protection of marine resources on the Southeast Peninsula.

Like the Fisheries Division, the **Forestry Division** (Ministry of Agriculture) is inadequately staffed (there have been no Forestry personnel in Nevis for over a decade). In St. Kitts, the Division is headed by a Forestry Officer who is an agronomist with no wildlife or forestry training. In addition, there are three part-time rangers and a forest guard. Except for the Forestry Officer, the staff has had neither sub-professional or

short-term exposure to training (Mills, 1988). Traditionally, forestry is a sector in St. Kitts in which Government's role has been more limited than in other Eastern Caribbean islands, due to the fact that forest lands were under the management control of sugar estates. Prins (1987) provides a detailed assessment of the Forestry Division with recommended guidelines for its development.

The National Conservation and Environment Protection Act of 1987 repealed the Forestry Ordinance of 1904 which had been the operative forestry legislation. The NCEPA provides for the establishment of forest reserves and the necessary regulations to protect them, and the Forestry Division assumes (once enabling regulations to the NCEPA have been provided) that it will retain responsibility for forest reserves and might be given legal responsibility for mangroves and wildlife under the legislation (CIDE, 1988).

A Cabinet-appointed **Committee on Sand Mining and Construction Waste** (chaired by the Director of Planning) was established in 1989 to examine serious concerns which had been raised in the state about beach and ghaut sand mining and solid waste disposal. Part of the Committee's mandate was to make recommendations for sand mining through implementation of a permit system with fee schedules and monitoring procedures (the Beach Control Ordinance of 1961, which dealt with sand mining regulation, was repealed by enactment of the National Conservation and Environment Protection Act of 1987). Sand mining recommendations provided by the Committee call for regulation of sand extraction in ghauts by the SSMC and for regulation of beach sand mining by the Department of Public Works. Independent monitoring for procedures recommended by the Committee is to be provided by the appointment of a **Conservation Officer**. The Committee was also to address the issue of informal/unauthorized dump sites and to provide strategies to restrict use of ghauts for solid waste disposal.

In September of 1989, the Committee completed its deliberations and delivered a report to Cabinet; a new Conservation Officer was appointed in December of that year. The waste disposal aspects of the Committee's report regarding implementation strategies are currently under review.

REGULATORY AGENCIES

The Pesticides Act of 1975 established a **Pesticides Board** to oversee the importation, labelling, distribution and use of pesticides in the country. The Board has never been fully functional, and no regulations have been enacted to strengthen the regulatory, oversight and enforcement responsibilities of the Board (see also Section 6 on Pollution Control). Technically, a Board should exist for St. Kitts and another in Nevis, but neither island has one in place.

Authority and responsibilities for the management and regulation of water resources in St. Kitts-Nevis are unclear. Administrative authority in the general area of water resource management is shared by the **Agriculture Department** (Ministry of Agriculture), **Health Department** (Ministry of Health) and the **Water Department** (Ministry of Communications, Works and Public Utilities). Several consultants (see Section 2 [Subsections 2.1 and 2.2] and Section 6) have highlighted problems with extant legislation (which dates to the 1950's) and with the ill-defined delineation of institutional responsibilities which exist for the control and management of water resources.

The Watercourses and Waterworks Ordinance of 1956 (with Regulations enacted in 1973) established a Water Board with regulatory powers, but the Board was subsequently abolished. It was reinstated in 1986 but with advisory powers only (Lausche, 1986). Several consultants have recommended that revised and updated water legislation be enacted and that a new institutional framework -- in the form of an autonomous Board -- be created to administer the legislation, which should also include responsibilities for sewage collection, treatment and disposal.

Recently, a new Litter Abatement Act (No. 8 of 1989) was passed by the National Assembly and became operative in September of 1990. It addresses a wide range

of litter prevention issues and prescribes penalties to discourage littering. Implementation will be handled by the Public Health Department, and provisions were made in the legislation for the appointment of **"litter wardens"** to enforce the Act (Frank, 1990).

RESOURCE CONSERVATION AND PROTECTION

The **National Conservation Commission** was created by the National Conservation and Environment Protection Act of 1987 (additional information on the NCEPA is found in Section 5 of the Profile). It is composed of nine members, five of whom (from both the public and private sectors) are appointed by the Minister (of Development), two are nominated by the Premier of Nevis, and one representative each is from the Brimstone Hill Fortress National Park Society and the Nevis Historical and Conservation Society. The St. Christopher Heritage Society is not named in the enabling legislation since it was not in existence in 1987, but the Society has been invited to participate in the Commission as an official observer.

The Minister of Development, in consultation with the Conservation Commission, is responsible for the implementation of the NCEPA which, generally speaking, will include such matters as (1) coastal conservation and beach protection; (2) forestry, soil and water conservation; (3) protection of wild animals and birds; and (4) antiquities and historic buildings. Sub-committees of the Commission from the private and public sectors have been formed to address issues which fall under its mandate, including (Edwards, 1990):

- Beautification and National Parks;
- Marine and Beach Resources; and
- Preservation, Restoration and Maintenance of Historic Sites and Buildings.

The Commission has jurisdiction over both St. Kitts and Nevis, but it has only recently (1990) begun its deliberations, which has effectively delayed implementation of the NCEPA.

Livingston (1989), in a report prepared for the Natural Resources Management Unit of OECS, provides a detailed review of the NCEPA, including an overview of the provisions of the Act and a proposed implementation strategy. The report provides a basis on which to build a recommended three year Strategic Plan to guide the implementation of the various programs required to support the legal obligations described under the Act. It should be given careful consideration by the Commission, which has just begun to meet as a formal body.

8.4 THE NON-GOVERNMENTAL SECTOR IN ENVIRONMENTAL MANAGEMENT

Non-governmental organizations (NGOs) in St. Kitts-Nevis, as elsewhere in the Eastern Caribbean, have traditionally been associated with social welfare activities or had religious affiliations. Until more recently, there has not been a strong tradition of volunteerism, nor have NGOs had much influence over public policy issues. Most NGOs in the country are small and only recently have some acquired paid professional staff. Their leaders are simultaneously policy-makers, administrators, fund raisers and project implementers -- while the organizations they head are often over-extended in terms of program objectives (Towle, *et al.*, 1987).

The oldest private sector "environmental" group in St. Kitts-Nevis is the Society for the Restoration of Brimstone Hill, recently reconstituted as the **Brimstone Hill Fortress National Park Society**. The sole objective of this organization (which was first established under the Companies Act in 1965) is to promote the restoration and development of St. Kitts' Brimstone Hill fortification (now an officially designated National Park). Under the 1987 National Conservation and Environment Protection Act, the Society was given management and administrative responsibilities for Brimstone Hill, with authority to make and enforce regulations, to collect and retain admission fees, and to employ personnel and

expertise from within and external to Government to assist in the execution of its management responsibilities. (See also Section 5.1 for more information on the Society and its history.)

The largest NGO in Nevis is also an environmental group -- the **Nevis Historical and Conservation Society** (NHCS). Unlike most other NGOs in the country, the Society is a registered non-profit group under the Friendly Society Act and has a formally adopted Constitution and By-laws under which it operates. The Society carries out a wide variety of programs -- e.g., it operates a museum; acts, in effect, as the island's "national trust"; carries out research; maintains the archives and library of Nevis history; publishes a quarterly newsletter; and provides a full range of public meetings, seminars, and educational events.

In its ten years as an operational organization, the Society has built a membership base which currently stands at over 400, with an annual budget in excess of EC$100,000. One of the Society's first projects was the reconstruction of the birthplace of Alexander Hamilton in Charlestown, which now serves as Society headquarters, as a museum, library and historical archives (under the direction of NHCS), and as the Assembly Chamber for the Nevis Island Administration. Day-to-day operations are handled by a staff of three paid employees, one of whom is provided by the Nevis Ministry of Agriculture and Tourism. (For additional information about the Society and its working relationship with Government, see Sub-section 5.1 of Section 5.)

NHCS, along with the Caribbean Conservation Association, was instrumental in helping to organize a second Nevisian environmental group, the **Nevis Environmental Education Committee** (NEEC), which has since become a separate NGO (although it continues to rely on NHCS for a variety of support services). NEEC was formed in 1988 for the purpose of promoting public awareness about the environment and generating concern for its conservation and preservation. The Committee is governed by a President and other officers, but it is not a registered body and does not have a Constitution or By-laws. Programs to date have focused primarily on building environmental awareness but have also included anti-litter campaigns, Charlestown clean-up efforts, nature hikes, and an assortment of educational and lobbying activities.

In St. Kitts, NGO environmental leadership has passed to the **St. Christopher Heritage Society** (SCHS), which was founded in 1989 with the broad overall goal of safeguarding and preserving the island's national heritage. In its short time as an operational body, SCHS has built a membership base, secured funding, established a headquarters office, launched a publication entitled *Heritage*, and begun to put into place a long-term institutional development plan, which may include establishment of a museum in downtown Basseterre in cooperation with GOSKN and other community groups such as the Chamber of Industry and Commerce. The Society's first major project has been to assist with the preparation of this Country Environmental Profile, while the NHCS has undertaken a similar task for the island of Nevis.

Under the leadership of the **Chamber of Industry and Commerce**, a **Basseterre Beautification Committee** has been formed, growing out of the Chamber's original concern about the deterioration of Basseterre's distinctive, park-like Independence Square in the heart of the urban area. The overall objective of the Committee is to support efforts to preserve and enhance the unique historical character of the town. To date, the group has promoted the beautification of Independence Square and has initiated a public education campaign to foster appreciation of Basseterre's architectural heritage. It has also worked with a number of businesses to assist with improvements to or construction of buildings that are compatible with traditional West Indian design elements.

8.5 ENVIRONMENTAL EDUCATION

One major factor influencing the development of environmental education in St. Kitts and Nevis is the interest and the commitment of groups like the Nevis Historical

and Conservation Society (NHCS), the Nevis Environmental Education Committee (NEEC), and the St. Kitts Environmental Education Committee, all of which have embraced a basic philosophy which suggests that economically-sound development must be predicated upon environmentally-sound practices.

Although structured environmental education activities in St. Kitts and Nevis are of relatively recent origin, the basis for the development of a dynamic program has already been laid, spear-headed first by the NHCS, which began publishing a quarterly newsletter for its membership in 1985, and more recently consolidated by the activities of the NEEC and the St. Kitts Environmental Education Committee, both established in 1988 through the initiative of the Caribbean Conservation Association (CCA).

The recently formed St. Christopher Heritage Society, the Basseterre Beautification Committee, and the Brimstone Hill Fortress National Park Society have also contributed to an awareness of environmental issues.

OBJECTIVES AND COMPONENTS OF ENVIRONMENTAL EDUCATION

Environmental education (EE) as a process promotes an awareness and understanding of ecological principles and their relationship to human activities. Specifically, environmental education seeks to: develop a positive, caring attitude towards nature and natural resources, create new patterns of behavior in individuals, groups and the society as a whole towards the environment, and motivate active participation in formulating and implementing solutions to environmental problems.

Environmental education embraces both formal and informal approaches. Formal environmental education includes activities initiated through the established school system, at the primary and secondary levels and through tertiary level institutions of higher learning.

Informal environmental education comprises activities and approaches which span both the private and public sectors and embraces environmentally-oriented activities of youth and community groups, service clubs, industry, the church, theater groups, government agencies and indeed all interest groups. Activities and approaches might include awareness-building tools like pamphlets, posters, radio talk shows, clean-up campaigns, consumer awareness campaigns, exhibitions, workshops, newspaper articles, television "promos", rallies and indeed any other awareness-generating techniques or media. To be effective, environmental education must be an on-going, inter-disciplinary, integrated process, and must involve all sectors of the community.

STATUS OF ENVIRONMENTAL EDUCATION IN ST. KITTS AND NEVIS

Environmental education activities in St. Kitts and Nevis are currently being implemented largely on an informal basis. These activities, which seek to increase public awareness about sensitive environmental issues, are carried out sporadically on World Environment Day, Earth Day during summer vacation, and other specific periods each year. Activities include radio talk shows, EE publications, clean-up campaigns, a children's summer program through the public libraries, promotion of village improvement competitions, and other similar activities.

Although these on-going events continue to contribute significantly to the level of awareness of the average citizen regarding the need and importance of sound environmental practices, there is also an urgent need to include environmental awareness-generating information in the curriculum of the formal education system on a structured basis.

FORMAL ENVIRONMENTAL EDUCATION

Specific aspects of ecology have been infused into the curriculum of the country's schools at the primary and secondary levels. This infusion approach to teaching environ-

mental concepts has been generally effective. It has been used successfully at the secondary level in areas like social science, geography, biology, and agricultural science. This approach has been substantially encouraged by the development of syllabi by the Caribbean Examinations Council and has served to emphasize the importance of environmental issues and principles relevant to students and to Caribbean society as a whole.

Although a tertiary level institution (College of Further Learning) is based in St. Kitts, there is to date no evidence of any effort being made to include in its operation programs geared towards teacher training in environmental issues, nor is there any indication that efforts are being made to include environmental education programs in the curriculum.

INFORMAL ENVIRONMENTAL EDUCATION

Informal environmental education in St. Kitts and Nevis consists primarily of public awareness-generating activities conducted by non-governmental organizations and through the children's libraries project implemented during the peak summer months across the Caribbean. The summer libraries project, currently in its third year, addresses issues related to natural resources conservation and management and the preservation of historical resources, art, music and culture. Programs designed to increase awareness of environmental health issues are arranged by the Ministry of Health on an *ad hoc* basis.

The Nevis Historical and Conservation Society is credited with having pioneered the thrust toward environmental awareness through its quarterly newsletter *ECO NEWS*, first published in 1985 for its membership. Distribution was later expanded to include key Government employees, organizations and interested individuals. More recent and perhaps more successful efforts have been initiated by the Nevis Environmental Education Committee. This Committee comprises a group of young, dynamic members who have been credited with the successful implementation of a wide range of awareness-generating projects. These include: campaigns to stop the indiscriminate cutting of trees, radio call-in shows on sand mining and other environmental issues, week-long activities to heighten public awareness, publication of newsletters, activities to mark Earth Day and World Environment Day, rallies, an elocution contest, and a "best kept village" competition. Similar activities are carried out to a lesser extent by the St. Kitts Environmental Education Committee.

These and other on-going activities continue to contribute toward a greater appreciation of the country's natural heritage and the need to protect, preserve and better manage it. Of particular importance is the monthly publication, *ECO NEWS*, which focuses on a different topic each month and is now in its fourth year of publication. The St. Christopher Heritage Society is already proving to be a useful ally in the process of assembling and disseminating information about the environment.

KEY ISSUES AND CONSTRAINTS

Environmental education at the primary, secondary and tertiary levels of formal education must be given high priority. The approach at this level must, however, be fully supported by the country's Ministry of Education and by tertiary level institutions if the anticipated EE break-through is to be achieved. Curricula relevant to the country's needs must be developed and other teaching materials provided. Several constraints, however, stand in the way of fully attaining these objectives.

(1) Shortage of Trained Environmental Educators. The lack of teachers who are trained in specific areas of environmental management remains a key issue which can be addressed by strengthening the capacity of regional institutions to provide training programs for teachers in environmental education skills.

This will necessitate the expansion of teacher training programs and the development of pertinent curricula in environmental education and other non-formal disciplines. The use of the Distance Teaching facility

(UWIDITE) of the University of the West Indies (Cave Hill) to facilitate the process is recommended. Through UWIDITE, teachers in the non-campus countries of the region could benefit from training without the inconvenience of out-of-country living. Pre-service and in-service training in environmental education methodologies to facilitate the professional development of teachers is indispensable to achieving EE goals.

(2) Inadequate Financial Resources. Government's allocation for education needs to be increased. An allocation geared specifically towards environmental education should be a permanent component of the annual budget. These resources should be earmarked for teacher-training and for the provision of pertinent materials.

(3) Inadequate Media Involvement. Although environmental issues are covered occasionally by VON Radio, ZIZ Radio and the Trinity Broadcasting Network, environmental issues need to be included as a regular part of the programming policy of all media houses.

8.6 POLICY RECOMMENDATIONS

In her 1986 review of natural resource legislation in St. Kitts-Nevis, Lausche concluded that the legal base for natural resource management issues in the country needed considerable strengthening in every sector, except in some aspects of fisheries management. However, four year later, with the National Conservation and Environment Protection Act having been enacted in the interim, many of Lausche's concerns would seem to have been addressed. This broadly-based legislation attempts to bring together under one resource management, resource protection, and resource regulation framework many of the institutional and legislative concerns raised by Lausche and other consultants in the past.

Yet all has not been made right by the NCEPA, and serious institutional and legislative issues remain unresolved and still need to be addressed.

(1) Full Implementation of the National Conservation and Environment Protection Act. It has been three years since enactment of this important legislation in 1987, and the National Conservation Commission, whose establishment was mandated under the Act, has only recently become functional. Its work agenda will be substantial if the potential of this widely-commended environmental legislation is to be fully realized in the near future. The activities, programs, and regulations called for in the legislation will provide an administrative framework within which to execute the legal obligations described under the Act. Livingston (1989) provides a good overview of the tasks required, and every effort must be made by GOSKN to assist the Commission to move forward rapidly in carrying out its assigned responsibilities.

(2) Institutional Strengthening. It is clear from previous assessments (e.g., Bourne, 1989; Livingston, 1989) and from the brief institutional analysis provided in this section of the Profile that if the ambitious legislative reforms provided by the NCEPA are to be effective, considerable institutional strengthening of those departments and agencies responsible for resource management and resource protection in the State will be required. The lack of adequate technical, monitoring, and enforcement personnel has often been cited for the inability of respective departments to enforce existing environmental legislation (a problem throughout the Eastern Caribbean). This staffing problem will be exacerbated in St. Kitts-Nevis when the NCEPA becomes fully operational.

Therefore, probably with the assistance of donor agencies, GOSKN needs to carefully examine the technical and regulatory implications of the full spectrum of extant environmental and resource management legislation and take steps immediately to improve both the quantity and quality of staff required for implementation, particularly middle-level management and technical staff.

This general recommendation is particularly important for the Ministry of Agriculture, Housing, Lands and Development, which carries primary responsibility for implementation of resource *development* as well

as resource *management* programs in the State.

(3) Harmonization of Planning and Development Control Functions. As also discussed in Sections 4 (Tourism) and 7 (Planning and Development Control), the decentralization of planning and development control functions in St. Kitts-Nevis does not necessarily provide the most effective framework to guarantee rational growth and development in the country.

At present, there are two autonomous statutory bodies which have considerable authority for managing and regulating development within the specific land areas under their jurisdiction, namely, the Frigate Bay Development Corporation and the Southeast Peninsula Land Development and Conservation Board. Additionally, the St. Kitts Sugar Manufacturing Corporation, by virtue of the amount of land and natural resources under its management control, should also be considered a primary development planning agency in the State. The Central Housing and Planning Authority in St. Kitts and the Housing and Land Development Corporation in Nevis function somewhat like development control bodies, although both are primarily involved with the regulation of building construction. Additionally, each island has a Building Board which reviews building applications. Finally, the Physical Planning Unit (one in St. Kitts and one in Nevis) carries out responsibilities related to the design of land use strategies, evaluation of development proposals, and preparation of development guidelines. However, its functions do not carry any legal authority (e.g., the PPU is not legislatively mandated to prepare a national physical development plan) and, furthermore, the delineation of responsibilities between this unit and other planning/development control agencies (such as the Central Housing and Planning Authority) is not formalized or always clear to the external observer.

In the absence of clearly-established lines of authority or coordination in the planning and development control process, serious consideration should be given to the implementation of Environmental Impact Assessment (EIA) procedures, which should be required for all development projects falling within a designated classification, whether public or private sector. From an institutional perspective, EIAs are useful because they force a more holistic integration of technical data and environmental expertise across departmental lines while, at the same time, guaranteeing more systematic input of environmental as well as social considerations at an early stage in the planning process.

In the specific area of physical planning, Bourne (1989) and others have identified additional problems: outdated legislation, unclear procedures, overlapping functions, little formalized coordination with other bodies, shortage of staff, and -- perhaps most importantly -- no long term-planning requirements. Under these circumstances, GOSKN needs to take steps which would provide for a strengthening of its physical planning units and an upgrading of their staffs. Additionally, consideration needs to be given to more effectively centralizing and coordinating authority for overall planning and development control functions.

At one point, during the initial planning phases for the Southeast Peninsula Road Project, a recommendation for establishment of a Environmental Management Unit (EMU) within the Planning Unit was under consideration (Towle, *et al.*, 1986b). It was proposed that the EMU could monitor the environmental impacts of development projects, advise on ways of mitigating adverse environmental effects, ensure compliance with existing land use plans, laws, and procedures, and assist in drafting regulations and procedures for the protection of the environment. There has been no follow-up to this recommendation, but -- with the enactment of the NCEPA and the considerable regulatory/enforcement requirements implicit in the legislation -- reconsideration might be in order.

(4) Updating Public Health Legislation and Water Resources Legislation. In a recent review of natural resource legislation in SKN, Lausche (1986) points to the need for an up-dating of public health legislation, noting the difficulty of pollution control procedures

under existing legislation. Regulations to the Public Health Act of 1969 were never enacted, thus effectively limiting the substantive authority of that legislation.

Water management responsibilities are shared by several agencies of Government. The public water supply is managed by the Water Department (Ministry of Communications, Works and Public Utilities); the Department of Agriculture (Ministry of Agriculture) overseas irrigation projects; the Health Department (Ministry of Health) is responsible for water quality monitoring. The primary legislation pertaining to water resources is the 1956 Watercourses and Waterworks Ordinance. Several consulting reports have highlighted weaknesses in this legislation (e.g., with respect to authority, duties and responsibilities); furthermore there are no provisions for the management of sewage disposal. Consideration should be given to revising and updating water resource management legislation as well as to the creation of a new tariff structure for water utilization as current revenues impose significant fiscal constraints on the Water Department. It may also be time for St. Kitts-Nevis to consider following the example of other OECS countries by merging responsibilities for water and sewage control in a single agency or statutory body.

(5) Pesticides Control Board. Although the use of agrochemicals does not appear to be a severe environmental problem at the present time, with increasing emphasis being placed on agricultural diversification, the use of biocides is certain to expand. In any event, the Pesticides Board (established by legislation in 1973 but non-functional for several years) needs to be reactivated as an operating body and needs to exercise its authority for monitoring and regulating biocides in the country. A separate Board for St. Kitts and a second for Nevis should be put in place.

(6) Public Participation. How effectively the Government is using a process of public participation and public involvement to inform and expand the planning process in the country is not clear. In all probability, GOSKN needs to improve the opportunities for public consultation in its planning process and in its deliberations about resource development issues.

While efforts to facilitate public participation can make the task of the government planner or resource manager more complex and time consuming, such efforts also provide important advantages by:

- facilitating Government access to a larger information base, e.g., public perceptions and preferences and NGO technical expertise;
- providing an opportunity for Government to build coalitions or support on behalf of its projects or decisions;
- allowing for discussion and possible resolution of conflicts prior to an extensive commitment of resources to a potentially controversial activity or project;
- enhancing the likelihood of success by expanding the base of information, expertise, public opinion, and potential support available to Government decision-makers.

(7) Environmental Education. The following recommendations for policy reforms are offered to facilitate the integration of environmental education considerations into national development policies.

- *Develop and implement a National Policy on Environmental Education.* Environmental education in St. Kitts and Nevis is constrained by a lack of regional and national environmental education policies. This has resulted in an uncoordinated approach. To be effective, environmental education must be developed and delivered within a framework of clearly-defined policy guidelines, supported by a regional network established to implement a regional policy at the national level.

- *Conduct on-going research to establish a reliable base of scientific data to legitimize information and statistics used in EE programs.* The importance of informal information sources should be recognized. Nevertheless, if environmental education is to be effective in helping to solve the environmental problems of St. Kitts and Nevis, the content of this education must be firmly based on sound scientific research and evidence.

- *Develop an adequate funding base for on-going environmental education programs and for project implementation.* To facilitate environmental education in St. Kitts and Nevis, it is important that the commitment of Government be secured and adequate funding and logistical support provided. A regional Environmental Education and Communications Strategy, recently developed by the CCA, could form the basis for the successful implementation of environmental education in St. Kitts and Nevis, and throughout the region, once the major recommendations of this Strategy are accepted and implemented.

- *Expand support base.* Enlist the support of community groups and service clubs (such as Boy Scouts, 4-H Clubs, Lions Club, Girl Guides) to augment the work already being done in disseminating environmental information and implementing environmental projects.

- *Employ innovative and non-traditional media and approaches in teaching ecological concepts.* Solicit the support of Calypsonians, dub artistes, popular theater groups, the church, comedians, etc. in getting the environmental message across. Make the message "fun".

(8) NGO Priorities. The country's leading environmental NGOs -- in particular the Nevis Historical and Conservation Society and the St. Christopher Heritage Society -- can provide valuable input to the working agenda of the National Conservation Commission by assisting with the identification of priority sites and areas for inclusion in a parks and protected areas system for the country. The NHCS has already taken significant steps in this direction, including establishment of an environmental documentation and reference library. One of the priority items for the institutional development program now being put in place by the SCHS should be to carry out a more detailed assessment of potential protected areas and sites for the island of St. Kitts for formal submission to the Conservation Commission as soon as possible. In general, the considerable resources and expertise of NGOs can often be overlooked by governments in implementing national programs. In small island countries, with limited resources, this is particularly unfortunate, and in the specific case of St. Kitts-Nevis, this valuable base of information and skills should be heavily drawn upon by the Conservation Commission as it puts mandated resource management and protection programs into place.

SECTION 9 SYNTHESIS OF POLICY ISSUES AND RECOMMENDATIONS

". . . but the earth abideth forever."
(Ecclesiastes i, 4)

INTRODUCTION

The main tasks, the research, the interviews, field work and writing and re-writing have been completed, and the St. Kitts and Nevis Country Environmental Profile is almost finished. But for the Project Team there have been some special dividends and some special lessons learned about the nature of the place (no pun intended). Environmental concerns run deep in this country, but so does a gentle resistance to new layers of bureaucratic formality. There is a cautious skepticism about proposed new regulations for this and procedures for that, about fixed codes and standards and prescribed environmental remedies. There is a great preference for risk spreading and modest institutional and legal redundancies, for informal meetings, for consensus-building, and for painfully slow resolution of an issue instead of a hasty resolution that is painful in the end. There is respect for research even though it takes time. And, finally, there is a love of the landscape, of the fine mix of man and nature's works so well looked after in centuries past. The environments of St. Kitts and Nevis are literally in good hands. This Profile is merely a tool for them to use.

The critical environmental issues identified in this volume will not surprise those who know St. Kitts and Nevis well. And unlike some of the other countries in this Profile series, there is no dark cloud of crisis or compelling urgency lurking in the distance. Some of the issues cited here have been vetted in various local and regional fora long before the current CEP project began. Ironically, one of the most serious reasons for moderate concern at this juncture is that some of the problems have been around just a little bit too long and enough is known to make the informed observer nervous about the possibility of other missed signals or misread symptoms and why the proper resources have not been systematically applied to develop either preventive or remedial strategies.

This final section does not attempt to fully summarize the findings and especially the detailed recommendations of this 250 page document, for each preceding sector-focused section has already done this with a closing sub-section on "Policy Issues and Recommendations". As a less cumbersome substitute, a smaller set of issues -- more national, more institutional, more interdisciplinary or more pressing -- has been singled out and presented in this concluding section. There is a risk in doing this, for any issue (or cluster of issues) should generally not be considered in isolation. There are important linkages between sectors, and the inter-relatedness of both natural and human elements within ecosystems constitutes an important point of departure for some problem solving.

Solutions in most cases will require inter-disciplinary and inter-ministerial cooperation and coordination; they are seldom as neat and orderly as their presentation in paragraph form would suggest. Furthermore, a complex problem will appear, and in fact will prove, intractable until it is attacked creatively, aggressively and simultaneously by both government and private sector entities working together more or less as partners. One of the purposes of the Country Environmental Profile Project in St. Kitts and Nevis was to open such avenues of dialogue in the search for workable solutions.

Under the best of circumstances, this first St. Kitts-Nevis Environmental Profile could be seen as an immediately useable agenda for the Government's Conservation Commission, from which it could develop an action program of its own for presentation to Cabinet.

Additionally, the Profile could also be seen strategically, i.e., as a comprehensive planning document for use by the National Conservation Commission, perhaps as a first step leading to the design and implementation of a *national conservation strategy* or its equivalent. What is most needed now is a policy framework and a schedule of implementation which could and hopefully will arise out of the discussions triggered by this document and these recommendations.

(1) DEVELOPMENT PLANNING AND CONTROL

For small island ecosystems and economies, weak development planning and ineffective monitoring and control, when any major growth and development activity is underway, represent one of the more pernicious environmental threats. The best of plans can go awry -- and most development-based surprises have environmental implications.

The problems arising from inadequate development planning and control are not easy to deal with in the near term because needed legal, structural and institutional changes may take years to design and put in place. Good planning, especially anticipatory planning, can help, but it is easy for traditional environmental controls and accepted limits to become overwhelmed by the pace and nature of contemporary change. Within the course of one generation, St. Kitts-Nevis has moved rapidly from being wholly dependent on agriculture to a mixed economy where the most dynamic growth sector is tourism. Both St. Kitts and Nevis are concerned about a weakening agricultural sector, about how to diversify the sector and the economy at the same time and about the prospect of exchanging one kind of monoculture for another.

Many countries in the world, irrespective of their size or economic status, have recognized the necessity of good land use planning. It could be argued that the importance of planning is inversely related to a country's size and GDP, i.e., in smaller, less wealthy countries like St. Kitts and Nevis, there is little margin for error, fewer funds available to remedy the mistakes of ill-planned schemes and strategies. For example, some of the resort developments previously proposed for the Southeast Peninsula and for Nevis could, in a relatively short span of time, completely alter if not ruin a significant portion of the country's wetlands and coastal environment.

Like most small islands, St. Kitts and Nevis simply cannot afford the consequences and costs associated with poor planning decisions and the failure to assert sound development control principles in the face of project schemes that would injure the environment unnecessarily.

* **Recommendation.** A national land use plan needs to be prepared, focusing on the achievement of sustainable development over the long term. The plan should guide future development into areas which are best suited for particular kinds and densities of land use -- based on physical and ecological constraints as well as national social and economic priorities. Preparation of land use maps should be the initial step in the process of designing a land use and growth management plan for the country.

* **Recommendation.** Legislation is needed to require the preparation of Environmental Impact Assessments for all major development projects (public or private sector), especially those within the coastal zone, within the boundaries of designated protected areas, or affecting other critical areas. From an institutional perspective, EIAs are particularly useful because they force a more holistic integration of technical data and environmental expertise across departmental lines while, at the same time, guaranteeing more systematic input of environmental as well as social considerations at an early stage in the planning process.

An institutional capability for interpreting, and later carrying out, the technical aspects of impact assessment needs to be created within the Physical Planning Unit and other appropriate GOSKN agencies. Private developers of large projects or projects affecting environmentally sensitive areas should

be required to bear the costs of preparing impact assessments.

* **Recommendation.** The institutional structure and legal authority of the Planning Unit should be revised to allow it to function in a more integrated and efficient manner. This should involve the assumption of more formalized development review and development control responsibilities, development of an expanded and improved land use database, and development of formal zoning restrictions and subdivision regulations.

* **Recommendation.** Consideration should be given to the establishment of an environmental technical arm of the Planning Unit (i.e., an Environmental Management Unit) to assume responsibilities for monitoring the environmental impacts of development projects, to provide advice on ways to mitigate adverse environmental impacts, to ensure compliance with existing land use plans, laws, and procedures, and to assist in drafting regulations and procedures for the protection of the environment. Technical assistance from international agencies should be considered to help Government initially staff and develop the work program of an Environmental Management Unit.

(2) RESOURCE CONSERVATION AND HERITAGE PROTECTION

At present, there is only one officially designated, actively managed national park in the country -- the Brimstone Hill Fortress National Park. Nevertheless, heritage sites -- broadly defined to include areas of biological and geological importance, and pre-historical, historical and cultural sites -- represent valuable resources that St. Kitts-Nevis can ill-afford to squander. This is particularly important as the country enters a period of intensive tourism development where the base of natural and cultural/historical heritage amenities needs to be expanded in order to enhance the attractiveness of the St. Kitts-Nevis destination in an ever more competitive Caribbean market.

Recently, St. Kitts-Nevis put into place the legal framework not only for the development of a full national parks and protected areas system (of which Brimstone Hill is only the first designated site), but also for the protection and management of a wide diversity of natural and historical resources. The National Conservation and Environment Protection Act (NCEPA), which was enacted by the National Assembly in 1987, provides for the selection and establishment of protected areas and requires preparation of management plans for designated sites; additionally, the Act requires the implementation of a coastal zone management plan; prohibits unauthorized sand mining and removal of beach vegetation; provides for the establishment of soil conservation regulations; declares ghauts to be areas of special concern; provides for the establishment of forest reserves and for the protection of designated wildlife; prohibits unauthorized search and recovery of antiquities; authorizes development controls for historic buildings; and generally promotes conservation in the Federation as a part of long-term development planning. It is truly an impressive and important piece of legislation.

Yet all has not been made right by the enactment of the NCEPA. Important procedural, institutional and legislative issues remain unresolved. In fact, it would not be incorrect to say that the future of effective resource protection and environmental management strategies in St. Kitts-Nevis may well depend on GOSKN commitment to full implementation of the NCEPA and full support for the authority of the Conservation Commission established under the Act.

* **Recommendation.** Although it has been three years since enactment of the NCEPA, the Conservation Commission, established by the law and vested with powers to assist the Minister (of Development) in implementing the provisions of the Act, has only recently become functional. Its work agenda, however, is substantial, for it is the Commission which must provide the regulations, activities, and programs which form the administrative framework within which the legal obligations prescribed under the Act will be executed. Every effort must be made by GOSKN to assist the Commission in moving

forward expeditiously if the promise and potential of this innovative legislation are to be realized in the near future.

* **Recommendation.** A parks and protected areas plan is needed to ensure that all critical natural and cultural resources receive adequate protection and that management is carried out in an integrated fashion. Guidelines need to be prepared which establish national priorities for the process of identifying, evaluating and acquiring protected area sites. Management plans for each protected area class or category need to be provided and provisions made for monitoring/enforcement procedures. A central management authority to oversee the system needs to be designated, but mechanisms also should be provided for inter-agency and interdepartmental cooperation and for defining an appropriate role for NGOs in the development and implementation of the parks and protected areas system.

* **Recommendation.** If the ambitious legislative reforms provided by the NCEPA are to be effective, considerable institutional strengthening of those departments and agencies responsible for resource management and resource protection will be required, particularly within the Ministry of Agriculture, Housing, Lands and Development which carries primary responsibility for implementation of these programs. GOSKN, with the assistance of donor agencies, needs to review the technical and regulatory implications of extant environmental legislation, including the NCEPA, and take steps immediately to improve the quantity and quality of staff required for effective implementation.

* **Recommendation.** St. Kitts-Nevis needs to explore ways to more effectively integrate ecotourism amenities into the country's tourism planning and marketing. Both St. Kitts and Nevis have considerable potential in this regard, but such attractions -- whether marine parks for divers or avian sanctuaries for bird watchers or forested mountain trails for hikers -- require resource management plans which address the issue of what the country should do to protect such resources from visitor damage, to monitor their use, and to earn income from their utilization -- in part to cover costs of protection and monitoring.

(3) POLLUTION CONTROL AND WASTE MANAGEMENT

Waste disposal and pollution control problems associated with solid wastes, sewage and other liquid domestic wastes, and agrochemicals collectively represent an increasingly serious yet difficult set of issues facing not only St. Kitts-Nevis but all developing island nations in the Eastern Caribbean. These problems have potentially injurious environmental implications both for public health and for the natural environment. There are also potential economic impacts in neglecting these related pollution issues, particularly as the country's diversification program relies heavily on selling St. Kitts-Nevis as a pristine, well-managed tropical environment.

As is the case throughout the OECS countries, public health legislation is seriously outdated and based on legal concepts which are inadequate to deal with modern pollution control problems. In St. Kitts-Nevis, regulations to the Public Health Act of 1969 were never enacted, thus effectively limiting the substantive authority of that legislation. Furthermore, existing water legislation (the Watercourses and Waterworks Ordinance of 1956) does not include responsibilities for sewage collection, treatment, and disposal.

Agrochemical pollution does not appear to be a substantial problem as yet, but, at present, GOSKN capabilities for monitoring and evaluation of agrochemical pollution are very limited, and the institutional base for regulating the importation and use of such chemicals is not in place. Furthermore, the country's agricultural diversification policy will not only greatly expand the number of users and types of biocides but also the locations and circumstances under which they will be applied.

* **Recommendation.** The quantitative and systemic aspects of environmental pollution in St. Kitts-Nevis are not sufficiently

well-documented at present to permit proper development of remedial or regulatory measures. A national pollution assessment is needed to establish the basic dimensions of each waste stream and to identify and quantify sources, causative agents, volumes, flow rates, destinations, impacts and projections. Additionally, a long-term water quality and marine biological monitoring program should be designed and implemented by the Department of Health in order to gather baseline data and identify areas requiring remedial action.

* **Recommendation.** Laboratory and personnel capabilities for water quality monitoring will have to be upgraded, and consideration should be given to creating a central environmental laboratory facility for the country (including pesticide monitoring functions), combining the equipment and capabilities of the Departments of Health and Agriculture.

* **Recommendation.** The Pesticides Act of 1973 needs to be effectively implemented and regulations provided which reflect new chemicals introduced, levels of safe tolerance, and modern application methods. The Pesticides Board needs to be reactivated as an operational body and needs to exercise its authority for monitoring and regulating the importation, sale, and distribution of biocides in the country. Agricultural extension agents and representatives of farmers organizations should be trained to certify farmers and other users in the safe use and application of biocides.

* **Recommendation.** Public health legislation and water legislation need to be updated and strengthened by the inclusion of national standards and criteria for water quality, pollution control, and waste management. Consideration needs to be given to the country's existing institutional capabilities and technical/fiscal resources in designating both pollution control standards and oversight/regulatory responsibilities.

* **Recommendation.** A Solid Waste Management Plan, which supports national growth and land use goals, should be prepared covering a minimum period of twenty years. The most attractive short-term option for solid waste disposal i both St. Kitts and Nevis, from an economic viewpoint, is likely to be a properly operated sanitary landfill. However, strategies to reduce the quantity of solid waste and to promote a variety of recycling options also need to be explored. Consideration needs to be given to turning waste management and disposal requirements into revenue-generating activities by the simple procedure of establishing prices for many facets of waste disposal. Once this is accomplished, segments of the process can be privatized, e.g., selling franchises to private waste collectors for designated collection areas.

(4) COASTAL ZONE MANAGEMENT

Because so much of the coastlines of St. Kitts and Nevis are dominated by high rocky cliffs, most water-dependent uses -- except for residential settlements on top of the cliffs -- are compressed into limited stretches of the coastal zone where sand beaches and low-lying land or even wetlands can be found. Residential, commercial, recreational and industrial activities are concentrated and juxtaposed within this segment of the shoreline.

The coastal zone is the most heavily populated area of St. Kitts-Nevis and figures prominently in the recreational pursuits of its citizens. Almost all industrial activities in the country are sited in the coastal zone, while the country's emerging tourism sector is dependent upon its natural features and development of infrastructure within its borders. Coastlines in both St. Kitts and Nevis are experiencing significant erosion as well as development, primarily for tourism. Major concerns about a continuing supply of construction sand are paralleled by concerns about ongoing damage by development activities to critical coastal resources, especially in the absence of an effective policy for coastal zone management.

Several environment/development issues -- especially tourism and industrial expansion, port/marina development, environmental monitoring, and marine parks and recreation, to name a few -- point to the fact that management and development of the coastal environment cannot be viewed in iso-

lation. Traditional land use planning needs to be expanded to include marine resource features and environmental factors.

Previous adverse impacts associated with *ad hoc*, unregulated development in the country's coastal zone have been documented. While the tendency has been to focus upon such problems selectively, their increasing, cumulative visibility reflects the absence of comprehensive development control guidelines and policies committed to maintaining the quality of coastal resources. This, in turn, reconfirms the need for a full-fledged coastal zone resource assessment and management planning exercise.

* **Recommendation.** An evaluation and design project for a coastal zone management program should be implemented to provide overall guidance for the eventual development of a CZM program. The National Conservation and Environment Protection Act calls for the preparation and implementation of a coastal zone management plan, and the National Conservation Commission needs to give early attention to this legislative requirement. A useful island model with over a decade and a half of adaptive testing is provided by the U.S. Virgin Islands, a neighboring insular area which has had to face similar coastal-intensive development issues.

Oversight authority for a CZM program should reside in one agency, although responsibility for specific components almost certainly will have to be an inter-ministerial undertaking and better coordination of multi-agency responsibilities for the nation's coastal resources and wetlands will have to be provided for. Emphasis should be placed upon development planning, adherence to a policy of review of all development proposals by the Planning Unit, and requirements for Environmental Impact Assessments for all major developments in the coastal zone, especially marinas, docks, jetties, dredging, and pipelines or cables.

* **Recommendation.** A program to monitor the country's sand resources and commercial exploitation thereof needs to be put in place. Following up on earlier studies in the country, an assessment should be made of the overall impact of sand mining on the rate of beach loss, and GOSKN resource managers need to make periodic judgments as to where continued sand removal will have the least detrimental impacts and is most compatible with current site utilization. Priority areas where sand removal will be absolutely prohibited have been designated, but more areas of lesser concern also need to be identified where regulated sand removal can be carried out at some determined and managed level. Fees for removal need to be set, pegged to actual volumes extracted.

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CARIBBEAN CONSERVATION ASSOCIATION

The *Caribbean Conservation Association (CCA)* is a regional, non-governmental, non-profit organization dedicated to promoting policies and practices which contribute to the conservation, protection and wise use of natural and cultural resources in order to enhance the quality of life for present and future generations. In fulfilling its mission, the Association establishes partnerships with organizations and groups which share common objectives; it focuses attention on activities designed to anticipate and prevent, rather than react and cure.

Established in 1967, CCA's membership comprises Governments (currently 19), Caribbean-based non-governmental organizations, and non-Caribbean institutions, as well as Associate (individual), Sponsoring and Student members. CCA's activities span five major program areas: (1) the formulation and promotion of environmental policies and strategies; (2) information collection and dissemination services; (3) promotion of public awareness through environmental education activities; (4) research about, support for, and implementation of natural resource management projects to foster sustainable development; and (5) assistance for cultural patrimony programs.

CCA's support is derived from Caribbean Governments, membership contributions, international donor agencies, private corporations and concerned individuals. It is managed by a Board of Directors, while its day-to-day activities are supervised by a Secretariat comprising a small core of dedicated staff. For more information, write: Caribbean Conservation Association, Savannah Lodge, The Garrison, St. Michael, Barbados. Telephone: (809) 426-9635/5373; Fax: (809) 429-8483.

ISLAND RESOURCES FOUNDATION

The *Island Resources Foundation (IRF)* is a non-governmental, non-profit research and technical assistance organization dedicated to the improvement of resource management in offshore oceanic islands. Established in 1970, its programs focus on providing workable development strategies appropriate for small island resource utilization through the application of ecological principles and systems management approaches that preserve the special qualities of island life.

Key program implementation areas include coastal and marine resource utilization, land use planning, environmental impact assessment, national park and tourism planning, cultural resource development, and resource sector policy studies. In 1986 the Foundation launched a program of assistance to non-governmental organizations in the Eastern Caribbean designed to improve the capabilities of such groups to provide private sector leadership for achieving environmental goals in the region.

Foundation funding is derived from private foundations, government agencies, international organizations, and through donations and contributions. IRF publishes research and technical reports and maintains a publications office for distribution of these documents. Its reference libraries in the Virgin Islands and Washington, D.C. are widely recognized as a unique collection of over 10,000 documents on insular systems and resource management, with a primary emphasis on the Caribbean. The Foundation is based in the U.S. Virgin Islands, with a branch office in Washington, D.C. and a program office in Antigua. For additional information, write: Island Resources Foundation, Red Hook Center Box 33, St. Thomas, U.S. Virgin Islands 00802. Telephone: (809) 775-6225; Fax: (809) 779-2022.