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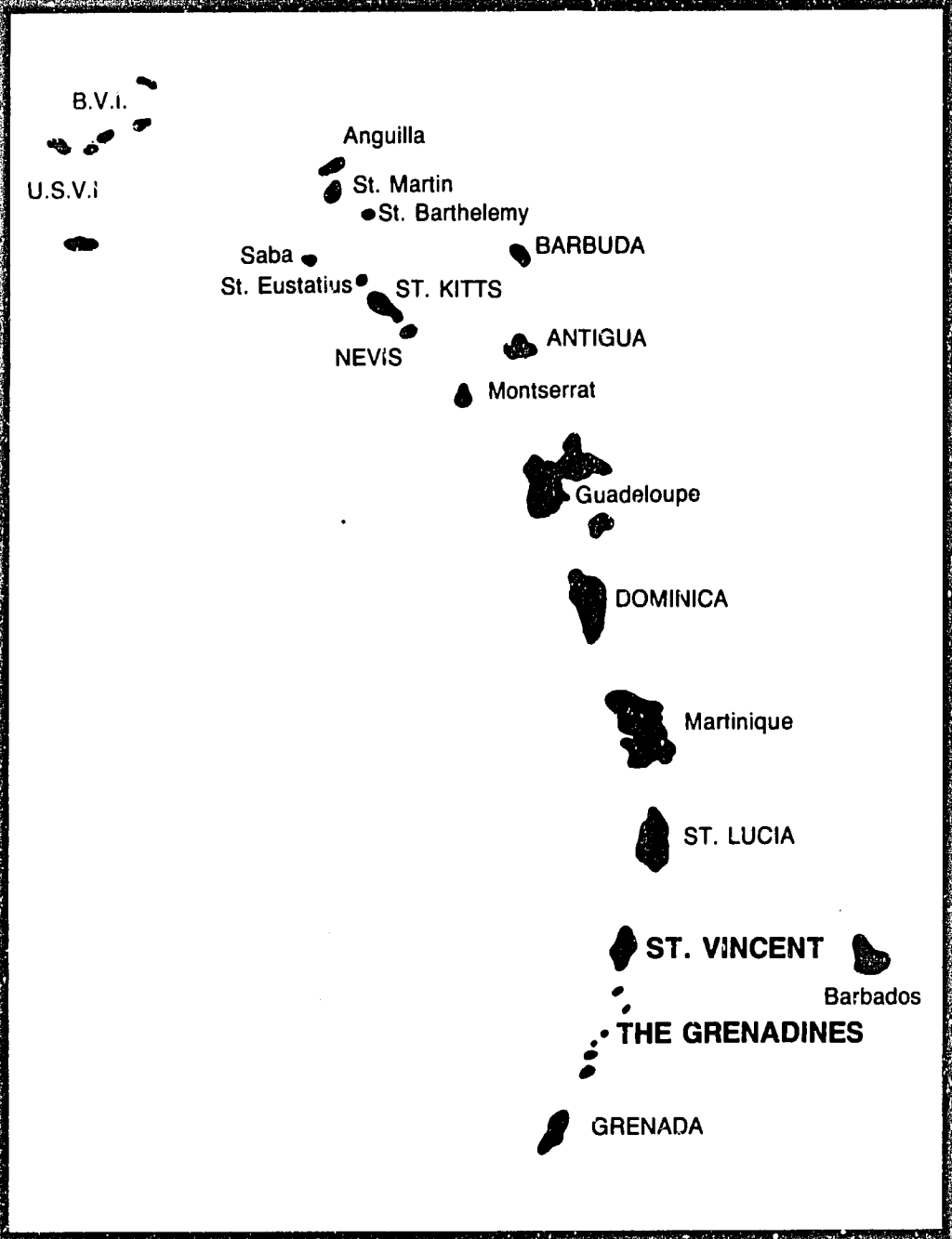
ST. VINCENT the GRENADINES



S T. VINCENT And The GRENADINES

COUNTRY ENVIRONMENTAL PROFILE

Prepared Under the Aegis Of:

THE CARIBBEAN CONSERVATION ASSOCIATION
St. Michael, Barbados

On Behalf Of:

THE GOVERNMENT OF ST. VINCENT AND THE GRENADINES
Ministry of Health and the Environment

With the Technical Support Of:

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

And

THE ST. VINCENT NATIONAL TRUST
Kingstown, St. Vincent

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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. Vincent and the Grenadines 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; Ms. Judith A. Towle, IRF Vice President, is the Editor of the CEP Report Series; and Mr. Robert Teytaud served as Deputy Team Leader for the Profile Project in St. Vincent and the Grenadines.

St. Vincent and the Grenadines Government liaison for the CEP effort was the Ministry of Health and the Environment, the Honorable Burton Williams, Minister. The Junior Minister for the Environment, the Honorable Alpian Allen, was very helpful in executing the project and provided coordination with the Ministry. The CEP National Committee for St. Vincent and the Grenadines (a sub-committee of the National Environmental Protection Task Force) was ably chaired by Mr. Daniel Cummings, Manager of the Central Water and Sewerage Authority.

Local project management was implemented through the offices of the National Trust of St. Vincent and the Grenadines. The Trust's officers and trustees were particularly helpful, and a special acknowledgement is due for the assistance provided by Dr. Earle Kirby, Chairman; Mrs. Lavinia Gunn, Vice Chairman; and Ms. Marlon Mills, Secretary, in providing a warm welcome and arranging for essential support services for the IRF in-country team. Ms. Diana DeFreitas of the National Trust staff also provided expert assistance to Profile writers and investigators.

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Many other organizations and individuals in St. Vincent and the Grenadines gave 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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Bananas or "green gold," the mainstay of St. Vincent's agricultural output.

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ACRONYMS USED IN THE COUNTRY ENVIRONMENTAL PROFILE

ARDP	Agricultural Rehabilitation and Diversification Project
BDD	British Development Division
CARDATS	Caribbean Agricultural Rural Development Advisory and Training Service
CARDI	Caribbean Agricultural Research and Development Institute
CARICOM	Caribbean Community
CARIPEDA	Caribbean People's Development Agency
CARIPOL	Caribbean Pollution Program of UNEP
CCA	Caribbean Conservation Association
CDB	Caribbean Development Bank
CDC	Commonwealth Development Corporation
CEHI	Caribbean Environmental Health Institute
CEP	Country Environmental Profile
CFTC	Commonwealth Fund for Technical Cooperation
CIDA	Canadian International Development Agency
CITES	Convention on International Trade of Endangered Species of Wild Flora and Fauna
CLOS	United Nations Law of the Sea Convention
CPD	Central Planning Division
CPU	Central Planning Unit
CTO	Caribbean Tourism Organization (formerly Caribbean Tourism Research and Development Center)
CTRC	Caribbean Tourism Research and Development Center
CWMP	Cumberland Watershed Management Project
CWSA	Central Water and Sewerage Authority
CZM	Coastal Zone Management
DEVCO	St. Vincent and the Grenadines Development Corporation
ECNAMP	Eastern Caribbean Natural Area Management Program (renamed 1989 as Caribbean Natural Resources Institute, CANARI)
EDF	European Development Fund
EEC	European Economic Community
EEZ	Exclusive Economic Zone
EHO	Environmental Health Officer
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GSVG	Government of St. Vincent and the Grenadines
GTZ	German Agency for Technical Co-operation (Deutsches Gesellschaft fur Technische Zusammenarbeit)
HIAMP	High Impact Agricultural Marketing and Production (USAID)
IARM	Inter-Agency Resident Mission
ICBP	International Council for Bird Preservation
ICOD	International Center for Ocean Development (Canada)
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IICA	Inter-American Institute for Cooperation on Agriculture
IPM	Integrated Pest Management
IRF	Island Resources Foundation

IUCN	International Union for the Conservation of Nature and Natural Resources
LAC	Latin America and the Caribbean
MARPOL	International Convention for the Prevention of Pollution from Ships
NCS	National Conservation Strategy
NFPP	National Family Planning Program
NGO	Non-Government Organization
NRSE	New and Renewable Sources of Energy
OAS	Organization of American States
OECS	Organization of Eastern Caribbean States
OECS-NRMP	Organization of Eastern Caribbean States-Natural Resources Management Project
ORD	Organization for Rural Development
OTA	Office of Technology Assessment (U.S. Congress)
PADF	Pan American Development Foundation
PAHO	Pan American Health Organization
PPC	Planning and Priorities Committee
PPDB	Physical Planning and Development Board
PPU	Physical Planning Unit
PSIP	Public Sector Investment Program
SNA	System of National Accounts
SNAP	St. Vincent National Agricultural Plan
SVAIA	St. Vincent Arrowroot Industry Association
SVBGA	St. Vincent Banana Growers Association
SVG	St. Vincent and the Grenadines
SVPPA	St. Vincent Planned Parenthood Association
SWCUT	Soil and Water Conservation Unit
TFR	Total Fertility Rate
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
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
UWI	University of the West Indies
VINLEC	St. Vincent Electricity Services Ltd.
WHO	World Health Organization
WINBAN	Windward Islands Banana Growers Association
WRI	World Resources Institute
WWF	World Wildlife Fund

ABBREVIATIONS USED IN THE COUNTRY ENVIRONMENTAL PROFILE

ac	acre	kV	kilovolt
BOD	biochemical oxygen demand	kW	kilowatt
cm	centimeter	kWh	kilowatt-hour
EC$	Eastern Caribbean Dollar	l/s	liter per second
ft	foot	lb	pound
g	gram	m	meter
gpd	gallons per day	MGD	million gallons per day
ha	hectare	mi	mile
in	inch	ML	millions of liters
kg	kilogram	mm	milimeter
kgoe	kilograms of oil equivalent	MW	megawatt
km	kilometer	TOE	Tonnes of Oil Equivalent
kn	knot	US$	American Dollar (US$1.00 = EC$2.67)

CONVERSION CO-EFFICIENTS 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

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, principally in Latin America and the Caribbean. CEPs 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, influenced 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 served to strengthen local institutions and to 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. VINCENT AND THE GRENADINES ENVIRONMENTAL PROFILE

Early in 1990 a Memorandum of Understanding (MOU) was signed by CCA and the Government of St. Vincent and the Grenadines (GSVG) for the purpose of executing a Country Environmental Profile, with the recently established Ministry of Health and the Environment serving as the designated counterpart agency for the Government. At the same time, the St. Vincent National Trust was designated by CCA and GSVG as the local implementing and coordinating organization for the CEP project.

A CEP National Committee was formed as an advisory, technical information, and review body for the project in St. Vincent and the Grenadines. The CEP Committee is an officially designated sub-committee of the National Environmental Protection Task which was created in 1989 to advise the Minister of the newly established Ministry of Health and the Environment. Like the Task Force itself, the CEP Sub-Committee included representatives from GSVG departments with environmental responsibilities as well as persons representing private sector environmental organizations.

The CEP National Committee was called on to assist the research and writing team from the Island Resources Foundation in drafting the CEP report outline, identifying critical environmental issues, obtaining reference materials, and coordinating the in-country review of materials prepared by the CEP technical team.

The commencement of the CEP Project in St. Vincent and the Grenadines in February of 1990 coincided with establishment of a new headquarters office by the St. Vincent National Trust in Kingstown. A library of environmental reference materials was established at this location with documents provided by IRF and others. This collection will form the nucleus of a National Trust environmental library or information center which will continue to serve the community long after the completion of the Profile Project.

The draft Profile Report was prepared during a five month period, February - June, 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 June and widely disseminated for final review both in St. Vincent and to other reviewers in the Caribbean region.

ORGANIZATION OF THE ST. VINCENT CEP REPORT

As determined by the St. Vincent and the Grenadines CEP National Committee and the IRF technical writing team, this Profile has been organized in ten primary sections plus an EXECUTIVE SUMMARY section which introduces and summarizes the country's critical environmental issues.

SECTION ONE provides background information on the general environmental setting of the country and also briefly reviews historical, economic and demographic features.

SECTION TWO begins a review of the country's resource base, including a discussion of primary environmental issues within each key resource sector. SECTION TWO focuses on Forests and Wildlife, SECTION THREE on Agriculture and Watershed Management; SECTION FOUR reviews the country's Water Resources while SECTION FIVE specifically deals with Coastal and Marine Resources.

The Profile moves away from an examination of the physical environment to consider Energy, Transportation and Industry issues in SECTION SIX and Tourism issues in SECTION SEVEN. Pollution and Environmental Health are the subjects of SECTION EIGHT.

The topics of land use planning, development control, parks, and other protected area programs are jointly examined in SECTION NINE, along with issues related to environmental education and family planning education.

The final chapter, SECTION TEN focuses on the institutional framework for environmental management in St. Vincent and the Grenadines, including an overview of key agencies and organizations with resource management and development responsibilities.

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. Vincent and the Grenadines or with the Eastern Caribbean sub-region. It is the most thorough assemblage of such reference material on St. Vincent and the Grenadines to be published to date.

EXECUTIVE SUMMARY

The St. Vincent and the Grenadines Country Environmental Profile serves as a "catchment" for identifying environmental issues within the state. Most issue statements which surfaced during the writing of the Profile and which are elaborated upon within this document constitute a national work list for which some modicum of consensus has already been established. They could also be used constructively as a guide for a nationwide environmental education program.

Under the best of circumstances, this Profile and its action recommendations could and should lead directly to the design and implementation of a *national conservation strategy* or its equivalent. At the very least, the document stands as an addendum to St. Vincent's development strategy and public sector investment program. What is most needed at this juncture is a policy framework and a schedule of implementation.

There are two groups of issues addressed within the Profile. The first is derived from the sector review and analysis which constitute the chapters of the CEP which follow. For the convenience of the reader, the sector-specific issues and recommendation summaries accompany each sector overview statement and are clearly identified within each chapter or sub-chapter.

The second, smaller group of critical environmental issues and recommendations -- more national and less sectorial in scope -- have been singled out and presented in this Executive Summary. There is a risk in doing this, for no issue should be considered in isolation. There are important linkages, and the inter-relatedness of elements within both natural and human ecosystems constitutes an important concept for the Vincentian resource manager. Solutions generally require interdisciplinary and inter-ministerial cooperation and coordination and are seldom as neat and orderly as their presentation in list form would suggest.

CRITICAL FACTORS OR "IMPERATIVES"

Essential features on which policies depend are called key inputs, variables, or "imperatives"; they are considered critical for future development and must be addressed. Imperatives are not options from which the government may choose a policy. If any of them is disregarded, the policy will fail and, in extreme cases, some kind of national catastrophe (environmental, economic, social or political) will follow. In short, imperatives are not negotiable.

Imperatives may be used as a yardstick by which to measure the success of previous policies and as a basis for comparing the merits of alternative future strategies. They are inter-related and need to be kept in balance with one another. In practice, over-emphasis of one may divert resources from others in the short term, but over a longer period they are mutually reinforcing.

Six imperatives were identified for the forestry sector by McHenry and Gane (1988) but apply equally well to the environment in general.

(1) *Water*: maintaining and improving the island's capacity to collect and store water for domestic, industrial and agricultural use, and safeguarding water quality by proper management of the watersheds and forest resources.

(2) *Soil*: preventing loss of soil from erosion and maintaining and improving soil fertility by managing the natural woody vegetation and planting trees in accordance with sound land use practices.

(3) *Heritage*: safeguarding the national heritage for present and future generations by preserving features of particular landscape value and sites of cultural, historic, scientific or educational significance; protecting endangered or threatened species; controlling the rate of exploitation of economically useful species; preserving examples of terrestrial and

marine ecosystems and maintaining the habitat of plants and animals; creating national and marine parks for the public to enjoy this heritage.

(4) *Sustainable Output*: generating the largest possible output of products from each sector, *on a sustainable basis*. This means that the growth of each sector and its effects on all the other sectors must be monitored so that no sector grows at the expense of the others. Any given sector should be allowed to grow only to the point where it makes its optimal contribution to gross domestic product, foreign exchange, employment and investment opportunities, while maintaining the quantity and quality of the natural and human ecosystem. This will allow the potential of each sector for meeting the nation's socio-economic needs and aspirations to be realized over the long term.

(5) *Public Participation*: widening the range of participation in all aspects of development, especially land and natural resource allocation decisions, so that all elements of the community have an opportunity to become involved in the process. Private citizens and non-government organizations should share in the costs and the work of conserving the national heritage, thereby reducing the strain on government resources.

(6) *Public awareness*: to be developed about the vital role of natural resources in national socio-economic development, in order for all citizens to appreciate the extent to which they depend on these resources for their survival.

To these six imperatives identified by McHenry and Gane may be added a seventh:

(7) *Coastal and Marine Environment*: the need to manage coastal and marine resources, including mangroves, beaches, coral reefs, seagrass beds, water quality, wildlife and fish stocks, and aesthetic qualities so as conserve these resources and assure their optimum and sustainable long-term use.

OBSTACLES TO PROGRESS

Effective action to sustain and develop all natural resource sectors is hampered by several major socio-economic obstacles in St. Vincent and the Grenadines at the present:

(1) *Inadequate basis for resource management*. Most historical, cultural, and natural resources cannot be effectively protected or managed until the area they occupy is secured. Marine conservation areas have already been designated. Although large parts of the primary watersheds covering the upper catchments above water supply intakes and hydro-electric schemes are state-owned land and some areas have been designated as forest reserves, none are adequately protected. Reserve boundaries are mostly unmarked, and enforcement is not very effective in both marine and terrestrial reserves.

A national park system has been considered but not fully approved or implemented. At the present time, draft legislation for creating such a system is being circulated for review, but as yet only the Tobago Cays Marine Park has been designated and approved. CIDA's Forestry Project, which was originally intended to designate national park sites, is awaiting passage of revised forestry legislation before it can move ahead. Overall responsibility for national parks must be assigned to a single agency, a national parks unit needs to be set up, and a phased process for development and management of national parks and heritage sites must be implemented. The process of safeguarding the resource base takes time, but it is an urgent task because attrition continues in the meantime, and once non-renewable resources are thoughtlessly or deliberately destroyed, they cannot be replaced.

(2) *Misuse of the land in watersheds*. Government ownership of land at higher elevations in the mountainous interior of St. Vincent and the Grenadines should, in theory, enable most of the catchments above water supply intake points to be kept unoccupied and free of cultivation and use of agricultural chemicals. Unfortunately, the Government of St. Vincent and the Grenadines (GSVG) has not exercised clear authority in this domain,

and large areas of crown lands are occupied illegally by squatters. Deforestation for agriculture and fuelwood is causing widespread erosion. Heavy use of agricultural chemicals by small farmers in the upper watersheds increases the risk of polluting drinking water, rivers, aquifers and coastal waters. At lower elevations, most land is privately owned, and there is no effective control of its use. Cultivation on precipitous slopes affects stream flow, causes serious erosion and siltation, and may endanger lives due to landslides.

Although it raises sensitive political and social issues, some curtailment of owner's rights is unavoidable if these issues are to be addressed in the national interest. The consequences of continuing to disregard such problems are serious enough to warrant immediate action for the most vulnerable areas, either by legislative steps or by incentives to alter current land use practices.

(3) *Underutilization of resources and low productivity.* The most efficient utilization of natural resources is desirable so that these resources make a maximum contribution to the socio-economic development of the country. Low productivity results in fewer people being employed or dependent on the natural resource base for their livelihood and less appreciation by the pubic of the importance of these resources. As a consequence, natural resource management receives a lower priority in public spending plans. Substantial improvements in output are possible because these resources are undermanaged at present. Many natural resources are unvalued, unmeasured or intangible, but it is important to start to measure their benefits and to increase their productivity through sustainable resource management.

(4) *Economic capability.* The economies of the small island countries in the Eastern Caribbean are for the most part not sufficiently developed to take on the broad range of resource management activities which are increasingly expected of modern states. The variety of scientific and technical expertise needed to cope with the management of forest resources, degraded catchments, pollution control, wildlife and national park management, and the like requires a larger, better trained staff than most Eastern Caribbean countries, including St. Vincent and the Grenadines, can afford to employ or keep fully occupied. Training in a variety of specializations cannot be provided locally; overseas training is long and costly, and qualified applicants may not be available. Infrastructure is also a problem. Improved infrastructural facilities are most often built and funded by external aid agencies but then must rely on local financial resources and local technical staff to support and maintain efficient systems, not always an easy task in the developing world.

RECOMMENDATIONS RELATED TO THE MOST CRITICAL ISSUES IDENTIFIED IN THE COUNTRY ENVIRONMENTAL PROFILE

The Short Term

(1) CONTROL AND MONITORING OF PESTICIDES

Existing pesticides control legislation, which establishes a Pesticides Control Board, contains no regulations and therefore the Board is essentially powerless in regulating pesticide use in the country (pesticide regulations were recently drafted by an OAS consultant and submitted to the Attorney General for review). At present there are, practically speaking, no good data on the types and quantities of pesticides imported or applied in the field. There are no in-country capabilities for sampling and analysis of pesticide residues and no on-going monitoring of the levels of these chemicals in drinking water, crops, the environment or human tissues. Decision-makers therefore have little quantitative data on which to base their decisions. Neverthe-

less, because of the extreme toxicity of some of the chemicals which are in common use, the careless manner in which they are used, and the large quantities believed to be imported each year, it is imperative for GSVG to take immediate action to protect public health. Ironically, nations such as the United States and Great Britain, which manufacture and export agrochemicals to Third World countries, are at the same time produce-importers and, as such, are becoming increasingly concerned over the high levels of pesticide residues in agricultural products coming from the Caribbean region. Such concerns could have serious economic implications for the agricultural sector of Eastern Caribbean countries.

* **Recommendation**. As a matter of considerable urgency, regulations should be passed giving the Pesticide Control Board authority to require permits for the importation and sale of any biocide, to deny permits for the importation and sale of pesticides on the USEPA's (or other suitable agency's) list of restricted or cancelled chemicals, to require distributors to report quantities sold and major users to report quantities applied in the field. The use of biocides in drinking water catchment areas should be stopped immediately (see No. 2 below).

* **Recommendation**. Agricultural extension agents and representatives of rural development NGOs and farmers organizations should be trained to certify farmers in the safe use of biocides. The training programs should emphasize the use of visual instructional materials rather than lectures (e.g., videos) and should make a major effort to involve the children of farmers through schools and youth clubs. 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 biocides.

* **Recommendation**. The Ministry of Agriculture should continue to maintain and improve its linkages and arrangements for obtaining information and advice from biocide experts through use of manuals, libraries and computerized information systems supported by USAID/USEPA, FAO/WHO, CIDA, World Bank, Caribbean Environmental Health Institute, and other international donor agencies and health organizations. This information is necessary not only to protect public health but also to assure competitiveness on the international market in producing fruits and vegetables using acceptable biocides, i.e., those that have residue levels which fall within internationally acceptable tolerances.

* **Recommendation**. The Ministry of Agriculture should obtain donor assistance to establish a produce laboratory and to train a technician in extraction of biocide residues from samples (produce, meat, fish, human blood/urine or environmental samples such as water and sediment). Monitoring programs should start with sampling for biocide residues in produce and in drinking water. Analysis can then be conducted by the Caribbean Environmental Health Institute (CEHI) at its laboratories in St. Lucia. Donor support to make these facilities functional should be contingent upon the passage of legislation that includes revenue-generating schemes which ensure the self-sufficiency of the produce lab over the long-term, e.g., requiring all produce exporters to have residue analyses conducted with such fees placed in a specific account to support operational and maintenance costs for laboratory equipment.

* **Recommendation**. Once the produce lab is operational, a chemist could be trained in biocide residue analysis, and a gas chromatograph could be obtained so that the analyses were eventually conducted in-country. At this point, the biocide monitoring program could be expanded to include regular sampling from the tissues of farm workers and from the environment. The environmental sampling capabilities of the Central Water and Sewerage Authority or the Public Health Department would need to be strengthened with support for equipment and training. Donor assistance should be contingent upon enactment of legislation establishing a special environmental monitoring fund with revenues earmarked for the fund. CEHI should consider eventually assuming a quality-control function for all the in-country biocide analysis laboratories in the OECS countries.

(2) CONTROL OF ILLEGAL ACTIVITIES IN WATER CATCHMENT AREAS, FOREST RESERVES AND MARINE CONSERVATION AREAS

Existing legislation provides for the protection of water catchments, crown lands and forest reserves against illegal squatting, deforestation, pollution by agricultural chemicals and erosion. There is also legislation prohibiting illegal fishing, mining, dredging, and pollution in marine conservation areas. Most of this legislation is widely ignored and inadequately enforced. Revised legislation for forestry and water resources management is currently under review by GSVG.

In order to protect drinking water quality, a solution to the "squatter problem" -- with its environmental ramifications in critical water catchments, i.e., deforestation and extensive use of agrochemicals -- needs to be identified. Additionally, effective regulation of biocide imports and use should be implemented. The required technical information on biocides already exists, a land reform program is underway, and surveys of catchments and crown lands are now in progress (see Sections 2, 3 and 8). The remaining difficulties appear to be primarily social and political rather than technical; solutions will therefore depend on Government's ability to implement the regulatory and enforcement provisions of pending legislative reforms, rather than on further research or technical assistance.

* **Recommendation.** A system for effective watershed and catchment area management needs to be put in place as rapidly as possible, squatters must be relocated, and steps must be taken to restore those areas which have already been damaged.

* **Recommendation.** Management plans are needed for all designated marine conservation areas. Signs and markers advising the public of the existence and boundaries of marine conservation areas, and the restrictions which apply within them, should be posted immediately in appropriate locations. This is especially needed in the Indian Bay-Villa-Calliaqua area in St. Vincent and in the Tobago Cays.

(3) COASTAL ZONE MANAGEMENT ISSUE: CONTROL OF SAND MINING AND COASTAL EROSION

One causative factor responsible for widespread beach erosion appears to be the on-going mining of sand and aggregate from virtually all beaches, a situation encouraged by a lack of enforcement of existing legislation. Alternate sources of aggregate and specific beaches for sand mining have been designated, at least on St. Vincent proper. The Ministry of Agriculture has been designated as the lead agency for beach and coastal conservation, and legislative revisions are currently under review. Again, the remaining difficulties appear to be primarily political rather than technical, and ultimate solutions will depend on Government's ability to implement the regulatory and enforcement provisions of existing laws and pending legislative reforms.

Although it has been recommended that GSVG consider beach renourishment with dredged sand to restore the tourist beaches on the south side of St. Vincent (e.g., Villa-Indian Bay-Calliaqua), this poses considerable danger of destroying the nearshore coral reefs which produce the white sand on which the area's popularity as a recreational and tourist destination depends. This area has also been designated as a marine conservation site because it has the best reef development in St. Vincent. The reefs here are already under stress from nutrient enrichment and sedimentation, and their further degradation would imperil the long-term viability of the economically vital recreational beaches.

* **Recommendation.** GSVG should establish workable coordination linkages between the Ministry of Communications and Works and the Ministry of Agriculture regarding jurisdiction and responsibilities for protection of the nation's beaches. A program needs to be established to educate the public about the severity of the problem and about the existing law and penalties for its violation. Law enforcement officers need to be given authority to arrest violators of the beach protection legislation, and those so charged need to be vigorously prosecuted.

* **Recommendation**: A study of the beaches and reef systems on St. Vincent's south shore should be undertaken by experts in beach dynamics and reef biology, with a view to reducing man-made disturbances and enhancing natural regenerative capacities without artificial beach "renourishment". The effects of removing the various groins which impede longshore movement of sand should be studied, and measures should be taken to improve the water quality in the Calliaqua Bay area.

(4) SOLID WASTE MANAGEMENT

Solid waste disposal practices are inadequate. Most of the population disposes of its waste in any convenient place, including roadsides, streams, the shorelines and beaches, and open fields. Citizens in the countryside and in most villages and towns have no garbage collection services, and such designated disposal sites as there are operate as unsightly and unsanitary open dumps which are continually smoldering, contributing to both water and air pollution and the hazard of disease. Many of the designated dump sites are located in environmentally inappropriate places such as in wetlands and along riverbanks. There are no programs aimed at waste recycling or source reduction and no provision for safe disposal of toxic wastes.

* **Recommendation.** The Central Water and Sewerage Authority (CWSA), which already has sanitary engineering expertise, should be given the authority to manage solid waste disposal throughout the country (if CWSA is not granted this authority, then it should lend necessary technical support to the designated responsible department). A "solid waste mandate" should include authority to define criteria for the siting of dumps, to survey and purchase necessary land, to conduct feasibility studies in source reduction and recycling of solid waste, and to explore alternative means of disposal. The designated authority should also be responsible for all aspects of the operation of the disposal sites as sanitary landfills, including the authority to charge fees for waste disposal; such fees should be earmarked for a special account used for operation and maintenance of equipment. Funding should be sought from donor agencies for purchase of equipment to operate the landfills.

* **Recommendation.** Consideration should be given to privatizing garbage collection and to approval of a fee structure to be used by private companies providing this service. An appropriate GSVG authority, such as the Public Health Department, should license such companies and should have the power to rescind franchises if collectors do not perform satisfactorily.

* **Recommendation.** Existing industries discharging toxic and/or high-BOD wastes into the environment should be identified and required to treat their wastes and clean up already polluted areas. A system of fines should be implemented for violators, with the monies collected going into a special fund for environmental clean-up and restoration.

(5) PREVENTION AND CONTROL OF OIL AND HAZARDOUS MATERIALS SPILLS

The potential occurrence of oil and hazardous materials spills, which pose a threat to the beaches and marine communities as well as the groundwater resources of the nation, is an issue not presently being addressed. This is especially important in the islands of the Grenadines, which are close to heavily used shipping lanes and where tourist beaches and extensive shallow-water marine ecosystems are very vulnerable to such spills.

* **Recommendation.** An oil and hazardous materials spill contingency plan should be prepared and implemented. Legislation is needed to require proper disposal of waste automotive oil and hazardous materials, and facilities to accomplish this must be provided.

* **Recommendation.** The nation's maritime legislation gives St. Vincent and the Grenadines authority to regulate ship traffic and pollution within its exclusive economic zone (EEZ) as defined by the law. This authority should be used to set up a traffic separation system for oil tankers passing through

the EEZ, and such traffic should be prohibited in high-hazard areas. At the same time, it is recognized that a regional system of pollution control is required since a pollution problem could originate from a source beyond national waters and affect more than one country.

(6) ENVIRONMENTAL IMPACT ASSESSMENT PROCEDURES

* **Recommendation.** The preparation of environmental impact assessment (EIA) reports should be required of all proposed major projects, especially industrial projects and those in the coastal zone, before they are granted development permits. Regulations should be prepared by the Central Planning Division which provide standardized requirements and guidelines for the content of such reports.

(7) STRENGTHENING OF RESOURCE MANAGEMENT UNITS OF GOVERNMENT

St. Vincent is presently moving in the direction of concentrating environmental responsibilities in a traditional line ministry -- the newly established Ministry of Health and the Environment. However, some resource management responsibilities already reside in departments outside of the Ministry of Health and the Environment. Moreover, the new Ministry has not yet developed its environmental portfolio, and there is not a defined structure under which its environmental responsibilities are to be carried out.

At the same time, an ambitious body of proposed environmental legislation is currently under consideration by Government in the following areas: forest resource conservation, water resources management, national park development, planning and development control, public health, pesticide regulation, and litter control.

* **Recommendation.** GSVG needs to address as soon as possible the institutionalization of environmental responsibilities within the Ministry of Health and the Environment; consideration should be given to the establishment of a Department of the Environment within the Ministry, with clearly mandated responsibilities. Coordination of the Ministry's environmental management responsibilities with other GSVG agencies needs to be established, perhaps through an institutionally strengthened Environmental Protection Task Force.

* **Recommendation.** The lack of adequate technical, monitoring, and enforcement personnel is often cited as the reason for the inability of GSVG departments to effectively enforce existing environmental and resource management legislation. Staffing problems will be exacerbated if proposed new environmental legislation is enacted in the near future. Therefore, with the assistance of donor agencies, GSVG needs to examine the technical and regulatory implications of the full spectrum of existing and proposed environmental legislation and take steps now to improve both the quantity and quality of staff required for implementation, particularly middle-level management and technical staff.

RECOMMENDATIONS RELATED TO THE MOST CRITICAL ISSUES IDENTIFIED IN THE COUNTRY ENVIRONMENTAL PROFILE

The Medium Term

(8) LIQUID WASTE MANAGEMENT

The only two municipal sewerage systems in the country service one small area of downtown Kingstown and another small area in the Kingstown suburb of Arnos Vale. The remaining population relies on pit privies and a small number of septic tank systems or else has no sanitary disposal facilities at all. Rivers and coastal waters are polluted by

human excreta, and there is increasing risk to public health as a result.

In addition to the urban areas and villages, one especially critical marine area is the Indian Bay-Villa-Young Island-Calliaqua-Carenage complex, where St. Vincent's best examples of shallow-water reefs, white sand recreational beaches, snorkeling and sport diving facilities, yacht anchorages and important tourist hotels are located. The reefs here appear to be under considerable stress, presumably from liquid wastes and sediments from land (see Section 5). Since the continued viability of all the recreational and tourism activities in this area depends on protecting the health of the reefs, it is clear that action must be taken soon to reduce the wastewater and sediment pollution load entering the bay.

* **Recommendation.** The most cost-effective *and* ecologically sound sewage disposal option needs to be identified and then implemented for all urban areas of St. Vincent as soon as possible. Given the fact that it is crucial to prevent both public health hazards and nutrient enrichment of nearshore waters, and taking into consideration existing technological and financial constraints, that option is likely to be primary treatment of sewage combined with a long outfall which discharges into deep water in an area of strong currents. Such waste disposal systems should be designed to be easily upgraded to a higher level of treatment should this prove to be necessary later. This solution for sewage disposal may be difficult if not impossible to implement in some places in the Grenadines, due to the shallow shelf area and reefs.

* **Recommendation.** Solving the liquid waste pollution problems in the Indian Bay-Calliaqua area will probably require construction of a sewerage system. Other measures may be considered, e.g., retrofitting existing hotels and houses with septic tank systems and grease traps, imposing and enforcing building density controls and strict waste disposal requirements on new developments, and requiring yachts to be equipped with holding tanks. However, the expense and enforcement effort required to implement these would probably make them impractical.

(9) ENVIRONMENT, ECONOMICS, AND POPULATION

Perhaps the most important condition for sustainable development is for environmental and economic concerns to be merged in decision-making. An optimal development strategy would combine accelerated economic and social development (emphasizing environmentally benign technology and environmental protection) with increased efforts for family planning.

* **Recommendation.** The 1991-1994 National Development Plan which is currently being prepared should focus on the achievement of sustainable development over the long term. The feasibility of implementing a system of national income accounts which includes natural resource assets should be explored not only by St. Vincent and the Grenadines, but by the OECS countries collectively. Donor support should be sought for an Eastern Caribbean regional feasibility project to study the costs and benefits of implementing such an accounting system and of extending the concept of depreciation to natural resource assets.

* **Recommendation.** The *real* (often hidden) costs of resource allocation decision-making need to be accounted for by internalizing environmental costs in prices, i.e., the principle of "the resource user or the polluter pays". Additionally, it is important that national economic policies, budgets and subsidies that actively, if unintentionally, encourage environmental degradation be reformed.

* **Recommendation.** The development of innovative means of raising revenues for environmental protection is necessary to reduce the burden on Government finances. Possible options include: charging a levy to hotels for waste collection and treatment services; selling franchises to private waste collectors for designated collection areas; charging industrial and commercial users for waste collection and disposal; and billing polluters for cleanup and restoration costs.

* **Recommendation.** A decrease in the birth rate is linked to the long-term success of a national environmental protection

agenda in St. Vincent and the Grenadines. While encouraging steps have been taken through the provision of family planning education and services, a greater effort will be required to accomplish the stated goals of the country's National Population Policy. This will involve, among other things, increased efforts to deal with the major underlying social and economic constraints which influence efforts to curb high birth rates. Underlying cultural factors could be better identified and clarified by carrying out a national "knowledge, attitudes, beliefs and practices" survey to guide family planning policy makers. Educational and outreach activities need to be continued, but other options for facilitating change should not be neglected, such as expansion of facilities for services or efforts to improve the cooperation of medical practitioners.

(10) DEVELOPMENT CONTROL

The existing Physical Planning and Development Guidelines could form the basis for legally adopted regulations to the Town and Country Planning Act, but they would have to be strengthened by the addition of standards for different types of development activities, the inclusion of environmental impact assessment requirements, and provisions for the regulation of public sector, coastal and agricultural developments. A draft revision of the Town and Country Act, including regulations, has been submitted to Government for review.

* **Recommendation.** Consideration should be given to updating the institutional structure and legal powers of the Physical Planning and Development Board (PPDB) so that it can require other GSVG agencies to comply with its decisions and regulations; a more effective system of development control, including monitoring and enforcement responsibilities, is also needed. A technical advisory group should be created to support the PPDB in decision-making related to integrated watershed management.

* **Recommendation.** The Central Planning Division (CPD) needs to create and maintain a functional land use data base and information management system, including new large scale aerial photographs and land use maps, up-to-date cadastral maps, and land ownership information. There is a need to increase the level of training in information management within the CPD and to provide a capability for on-going monitoring of land use changes.

* **Recommendation.** Legislation is needed to require the preparation of environmental impact assessments for major projects, *especially within the coastal zone* and other critical areas identified in the Profile. Appropriate standards for development should be included in the legislation now pending before GSVG and, when enacted, such standards should be rigorously enforced. An institutional capability for interpreting, and later carrying out, the technical aspects of environmental impact assessment needs to be created within the CPD and other appropriate GSVG agencies.

(11) INITIATE BASELINE SURVEYS AND LONG-TERM MONITORING OF FORESTS, CORAL REEFS, SEAGRASS BEDS AND MANGROVES IN PROTECTED AREAS

* **Recommendation:** A long-term water quality and marine biological monitoring program should be implemented as soon as possible, in order to gather baseline data, to determine the impacts of liquid waste disposal from urban areas and industrial sites and to determine the need for remedial action. Laboratory and personnel capabilities in the country will have to be upgraded in order to accomplish this.

RECOMMENDATIONS RELATED TO THE MOST CRITICAL ISSUES IDENTIFIED IN THE COUNTRY ENVIRONMENTAL PROFILE

The Long Term

(12) LONG-TERM SOLID WASTE MANAGEMENT PLAN

* **Recommendation.** A solid waste management plan should be prepared for a minimum period of twenty years. From a financial viewpoint, in the short term, a properly operated sanitary landfill is likely to be the most attractive option for solid waste disposal. However, over the long term, 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 assure that such schemes are organized on economically defensible grounds.

(13) INTEGRATED NATIONAL PARKS AND PROTECTED AREAS SYSTEM

* **Recommendation.** A national 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. A single agency should be given the task of coordinating resource management in parks and protected areas. Allocation of manpower resources for enforcement and management activities should be made on the basis of priorities set out in the plan.

* **Recommendation.** Critical areas -- such as habitat for endangered and threatened species, important watersheds and catchment areas, aquifers, wetlands, beaches, marine reserves, major diving sites, forest reserves and recreation areas, wildlife reserves, scenic vistas and roads, historic and archaeological sites, and natural tourist attractions -- should be delineated on national land use maps for incorporation into a national parks and protected areas system.

(14) NATIONAL LAND USE PLAN, EMPHASIZING SUSTAINABLE DEVELOPMENT, MANAGEMENT OF GROWTH AND MAINTENANCE OF BIODIVERSITY

* **Recommendation.** A national land use plan needs to be prepared, incorporating and updating some or all of the many sectoral plans which have been written and focussing on the means of achieving sustainable development over the long term. The land use plan should attempt to 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. The watershed should be adopted as the appropriate management unit for land use planning.

* **Recommendation.** The preparation of new land use maps should be the initial step in the process of designing a land use and growth management plan for the nation. The degree of correlation between land *capability* and present land *use* should be determined after new land use maps are generated, and areas in which there are serious discrepancies should receive priority attention for remedial and/or restoration programs.

(15) COASTAL ZONE MANAGEMENT

The coastal zone is the most heavily utilized and heavily populated area of St. Vincent. In the Grenadines, because of the size of the islands, the coastal zone in effect constitutes the primary resource management unit. Future growth of the country's tourism industry is dependent on implementation of policies which promote the orderly development and sustainable use of the coastal zone.

Nevertheless, significant environmental problems affecting the coastal zone were identified in the course of preparing the Country Environmental Profile, some of

which have been discussed in this Executive Summary. These include:

- Accelerated "piecemeal" development of the coastal zone, with minimum consideration of the *cumulative* effects of coastal development projects and activities;

- Unregulated removal of sand and vegetation in the coastal zone resulting in increased rates of coastal erosion;

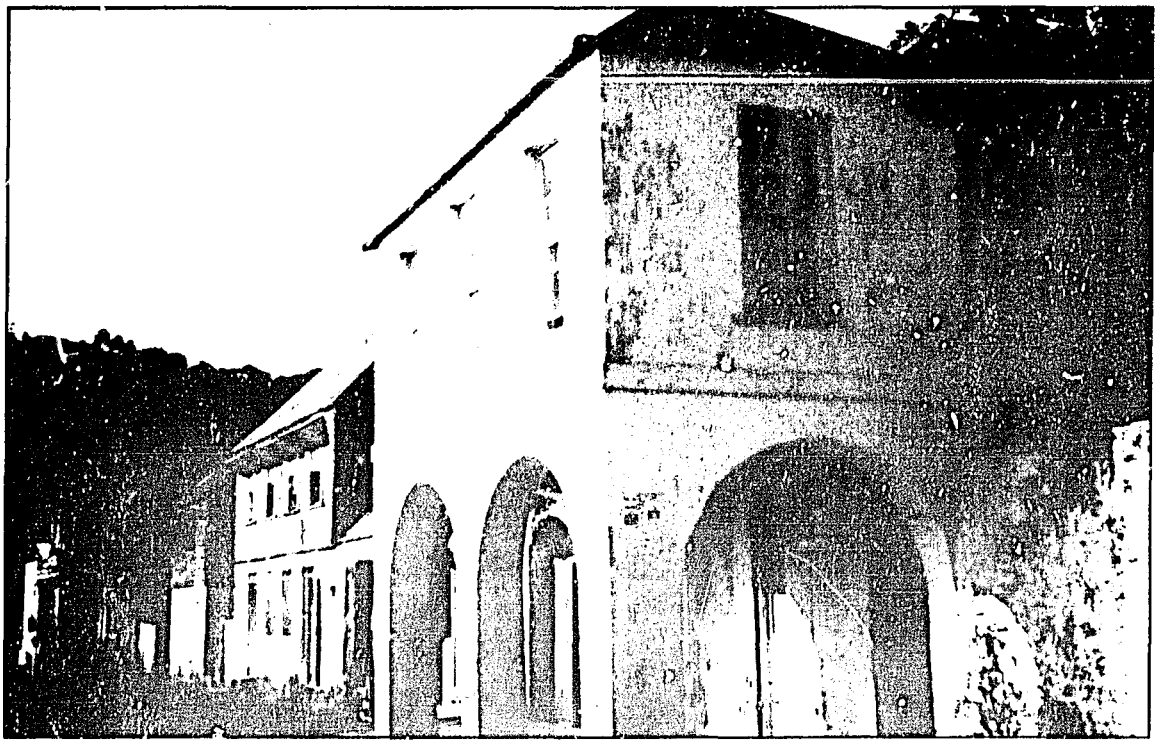
- Increasing threats to marine life and marine ecosystems as a result of unregulated development activities not only in the coastal zone but in upland watershed areas;

- Failure of artificial barriers to withstand the erosive force of sea swells during periods of high wave activity;

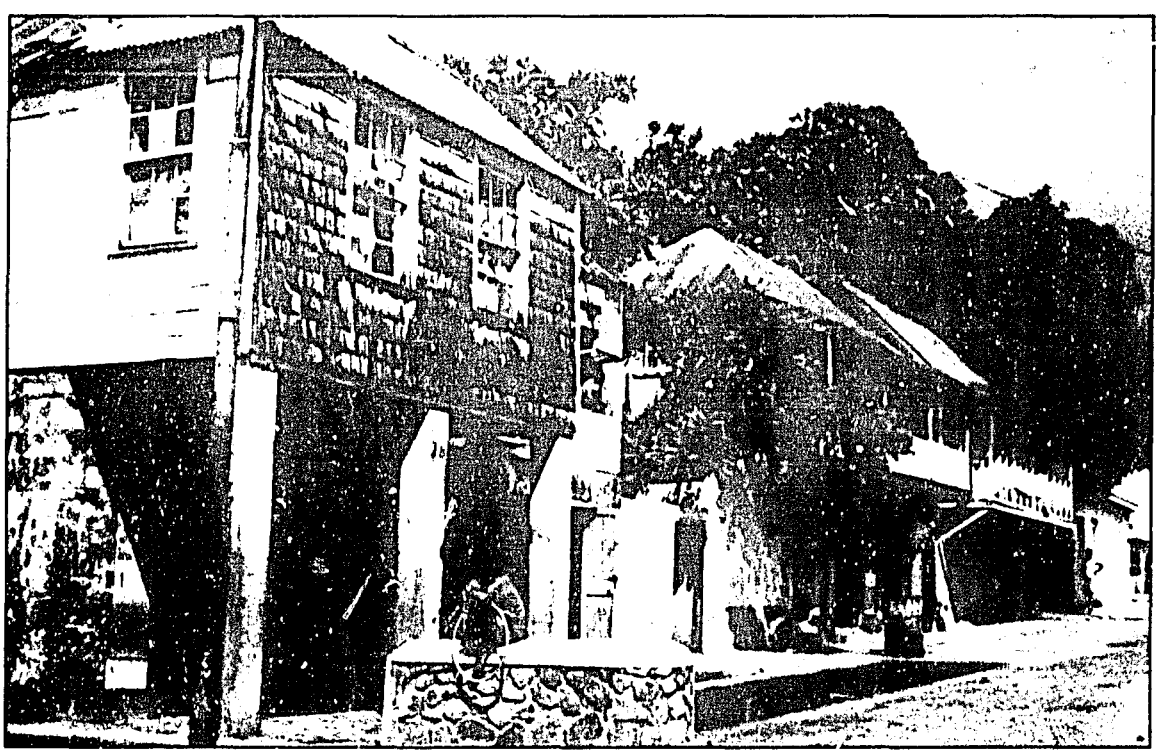
- In the absence of a coastal setback requirement, increased risk of coastal flooding and destruction of structures in the coastal zone during periods of high tide and heavy sea swells.

Government's overall approach to these and other development problems in the coastal zone has lacked coherence and has generally been one characterized by an *ad hoc*, case-by-case response.

* **Recommendation.** In addition to other recommendations in this Executive Summary which focus on the coastal zone (e.g., see nos. 1, 2, 3, 4, 5, 6, 8, 10, 11, 13, and 14), Government should seek donor assistance for preparation of a comprehensive coastal zone management (CZM) plan and follow-on CZM program; consideration should be given to designing a permitting system targeted at coastal developments, legislation to support the CZM program, training and other support for staff to implement the CZM program, monitoring and enforcement procedures for regulation of development in the coastal zone, and a public education campaign focused specifically on coastal environments and their critical importance to national development.



Fine examples of vernacular architecture can still be found in the country's capital of Kingstown, but the town's historical architectural flavor is slipping away in the absence of enforced protective legislation. An architectural enhancement and preservation program would greatly enhance the long-term liveability and viability of urban Kingstown's surviving mixture of vernacular and colonial buildings. Arched arcaded buildings, such as the example above, show a French influence, although France held the island for only a short time in the late eighteenth century.



Traditional West Indian style buildings in Kingstown, featuring a cut stone and masonry first story and an overhung wooden second story, one without and two with standard verandas and fancy wooden railings.

SECTION 1 INTRODUCTION AND BACKGROUND

1.1 HISTORICAL AND DESCRIPTIVE OVERVIEW OF THE NATION

St. Vincent and the Grenadines is truly an archipelagic state composed of over 30 islands, islets and cays which extend from St. Vincent, the largest, southward for some 45 miles toward the neighboring island country of Grenada (Figures 1.1(1) and 1.1(2)). The smaller isles in the chain comprise the St. Vincent Grenadines, several of which are inhabited -- Bequia, Mustique, Canouan, Mayreau, Union, Palm, and Petit St. Vincent. The country is one of four Eastern Caribbean islands falling within the Windward Island grouping, with another of the Windwards (St. Lucia) lying to the north and a second (Grenada) to the south.

"Rugged and mountainous" are the descriptive terms used most often to describe the topography of St. Vincent, the country's largest island and host for the capital city of Kingstown. As the "mainland" of the nation of St. Vincent and the Grenadines (SVG), its high mountains cloaked in wet forests, numerous rivers, and black sand beaches offer a contrast to the smaller islands of the Grenadines chain to the south. These 32 archipelagic islands and cays scattered over the Caribbean Sea present a vivid panorama of low dry hills, gleaming white beaches and clear blue water, numerous protected bays, and extensive coral reefs.

The main island of St. Vincent is dominated by one large volcanic cone, La Soufriere, which rises to 4,000 feet in the north of the island. Dismissed prematurely in more recent times as dormant, La Soufriere erupted on Good Friday in 1979, thus explosively ushering in the country's independence the same year. Earlier explosive eruptions -- recorded since the eighteenth century -- occurred in 1718, 1812, and 1902 and have influenced the history, settlement patterns and vegetation of the island. Most significantly, the repeated eruptions have periodically destroyed vegetation on the flanks of the volcano, resulting in slopes of loose cinders and ash which revegetate very slowly.

Mountainous and fertile, St. Vincent proper is the world's leading producer of arrowroot. Nevertheless, the country now survives by bananas and almost by bananas alone, for that single crop supports approximately 85 percent of St. Vincent's population and accounts for the majority of agricultural exports -- which in turn account for close to 100 percent of total exports (*Courier*, 1989).

Most of the island below 1,000 feet has been cultivated for many years. This, however, is by no means the upper limit of cultivation, and many very steep slopes have been cleared and planted by shifting agriculturalists. However, significant stands of primary forest, some of it tropical rain forest, remain on the largely inaccessible interior mountain ridges and at the heads of the deep, steep valleys of the leeward coast. This designated protected forest area provides the remaining habitat for the endangered St. Vincent Parrot and other wildlife, but it is coming under increasingly heavy pressure from squatters.

The Grenadines stand somewhat apart from the main island. Noted for their beautiful white sandy beaches, excellent sailing waters, and internationally acclaimed resort communities, some of these islands (like Mustique) are privately owned, or virtually so, and have more recently been host to royalty and stars of the entertainment world. The protected waters of the Tobago Cays, now designated a marine reserve, have become a haven for avid snorkelers and divers. Several of the Grenadines, in particular Bequia, were once whaling islands, from the late nineteenth to early twentieth century during a time when these waters were a favorite hunting ground of American whalers. Today the Grenadines are a community of small farmers, fishermen, boat-builders and sailors (Frank, 1976).

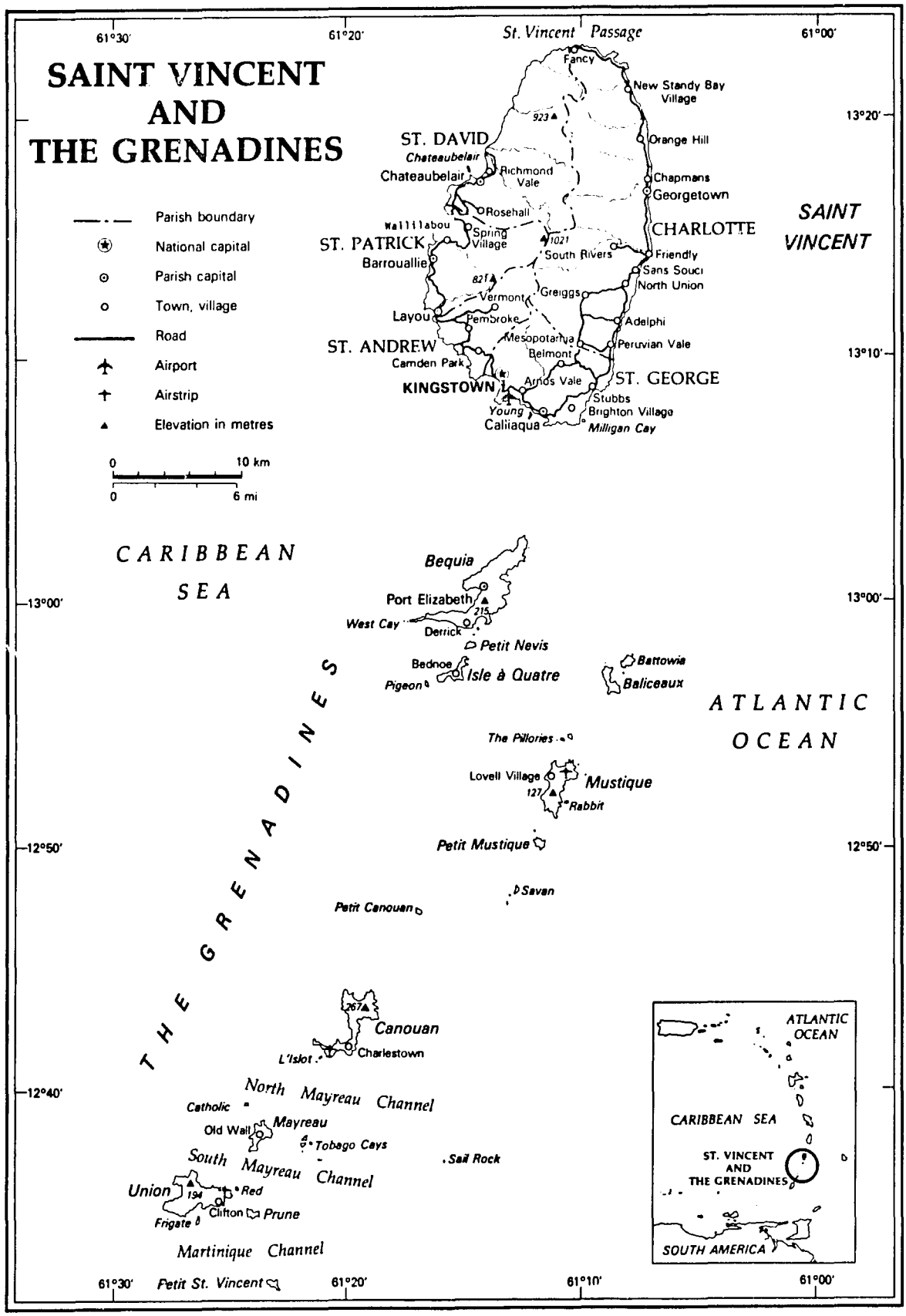


Figure 1.1(1). Country location map, St. Vincent and the Grenadines (source: GSVG, 1986b).

To the casual visitor, the Grenadines of St. Vincent appear to be the prototypic tropical dream island of tourist brochures and posters -- rolling hills ending in gleaming, palm-fringed beaches, clear water in multiple shades of blue, and coral reefs to entice the more adventurous. This surface appearance, while eminently marketable, disguises more deeply-entrenched and inter-connecting socio-economic and ecological problems. For example, Government has embarked on an ambitious tourism development program to stimulate a depressed economy. Unfortunately, the large influx of cruise ship and air tourist arrivals to Bequia, Union and other islands is now causing increasingly serious infrastructural, socio-cultural and ecological stress. The reefs of the Tobago Cays, long a noted attraction for visiting yachtsmen, have recently suffered a marked decline which has been variously attributed to overfishing, pollution from transient boats, and careless diving practices. The actual cause or causes remain elusive and conjectural.

HISTORICAL BACKGROUND

Like many of its Caribbean neighbors, the early history of St. Vincent was enacted against a backdrop of colonial warfare between the French and British. Closely enmeshed within that rivalry was a second struggle, that of the indigenous Carib Indians who long and determinedly fought to defend their island home against European incursions.

Sighted by Christopher Columbus in 1498 on the feast day of St. Vincent and named in honor of the saint, the island was not occupied by Europeans until the eighteenth century. While Britain and France fought for possession of the Lesser Antilles, the indigenous Carib Indian population (which had earlier conquered the more peaceful Arawak Indians) mounted a formidable resistance to settlement by either European power. In this struggle, the Caribs of St. Vincent were aided in no small measure by the island's rugged, mountainous terrain which afforded substantial protection against would-be European settlers. So determined were the Caribs that in 1748 by the Treaty of Aix-la-Chapelle, the British and French agreed to designate the two Antillean islands with significant Carib populations -- St. Vincent and Dominica -- as "neutral territory" for the sole benefit of their Carib inhabitants.

St. Vincent's Caribs were particularly impressive in warfare against the Europeans, in part because they had as allies a larger, more intransigent population known as "Black Caribs," a mixed group of Indians and mainly runaway African slaves. Together, they exercised effective sovereignty over St. Vincent until the British finally took possession in 1763. Even then, between 1771 and 1773, the Caribs continued to mount a steady resistance movement against the Europeans, while the British undertook a full-scale effort to exterminate them. The British were forced to execute a treaty in 1773 setting aside some of the best agricultural land on the island in a special district for the Caribs, in return for Carib recognition of the sovereignty of the English monarch. The truce was short-lived, however, for the Caribs joined forces with the French in 1778 who subsequently captured and occupied St. Vincent until 1783.

Fighting between the British and Caribs broke out once more in 1795, in a French-supported revolt which lasted 16 months and resulted in the eventual defeat of the Black Caribs. In 1797, over 5,000 Caribs -- the majority of St. Vincent's Carib population -- were forcibly removed from the island by British troops and banished forever to Ruatan Island off the coast of Honduras. The few Caribs who remained were allocated 233 acres by the British for their subsistence (Gregoire and Kanem, 1989).

Evidence of the Carib presence in St. Vincent's early history can still be found in petroglyphs scattered throughout the island and also in the chief military monument, Fort Charlotte, an impressive fortification overlooking Kingstown Harbor on the leeward coast. It once mounted 34 guns, but these were sited facing north and east -- not to protect its seaward approaches but to safeguard the fort from land attack from within the interior, where the Caribs so long maintained control (Buisseret, 1973).

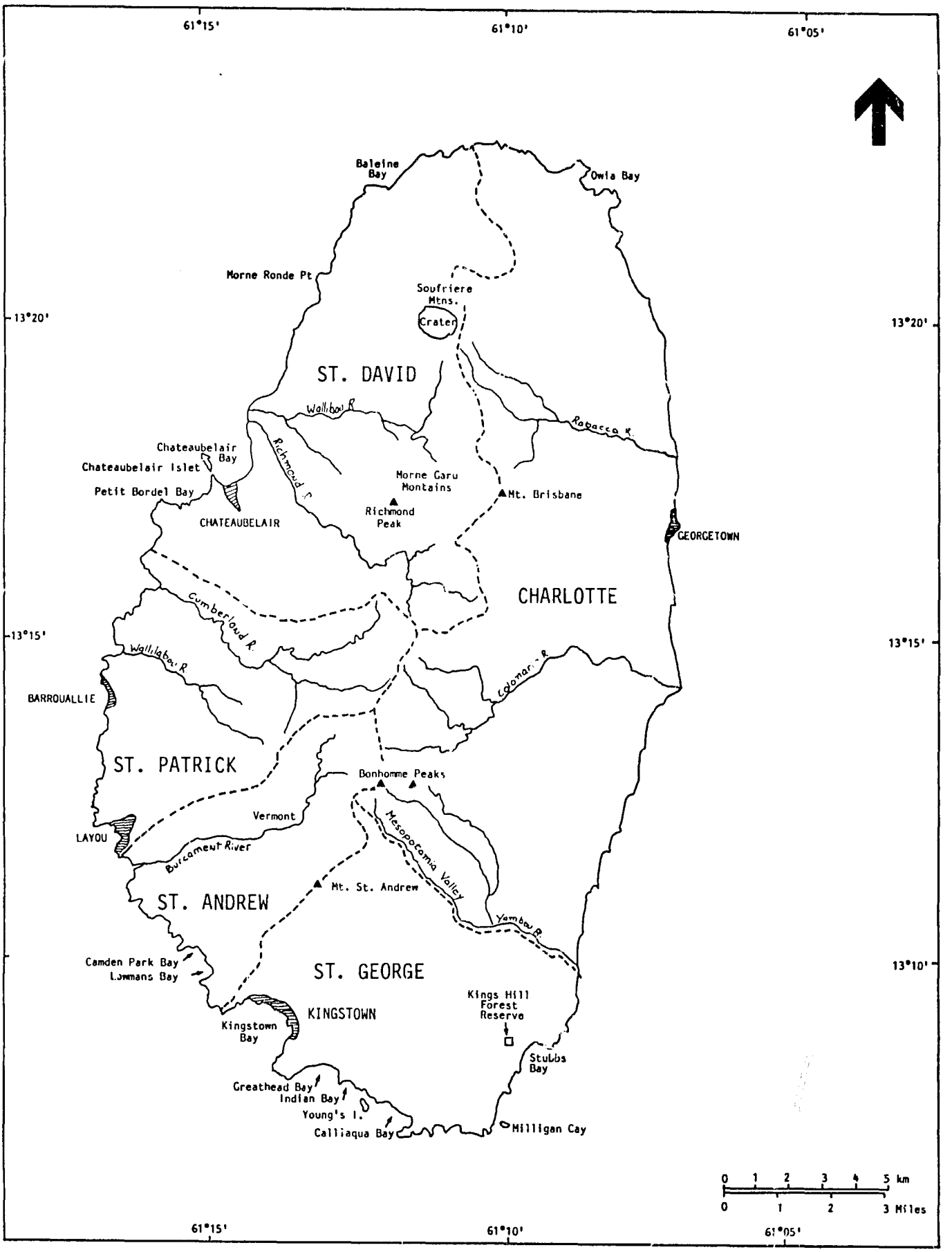


Figure 1.1(2). Location map for the island of St. Vincent.

While warfare dominated the island's development in the eighteenth century, one notable achievement took place far from the battlefield, namely, the establishment of a botanical garden. The oldest such site in the Western Hemisphere, the Botanic Gardens of St. Vincent, was first proposed and established by the military governor of the Windward Islands in 1765. This idea for the establishment of a government-supported botanical garden, similar to the famous Kew Gardens in England for "the cultivation and improvement of many plants now growing wild and the importation of others from similar climates" (Howard, 1954), immediately took hold, and 20 acres of woodland about a mile north of Kingstown were cleared and set aside for an experimental garden. Under the direction of Dr. Alexander Anderson, who was appointed in 1783, the garden flourished and reached its peak of maintenance and inventory, including 1,170 species of commercial and medicinal plants, fruits, valuable woods and ornamentals. Among the most renowned introductions were nutmeg and breadfruit trees from Captain Bligh's voyage to the West Indies following the infamous *Bounty* mutiny. After more than 200 years, the St. Vincent Botanic Gardens are still a place of beauty with many interesting and economically important plants (Birdsey, Weaver, and Nicholls, 1986; Howard, 1954; Howard and Howard, 1983).

St. Vincent's rugged interior and small size made the island less attractive for the development of large-scale, plantation-style agriculture during the decades when sugar cane dominated West Indian landscapes. Smaller estates, reflecting a diversity of agricultural production, were more representative of settlement patterns in the seventeenth and into much of the eighteenth centuries. Sugar did not become the dominant crop until late in the eighteenth century when planters from neighboring sugar islands like Antigua and Barbados began to settle in larger numbers in St. Vincent.

By the end of the nineteenth century, the cane industry was struggling for survival, precipitating the island's early specialization in arrowroot production. The demise of sugar was accelerated by the occurrence of two environmental disasters at the end of the century -- a hurricane in September 1898, followed by a volcanic eruption in May 1902 which killed over 1,500 persons. The dual calamities drove many white planters from the island, effectively reducing enthusiasm for a recapitalized, modernized sugar industry. What followed was an intensified effort by the British Colonial Office to purchase estate lands and redistribute such parcels to black smallholders. Thus began a process which eventually transformed St. Vincent's work force in the twentieth century from a sugar proletariat (like St. Kitts) to a system of landed small farmers characterized by crop diversity, occupational multiplicity and a small-scale subsistence economy (Richardson, 1989; Finisterre and Renard, 1987). In effect, the twin forces of topography and landscape, combined with the consequences of environmental change, helped to shape settlement and land-use patterns in St. Vincent which continue to influence the country's development to the present time.

From 1783 (when St. Vincent was restored to British control by the Treaty of Versailles following four years of French occupation) the island remained under British sovereignty. Constitutional advancements had to wait until the twentieth century when elections for a Legislative Council were first held in 1925 under a limited franchise; universal adult suffrage was not introduced until 1951. In 1969, St. Vincent became a State in Association with Great Britain, with complete internal self-government. A decade later, in October of 1979, St. Vincent and the Grenadines became an independent State within the British Commonwealth.

As the decade of the 1980's drew to a close, the Government of St. Vincent and the Grenadines took significant steps to focus public attention on environmental concerns in the new decade. Government reorganization in 1989 witnessed the creation of a new Ministry of Health and the Environment, and, although the responsibilities of the Ministry relative to the environment have not yet been clearly defined, the potential for centralizing and coordinating Government's environmental mission within the Ministry are encouraging.

ST. VINCENT AND THE GRENADINES

St. Vincent and the Grenadines consists of 32 islands and cays, eight of which are inhabited. Located at the northern end of the archipelago bounded to the south by Grenada, the main island of St. Vincent is 100 miles west of Barbados. Bequia is the largest of the Grenadines. The other inhabited islands are Mustique, Canouan, Mayreau, Union, Prune (Palm) and Petit St. Vincent.

Location
Latitude : 13 degrees 7 minutes/13 degrees 23 minutes North
Longitude: 61 degrees 7 minutes/61 degrees 17 minutes West

Area/St. Vincent 133 square miles (85,120 acres) - 18 miles long and 11 miles wide

Area/Grenadines

Bequia	7 square miles	4,420 acres
Mustique	2 square miles	1,290 acres
Canouan	3 square miles	1,832 acres
Mayreau	1 square mile	640 acres
Union	)	2,070 acres
Prune (Palm)	) 4 square miles	100 acres
Petit St. Vincent	)	96 acres

Total Land Area 150 square miles (95,568 acres)

Population Estimated 113,000 (see Section 1.2); most dense around Kingstown on the southwest coast; large settlements also in Mesopotamia Valley and on the leeward coast in Layou and Barrouallie

Economic Activities/St. Vincent Agriculture, tourism, fisheries, small manufacturing sector
Economic Activities/Grenadines Tourism, fisheries, boat-building

Primary Crops Bananas, coconuts, cocoa
Secondary Crops Root crops, citrus, mangoes

Tourism In St. Vincent: centered around the southwest Kingstown-Indian Bay-Calliaqua area; in the Grenadines: Bequia is a yachting center, Palm Island and Petit St. Vincent are private resorts, and Mustique is a residential tourism center

Ports of Entry St. Vincent: Kingstown, Wallilabou; Grenadines: Port Elizabeth, Bequia and Clifton, Union Island

Airports Principal airport is the E.T. Joshua Airport at Arnos Vale outside Kingstown. Smaller airports at Union, Canouan, and Mustique; an airport is under construction for Bequia at Paget Farm. St. Vincent and the Grenadines does not have an international airport; expansion of the E.T. Joshua facility has been discussed but is not planned at this time.

Physical Features/St. Vincent St. Vincent is of volcanic origin, dominated by a 3,864 foot volcano, La Soufriere, which last erupted in 1979. The interior of the island is mountainous, with sharply dissected ridges and valleys and lush vegetation.

Physical Features/Grenadines Also volcanic, the Grenadines are lower and drier than St. Vincent, with extensive reefs and white coral sand beaches. The Tobago Cays in particular have been noted for exceptional reefs, but these are at risk from pollution.

At approximately the same time, the Prime Minister designated the 1990's as The Decade of the Environment in St. Vincent and established an Environmental Protection Task Force to assist Government in developing an environmental agenda and programs. Equally promising are recent initiatives to revitalize the long-dormant St. Vincent National Trust and to put forward new legislation for the development of a national forest conservation plan and for the establishment of other conservation areas. Indeed, as St. Vincent moves forward in the 1990's, it has begun to exert the kind of environmental leadership which once made it predominant in the region -- as the first Eastern Caribbean island to establish both a botanical garden (1765) and a forest reserve (King's Hill in 1791).

1.2 THE NATURAL ENVIRONMENT

1.2.1 Climate

THE REGIONAL CLIMATE

The normal climate of the oceanic region at the latitude of St. Vincent and the Grenadines is a humid tropical marine type, with little seasonal or diurnal variation and a fairly constant, strong wind out of the east. This regional climate is affected mainly by the subtropical anticyclone belt and the intertropical convergence zone. The location of these two meteorological systems varies in a cyclical pattern, and their movement gives a marked seasonal character to the weather. Rain tends to be showery and is distributed roughly into a drier season from January to May and a wetter season from June to December. There is some risk of hurricanes from June to December.

THE LOCAL CLIMATE

High islands like St. Vincent manufacture their own local weather, creating a range of microclimates which varies greatly with height, location and orientation on any given island. St. Vincent has several mountain masses which cause a marked upward deflection of the 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 summits day after day and is only dissipated in very still or very dry weather.

The Windward Island group of which St. Vincent is a part is located within the belt of "trade winds" famous among seamen for their directional reliability and generally predictable schedule. These winds move westerly along the southern edge of the Atlantic-Azores sub-tropical high pressure zone and approach St. Vincent from directions between east-northeast to east-southeast. Changes in this wind regime are mostly caused by the annual seasonal (vernal and autumnal) shift in the declination of the sun from the equator, with stronger, more northerly winds being common from December to May. Disturbances to this system can be induced by the passage of so-called "easterly waves" in the upper atmosphere and other low pressure systems during the "wet season." St. Vincent and the Grenadines lie just within the hurricane belt and have suffered the impacts of several severe storms in the past.

Typical of small tropical islands, the temperature of St. Vincent at sea level is generally rather high (annual mean of 26.7 degrees C., with a maximum of 31 degrees C.). There is little seasonal, diurnal or locational variation, due to the damping effect of the surrounding ocean. Temperature data for Kingstown on St. Vincent (close to sea level) are displayed in Table 1.2(1). Temperature records for the higher elevations in St. Vincent do not appear to be available; however, the temperature falls with altitude above sea level at a rate of one degree C drop per 100 metres in elevation. This method of estimating upland temperature at a given altitude is very approximate, but it is useful in classifying environmental units and in working out evapotranspiration rates.

Table 1.2(1). Temperatures as recorded at the Department of Agriculture, Kingstown, 1983-1987.

Period		Temperatures (Degrees F)					Mean Relative Humidity
		Mean	Mean Maximum	Mean Minimum	Extreme Maximum	Extreme Minimum	
1983	March	82.6	88.3	72.9	90.0	70.0	72.9
	June	82.4	88.0	75.9	89.0	75.0	72.0
	Sept.	82.7	89.1	75.9	91.0	74.0	73.6
	Dec.	80.9	85.7	71.9	87.0	70.0	72.1
1984	March	80.5	85.4	70.7	87.0	69.0	69.8
	June	83.3	87.6	75.8	89.0	74.0	70.5
	Sept.	82.6	87.5	74.9	90.0	72.0	72.5
	Dec.	80.9	90.4	69.2	91.0	66.0	83.3
1985	March	78.6	83.6	72.8	85.1	71.4	74.2
	June	82.3	86.6	77.0	88.7	70.0	73.9
	Sept.	83.4	87.1	76.7	89.2	72.9	75.8
	Dec.	80.6	84.0	74.3	86.2	71.2	75.1
1986	March	79.2	84.2	73.2	85.6	66.9	72.9
	June	81.1	85.3	76.3	86.4	73.4	78.7
	Sept.	81.9	86.2	76.5	87.8	71.6	79.4
	Dec.	80.1	84.2	74.7	86.2	72.1	77.0
1987	March	81.1	86.4	75.0	87.8	70.0	71.3
	June	82.8	86.9	77.5	89.1	73.8	78.9
	Sept.	83.1	87.3	76.8	89.1	73.6	78.9
	Dec.	81.7	86.0	75.6	88.9	71.6	77.7

Source: GSVG, 1989b.

The extremes of St. Vincent's wet and dry season rainfall regime and its temporal and spatial patterns create wide variations in annual precipitation at different locations. For the island as a whole, the period of lowest rainfall occurs generally in winter, when the so-called Bermuda high pressure cell extends its sphere of influence southward, bringing attention to its arrival by forcing a pronounced shift of the ubiquitous trade winds from the southeast to out of the northeast. These "Christmas winds," as they are known to seamen, also bring clear, relatively dry conditions to St. Vincent from mid-December to early May.

Island-wide average rainfall data are presented in Section 4 (see Table 4.1(1) and Figure 4.1(1) which show the spatial variation in rainfall distribution). St. Vincent's rainfall is highest in the hilly or mountainous part of the country; for example, it is estimated that the highest elevations receive between 260-275 inches of rainfall per year. By contrast, most of the valleys and coastal plains are relatively

dry, with annual precipitation averaging about 70-90 inches.

1.2.2 Geology and Topography

GEOLOGY OVERVIEW

The Antillean arc of islands in the Caribbean is geologically young, probably not exceeding 50 million years, and is predominantly volcanic in origin; St. Vincent is one of the youngest of the major islands. St. Vincent and the associated undersea ridge upon which it is perched are located near the edge of what is known as the Caribbean Tectonic Plate (see Figure 1.2(1)). Tectonic plates are mobile; they behave like rafts of solid crust floating on the less dense "fluid" materials of the underlying mantle layer of the earth. Their movements are apparently related to the convection "currents" in the mantle.

The Caribbean Plate is bounded by the North American Plate to the north and east, the South American Plate to the south and the Cocos Plate to the west and southwest. The North American Plate moves to the west relative to the Caribbean Plate, while the Cocos Plate subducts towards the northeast. There is little relative displacement between the Caribbean and South American Plates at this time in geologic history.

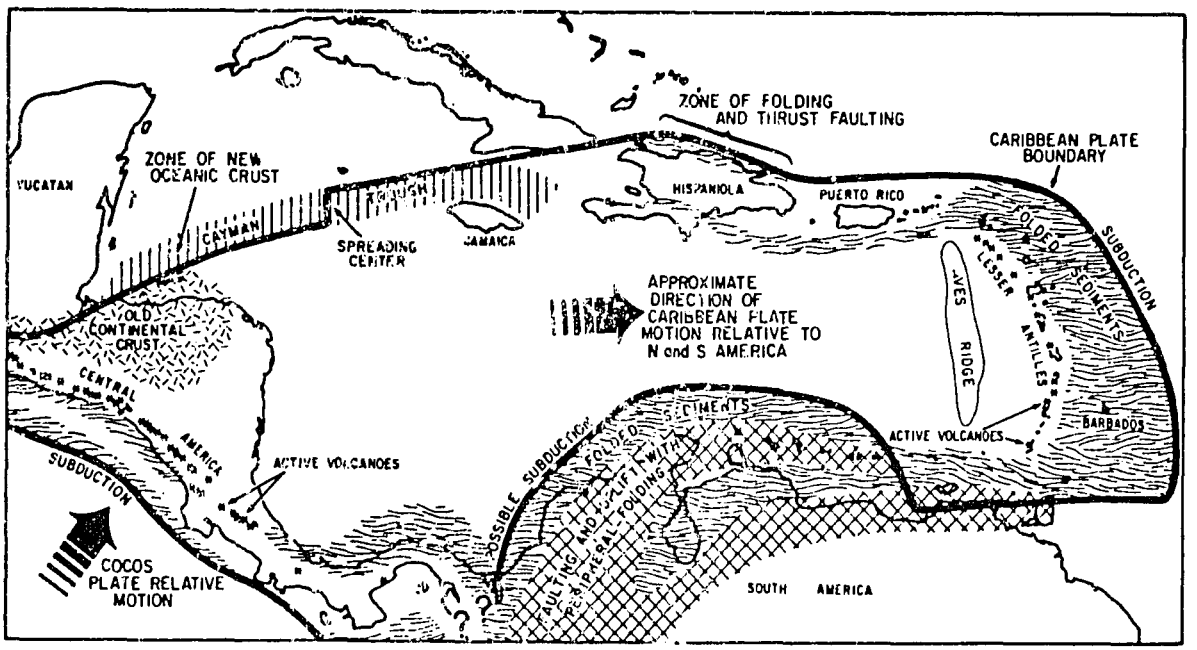
The eastern boundary of the Caribbean Plate is a "subduction zone" in which the North American Plate passes under the Caribbean Plate and into the mantle where melting occurs. The melted plate material forms magmas which, when extruded as lavas by volcanos, have resulted in the formation of the islands of the Antillean Arc. At the present time the active tectonic or mountain forming process has all but ceased in the region, except for Soufriere volcano on St. Vincent and an underwater volcano to the north of Grenada called Kick 'em Jenny. But within the West Indies island arc, eight other sites on as many islands still show signs of volcanic activity -- gas vents, fumaroles, steam vents, one boiling lake, and a few near-surface hot spots that have promising geothermal energy potential.

St. Vincent's Soufriere volcano has erupted frequently during its present period of activity which has been going on for about 700 years; historically recorded eruptions have occurred in 1718, 1812, 1902, 1971 and 1979. While non-explosive lava emissions do occur on occasion (e.g., 1971) most eruptions have been violent and destructive, characterized by ashfalls, mudflows and glowing avalanches of incandescent gas called "nuees ardentes". The lake which formerly occupied the volcano's crater disappeared after the 1979 eruption, and today only a small pond remains inside the volcano.

Kick 'em Jenny is the only known active submarine volcano in the Lesser Antilles, as well as the most active volcano in these islands. Its summit lies at a depth of about 160 m below sea level. The volcano has no connection with nearby Diamond Island, for which the name "Kick 'em Jenny" is given on some charts. Caille Island, just to the south of Ronde Island, is the most recently emerged island in the Lesser Antilles. It is very close to Kick 'em Jenny and was probably formed from a similar submarine volcano only within the last thousand years (Francis, 1988).

The geology of the Grenadines is fairly well known, and many papers have been produced on the volcanic phenomena of Soufriere, but there has been little comprehensive or recent work on the geology of St. Vincent. The island's earliest volcanic eruptions apparently occurred in the Miocene and have continued intermittently. Reconnaissance-level studies have produced a map of surficial geology (Figure 1.2(2)), which indicates that St. Vincent is composed entirely of volcanic ejecta (mainly pyroclastics) ranging in age from Pleistocene to Recent (Talbot, 1983).

The structure of St. Vincent is made up of a central north-south chain of mountains and a coastal plain of varying width. The rugged central mountain chain seems to be the eroded remnants of a series of volcanos, with the oldest extinct remnants found in the south. All of these extinct volcanos are from



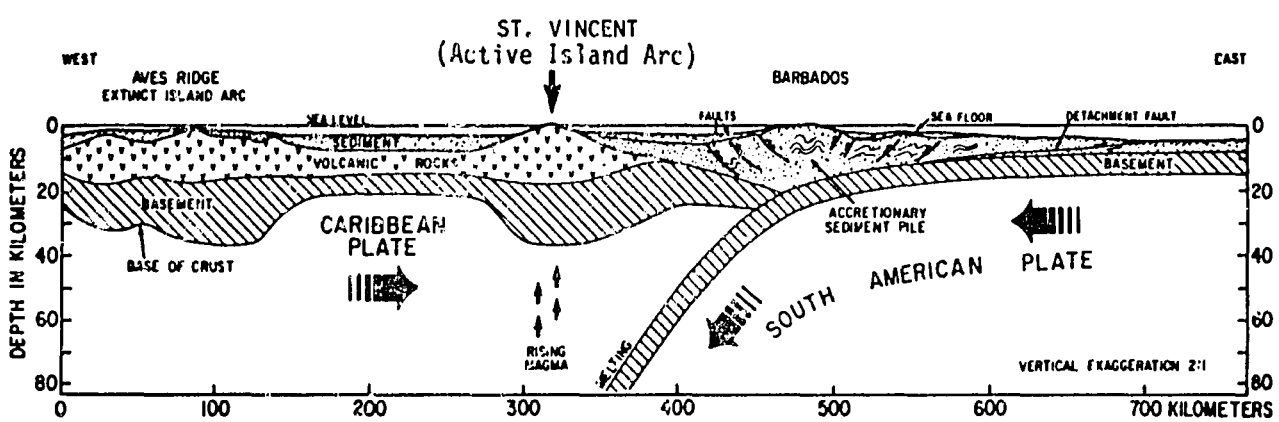


Figure 1.2(1) Above: Geological features of the active boundary zone of the Caribbean Plate (source: Dillon, *et al.*, 1987).

Below: The eastern margin of the Caribbean Plate at the location of Barbados and St. Vincent. Cross section showing the Caribbean Plate being underthrust by the South American Plate. Figure adapted from Dillon, *et al.*, 1987.

two to five million years in age. Soufriere is much more recent, probably being built up within the last half-million years, with major activity occurring only a few thousand years ago when massive eruptions showered the entire island with andesitic ash and rock (UNESCO, 1982).

Geologically older than St. Vincent, the Grenadines islands have had a more complex geological history and have more varied rock types of both volcanic and sedimentary origin. The Grenadine Islands formed in the late Oligocene Period, sank or eroded away during the Pliocene and were completely submerged during the Pleistocene Period. Since that time a regional uplifting of the sea floor has raised the islands above sea level.

TOPOGRAPHY (Figure 1.2(3))

The interior of St. Vincent is very rugged; 50 percent of the island's total surface has slopes of 30 degrees or more, and only 20 percent has slopes less than 20 degrees (Barker, 1981). Mt. Soufriere (3,864 ft.) dominates the northern end of the island and is separated from the Morne Garu Mountains and the rest of the central mountain massif by a deep trough. Two rivers flow in this trough; the Wallibou River to the west and the Rabacca River to the east. Richmond Peak (3,533 ft.) and Mt. Brisbane (3,058 ft.) are the two highest peaks in the Morne Garu range. The major peaks in the remainder of the central mountains from north to south are: Grand Bonhomme (3,181 ft.), Petit Bonhomme (2,481 ft.), and Mt. St. Andrew (2,413 ft.). Numerous sharp lateral ridges radiate from these steep highlands of the central range. Deep-cut valleys and high vertical coastal cliffs characterize the leeward side of the island, while on the windward coast the valleys tend to be wider and flatter, opening onto a fairly flat coastal plain.

1.2.3 Soils

SOILS OVERVIEW

Soils can be classified in many different ways. Some classifications in common use are based on: (a) geology of the parent rocks; (b) climate and vegetation; (c) measurements of the actual physical and chemical characteristics of the soil; (d) color, physical appearance, and stratification of the soil profile as observed in the field; and (e) texture. The classification scheme which has been most used in St. Vincent and the Grenadines is based largely on a combination of the last two methods.

The soils of St. Vincent have been studied and mapped by Hardy, *et al.* (1934), Hardy (1939), and Watson, *et al.* (1958). They are derived mainly from volcanic ash and rock fragments, and most are relatively young and immature. Three major soil groups are usually recognized -- recent volcanic ash soils, yellow earth soils, and alluvial soils of the coastal plain and valleys. For the present report the grouping shown in Figure 1.2(4) is most convenient (Llewellyn-Davies, 1972; based on Hardy, *et al.*, 1934):

- *Recent volcanic ash soils.* Unconsolidated, immature, coarse-textured, and porous soils with generally good potential fertility. They cover roughly the northern third of the island, especially the slopes of the Soufriere volcano, and are highly vulnerable to erosion.

- *High-level yellow earth soils.* Mainly found above the 600-foot contour, these are "zonal" soils with impeded drainage. They are deeply weathered, leached and highly acid due to their occurrence in high rainfall areas.

- *Low-level yellow earth/brown earth soils.* Mainly found below the 600-foot level, these are "intrazonal" soils, less leached

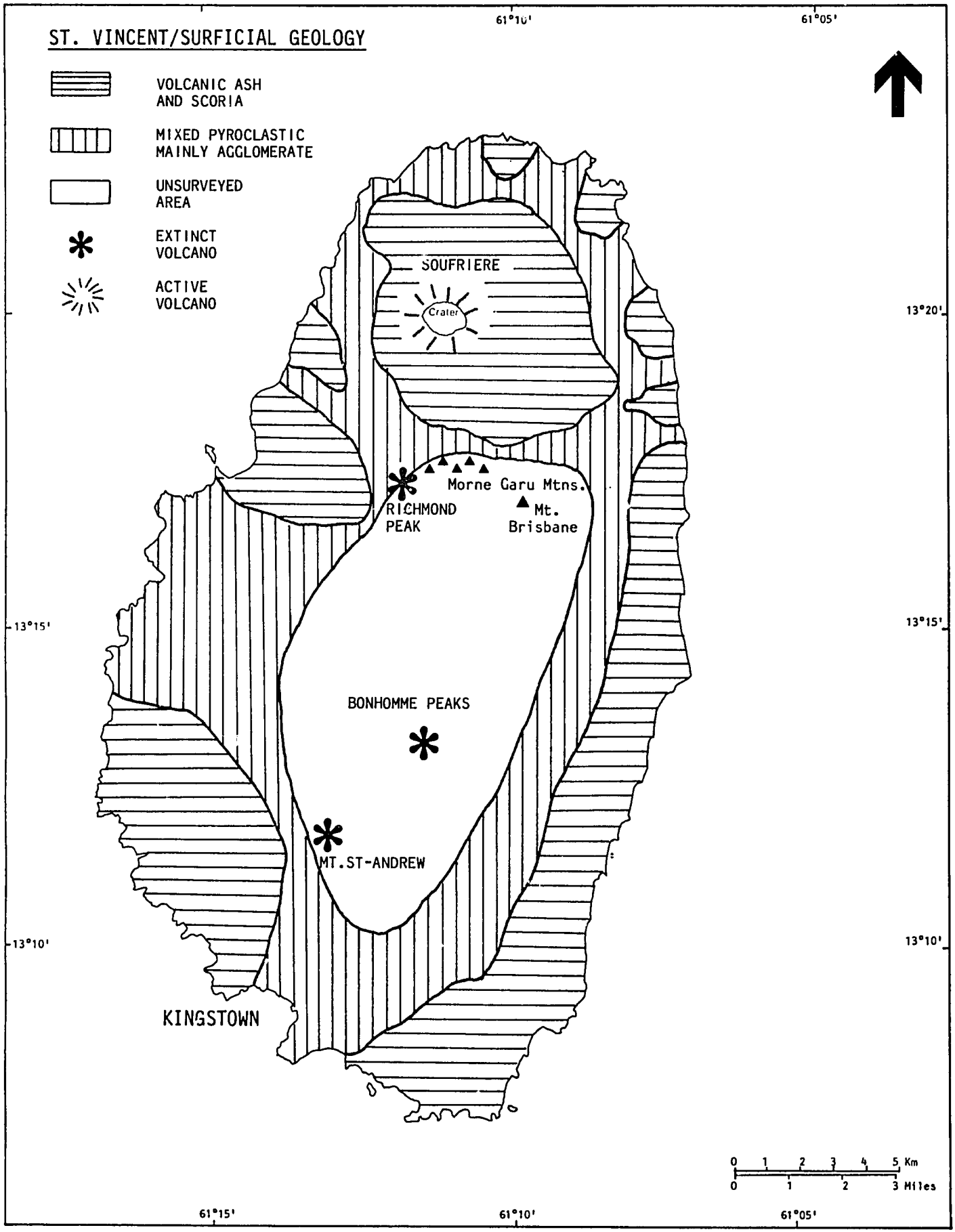


Figure 1.2(2). Surficial geology of St. Vincent (source: adapted from Talbot, 1983).

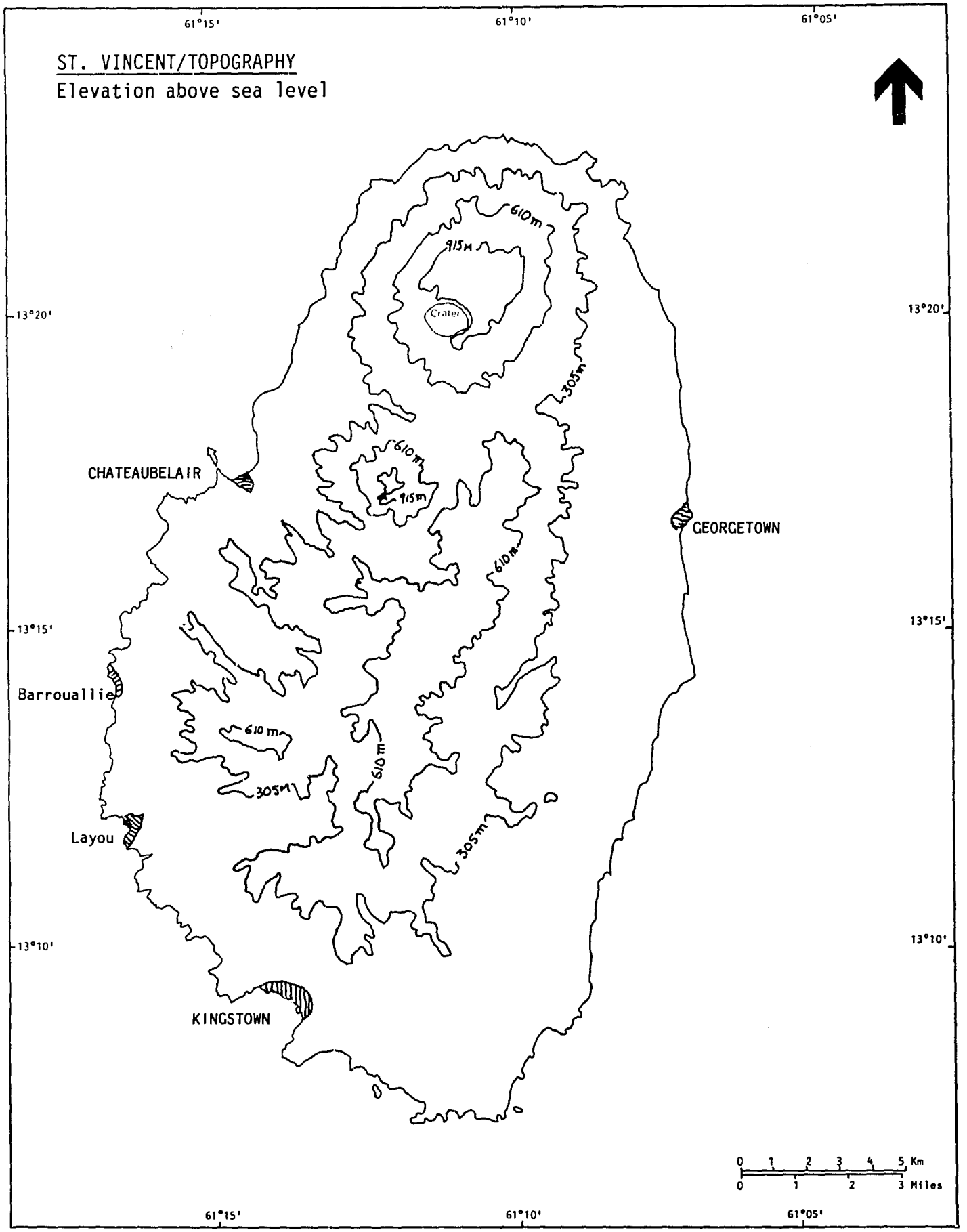


Figure 1.2(3). Topography of St. Vincent (source: Birdsey, *et al.*, 1986).

TERMS USED IN SOIL CLASSIFICATION

Various terms are frequently encountered in descriptions of St. Vincent's soils.

Texture refers to the relative amounts of different-sized soil particles (i.e., sand, silt and clay) present. Clay soils have a predominance of very fine particles (> 40 percent), sand soils have a predominance of sand-sized particles (> 80 percent) and loam soils are in between. These classes can be subdivided further to cover intermediate soil compositions, e.g., sandy loams or clay loams. Sandy soils are sometimes called "light" and clay soils are called "heavy" -- these terms refer not to weight but to the ease of working the soil.

Shoal is a term used to describe a special type of soil found in the relatively dry areas of all volcanic islands. Actually "shoal" is a kind of parent rock which is made up of cemented volcanic lava material; the cementation process is thought to have taken place under water during a period of submergence. Shoal clay soils are fine-textured, dark brown to grey, and have a poor physical structure. In the dry season they shrink and develop large cracks; in the wet season they become very plastic and sticky.

Alluvial soils are derived from river-transported sediments; *colluvial soils* are derived from materials brought down from neighboring hillsides by gravity.

Latosols are a very broad grouping that includes most of the red, yellow and brown soils of the Caribbean region. These are generally mature soils of moist or wet areas with free or only slightly impeded drainage. They vary from slightly acid to acid in reaction and are usually leached of bases.

Lithosols are very shallow, rocky soils found in steep, hilly areas with stony, rocky or shaly parent materials.

and more freely drained. The brown earths are transported soils which are generally more fertile, and occur on gentler slopes.

- *Alluvial soils*. These mature soils occupy only about three square miles of valley bottoms mainly in the south-west of St. Vincent. They are the most fertile and productive soils on the island.

- *Shoal soils*. These occur in coastal areas in the south and west of the island. They are mature soils, sticky when wet and hard and cracked when dry, are of medium fertility and are difficult to cultivate.

- *Central mountain soils*. Generally shallow soils occurring in high rainfall areas over about twenty percent of the island of St. Vincent. Most of these soils are under forest, have a high organic matter content near the surface, and are highly leached and acidic. Because of the steep slopes and high rainfall these are the soils with the most serious erosion potential; their cultivation should not be considered.

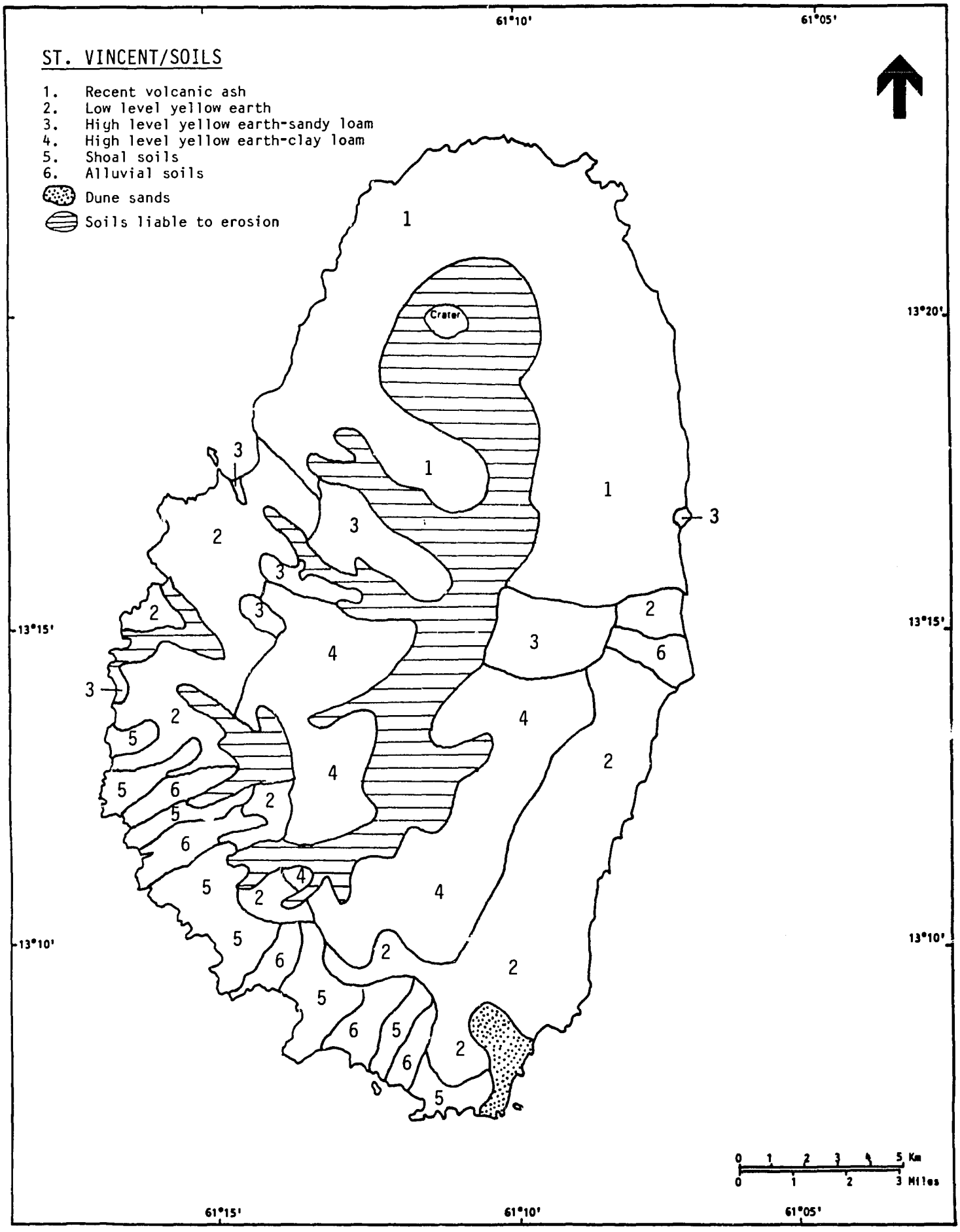


Figure 1.2(4). Major soil types in St. Vincent. (source: Llewellyn-Davies, 1972, based on Hardy, *et al.*, 1934).

RESPONSE OF SOILS TO HUMAN DISTURBANCE

The soils of St. Vincent are in general readily erodible, since they tend to be unconsolidated and friable; where cementation of the subsoil occurs it is only incipient and the cemented layers readily decompose when exposed at the surface. The risk of erosion depends on many factors, including: the type and properties of the soil; the intensity, duration and amount of rainfall; the slope of the land; the extent and nature of the vegetation; and the agricultural or silvicultural practices used.

On steep slopes denuded of their tree cover by clearing, the soil surface is directly exposed to the erosive force of rain and soil erosion is greatly accelerated. Alterations in the pathways and rates of water flow due to clearing of vegetation can cause changes in the timing of peak flows and greater flood discharges downstream. Erosion transports soil downslope and causes the loss of plant nutrients from the uplands. When topsoil is lost,

Table 1.2(2). Mature or "climax" vegetational formations in the Lesser Antilles.

OPTIMAL FORMATION (essentially no dry season, well-drained soils):
- Lowland Rainforest

SEASONAL FORMATION-SERIES (wet seasons alternating with dry seasons, well-drained soils):
- Evergreen Seasonal Forest
- Semi-evergreen Seasonal Forest
- Deciduous Seasonal Forest
- Thorn Woodland
- Cactus Scrub

MONTANE FORMATION-SERIES (mountain climates and soils):
- Lower Montane Rainforest
- Montane Thicket (Elfin Woodland is a subtype due to wind and soil conditions)

DRY EVERGREEN (INCLUDING LITTORAL) FORMATION-SERIES (constant effective drought regardless of actual rainfall, due to wind and/or excessively drained soils):
- Dry Evergreen Rainforest
- Dry Evergreen Forest
- Dry Evergreen Woodland
- Dry Evergreen Thicket
- Dry Evergreen Bushland/Rock Pavement Vegetation/Cactus Scrub

SWAMP FORMATION-SERIES (constantly or frequently flooded areas with trees):
- Freshwater Swamp
- Mangrove Swamp

MARSH FORMATION-SERIES (constantly or frequently flooded areas with herbaceous vegetation):
- Freshwater Marsh

Sources: Adapted from Beard, 1944, 1949, 1955; Teytaud, 1988.

the formation of replacement soils is an extremely slow process; it may take hundreds of years just to form one inch of top soil.

When trees are clear-cut, there is a permanent loss of nutrients from the soil if the felled vegetation is removed as in logging, and an even greater loss if the slash is burned. If the area is replanted in crops or timber plantations, plant diversity is sharply reduced. If herbicides are used to keep planted areas free from weeds, the soil is then much more exposed than it would be under natural conditions, and erosion is thereby increased.

1.2.4 Vegetation

VEGETATION CLASSIFICATION: BEARD'S SYSTEM

In 1942 the British Treasury in London provided funds under a Colonial Development and Welfare plan for a forest resource assessment in the Windward and Leeward island group. The assessment was carried out by J.S. Beard, then of the Colonial Forest Service in Trinidad and Tobago. When Beard started his decade of work in the Lesser Antilles, he found that the systems of vegetation classification then in use lacked any real ecological basis. He therefore proposed a new classification of vegetation (Beard, 1944) which led to publication of his classic monograph, *The Natural Vegetation of the Windward and Leeward Islands* in 1949. This is still widely used as a basic reference, over forty years later.

Beard defined his climax natural vegetation types ("formations") on the basis of physiognomy, structure and life-form and arranged them in several "formation-series" along environmental gradients. Each formation was then subdivided into communities ("associations") on the basis of floristic composition. Lowland Rain Forest was held to be the "optimum" expression of vegetational development; the various formation-series represented deviations from the optimum formation along axes of increasing severity of drought (seasonal formations), increasingly poor soil conditions (edaphic formations), and so on (see Table 1.2(2)).

ECOSYSTEM CLASSIFICATION: HOLDRIDGE'S LIFE ZONES

A complementary system to Beard's classification of vegetation is the Holdridge scheme of bio-geoclimatic "life zones" (Holdridge, 1967, Holdridge, *et al.*, 1971; Holdridge and Tosi, 1972). This system uses a nomogram which identifies the major bio-climatic zones of the world based on "bio-temperature," potential evapotranspiration and total precipitation. Use of the Holdridge system allows one to place local ecosystems in a worldwide classification framework so that comparisons may be made with other areas.

Life zone maps are useful for environmental management in places where the natural vegetation has been severely disturbed, since they are based on the measured or inferred spatial distribution of physical climatic factors. Conversely, observation of existing mature natural vegetation can be used to predict broad environmental conditions and the response of an ecosystem to human manipulation where site-specific climatic data are not available. A map displaying the Holdridge life zones has never been prepared for St. Vincent and the Grenadines. However, the life zone map of St. Lucia produced by the OAS (1984) gives a good indication of the zones that are likely to be present in this country (Table 1.2(3)).

NATURAL VEGETATION IN ST. VINCENT AND THE GRENADINES

The classic description of the vegetation of the Windward and Leeward Islands, including St. Vincent and the Grenadines, was given by Beard in 1949; Howard (1952) described the vegetation of the Grenadines. Beard characterized the existing vegetation during the 1940's as primarily resulting from man's use of the land during historical times; only in certain small areas was the vegetation relatively unmodified from its natural state. Beard provided a small-scale sketch map (Figure 1.2(5)) showing the major areas of

Table 1.2(3). Lesser Antillean life zones (Holdridge's terminology), showing rough correspondence with Beard's formations.

HOLDRIDGE'S LIFE ZONES	BEARD'S CLIMATIC CLIMAX FORMATIONS
Tropical dry forest, transition to tropical very dry forest	Thorn Woodland
Tropical dry forest	Thorn Woodland or Deciduous Seasonal Forest (depending on length of drought)
Tropical moist forest	Semi-Evergreen or Evergreen Seasonal Forest or Rain Forest (depending on length of drought)
Subtropical moist forest	Semi-Evergreen or Evergreen Seasonal Forest or Rain Forest (depending on length of drought)
Subtropical wet forest,	Lower Montane Rain Forest
Subtropical wet forest, transition to subtropical rain forest	Montane Thicket or Elfin Woodland
Subtropical rain forest	Montane Thicket or Elfin Woodland

Sources: Adapted from OAS, Life Zones Map for St. Lucia (1984); Beard, 1944, 1949, 1955; Teytaud, 1988.

natural vegetation remaining in St. Vincent at the time of his survey, but he gave no estimates of coverage by any of the types.

For comparison, the theoretical distribution of potential natural vegetation, based only on environmental factors, is shown on a map (Figure 1.2(6)) constructed by Watson, *et al.* (1958). On this map, the vegetational belts mirror the climatic belts, and this results in a nearly concentric zonation of vegetation types due to the increase of rainfall with altitude above sea level. However, the northern end of the island is shown as covered by Secondary Forest because of frequent disturbance due to the intermittent eruptions of Mt. Soufriere; subsequent plant succession on such young volcanic soils is a slow process.

Beard (1949) provided some comments on the occurrence and distribution of the natural vegetation types he found in St. Vincent and the Grenadines; this material is summarized below.

Rain Forest. This formation in Beard's time occupied only small areas in the Colonarie, Cumberland, and Buccament Valleys, mainly between elevations of 1,000 to 1,600 feet. There was no Lower Montane Rain Forest in St. Vincent. There were probably never many good stands of heavy forest because the slopes of the central mountains are so steep and loose as to preclude its development there. Where the slopes were gentler the forest had already been cut down.

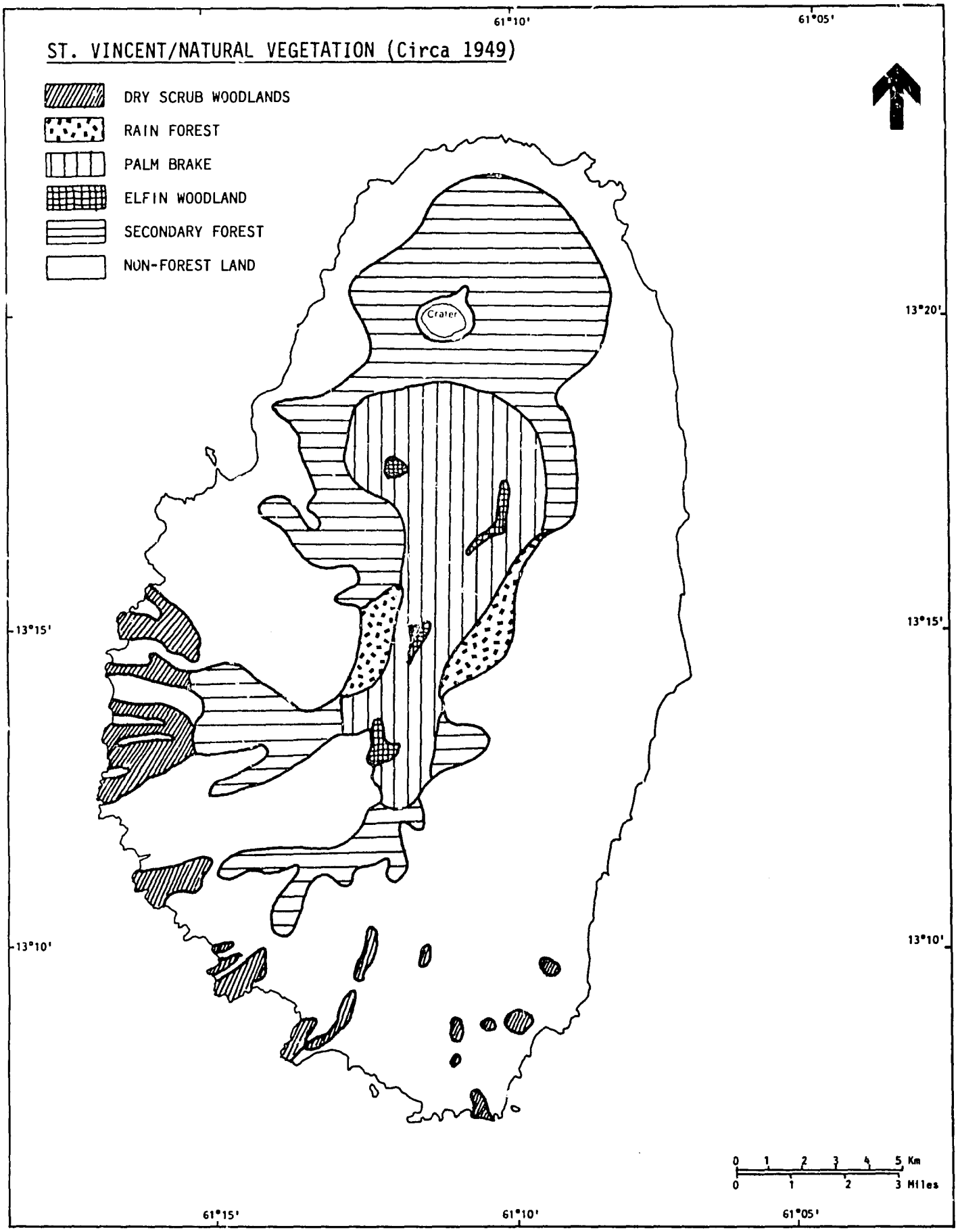


Figure 1.2(5). Natural vegetation in St. Vincent, circa 1949 (source: Prins, 1986, from Beard, 1949).

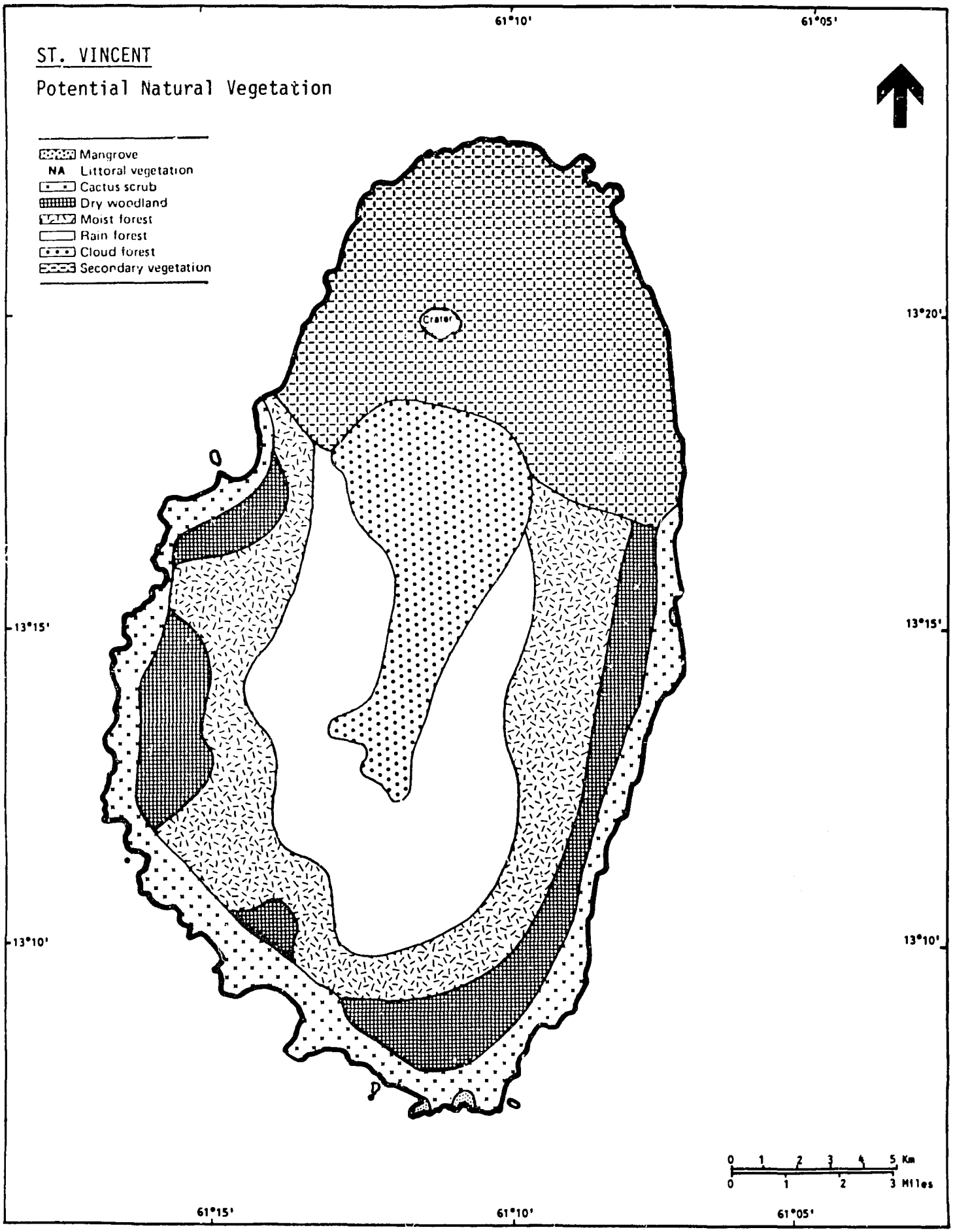


Figure 1.2(6) Potential natural vegetation in St. Vincent, based on environmental factors (source: ECNAMP, 1980a, based on Watson, *et al.*, 1958).

Secondary Rain Forest. This term was applied to a broad spectrum of forests disturbed either by natural occurrences such as volcanic eruptions and hurricanes, or by human activities. On Soufriere Mountain, the plant communities that would normally become established in the absence of disturbance range from Rain Forest at the lowest elevations to Elfin Woodland at the summit (Birdsey, *et al.*, 1986). In actuality, due to disturbance from the recurrent eruptions of the volcano, there is a suite of secondary plant communities ranging from almost bare soil at the summit to fairly advanced stages of succession at lower elevations.

Montane Thicket. This formation did not occur in St. Vincent.

Palm Brake. The Palm Brake was evidently a sub-climax type, due to disturbances such as landslides or storms, but it covers large areas in the central mountains above 1,640 feet. Sites where landslides had recently occurred were covered with moss which appeared to stabilize the soil, the next stage being a thicket of small tree ferns or balisier. Other less recent landslides were colonized by Mountain Cabbage, forming a patch of Palm Brake.

Elfin Woodland. At the exposed summits above 1,640 feet on both sides of the central mountains pure stands of Elfin Woodland were found, a gnarled, mossy, repressed growth of trees about 10 feet in height. Most Elfin Woodland vegetation was covered with moss epiphytes and climbers. These areas of Elfin Woodland were set in a matrix of Palm Brake.

Evergreen and Semi-evergreen Seasonal Forest. Beard (1949) does not mention this formation, probably because these moist forest types had been extirpated by the time of his study.

Deciduous Seasonal Forest/Cactus Scrub. On St. Vincent some uncultivable slopes near the coastlines were covered with a degraded dry scrub woodland; cactus scrub and bush (not mentioned by Beard) probably occupied the driest coastal sites. These formations probably formed most of the original tree cover in the dry-climate Grenadine islands.

Littoral Woodland. Very little remained of the dry evergreen Littoral Woodland formation in St. Vincent and the Grenadines. Consisting of seagrape, button mangrove, manchineel, and other typical species, it presumably occupied a thin strip along the coastlines in former times.

Swamp. There were some small mangrove swamps, chiefly in the southern part of St. Vincent and in the Grenadines. These contained the usual red mangrove, black mangrove, white mangrove, and button mangrove. *Pterocarpus* freshwater swamp does not occur in St. Vincent and the Grenadines.

1.2.5 Natural Hazards

The Caribbean -- one of the most disaster-prone areas of the world -- is exposed to hurricanes and their associated storm surges and wave action, earthquakes and earthquake-generated ocean waves (tsunamis), volcanic eruptions, landslides and rockslides, flooding and droughts. Natural hazards, as the term is used here, include all these occasional short-term natural phenomena which have the potential for negative impacts on the physical, economic and social environment of an area (man-made and technological disasters will not be considered in this section). The islands of the Eastern Caribbean are particularly vulnerable to natural hazards because of their small size and their dependence on foreign revenues earned from agriculture and tourism. St. Vincent and the Grenadines has suffered a number of such occurrences and is well acquainted with the effects of all types of natural disasters.

VOLCANIC ACTIVITY

As mentioned in Section 1.2.2 above, the Soufriere volcano on the northern end of St. Vincent has erupted explosively many times in the nation's history. In the 1902 eruptions 1,565 people were killed by a glowing avalanche which swept down the slopes of

the volcano, and explosions continued for some ten months after the initial outbursts. In the 1979 eruptions, although there were no fatalities, there was extensive loss of crops, livestock and property; over 14,000 persons were evacuated from the northern half of the island.

A submarine volcano, called "Kick 'em Jenny", located 160 meters below sea level about seven kilometers north of Grenada, is one of the most active volcanos in the Lesser Antilles. It has erupted at least nine times this century, and some scientists believe it may emerge above sea level during its next major eruption. The last eruption occurred in early 1990. Seismic activity in the area is being monitored by scientists in Trinidad.

EARTHQUAKES AND TSUNAMIS

The location of St. Vincent and the Grenadines near the Caribbean Plate margin makes the islands vulnerable to considerable seismic activity. In addition, earthquakes are frequently produced on St. Vincent proper by the volcanic activity of Soufriere. No major faults or folds have been reported by previous geological investigations of St. Vincent, which suggests that no major tectonic disturbances, other than the volcanic ones, have occurred on the island.

Seismic activity at Mt. Soufriere is monitored by a network of sensors located at Wallibou, Owia, Belmont, Fort Charlotte, and the summit of the volcano. These stations transmit measurements directly to the seismic laboratories of the Seismic Research Unit in Trinidad, where all data processing and interpretation is done. GSVG also maintains a small Soufriere Monitoring Unit within the Department of Agriculture to keep watch on the level of volcanic activity. The Unit has recently prepared a draft Volcanic Emergency Plan (Robertson, 1989a, 1989b).

Seismic activity caused by plate movements, faulting, and volcanic eruptions has the potential to generate seismic sea waves, or tsunamis, which can be very destructive to coastal areas in the region. Given the proximity of the Kick 'em Jenny underwater volcano, tsunamis pose a particular threat to the Grenadine islands and the southern coast of St. Vincent.

HURRICANES AND OTHER STORMS

Tropical storms and hurricanes are prevalent in the Eastern Caribbean during the June through October hurricane season. The earliest recorded hurricane in St. Vincent and the Grenadines occurred in 1780 and the most recent (Hurricane Allen) in 1980; other tropical storms and hurricanes have struck the islands in 1819, 1830, 1886, 1897, 1898, 1921 and 1967 (Birdsey, *et al.*, 1986). Hurricane Allen caused extensive damage to beaches, agriculture, housing and general infrastructure, including the then new deepwater port in Kingstown. Significant damage has also been done by tropical storms such as those which occurred in 1983 and 1986.

Although high winds are the most distinctive feature of hurricanes, usually the most damaging winds affect a very small radius (as small as 20 miles) of the entire storm system. On the other hand, torrential rains can be experienced from one edge to the other of a 300 mile diameter storm, and ten inch rains from well-developed tropical storms are not unusual. Therefore, unless a storm has very strong winds and the center passes directly over an island, much of the damage will be from the direct and indirect effects of flooding. In order of decreasing impact, the major causes of damage from most hurricanes can be ranked as follows: flooding from rainfall, coastal flooding and damage from storm waves, landslides, and -- lastly -- winds.

Floods may cause property damage, severe erosion and even the loss of life during natural events such as rainstorms and hurricanes. Floods can be the result of downslope rainwater run-off, especially over paved or deforested areas, and/or seawater driven inland by above-normal tides and surges. Additionally, storm surges caused by reduced atmospheric pressure during hurricanes can be augmented by wind-driven waves, swells, and spray.

The extent of the problem associated with inland flooding in a particular area is dependent on the amount of rainfall, the slope of the land, the porosity of the soils, and the size and shape of the river basin through which the water will eventually flow. Damages from inland flooding include: water damage to normally dry property; physical damages from the force of the waters and associated mud, silts and rocks; biochemical and physiological damage due to the introduction of large volumes of freshwater to the nearshore marine ecosystems; and destruction of sea life from overloading with silt and nutrients washed from the land.

LANDSLIDES AND ROCKSLIDES

Because of its steep topography and the common occurrence of unconsolidated pyroclastic rocks, slope instability leading to landslides and slumping is a major problem in St. Vincent (Talbot, 1983), and unstable slopes tend to be the rule rather than the exception. It can be expected that many roads would be significantly impacted by landslides during heavy rainfall and storms.

Generally, landslides are localized events and depend on the type of soil, the angle of repose and the steepness of the slope at the site. Landslides occur when the forces of gravity exceed the strength of the forces holding soil material together, resulting in a mass of soil being pulled downward. A secondary effect of flooding on steep slopes covered with clay-rich soils is the increased tendency for landslides to occur. Water in soils contributes to increased landslide risk because the weight of the water is an added stress on the soil mass that is also being lubricated by the water molecules.

TRENDS AFFECTING FUTURE RISKS FROM NATURAL HAZARDS

The continuing urbanization of existing towns and villages, as well as the development of new communities -- all of which require modifications to the natural landscape -- could easily increase the risk of damage from natural hazards such as flooding and landslides. Such modifications may include:

- the construction of higher density, high-cost structures (like hotels and condominiums) closer to the shoreline or in flood plains;
- removal of mangrove trees along the shore which buffer sea wave and wind energy as well as help to maintain balanced nutrient levels in adjacent waters by absorbing nutrients in run-off;
- filling of salt ponds and swamps which absorb energy and sediments of out-flowing surface waters as well as buffer incoming storm surges and waves;
- offshore dredging to eliminate sandbars and shallows which normally absorb sea wave energy and prevent inland damage;
- deforestation of inland watersheds, including loss of ground cover such as decayed leaves or understory vegetation and the decomposition of subterranean root systems of former plants;
- road building and paving.

Population growth and increased emphasis on tourism will promote growth of the major towns of SVG which are all located in the coastal areas of the country. Problems associated with high population densities, insufficient community planning, and inadequate infrastructural support have been identified and linked to potential environmental impacts resulting from specific natural hazards.

Enlarged populations in towns would place more people at risk from both inland and coastal flooding. Steep slopes and river banks which have been denuded of trees promote rapid rain run-off, causing an increased risk of flooding and facilitating the occurrence of landslides. Additionally, deforestation to accommodate agriculture and development

increases the silt load carried by surface run-off into rivers and streams and out to sea.

Construction and waste disposal practices of human settlements along the banks of the major rivers of St. Vincent have produced blockages of the river channels, increasing flood risk and damages in these areas. Blockages result from poorly situated roads and levees; undersized bridges, culverts, and drains; and trash dumped in river channels.

The continuing removal of sand from the beaches and dunes of St. Vincent and the Grenadines for construction purposes has significantly reduced the country's sand buffers to storm waves and tides, thereby increasing their destructive impacts on the shoreline. The problems with sand mining are localized, but severe enough to warrant serious attention. Beach sand mining and its negative environmental implications are likely to continue, unless alternative sources of fine aggregate are made available at affordable prices and, simultaneously, the Beach Protection Law is enforced.

1.2.6 Local Implications of Global Environmental Change

It is becoming increasingly obvious that multiple feedback interactions are taking place between human activities and the state of the environment everywhere (Clark, W., 1989). For example, there is growing concern that human-induced changes in concentrations of carbon dioxide and other so-called "greenhouse gases" can cause significant warming of the atmosphere, with consequent climatic changes. Resulting changes in temperature and precipitation distribution could threaten natural ecosystems as well as agricultural production and could trigger a worldwide rise in sea level.

Such changes would pose particularly severe challenges for developing nations like St. Vincent and the Grenadines. In the Caribbean region, critical ecosystems such as coral reefs and mangrove swamps would be seriously damaged if the sea level rises so fast they cannot compensate. Global warming would increase sea-surface water temperatures, and may cause changes in the strength, frequency and paths of hurricanes and an extension of the hurricane season. Beaches vital to the tourism industry, such as St. Vincent's already eroding south coast beaches, are also at risk.

Some studies suggest that the sea level rise due only to climatic effects will be on the order of 2-3 cm per decade in the Caribbean region (Maul, 1988), but others indicate that it may be larger and not necessarily linear. This may seem like a trivial change, but one rule of thumb states that a one centimeter sea level rise will generally result in a one meter shoreline retreat (Gable, 1987/1988). At a conservative rate of 2-3 centimeters rise per decade, within the next 40 years St. Vincent and the Grenadines could therefore expect to lose some 8-12 meters (26-40 feet) of beach width in areas where sea level change is due solely to climate.

At this time many if not most experts believe that some global warming will occur, but there is a great deal of uncertainty about the rate and magnitude of warming and its effects on sea level. In the face of such uncertainty, most experts recommend that governments should adopt a flexible, adaptive strategy for coping with the expected effects of climate changes. This is easiest to implement in planning for the construction or renovation of infrastructure such as roads, buildings, and coastal facilities.

In the case of older infrastructure (which would have to be replaced in any event), the best and cheapest response may be to do nothing and accept the loss of the structures, provided that they can be rebuilt in an alternative location. Where existing, economically vital infrastructure is threatened and no alternative location exists, such as certain sections of the coastal road and some coastal villages, an immediate defensive response would be justified provided it is cost-effective and environmentally sound.

In other cases, especially where infrastructure has not yet been built, measures to adapt to the warming trend should be taken

only if such steps have good prospects of yielding benefits even without a climate change. If the predicted climate changes do occur, then the measures taken, of course, will yield a much greater benefit.

1.3 SOCIO-ECONOMIC CONTEXT

1.3.1 Demographics: Trends In Population Size, Distribution and Density

POPULATION CHARACTERISTICS

St. Vincent's first census in 1844 recorded a national population of 27,248. Beginning in 1851, St. Vincent held censuses every ten years until 1931, except for the decade beginning in 1901 (see Figure 1.3(1) and Table 1.3(1)). These statistics enable the reader to examine changes in SVG population data over five specific periods of time (see also Bouvier, 1984 and CARICOM, 1987).

(1) **1844-1881.** This was a period of relatively rapid population growth; in 1881 total population was 40,548, representing an average increase of about 1.1 percent per year. After emancipation, large numbers of former slaves chose to emigrate almost as soon as they gained freedom. In order to offset the labor shortage created by this wave of emigration, between 1841 and 1882 over 6,000 free and indentured workers were brought to the Colony -- other West Africans, Portuguese, East Indians, and poor whites from Barbados (Rubenstein, 1987). Birth rates for this period were high, about 46 per thousand; death rates were also high, at 24 per thousand.

(2) **1881-1911.** Population growth during this time was negligible, remaining between 41,000 and 44,000 because of heavy emigration. Population loss also occurred because of the closely-spaced disasters of 1898 (hurricane) and 1902 (volcanic eruption). The 1898 hurricane resulted in the death of an estimated 300 persons, while 2,000 lost their lives in the 1902 eruption of La Soufriere volcano.(Bouvier, 1984). Furthermore, many Vincentian laborers were attracted to Panama to work on the French attempt to build a canal (Rubenstein, 1987). Birth rates declined somewhat to 39 per thousand.

(3) **1911-1931.** These years marked the beginning of a trend of steady population growth. Population increased from 41,877 in 1911 to 47,961 in 1931. This growth was fueled by a decline in the death rate to 16 per thousand, while birth rates remained high; at the same time, emigration decreased from a rate of 94 percent of the natural increase over the previous thirty years to a rate of 62 percent of the increase (CARICOM, 1987). However, one source (Bouvier, 1984) differs somewhat with these figures, stating that death rates in 1920-25 were 19.3 and that net migration was "particularly high, between 1921 and 1931, about 570 persons per year".

(4) **1931-1960.** Very rapid growth was the hallmark of this period, with the total population going from 47,961 in 1931 to 79,948 in 1960. The birth rate increased over these years from 38.7 per thousand in 1946 to 49.4 in 1960. The 1960 rate is one of the highest ever recorded in the Eastern Caribbean and may, in fact, have surpassed 50 per thousand in the mid-1950's. Mortality levels remained at the 15 per thousand level according to Bouvier (1984); however, CARICOM (1987) states that during this time, death rates were 9/1,000. During the 1930's and 1940's out-migration slowed from the rates of the 1920's to about 200 per year, although it increased substantially after World War Two. If a relatively high level of emigration had not continued, the 1946 population may well have been over 80,000 rather than the actual 61,780 counted (Bouvier, 1984).

(5) **1960-Present.** After 1955, the very rapid growth rate of the previous three decades appears to have slowed substantially, at least for the first decade and a half. In 1970, the national population was 86,314, only a little more than 6,000 greater than it had been in 1960. This represented a growth rate of about 0.8 percent (Bouvier, 1984). By 1970, birth rates had fallen to 35.7 per thousand from their 1960 high of 49.4. Death rates had also declined from 15.0 to 8.3. In absolute numbers, 36,565 births and 9,164 deaths were recorded over these ten years.

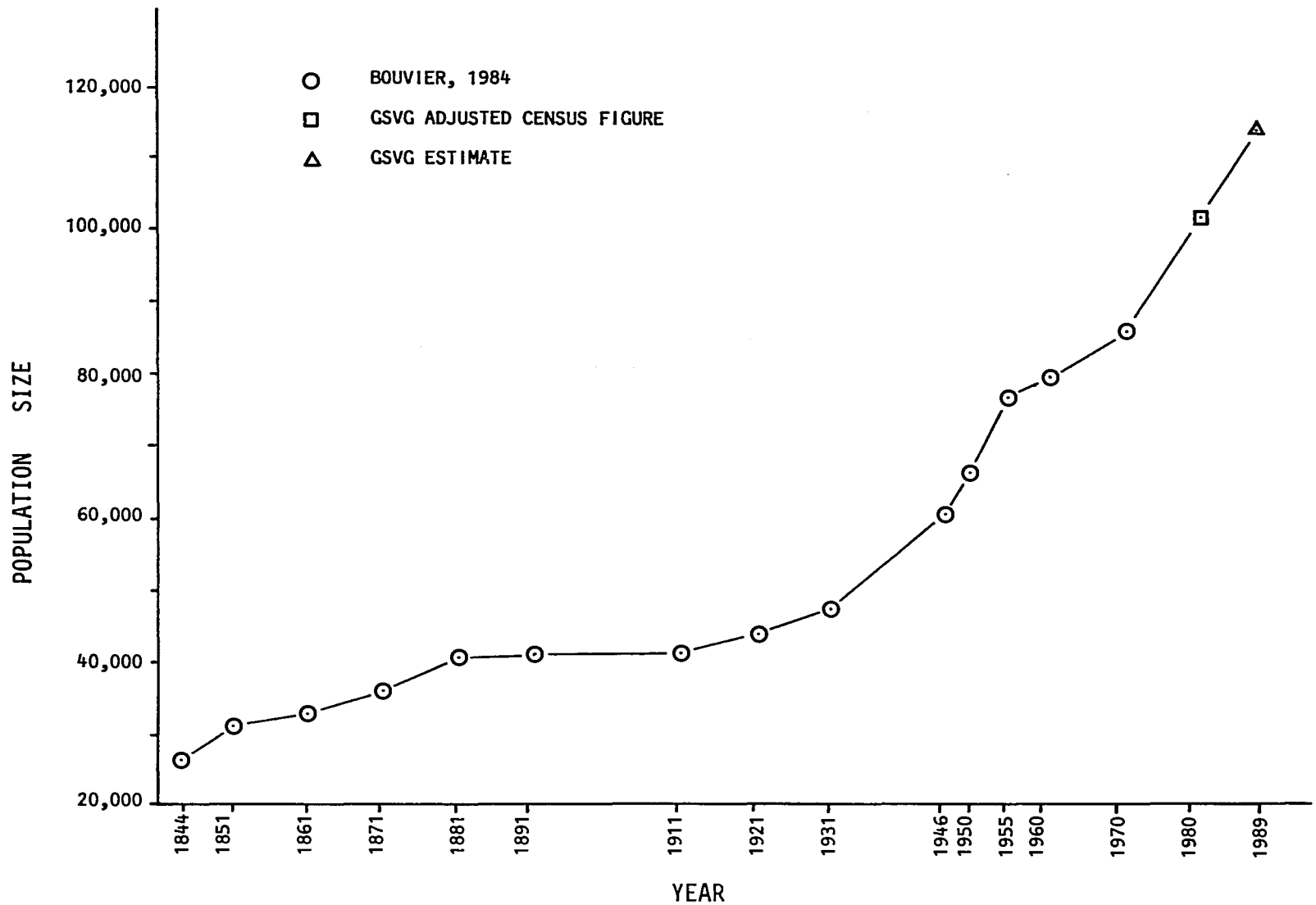


Figure 1.3(1). St. Vincent and the Grenadines national population curve, 1844-1989 (sources: Bouvier, 1984; CARICOM, 1987; GSVG, 1989b).

Table 1.3(1). St. Vincent and the Grenadines national population, 1844 - 1989.

YEAR	NUMBER
1844	27,248
1851	30,128
1861	31,755
1871	35,688
1881	40,548
1891	41,054
1911	41,877
1921	44,447
1931	47,961
1946	61,780
1950	67,120 *
1955	76,050 *
1960	79,948
1970	86,314
1980	102,000 *
1989	113,000 *

* indicates estimated number.

Sources: Bouvier, 1984; CARICOM, 1987; GSVG, 1989b.

These data imply that emigration was occurring at higher rates than ever before (Bouvier, 1984). Emigration in the 1960's was estimated at about 24 per thousand per year. Between 1960 and 1970, 21,000 more people left St. Vincent and the Grenadines than moved to the islands. Emigration at this level was fueled mainly by economic necessity -- Vincentians leaving in search of jobs elsewhere. Many moved to larger neighboring islands, such as Trinidad and Tobago, or to more developed countries in the hope of finding employment (CARICOM, 1987).

Birth rates continued to fall in the 1970's and 1980's, reaching 31.0 per thousand in 1980 and 23.4 per thousand in 1987 (Department of Family Planning Statistics, 1990). Crude death rates dropped to 7.3 per thousand by 1980; infant mortality in 1979 was 39 per thousand births in infants under one year of age (CARICOM, 1987). Net migration during the 1970's was estimated at about 1,000 per year, mostly young adults, and slightly more women than men (Bouvier, 1984).

The 1980 census initially showed a total population of 97,845, but this was later revised upward by the Government's Statistical Office to 102,000. As of February 1990, estimates from the Statistical Office report a SVG national population of 113,000 (pers. comm., K. Israel, Family Planning Administrator, Min. of Health, Feb., 1990). If these figures are approximately correct, then the country may have entered a new phase of rapid population growth. Another census is scheduled for 1990; the results of this exercise will have extremely important implications for future environmental planning efforts in the nation (see also Section 9.4 of the Profile).

POPULATION AGE STRUCTURE

As shown by the population-age pyramid in Figure 1.3(2), in 1980 the popula-

tion of St. Vincent and Grenadines was a very young one; indeed, this has historically been the case. In 1980, the median age was about 16.5, up slightly from the extremely low figure of 14.5 in 1970. The reasons for this low median age (among the lowest in the world) are dual: continued high fertility levels and the emigration of large numbers of young adults (Bouvier, 1984). In 1980, 44 percent of the population was under 15, while only 6 percent was over 65 (Wirt, 1986).

POPULATION DENSITY

The main island of St. Vincent is extremely mountainous with a total of 133 square miles in land area. Using the most recent population estimate of 113,000 (GOSV estimate, Statistical Office, 1989) for the entire country, and subtracting the estimated population of the Grenadines (9,000), this results in a population density for St. Vincent of 782 persons per square mile. This figure places St. Vincent in close competition with, and probably slightly ahead of, Grenada for the dubious honor or the most densely populated of the OECS countries. However, this figure is somewhat misleading since a large portion of the island is essentially inaccessible and uninhabitable due to its topography. The relative density is significantly higher in the less steep areas along the coasts, with the area of greatest population concentration in Kingstown and its environs, reflecting the movement of Vincentians from small rural settlements to the area offering relatively more employment opportunities. Many small villages can be found in the low-lying coastal areas of both the leeward and windward sides of the island.

The land area, population, and densities of the Grenadine Islands are displayed in Table 1.3(2).

Table 1.3(2). Population densities for the Grenadine Islands of St. Vincent.

ISLAND	AREA	POPULATION	DENSITY
Bequia	7 mi^2	4,420	671/mi^2
Mustique	2 mi^2	1,290	645/mi^2
Canouan	3 mi^2	1,832	610/mi^2
Mayreau	1 mi^2	170	170/mi^2
Combined:			
- Union			
- Prune(Palm)*	3.5 mi^2	1,900	----
- Petit St. Vincent*			

* Both Prune (Palm) Island and Petit St. Vincent are primarily resort islands with very few permanent residents.

Source: GSVG, 1989c.

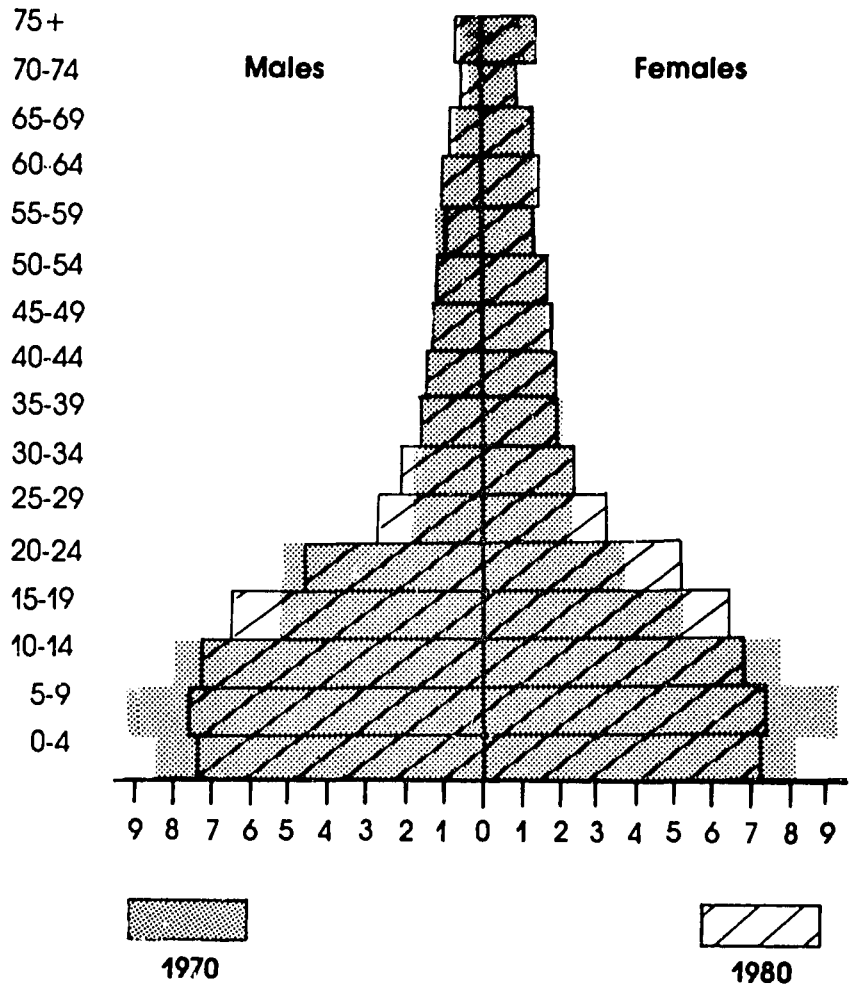


Figure 1.3(2). St. Vincent and the Grenadines national population age-sex structure (source: Bouvier, 1984).

BENEFICIAL EFFECTS OF OUT-MIGRATION

Although the 1980's have seen birth rates drop from 31.5 per thousand in 1982 to 23.4 per thousand in 1987, St. Vincent and the Grenadines still faces the prospect of a degree of population growth which will place great demands on the economy and the Government's ability to provide services. Current out-migration stands at about 1,000 per year; this rate of emigration has played an important part in slowing what would have been an even more rapid population growth rate had it not occurred.

1.3.2 National Economy and Development Trends

OVERVIEW

The economy of St. Vincent and the Grenadines is similar to its sister OECS states, where the primary characteristics are openness and dependency on outside influences. The SVG economy is still rather small, producing annual per capita incomes among the lowest in the Eastern Caribbean. However, despite its small size, the economy has shown steady growth over the past decade, as measured by the increase in Gross Domestic Product, illustrated for 1980 through 1987 by Figure 1.3(3).

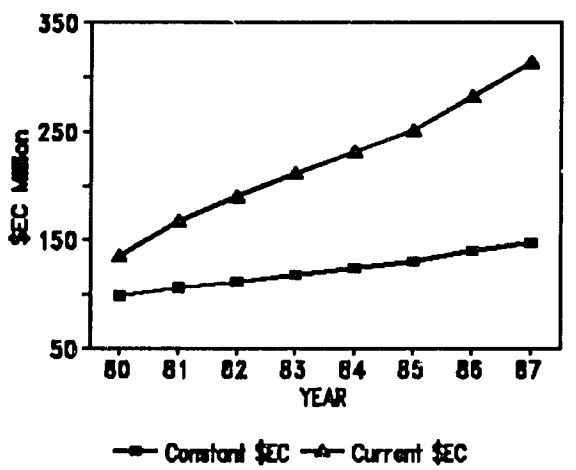


Figure 1.3(3). Gross Domestic Product, 1980 - 1987 (both constant 1977 and current EC$), adapted from GSVG, 1989d.

Other characteristics of the SVG economy are:

- an unusually vigorous manufacturing sector;
- a dominant agricultural sector with major export markets in both European and CARICOM countries;
- a fast-growing tourist sector with major significance for the Grenadine Islands;
- a growing foreign debt;
- high costs for transportation on, off and among the islands;
- expensive energy systems, given small scale and import costs;
- parallel economic systems, representing (i) the traditional subsistence economy and (ii) the export-oriented cash economy.

A special feature of the SVG economy is the marked differences between the economic and social systems of the main island of St. Vincent and the satellite islands of the Grenadines. Although other island systems in the Caribbean display differences when subcomponents are compared, few embody the contrasts of St. Vincent and the Grenadines, i.e., the predominantly agricultural, "pre-tourism" model of St. Vincent and the world-class enclave and yachting-based tourism economy of the Grenadines.

A major limitation in comparing the two is the fact that there are few data available which distinguish between economic activity in the Grenadines and on the main island of St. Vincent. This means that many of the rather stark differences which might otherwise be apparent are lost when data from the two areas are casually merged.

THE DANGER OF AVERAGES

Most of the economic analysis in the St. Vincent CEP uses aggregate data for St. Vincent and the Grenadines, in which the differences between the two areas -- and the unique tourism dependency (and associated impacts) of the Grenadines -- are lost. This problem is evident in the most recent development plans prepared by Government (GSVG, 1986b and 1987), which do not deal substantively with differential strategies for the Grenadines and for St. Vincent. For purposes of environmental planning, it is important for GSVG to tabulate, publish and plan on the basis of disaggregated data, which allows full appreciation of the special character of each subsystem. In the broadest sense, the ecosystems of each of the islands of the country are unique, and it is important to preserve this diversity for data analysis, planning, and development control purposes.

In the Eastern Caribbean context, the economy of St. Vincent and the Grenadines might be termed "pre-modern" (McElroy and deAlbuquerque, 1989). The pre-modern designation, however, is potentially a very positive factor for the country because it means that many of the crucial choices about future development paths have *not* been already foreclosed, as they have been in the U.S. Virgin Islands, for example. Furthermore, although cash incomes are relatively low, they have been advancing steadily over the past few years, as shown in Figure 1.3(4).

The same conditions, however, do not prevail to the same extent in the Grenadines, which are (relative to their total land area of 16.5 square miles and their population of approximately 9,000 people) already intensively involved with primarily three styles of tourism: cruiseship visits, bareboat and crewed charter yachts, and world-class enclave resorts.

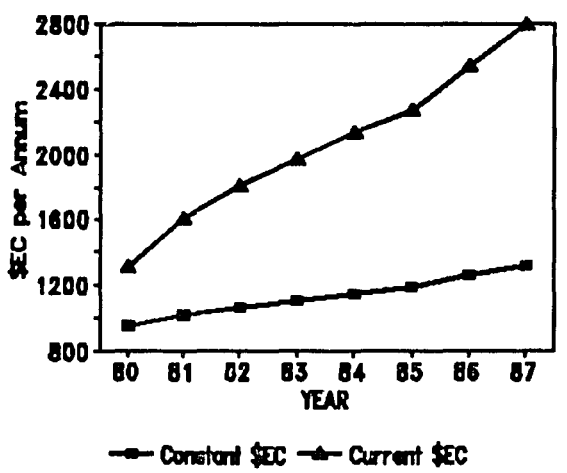


Figure 1.3(4). Growth in per capita income, St. Vincent and the Grenadines, adapted from GSVG, 1989d.

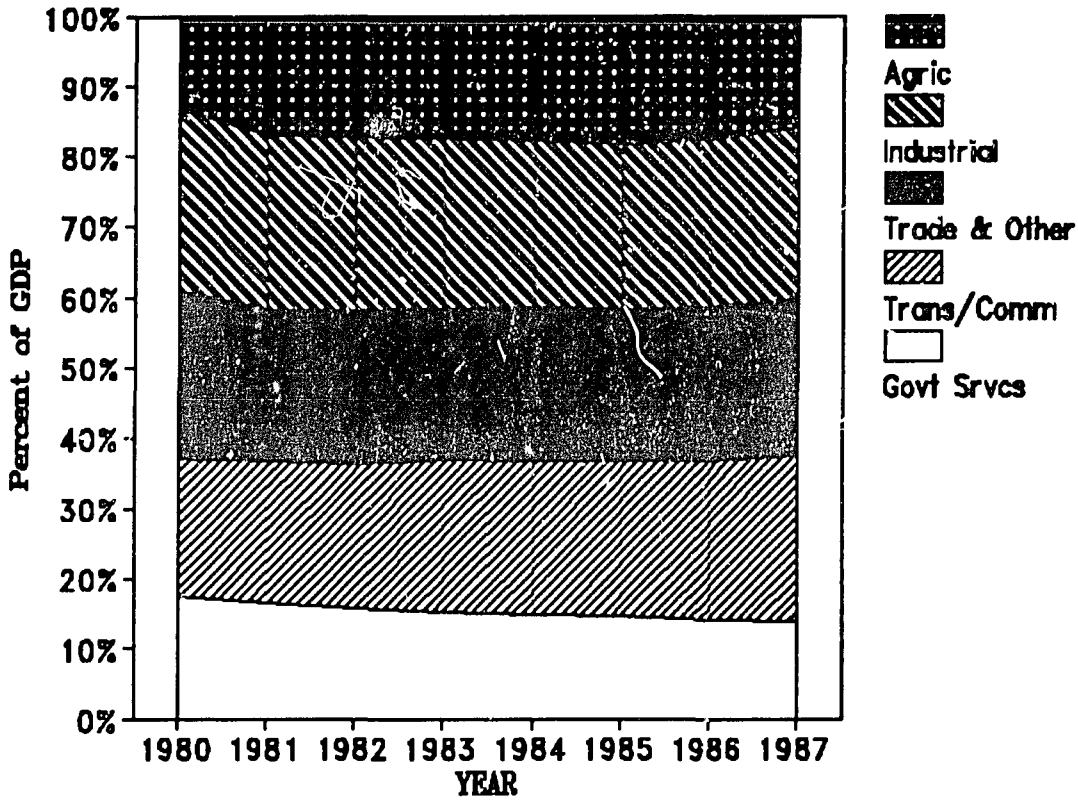


Figure 1.3(5). Economic contribution by sector, adapted from GSVG, 1989d.

INDUSTRIAL SECTOR

According to National Accounts data published by the Ministry of Finance and Planning, the economy of St. Vincent and the Grenadines is diversified and relatively stable, as is illustrated in Figure 1.3(5).

In comparison with other Eastern Caribbean states, SVG has a moderately large industrial sector, comprising manufacturing, electricity and water, construction, and mining and quarrying. This is especially evident in view of the small size of the total economy (i.e., per capita income around EC$3,000 per year). Manufacturing has doubled and utilities have quadrupled in the past decade. It should be noted, however, that manufacturing still accounts for less than 20 percent of GDP. Nevertheless, with a relatively significant industrial base, it will be increasingly important for St. Vincent and the Grenadines to enforce procedures which monitor potential sources of industrial pollution to avoid irreversible problems in the future.

AGRICULTURAL SECTOR

Agriculture is very important to the country, and it is a sector which has gone through a variety of changes during the past decade. Figure 1.3(6) provides an overview of major agricultural exports in St. Vincent and the Grenadines for the period 1983 through 1987.

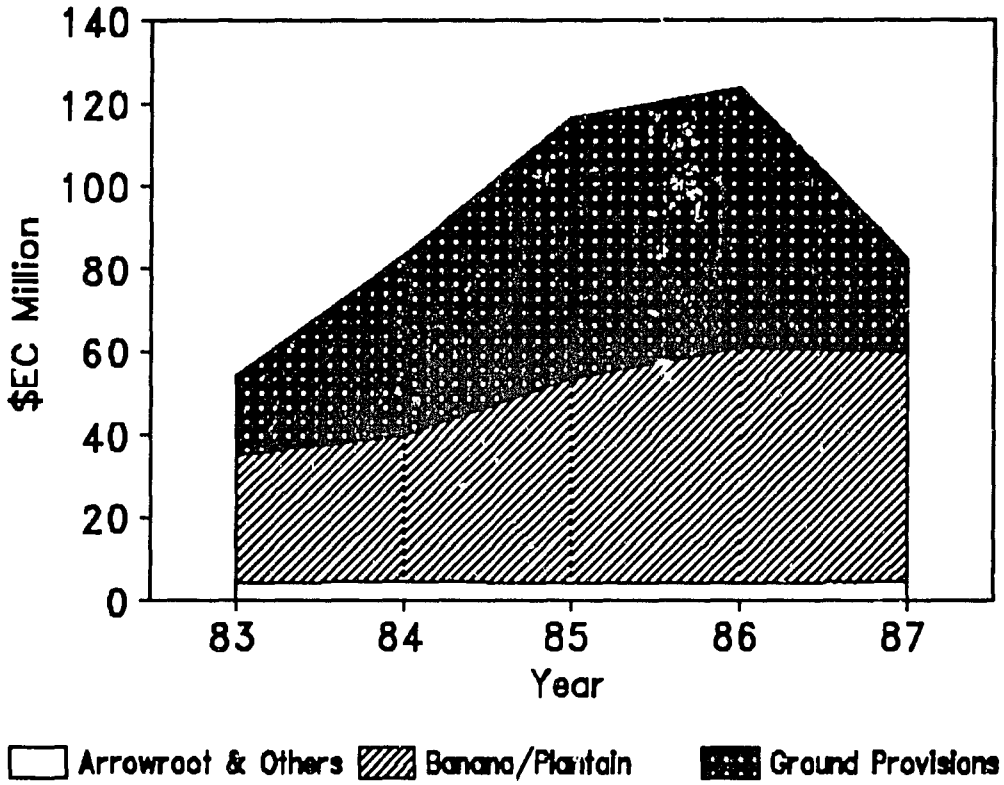


Figure 1.3(6). Major classes of agricultural exports, adapted from GSVG, 1989b.

The most significant factor influencing the sector has been the large increase in banana production, representing a response to high prices in protected British markets. The effect of expanding banana production throughout the Windward Islands has been not only increased agricultural exports and revenues for these islands but also increasingly significant environmental problems, discussed in more detail in Section 3.

A second factor influencing the agricultural sector in recent years has been the "boom and bust" character of agricultural export marketing to CARICOM countries, Trinidad in particular. On the production side, the remarkable growth in root crops, shown in Figure 1.3(6), is paralleled on the export side by the growth and subsequent drop-off in exports to Trinidad, shown in Figure 1.3(7).

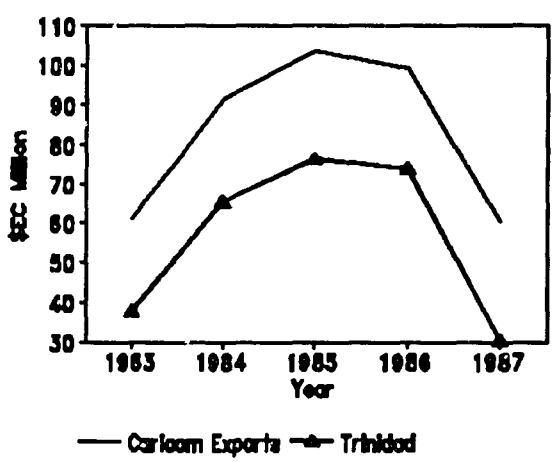


Figure 1.3(7). Exports to CARICOM, adapted from GSVG, 1989b.

A final occurrence marking development of the agricultural sector in recent years has been the abandonment of a scheme to reintroduce sugar production, proposed as a major new source of export earnings. Apparently the instability of the world sugar market, combined with the uncertainties associated with the region's access to U.S. markets, high costs of production in St. Vincent, and perpetual operating problems at the mill, was sufficient to finally put the proposal to rest. Most of these circumstances reflect similar problems associated with sugar cultivation in St. Vincent in the nineteenth century -- which could serve to remind planners that an important reason for focusing on environmental issues is to learn from past mistakes by studying earlier conditions for clues to the viability of proposed future options.

TOURISM SECTOR

In addition to expansion of the manufacturing sector in recent years, tourism overall has continued to grow rapidly, although its contribution to the economy remains relatively small -- probably about 10 percent of GDP.

Figure 1.3(8) illustrates the rapid recent increase in tourists, as reported by the Caribbean Tourism Organization (formerly the Tourism Research Center).

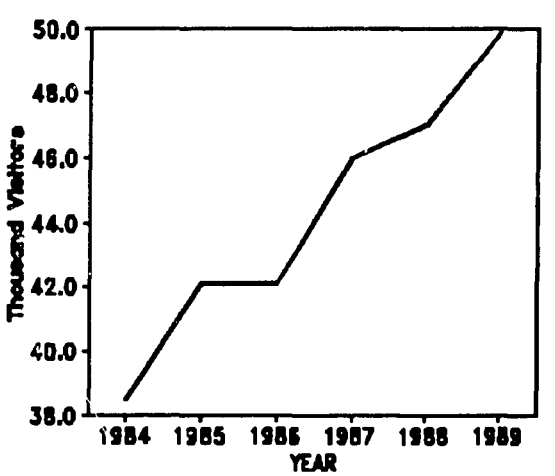


Figure 1.3(8). SVG stay-over visitors, adapted from CTO, 1989.

Although some of the figures reported by Government from different sources are difficult to reconcile, all the data are in agreement on the direction and general significance of the growth in tourism. Other implications of tourism growth are discussed in Section 7. The most important point to bear in mind, however, is that the impact of tourism is felt almost entirely in the Grenadines. In fact, there is some indication that because of the curtailment of cruiseship visits to Kingstown, actual tourism impacts may have substantially diminished in St. Vincent proper, while accelerating in the Grenadine Islands. At the same time, a number of groups in the Grenadines have expressed concern that cruiseships are overwhelming some of the smaller islands.

TRADE AND FOREIGN DEBT

For all of its relative vigor and diversity, the economy of St. Vincent and the Grenadines is still unable to approach a balance in merchandise trade. Figure 1.3(9) displays graphically the persistence of the deficit in visible trade -- in spite of the value of bananas and root crops in recent years.

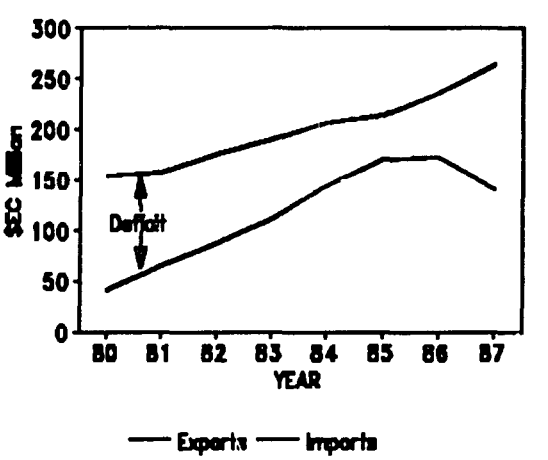


Figure 1.3(9). SVG balance of trade, adapted from GSVG, 1989d.

A simple trade deficit is relatively harmless, however, if it is financed out of other sources of *invisible* trade, such as remittances from abroad and components of the tourist

trade. Unfortunately, that does not appear to be the case in St. Vincent and the Grenadines, as illustrated by Figure 1.3(10), which displays the rate of increasing foreign-held debt.

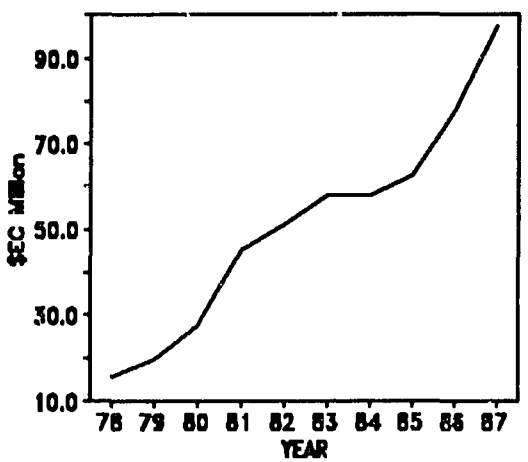


Figure 1.3(10). St. Vincent and the Grenadines' foreign-held debt, adapted from World Bank, 1989.

It's worth noting that virtually all of the country's foreign debt is held by public institutions, rather than private banks. Nevertheless, a debt this large is worrisome, unless it is simply keeping up with inflation. That is, for a given level of foreign debt, policy makers (and creditors) need not worry excessively if the growth in debt simply maintains parity with the growth in the overall economy. This implies that in spite of the growth in debt, the overall economy is able to maintain debt service with a constant, rather than a growing portion of economic performance.

Figure 1.3(11) shows that debt is growing as a proportion of GDP -- substantially. As discussed in McElroy and deAlbuquerque (1990), "traditional debt-to-GDP and debt service ratios may be poor predictors of credit worthiness [for OECS states]." Basically, the authors suggest that the extreme openness of their economies, plus poor or inelastic revenue collection mechanisms, make OECS states much more prone to defaulting on foreign debt than has been assumed in the past.

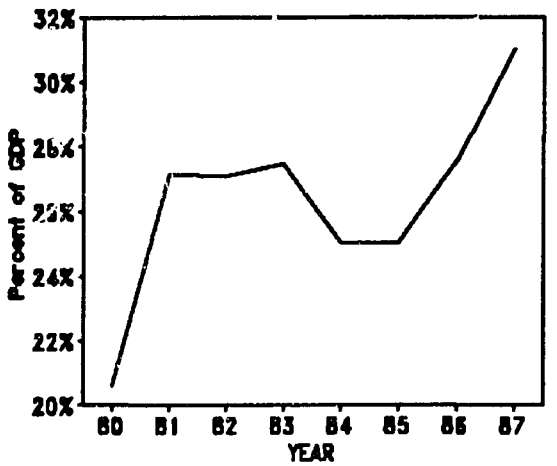


Figure 1.3(11). SVG debt as a percent of GDP, adapted from World Bank, 1989 and GSVG, 1989d.

The implications of these trends in St. Vincent and the Grenadines is that future economic policy must devote more attention to reducing the rate of growth of foreign-held debt and to increasing the foreign exchange earnings (i.e., the efficiency) of investments. This will probably result in increased pressure for tourism developments and export manufacturing as well as higher returns from export agriculture. All three options tend to increase risks to the environment.

In summary, development priorities for St. Vincent and the Grenadines will be driven by the problem of managing high levels of foreign debt, while stimulating foreign exchange earnings from tourism, agriculture and manufacturing. An important boost to these efforts can be accomplished by adding elements of nature-based tourism on the main island of St. Vincent, in addition to the more traditional Caribbean tourism experiences offered by the Grenadines.

THE "GREENING" OF ECONOMICS

In the area of environmental management, the role of economics traditionally has been diagnostic, scene-setting, and 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.

In the spring of 1990, two major conferences, sponsored by the President of the United States and the Prime Minister of Norway, specifically invited ministers of finance to discuss environmental topics. As the *Economist* magazine (5 May, 1990) noted,

> *Environment policies that take no heed of economics will backfire; but so will economic policies that ignore the environment.*

Nowhere is this more evident than in the Eastern Caribbean in general and St. Vincent and the Grenadines specifically.

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 (e.g., in St. Vincent: water, electricity and other utilities). Regulations and direct subsidies are demonstrably less effective than economic tools which control prices to consumers.

It is most important that governments eliminate all 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 with usually 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 while ensuring that the prices of such goods more fully reflect the full costs to society.

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

- Are timber tax and depletion policies designed to encourage wise cultivation and harvesting of exotic varieties and sustainable silviculture practices for utility grades of lumber?
- Do agricultural support programs encourage and/or enforce environmentally sound farming and soil conservation practices?

It is important for St. Vincent and the Grenadines to explore more ways for economics and the environment to work together creatively.

ASSESSING ENVIRONMENTAL GAINS AND LOSSES

[*The discussion which follows in this section is summarized and adapted from Repetto, 1989 and Repetto, et al., 1989.*]

The System of National Accounts (SNA) presently used by virtually all nations is seriously flawed in its treatment of natural resources and the environment. National income accounts treat assets such as buildings and equipment as productive capital whose value depreciates over time as they perform valuable work for the economy. Natural resources, on the other hand, are treated as free "gifts of nature" -- not as productive assets whose value must also be depreciated as they are used up.

In other words, a country could conceivably exhaust its mineral resources, cut down its forests, pollute its water supplies, exterminate its wildlife, and over-utilize its fisheries, but still its *measured* income would not be directly affected as those assets disappeared. In the long term, such a situation is economically unrealistic for any country but is especially so for low-income, developing nations which are typically the most directly dependent on their natural resource base for employment, revenues, and foreign exchange. In effect, such nations are presently using an accounting system which basically disregards their principal assets.

Governments need to recognize that natural resources make important contributions to long-term economic productivity and should be considered as economic assets whose value lies not in their investment cost but in the potential *income* they can generate. Any definition of

income should include the notion of *sustainability*. For example, business income is defined as the maximum amount a firm could pay out in current dividends without reducing its net worth. This income concept encompasses not only current earnings but also changes in asset positions, i.e., capital gains are a source of income, and capital losses are a reduction in income. Depreciation reflects the fact that unless capital stock is maintained and replaced, future consumption possibilities will inevitably decline.

In resource-dependent countries, the failure to extend this depreciation concept to the capital stock embodied in natural resources seriously distorts economic evaluations and projections. Natural resources depreciate in the same sense that a machine depreciates; for example, soils depreciate as they are eroded or as their

ECONOMICS AS IF TOMORROW MATTERED

As countries like St. Vincent and the Grenadines begin to utilize economic measures which take account of natural resource assets, a more effective analysis of economic policy -- one which reflects long-term sustainability -- will become increasingly possible. Donor support should be sought for an Eastern Caribbean regional project to study the concept of depreciation for natural resource assets. Most Eastern Caribbean nations share the same basic set of economically valuable natural resources, and the methodology could be applied to all. The process (perhaps using methods similar to those in the WRI report by Repetto, *et al.*, 1989) would involve the development of a common framework for: (a) determining which resources are the most important to measure and how the measurement could best be employed; (b) collection of basic field data on existing stocks of natural resources (in many islands within the region such data may not be available for some resources); (c) constructing physical accounts for each chosen resource; (d) determining a monetary value for each resource -- the specific methodology will vary depending on the resource being measured; and (e) integrating these assets into national macro-economic evaluations.

It is important to start work now on an accounting methodology so that appropriate data can be collected. This process is admittedly not as straightforward as it may sound since many important resources may have no market value, and most of the Eastern Caribbean nations do not yet have an extensive natural resources data base. This situation is changing, however. Recent years have seen many advances in the development of techniques to determine surrogate values for non-market resources (Barbier and Burgess, 1989; Barbier, *et al.*, 1989; Cambers, 1989; Dixon, 1989). Several Eastern Caribbean nations either have begun compiling resource data (e.g., the CIDA Forestry Project in St. Vincent) or will soon need to do so for resource management reasons; it would be advantageous to collect these data in such a way that they could be integrated into a revised national accounting system.

As the physical impact of economic activities impinge on natural systems in the Eastern Caribbean, environmental damage gradually becomes more visible and is less easily ignored by the political leadership. In the search for a solution to this problem, attention is drawn to a 1989 OECS/NRMP-sponsored simulation model for sustainable development for Montserrat that attempted to assess the extent to which current resource use exceeds the rate of renewal, producing a declining asset base. The OECS/NRMP group, having tested the model first in Montserrat, is currently implementing a new testing phase with the Economic Development Unit of Dominica. One aspect of this involves finding new ways of valuing natural resources for use in improved national income accounting systems.

fertility is diminished, since they can produce only at higher costs or lower yields.

The present United Nations system of national accounts fosters a fictitious dichotomy between the economy and "the environment" that in effect seems to encourage policymakers to ignore or destroy the latter in the name of economic development. The system equates utilization of valuable assets with the generation of income and promotes the notion that rapid economic growth can be achieved and sustained while depleting the resource base.

Since most countries follow the system of national accounts established by the United Nations Statistical Office, at least in regard to their core accounts, that office is presently considering revisions to the SNA, although it has made a preliminary decision to forego fundamental changes. Instead, countries are being encouraged to implement balance sheet accounts for reproducible and non-reproducible tangible assets and to link those to conventional national income measures through *"satellite accounts"*. Although there are other problems with this approach (discussed at length in Repetto, 1989), one of the most serious is limited expertise and manpower resources. Given the overriding priority to calculate the traditional income accounts and the perceived difficulty of calculating these ancillary accounts, it is very unlikely that many developing countries will actually do so. This means that unless fundamental changes are made, economists and politicians will continue to use the present system whereby Gross Domestic Product is viewed as the prime measure of each country's economic performance.

SECTION 2 FORESTS AND WILDLIFE

2.1 FORESTS AND FORESTRY

2.1.1 Overview

NATURAL FORESTS

In 1984, Birdsey, *et al.* (1986), for a project funded by USAID, carried out a forest inventory of St. Vincent which was based on photo-interpretation and field sampling. These authors calculated at that time that 32,385 acres or 38 percent of St. Vincent was still covered by forests (Table 2.1(1)); most of this remaining forested area was located on crown lands. Primary forest (including rain forests and moist forests) comprised only 13 percent of the forested area (five percent of the total land), while palm forests and dwarf or elfin forests made up 21 percent of the forested area (eight percent of the total land).

Taken together, the secondary forests, dry scrub forests and plantation forests made up 67 percent of the forested area and 25 percent of the total land. Almost 6,900 acres or eight percent of the total land area had been deforested by the 1979 eruption of Soufriere. The western side of the island, and particularly the northwest, contained the highest proportion of forest (Table 2.1(2)).

(N.B. Forests which are designated as "primary" or "mature" have never been disturbed, or at least have been undisturbed for such a long time that they show no recognizable signs of disturbance. "Secondary" or "successional" forests are those that have been disturbed by man or natural forces in the relatively recent past and are now in the process of recovery.)

It is often repeated (by authors quoting Beard, 1949) that St. Vincent's remaining primary forests are found mostly in the upper parts of the Colonarie, Cumberland and Buccament Valleys, where they occupy small pockets between 1,100 and 1,500 feet elevation in areas too steep for cultivation. However, agricultural clearings have clearly caused much damage to the remnant primary forests, and Lambert (1983) found that the rain forest which Beard had recorded in the Colonarie Valley remained only in small, disturbed patches. He felt that primary forest occurred only in the Wallibou, upper Cumberland, and upper Buccament Valleys. Lambert observed, however, that Hurricane Allen, which devastated the forests of St. Lucia in 1980, seems to have had minimal effect on the rain forest in St. Vincent.

The Grenadines have been severely damaged ecologically by the clearing of vegetation and overgrazing of livestock which are turned loose during the dry season to wander at will. Their vegetation now consists mostly of badly degraded secondary dry scrub and brush. Only Bequia has significant areas of dry woodlands. These have been disturbed by grazing and cut over for fuelwood, charcoal and wood for boat-building. On Canouan, Beard (1949) mentioned a single small stand of tall, fairly mature dry forest at a 800-900 foot elevation on the lee side of Mt. Royal which may still exist. However, Government has intentions to lease these lands.

Birdsey, *et al* (1986) have stated that the primary forest may be the most valuable natural resource on St. Vincent. Besides helping to maintain the island ecosystem and sustain water supplies in the water catchments, natural forests have the potential to attract tourists and provide habitat for endangered species. The secondary forests also play a similar role, and many of them are located adjacent to or within the primary forests, forming a single ecosystem.

The actual coverage and distribution of forests and other vegetation types in St. Vincent and the Grenadines today is very poorly known. Talbot (1983) produced a sketch map of actual (as opposed to potential or "climax") vegetation on St. Vincent (Figure 2.1(1)). This map differed from an earlier version (Beard, 1949; see Figure 1.2(5))

Table 2.1(1). Area by land class, St. Vincent, 1984.

Land Class	Area	
	Hectares	Percent
Timberland		
Young secondary forest	3,570	10.5
Secondary forest	3,706	10.9
Primary forest	1,632	4.8
Plantation forest	34	0.1
TOTAL	8,942	26.3
Other forest land		
Palm forest	1,734	5.1
Dwarf forest	952	2.8
Dry Scrub forest	1,326	3.9
TOTAL	4,012	11.8
Non-stocked land*	2,754	8.1
Non-forest land	18,292	53.8
TOTAL LAND**	34,000	100.0

* Land deforested due to natural disturbance and not currently in Non-forest use.

** Values for total land from Nicholls, 1982.

Source: Birdsey, *et al.*, 1986.

mainly in showing the extent of vegetation disturbance due to the 1979 eruption of Soufriere. Unfortunately, in the course of their study Birdsey, *et al.* (1986) did not prepare a new forest cover map; the map of forest types on page 6 of their report is adapted from Beard's 1949 study.

TIMBERLAND

Timberland is defined as those areas of forest which can be used for production of timber, including primary, young secondary and secondary natural forests and plantation forests according to the classification scheme of Birdsey, *et al.* (1986) -- see Table 2.1(1).

Table 2.1(2). Proportion of forest land by watershed region and elevation, St. Vincent, 1984.*

Watershed Region	Elevation**	
	Below 305 m	Above 305 m
	(percent)	
Northwest	56	94
Southwest	36	69
Southeast	4	32
Northeast	6	83

* Forest land includes Non-stocked land; watershed regions are outlined in Figure 3.1(1).

** The 305 m used here equates to the proclamation that reserves are all crown lands above 1,000 ft.

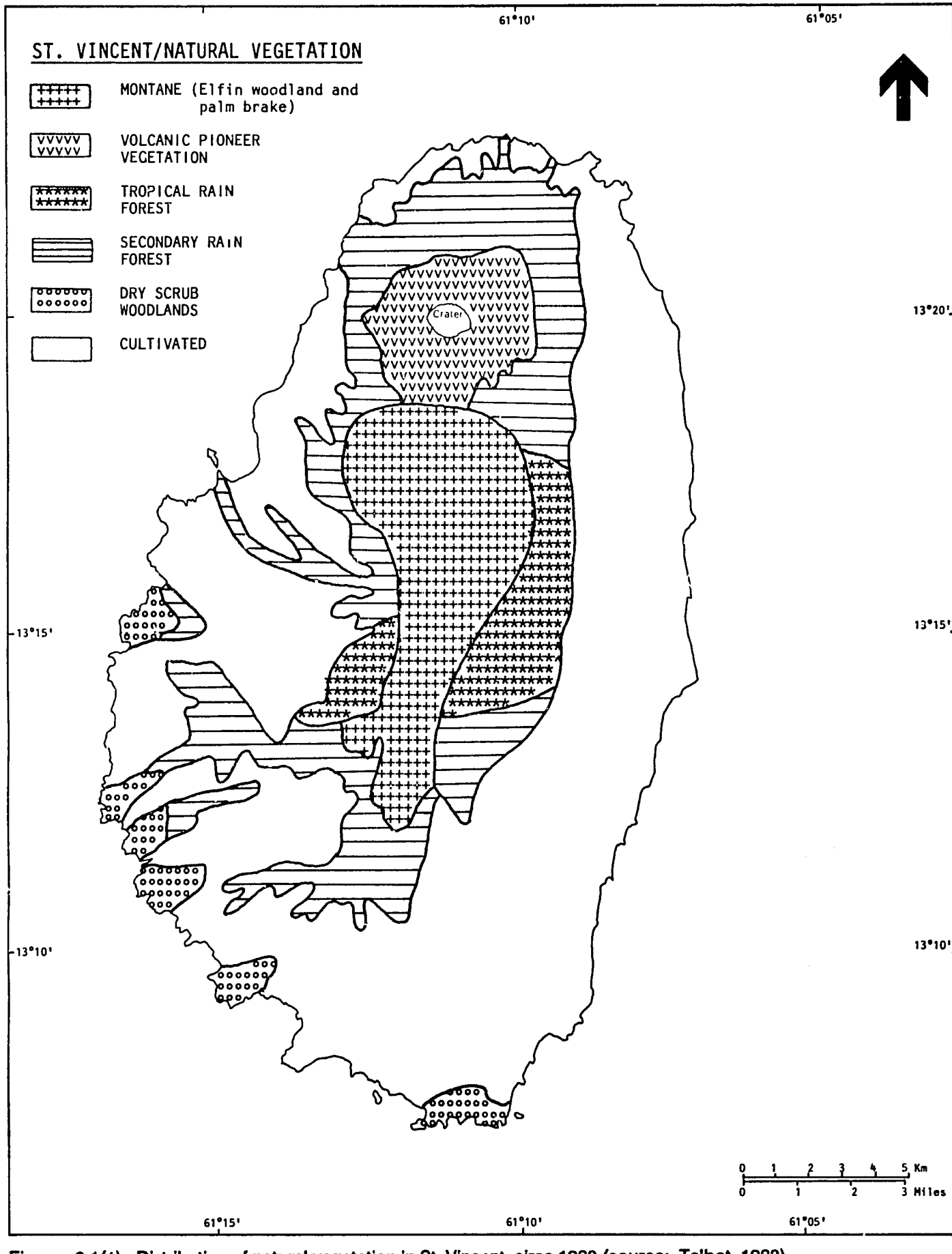
Source: Birdsey, *et al.*, 1986.

Young secondary forests are located in more accessible areas and tend to be associated with recent agricultural activity, but most of their usable timber volume resides in the occasional large remnant trees. Secondary forests are mainly found in very rugged, uninhabited terrain and are probably the result of natural disturbances; while they contain reasonably large volumes of timber, physical difficulties would make log extraction extremely difficult and/or damaging to the environment. The primary forests contain the largest volumes of timber, but they also are found in very rugged terrain with no roads or easy access. It therefore appears that the remaining natural forests offer poor opportunities for production forestry; the best hope for increasing timber production is through increasing the acreage of plantation forests.

GSVG's Forestry Division maintains small parcels attached to several of the plantation forests where it raises Christmas trees for sale. The Division also sell trees for lumber, posts and fuelwood; these constitute its major activities in forest utilization. There is only a small primary forest industry in the country which supplies about 15 percent of the lumber demand via a few pit sawyers using "Alaskan mills," chain saws adapted for cutting logs into slabs (Prins, 1986a). The secondary forest industry sector is well-developed, producing mainly custom-built furniture and other finished or semi-finished products, mostly from imported (and some local) lumber.

PLANTATION FORESTS

To date, reforestation efforts in St. Vincent and the Grenadines have mostly been carried out in deforested upper watersheds for the purpose of soil and water conservation, with the production of poles, posts and timber being of secondary importance. Three species make up most of the plantations: blue mahoe (*Hibiscus elatus*) accounts for 70 percent of



Figures 2.1(1). Distribution of natural vegetation in St. Vincent, circa 1983 (source: Talbot, 1983).

the acreage, mahogany spp. (*Swietenia macrophylla* and *Swietenia mahagoni*) and Caribbean pine (*Pinus caribaea*) together make up 18 percent, and about six other species make up the remainder. Annual planting rates have ranged from 5 to 10 acres per year, depending on the availability of land and funding (Prins, 1986a).

About one-third of the plantations were established in 1968-1969, and another 40 percent during the period 1980-1982 through the USAID/CDB Basic Human Needs Program (Figure 2.1(2)). Although it had been reported by a former Chief Agricultural Officer that about 285 acres of plantations existed in 1982, the 1984 forest inventory could locate records for only 125 acres, making assessment of production difficult.

A U.S. Peace Corps Volunteer forester recently prepared stand data cards for a total of 283 acres of plantation forests; several small plantations have not been included because of their inaccessibility or their failure to become established. Sixty or seventy percent of the plantations have never had silvicultural treatments (like thinning) for timber stand improvement. Hence, the majority of the plantations are not reaching or maintaining their optimal growth potential. With proper management, the established plantations could be much more productive (pers. comm., W. Metz, U.S. Peace Corps Volunteer, April, 1990).

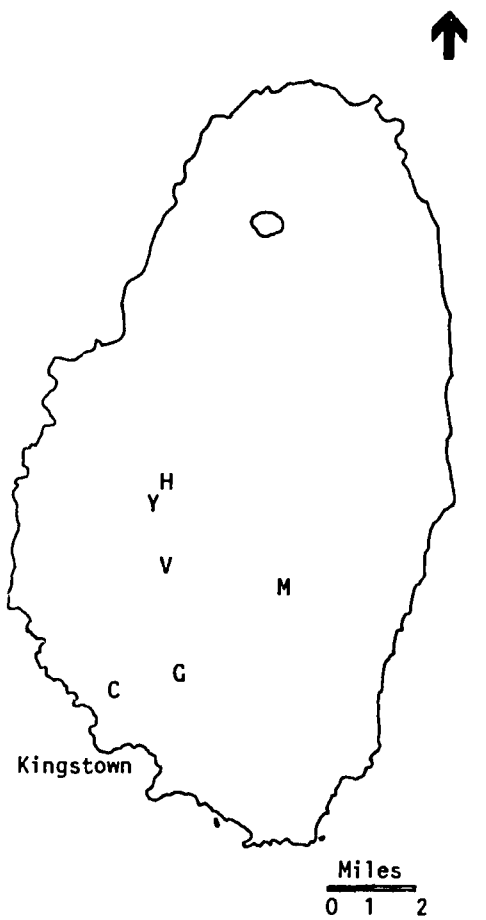


Figure 2.1(2). Forest plantations surveyed by forestry team in 1984 (source: Birdsey, *et al.*, 1986).

KEY TO SITES SURVEYED:

Y	Young Man's Valley	H	Hermitage
G	Government House	V	Vermont
M	Montreal	C	Camden Park

FOREST RESERVES

St. Vincent's first forest reserve, King's Hill, was set aside by Order No. 5 of 1791. This 55 acre tract of dry forest should in theory have been protected from cutting ever since, but Beard (1949) observed that the law had been "more honored in the breach than in the observance". Nevertheless, this reserve still exists in a relatively intact state and has been the focus of recent discussions by a local community group interested in seeing the site developed as a potential park site with facilities for researchers.

In 1946 Proclamation 12 declared as a reserve "... all that area of crown land lying upon the central main ridge and mountainous interior of the island to the south of the Wallibou and Rabacca Rivers, such Forest Reserve to be entitled the Central Reserve". Much of this area is still intact, at least in the higher elevations and north of an east-west line through the peaks of Petit Bonhomme

and Grand Bonhomme to the vicinity of Dalaway, which forms the approximate southern boundary of the Parrot Preserve. South of this line the forest has been more fragmented and disturbed, and only the highest and steepest areas may still be intact.

The Crown Lands Forest Reserve (Declaration) Order of 1948 set aside as forest reserves the following areas:

(1) "**The Soufriere Forest Reserve** comprising all that area of crown lands lying upon Soufriere Mountain, its foothills and the mountainous interior of the parishes of St. David and Charlotte lying to the north of the Wallibou and Rabacca Dry Rivers." The upper parts of this area have not been greatly disturbed by man, but are subject to natural disturbance from the eruptions of Soufriere.

(2) "**The Mesopotamia Forest Reserve** comprising all that area of crown lands lying upon the catchment area of the Yombou River, including the peaks of Petit St. Andrew and Grand Bonhomme, in the parish of St. George." Most of this area, with the exception of the very highest and steepest portions, has been cleared for agriculture.

(3) "**The Colonarie Forest Reserve** comprising all that area of crown lands lying upon the catchment area of the Colonarie River, including the peak of Petit Bonhomme and its foothills in the parish of Charlotte." Parts of the upper watersheds are still forested, but agricultural clearings are rapidly expanding.

The UK's Directorate of Overseas Surveys (D.O.S.) 1:50,000 scale map shows seven "reserves" (presumably forest reserves) on Union Island but does not show their boundaries. Jackson, *et al.* (1986) indicated that at least portions of several reserves in the western part of the island, and an area on the eastern slopes of Mt. Olympus, had dry woodlands worthy of protection (see Section 9).

According to Butler (1988), his discussions with the Chief Surveyor indicated that the St. Vincent reserves "... were all surveyed (many of them in the mid-1960's) and the survey plans of several were located and lodged in the surveys office of the Ministry of Trade, Industry and Agriculture" (sic). If this was indeed done, the survey plans appear to have been lost, and in any case the reserve boundaries have now become overgrown, and encroachment by agriculture is common. A more recent survey was completed by the Forestry Division in October 1990 (pers. commun., CEP National Committee, 1990).

2.1.2 Problems and Issues

SUPPLY AND DEMAND OF WOOD PRODUCTS

St. Vincent and the Grenadines imports about EC$8 million worth of roundwood, lumber and other wood products each year, representing 50 percent of the roundwood demand, 85 percent of the lumber demand, and 75 percent of the demand for other wood products. These imports are approximately five percent of the value of all the nation's imported goods (Prins, 1986a). Prins calculates that with proper management, at the end of a decade of forest development, it would be well within the capacity of managed natural forests, agro-forestry operations and plantation forests to reduce wood imports by about 50 percent.

Based on an estimate of 40 percent of households which use charcoal exclusively for domestic cooking, and another 30 to 40 percent which use it along with other fuels, Prins concludes that this level of consumption can at least be maintained without detrimental effects *if* forest management is successfully introduced.

THE CROWN LANDS PROBLEM

An official proclamation of August 22, 1912, reserves all crown lands in St. Vincent above 1,000 feet in elevation to pro-

tect them from any act that would be prejudicial to forest conservation (Birdsey, *et al.*, 1986); this area has been estimated at about forty percent of the total land area of the island (Figure 2.1(3)). Although Butler (1988) states that neither the Legal Affairs nor Crown Lands Officers have been able to produce a copy of the document, a copy has recently been located in Barbados and is on file at the Forestry Division and the CIDA Forestry Project Office.

A major problem is that the legal definition of crown lands in various acts is very vague. For example, the Crown Lands Ordinance of 1906 gives the following definition: "'Crown Land' means land vested in the Crown, or vested in the Governor for the public uses of the Colony, but shall not include lands acquired under the Land Settlement Ordinance." In the absence of survey maps and deeds, such a definition is virtually useless for purposes of land management.

DEFORESTATION

It is known that most of the area below the 1,000 foot elevation is under permanent agriculture, as well as many valleys at higher altitudes -- this is where the best land is found, and it has been deforested for centuries. Squatters on crown lands have caused a significant but unquantified amount of deforestation in the natural forests. More rapid upslope expansion of agriculture at the expense of the forested areas has been occurring in recent years, especially for banana cultivation which is currently driven by the desire to plant as much acreage as possible before British price supports are withdrawn or reduced in 1992.

Both the intensity and extent of deforestation for agriculture are thought to be far greater in the windward forests. One "guesstimate" puts the rate of forest loss in just six watersheds (Montreal, Vermont, Cumberland, Silver Spoon, Colonarie, and Perseverance) at 60 to 70 acres/year, based on field observations (pers. comm., W. Metz, U.S. Peace Corps Volunteer, April, 1990). There is no information on the island-wide rate of deforestation, but other major area of deforestation are in Lauders, Greiggs, Montreal and the Upper Colonarie Valleys (pers. comm., J. Poyer, GSVG Forest Officer, April, 1990).

Fuelwood cutting and charcoal production may be a serious problem, but it has not been quantified to date (see Section 6.1 for further discussion of the fuelwood problem). A report funded by the CDB (Deutsch Forstinventur Service, 1983) stated that the total annual demand for charcoal and fuelwood amounted to some 25,000 to 35,000 cubic meters of wood, but this figure seems to be based on some guesswork (pers. comm., J. Latham, Project Manager, CIDA Forestry Project, April, 1990). According to Prins (1986a), the main areas where illegal charcoal burning takes place in the forest are in the Buccament, Cumberland, Locust and Colonarie Valleys, particularly the latter. However, according to a Forest Officer, the areas with the highest rate of fuelwood deforestation today are in Sandy Bay, Fancy, Rose Bank and Richmond (pers. comm., J. Poyer, GSVG Forest Officer, April, 1990).

LACK OF ENFORCEMENT AND MANAGEMENT

Laws prohibiting the cultivation of crown lands are not adequately enforced. The Crown Lands Office reportedly leases, and in some cases has even sold, crown lands above the 1,000 foot elevation line to private individuals (Butler, 1988). Other factors making it difficult to manage crown lands and forest reserves are:

- outdated forestry legislation;
- the fact that forest officers have no powers of arrest;
- the lack of surveys and demarcation of boundaries on the ground;
- the development of agricultural feeder roads which open up new areas to cultivation;
- increasing size of the population;

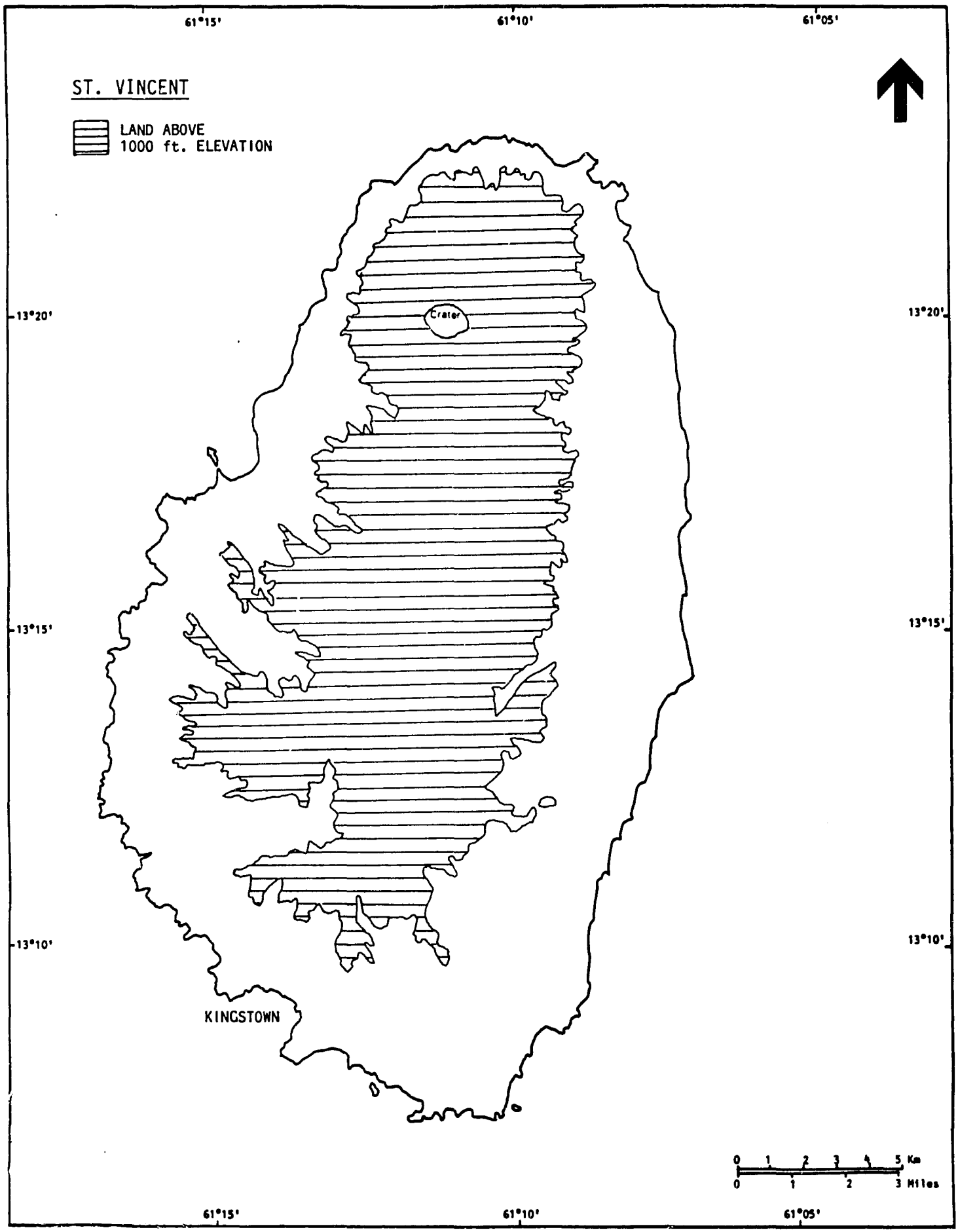


Figure 2.1(3). Land above 1,000 feet in elevation (source: Birdsey, *et al.*, 1986).

- shortage of man-power on the ground, a result, in part, of poor benefits for staff (e.g., salary);

- lack of transportation for forest officers;

- the legal, political and social problems associated with the eviction of squatters from crown lands.

To date there is no formal written forest policy and no forest management plan. Besides patrolling of forest reserves and some reforestation of illegally cleared areas, little actual management of forest reserves is currently practiced.

CIDA FORESTRY ASSISTANCE PROGRAM

A five year (1989-1994) Can$4.5 million forestry assistance program, funded by CIDA, is currently addressing many of these problems. Some of the major components of the CIDA project are:

(1) A National Forest Management Plan will be prepared by the CIDA project team, which will be coordinated with the National Forestry Action Plan to be prepared within the next year by the FAO Tropical Forestry Action Plan Mission.

(2) The personnel employed by the Forestry Division will be expanded from the present 34 to about 50.

(3) The project will assist in the reorganization of the Forestry Division, training of Forestry Division personnel and building of a new headquarters.

(4) The role of the Forestry Division in watershed management will be defined, and a watershed management plan for at least some of the forest reserves will be prepared. A social forestry pilot project will be begun in the Colonarie Valley which will attempt to involve local people in the management of this watershed via silvicultural and agro-forestry projects.

(5) An environmental education program, with components for schools and the general public, is a large part of the project (see also Section 9).

(6) Forest management policies and a draft Forest Resource Conservation Act have been prepared. The Forest Resource Conservation Act is intended to replace the Forests Ordinance, No. 25 of 1945. The new act greatly expands the powers of the Forestry Division in forest conservation and management. It contains a Schedule which declares a Cumberland Forest Reserve.

(7) CIDA will soon survey and gazette the boundaries of the forest reserves. At present, there is a significant problem of squatters encroaching on the reserves.

A new aerial photography mission is also planned by CIDA as a separate project. This effort will provide coverage of the entire nation. The photographs will be used to prepare maps of land use, forest cover and vegetation types, and to derive estimates of deforestation rates by comparison with earlier photographs.

2.1.3 Policy Recommendations

FOREST MANAGEMENT

* The highest priority and best use of the few remaining mature or nearly mature forest stands may well derive from conserving a major portion of them for their potential as

a genetic reserve, for wildlife habitat, for watershed protection, for education, for scientific research and for nature tourism development. Plantation forests are more suited for the production of forest products.

RESEARCH

* The rationale for the current emphasis on exotic species in plantation forestry needs to be examined. In St. Lucia, CIDA has proposed that a review of Beard's (1949) classification of the indigenous forest be carried out and that one or more indigenous and/or exotic species, adapted to each ecological condition, be identified, followed by establishment of small experimental plantations of species within each ecological type. Research efforts would be initiated which focus on the most highly valued indigenous species, with a view toward establishing silvicultural prescriptions for these. A similar program in St. Vincent would be of great interest.

* Research to select the most appropriate silvicultural system needs to be conducted with indigenous species in each of the secondary forest types. The major alternatives for tropical forest management are plantations, shelterwood cuttings, secondary forest management following natural disturbance or logging, enrichment plantings, and agro-forestry with timber species.

* Throughout the Caribbean region, dry forests have been disturbed more than any other type, and St. Vincent is no exception. At the Virgin Islands Biosphere Reserve in St. John, U.S. Virgin Islands, techniques are being developed for the restoration of degraded dry forests. Similar research should be applied to the dry forests in the King's Hill Forest Reserve and other areas, perhaps through a cooperative agreement with the Virgin Islands Biosphere Reserve.

FOREST CONSERVATION AND DEVELOPMENT

* To reduce and eventually halt forest cover loss, GSVG conservation and resource development policies should focus on the need to:

(1) Prevent agricultural encroachment and the harvesting of trees in specifically designated "completely protected" forest areas;

(2) Provide for carefully supervised harvesting on the basis of ecologically sound, sustained yield management in other parts of forest reserves, including some young secondary natural forest areas and plantations, which should be zoned according to their most appropriate use, e.g., "wildlife conservation", "sustained yield production" or "exploitation/conversion to plantation forest".

(3) Develop new plantations in areas where they are appropriate, such as on marginal farm lands and on some degraded forest lands.

(4) Rigorously defend water catchment areas against encroachment and permit no land use other than controlled forestry in such areas.

* Specific recommendations to assist in carrying out these general policy goals include:

Experimentation with Agroforestry Techniques. Given the high costs of plantation maintenance and the continued infringement on protected natural forests by illegal farming, additional projects in agro-forestry/social forestry should be implemented if the pilot project proposed for the Colonarie Valley supports the feasibility of these efforts. In such projects, farmers interplant agricultural crops with forest trees on selected sites which are monitored and evaluated.

Incentives for the practice of private forestry -- e.g., technical

assistance, tax credits -- need to be studied, and *legislation that will strengthen the ability of Government to protect and manage critical land areas*, including private watersheds, is needed. In St. Lucia, for example, the institution of a levy on domestic water bills to raise funds for the purchase and maintenance of private forested watersheds has been recommended. This is an innovative proposal and could serve as a model for the Eastern Caribbean region.

* A similar source of funds will need to be identified in St. Vincent to finance protective measures such as the following:

(1) purchase of conservation easements (where the owner agrees not to do certain things, e.g., to forego building a road, cutting trees, harvesting fuelwood);

(2) purchase of development rights;

(3) payment of a premium for improved landscape/forest management, e.g., terracing of damaged areas or reforestation;

(4) payment for a long-term lease of watershed land needing protection;

(5) compensation to landowners for down-zoning (reclassifying) land as a restricted or no development, protected area (which might allow certain uses but not others, by definition).

FUELWOOD

* A more systematic evaluation of fuelwood extraction rates is required in order to identify specific areas in St. Vincent and the Grenadines where continued harvesting for this purpose poses a serious environmental problem. Although conclusive documentation is not presently available, it would appear that fuelwood production may represent a high-risk threat to forest resources. Obvious areas of concern are the forest reserves as well as primary watersheds where removal of ground cover for any reason endangers key water supplies.

* Key management strategies should focus on enforcement and monitoring (for example, repeated monitoring of the charcoal market to pinpoint production increases from areas of critical concern). Also, the planning, monitoring and quantifying of fuelwood harvesting may be sufficiently important to warrant the eventual creation of a fuelwood forester post and/or a community/social forester post within the Forestry Division.

2.2 BIODIVERSITY, ENDANGERED SPECIES AND WILDLIFE

2.2.1 Overview

BIODIVERSITY

Plants. According to Davis, *et al.* (1986), the best available information on the floristics of St. Vincent and the Grenadines is in a late nineteenth-century flora of these islands (Anon., 1893). This source, which is now very much outdated, lists about 490 genera and 1,150 species of flowering plants and 163 species of ferns. These numbers could change significantly now that up-to-date information on the taxonomy and distribution of Vincentian plants has recently become available with the completion of Richard Howard's six volume *Flora of the Lesser Antilles* (Howard, 1974-89).

Invertebrates. Information on the occurrence and distribution of most groups of terrestrial invertebrates in St. Vincent and the Grenadines is unavailable. However, the decapod crustacean fauna of these islands includes several species of freshwater shrimp and freshwater or terrestrial crabs, some of which are locally prized as food. Chace and Hobbs (1969), in their review of West Indian terrestrial crustacea, list only *Atya innocous, Macrobrachium carcinus, M. faustinum* and *M. heterochirus* as collected in St. Vincent and the Grenadines, but there are other species which occur here. In addition to the species mentioned above, Talbot (1983) lists two other species of Atya, four other species of *Macrobrachium*, the prawn *Palaemon pandaliformis*, and the shrimp *Micratya poeyi* as likely to be found in the freshwater streams. The Blue Land Crab (*Cardisoma guanhumi*) is common in wetlands near the sea, and other land crabs (e.g., *Gecarcinus* sp.) are present as well as a terrestrial Hermit Crab (*Coenobita clypeatus*). Shore-living species such as Ghost Crabs and Rock Crabs (family Grapsidae), considered semi-terrestrial by Chace and Smith, are also present. Most of these animals are widely distributed in the Caribbean.

Fishes. Estuarine fishes such as Mullet (*Mugil*), Mudfish (*Centropomus*), and Shad (*Alosa*) probably occur in the lower reaches of the large rivers in St. Vincent. The country's "fresh-water" fishes, comprising several species of gobies, mountain mullets, clingfish, etc., are not well studied. However, the freshwater fish fauna of the Lesser Antilles is derived from only a few families -- Poeciliidae, Anguillidae, Gobiidae, Eleotridae, Mugilidae, Gerridae, Centropomidae, and Carangidae. Apparently there are no species which occur exclusively in freshwater, i.e., all the known species can move between fresh and salt water, and many of them spawn at sea. Some freshwater fishes, particularly the mountain mullet (*Agonostomus monticola*) and the tri-tri (*Sicydium plumieri*), are a traditional West Indian food resource. The latter is a goby whose young seasonally swarm in river mouths to migrate upstream; they are caught in fine-meshed nets and made into tri-tri cakes, a local delicacy.

Excluding the freshwater fishes, the remainder of the living terrestrial vertebrate fauna of the country comprises about 125 species in the groups which follow below (Maclean, *et al.*, 1977; pers. comm., D. Corke, Northeast London Polytechnic, 1990).

Amphibians. The Marine Toad (*Bufo marinus*), two Tree Frogs (*Eleutherodactylus johnstonei* and *E. urichi shrevei*) and the Pond Frog (*Leptodactylus wagneri*) are the only amphibian species known to occur in the nation. The occurrence on St. Vincent of the edible "Mountain Chicken" frog (*Leptodactylus fallax*) was apparently reported in error by Faaborg and Arendt (1985); according to Johnson (1985) it occurs only in Montserrat and Dominica.

Reptiles. Maclean, *et al.* (1977) reported 12 species of reptiles (three gecko lizards, two anole lizards, two ground lizards, an iguana, a skink and three snakes) which occur on St. Vincent. Four additional species (three lizards and a tortoise) are known from the St. Vincent Grenadines (Table 2.2(1)). The list for herpetofauna as found in Faaborg and Arendt (1985) should not be used as it is mostly incorrect and displays species accidentally transposed from a Montserrat list. This accounts for the fact that Faaborg and Arendt report (erroneously) numerous

Table 2.2(1). Distribution of amphibian and reptile species, St. Vincent and the Grenadines.

St. Vincent
- Bufo marinus
- Eleutherodactylus johnstonei
- Eleutherodactylus urichi
- Leptodactylus wagneri
- Ameiva ameiva (?)
- Anolis griseus
- Anolis trinitatus
- Gymnophthalmus underwoodi
- Hemidactylus mabouia
- Iguana iguana
- Mabuya mabouya
- Sphaerodactylus vincenti
- Thecadactylus rapicauda
- Chironius vincenti
- Corallus enydris
- Mastigodryas bruesi
- Eleutherodactylus martinicensis

Petit St. Vincent
- Iguana iguana

Prune Island
- Anolis aeneus

Union Island
- Anolis aeneus
- Ameiva ameiva
- Iguana iguana
- Corallus enydris
- Mastigodryas bruesi

Tobago Cays
- Anolis aeneus
- Iguana iguana

Mayero (= Mayreau, Mayeau)
- Ameiva ameiva
- Anolis aeneus
- Hemidactylus mabouia
- Mabuya mabouya

Catholic Island
- Anolis aeneus

Canouan
- Geochelone carbonaria
- Ameiva ameiva
- Iguana iguana
- Bachia heteropus
- Mabuya mabouya

Petit Canouan
- Anolis aeneus

Savan Island
- Anolis aeneus
- Iguana iguana

Petit Mustique
- Anolis aeneus
- Iguana iguana

Mustique
- Ameiva ameiva
- Anolis aeneus
- Iguana iguana
- Corallus enydris
- Mastigodryas bruesi

Baliceaux
- Anolis aeneus

Battowia
- Anolis aeneus
- Iguana iguana

Quatre Island
- Anolis aeneus
- Iguana iguana
- Corallus enydris
- Mastigodryas bruesi

Bequia
- Leptodactylus wagneri
- Mastigodryas bruesi
- Ameiva ameiva
- Anolis aeneus
- Anolis richardi
- Bachia heteropus
- Hemidactylus mabouia
- Iguana iguana
- Mabuya mabouya
- Thecadactylus rapicauda
- Corallus enydris

Petit Bateau
- Ameiva ameiva
- Mabuya mabouya

Cabret
- Anolis aeneus

Source: Maclean, et al., 1977; pers. comm., Dr. David Corke, Senior Ecologist, Northeast London Polytechnic, 1990.

Table 2.2(2). Seabird species reported to breed in St. Vincent and the Grenadines.

Common Name	Scientific Name	Reg. Conserv. Priority
St. Vincent		
Red-billed Tropicbird	Phaeton aethereus	To be monitored
Yellow-billed Tropicbird	Phaeton lepturus	No immediate concern
Roseate Tern	Sterna dougallii	Special concern
Brown Noddy	Anous stolidus	No immediate concern
Grenada Grenadines/St. Vincent Grenadines		
Audubon Shearwater (?)	Puffinus lherminieri	Special concern
Red-billed tropicbird	Phaeton aethereus	To be monitored
Magnificent Frigatebird	Fregata magnificens	Special concern
Masked Booby	Sula dactylatra	Special concern
Red-footed Booby	Sula sula	To be monitored
Brown Booby	Sula leucogaster	To be monitored
Laughing Gull	Larus atricilla	No immediate concern
Royal Tern	Sterna maxima	To be monitored
Roseate Tern	Sterna dougallii	Special concern
Bridled Tern	Sterna anaethetus	No immediate concern
Sooty Tern	Sterna fuscata	No immediate concern
Brown Noddy	Anous stolidus	No immediate concern

(?) means breeding is unconfirmed.

Source: Halewyn and Norton, 1984.

species not cited by any other investigators, including Maclean, *et al.*, 1977 and D. Corke (Northeast London Polytechnic, pers. comm., 1990), who are generally in agreement.

Birds. Faaborg and Arendt (1985) list a total of 95 species of breeding land birds in St. Vincent and the Grenadines, with information on their status. Halewyn and Norton (1984) reported that St. Vincent has only four species of breeding seabirds and is therefore relatively unimportant to this group; however, the Grenadines, with at least 12 breeding species, are of major regional importance (Table 2.2(2)).

Mammals. There are fifteen extant, non-marine species of native or naturalized mammals which are found in the wild in St. Vincent and the Grenadines. The mammal fauna (mostly consisting of native bats) is shown in Table 2.2(3). Of the non-flying mammals, only the extinct St. Vincent Rice Rat is thought to be native to the country; the other species were introduced by either Amerindian or European settlers.

Table 2.2(4) is a provisional and incomplete summary of biodiversity information for the country.

Table 2.2(3). Non-marine mammal species occuring in St. Vincent and the Grenadines.

Bats:	*Noctilio leporinus* *Artibeus jamaicensis* *Ardops nichollsi* *Brachyphylla cavernosum* *Natalus stramineus* *Tadarida brasiliensis* *Molossus molossus* *Monophyllus plethodon*
Rice Rat:	*Oryzomys victus* (extinct St. Vincent endemic)
Agouti:	*Dasyprocta agutl* (introduced)
Mongoose:	*Herpestes auropunctatus* (introduced)
Rats:	*Rattus rattus* (introduced) *Rattus norvegicus* (introduced)
Mice:	*Mus musculus* (introduced)
Opposum:	*Didelphis marsupialis* (introduced)
Armadillo:	*Dasypus novemcinctus* (introduced)

N.B. Faaborg and Arendt list two (unspecified) species of extinct *Oryzomyini*, but do not include the bat *Monophyllus plethodon*, which is listed by Johnson. Butler lists the armadillo, which is not listed by any of the others.

Source: Faaborg and Arendt, 1985; Johnson, 1988; Butler, 1988; CEP National Committee, 1990.

ENDEMISM AND THREATENED/ENDANGERED SPECIES

A Kew Garden report (Anon., 1893) listed sixteen species of flowering plants and four species of ferns (Table 2.2(5)) as *endemic* to St. Vincent and the Grenadines, i.e., occurring nowhere else in the world. Beard (1949) listed 29 regionally endemic tree species which occur in St. Vincent but listed no single-island endemic trees. No information on status is available for any of these endemic or rare plant species. Miller, *et al.* (1988) pointed out that any native plant species restricted to the dry forest habitat would probably be under the greatest threat since that vegetation type is the most disturbed. *Spachea perforata*, known as the "Soufriere Plant of St. Vincent," has been widely publicized as an all-but-extinct endemic because the only known living specimen resides in the Kingstown Botanical Garden. However, this species is now believed to be an introduction from South America (Howard; in Davis, *et al.*, 1986).

No endemic invertebrates or fishes have been described in St. Vincent and the Grenadines. Johnson (1988) was unable to find any sources of information on regional endemism among invertebrates or freshwater fishes or any information on the ecology and status of these groups.

Table 2.2(4). Biodiversity summary: St. Vincent and the Grenadines.

	Total Species	Species Endemic to: Island	Group/Region	RDB Species*
Mammals	15	(1)	3	-
Birds	95	2	7	4
Reptiles	16	3	3	3
Amphibians	4	-	-	-
Fish	N/A	N/A	N/A	-
Invertebrates	N/A	N/A	N/A	-
Plants	1,150	12	N/A	-

*RDB means IUCN Red Data Book of Endangered Species.
Parentheses indicate known species extinctions since 1600.

Source: Johnson, 1988; Butler, 1988; pers. comm., Dr. David Corke, Senior Ecologist, Northeast London Polytechnic, 1990; CEP National Committee, 1990.

Table 2.2(5). Flowering plants and ferns endemic to St. Vincent and the Grenadines.

Endemic Flowering Plants:	Endemic Ferns
Trigynaea antillana	*Cyathea tenera*
Meliosma herbertii	*Pteris longibrachiata*
Calliandra guildingii	*Asplenium godmani*
Psidium guildinglanum	*Acrostichum smithii*
Gustavia antillana	
Tibouchina cistoides	
Begonia rotundifolia	
Hoffmannia tubiflora	
Malouetia retroflexa	
Columnea speciosa	
Peperomia cuneata	
Peperomia vincentiana	
Croton guildingii	
Epidendrum vincentinum	
Tillandsia megastachya	
Spachea perforata	

Source: Anon., 1893, cited in Miller, *et al.*, 1988.

None of the amphibian species is currently thought to be a single-island endemic or a regional endemic. However, the frog *E. urichi shrevei*, now thought to be an endemic subspecies, may eventually turn out to be a valid endemic species (Crombie; in Johnson, 1988).

Two St. Vincent species of lizards (*Anolis griseus* and *A. trinitatus*) and a snake (*Chironius vincenti*) are single-island endemics, and two other lizards (*Gymnophthalmus underwoodi* and *Sphaerodactylus vicenti*) and a snake (*Mastigodryas bruesi*) are regional endemics. No information on status is available for these reptiles, except for *Anolis griseus* which is reported to be "fairly common" in coastal areas (Johnson, 1988).

Two St. Vincent land birds (the St. Vincent Parrot, *Amazona guildingii*, and the Whistling Warbler, *Catharopeza bishopi*) are single-island endemic species. There are endemic sub-species of the Rufous-throated or St. Vincent Solitaire (*Myadestes genibaris*) and the House Wren (*Troglodytes aedon*), and an additional seven bird species which occur in the nation (listed in Johnson, 1988) are endemic to the Lesser Antilles. The Tundra Peregrine Falcon (*Falco peregrinus tundrius*) and the St. Vincent Solitaire are both listed in the IUCN Red Data Book (King, 1978-79) as endangered; the House Wren was also formerly listed as endangered but is not so listed at present.

THE ST. VINCENT PARROT

The St. Vincent Parrot is one of four remaining species of Lesser Antillean parrots in the genus *Amazona* (out of an original seven). Because it is a single-island endemic and has a very low population which is under pressure, it is listed as an endangered species by the ICBP International Bird Red Data Book and also in Appendix 1 of the Convention on International Trade in Endangered Species (CITES).

The St. Vincent Parrot at present has a small but apparently stable population of about 500 (Butler, 1988), concentrated in the upper watersheds of the Buccament, Colonarie and Cumberland Rivers. The parrot is a bird of the forest canopy and is primarily found in undisturbed rain forest habitats; its present range is shown in Figure 2.2(1). Butler (1988) provides the most up-to-date and comprehensive information on the St. Vincent Parrot, including summaries of previous research, conservation efforts, legislation, present status, and public education programs. According to Butler, the major threats to the continued existence of the parrot are: hurricanes, volcanic activity, hunting (virtually ceased at present), the pet trade (now illegal but highly lucrative and therefore a continuing threat), and habitat disturbance (deforestation for fuelwood and agriculture are the most serious threats). *Areas of principal concern at this time are the Congo, Jennings, and Perseverance Valleys, Vermont, and Cumberland, all of which have high parrot concentrations and are threatened by illegal agricultural activities.*

In 1972 the Houston Zoo reported that a St. Vincent Parrot had been hatched in captivity for the first time; however, only one more was successfully hatched by 1980, and the Zoo's captive breeding program was discontinued. Another attempt at captive breeding at the Jersey Wildlife Preservation Trust/Jersey Zoo has also been discontinued. Twenty-four captive parrots are maintained in an aviary located at the Kingstown Botanic Gardens and run by the GSVG's Forestry Division with assistance from World Wildlife Fund-US, the Jersey Zoo and the Jersey Wildlife Preservation Trust. There is presently an on-going captive breeding project at the Botanic Gardens; five chicks were hatched and successfully fledged as of 1990.

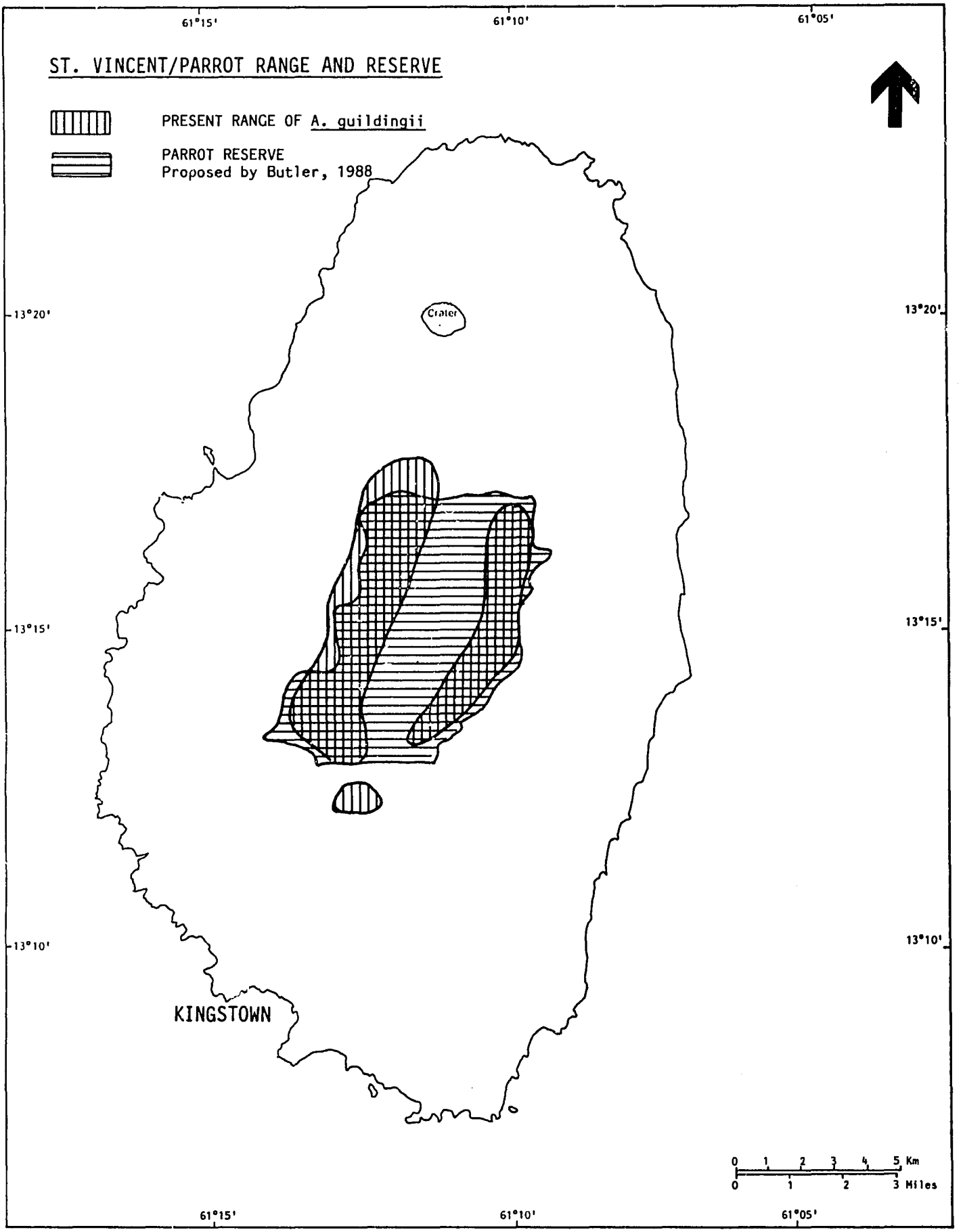


Figure 2.2(1). Distribution map of the St. Vincent Parrot and boundaries of the Parrot Reserve (source: adapted from Butler, 1988).

The status of the St. Vincent Parrot is discussed below. The Whistling Warbler inhabits forest understory, and, according to Johnson (1988), its population is believed to be sparse and apparently localized at lower altitudes where forest and agricultural areas meet, but common at moderate altitudes. A field survey of the Whistling Warbler was carried out from late June to mid-August, 1988 by four students from the University of East Anglia with secondary studies on the St. Vincent Solitaire and St. Vincent House Wren (Univ. of East Anglia, 1988).

Population estimates from this survey were not reported in the University of East Anglia report, but preliminary analysis indicated that the warbler was common in primary rain forest, palm brake, and elfin woodland; it was uncommon in old growth secondary forest and absent from plantations. The Rufous-throated Solitaire was common in the palm brake and elfin woodland in the area of Richmond Peak and fairly numerous in the higher areas of primary rain forest. The House Wren was abundant on the southwest slopes of Soufriere and around Chateaubelair, where it occurs in all habitats from coastal banana plantations up to the lower limit of the palm brake. The conclusion of this study was that none of the three bird species is presently endangered due to habitat destruction or to any other cause.

There are no single-island endemic mammals in the country, but three bats (*Ardops nichollsi*, *Brachyphylla cavernarum*, and *Monophyllus plethodon*) are regional endemics (Johnson, 1988). The IUCN Mammal Red Data Book (Thornback and Jenkins, 1982) does not list any of the local species as threatened.

WILDLIFE HUNTING SEASONS AND PROTECTED AREA LEGISLATION

The Birds and Fish Protection Ordinance passed in 1901 provided legislative protection of all species of wild birds as well as fish and lobsters. Absolute protection was given to all seabirds, certain wading and swamp birds, and all land birds with the exception of doves, pigeons, chachalaca, quail, peregrine falcon, and merlin. A closed season provided partial protection for pigeons, doves, ducks, and wading birds, as well as lobster and sea turtles. It also authorized the Governor General to designate any area as a sanctuary affording year-round protection from hunting for all species. Proclamations 43 of 1947 and 82 of 1950 declared Young's Island, King's Hill, Government House Grounds and Botanical Gardens, Milligan Cay, Pigeon Island and Isle de Quatre to be bird sanctuaries. However, none of these laws was enforced, and in any case the low penalties prescribed failed as a deterrent.

In 1987 the Wildlife Protection Act (No. 16 of 1987) was passed; this law repealed the Birds and Fish Protection Ordinance as far as it pertains to wildlife covered under the new act. This act provides for the appointment of a Chief Wildlife Protection Officer who will be responsible for the management of wildlife and the administration and enforcement of the Act. Until this officer is appointed, the Chief Forest Officer will have the responsibility of carrying out these duties. The Act provides for the establishment of a number of wildlife reserves (in addition to the forest reserves) in which all wildlife is protected year-round; these reserves are listed in Table 2.2(6) and displayed in Figure 2.2(2). The Act also set aside as a Parrot Reserve an area of 7,596 acres in a single, contiguous parcel including the Upper Buccament Valley, the Upper Cumberland River Valley, and the Upper Colonarie River Valley; a separate, isolated parcel of some 3,690 acres lying to the north and bounded by the peak of La Soufriere was also included in the Reserve.

The 1987 Act provides absolute year-round protection for four species of reptiles; all seabirds; all wading birds except yellow legs, snipe, sandpipers, plovers and ducks; and all land birds except doves, pigeons, chachalaca and quail. The exempted species as well as the opossum, agouti, armadillo, and iguana may be hunted except during a closed season. The closed season for the birds is from 1 March to 30 September; and for the armadillo, opossum, agouti and iguana it is from 1 February to 30 September. Bats, rats, mice and mongoose are defined as "vermin" and may be hunted at any time.

Table 2.2(6). Wildlife reserves declared under the 1987 Wildlife Protection Act in St. Vincent and the Grenadines.

	Name of Reserve	Reserve Area
1.	Young Island	Entire island
2.	King's Hill	Boundaries set by Chief Wildlife Officer
3.	Falls of Baleine	Boundaries set by Chief Wildlife Officer
4.	Govt. House Grounds	Including Botanical Gardens
5.	Milligan Cay	Entire island
6.	Pigeon (Ramier) Island	Entire island
7.	Isle de Quatre	Entire island
8.	All Awash Island	Entire island
9.	Catholic Island	Entire island
10.	Battowia Island	Entire island
11.	Catholic Rocks	Entire island
12.	Chateaubelair Islet	Entire island
13.	La Paz Island	Entire island
14.	Frigate Rock (Island?)	Entire island
15.	Petit Canouan	Entire island
16.	Sail Rock	Entire island
17.	Tobago Cays	Entire island group
18.	Big Cay	Entire island
19.	West Cay	Entire island
20.	Petit St. Vincent	Entire island
21.	Prune (Palm) Island	Entire island
22.	Savan Islands	Entire island group
23.	Northern end of Bequia	Beyond "Industry Point"

Sources: Wildlife Protection Act, No. 16, 1987; Butler, 1988.

The Act also provides for fines and jail sentences for offenders, the issuance of hunting licenses and import or export permits, and special provisions for the management of the St. Vincent Parrot.

2.2.2 Problems and Issues

THE WILDLIFE PROTECTION ACT

Unfortunately, parts of the 1987 Wildlife Protection Act contained several significant errors. Schedule 1 has an error relating to the boundaries for the Parrot Reserve. Schedule 2 designates some species for absolute protection which are endemic to St. Lucia and which do not occur in St. Vincent and the Grenadines; it also omits others which are endemic to this country and deserve protection. Schedule 3, which lists species that may be hunted in season, also contains errors.

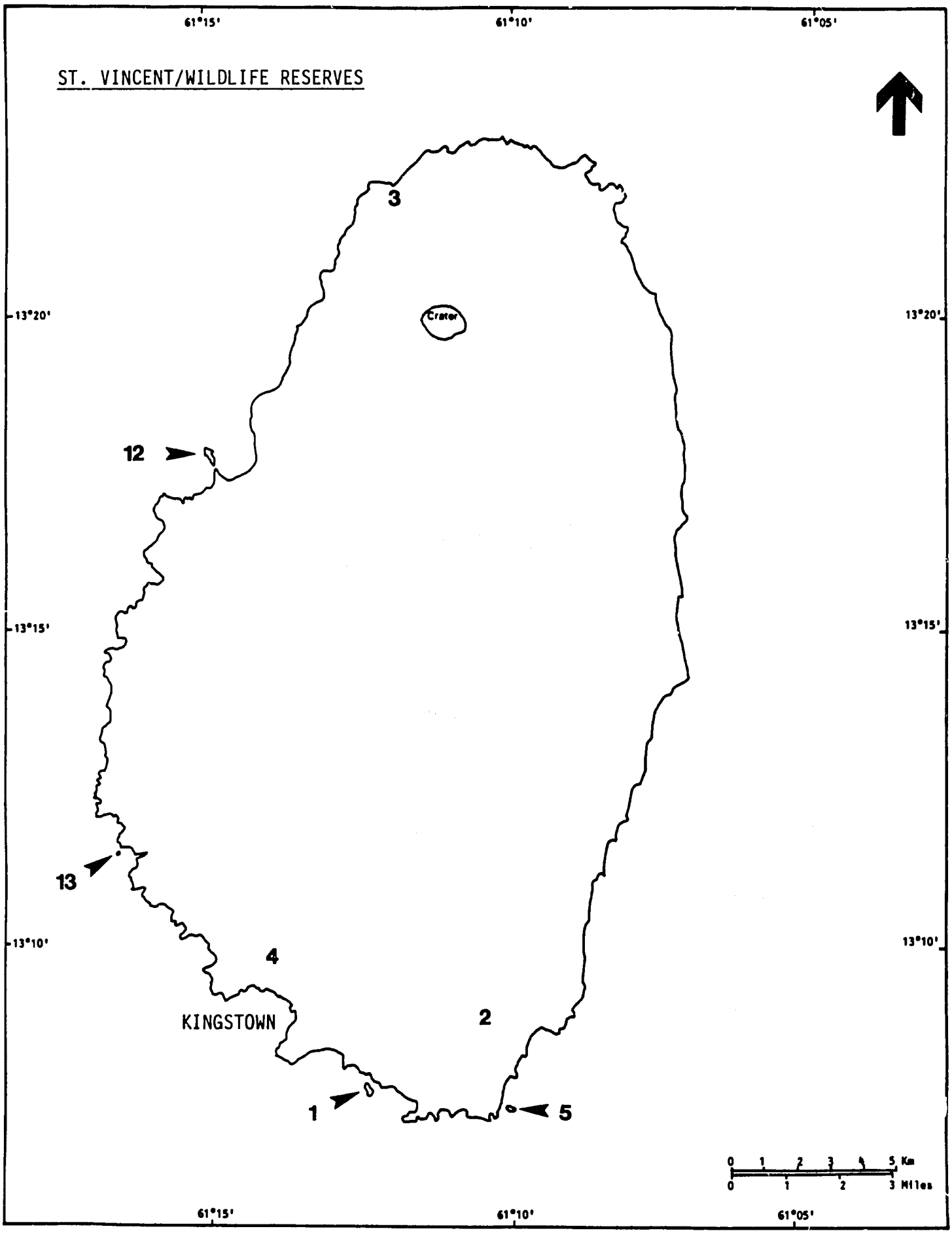


Figure 2.2(2a). Location of designated wildlife reserves, St. Vincent (source: Wildlife Protection Act, No. 16 of 1987). Numbers correspond to names of reserves in Table 2.2(6).

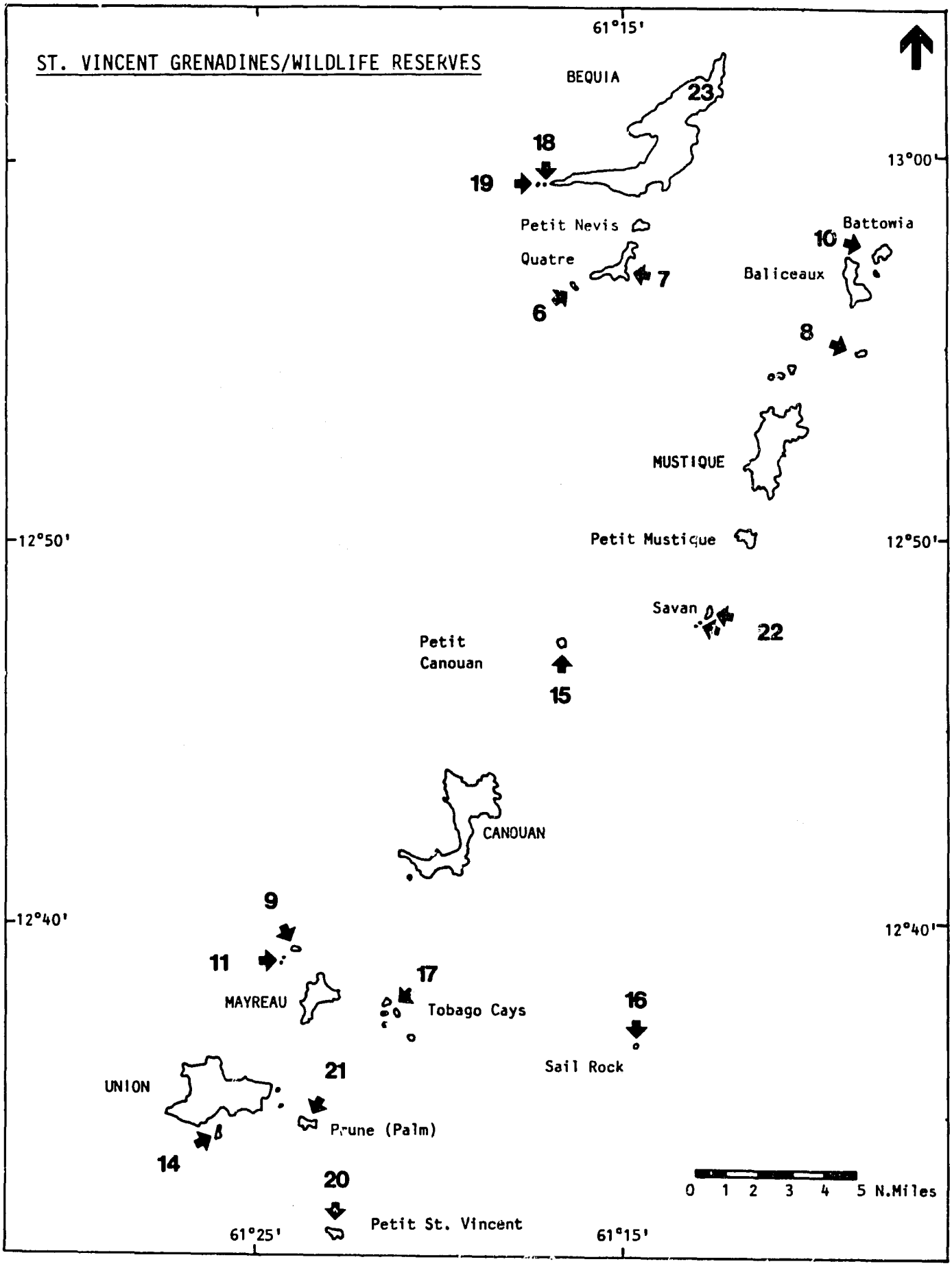


Figure 2.2(2b). Location of designated wildlife reserves, St. Vincent Grenadines (source: Wildlife Protection Act, No. 16 of 1987). Numbers correspond to names of reserves in Table 2.2(6).

Butler (1988; see his section 8:2:1) made recommendations for the correction of Schedules 1, 2 and 3 and for the clarification of other language in the legislation; Schedules 1 and 2 were corrected in 1988.

There were fundamental problems with the two separate areas comprising the Parrot Reserve as originally defined in Schedule 1 of the Act, including: land ownership and land use conflicts; the difficulties and expense involved in demarcating a long boundary which did not follow easily visible physical features; and the fact that much of the area set aside had no parrots in it, while at the same time large areas of known parrot habitat were excluded. Butler, as the Forestry Division's consultant on the parrot project, therefore recommended that the GSVG redefine and gazette the boundaries of the Parrot Reserve as an amendment to the original legislation.

This redefined parrot reserve forms a single contiguous unit of 10,870 acres with easily identifiable boundaries which for the most part are comprised of ridges and rivers. With the exception of a few small parcels in the Young Man's Valley area, the entire reserve is crown land. By almost entirely excluding areas under cultivation, it minimizes conflict with farmers and at the same time affords coverage to all the principal areas of parrot habitat. It also protects habitat for the Whistling Warbler and gives maximum protection to major watershed areas, including the Cumberland and Colonarie Rivers which are used for hydroelectric power generation. Finally, the reserve lies entirely within the proposed forest reserve which will act as a buffer zone. The forest reserve is expected to include all remaining forested crown lands as well as extremely steep lands (Butler, 1988), and its boundaries will be demarcated by the CIDA forest management project.

The Act's definition of all species of bats as "vermin" which can be hunted indiscriminately is unfortunate. Several species of native bats are insectivorous; such bats are some of the most efficient predators of insects and should be protected as an important form of biological control which reduces the need for chemical insecticides. Other species may be important pollinators of the native flora, including forest trees; even the frugivorous species which are commonly classed as pests can be important disseminators of plant seeds.

LOSS OF NATIVE WILDLIFE HABITAT

The primary negative impact of development on all forms of wildlife in most Caribbean islands appears to be habitat reduction via the conversion of forested wildlands to other habitat types and land uses. In SVG, habitat and home range requirements and minimum viable population sizes for most species are as yet poorly known. The small land mass of the country means that any 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 forest and other native vegetation types, such reserves could perhaps include sufficient area to prevent the extinction of some of the 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 perhaps needs to be underscored. Unfortunately, even-age plantations of exotic timber trees are typically almost free of native wildlife; even mixed tree-crops are better habitat. The suggestions offered earlier that, for the smaller species, existing forest reserves and proposed parks may be adequate to assure species survival depends on retaining substantial tracts of native forest. To the extent that native forest within the reserves is replaced by exotic trees, those suggestions grow more tenuous. The question of how much forested land is necessary to have a reasonable probability of maintaining a given species or community is difficult but not impossible to answer by means of research.

Various long-term studies of the fauna of natural vegetation types in Dominica (carried out by P. Evans and summarized in Rainey, *et al.*, 1987) showed that rain forest supported the highest bird diversity and biomass (but this is not necessarily the case on St. Vincent). Cultivated plots with native

forest adjacent had higher bird diversity than extensive crop monocultures. The pattern as well as the extent of forest clearing was found to be significant because the forest birds differed considerably in home range size. Some forest birds had a small home range and thus could be expected to persist in a smaller remnant of forest. Others, such as the Red-necked Pigeon, the Ruddy Quail Dove and the Amazona parrots, required relatively large areas of intact forest. A substantial number of birds which foraged in cultivated areas required adjacent forest for roosting and nesting.

IMPACT OF BIOCIDES ON WILDLIFE

Large amounts of pesticides and herbicides (collectively referred to as biocides) are applied to agricultural crops in St. Vincent (see Section 8), but the effects of these chemicals on wildlife and the terrestrial and marine ecosystems of St. Vincent remain unstudied. Many persons are concerned that the freshwater fishes, shrimp ("crayfish") and crabs which are traditionally harvested for food in St. Vincent have suffered a serious decline in abundance in recent years. This decline has not been quantitatively documented, but there appears to be wide agreement that the perceived trend is significant and real. It has been reported that the deliberate poisoning of streams using biocides such as Sevin is a common means of collecting fish and crayfish for sale. The decline has also been attributed by some to the widespread agricultural use of potent biocides and to the decline in streamwater quality caused by sedimentation or pollution by sewage and industrial wastes.

The larvae of the West Indian freshwater stream fauna generally require some salinity (varying from estuarine conditions to full-strength seawater) to complete their development. Several land-crab species undertake seasonal mass migrations, moving from inland areas to form dense aggregations at the shore where they release their larvae into the sea. For such species, the local populations are likely to be maintained by larvae spawned on other islands and dispersed by ocean currents. Restocking of depleted streams would probably occur naturally if streamwater quality were restored, *provided* that viable breeding populations still remained in the up-current source areas. However, given the prevalence of biocide abuse and stream pollution in the region, the continuing availability of larvae should not be taken for granted.

Even if standard toxicological data were available for St. Vincent (which they are not), 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 biocides 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 biocides, often in combination with additional environmental stresses (e.g., habitat reduction or an unusually severe dry season), cannot yet be predicted even at the single-species level. Because detailed ecological field data is not available for most species and biological communities in St. Vincent, the reader is referred to Evan's study in Dominica (cited in Rainey, *et al.*, 1987), which was concerned primarily with the effects on wildlife of the fungicides and nematicides used in the banana industry.

With these sweeping caveats in mind, 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.

WILDLIFE MANAGEMENT

Little is known about the ecology, distribution or habitat requirements of wildlife in St. Vincent and the Grenadines. Thus far, the major wildlife focus of the Forestry Division has been on the conservation of the St. Vincent Parrot, with funding for captive breeding from the World Wildlife Fund-US, Wildlife Preservation Trust International, and Jersey Wildlife Preservation Trust (UK).

A new U.S. Peace Corps Volunteer Wildlife Biologist has recently arrived in the country; over the next two years he will study the distribution and habitat requirements of various wildlife species and prepare management plans for them (pers. comm., B. Johnson, Senior Forest Supervisor, April, 1990).

INTERNATIONAL WILDLIFE TRADE

International trade is a major threat to the survival of many wildlife species in the Caribbean (TRAFFIC, [U.S.A.], 1988). 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 trade through a worldwide system of import and export controls for species which are listed in three appendices. Appendix I of the Convention lists species which are threatened with extinction and for which commercial trade is prohibited; Appendix II lists species which may become extinct unless trade is strictly regulated; and Appendix III reports those species protected in their country of origin and for which the cooperation of other nations is required in order to enforce export restrictions. Species occurring in St. Vincent and the Grenadines which are covered by the Convention include the St. Vincent Parrot, the Green Turtle, the Hawksbill Turtle, and all large species of whale.

CITES offers very imperfect protection to endangered species since a member country is obligated only to ensure that products from such species do not enter *international* trade; hunting and killing of these species for *local* trade is not prohibited. Moreover, any country is allowed to enter "reservations" at the time of ratifying the Convention which allow it to continue its international trade in certain species which it so designates (e.g., GSVG has entered reservations for the Leatherback Turtle and Humpback Whale; pers. commun., CEP National Committee, 1990).

St. Vincent and the Grenadines became a signatory to the CITES convention in November, 1988. Membership in CITES may help to curtail trade in such species as the endangered St. Vincent Parrot, but illegal export still poses a threat because of the high prices commanded by Caribbean parrot species. Also, see Section 5 for further discussion of CITES in relation to marine species.

2.2.3 Policy Recommendations

LEGISLATION

* The changes in the 1987 Wildlife Protection Act regarding revision of Schedules 2 and 3 and the boundaries of the Parrot Reserve which were proposed by Butler (1988) should be officially adopted by GSVG. The status of species in Schedules 3 and 6 should be reviewed; some species (at a minimum some of the bats) may need to be transferred to Schedule 2 for absolute protection.

* The St. Vincent National Trust recommends that the chachalaca, quail and iguana also be considered for absolute protection (due to the increasing disturbance of their habitat and their apparently reduced populations), and concurs that bats should be removed from the vermin list (pers. comm., E. Kirby, Chairman, St. Vincent National Trust, April, 1990).

* Once a survey of wildlife habitat and populations has been carried out (see below), additional wildlife reserves may need to be designated in order to protect critical habitat for species not adequately represented in the present system of reserves. On the other hand, it may be determined that some of

the presently designated reserves have little actual value for wildlife and might be dropped from the system.

RESEARCH AND MONITORING

* Distribution and habitat studies need to be undertaken for wildlife, with priority being given to those that are endemic, locally or internationally endangered or threatened, migratory species, and those species that are legally hunted. Population monitoring should be undertaken for critical species in addition to the St. Vincent Parrot.

* The Forestry Division should encourage the participation of visiting researchers, natural history study expeditions (e.g., Earthwatch), and local bird watching enthusiasts to assist in the assemblage of monitoring data. The use of such citizen groups in environmental monitoring is invaluable and does not require the expenditure of scarce government funds. The use of standard methods should be required of these participants in order to obtain useful and comparable data.

* To maintain biodiversity in the face of increasing demands for agricultural land requires at least semi-quantitative knowledge of the parameters for maintaining species or communities (e.g., in terms of land area or other resources). One way external aid agencies, whose funds fuel the engines of development, can aid in the maintenance of biodiversity is to support ecological and demographic assessments of species which are either obviously threatened or are less well-known but closely linked to the habitat being modified.

* A Wildlife Unit needs to be established within the Forestry Department, employing a trained wildlife biologist and one or two assistants. Responsibilities of the Unit should emphasize applied research in wildlife management for selected species (e.g., establishing ranges and ecological requirements, assessing degree of threat, estimating minimum population and habitat sizes, etc.) as well as long-term monitoring of wildlife populations and habitats. Those species which are most significant and/or most critically endangered should be given priority attention by the Unit.

* Seabird breeding sites should be surveyed and populations should be monitored, particularly on the offshore islets and in the Grenadines. Some management of exotic species (e.g., goats) and habitat restoration may be required. Seabird population dynamics around the world appear to be greatly influenced by unpredictable climatic events such as the El Nino-Southern Oscillation phenomenon (Schreiber and Schreiber, 1989). Therefore, long-term monitoring is the only method of gaining insight into the true status of seabird species in a local area.

* A data base on the status of wildlife populations *and their habitats*, probably in computerized form, should be established and maintained by the recommended Wildlife Unit.

TRAINING OF STAFF

* The Forestry Division should seek funding from appropriate donor agencies for staff training, technical support, and equipment for the Wildlife Unit and the public education program. Forestry Division staff training is needed in the following areas (Butler, 1988): basic veterinary techniques with an emphasis on parrots; tour guides and nature interpretation; and wildlife management.

LAND USE

* A detailed land use plan should be completed for St. Vincent and the Grenadines, including consideration of biodiversity issues. Restrictions should be placed on clearing native forest from agriculturally marginal lands in certain areas and habitat types. Since wildlife values are typically given little weight in planning efforts, one requirement should be the development of an ecologically-sound, quantitative analysis of current land use practices and trends and their effects on wildlife.

BIOCIDES

* An "institutional memory" should be developed for pollutant impacts on wildlife, by means of a simple data base. Descriptive information, even if unconfirmed by site visits, would provide a perspective on the frequency and distribution of events. It would also be desirable to do selective sampling of soil and groundwater levels for the more toxic biocides used in the agricultural industry. Such a survey could constructively include a limited assessment of chlorinated hydrocarbon residues in wildlife as well.

* There is a need to establish a small-scale pesticide disposal system and to review methods to avoid or minimize the dispersal of pesticides from agricultural industry warehouses in natural disasters such as hurricanes.

ENFORCEMENT AND EDUCATION

* St. Vincent and the Grenadines has had legislation to protect wildlife since 1901, but such laws seem to have had little or no effect due to an almost total lack of enforcement. If the 1987 Act is to have more impact, it is obvious that GSVG must allocate sufficient resources to implement the law. Enforcement alone will not achieve total protection of wildlife; in order to fulfill legislative goals, enforcement must be coupled with greater and more effective public education efforts.

PROTECTED AREAS

* The proposed system of National Parks, Forest Reserves, and Protected Areas, or some subset of it which includes the most critical areas for the preservation of St. Vincent's biodiversity, should be implemented as soon as possible.

The expansion of banana production, the mainstay of Vincentian agriculture, on to much steeper areas can result in serious erosion and downstream sediment pollution problems.

SECTION 3 AGRICULTURE AND WATERSHED MANAGEMENT

3.1 OVERVIEW

PROFILE OF THE AGRICULTURAL SECTOR

Agriculture remains the most productive sector of the national economy of St. Vincent and the Grenadines and is the primary generator of foreign exchange. It accounts for almost 20 percent of GDP (see Figure 1.3(5) and Table 3.1(1)) and 65 percent of exports. Agriculture is the main source of employment, with some two-thirds of the labor force employed in that sector (FAO, 1987; IICA, 1989). Table 3.1(2) displays exports of selected commodities for 1983-1986, and Table 3.1(3) provides production data for selected agricultural commodities.

Agriculture in the Eastern Caribbean is often characterized as comprising two distinct farming systems: (1) the export-oriented, plantation system depicted chiefly by monocultures on large estates, and (2) the small farmer agricultural system, often subsistence-based and developed on the more marginal agricultural lands.

Of the plantation crops that have been important in St. Vincent and the Grenadines, only bananas remain a major export crop. The sugar industry collapsed in the late 1800's, tried to make a comeback in the 1970's, but was abandoned again in 1985 (IICA, 1989).

Bananas. This has been the dominant crop for more than 30 years in St. Vincent and the Grenadines. Banana production is the major employer of labor, the main earner of foreign exchange (accounting for approximately 40 percent of all export earnings [World Bank, 1985]) and the principal user of arable land (some 7,500 active growers use about 1,200 acres of the 29,000 acres of arable land in the country [SVBGA data, 1990]). Frequently, the area under bananas is kept free of other crops, leading to excessive soil erosion (Miller, *et al*, 1988). Productivity for bananas is quite low, with an average yield of 6.7 tons/acre. For comparison, the average yield in commercial plantations in banana-exporting countries is about 20 tons/acre (Gonsalves, 1989).

Bananas for export from St. Vincent and all the Windward Islands are bought exclusively by Geest Industries (Thomson, 1987). This trans-national corporation sells the produce almost entirely in the United Kingdom, where it enjoys preferential market treatment. Without some sort of market protection, the Windward Islands would likely lose their share of the market to other banana-exporting countries which produce cheaper bananas at a consistently higher quality. The Single Europe Act of 1992, which will remove all tariff and non-tariff barriers within the 12-nation European Economic Community, could devastate St. Vincent's banana industry. Although steps are being taken in St. Vincent to improve banana productivity and quality and to diversify into other crops, it is clear that only a political solution is capable of averting a collapse of the banana industry which could potentially undermine the entire national economy (Gonsalves, 1989; *Courier*, 1989).

Ground provisions. Ground provisions (eddoes, tannias, sweet potatoes, yams and dasheens) collectively make a significant contribution to foreign earnings. During the mid-1980's, exports of ground provisions may even have overtaken bananas as the main source of foreign currency. As noted in the IICA (1989) report, however, the downturn in the economy of Trinidad and Tobago, the major buyer of SVG ground provisions, has hurt that market considerably.

Arrowroot. From the time of the collapse of the sugar industry in the late 1800's until the predominance of banana production in the mid-1950's, arrowroot was St. Vincent's primary agricultural commodity (Gonsalves, 1989). By 1957, arrowroot's share of total exports had dropped from a 1955

Table 3.1(1). Contribution of agriculture sector to GDP (millions EC$).

Sector and Subsectors	1980	1981	1982	1983	1984	1985
Agriculture	12.5	17.7	18.7	19.1	20.5	22.7
Crops	9.0	14.3	15.2	16.1	16.9	17.7
Livestock	1.7	1.5	1.5	1.5	1.5	2.3
Forestry	0.5	0.4	0.3	0.3	0.3	0.4
Fisheries	1.7	1.5	1.7	1.7	1.7	2.3
% of real GDP	13	17	17	17	17	19

Source: Central Statistic Unit. Adapted from N.C. Reninga, 1988, Proposal for Livestock Development, cited in IICA, 1989.

figure of 50 percent to 28 percent. Output of arrowroot declined steadily through the 1960's and 1970's, reaching a low of 600 tons of starch in 1971. Production increased as a new market developed for arrowroot starch as a coating on computer paper. However, two factors now conspire to depress the St. Vincent arrowroot market: (1) competition from other countries that can produce arrowroot less expensively and (2) development of a process for modifying less expensive starches to substitute for arrowroot starch (World Bank, 1985). As a consequence, arrowroot production continues to decline; as of 1988, only 130-140 acres were planted in arrowroot, and this figure is only expected to increase to 200 acres even with GSVG support (CDB, 1988).

Vegetables. Vegetables are cultivated for local consumption but must be supplemented with imports to meet domestic demand. The vegetable sub-sector is expected to play an increasingly important role as part of the Government's agricultural diversification policy. Although the country's climatic and soil conditions are generally favorable for vegetable production (see Table 3.1(4)), St. Vincent's steep slopes are not ideal for intensive vegetable cultivation. Sustainable production is possible, however, if vegetables are grown as part of mixed crop farming systems.

Fruit Tree Crops. Favorable ecological conditions support over 30 species of fruit crops. As indicated in Table 3.1(5), mangoes, coconut, breadfruit, avocadoes, golden apple, oranges, grapefruit, and limes are the primary tree crops in the country (IICA, 1989).

Livestock. The livestock sector is not a major factor in the agricultural economy, although the majority of farms include some form of livestock production which contributes substantially to domestic consumption (see Tables 3.1(6) and 3.1(7)).

On the average, a Vincentian farmer owns 1-5 head of cattle, 3-6 sheep, 1-4 goats, and 1-3 pigs. Half of the livestock farmers are landless, using communal grazing on private and government open lands, roadsides and abandoned crop lands. Native grasses growing in relatively unmanaged pastures are the main feed. The tree legumes *Leucaena*

Table 3.1(2). Exports of selected commodities (tons and 1,000 EC$), 1983 -1989.

Crop	1983 Volume	1983 Value	1984 Volume	1984 Value	1985 Volume	1985 Value	1986 Volume	1986 Value
Bananas	33,919	29,760	32,109	31,966	40,570	45,623	39,393	52,389
Arrowroot	4	6	1	1	4	6	3	5
Coconuts	926	327	3,902	1,593	831	721	865	617
Peanuts	32	212	52	342	17	183	18	60
Sweet Potatoes	944	1,187	2,202	3,045	7,754	10,982	10,729	15,370
Nutmeg	73	158	74	141	51	102	79	154
Mace	17	74	20	66	33	79	11	44
Carrots	3	4	-	-	-	-	-	-
Plantains	1,430	1,595	3,056	3,389	3,520	3,853	4,016	4,673
Ginger	158	185	256	290	329	354	644	545
Eddoes/Dasheen	8,348	11,534	16,001	24,140	23,069	34,509	20,756	31,622
Tannias	2,691	4,151	6,249	9,684	8,504	13,044	8,829	14,494
Yams	1,236	2,088	3,893	6,459	2,827	4,466	712	1,164

Crop	1987 Volume	1987 Value	1988 Volume	1988 Value	1989 Volume	1989 Value
Bananas	36,623	53,052	57,560	86,103	66,100	89,933
Arrowroot	1	2	1	1	*	*
Coconuts	999	868	881	776	880	736
Peanuts	4	21	2	6	1	4
Sweet Potatoes	4,169	5,958	7,583	10,821	3,575	5,113
Nutmeg	86	189	128	444	80	425
Mace	13	48	17	93	8	64
Plantains	2,417	2,668	2,809	3,102	1,658	1,830
Ginger	634	741	1,060	1,222	784	1,063
Eddoes/Dasheen	7,552	11,292	14,325	21,409	5,634	8,576
Tannias	2,920	4,436	5,747	8,862	1,248	1,922
Yams	526	865	638	1,047	324	580

* No exports this year.

Source: CEP National Committee, 1990.

Note: It is useful to keep in mind the general caveat raised by a consultant team asked to develop an Eastern Caribbean agricultural sector strategy: "Agricultural statistics in the Eastern Caribbean countries are few, unreliable, and inconsistent from source to source" (Chemonics, 1988).

Table 3.1(3). Estimated production of selected agricultural commodities, 1984 - 1987.

Commodity	Unit (in thousands)	1984	1985	1986	1987
Rum	Imperial Gal.	81	145	131	136
Sweet Potatoes	Kg	2,317	8,529	11,802	4,596
Yams	Kg	3,773	3,262	783	612
Tannias	Kg	6,512	9,354	9,711	2,947
Eddoes, Dasheen	Kg	16,068	23,326	20,964	74
Arrowroot Starch	Kg	783	434	315	161
Bananas	Kg	33,556	41,922	39,936	37,472
Nutmegs	Kg	73	53	81	88
Mace	Kg	20	34	11	13
Carrots	Kg	68	1	-	-
Ginger	Kg	122	362	545	668
Peanuts	Kg	84	45	32	7
Tobacco	Kg	41	73	66	76
Plantains	Kg	3,099	4,222	4,619	2,776

Sources: Agricultural Statistics Unit, Ministry of Trade and Agriculture; Arrowroot Association; Customs Department; Banana Association; Marketing Corporation; cited in Caribbean Development Bank, 1988.

leucacephala and *Glericidia sepium* scattered throughout the island provide fodder, particularly during the dry season when grass forage is not available (IICA, 1989).

LAND HOLDINGS AND TENURE SITUATION

St. Vincent and the Grenadines has the highest population density of the OECS countries (Chemonics, 1988; see also Section 1.3.1 of the Profile). Estimates of the amount of cultivable land per capita differ as a result of inconsistencies in projections of population size and the amount of land suitable for crop production. In any event, well over half the land in the country is mountainous or otherwise unsuitable for agriculture, making land a very scarce resource. There is general agreement that current demand for land suitable for agriculture or urban development significantly exceeds the supply (FAO, 1987; Chemonics, 1988). Table 3.1(8) shows land use patterns on SVG's 29,649 acres of arable land, the total reported in the most recent national agricultural census (GSVG, 1989a).

Since the end of the nineteenth century and the collapse of the sugar industry, two basic patterns reflecting changes in land ownership have emerged, both of which continue to the present. First, GSVG has acquired large, private estates and gradually redistributed such land to independent small farmers. In 1899, 5,600 acres were acquired; some 7,000 acres were acquired in 1915, and subsequent acquisitions have been made on a smaller scale. Table 3.1(9), which lists the estates currently a part of the Government's Land Reform Program, reports that some 7,760 acres are in the process of being redistributed from GSVG ownership to private, small-scale ownership. All of this land will be redistributed except for small areas of non-agricultural lands that will be reserved for watersheds and parks.

The second pattern of land ownership reflects a long-standing tradition for the transfer of family-held farm land, whereby --

Table 3.1(4). Number of holdings and area of vegetable crop harvested.

Crop	No. of Holdings	Acre (acre) Harvested
Cabbage	1,086	1,393.28
Tomato	1,222	1,267.46
Carrot	528	663.02
Cucumber	368	443.00
Sweet Pepper	330	381.14
Pumpkin	152	126.98
Eggplant	96	124.82
Onion	80	79.82
Watermelon	32	65.82
Hot Pepper	76	60.98
Lettuce	62	27.58
Christophene	40	18.48
Cauliflower	40	15.14
Zucchini	2	8.00
Beet	28	3.22
Radish	16	1.06
Melon	4	.02

Source: St. Vincent and the Grenadines Agricultural Census 1985/1986, cited in IICA, 1989.

through cross-generational inheritance -- an attempt is made to provide all members of a family with agricultural plots. The result has been the extensive fragmentation of farm land. Furthermore, a "family farm" often is considered one legal unit, even though each fragment may be under the management of a different offspring. Statistics on the current distribution of various-sized land holdings are not consistent among sources, but the general pattern is clear enough. Most land holdings are quite small -- many, in fact, too small to be economically viable (see discussion below on Phase 1 of the Land Reform Program). In one source, ninety-seven percent of all farms were reported as less than 10 acres, of which close to half were less than one acre (CIDA, cited in Chemonics, 1988). Of the 6,799 land holdings included in the most recent Agricultural Census, 5,862 were less than five acres, 903 were 5 to 99.9 acres, and only 34 were over 100 acres (GSVG, 1989a; but see also Brierley and Rubenstein, 1988, for statistics indicating a greater number of smaller parcels).

WATERSHEDS

In 1912, all land above one thousand feet in elevation was designated as crown land, reserved by law to protect forests in the upper watersheds (see Figure 2.1(3)). Almost all arable land below this elevation is under permanent cultivation, and considerable cultivation has occurred above this line as well. Some of this agricultural development has been sanctioned through rental agreements with GSVG, plus there has been considerable illegal encroachment. A recent assessment on the status of selected catchments within the watersheds indicates that substantial encroachment has occurred both into the catchments and the surrounding watersheds (pers. comm., N. Weeks, Forest Officer, Forestry Division). The extent of legal -- much less

Table 3.1(5). Production, farm gate prices and value of output at current producer prices for selected fruit commodities in St. Vincent and the Grenadines, 1984 - 1987.

	CROPS						
	Coconut	Golden Apple	Avocadoes	Limes	Oranges	Mangoes	Bread Fruit
1984							
Quantity (000 lbs)	10,564	450	470	411	391	6,464	1,791
Farm Gate Price, EC$/lb	.25	.43	.40	.43	.26	.26	.35
Value Output, EC$	2,641	194	188	177	102	1,681	627
1985							
Quantity (000 lbs)	7,940	480	473	493	580	5,857	1,695
Farm Gate Price, EC$/lb	.36	.38	.42	.36	.085	.52	.25
Value Output, EC$	2,696	180	207	2,109	650	751	80
1986							
Quantity (000 lbs)	7,817	420	495	185	768	4,160	1,600
Farm Gate Price, EC$/lb	.29	.43	.43	.43	.35	.51	.35
Value Output, EC$	2,267	181	213	80	269	2,122	560
1987							
Quantity (000 lbs)	7,426	420	446	185	768	4,992	1,600
Farm Gate Price, EC$/lb	.25	.43	.59	.499	.16	.42	.374
Value Output, EC$	1,857	181	263	92	123	2,092	598

Source: IICA, 1989.

illegal -- encroachment is unknown but will be determined as part of CIDA's Forestry Development Program (pers. comm., J. Latham, Manager, CIDA Forestry Dev. Prog.).

Watershed management priorities have been identified for St. Vincent and the Grenadines based on the assumption that agricultural development is the major driving force in the country's economic development, with tourism playing a secondary role (although tourism is the leading force in the Grenadines) (Prins, 1986b). Prins' (1986b) comprehensive study for the Orange Hill Estate remains the definitive work on SVG watershed management issues. Since little would be gained by paraphrasing Prins' report, the Policy Recommendations section of this chapter instead attempts to update his study and suggests possible next steps.

ENVIRONMENTAL ASPECTS OF THE AGRICULTURAL SECTOR

Many of the issues associated with the agricultural sector are not environmental *per se* -- e.g., low productivity due to inefficient input and output services and markets -- and the responsible factors have been detailed in other reports and studies (e.g., Chemonics, 1988; FAO, 1987). The Chemonics (1988) report, in particular, provides an excellent overview of the constraints and limits of agricultural development in Eastern Caribbean countries. In addition, IICA, in conjunction with GSVG, is in the process of completing an

Table 3.1(6). Number of livestock on all holdings.

	1946	1961	1972	1985/1986
St. Vincent				
Cattle	6,944	6,458	5,891	4,010
Sheep	2,243	4,724	4,766	8,609
Goats	8,475	6,284	3,293	5,268
Pigs	8,602	5,044	5,096	1,668
Grenadines				
Cattle	797	1,444	578	358
Sheep	1,511	799	1,254	1,978
Goats	2,564	583	905	1,348
Pigs	767	428	428	183

Source: 1986 Agricultural Census, cited in IICA, 1989.

Table 3.1(7). Distribution of livestock by size of livestock holding.

Size of Livestock Holding	Number of Holdings			
	Cattle	Sheep	Goats	Swine
1 - 4 head	1,506	2,097	1,496	582
5 - 9 head	121	578	305	45
10 - 19 head	16	117	77	16
20 - 25 head	7	25	18	11
TOTAL	1,650	2,817	1,896	654

Source: 1986 Agricultural Census, cited in IICA, 1989.

assessment of the country's agricultural sector. Thus, the focus of the discussion in the St. Vincent Country Environmental Profile will be on the environmental issues that affect, and are affected by, agricultural practices.

3.2 PROBLEMS AND ISSUES

The major environmental issues associated with the agricultural sector can be summarized as: (1) mismanagement of watersheds, (2) environmentally unsound agricultural practices, and (3) agrochemical pollution. The latter is briefly discussed in

Table 3.1(8). Area (acres) of land holdings by land use, 1985 - 1986.

	All Land	Arable Land: Temp. Crops	Temp. Pasture	Temp. Fallow	Other Arable	Perm. Crops	Forest/ Wood-land	All Other
St. Vincent/ Grenadines	29,649	4,016	2,255	2,289	371	16,062	3,625	1,030
St. Vincent	27,831	3,897	2,182	2,279	347	15,779	2,755	592
Grenadines	1,818	119	74	10	24	283	870	438
Northern	1,338	32	66	1	6	274	859	100
Southern	480	37	8	9	18	9	11	338

Source: 1986 Agricultural Census, cited in IICA, 1989.

this chapter within the context of agricultural issues but is dealt with in more detail in Sections 4 and 8 of the Profile.

WATERSHED MANAGEMENT CONCERNS

Despite the 1912 Crown Lands Proclamation, some previously forested areas above 1,000 feet have been converted to agriculture. Conversion of forested land to agriculture in watersheds has important implications for environmental planning and management in St. Vincent and the Grenadines.

Even under conditions of gently sloping topography, upland watershed areas must be protected to ensure adequate, safe supplies of water for agricultural and domestic purposes. SVG watersheds are not only steeply sloped, but much of their natural vegetation has been replaced by annual and short-lived perennial crops, which have less extensive canopies and shallower root systems compared to trees. Soil erosion is leading to loss of soil fertility and increased sedimentation of catchment areas and dams. When they are able to afford them, farmers often add inorganic fertilizers to the soil in an attempt to replace the minerals lost through erosion. But the eroded soils typically are low in organic matter and therefore are inefficient at binding inorganic nutrients. Synthetic fertilizers are quickly washed away from the agricultural land where they are applied and re-emerge as pollutants downstream. Pesticides are linked with fertilizers through the same process but are more problematic because of their greater toxicity (OECS-NRMP, 1987).

ENVIRONMENTAL IMPLICATIONS OF CURRENT AGRICULTURAL PRACTICES

St. Vincent and the Grenadines was once recognized regionally for its efforts in soil and water conservation. Unfortunately, conservation measures, such as grass barriers which students from the University of the West Indies once came to St. Vincent to observe, have largely been abandoned. The fact

Table 3.1(9). St. Vincent land reform program.

Estate	Area (acres)
1. Orange Hill	3,400
2. Langley Park	332
3. Grand Sable	150
4. Colonarie	300
5. Sans Souci	88
6. Diamond	90
7. Cane Grove	100
8. Wallilabou	1,300
9. Richmond	2,000
TOTAL	7,760

Source: FAO, 1987.

that cultivation occurs on steeply-sloped land and that the fairly erodible soils are exposed to heavy seasonal rainfall suggests that current and potential soil losses are high (OECS-NRMP, 1987). Soil erosion losses in one study area of the Rabacca River have been estimated to be at least 50 acres per year, but this approximation was based only on visual inspection of the land (John, 1985). Much of the country's crop production takes place with little, if any, consideration of possible environmental impacts, and the data base on soil erosion rates is woefully inadequate.

In many areas, land that once was considered too steep to farm, now is used to grow bananas and a variety of other crops. Only 20 percent of the land available for farming in SVG is on less than a 20 degree slope. According to IICA (1989), cultivation is rapidly advancing onto marginal agricultural lands due to economic pressures to make room for banana production and because small landholders are not knowledgeable about soil conservation practices (IICA, 1989). The relative importance of these factors is uncertain, but it would be naive to assume that ignorance -- rather than economic pressure -- is driving the actions of these farmers who make their living from the land.

Basic soil conservation measures, e.g., contour planting, grass barriers, mini-terracing, are seldom employed, even on slopes as high as 40 degrees. The negative impacts of soil erosion and of run-off water containing excessive agrochemicals are discussed above ("Watershed Management Concerns"), but it should also be noted that these problems occur even on moderately sloped, low-elevation farms in the absence of adequate conservation measures (OECS-NRMP, 1987; Prins, 1986b).

IMPACT OF INSECURE LAND TENURE

The majority of arable land in St. Vincent and the Grenadines -- some 85 percent -- is owned or held in owner-like possession (GSVG, 1989a). Nevertheless, lack of *secure* tenure is thought to be an important issue as it affects two groups of landholders. The most important, in terms of negative environmental impacts, is the squatters cultivating land in water catchment areas. The critical issue here, however, may not be lack of tenure but the fact that agriculture is occurring at all in these areas. Secondly, insecure tenure is also a problem for farmers operating "family" farms, many of whom may lack clear legal title to the fragment they cultivate.

Lack of clear tenure often is cited in development literature as an obstacle to good natural resource management, including the adoption of conservation practices. This conventional wisdom is now being questioned, specifically in terms of the necessity for tenure to be legal rather than *de facto*; but it is clear that farmers cannot be expected to invest in long-term conservation measures unless they are confident they will reap the returns of their investment. The absence of secure tenure rights to farms and farm fragments probably is hindering greater adoption of conservation practices in St. Vincent, although the extent of the problem is presently undocumented.

The combined effect of these related problems -- ineffective watershed management, environmentally damaging cultivation practices and insecure land tenure -- can be a formidable obstacle, as evidenced by the modest accomplishments of the conservation component of the recently completed Cumberland Watershed Management Project (CWMP). CWMP, an adjunct to the USAID-funded Cumberland Hydroelectric Project, had a budget of US$500,000 for watershed management activities to be implemented over the four year period from January 1985 to March 1989. At the completion of the project, only 31.3 acres of farm land had been treated with conservation measures, and some of these were not being properly maintained (see GSVG, n.d., circa 1989). A variety of factors, many based on the project's inability to find technically viable and socially acceptable technologies, hindered the adoption of conservation measures by farmers.

CWMP is cited as a case in point not to criticize retroactively project efforts (in fact, the forestry components, survey work, and training were considered quite successful). Rather the project serves as a case study from which important lessons can be drawn. Two points seem paramount:

(1) Conservation activities require long-term commitments and support; progress may have to be measured through small and incremental improvements; and

(2) Conservation measures require close collaboration with and the full participation of the farmers intended to benefit from them.

As a recent study of technology transfer and adoption in developing countries concluded, "promising technologies" share some common characteristics: they are technically and environmentally sound, socially desirable, economically affordable, and sustainable (OTA, 1988).

INSTITUTIONAL CONSIDERATIONS

During the last five years, several projects and studies dealing with SVG's watersheds and related resources have been implemented. The discussion that follows provides a summary of these activities with an emphasis on what remains to be done.

(1) Soil and Water Conservation Unit (SWCUT). SWCUT, a new section of GSVG's Ministry of Agriculture, Industry and Labor, was established in 1988 as a by-product of the Cumberland Watershed Management Project. Its mandate and responsibilities are not yet fully defined, but SWCUT would be a logical lead institution to coordinate watershed management in the country. The unit's program plan for 1990-91 proposes to accomplish the following:

(1) Evaluate the magnitude and rate of soil erosion in St. Vincent. SWCUT is in the process of administering a questionnaire to farmers to determine their attitude on, and knowledge of, conservation practices.

(2) Evaluate and demonstrate traditional and more recently developed techniques in soil conservation.

(3) Collect data to demonstrate how soil conservation affects the fertility and productivity of agricultural land and consequently the expected income from it.

(4) Extend the above information to the farming community and the general public through an ongoing public educational program.

(5) Train extension officers, forest officers and farmers in the establishment and maintenance of soil and water conservation techniques.

(6) Coordinate, monitor and provide technical assistance on all soil conservation field work.

(7) Review and upgrade legislation on soil and water conservation.

(8) Contribute to the Government's Agricultural Rehabilitation and Diversification Project by using elephant grass (*Pennisetum purpureum*) both as a conservation measure and a source of forage for livestock in a cut-and-carry system.

In order to implement its ambitious soil conservation program, SWCUT will need additional financial and personnel resources (IICA, 1989). In its Advance Proposals for 1990-91, SWCUT has requested that the Ministry of Agriculture implement specific proposals put forward by the Unit (pers. comm., C. Simon, Chief Of., SWCUT, March 1990). These include:

- Assignment of two extension agents and an extension supervisor to SWCUT;

- Increasing the Unit's operating budget and enabling it to buy simple monitoring equipment;

- Incorporation of soil and conservation issues into the biannual in-service training that all Extension Agents receive; and

- Collaboration with independent farmers or farmers participating in the GSVG's Land Reform Program to establish demonstration sites that illustrate conservation practices and explain the economic advantages associated with such practices.

(2) Land Reform Program. The overall objectives of the GSVG Land Reform Program call for promoting growth and diversification in agricultural production and improving income distribution for smallholder farmers. Program components include divestiture of state-owned land to small-scale farmers, improvements in farm access roads, and technical assistance and training to support the program and strengthen the Ministry.

Administratively, the Land Reform Program is divided into two phases: Phase 1 - Rabacca Farms and Phase 2 - Agricultural Rehabilitation and Diversification Project (ARDP).

Rabacca Farms. The project to develop Rabacca Farms, formerly called Orange Hill Estate, is a collaborative effort of GSVG, the European Economic Community and the Caribbean Development Bank. Loans to small farmers under the program only became available in 1989. The effort will involve 3,400 acres and some 550 farmers (pers. comm., A Standon, Manager, Rabacca Farms, March 1990).

Agricultural Rehabilitation and Diversification Project. This effort began in 1988 with joint support from GSVG, the World Bank, and the Governments of Japan and Denmark. It involves some 4,250-4,500 acres of the former estates of Langley Park, Grand Sable, Colonarie, Sans Souci, Cane Grove, Wallilabou and Richmond. The number of farmers involved is estimated to be 750, but the actual number will be based on project determinations of economically viable farm size (*The Vincentian*, 2 February, 1990; pers. comm., K. John, Manager, ARDP; FAO, 1987).

A similar approach is being used for both projects:

- A survey of the current land use of the area.

- Establishment of a protected watershed area, relocating farmers so that this zone is free of agriculture, and rehabilitation of watersheds where necessary.

- Consolidatation of farmers' residences in the lower elevation lands to protect watersheds and agricultural land and to provide services such as potable water.

- Determination of an economically viable farm size, to be based on factors such as topography and preferred crops and livestock. Preliminary estimates for Rabacca Farms call for average farms of 4.2 acres.

- Provision of leases for approved farmers, many of whom are squatters; some farmers will have to be relocated out of the project areas.

- Establishment of conservation measures that are most appropriately done at the community level; e.g., water run-off ditches for feeder roads.

- Development of conservation measures tailored to each individual farmer's needs; e.g., one farmer may want to establish an agro-forestry system of field and tree crops, while another farmer may use grass barriers and agro-forestry tree species for fodder to feed his or her livestock.

Each project is staffed to provide some extension requirements, but GSVG services are expected to supplement project needs. Potentially, this could be very problematic, and attention will have to be paid to ensure that the necessary coordination occurs. For example, currently neither ARDP, the Ministry of Agriculture, nor the Central Planning Division have agreed to assume responsibility for the farmer conservation component of ARDP (pers. comm., K. John, Manager, ARDP; A. Standon, Manager, Rabacca Farms; L. Daisley, Chief Agricultural Officer; R Cato, Director of Planning, March 1990).

3.3 POLICY RECOMMENDATIONS

* *(1) Clarify the responsibilities of the various institutions involved in management of SVG's watershed areas, soil and water resources and redefine these responsibilities, if necessary, to ensure that there is a coordinated approach for resource management and conservation efforts. Since responsibilities reside in several agencies, establishment of a coordinating committee should be considered; alternatively, a single agency could be designated as the lead agency for watershed management and soil and water conservation programs.*

As noted by Prins (1986b), numerous agencies, authorities, associations and organizations are involved in and affected by watershed management issues. Prins (1986b) proposed that GSVG adopt a three-pronged institutional approach to watershed management:

(a) The Central Planning Division (the renamed Central Planning Unit) would focus on those policy issues related to integrating watershed management with agricultural development;

(b) A new body (subsequently established as SWCUT) would focus on the technical aspects of watershed management, including coordination of field activities;

(c) A Watershed Management Committee -- chaired by a senior official of the Ministry of Agriculture and including representation from the Forestry Division, the Central Water and Sewerage Authority, the St. Vincent Electricity Services Ltd. and the Central Planning Division -- would handle day-to-day coordination of watershed management activities.

It may be more effective to designate one agency and invest it with the necessary authority. To be successful, this Government unit would need to be on an equal administrative basis with the other agencies of Government indicated above, and would require overriding authority for watershed management issues. An OAS consultant is in the process of working with GSVG to sort through these institutional issues and propose steps to allow a coordinated national approach to management of watershed areas and soil and water resources (pers. comm., W. McCalla, OAS consultant, April 1990).

The Soil and Water Conservation Unit has an important role in managing field operations, but its responsibilities and authority need to be clarified. In order for SWCUT to be able to implement its program objectives, it will need an increase in staff and in budget to enable it to have access to simple monitoring equipment and to ensure that extension agents meet with farmers on a regular basis. In order to develop the economic arguments necessary to convince farmers to adopt conservation measures, an economist should work with SWCUT on its proposed demonstration sites.

* *(2) Consolidate soil and water conservation legislation into a single legislative mandate, with clearly designated lines of responsibility and authority.*

A recent report by Mains (1989) identifies seven SVG legislative acts related to soil conservation but notes "that much of the legislation is either not used or rarely enforced." Conservation efforts would clearly be advanced by updating and possibly consolidating such legislation.

The proposed Forest Resource Conservation Act draws on the legislative suggestions contained in Prins' study (1986b) which calls for an increase in forestry responsibility by providing for: (1) expansion of forest reserves in upper watersheds to preserve wildlife habitat and areas of biological and recreational interest; (2) expansion of forest plantations to protect water catchments and to increase production of fuelwood and timber for wood products; and (3) integration of forestry with agriculture in those parts of the watersheds where the growing of food and tree crops are the major economic activity (McHenry and Gane, 1988). Main feels that the proposed forestry legislation will benefit conservation efforts but may still leave some issues unresolved. For example, he claims that "conservation areas" as defined by the act exclude a great deal of agricultural land; and even for the areas covered by the act, it is unclear what constitutes proper soil conservation (Main, 1989).

Nevertheless, the steps now being taken by Government to provide the legal framework for an integrated watershed management approach and for strengthening administrative authority for forest, soil and water conservation are a promising development (see also Section 10). At the same time, it is important that GSVG consider strengthening national planning legislation to provide the authority and mechanisms for systematic analysis of those development projects which impact upon the integrity of watersheds (Prins, 1986b).

* *(3) Support applied research to develop more ecologically appropriate agricultural practices. GSVG needs to systematically support such research by governmental and non-governmental institutions and to encourage this research agenda in its interactions with regional groups such as OECS' Agricultural Coordinating and Diversification Unit, the University of West Indies, CARDI, CARDATS, IICA, and WINBAN.*

It is particularly important for small countries like St. Vincent, which find it difficult to be competitive in international agricultural markets, to emphasize the use of internal resources before turning to externally purchased inputs. Those resources "internal" to the agricultural sector include, for example, nitrogen fixed by legumes or nutrients cycled up from lower soil strata by deep-rooted trees or recycled from plant and animal wastes. In many cases, these renewable resources can substitute for expensive external resources

such as synthetic fertilizers and pesticides, thereby reducing production costs. Mixed cropping and agro-forestry systems also maximize internal resources while serving multiple purposes, i.e., diversification of crop production, more efficient use of rain water, reduction of soil erosion and pest problems, and production of forage and fodder for livestock (OTA, 1988). Fruit trees, many of which grow well intercropped with bananas, also have considerable potential (IICA, 1989). Such techniques warrant further support and adaptive research to expand their use in St. Vincent.

Several excellent opportunities exist for collaborative efforts among government and non-government organizations for the purpose of improving cultivation practices. For example, the Government's Soil and Water Conservation Unit hopes to establish and maintain demonstration sites to illustrate soil and water conservation practices. The newly established organic farmers group in St. Vincent -- AMOVA -- could be a valuable resource in this regard, and the St. Vincent-based Organization for Rural Development (ORD) could contribute information and experience gained through its decade of work on non-traditional crops. There is also potential for institutional collaboration within GSVG's Land Reform Program, where Phase I and Phase II projects call for demonstration farms producing mixed crops using appropriate conservation measures.

* *(4) Regulate the importation, use and disposal of agrochemicals.*

At a minimum, GSVG should prohibit importation of pesticides and other agrochemicals that have been banned for use in the United States and other developed countries (see Section 8 for a fuller discussion of this issue).

SECTION 4 FRESHWATER RESOURCES

4.1 OVERVIEW

Annual rainfall in St. Vincent proper varies from approximately 1,700 mm (67 in) in dry coastal locations to 7,000 mm (276 in) in the wet central mountains (Shawnigan, 1983; cited in Talbot, 1983); see Table 4.1(1) and Figure 4.1(1). The length of the dry and wet seasons varies greatly depending on location, but there tends to be a comparatively dry season from about January to May and a wet season from about June to December. Data on daily rainfall for St. Vincent are collected by the Central Water and Sewerage Authority (CWSA) using a network of rain gauges. In the Grenadines annual rainfall is variously estimated at between 762 mm (30 in) to 1,360 mm (54 in), although there are no long-term meteorological records readily available.

It has been estimated (Birdsey, *et al.*, 1986) that on average St. Vincent receives about 838,500 acre-feet (1,035 million cubic meters) of rainwater on its surface each year. No data or estimates are available for evapotranspiration, run-off, or groundwater storage, but rough evapotranspiration estimates from Grenada and other neighboring islands range from 1,000 mm/year to 1,500 mm/year.

Rivers in St. Vincent tend to be short and straight; in the mountains they have deep, narrow valleys which broaden into small alluvial flats in the lowlands. The largest river is the Colonarie, and the next largest is the Wallibou. Very little good data on streamflow, flood peaks, sediment loads or other hydrologic characteristics exist for any watershed in St. Vincent. The only long-term streamflow data is from the Richmond River hydroelectric project which collected data between 1971 to 1981. A water resources study by Underwood-McLelland (1972) collected streamflow data from several small rivers between 1969 to 1971. Rough estimates for some basic climatic and hydrologic characteristics have been made for the Cumberland watershed (Talbot, 1983), which may give an indication of conditions in other comparable sites.

A study of the streamflow, water quality and rainfall in the Buccament River watershed was initiated in 1983 (Diaz, *et al.*, 1985) as part of a comparative study of one watershed on each of three Eastern Caribbean islands. The intent of this study was to obtain a two-year data base in order to construct and calibrate a rainfall/run-off sediment model to be used in watershed management of high-rainfall areas in the region. Preliminary results indicated that the Buccament River had the highest sediment concentrations of the three rivers, ranging from 2 to 654 mg/L. This project was discontinued before completion, at least in St. Vincent.

Surface water (streams, rivers and springs) constitutes the major source of fresh water for human consumption and agriculture in St. Vincent. Household water supplies in the Grenadines depend almost entirely upon catching rainwater and storing it in cisterns, while water for agriculture and livestock comes mainly from withdrawal of groundwater and surface water run-off stored in ponds.

KEY CATCHMENT AREAS

A watershed is a topographically defined area having a common system of drainage and a network of drainage channels, streams, or rivers. The watershed provides a convenient conceptual framework for the assessment of hydrological budgets and erosion, as well as for the delimitation of ecological systems. For these reasons, watersheds have been recognized as fundamental units for land use planning, land suitability analysis and land use management. By contrast, the term "catchment area" as used herein simply means a sub-watershed area upslope from a water supply or hydropower intake, from which the water feeding into the intake is collected. It should be kept in mind that it is usually *not* a complete watershed as defined above. The

Table 4.1(1). Monthly rainfall for selected areas, 1987.

STATIONS	JAN	FEB	MAR	APR	MAY	JUNE	JULY
Botanic Gardens	4.15	1.43	0.39	1.10	5.11	13.43	4.47
Belmont	3.53	1.11	0.23	0.19	9.22	12.25	10.26
Campden Park	3.12	1.00	0.19	0.36	8.29	13.09	5.66
Dumbarton	4.64	1.14	1.07	0.18	9.22	15.16	7.70
Georgetown	4.73	0.89	0.17	0.48	12.22	8.52	7.13
Laycu	–	–	–	0.31	2.65	5.75	5.26
Rivulet	4.29	0.42	0.27	0.35	4.04	9.65	3.86
Spring Village	3.06	1.11	0.03	0.33	7.01	12.67	9.38
Three Rivers	0.50	1.02	0.04	0.40	5.52	6.80	10.25
Wallilabou	1.77	0.35	0.03	–	0.66	11.95	4.62
Greggs/Lauders	0.03	1.98	1.50	0.03	9.82	2.92	9.11
Vermont	5.50	0.35	0.74	0.37	10.50	13.60	10.50
Head Office	3.84	0.82	0.63	0.33	5.61	13.41	6.14

	AUG	SEPT	OCT	NOV	DEC	TOTAL YEAR	AVERAGE MONTH
Botanic Gardens	10.61	13.15	8.74	16.84	7.68	87.10	7.26
Belmont	12.58	22.31	9.82	10.35	5.43	97.28	8.11
Campden Park	10.38	14.95	7.51	13.98	6.54	85.07	7.09
Dumbarton	8.35	14.82	11.31	28.06	16.51	118.16	9.85
Georgetown	6.71	15.29	11.17	29.13	8.90	105.34	8.78
Laycu	2.75	8.80	5.04	13.57	5.62	49.75	4.15
Rivulet	3.04	8.83	6.22	11.87	9.39	62.23	5.19
Spring Village	13.96	20.31	9.51	13.15	6.00	96.52	8.04
Three Rivers	7.10	11.40	12.40	28.66	7.57	91.66	7.64
Wallilabou	14.72	21.83	6.66	12.72	2.85	78.16	6.51
Greggs/Lauders	9.04	8.15	7.96	28.36	7.92	86.32	7.19
Vermont	11.95	22.90	8.96	14.40	9.30	109.07	9.09
Head Office	8.51	14.74	7.70	13.46	8.02	83.26	6.94

Source: GSVG, 1989b.

watersheds of the island of St. Vincent are identified in Figure 4.1(2)

There are 16 public potable water supply systems in operation in St. Vincent. In addition, some seven springs are available as emergency supplies. There are no wells in production. All water is supplied by surface water sources (rivers) or springs. The Dalaway, Cumberland, Montreal and Majorca systems together comprise about 90 percent of total production. Dalaway serves Kingstown and its environs. The Cumberland system serves the northern leeward area from Barrouallie to Fitzhuges. The Majorca and Montreal systems serve the southeastern coastal areas. (pers. comm., D. Cummings, CWSA Manager, February 1990).

The locations of the water supply facilities and hydropower sites in St. Vincent are given on Figure 4.1(3). Information on supply sources is provided in Table 4.1(2). The catchment areas which contribute to the water

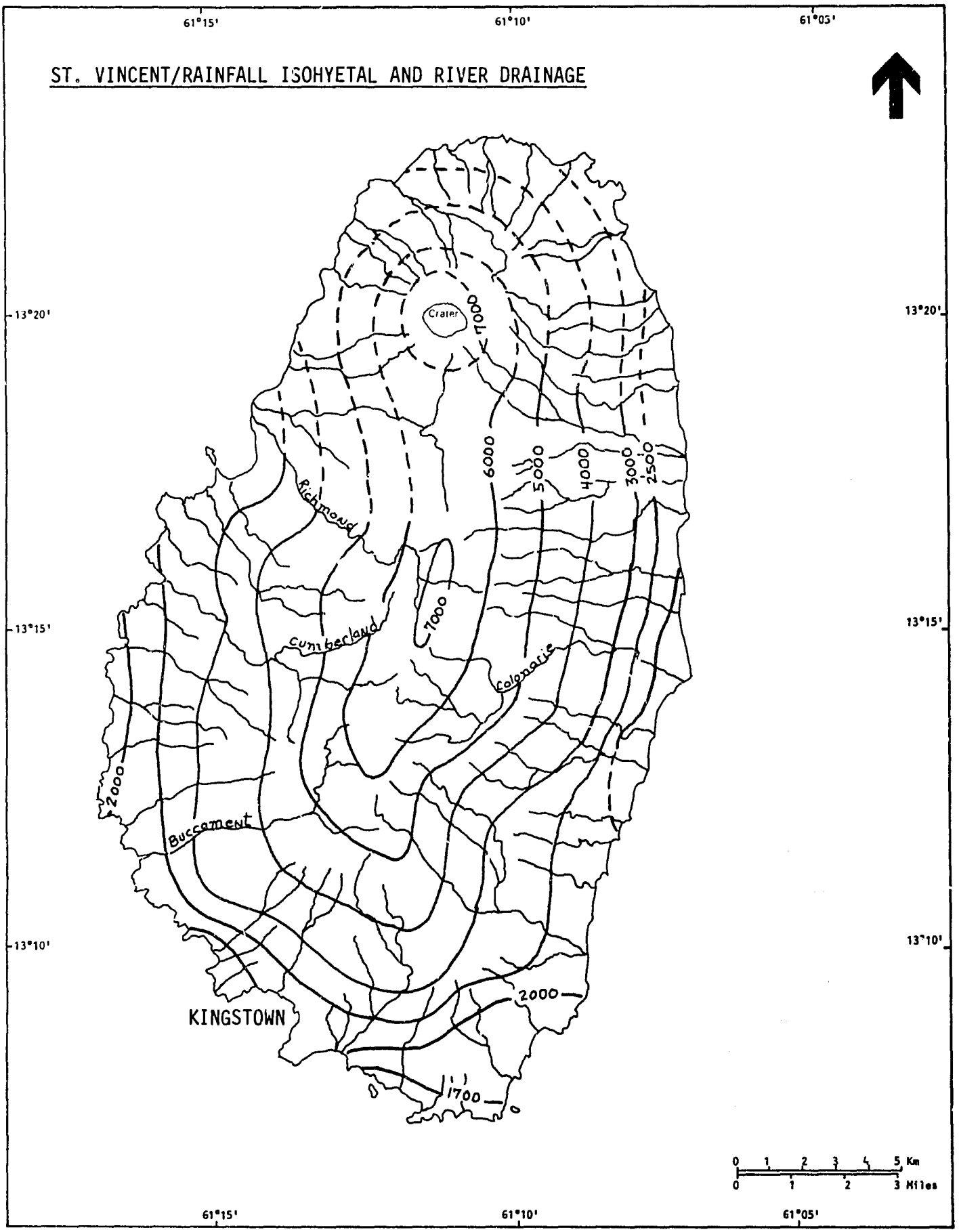


Figure 4.1(1). Rainfall isohyetal map and river drainage network in St. Vincent (source: Talbot, 1983).

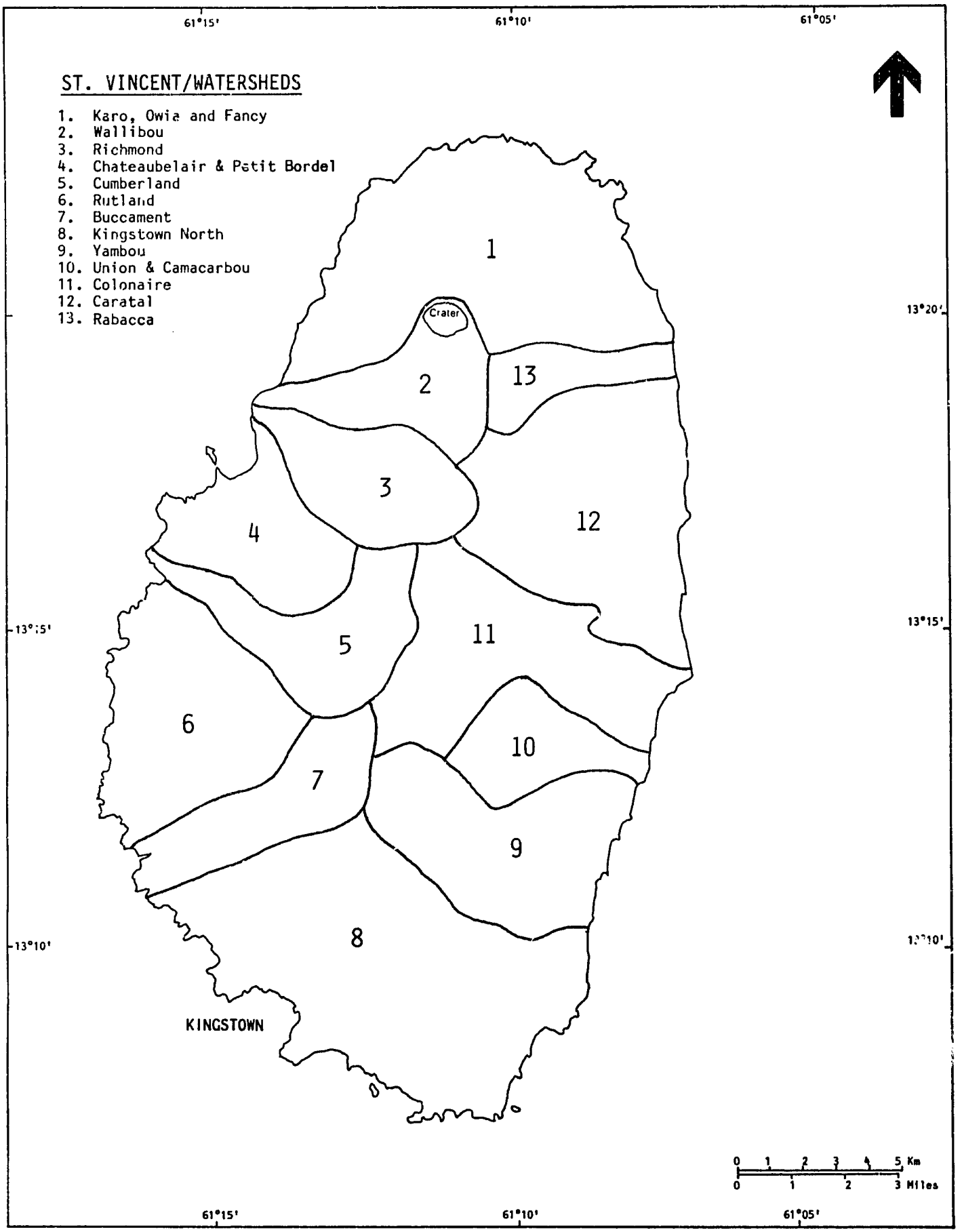


Figure 4.1(2). Watersheds in St. Vincent (source: Prins, 1986a).

supply systems are given in Figure 4.1(4). Catchment areas for the three existing hydropower sites are also shown in this Figure.

WATER SUPPLY AND DEMAND

Potable water supply in St. Vincent is estimated to vary from 6.2 million imperial gallons per day in the rainy season to 3.5 million per day at the height of the dry season. Water supply matches demand in the rainy season. In the dry season, particularly in the month of April, there is a shortfall of up to fifty percent in some areas, and rationing becomes necessary. This, however, only occurs during very dry years. Estimates of per capita consumption vary from 30 gallons per capita per day for standpipe users to 50 gallons per capita per day for house connection service.

About 25 percent of the population of St. Vincent obtains water from public standpipes. An additional sixty-five percent has piped water to their homes, and the remainder of the population is located more than 300 yards from a piped supply. Losses in the distribution system are high; estimates put the rate at 40 percent. There is a full-time leak detection unit in CWSA which is responsible for ensuring a steady reduction in losses. Metering of consumers is also reducing the rate of loss.

Apart from resort hotels and similar tourism-related demands, water usage rates in the Grenadines are extremely low. The public water supply is limited to rainwater catchment and storage with discharge through standpipes. Private rainwater cistern systems are, however, quite popular. Desalination units are employed on Mustique, Union Island, Petit St. Vincent, and Canouan for the major hotels.

WATER MANAGEMENT AND LEGISLATION

The CWSA is responsible for coordinating the collection of hydrological data in conjunction with the Ministry of Agriculture, VINLEC, and the Metrological Office at the E.T. Joshua Airport. In conjunction with the British Geological Service, the CWSA has recently produced a hydrogeological atlas of St. Vincent and the Grenadines (Cummings and Lawrence, 1989).

The water resources study completed by Underwood, McLelland and Associates Ltd. (1972) remains the most comprehensive analysis of water resources in St. Vincent and the Grenadines. At present, the CWSA is in the process of preparing a five-year development plan.

CWSA has its own laboratory which monitors drinking water quality throughout the state. The frequency of sampling varies from daily to monthly, depending on the size and location of the water supply system. Analysis are carried out routinely for bacteriology, chlorine residual, odor, taste, turbidity and acidity. Results of all analyses are forwarded to the Ministry of Health and the Environment through the Chief Environmental Health Officer. There is no substantial monitoring of water quality for the public supply in the Grenadines (pers. comm., Dr. A. Eustace, Medical Officer, Min. of Health and the Environment, 1990).

The present legislation under which CWSA operates dates to 1978, while the regulations date back to 1973. Both the CWSA Act and accompanying regulations have been under review for several years. A revised act was prepared by a PAHO consultant (Dr. N. Liverpool) in 1985. In 1989, a legal consultant from FAO proposed a new water resources act as well as water supply and sewerage regulations (Clark, S., 1989). More recently, a harmonization of the two proposals was accomplished by an OAS consultant, Dr. W. McCalla. This new act and regulations are expected to become law in the near future. The proposed legislative package will provide CWSA with the necessary authority to protect and distribute water resources properly (pers. comm., D. Cummings, CWSA Manager, 1990).

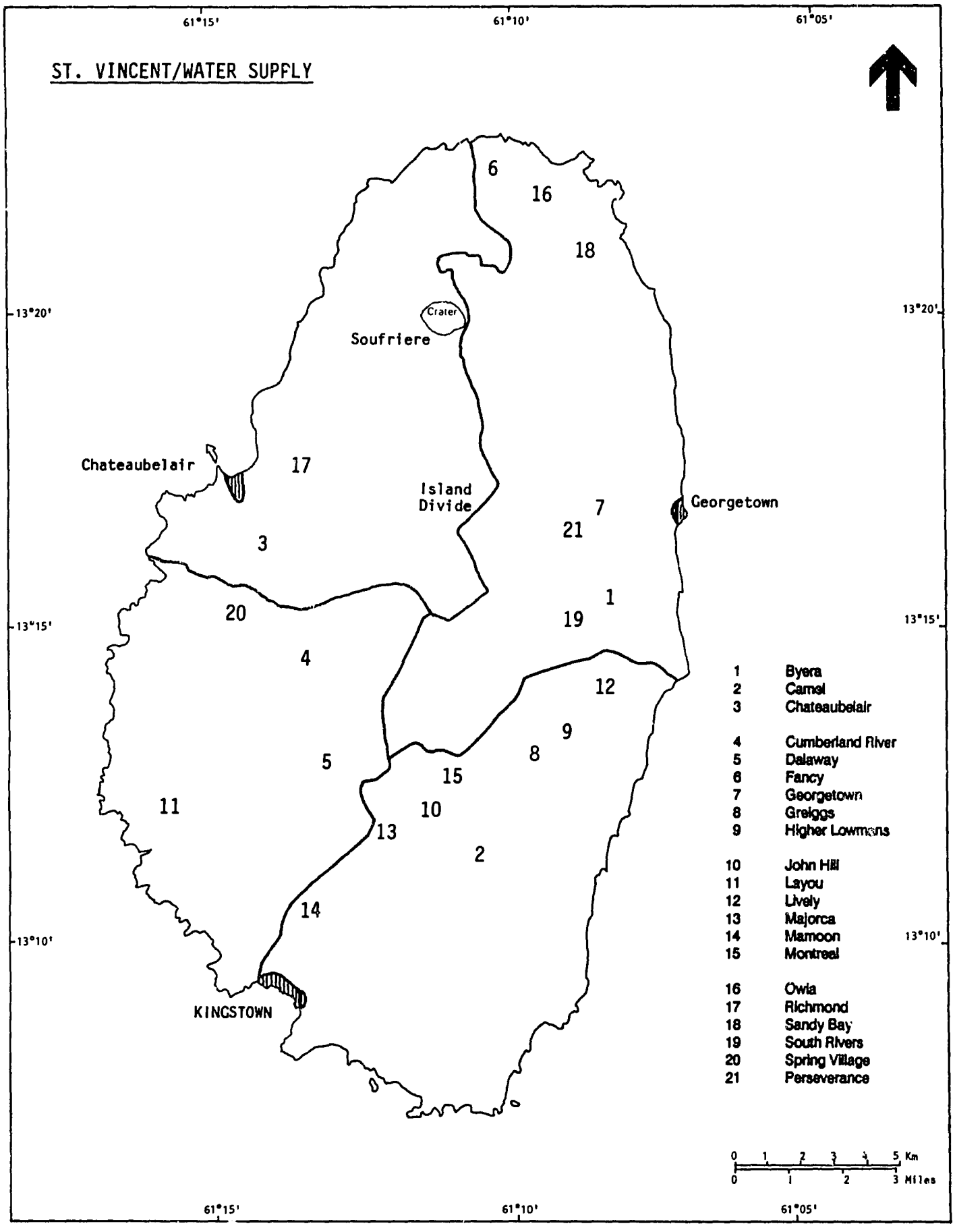


Figure 4.1(3). Location of existing water supply intakes and hydropower sites. Lines delineate watershed regions (source: adapted from Birdsey, *et al.*, 1986).

Table 4.1(2). Water supply sources on St. Vincent (production figures).

No.	Name	Number and Type of Intake	Average Production (gals./min.)	Average Production (liters/min.)
1	Camel	2 springs	7	32
2	Dalaway*	2 rivers	2,397	10,897
3	Diamond	1 spring	22	100
4	Greiggs	2 springs	21	96
5	Higher Lowmans	1 spring		
		1 river	35	159
6	Lauders (Lively)	2 springs	30	136
7	Layou	2 springs	161	732
8	Majorca**	2 rivers	420	1,909
9	Mamoon	1 river	32	145
10	Montreal	1 spring		
		6 rivers	388	1,764
11	Owia	1 river	16	73
12	Sandy Bay	1 river	80	364
13	South Rivers	2 springs	142	646
14	Perseverance	1 river	175	796
15	Fancy	1 river	3	14
16	Hermitage	1 river	800	3,637
17	Cumberland R.	1 river	3,785	6,359

* Dalaway includes both 6" x 12" pipes.

** Majorca also includes John Hill.

Source: CEP National Committee, 1990.

4.2 PROBLEMS AND ISSUES

PRESENT CONDITION OF WATER SUPPLY CATCHMENTS

A survey of the conditions and existing problems in the water catchments was carried out in March, 1990 by the Forestry Division (pers. comm., N. Weeks, Forest Officer, Forestry Division and W. Metz, US Peace Corps Volunteer, April 1990). The preliminary results of the survey can be summarized as follows:

- *Biggut* (spring northwest of Layou), supplies water to Layou and Buccament). Excellent condition; vegetation is Seasonal Evergreen Forest. No land use conflicts.

- *Chateaubelair*, abandoned due to impacts from poor agricultural land use practices.

- *Dalaway* (Stream 24) supplies water to areas from Lowmans leeward to Villa. Unsatisfactory condition; vegetation is Rain Forest, Seasonal Evergreen Forest, and Blue Mahoe plantations; banana and cocoa plantations, ground provisions; erosion, siltation, agrochemical use.

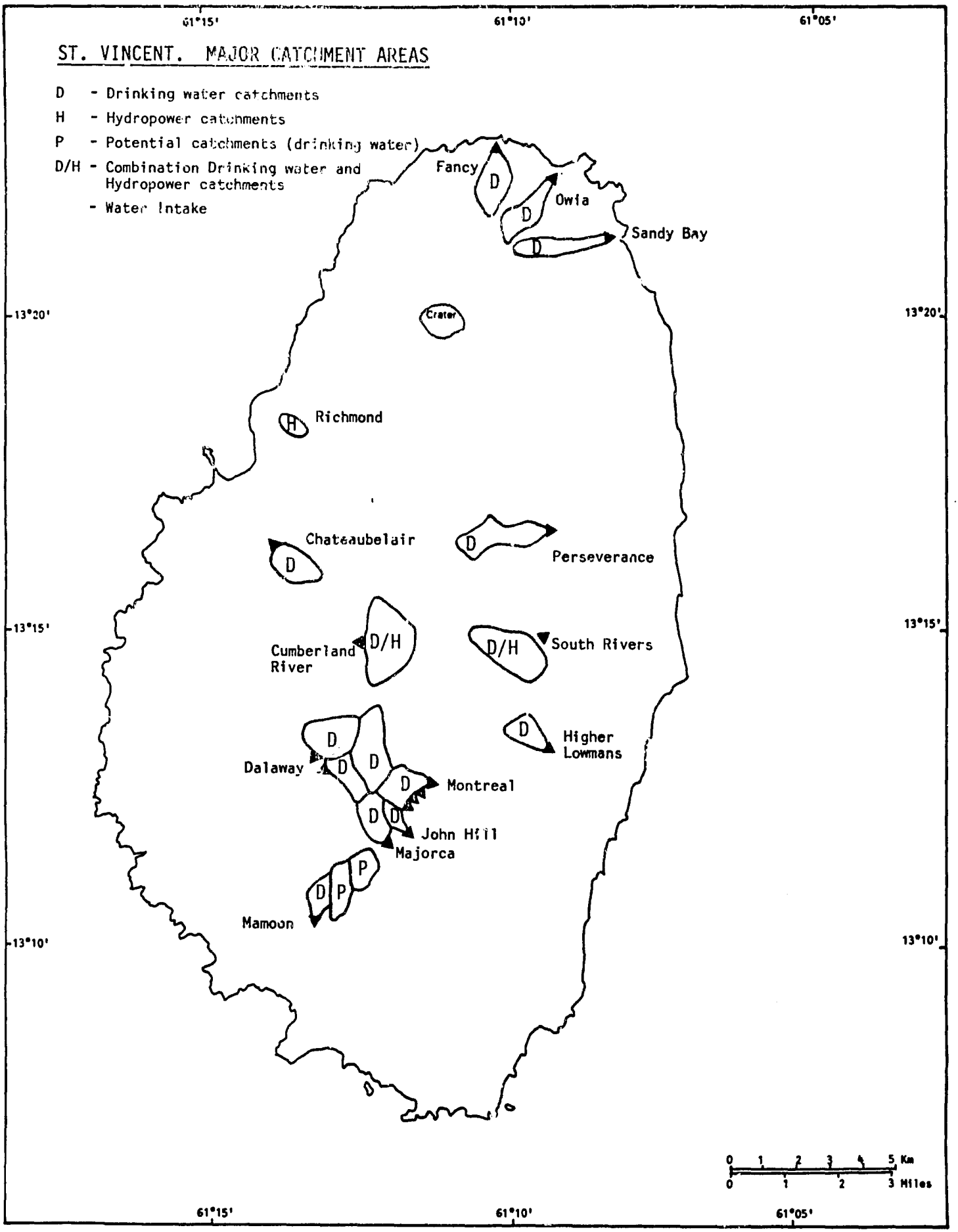


Figure 4.1(4). Major catchment areas in St. Vincent (source: CWSA, 1990.)

- *Dalaway* (6" systems), supplies water to areas from Campden Park to Vermont to Lowmans/Campden Park. Excellent condition; vegetation is wet Evergreen Forest; no farming, no erosion or siltation (except naturally occurring), no agrochemical use, no land use conflict in the catchment.

- *Diamonds* (spring near Lively), supplies water to Mount Greenan and Diamonds. Unsatisfactory condition; vegetation is Seasonal Evergreen Forest; intensive banana cultivation, livestock farming, intensive use of agrochemicals.

- *Fancy* (Fancy River), supplies water to Fancy Village. Marginally acceptable condition; vegetation is secondary forest, fair to good vegetative cover; but erosion from footpaths in catchment leading to subsistence farming in upper areas; livestock pasturing, possible use of agrochemicals.

- *Grieggs* (spring north of Grieggs Village), supplies water to Grieggs and Halyd's Villages. Extremely unsatisfactory condition ("the worst catchment in St. Vincent"), almost no natural vegetation; intensive banana farming throughout the catchment; livestock farming, agrochemicals, erosion.

- *Hermitage* (Cumberland River), supplies water to North Windward and to the VINLEC hydroelectric plant. Excellent condition; vegetation is Rain Forest. No land use conflicts or other problems at present.

- *Higher Lowmans* ("system 9"; Union River and one spring near New Adelphi), supplies water to Biabou, Chapmans and Lowmans. Extremely unsatisfactory condition; vegetation is Seasonal Evergreen Forest; intensive banana plantations and provision cultivation; erosion, agrochemicals, livestock farming.

- *Majorca* (Yambou River), supplies water to Sharps Vale, Gommier, Belair, Rockies, Murray Villages, east central Kingstown and St. George areas. Excellent condition; vegetation is primary Rain Forest; no land use conflicts or other problems at present.

- *Mamoon* ("system 1"; Kingstown North River), supplies water to Largo Heights and Green Hill. Satisfactory condition; vegetation is Seasonal Evergreen Forest; no farming or use of agrochemicals, but some erosion due to steep road leading to the radio-telephone transmission facilities operated by the Cable and Wireless Company.

- *Montreal and John Hill* ("system 5"), supplies water to Mesopotamia Valley and the area from Peruvian Vale south to Villa. Extremely unsatisfactory condition; vegetation is Rain Forest and Seasonal Evergreen Forest; erosion, siltation, banana plantations, agrochemical use, marijuana cultivation, livestock pasturing and other land use conflicts.

- *Owia* ("system 15"; Big Owia River), supplies water to Owia and Point Villages. Marginally acceptable condition; vegetation is secondary forest, fair to good vegetative cover, but provision cultivation and deforestation; erosion from footpaths in catchment leading to subsistence farming in upper areas; possible use of agrochemicals.

- *Perseverance* ("system 20"; Caratal River), supplies water to Georgetown. Marginally acceptable condition; vegetation is Seasonal Evergreen Forest with adequate cover except for private land adjacent to catchment; water system was only installed about one year ago, but access road to intake allowed banana and provision farmers to invade a previously inaccessible area. Erosion, siltation, use of agrochemicals.

- *Sandy Bay* ("system 14", Cayo River), supplies water to Sandy Bay. Satisfactory condition; vegetation is secondary forest; some agrochemical use and erosion from subsistence farming in catchment.

DRINKING WATER POLLUTION

The silting-up of streams due to soil erosion in the catchment areas and consequent loss of water quality at water production facilities is a growing problem. There are often high levels of turbidity and particulate matter in drinking water (pers. comm., Dr. A. Eustace, Medical Officer, Min. of Health and

the Environment, Feb. 1990), especially during the rainy season. In addition to instituting more effective watershed and catchment area management, the installation of treatment equipment (coagulation, sedimentation and filtration) at the water production facilities is necessary to correct this condition, but funding has not yet been identified.

St. Vincent lacks legislation which establishes specific drinking water quality standards or sampling and analysis procedures. The CWSA currently uses PAHO standards as guidelines for water quality (pers. comm., D. Cummings, Manager, CWSA, Feb. 1990).

All drinking water is chlorinated to eliminate disease organisms. One of the dangers of chlorinating water without prefiltration is that a class of carcinogenic compounds called chloramines can be formed if the waters are rich in organic substances. There is no information on the extent to which this may be a problem in St. Vincent.

As also discussed in Sections 3 and 8, agricultural encroachment in the catchment areas for drinking water intakes has caused considerable concern about contamination from fertilizers and biocides. Although attention has been focused mainly on the Montreal catchment, the problem is certainly not confined to that single area. Since several of the biocides used in large quantities in St. Vincent are very hazardous to human health, and since high nitrate levels in potable water (exceeding 10 mg/liter as nitrogen or 45 mg/liter as nitrate) are very toxic to infants, such concern does not appear to be unwarranted.

WATER SUPPLY AND DEMAND

Hydrogeological surveys have shown that there is good groundwater potential in the Rabacca, Yambou, and Vermont river valleys in St. Vincent. There are plans to increase groundwater production by the construction of several new bore-holes in these areas in the future. This may compensate for a projected increase in water demand in the agricultural sector. While bananas do not require irrigation during the dry season, under GSVG's agricultural diversification program, the production of new crops which do require dry season irrigation is increasing, and there is potential for further expansion of vegetable production.

In the dry climate characteristic of the Grenadines, an adequate water supply is highly dependent on the timely arrival of the rainy season. During a drought, private individuals and businesses depend on Government storage reservoirs to make up the shortfall, but because there is not enough storage capacity, all the Grenadine islands now import water by tanker from St. Vincent. Estimates of the water resource availability or demand in these islands have been made by Jackson, *et al.* (1986).

POLICY MATTERS AND LEGISLATION

The CWSA shares administrative authority in the area of water quality monitoring with the Public Health Department of the Ministry of Health and the Environment. Responsibility for monitoring water quality in the distribution network and at the consumer lies with the Ministry of Health, but because the Ministry does not have laboratory facilities, the CWSA takes its own samples for chemical and bacteriological testing and sends results to the Ministry of Health. This is not the optimum situation from a regulatory standpoint, but no funds have been allocated to give the Public Health Department its own monitoring capability. It is also not clear which agency is actually responsible for monitoring and enforcement of water quality in rivers and marine waters.

The Central Water and Sewerage Authority Act of 1978 contains substantial authority to protect water supplies from pollution by agricultural chemicals and sediment (Lausche, 1986). The Minister of Health and the Environment has the power, upon the recommendation of the CWSA Board, to declare any site a protected area for water resource conservation; although this authority does not appear to be restricted to public lands, it has simply not been exercised. The proposed Water Resources Act and accompanying Regulations would also enable

CWSA to establish "protected zones" around water supplies, but -- even if enacted -- enforcement of the regulations which protect designated conservation areas would be required.

There are also major weaknesses in existing legislation pertaining to water resources management. Most catchments and intakes for water production are located on crown lands, but the provisions of the Crown Lands Ordinance and Regulations pertain primarily to the rental and sale of lands. Forestry legislation also relates principally to crown lands but has virtually no provisions for water resource protection; this will be rectified if currently proposed revisions (i.e., Forest Resource Conservation Act) are enacted (see also Section 10).

Although the issue has been recognized and discussed for years, the problem of squatters on crown lands has not been resolved, with squatters continuing to deforest critical water catchments and pollute them with agrochemicals. As early as 1968 and repeatedly during the 1980's, attempts were made to remove squatters from the Montreal catchment, but these efforts met with little success. There now seems to be a general attitude among GSVG middle-management personnel that the squatter issue is too politically sensitive for them to deal with effectively. Under these circumstances, many question whether proposed legislative revisions will accomplish stated objectives, no matter how well-designed they may be.

4.3 POLICY RECOMMENDATIONS

* In order to protect drinking water quality, a solution to the "squatter problem" -- with its environmental ramifications in critical water catchments, i.e., deforestation and extensive use of agrochemicals -- needs to be identified. Additionally, effective regulation of biocide imports and use should be implemented. The required technical information on biocides already exists, a land reform program is underway, and surveys of catchments and crown lands are now in progress (see Sections 2, 3 and 8). The remaining difficulties appear to be primarily social and political rather than technical; solutions will therefore depend on Government's ability to implement the regulatory and enforcement provisions of pending legislative reforms, rather than on further research or technical assistance.

* A system for effective watershed and catchment area management needs to be put in place as rapidly as possible, and steps must be taken to restore those areas which have already been damaged (see Sections 3 and 9 and especially Prins, 1986b).

* It is critical that the wastage of water in the public distribution system on St. Vincent be reduced in order to avoid shortfalls in supply.

* Full treatment should be installed at all the major surface water supplies to improve the quality during the rainy season and to eliminate the danger of chloramine contamination.

* Consideration should be given to placing responsibility for monitoring and enforcing water quality standards within the Public Health Department. Laboratory facilities and staff would need to be provided for this purpose within the Department.

Coastal village with typical picturesque line of coconut palms along the back beach area and with equally typical and ubiquitous bananas in the foreground.

SECTION 5 COASTAL AND MARINE RESOURCES

5.1 OVERVIEW

PHYSICAL FEATURES

The shallow coastal shelf (less than 100 meters or 330 feet deep) surrounding St. Vincent and the Grenadines encompasses a total area of about 690 square miles (Figure 5.1(1)). Around St. Vincent proper, the shelf is widest on the southeastern side of the island and very narrow on the northern, western and southwestern sides. There is a narrow trough between St. Vincent and the Grenadine Islands, which attains depths of 1,800 feet or more. The Grenadines are situated on a long, relatively broad shelf which falls off steeply to deep water on the north, east and west.

The dominant ocean currents in the vicinity of St. Vincent and the Grenadines flow from the east-southeast. Some upwelling of deeper ocean waters is thought to exist along the eastern part of the insular shelf. During the South American rainy season enormous quantities of fresh water are discharged from the Orinoco and Amazon rivers; this water then drifts toward and across the southern islands of the Eastern Caribbean chain. As this low-salinity water mass moves across the area, distinct interfaces between the turbid green (Orinoco) and clear blue (oceanic) water are recognizable. This phenomenon is believed to affect fishing operations in that neither oceanic pelagic fishes nor bottom fishes are thought to be easily catchable when such water masses are present in the area.

Most beaches in the Grenadines are composed of the brilliant white sand so beloved by tourists and hoteliers. White sand is produced by the fragmentation of skeletal material from the organisms making up the extensive coral reefs in these waters, e.g., corals, calcareous algae and coraline algae. The long-term existence of this type of beach therefore depends on the continued health of their "sand factories" -- the living animals and plants of the adjacent reefs.

By contrast, the majority of St. Vincent's beaches are made up of black sand, stones and boulders derived from the volcanic rocks of the mountains which are delivered to the coastline by rivers. Only at Indian Bay, Villa Bay, Calliaqua Bay and Young Island on the south coast are there white coral sand beaches, due to the extensive reefs in these bays. Not surprisingly, the major tourist hotel and resort developments are found in this area.

Along the southeastern coast of St. Vincent, the beaches are backed by extensive vegetated black sand dunes which can be as high as 150 feet; these dune systems are best developed at Brighton and Diamond Bays. Some of the bays in the Grenadines also have dunes, e.g., Carenage, Godhalt, Mysore and Windward Bays on Canouan, and Chatham and Bloody Bays on Union.

CRITICAL HABITATS

Three habitats -- mangroves, coral reefs, and seagrass beds -- are of critical importance in nearshore tropical marine ecosystems. There are many direct links between the extent and health of these habitats and the productivity of the inshore fisheries. The majority of bottom-dwelling fish species in the shallow nearshore waters of the Eastern Caribbean (more than 300 species, of which an estimated 180 species are landed for human consumption) are associated with coral reefs as adults. Many of these reef fishes, including species important in local fisheries, utilize mangrove swamps and/or seagrass beds as "nursery" habitats in the juvenile stages. Commercially important invertebrates such as conch and lobster also are found in these habitats as juveniles and in some cases as adults. Seagrass beds provide significant energy inputs to the reef system by serving as feeding grounds for adult reef fishes. Mangroves and seagrass beds also serve important functions in protecting coral reefs by filtering

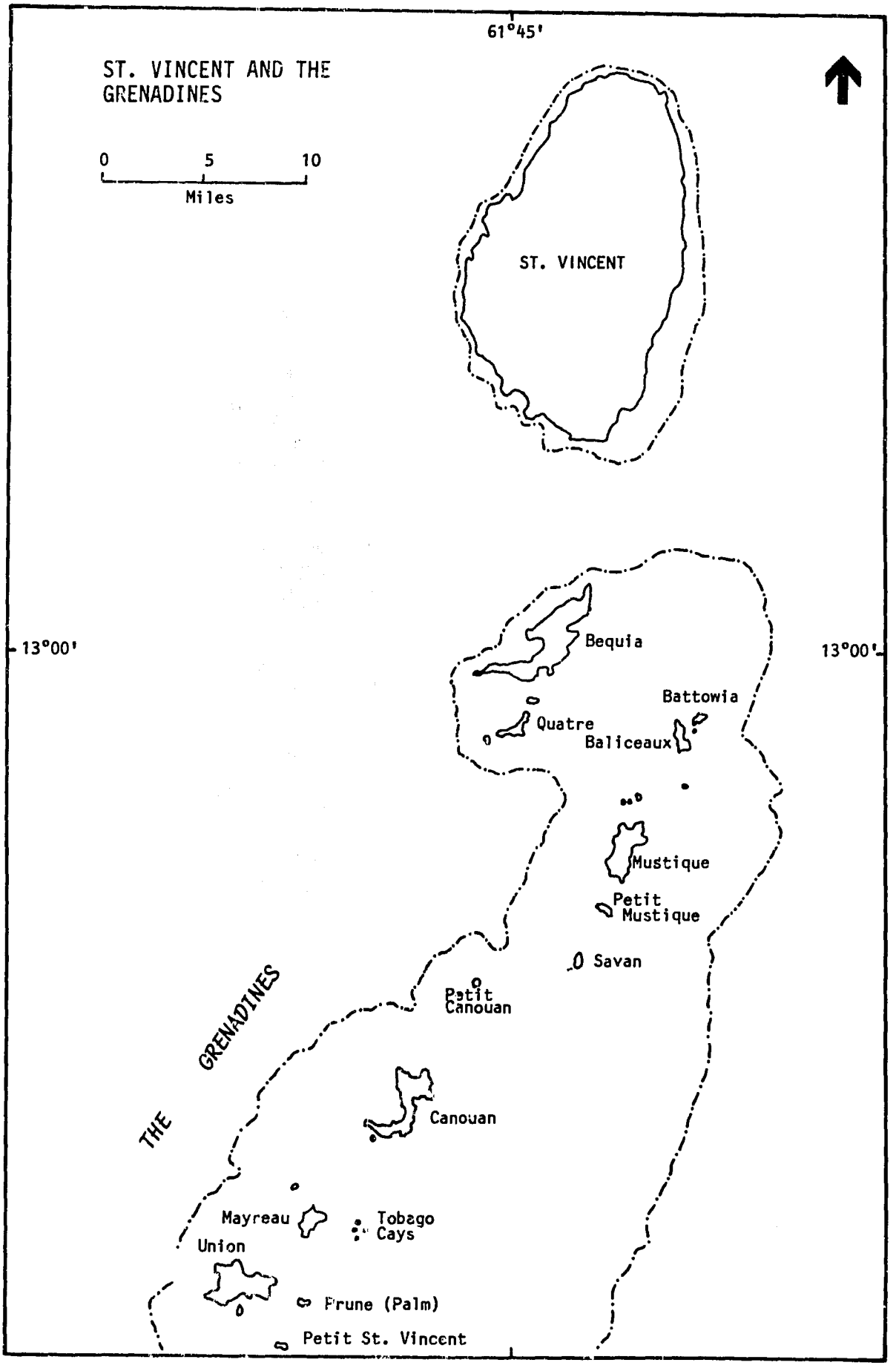


Figure 5.1(1). Coastal shelf area, 100 m contour, St. Vincent and the Grenadines (source: Wells, 1987).

out sediments from land run-off, and reefs in turn protect mangroves, grass beds and beaches from the destructive effects of storm waves.

A very general and incomplete picture of the distribution of these major coastal and marine habitat types in St. Vincent and the Grenadines is shown in Figure 5.1(2). Detailed mapped information on marine biological communities in the country is unfortunately lacking, but partial surveys and mapping of bottom habitats have been carried out in a few locations such as the Tobago Cays, the southwest coast of Bequia and southeastern St. Vincent. The Forestry Division is currently engaged in mapping mangrove areas throughout the country.

(1) Mangroves (information provided by W. Metz, US Peace Corps Volunteer, Forestry Div., pers. comm., April 1990). On St. Vincent only a few very small areas of mangroves remain today; however, it is probable that there never were extensive areas of this habitat type on the island. A small (0.4 ac) fringe of white mangroves surrounding a pond at Milikin Bay on St. Vincent's south coast is thought to be that island's most important mangrove habitat for wildlife (mainly birds). The Forestry Division has recently (June 1990) entered into a five year renewable Cooperative Forest Agreement with private landowners to protect and preserve the Milikin Bay mangroves. Other minor areas of mangroves occur at the Carenage in Calliaqua Bay and at Almond Tree Bay on Johnson Point.

Union Island in the Grenadines lays claim to the largest stand of mangroves in the nation, found in the 50 acre Lagoon Swamp adjacent to Ashton Harbor. In the past these mangroves were heavily damaged by cutting, according to Faaborg and Arendt (1985). Today the swamp is still bordered by a fringe of red mangroves and has good stands of black mangroves in its interior. This mangrove wetland is probably very important to birds and other wildlife, but no quantitative surveys have yet been done. The Forestry Division intends to designate Lagoon Swamp as a reserve or conservation area for protection of flora and fauna as well as to ensure sustainable yields of forest products. The swamp already lies within the boundaries of the Ashton Bay Marine Reserve.

Also on Union Island are about 15 acres of red, white, black and button mangroves at Richmond Bay; a 5 acre fringe of white, black and button mangroves and clumps of red mangroves in the salt pond at Belmont Bay; a red mangrove fringe at Queensberry Point; a fringe of red mangroves along the beach to the east of Lagoon Swamp; and some degraded mangroves in the salt pond adjacent to the airstrip at Point Lookout.

The Forestry Division completed a survey of the mangroves on Mustique in 1990. The most complex mangrove system on Mustique is found at Lagoon Bay on the southwest coast, an area occupying approximately 20 acres of sandy shoals and mud flats. It is characterized by a 19 acre zone of black mangroves; directly inland and adjacent to this zone is a 0.7 acre belt of red mangroves, encircling the southwest perimeter of the lagoon. About 0.3 acres of red mangrove can also be found north of the lagoon in proximity to the old salt pond that was turned into a refuse site. Another mangrove wetland, immediately adjacent to and north of the Mustique airport, encompasses approximately 27 acres of black and button mangrove. The privately-owned Mustique Company has reserved this mangrove wetland as a bird sanctuary (Forestry Division Mustique Mangrove Survey, 1990).

There is a narrow mangrove fringe around the large salt pond on Mayreau.

(2) Coral Reefs. In the waters around St. Vincent, well-developed reefs occur mainly on the south and southeast coasts in the Indian Bay-Young Island-Calliaqua Bay-Johnson Point area. The Indian Bay and Johnson Point/Sharps Bay reefs were studied in the early 1960's by Adams (1968). Concern has been expressed in the literature (e.g., Cambers, 1985b) that these reefs may be dead due to the effects of land-based pollution. While the reefs do show unmistakable signs of stress, they are far from dead, and there is still a considerable area of living coral remaining (R. Teytaud, IRF Staff Ecologist, personal observations, Feb.-April,

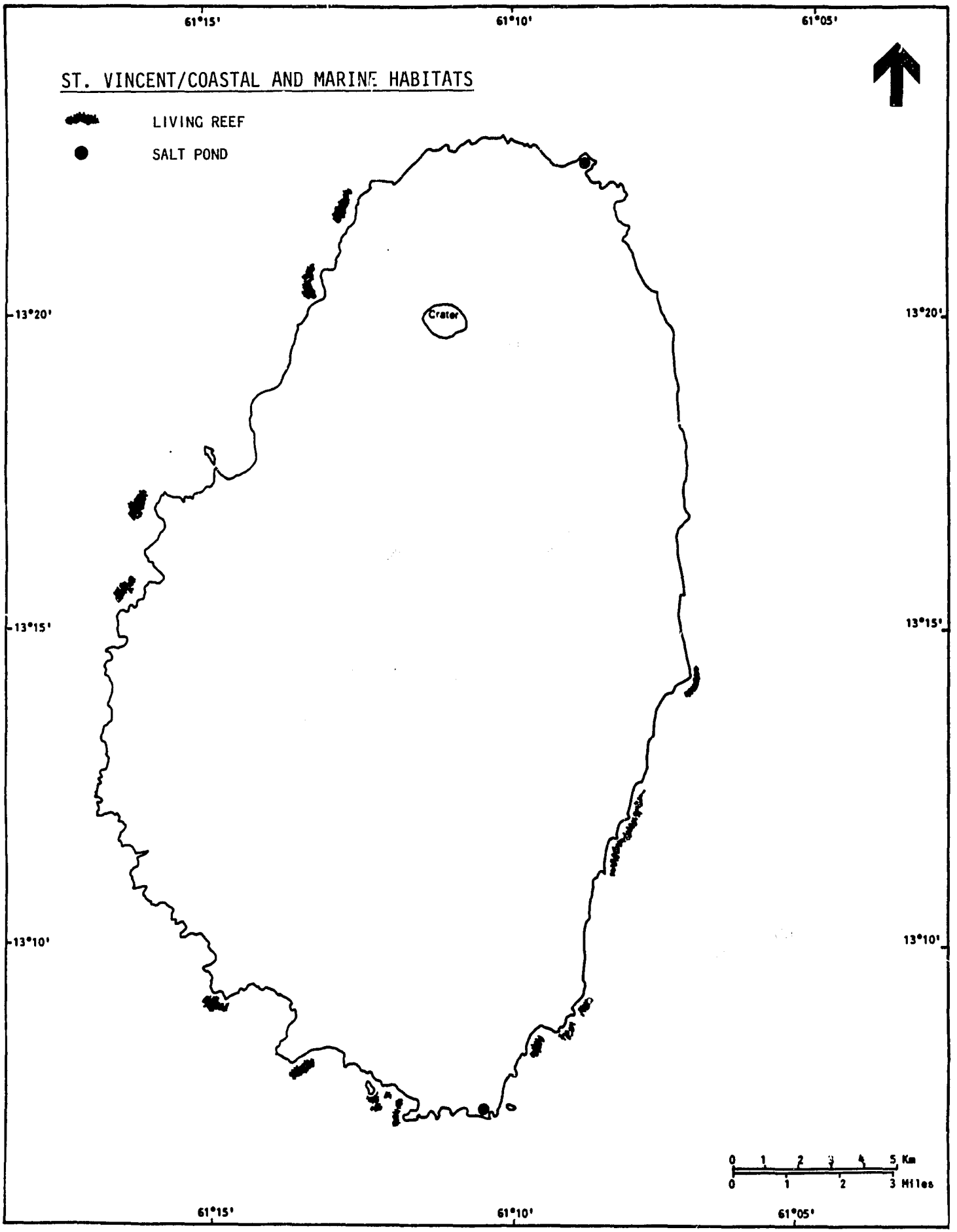


Figure 5.1(2a). Major coastal and marine habitats, St. Vincent (source: ECNAMP, 1980a).

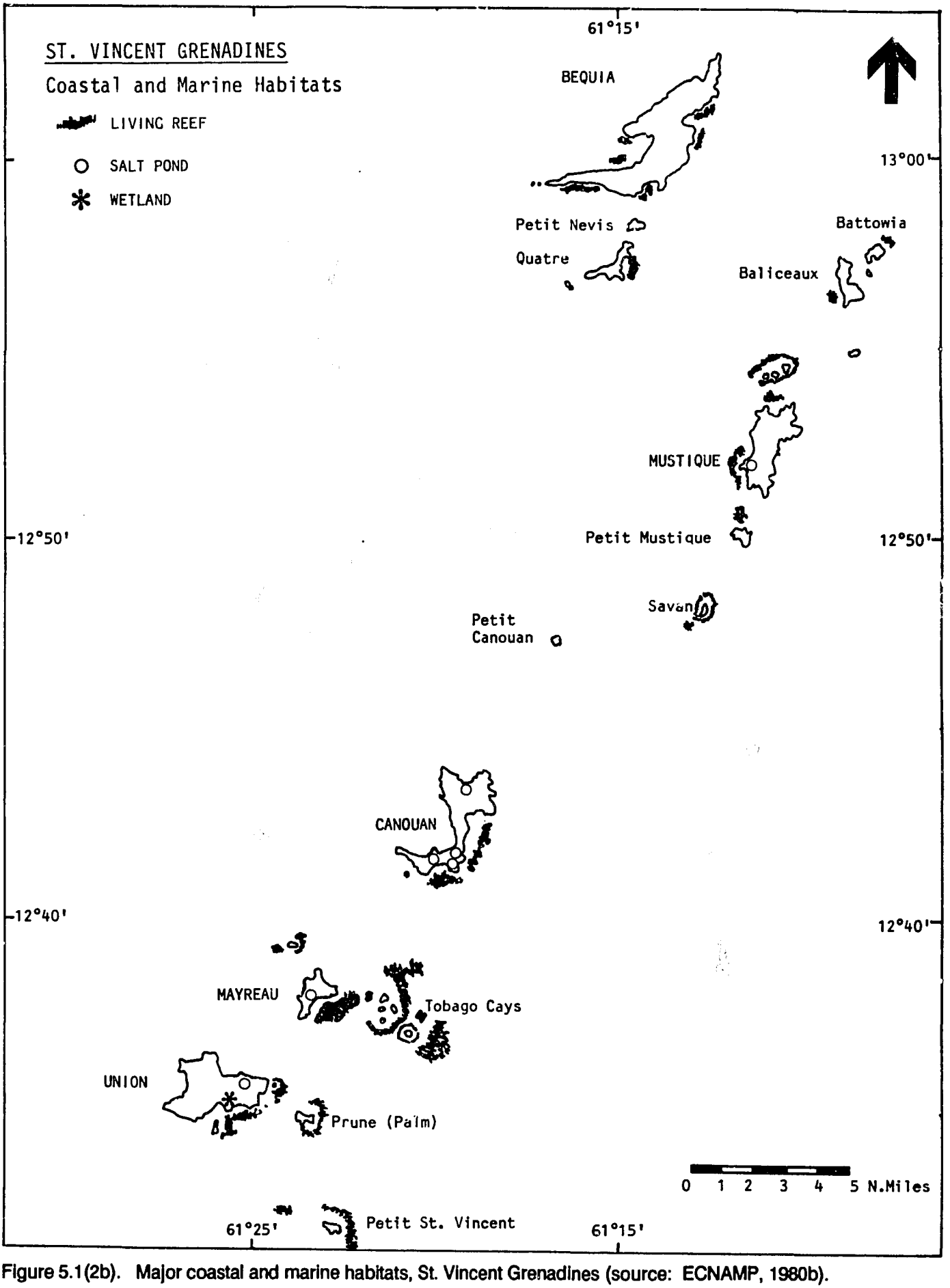


Figure 5.1(2b). Major coastal and marine habitats, St. Vincent Grenadines (source: ECNAMP, 1980b).

1990). A more recent detailed status report can be found in the St. Vincent chapter of IUCN's *Coral Reefs of the World*, published in late 1988 (Wells, 1988).

From Kingstown to Chateaubelair on the western coast, the narrow insular shelf supports a patchy but nevertheless considerable amount of coral growth on rocky substrates adjacent to many of the headlands. However, there are no well-developed fringing or patch reef structures here. According to Adams (1968) and Wells (1988), Sharps Bay is the easternmost occurence of vigorous coral growth and well-developed reefs on St. Vincent; the exposed north and east coasts are said to lack coral reefs entirely.

Three-quarters of the Grenadines platform is 120 to 130 feet deep and has no shallow coral reef systems. There is a significant submerged ridge system on the eastern margin of the shelf, extending for over 27 miles and presumably representing an extinct barrier reef (B. D'Anglejean and E. Mountjoy, 1973; cited in Wells, 1988). The northernmost parts of the Grenadines such as Bequia, Battowia and Isle de Quatre lack large bank-barrier reef systems, although some small reefs occur in coves, off headlands or between small islands. Although Mustique has a well-developed shallow shelf, it also lacks significant reef development. The eastern side of Canouan has large but relatively undeveloped tracts of reefs which are said to be dominated by coraline algae, with incipient mounds of coraline algae and fire coral but little growth of branching corals or head corals (Adey and Burke, 1976).

The most extensive and well-developed coral reef complexes in the country are found on the shallow (30 to 40 feet deep) shelves around the windward sides of Mayreau and Union Islands and the Tobago Cays. The bank-barrier and fringing reefs of the Tobago Cays are dominated by the branching elkhorn coral (*Acropora palmata*) in shallow water and by various head corals in the deeper fore-reef zones; their structure has been described by Lewis (1975), Adey and Burke (1976), and Heyman, *et al.* (1988). These reefs have long been famous for their underwater scenery and bountiful production of fish, conch and lobsters, but in recent years they reportedly have suffered serious deterioration. The present condition of these reefs is discussed in Section 5.2.

(3) **Seagrass beds.** Little or no accurate information exists on the distribution of seagrass beds in St. Vincent or the Grenadines.

MARINE WILDLIFE

Humpback Whales (*Megaptera novaeangliae*), Sperm Whales (*Physeter catodon*), Blackfish or Pilot Whales (*Globicephala macrorhynchus*), Killer Whales (*Orcinus orca*), Bottlenose Dolphins (*Tursiops truncatus*), Spinner Dolphins (*Stenella longirostris*), and several other species of dolphins are some of the marine mammals which frequent the waters of St. Vincent and the Grenadines. Humpback Whales migrate from northern waters to calving grounds in the Grenadines during January to April each year, Blackfish migrate through the area between July to November or mid-December, and a wide variety of dolphins are present year-round. Other cetacean species are less commonly encountered.

Four species of sea turtles are found in the nation's waters: the Hawksbill (*Eretmochelys imbricata*), the Green (*Chelonia mydas*), the Loggerhead (*Caretta caretta*) and the Leatherback (*Dermochelys coriacea*). Table 5.1(1) summarizes information on sea turtle populations in the area; unfortunately, although these data are a decade and more old, they are still the latest available information (Groombridge and Luxmoore, 1989).

FISHERIES

A regional context for fisheries resource management in the OECS nations is provided by Mahon (1988), who summarized the current state of knowledge regarding resource assessment and also suggested general management options for the various fisheries. A comprehensive and environmentally sensitive overview of the fishery sector in St.

Table 5.1(1). Summary of data on sea turtle populations in St. Vincent and the Grenadines.

Status	Nesting	Foraging	
		Adults	Juveniles
Abundant			
Common			
Frequent	El		
Occasional	Dc	Cc Cm El Dc	Cm El
Rare	Cc Cm		

Nesting Areas: Richmond Beach, Barrouallie (El, Dc); Rose Bank, Troumaka Bay, Cumberland Bay, Wallilabou Bay, Orange Hill, Colonarie Bay, Stubbs (El); Dark View, Clare Valley, Mt. Pleasant, Sandy Bay (Dc)

Foraging Areas: No data

Population Estimates: None

Key:

El	*Eretmochelys imbricata* (Hawksbill)
Dc	*Dermochelys coriacea* (Leatherback)
Cc	*Caretta caretta* (Loggerhead)
Cm	*Chelonia mydas* (Green)

Source: Bacon, 1981.

Vincent and the Grenadines was provided by an FAO consultant (Matthes, 1984). Additional background information on fisheries may be found in a series of papers by Adams (1970a, 1970b, 1971, 1973, 1977, 1980, 1985). The fisheries of the Tobago Cays have been described by Berwick (1986) and Heyman, *et al.* (1988). Morris (1989) provides data on landings and landing trends at the Kingstown fish market, describes the present fishing fleet and fisheries, and discusses the current fisheries data collection system.

In St. Vincent and the Grenadines fishing continues to be primarily an artisanal industry. No complete census of fishermen has yet been taken. According to the FAO fisheries development study, in 1984 there were perhaps 5,000 to 6,000 fishermen (about 3,000 full-time) and about 2,500 persons working in fishery-related sectors such as marketing, boat building and repair services (Matthes, 1984). Including families, this means that at the time of the study approximately 30,000 people depended for their living on marine fisheries-related activities. Some 85-95 percent of adult males in the Grenadines were either fishermen or active in related sectors. Berwick (1986), based on information from the Chief Fisheries Officer, gave a somewhat lower estimate of 2,500 full-time fishermen and 1,000 part-time. With the

growth of tourism and other sectors and the decline of stocks, these figures may be somewhat lower today (particularly in the Grenadines).

The major types of fisheries and the fishing gear and methods used in St. Vincent and the Grenadines include the following (Matthes, 1984; Morris, 1989):

- **Shallow reef fishes and deepwater bottom-living** (or "demersal") **fishes**, are fished most extensively in the Grenadines. Fish traps or "pots" may be set baited or unbaited for reef fishes in 100 to 200 feet. Bottom hand lines are fished in depths from 70 to more than 600 feet, by drift-fishing or stationary "banking". Occasionally bottom-set gill nets and "Palangs" (bottom-set longlines with about 100 hooks) are also used.

  Trammel nets or tangle nets are typically set in shallow reef areas where lobster, conch, and a wide variety of fish may be captured. Because they are unselective and are often left unattended for one to three days, these nets are very destructive. They are now illegal, but some no doubt continue to be used.

  Spearfishing is a popular method of taking reef fishes among local fishermen, and although it is now illegal without a license, no doubt it is still commonly done by visiting yachts and tourists in the Grenadines.

- **Offshore pelagic species** are mostly caught by trolling east of the Grenadines Bank. Trolling lines (with artificial feather lures or baited hooks) are deployed at 300 feet or more while the boat is drifting, or at the surface with outriggers when underway.

- **Small inshore pelagic species** are caught by seines, which are set from a rowboat to enclose these schooling fish and then hauled to shore or set offshore from a large double-ended rowboat assisted by two to three smaller boats and a team of SCUBA divers to tend the foot-rope. Seining is the most common fishery on the west coast of St. Vincent, especially at Barrouallie. Gill nets set at the surface are used primarily for catching ballahoo and in one location for flying-fish; some of these are used as drift nets.

- **Lobsters** are taken mainly in the Grenadines by teams of 11 or 12 men, five to six of whom are SCUBA divers using wire loops or nooses. Each team deploys four to five sailboats or boats with outboard engines; camps are subsequently set up, mainly on the Tobago Cays, Mustique, Petit St. Vincent and Palm Island. There are three to four such teams which are estimated to take about 90 percent of the catch. The live lobsters are kept at the camps in crawls until they are bagged and sold to a trader boat.

- **Conch** are taken by the SCUBA-diving lobster teams, but there are also specialized free-diving conch teams operating out of Union Island.

- **Sea turtles** (mostly Green and Hawksbill) are caught in turtle nets or harpooned, probably year-round despite a five-month closed season.

- **Whales and dolphins** are taken by harpooning with hand-held harpoons or harpoon guns. A Humpback Whale may occasionally be taken in the vicinity of Bequia or Mustique by whalers operating out of Friendship Bay in Bequia; none were taken in 1987, 1989, and 1990, although one was taken in 1988 (pers. comm., CEP National Committee, 1990). Blackfish, Sperm Whales, Bottlenose and other dolphins are routinely hunted by fishermen based in Barrouallie, mostly for the meat which is locally prized.

- **Recreational sportfishing** is done by private fishermen, but there are no charter boats at present.

Fishing vessels are mostly small, open or partly-decked boats of several types, powered by oars, sails, diesels or outboards. In 1984 it was estimated that some 30 seine teams were operating mainly on leeward and southern St. Vincent and Bequia. At least 100 boats were using gill nets, trammel nets, traps and palangs; and some 2,000 fishermen were

estimated to be either trolling or drop-lining. Many fishermen also used several types of gear either seasonally or simultaneously, and about 50 were regular SCUBA divers.

The main fishing centers on the island of St. Vincent are at Kingstown (the largest) and Barrouallie; there are about twenty other areas where fish are landed. Fishing is a major (if not the major) activity in all the villages in the Grenadine Islands. There are two fishing seasons during the year for St. Vincent fishermen, the "low season" from September to December or January and a "high season" from January or February to August. The higher landings are associated with the exploitation of migratory offshore pelagic species -- dolphin (*Coryphaena hippurus*), tuna (*Thunnus albacares*), kingfish (*Scomberomorus cavalla*), bonito (*Thunnus atlanticus*), and skipjack (*Katsuwonus pelamis*), and the inshore pelagics -- jacks (*Selar crumenophthalmus*), ballahoo (*Hemiramphus balao*), spratt (*Harengula pensacolae*), dodger (*Decpterus punctatus*), and robin (*Decapterus macarellus*). In the Grenadines year-round and in St. Vincent during the low season for pelagics, fishermen concentrate on shallow-water reef fishes or deep demersal species such as certain snappers and groupers.

No current data on the annual fish landings for the entire country are available, but between 1984 and 1986 annual landings were "guesstimated" to be at least 1,700-1,800 metric tons including about 850 tons from the Grenadines; perhaps 70 percent of the Grenadines catch was exported to Martinique via middlemen with iceboats. Shallow reef and deep demersal species probably accounted for 700-800 tons per year; offshore and inshore pelagics accounted for the remaining 1,000 tons (Matthes, 1984; Berwick, 1986). At that time, it was also estimated that landings of fish caught locally accounted for only one-half of the annual per capita fish consumption, with the remainder made up by imported fish products.

FISHERIES MANAGEMENT AND DEVELOPMENT

The multi-species nature of reef fisheries, coupled with the scarcity of information on landings, fishing effort and size of the exploited stock, makes it very difficult to obtain reliable estimates of sustainable yields for the fisheries of St. Vincent and the Grenadines and other Eastern Caribbean nations (Goodwin, *et al.*, 1985).

The current GSVG fisheries data collection system is limited to a total census at the Kingstown Fish Market (from purchase receipts by species) and data from incomplete export records for fish leaving the islands. Due to manpower limitations (only six persons are employed in the entire Fisheries Division, with plans to hire an additional five or six in the near future) and because of the number of islands and landing sites involved, expanding the system will be difficult. However, there are plans (Morris, 1989) to conduct a minimal sampling program in the future to acquire data from other landing sites on the main island and in the Grenadines. The OECS Fisheries Unit (with headquarters in Kingstown) has been assisting with implementation of standardized fisheries data collection systems throughout the OECS member states, including St. Vincent.

CIDA has recently funded a Can$18 million fisheries stock assessment project for the CARICOM region. The project will comprise three case studies on different types of fisheries. St. Vincent and the Grenadines will be the project center for the study of pelagic fisheries in the OECS countries; other centers will be in Belize (demersal fisheries) and Guyana (shrimp fisheries).

An EC$10 million grant from the Japanese Government has been used to finance a modern fish market complex just opened in Kingstown, with cold storage facilities and fisheries laboratory. Additional funds from the Japanese will be used to provide fishing equipment for the Fisheries Division. A Japanese fisheries expert was assigned to the country for three months in 1990 to look at lobster, turtle and conch management and possibilities for seamoss mariculture.

A new CIDA-funded Fisheries Development Program will provide fisheries infrastructure (retail centers, boat haulout sheds, improved gear and methods, fisherman training, cold storage facilities, etc.) in Union Island, Canouan, Bequia and Mustique.

LEGISLATION FOR FISHERIES MANAGEMENT AND MARINE CONSERVATION

The *United Nations Law of the Sea Convention (CLOS)*, of which St. Vincent and the Grenadines is a signatory, obligates coastal member states to "protect and preserve the marine environment" and provides a legal framework for doing so utilizing the concept of the Exclusive Economic Zone (EEZ). Following a seminar on the EEZ of small island states held in St. Vincent under the sponsorship of the Dalhousie Ocean Studies Program in 1981, GSVG declared an EEZ by passage of the Maritime Areas Act (No. 15 of 1983).

The EEZ extends seaward for 200 nautical miles and encompasses a total area of about 11,000 square miles (Matthes, 1984). Within this zone the nation claims exclusive control, through the Minister for Foreign Affairs, of: (1) fishing and other economic activities, (2) conservation and management of living and non-living resources, and (3) the protection and preservation of the marine environment. The Act also gives the Minister broad powers to set up sea lanes and vessel traffic separation schemes for the purpose of, among others, preventing pollution. The Act states that the Minister shall publish charts and lists of coordinates delineating the limits of the various special zones set up by the Act, but this has not yet been done (pers. comm., K. Morris, Chief Fisheries Officer, April, 1990).

GSVG is also a signatory to two other international conventions:

- *MARPOL (International Convention for the Prevention of Pollution from Ships)*, which prohibits nearshore discharges of oil, noxious liquid substances in bulk, harmful substances in packaged forms, sewage and garbage.
- *CITES (Convention on International Trade of Endangered Species of Wild Flora and Fauna)*, which regulates trade in species listed in three appendices (see also Section 2 of the Profile). Appendix I lists species which are threatened with extinction and in which commercial trade is prohibited; Appendix II lists species which may become extinct unless trade is strictly regulated; and Appendix III identifies species protected in their country of origin and in which the cooperation of other nations is required in order to enforce export restrictions.

The *Fisheries Act* (No. 8 of 1986) established for the first time a legal framework for fisheries management in St. Vincent and the Grenadines. The Act covers fisheries access agreements, foreign fishing licenses, fish processing establishments, fisheries research and the registration of fishing vessels. The Act also prohibits the use of any explosive, poison or other noxious substance for the purpose of killing, stunning, disabling or catching fish. It empowers the Minister to set up marine reserves for the conservation of the environment and the enhancement of fisheries and to promulgate regulations for prohibiting harmful fishing methods. The Minister may declare any area of the fishery waters (i.e., the waters of the EEZ, territorial sea, archipelagic waters, and internal waters as defined in the Maritime Areas Act), *and any adjacent or surrounding land*, to be a marine reserve.

The *Fisheries Regulations* (SRO No. 1 of 1987) pertain to the establishment of a Fisheries Advisory Committee and include provisions for foreign fishing vessels, local fishing licenses and fish aggregating devices. The regulations also set out fishery conservation measures, such as closed seasons and gear restrictions, and specify coordinates for the boundaries of ten marine conservation areas. Enforcement of the law regarding fisheries and marine conservation areas is the responsibility of "any authorized officer" (i.e., any fisheries officer, any customs officer or police officer, or any other person designated by the Minister); upon conviction for violating

any of the regulations, persons so charged are liable to a fine not to exceed five thousand dollars.

There is a closed season for lobsters from 1 April to 31 October. It is prohibited to take lobster other than by hand, loop, pot or trap or to take any lobster that is moulting, carrying eggs or undersize (less than 9 inches total length or 3.5 inches carapace length, or less than 1.5 pounds total weight).

There is a closed season for turtles from 1 March to 31 July. It is prohibited to disturb, take, possess, purchase or sell turtle eggs or to interfere with any turtle nest; or to take, sell, purchase or possess any undersized turtle or the shell of an undersized turtle.

There is a provision for the Minister to declare a closed season for conch, but this has not been done yet. It is prohibited to take, sell, purchase or possess any "immature" conch (defined as a conch having a shell without a flared lip or a shell smaller than 7 inches total length, or with a total meat weight of less than 8 ounces after removal of the digestive gland).

It is prohibited, except by permission of the Chief Fisheries Officer, to take or collect "coral" or to use a speargun within the fishery waters or to import, sell or export any aquarium fish. Fishing is not permitted at all in any designated marine conservation area.

The use of tangle nets is prohibited. The mesh size of seines must be greater than one inch square, and the mesh size of a "ballahoo net" must be greater than half an inch square. A ballahoo net may not be hauled out of the water onto land or any structure, or onto any vessel lying within fifty feet of land.

5.2 PROBLEMS AND ISSUES

SAND AND ROCK MINING FROM BEACHES

The unregulated mining of sand and rocks from beaches for use in the construction industry is generally perceived to be the most important coastal resource issue in the country. Mining is believed to have caused considerable damage to beaches over the years, and as a result many of them are thought to be greatly diminished in width. Virtually all the beaches which are accessible by road have been mined to some extent, but those closest to Kingstown and other population centers have been the most affected. Figure 5.2(1) shows the distribution of sandy beaches and dune systems, quarries for sand and aggregate, and beaches where mining has been particularly intensive.

There seems to be general consensus locally that the removal of sand and rock is the major causative factor in the reduction of the country's beaches. According to a report by Robertson (1990), the impact on beaches has accelerated over the last five years due to a combination of factors: a recent building construction boom, the destruction of beach vegetation by trucks used in transporting the sand, greater use of the shoreline for tourism-related construction, and increased damage to marine ecosystems from land-based sources of pollution. However, there are no quantitative data on the amount of materials that have been extracted or any documentation of the impact due to mining *per se*.

Beach mining has been recognized as a problem for many years, even as early as the 1960's (Robertson, 1990; Cambers, 1981 and 1985a), but Government has never made a serious attempt to control it. In 1981 a Beach Protection Act (No. 10) was passed, making it illegal to remove sand, corals, stones, shingle or gravel from any part of the beach or sea bed, except by permit from the Minister of Agriculture. Any police officer is empowered to arrest violators, and a schedule of fines was established. However, no alternative source of sand was provided, regulations were never

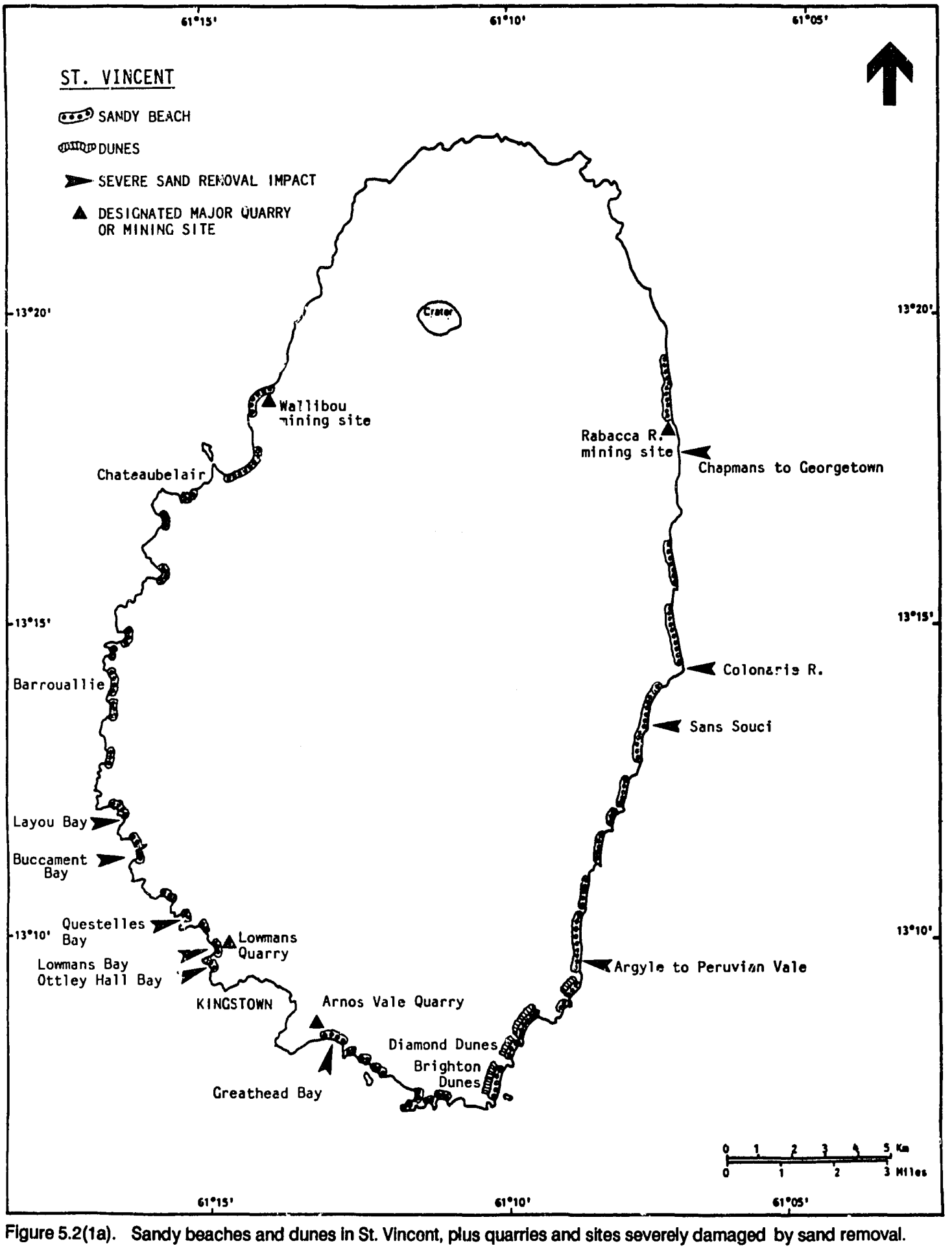


Figure 5.2(1a). Sandy beaches and dunes in St. Vincent, plus quarries and sites severely damaged by sand removal.

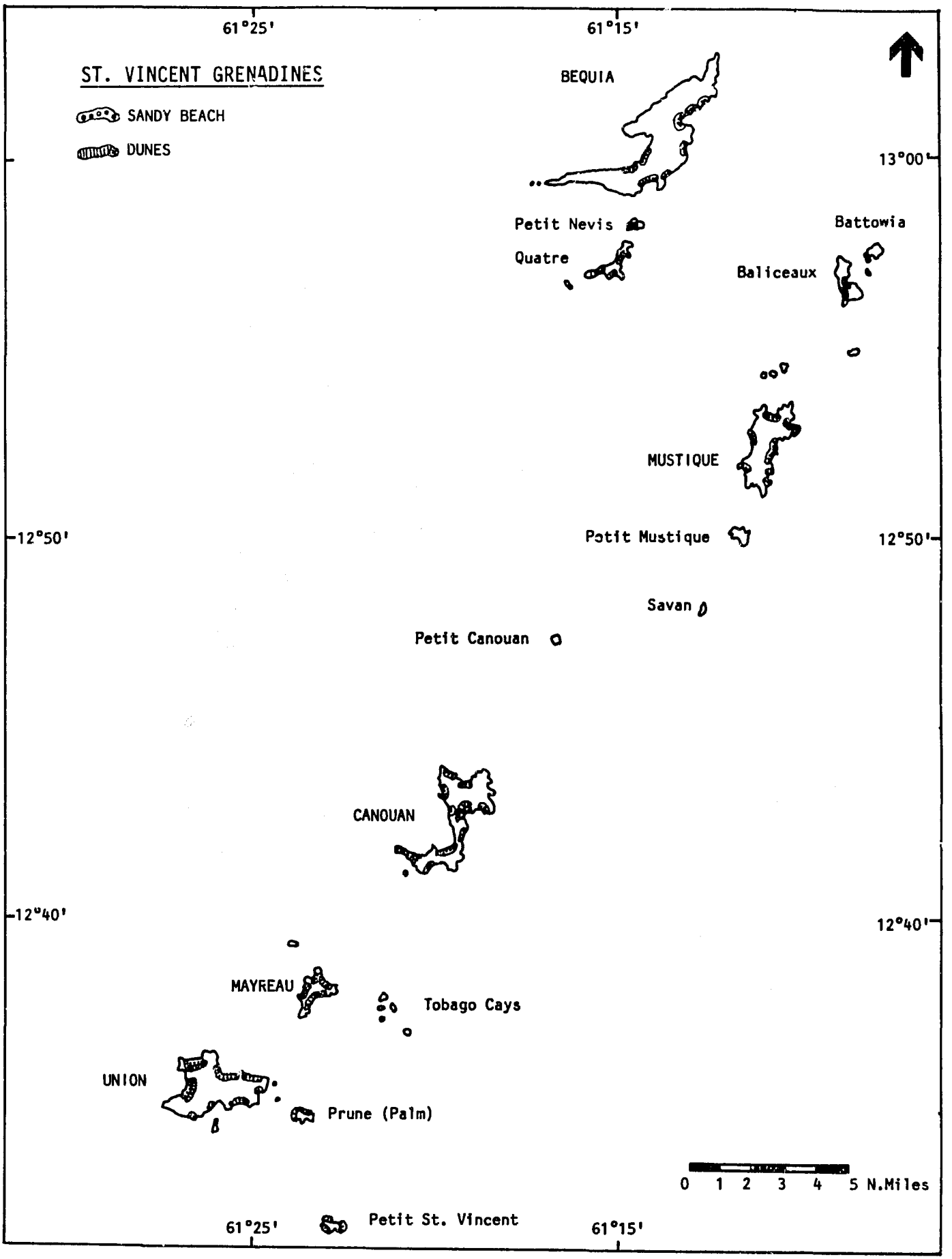


Figure 5.2(1b). Sandy beaches and dunes in the St. Vincent Grenadines.

enacted, and the legislation has generally not been enforced.

In 1983 an Environmental Improvement Committee was appointed by Government to study problems relating to sand mining and beach destruction. The Committee updated an earlier study by Cambers (1981) and made detailed recommendations and proposals for regulations to implement the Act. Its report, however, was never taken to Cabinet, and once again no regulatory action was taken by GSVG.

More recently, a study was commissioned by the Ministry of Communications and Works to determine the feasibility of quarry development to supply construction materials and to relieve the pressure on beaches. The consultants' report (Golder Associates, 1987) recommended that a statutory body should be set up to operate two quarries, one at Lowmans Bay to produce coarse sand and aggregate and another at Rabacca Dry River to produce aggregate only. These quarries are presently being developed.

The 1987 study recommended that beach mining in all other areas should be controlled and that a fee be charged for sand from Diamond Estate. The issue of charging for sand removal is a critical one; since beach sand is currently "free", unless the Government is prepared to institute a management system and to enforce the prohibition against illegal beach mining, the practice will undoubtedly continue unabated. Under the Golder Associates' plan, sand from the dunes at Diamond Estate would continue to be mined, since Rabacca sand is not fine enough for plastering. It has been stated that the sand deposits in the Diamond and Brighton dunes could supply St. Vincent's needs for the next few decades if sand extraction were properly managed (Cambers, n.d.). However, the assumptions underlying this calculation (e.g., rate of extraction) have not been clearly stated.

At the present time, various proposed mechanisms for regulating sand mining from beaches are still under review. Regulations are being drafted which would allow commercial mining from the Diamond and Brighton sand dunes, the Rabacca Dry River, and the Wallibou Dry River; mining would be prohibited on all other beaches in St. Vincent. In the Grenadines, it is proposed that sand removal for building homes on-island should be allowed only from specific beaches (still to be designated), except that no mining would be allowed on Bequia, Petit St. Vincent and Mustique, or the entire east coast of Canouan. Presumably, sand for any building on Petit St. Vincent, Bequia and Mustique, and for commercial building on the other Grenadines, would have to be imported. N.B. The Mustique Company reports that sand mining has already been banned on that island (pers. comm., 1990).

The Ministry of Agriculture has proposed that the Forestry Division "coordinate all aspects of beach protection," and the geologist attached to the Soufriere Monitoring Unit is currently advising the Ministry in this area. The Ministry of Communications and Works is responsible for management of the quarries and mining operations. A registration and license system for all sand miners has been proposed, but it is not clear at this time what the institutional relationship will be between the two ministries. During the next fiscal year, the Forestry Division plans to submit a request for funds to hire beach guards; in the interim, it is expected that Forest Guards will perform this function, in addition to their regular duties.

In the medium term, the Ministry plans to initiate a public awareness campaign, to seek assistance from donor agencies in conducting "studies of the coastal ecosystem", and to train local personnel in beach monitoring techniques. The Ministry has also expressed its interest in developing and implementing a comprehensive coastal zone management plan. However, there are at present no personnel within the Ministry with the necessary specialized expertise to deal with the marine-related aspects of such a program, i.e., physical oceanography and beach dynamics, biological oceanography, impact assessment or coastal zone resource management. The Fisheries Division, if strengthened, could conceivably assist in dealing with biological issues, but at present it is not able even to manage

the marine conservation areas for which it is responsible.

BEACH EROSION

The extensive beach erosion which has taken place over the last twenty years or so on the south coast of St. Vincent has caused considerable concern to GSVG tourism officials and to hoteliers and residents in the area. These beaches appear to be deficient of sand; at high tide only narrow strips of beach are visible where in former years the beach was considerably wider. Other beaches on St. Vincent and in the Grenadines have also experienced erosion during this period, which has usually been attributed to the impacts of sand mining. Although there is no doubt that sand removal has contributed to the erosion, it may or may not be the major cause of beach loss.

Hurricane Allen in 1980 also produced severe beach erosion on all coasts, including the beaches in the Indian Bay/Villa area. At Young Island the beach totally disappeared during the storm and never recovered to its former extent (Cambers, 1985b). To counter the erosion, arbitrary groins have been constructed at Young Island and at Calliaqua and Indian Bays. In addition there are gray water drains and jetties, which act as groins, and an artificial rock spit connecting Dike Island to the shore (built about twenty years ago). The great majority of these structures are probably either useless or actually do harm by impeding the natural longshore movement of sand along the bay.

In Bequia severe erosion is occurring along the shoreline of Port Elizabeth, where gabions and seawalls have been built to protect shoreline developments. Other Grenadine locations where erosion is a problem are Industry Bay on Bequia, Windward Carenage on Mayreau, Baradal Beach in the Tobago Cays, Palm Island Beach (north) and Southern Beach on Petit St. Vincent (Jackson, *et al.*, 1986).

The increased erosion of the nation's beaches during the past two decades parallels a similar trend noted in other islands in the region, e.g, Barbados, St. Kitts/Nevis, Montserrat, and Grenada. Data from studies carried out in Grenada (Cambers, 1984; 1988) indicate that during the period 1951-1970 there was generally little change in beaches, which were mostly stable except for localized erosion attributed to sand mining. From 1970 to the present, there was a general increase in beach erosion rates, attributed mainly to sea level rise and possibly also to increased wave energy from winter swells and hurricane swells. In some local areas, land subsidence may have played a dominant role. At least for Grand Anse Beach (the most intensively studied area in Grenada), human-induced causes of beach erosion, such as sand mining, removal of beach vegetation, and the death of coral reefs, were felt to be of lesser importance.

In order to pinpoint the major factors causing beach erosion in St. Vincent and the Grenadines, it would be necessary to carry out a research program similar to Grenada's, combining measurements (from aerial photographs) of the historical rates of beach erosion with long-term monitoring of beach profiles. A handbook of field procedures for such a coastal monitoring program has already been developed for Grenada (Cambers 1985a).

Recommendations have been made (Cambers, n.d.) for GSVG to investigate the feasibility of using sand dredged from offshore to "renourish" the beaches at Villa and Indian Bay. Under normal conditions, sand remains on a natural beach because its grain size is adapted to the average wave regime, but dredged offshore sand has a much wider range of grain sizes and always contains large quantities of fine sediments. Furthermore, sedimentation resulting from a beach renourishment project could combine with existing stresses (e.g., from increased nutrients in runoff and sewage or from anchor damage) to further degrade the remaining areas of living corals in these bays. For this reason, such a project for this particular location would be ill-advised because the reefs themselves are an invaluable resource in terms of fish production, as recreational attractions for local inhabitants and tourists, and as a continuing source of sand generation for the beaches.

OVERFISHING

Although hard data are lacking, on the basis of circumstantial evidence most authorities agree with Mathes (1984) that many of the nation's fish and shellfish stocks -- snappers and groupers, lobster, conch, whelk, white sea urchins, possibly black coral, and turtles -- are severely overfished. Inshore waters and the leeward shelves in particular appear to be the most over-exploited. The average size of fishes captured in the fishery is very small, and juvenile fish are often taken by the use of ever-smaller mesh sizes in the construction of traps and seines. Inshore fishing grounds in the northern and southern Grenadines have been badly depleted. Interviews with fishermen from the Grenadines (Berwick, 1986) indicated that drastic decreases in landings of fish, lobster and conch have occurred since about 1980. These fishermen must now make longer trips to fish the deeper banks such as those off Sail Rock.

The seasonal pelagic fish resource does not yet display any certain signs of overfishing. Unfortunately, this is no reason for complacency about its status if current regional trends towards industrialization of fisheries are pursued. Since the mid-1980's, the United States fishing fleet has greatly increased its exploitation of the billfish resource in the Eastern Caribbean. Japan, Taiwan and South Korea have also rapidly expanded their longlining activities in the Caribbean in the last few years. Their fleets have long operated as "outlaws" in the EEZ of nations which lack the means to patrol their waters, but several of these nations are now beginning to form fishing partnerships with Caribbean countries.

Estimates of abundance and sustainable yield are not available for most pelagic species (with the exception of some tunas, dolphin, and flying fish, e.g., Hunte, 1987b; Oxenford, 1985; Oxenford and Hunte, 1987). Many important species are migratory and possibly consist of several stocks, which implies that any management of such stocks must be carried out on a regional basis. Regional management, however, is not presently feasible pending collection of the required data.

Recent (1989) findings by the U.S. South Atlantic Fishery Management Council provide a sobering preview of the possible fate of industrialized pelagic fisheries in the Caribbean. The Council concluded after a lengthy study that the swordfish spawning biomass off the southeastern U.S. has declined steadily since 1979; the current biomass is estimated to be only 40 percent of the 1978 level (Leech, 1989). The average weight of swordfish has continually declined due to high fishing mortality rates. This stock assessment was based on 1987 data, the most recent available, but presumably the swordfish stock has continued to decline since then. An emergency management plan has been drawn up in an attempt to save the fishery; it recommends a quota system which is a reduction of 78 percent from the 1987 commercial harvest.

As another example, sharks have often been promoted as an "underfished" resource which holds great promise for industrial fishery development in the Caribbean, but it is now recognized by the U.S. National Marine Fisheries Service that shark stocks are heavily overfished in the Gulf of Mexico and the Caribbean, at least in U.S. waters. It is quite possible, therefore, that the pelagic fishery resources of the region are not great enough to sustain further large increases in fishing pressure. Uncontrolled expansion of industrial longline or drift-net fishing could severely deplete these fisheries in a very short time.

DETERIORATION OF CORAL REEFS IN THE TOBAGO CAYS

Within the past 10 to 15 years the widespread deterioration of coral reefs has emerged as a very serious problem in many areas of the world, including the Caribbean (Rogers, 1985). In addition to the south St. Vincent reefs (already mentioned), great concern has been expressed in recent years over the rapid decline of the famous reefs in the Tobago Cays. Reconnaissance surveys (e.g., Heyman, *et al.*, 1988) indicate that large areas of these reefs are in a degraded condition. This is particularly so in the vicinity of the "Lagoon", i.e., the yacht anchorage area behind Horseshoe Reef which is surrounded by

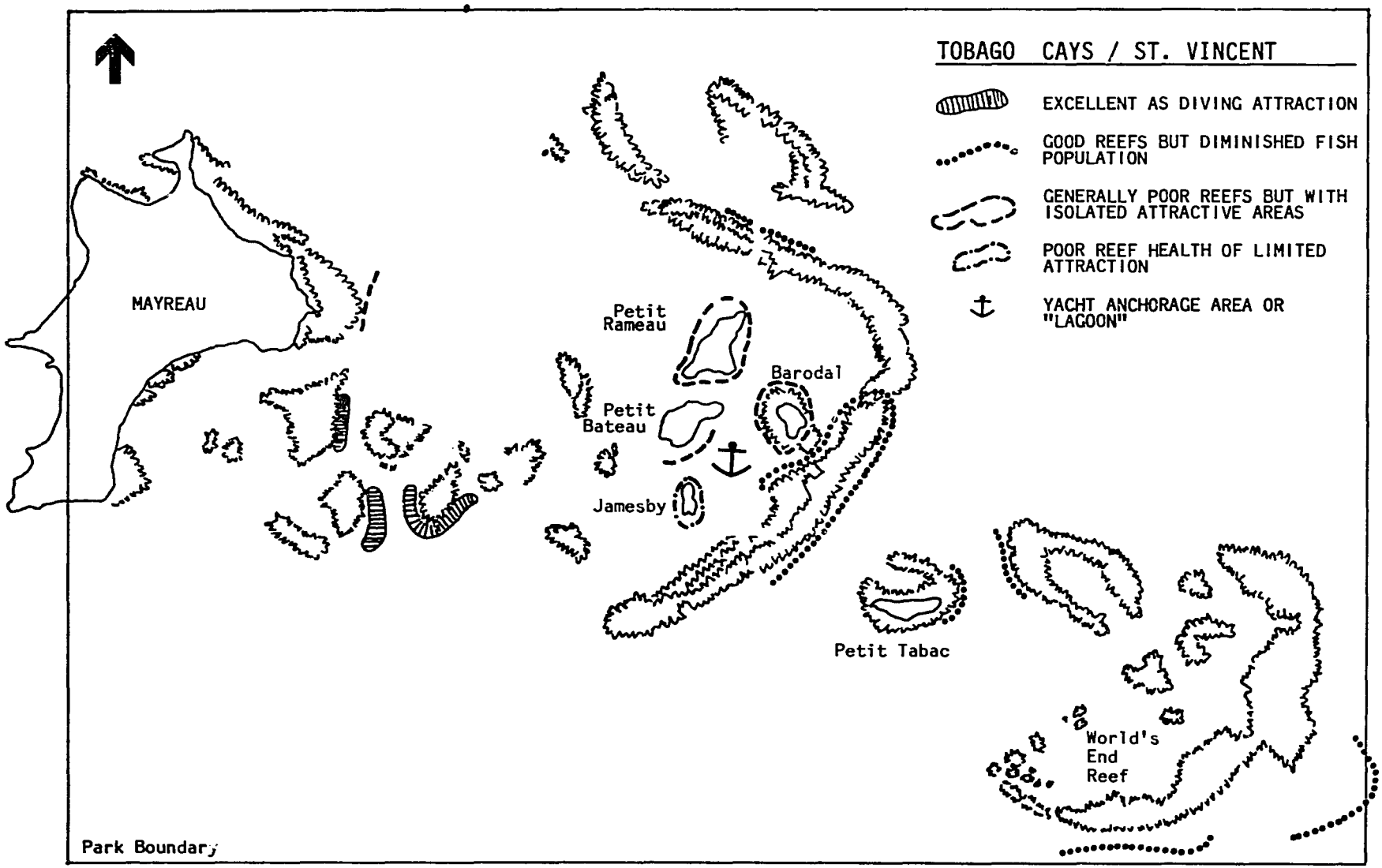


Figure 5.2(2). Condition of reefs in the Tobago Cays, St. Vincent Grenadines (source: Heyman, *et al.*, 1988).

the small islets of Petit Rameau, Petit Bateau, Baradal and Jamesby (Figure 5.2(2)). While there are still considerable areas of living corals and gorgonians remaining in the Cays, only one area of reef was still found by Heyman, *et al.* (1988) to be of truly exceptional quality.

The death of much of the elkhorn coral in the Tobago Cays can probably be attributed to the effects of White Band Disease, which has ravaged many shallow reef areas all over the Caribbean. However, there are extensive areas of dead corals belonging to other groups which are not susceptible to this disease. Algal overgrowth and the "bleaching" phenomenon are also very apparent, as well as areas of smashed coral. Both the local fishermen and the crews of visiting yachts have been responsible for the decimation of fish life; reef fishes have been so reduced by trap and spearfishing that very little of these activities now takes place in the area. Conch and lobster are very scarce in shallow water and are now being harvested by SCUBA divers at 60 to 90 feet. White sea urchins have been dramatically reduced by over-exploitation for sale to Martinique and Barbados.

Some have attributed the reef decline primarily to the effects of visiting yachts, e.g., the physical impacts (anchoring, grounding, breakage of coral by snorkelers) and the sewage discharged in the Lagoon. Until actual measurements of currents and water quality have been done, it will be difficult to determine the true significance of sewage from yachts as a factor in the decline of these reefs. Very preliminary calculations by Berwick (1986) suggest that the quantities of sewage discharged by the estimated number of yachts during the course of a year could contain enough nutrients to cause negative impacts on the marine communities in the immediate vicinity.

Even without such studies, the fact that reef damage is not confined to the Lagoon area, but includes large areas of dead coral and algal overgrowth on Horseshoe and World's End Reefs, indicates that more is involved than simply the impacts from yachting. The cause of reef decline in the Tobago Cays and elsewhere is more likely to be a complex mixture of natural and human-induced factors. In addition to localized sewage pollution, these probably include:

- storm damage;
- epidemics of "white band" and other coral diseases;
- drastically lowered populations of herbivorous black sea urchins (reduced by disease in 1983-84);
- the "bleaching phenomenon" of corals (agent unknown);
- physical damage from boats, anchors, fish traps, and divers;
- spearfishing;
- over-harvesting of white sea urchins and herbivorous fishes; and
- algal overgrowth stimulated by many of the preceding factors.

It is difficult but necessary to separate natural from the human-induced changes on the reefs so that management efforts can focus on controlling the latter while allowing the reef ecosystem to regenerate itself. Basic biological surveys and monitoring of reef communities and water quality, similar to the studies carried out in Grenada by Hunte (1987a), should therefore be an integral part of any management scheme for the site. An excellent plan which covers all aspects of management for the recommended Tobago Cays National Park has already been prepared by OAS (Heyman, *et al.*, 1988), but to date there has been little action by GSVG to implement it. If effective management is not begun soon, the area's attraction as a park may well be lost (see also Section 9.2).

LACK OF ENFORCEMENT IN MARINE CONSERVATION AREAS

Besides the Tobago Cays National Park, the boundaries of nine other marine conservation areas were established under the

Fisheries Act and Regulations; these are displayed in Figure 5.2(3) (additionally, the Mustique Conservation Act of 1989 designates the entire island, including its marine environment, as a conservation area). However, it seems that no action is being taken to enforce prohibitions against fishing or to regulate other damaging activities in these designated areas. For example, fishermen are observed on a daily basis using seines, gill nets, fish traps and spearguns in the Indian Bay Marine Conservation Area. Land-based and water-based sources of pollution, anchoring of vessels in coral, and sand mining are likewise unregulated. In the absence of signs, boundary markers or an educational campaign, it is also quite likely that a majority of people who live, use and fish in these areas may not even be aware of their designation as conservation zones or what that means in terms of their day-to-day activities.

Although Fisheries Regulations state "any authorized officer," including fisheries officers, can enforce the regulations, fisheries officers have no powers of arrest. Therefore, it appears that in practical terms enforcement rests with the Customs and Police Departments, especially the Coast Guard (which is under the Police Department).

DESTRUCTION OF MANGROVES AND OTHER COASTAL WILDLIFE HABITATS

Forests, wetlands and coastal habitats in the Lesser Antilles provide critical feeding and resting habitat for many species of birds migrating along the West Indian Flyway between North and South America (Johnson, *et al.*, 1988). The continuing loss of these habitats, especially coastal systems such as mangroves, salt ponds, and other wetlands, could threaten the long-term survival of a number of migratory shorebird and songbird species. Over 100 migrant species are regularly recorded in the Lesser Antilles; most of these species nest in North America and spend the winter in the Caribbean or South America.

There are reportedly plans for development of a 300 boat marina in, or adjacent to, the nation's largest mangrove swamp near Ashton on Union Island, ignoring the fact that the entire swamp is part of a designated marine conservation area. A preliminary survey of the area was made by GSVG Fisheries and Forestry personnel who recommended protection of the area as part of the nation's Fisheries Development Plan. Other surveys have been carried out by Smith (1986) and the Forestry Division in 1990, both of which supported the recommendation for protection. In spite of these findings, plans for the marina development are still moving forward. There appears to be no formal mechanism for coordination and project review between the Central Planning Division and the Fisheries Division (see also Section 10).

On Prune (Palm) Island, there were reportedly many swampy areas before the island was leased to a private individual for resort development. According to several accounts, the developer filled several swamps, planted great numbers of coconut trees, and poisoned armies of land crabs to turn the island into a "tourist's paradise". The development of the new airport on Bequia will fill in an area of degraded former reef and destroy a small mangrove stand, already partially bull-

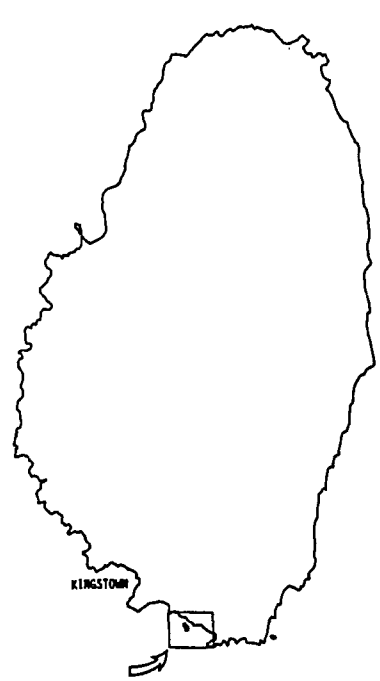


Figure 5.2(3a). Location of designated marine conservation areas in St. Vincent, as established by the Fisheries Act and Regulations.

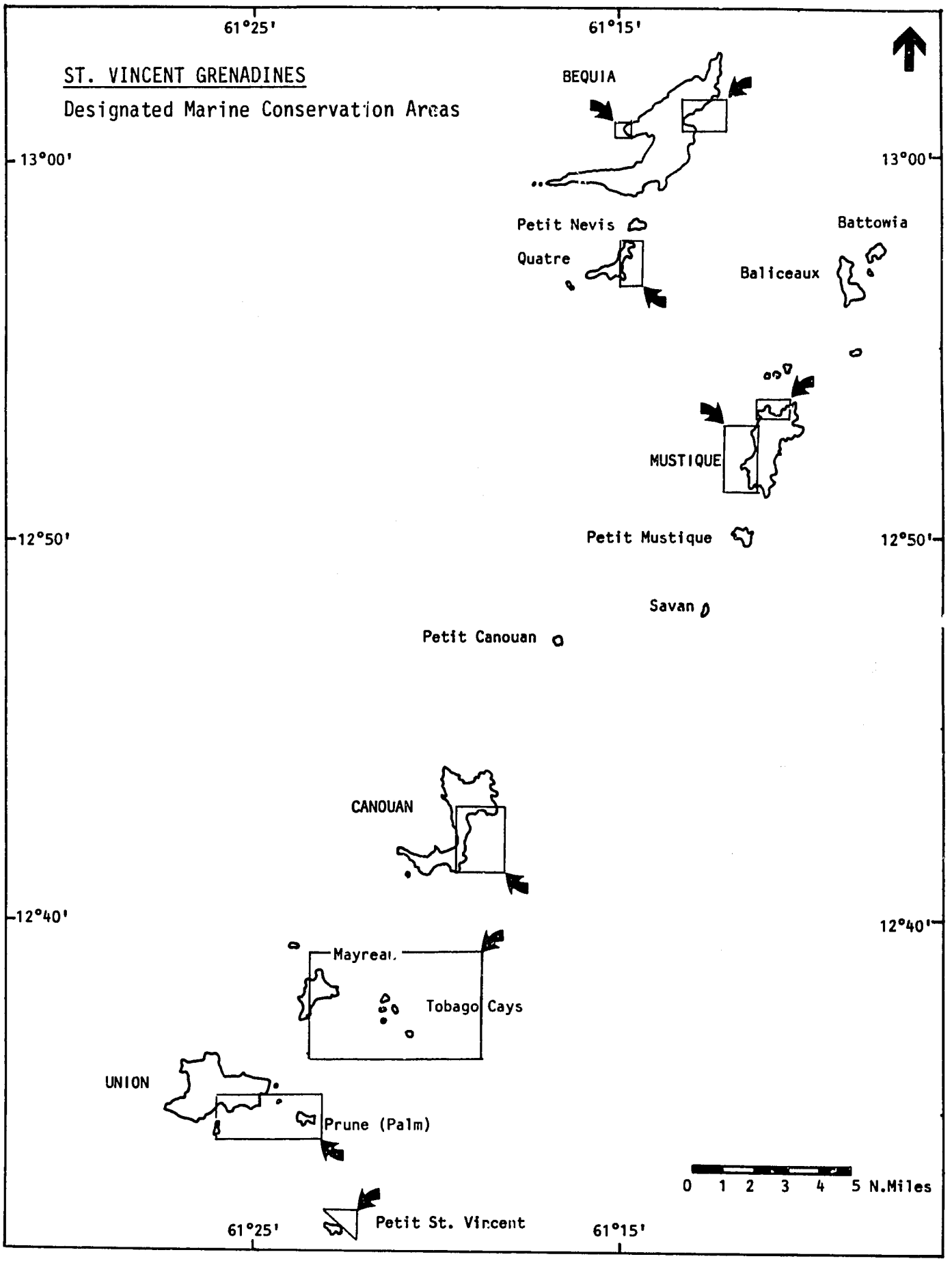


Figure 5.2(3b). Location of designated marine conservation areas in the Grenadines, as established by the Fisheries Act and Regulations.

dozed, at Paget Farm. There are plans to extend the airport runway on Union Island onto the backreef area of the adjacent living reef.

About 50-75 acres of land have reportedly been cleared during the last year at Chatham Bay on Union Island preparatory to construction of a tourist resort there. This area of Union, formerly mostly dry deciduous scrub and scrub forest, and some parts of Bequia are the only places in the nation where the "Cocrico" (*Ortalis ruficauda* or Rufous-vented Chachalaca) is found (pers. comm., W. Metz, US Peace Corps Volunt., Forestry Div., April 1990). The current status of the species in this country is not known, but its numbers are thought to be declining.

EXPLOITATION OF ENDANGERED AND THREATENED SPECIES

During the eighteenth and nineteenth centuries New England whalers from North America hunted Humpback Whales and Blackfish for their oil throughout the Caribbean, and by the 1860's regular trips were being made to the Grenadines in pursuit of the abundant animals (Price, 1985). The technology of whaling was picked up by West Indian seamen, and between 1870 and 1925 more than twenty shore whaling stations operated in the Grenadines, each with three to five boats and employing some 100 men. In St. Vincent and the Grenadines, there were stations on Bequia, Petit Nevis, Palm Island, Frigate Rock and Canouan. By the end of the nineteenth century, over-hunting had so reduced the stocks, especially the Humpbacks, that the American whaling fleets moved elsewhere, and by 1925 all the shore stations but Bequia and Petit Nevis had closed down.

Today a small-scale artisanal fishery for Humpbacks is carried on out of Friendship Bay (Bequia) and Petit Nevis and takes about zero to five whales per year. Whales are most often sighted in the area between Mustique and Bequia. Female whales with a calf are the preferred target of the whalers since the calf cannot swim very quickly; usually the calf is harpooned first and towed closer to the shore station. The mother always stays close to the calf even after it is dead; when close to shore she is also harpooned and dragged ashore. The meat and oil are sold for local consumption, and some of the oil is exported.

Between 1950 and 1984, it has been estimated that about 52 Humpback Whales were killed by the Bequia fishery, about 70 percent of them females (Price, 1985). However, this is in all probability a low estimate, since cow and calf pairs are often escorted by another whale, presumably a male, which may be lanced and driven off by the whalers to keep it from attacking the boat. These deep wounds are most likely fatal, so it is probable that more whales may have been killed during this period than the statistics show, for a total of up to 70 animals.

In Barrouallie whale boats operate all year in an area extending north to within a few miles of St. Lucia and up to 15 miles west of St. Vincent's leeward coast. From July to December Blackfish are the main species hunted, and during the rest of the year a variety of Dolphin species are taken as well as an occasional Sperm Whale or Killer Whale. The meat is sold at local markets, either fresh or corned and dried, and is locally prized. Some oil is rendered for local sale as a medicinal or tonic for bodybuilders. The sale of whale and dolphin teeth to artisans and tourists is becoming a lucrative part of the fishery (Price, 1985).

GSVG is a member of the International Whaling Commission, which regulates whaling worldwide. In 1987 the Commission for the first time established a quota for the Bequia fishery of three Humpback Whales per year during the 1987/88 to 1989/90 season.

Since St. Vincent and the Grenadines is one of the areas in the Caribbean where whales and dolphins can reliably be sighted, it should be possible to operate properly regulated whale and dolphin watching tours similar to those in Hawaii and many other tourist destinations. In fact, one tour boat operator already does this in St. Vincent on a small scale. If GSVG were to promote such tours on a larger scale, the potential revenue to fisherman would be greater than income cur-

rently derived from the continued slaughter of these endangered cetaceans.

Sea turtles, especially the Hawksbill because of its beautiful shell, are believed to be heavily exploited in the Grenadines, and small turtles are captured with spearguns to be stuffed and sold as tourist curios (Groombridge and Luxmoore, 1989). GSVG entered a "reservation" to allow continued exploitation of the endangered sea turtles at the time it ratified the CITES treaty; thus, these species are not protected under the ratified Convention. The Japanese have been major importers of Hawksbill shell from tropical countries all over the world. Although Japanese customs reports indicate that small quantities of Hawksbill shell have been imported from St. Vincent, much of the export to Japan and other countries is undoubtedly unreported.

Aside from the whale and turtle fisheries, the sale of exotic tourist souvenirs or live wildlife is probably the area of most concern to those monitoring wildlife trade in the Caribbean since it is largely unreported (TRAFFIC, [U.S.A.], 1988). As mentioned in Section 2, the CITES convention does not affect local trade in endangered species. Stony corals and black corals are examples of threatened species in which there is substantial local trade.

5.3 POLICY RECOMMENDATIONS

BEACHES AND GENERAL COASTAL ZONE MANAGEMENT

* A coastal setback of at least 50 m should be implemented and rigorously enforced, and beach vegetation should be protected. Revegetation of beaches cleared in the past should be accelerated in order to stabilize the beaches.

* Since sources of construction aggregate, which cause less damaging environmental impacts than the mining of beach sand, have been identified and developed, sand mining should be discontinued on all beaches in St. Vincent. What is needed now is effective enforcement and a long-term solution to the sand mining problem in the Grenadines.

* Control of upland erosion and sediment discharges and appropriate treatment of sewage and other discharges with high nutrient loads is vital to protect coastal water quality, public health and the integrity of coral reefs. This is especially critical in the south coastal areas of St. Vincent.

* An environmental impact assessment process should be required for all large coastal development projects. The *cumulative* effects of such projects must be assessed rather than analyzing each project in isolation. The Central Planning Division should be designated as the GSVG lead agency responsible for impact assessment in the country, but a formal evaluation process should be established whereby other agencies have an opportunity for input into review procedures, perhaps including veto power over development projects in critical areas.

MARINE PARKS AND PROTECTED AREAS

* Signs and markers advising the public of the existence and boundaries of marine conservation areas, and the restrictions which apply within them, should be posted in appropriate locations. This is especially needed in the Indian Bay-Villa-Calliaqua area in St. Vincent and in the Tobago Cays.

* A beach renourishment project for the south coast beaches on St. Vincent should *not* be considered, due to the probable adverse effects on the adjacent reefs. Instead, GSVG should consider engaging a specialist in coastal dynamics to make recommendations regarding the removal of the many structures (groins, etc.) built on the area's beaches, which are unsightly at best and may at worst be aggravating beach erosion.

* The OAS plan for management of the Tobago Cays National Park should be implemented as soon as possible. Quantitative investigations of water quality and flushing characteristics of the Lagoon and baseline

surveys of marine communities throughout the park should begin immediately. Long-term reef monitoring transects should also be established.

* Guidelines should be prepared for the visits of small cruise ships to the Tobago Cays. When passengers are deployed in the Cays, provision should be made for monitoring their activities by GSVG "beach wardens".

* Incoming tourists should be deprived of spearguns by Customs Officials upon arrival in the country (such equipment to be returned upon departure), in order to eliminate the use of spearguns by visitors (regulations only permit local residents to use them).

FISHERIES MANAGEMENT

* The most important fisheries management and development challenges for St. Vincent and the Grenadines are:

- to regulate fishing efforts so as to maintain stock levels which do not over-exploit the resource;

- to implement long-term monitoring of catch and fishing effort for each major fishery; and

- to introduce appropriate technologies that provide for economically efficient fishing operations and therefore provide good returns to local fishermen.

The enforcement of previously enacted conservation measures such as gear restrictions, closed areas, and closed seasons should also be a high priority.

* Given the scarcity of fiscal and staff resources, GSVG should opt for a strategy of adaptive management of fisheries; i.e., commonsense *trial and error* management measures should be implemented while simultaneously emphasizing *monitoring* of the fishery to evaluate the impact of such measures. Fisheries managers should always be ready to modify regulatory measures based on the results of monitoring. Summaries of appropriate management approaches for fisheries regulation are given in Mahon (1988).

* A priority item for Vincentian fisheries management is to expand the existing data collection system as soon as possible by providing for the following: sampling of landing sites; purchase slips for middlemen, hotels and restaurants; enforcement of export licenses; logbooks for large offshore boats to include catch and effort data; and monitoring of foreign fishing.

* Effective management of reef fishes could be implemented, at least for trap fisheries, once a working fisheries data collection system has been established. The immediate objective should be to reduce fishing mortality, particularly on juvenile fishes. Since it is clear that the resource is over-exploited, some means must be found to reduce the fishing effort by an appropriate figure and then to observe the results over a period of several years. However, in order for this to be a workable solution, some mechanism must be identified to ease the burden which a reduction of fishing effort would impose on artisanal fishermen.

* Lobsters are covered by the fisheries regulations which are already in place in St. Vincent and the Grenadines, but these regulations are poorly enforced. Monitoring of catch and effort for several years will be essential to determine whether the new regulations are effective. Some means of limiting effort will probably be required in the long run. The availability of suitable juvenile nursery habitats -- mangrove lagoons and seagrass beds -- may limit the abundance of harvestable lobsters, and these habitats should be protected.

* The situation for conch is very similar to that for lobster, and the same recommendations apply.

* Too little is currently known about the status of deep demersal fishes to propose management measures. However, there are reports of local depletion in the Lesser Antilles, particularly of known spawning aggregations. Monitoring of catch and effort, as

well as mapping the distribution of these resources, should be priorities for management.

The virtual lack of data on the distribution or migration of coastal pelagics also makes it impossible to do any serious management planning for these stocks. The most important priority is to implement data collection.

* A total moratorium on exploitation of all species of sea turtles and marine mammals should be adopted by GSVG. Assuming that in the near future such a moratorium can successfully be implemented and enforced, the recovery of turtle populations should be monitored by collecting data on nesting frequency. The participation of natural history groups (e.g., members of the National Trust) and schools may be an appropriate means of monitoring turtles and cetaceans at low cost and should be seriously considered by Government. Educational efforts to increase public awareness about biodiversity issues should be pursued by both public and private sector groups.

* Management of white sea urchins in St. Vincent and the Grenadines should aim at conserving the resource and monitoring the stocks.

SECTION 6 ENERGY, TRANSPORTATION AND INDUSTRY

6.1 ENERGY

6.1.1 Overview

One serious development problem facing St. Vincent and the Grenadines at the present time is the high cost of energy, much of it imported at prices set by fluctuating, hard-to-predict world market conditions. As in all the OECS nations, imported petroleum products constitute SVG's largest energy source as a proportion of total supply. The most common petroleum fuels are gasoline and diesel oil. Gasoline is used almost entirely within the transportation and fisheries sector. Diesel is used primarily for generating electricity but also for transportation and as an industrial fuel, e.g., for marine transport, farm machinery, and commercial enterprises such as over half the country's bakeries. All petroleum-based fuel used on the main island of St. Vincent arrives by tanker and is subsequently distributed by truck. For the smaller islands in the Grenadines, fuel is supplied in drums and by small tankers, which results in inefficiencies greatly increasing the landed cost.

St Vincent and the Grenadines has no known or proven fossil fuel resources, but the country does enjoy modest hydroelectric power potential and some expandable biomass (mostly wood fuel) sources. Table 6.1(1) displays the percentages for major energy sources for St. Vincent and the Grenadines and, for purposes of comparison, also shows data for St. Lucia, Haiti and several smaller island systems in the Pacific and Indian Oceans. In most cases, both oil and biomass, essentially wood fuel and charcoal, are the major contributors to the country's energy supply with each serving distinct sectors of the economy. Figures for per capita annual energy consumption (including non-commercial fuels) in Table 6.1(1) fall in the range of 220 kilograms of oil equivalent (kgoe) to 430 kgoe, levels of consumption that compare with many Third World countries. As the lowest consumer in the table, SVG typifies the problem facing other OECS island communities. With these levels of consumption, very significant increases will be necessary if tangible progress is to be made in sustainable economic development.

There is no formal national energy program although a number of strategies intended to reduce dependencies on imported fuels are underway. A 1984 World Bank-sponsored study is particularly instructive in this regard. The principal Government focus to date has been on improving the administration, power distribution efficiencies, and generating capacity of the St. Vincent Electricity Services, Ltd. (VINLEC), a joint corporation of the (U.K.) Commonwealth Development Corporation (CDC) and GSVG, which is the sole supplier of public electricity in the state.

VINLEC operates an integrated system with all generating units, regardless of type -- whether diesel direct-powered or hydro-powered units -- tied into a common distribution system or grid (Figure 6.1(1)). Before the expansion scheme outlined below was implemented, total installed capacity was officially just under seven megawatts (MW) but actually was probably about five MW, of which 60 percent was diesel and 40 percent was hydropower (World Bank, 1985). Since peak demand often exceeded five MW, load shedding (i.e., turning off the power) was a common occurrence with costly implications for most of the country's businesses and for the operation of Government facilities and other public services.

After several years of serious advance planning, in 1984 GSVG embarked on an ambitious five year public sector investment program (PSIP) to improve the delivery of electrical services and to reduce both petroleum imports and the level of system distribution losses which exceeded 26 percent for the year ending March 1983 (World Bank, 1984). The overall program included the construction of three new hydroelectric sites in the Cumberland watershed, rehabilitation of existing diesel-driven plants, new and improved high

Table 6.1(1). Energy sources for selected small islands.

	AREA (km^2)	POPULATION (000)	ANNUAL PER CAPITA CONSUMPTION (kgoe)	PRIMARY ENERGY SUPPLIES (%) Oil	Biomass	Others	OIL IMPORTS AS A % OF EXPORT EARNINGS
St. Vincent/ Grenadines	**388**	**113**	**220**	**53**	**45**	**2**	**9**
St. Lucia	616	124	320	61	39	--	17
Haiti	27,756	5,000	270	17	79	4	29
Mauritius	2,000	983	380	38	60	2	16
Seychelles	400	65	350	91	9	--	29
Solomon Is.	28,000	246	430	34	66	--	22
Fiji	18,371	658	370	43	55	2	10

Source: Kristoferson, *et al.*, 1985.

voltage transmission lines, a training and loss reduction program, and other refinements at a round figure cost of $US40 million. Funding was provided by a combination of donors: World Bank, CIDA, USAID, CDB and the European Investment Bank. One of the goals was to reduce the country's dependence on imported fuels by some 35,000 barrels of fuel (or about US$1 million per year at the time).

St. Vincent and the Grenadines has no formally established energy office although an energy desk was established (and later disestablished) in the Central Planning Division.. Additionally, while the country lacks an active energy conservation program, the Forestry Division's fuelwood plantation initiatives in years past were clearly rooted in a concern over the incremental depletion of fuelwood supplies.

THE CUMBERLAND WATERSHED HYDROPOWER SCHEME

The Cumberland Hydropower Project was an ambitious venture inasmuch as the Government had previously commissioned only two small hydropower projects in the 32-year period from 1952 to 1984. The Cumberland scheme, initiated in 1985 following a study of SVG's hydropower potential (Shawnigan Engineering, 1983), was the third in the state and is unique in that it was the first to require (at the initiative of the donor partners) a review of the environmental impacts of both the construction and operational phases of the project. The environmental assessment task was carried out by the Regional Environmental Management Specialist for USAID, who described the project components as follows: a run-off-river/diversion system consisting of a dam, diversion canal, settling basin, storage tank for low flow conditions, pipeline, penstock, power house with turbine/generator, and outlet works. Mitigative measures were presented in considerable detail, and a watershed management plan was prepared by USAID's Regional Forestry Advisor (Talbot, 1983).

Electrical line losses were cut by 1988 to 16 percent (CDB, 1988) and to approximately 11 percent by 1989 and 8 percent by 1990 (pers. comm., CEP National Committee, 1990). Other potential sites with various

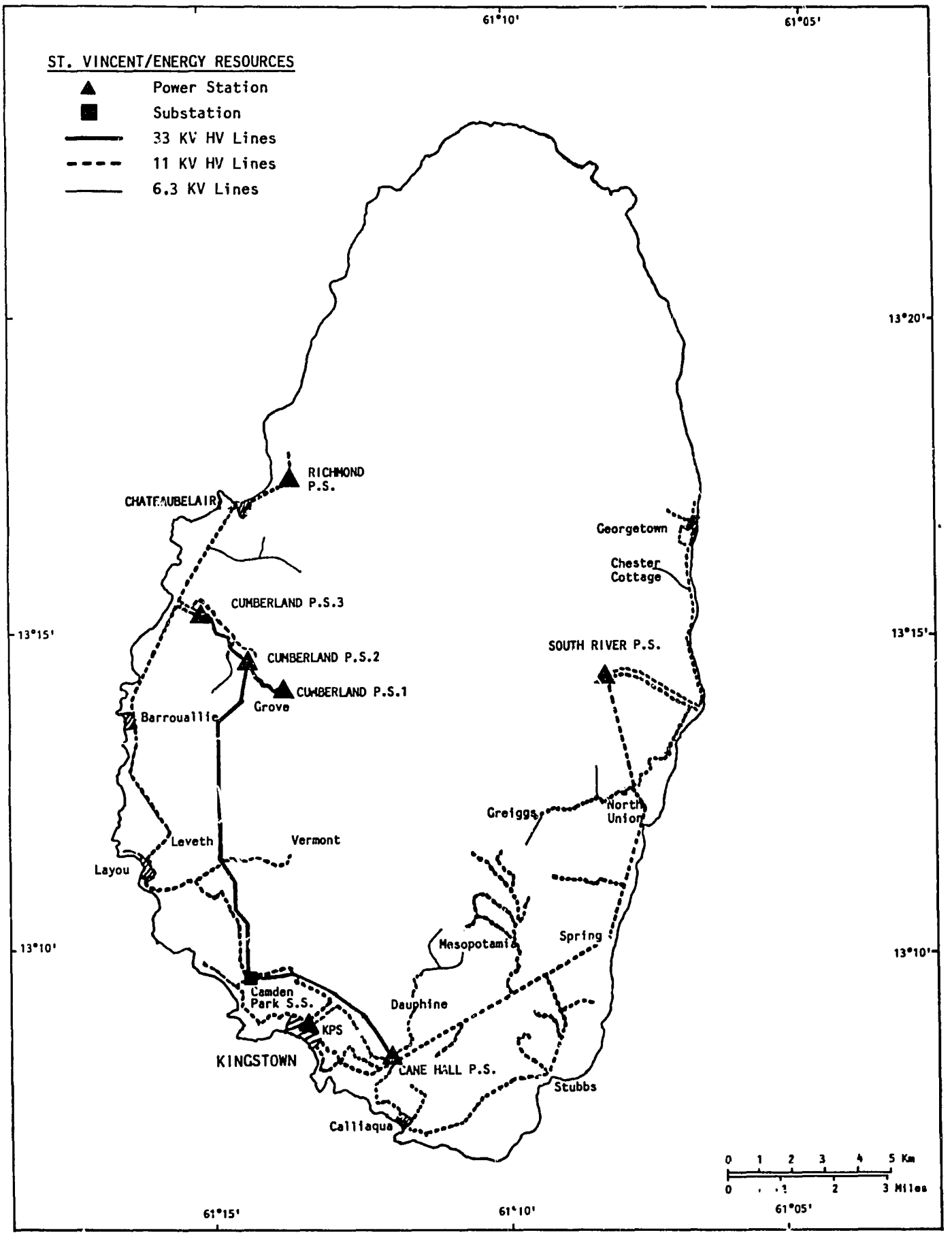


Figure 6.1(1). Energy resources, St. Vincent (source: adapted from World Bank, 1984 and updated by CEP National Committee, 1990).

degrees of hydroelectric possibilities, some with greater environmental risk, however, include: Colonarie, Buccament, Yambou, Rabacca, Wallibou and the possible upgrade of facilities at the older, smaller sites at South River and Richmond (see Figure 6.1(1)).

OTHER ENERGY SOURCES

Recent studies on energy in the state (one based on a household survey) showed that during the 1980's St. Vincent and the Grenadines annually used about 3,600 tons of charcoal and 8,000 tons of firewood for cooking and commercial baking, which translates to a total national domestic demand of about 63,000 cubic meters of wood (World Bank, 1984; CDB, 1988). Assuming a 10 percent conversion efficiency (by weight) for the traditional earth kilns that are in common use through the country, some 46,000 cubic meters of wood were consumed by charcoal production.

Based on standard biomass yields for St. Vincent's known areas of unmanaged tropical forests and woodlands (estimated at 13,000 hectares), there is some evidence at the present time of a national biomass deficit or production short-fall for fuelwood of perhaps 20,000 or more cubic meters per annum, depending on annual rainfall levels and other related factors such as the pace of land clearing for development activity. It is noteworthy that the Forestry Division has developed several experimental plots of a fast-growing fuel wood species, Leucaena, one of which is in the upper reaches of the Cumberland Valley. To protect the watershed and the water supply for the new hydropower facilities and to establish a replicable example for the community, it may be necessary to forego harvesting this particular patch of fuelwood forest. At the very least, it poses a challenging resource management problem for GSVG.

6.1.2 Problems and Issues

THE ALTERNATIVES

The spectrum of options available to St Vincent and the Grenadines for what are known by energy planners as NRSEs or New and Renewable Sources of Energy is not very wide and certainly not promising in the near future. The very narrowness of choice makes the "no choice" option of conserving existing energy sources initially the best choice and more likely to be effective in the short term. The major problem with assessing new energy options, one shared by all OECS countries, is the difficulty of identifying practical, intelligible, easy to use units for comparison, evaluation and exposition.

This is especially true for what is known as biomass which includes not only wood from trees from naturally forested areas, including secondary and scrub growth, but also coconut plantation waste (trees, husks and shells), bagasse, agricultural and agro-processing wastes, manure and even "left back" bananas, leaves and stems. They all represent stored solar energy options.

For example, the fuelwood/charcoal mix, derived from trees which are "renewable" on a ten to fifty year cycle, is a case in point. First, the trading units employed for traditional fuels of charcoal and firewood are inconsistent. Second, various wood species with differing ages, densities and moisture contents are utilized; and, third, it has always been and continues to be difficult to select a survey sample for which the re-growth rates or rate of tree renewal will be representative of the broader wooded landscape. Finally, the conversion ratio of wood to charcoal, i.e., the production efficiency rate, is as widely variable as are the illicit and informal sources of the resource (wood/charcoal) that materialize in the market or in any given coalpot. As a result of these factors, consumption of energy from NRSE is not regularly quantified or reported (OAS, 1987a).

There are some areas where even when the price is right, wood-derived energy sources cannot make a significant contribution

to overall energy needs, as in the case of energy requirements for transportation, whether on land or sea. Presently there are no viable alternatives to petroleum products as the power source in this sector, and the situation is not expected to change in the near future. Furthermore, in small island economies, energy conservation for transportation has proved to be extremely difficult (Kristoferson, *et al.*, 1985).

In light of the above, it is important to focus on alternative energy sources in those segments of the Vincentian economy where there is a proven technology and where adjustments to the energy mix in combination with targeted conservation efforts will contribute to greater self-reliance and reduced environmental risks, both for Vincentians and for the resource system.

BIOMASS/BIOGAS

Methane can be produced through the anaerobic digestion of vegetable and animal wastes. Since it does not require centralized production and distribution, it is well suited to small farms and remote communities (Hinrichsen, 1981) and thus to use in a country like St. Vincent and the Grenadines. However, the question has not yet been addressed of whether biogas can make a significant contribution to reducing St Vincent's dependence on petroleum. According to UNDP (1985), the years of biogas experimentation in the region have " ... merely endorsed the obvious fact that biogas can be produced, provided external funds can be obtained to construct and run the plants." Factors such as net production costs, optimal location of the plants, and social acceptability of the gas as an energy source have not been investigated. In fact, it appears to be generally true that the main attraction of biogas technology is its capability to dispose of agro-industrial and agricultural wastes, rather than its potential as a source of energy (UNDP, 1985).

ALCOHOL

Alcohol fuels can be produced from aerobic fermentation of sugar or starch bearing crops. These fuels can even be used as a substitute for gasoline (Hinrichsen, 1981). However, on the small islands of the Eastern Caribbean, any large-scale use of land to grow crops for this use rather than food production or export crops would likely be unacceptable and therefore not feasible.

CHARCOAL

Charcoal and firewood harvesting are not necessarily damaging to most forest ecosystems; the important variable is how much biomass per year for any given area can safely be removed. Where charcoal is produced as a by-product of land-clearing activities, there is even a positive benefit since the cleared biomass would otherwise be burned on the site for its nuisance value and thereby wasted. While the traditional earth kiln is not very efficient, it is simple, and charcoal production by this method requires very little capital investment (e.g., an axe, shovel, rake, and cutlass). A charcoal producer can live on the income from his/her efforts which are admittedly labor-intensive but socially useful.

Charcoal is produced from wood because it has a higher calorific output per unit weight and is thus more valuable (also per unit weight) than fuelwood on the open market. Firewood (because it is much heavier) generally must be gathered close to where it will be sold and/or used as it can rarely support transportation costs and remain competitive with other available fuels.

However, when producing charcoal from wood, a great deal of the latter is wasted due primarily to kiln and process inefficiencies. But this is not an insoluble problem and could be dealt with even without substantially changing the systems currently employed. For example, Nelson in OAS (1987a) reports that firewood is generally stacked for only a few days before it is put, insufficiently dry, into a charcoal kiln. Furthermore, in traditional earth kilns, it is difficult to restrict combustion to only that portion of the total wood supply required to generate sufficient heat to char the remainder. Since the conversion efficiency of charcoaling is primarily a function of the wood moisture content and of the tech-

nology employed for the pyrolysis process, there is room for considerable increases in efficiency and thus for less wastage of the country's wood (and other biomass) resources. Furthermore, for the traditional biomass fuels of firewood and charcoal, gains in efficiency could also be made through some combination of extension services, a licensing strategy, and a program for assisting charcoal producers in moving the more efficient metal kilns from place to place.

The efficiency of earth kilns can vary a lot depending on the size of the kiln, the skill of the charcoalers, soil dampness, winds, rainfall and the care provided to control smoke (Jennings, 1979). With modern, low-cost portable charcoal kilns, the conversion efficiency can reach 40 percent. The charcoal stoves used by individual households are more efficient than wood fires, but presumably a simple wood-burning cooking stove design could be developed to improve efficiency at this level.

OTHER ENERGY SOURCES

Hydropower. Currently hydropower is viewed by some Government officials as offering a nearly complete solution to energy generation in the country, except for very pronounced periods of water shortage in the dry season. However, the environmental assessment report prepared for the Cumberland Watershed Hydroelectric Project raised some difficult questions about the aggregate or cumulative effects of widespread deployment of dozens of hydro sites, in addition to the risk to pipelines and penstocks from landslides, earthquake tremors and flooding conditions. Nevertheless, on a more positive note, hydropower projects do generate one unique by-product -- namely, an induced national program of integrated watershed management.

Geothermal Energy. Manifestations of geothermal activity outside the crater of the Soufriere volcano are scarce or non-existent. Although the outside slopes of the volcano might have some thermal potential, the likelihood of recurring eruptions tends to inhibit the enthusiastic development of any such sites. In light of these factors as well as the very high-risk nature of geothermal exploration, the financial costs of development are high while the benefits appear to be marginal at this time.

Furthermore, the rugged topography of St. Vincent proper makes it difficult to construct facilities, roads and transmission lines without generating significant erosional effects. Other environmental impacts are also common in relation to geothermal projects, including air and water pollution.

Solar Energy. A number of small-scale solar units with different applications are presently available, including water heaters, water pumps, desalination devices, and crop driers. Such systems can contribute to improvements in the quality of life, particularly of rural people living in remote areas. Solar water heating, for example, is a very well-developed technology and the most immediate use worldwide of solar energy at present. Its adoption in St. Vincent and the Grenadines, however, has been slow due principally to the absence of a suitable combination of more favorable tax policies regarding import duties for solar units, a public education campaign, and a revised building code to encourage utilization of the technology available.

Offshore Oil. Favorable strata for oil and gas resources exist in many areas of the Eastern Caribbean, including the South American coastal shelf, Grenada, the Grenadines, and in St Vincent waters (Mitchell and Gold, 1982). St. Vincent and the Grenadines, like most of the countries in the region, does not possess the capability to develop any such deep water or shelf reserves on its own, The areas have not been aggressively examined by the larger oil companies, (with the exception of Venezuela's Aves ridge to the west), and it seems obvious that the major multinational companies have accepted the general assumption that the region, *for them*, is not commercially promising. However, what may not be a commercially promising prospect for a large oil firm, might be an important option for solving the energy problems of a small state like St. Vincent and the Grenadines. Both Barbados and Jamaica have, with help from Petro-Canada, developed

modest oil and gas fields previously disregarded by the larger companies.

Obviously, an offshore oil strike, even a modest find such as has been brought into production on land in Barbados, would have a significant impact on the energy (and economic) picture in the country; unfortunately, it would also have potential for substantial environmental damage, such as disturbances to bottom communities during exploration and installation phases and even more significant environmental risks during production phases as a result of the potential for oil spills from tankers and/or oil well accidents.

6.1.3 Policy Recommendations

It is clear that St Vincent and the Grenadines would greatly improve its balance of trade position if it were not quite so reliant on imported petroleum products -- a dependency which is increasing year by year. To move away from this undesirable situation, there are certain policy directions which could be viewed as prerequisites for change. The objective is to devise and implement an energy policy that will:

(1) place greater emphasis on energy conservation;

(2) improve and develop simple technologies for more efficient energy conversion and utilization of indigenous resources (e.g., better charcoal kilns); and

(3) make a greater effort to promote and adopt alternative forms of energy which already are feasible in the Caribbean context.

Pursuant to these general guidelines, the following is a series of more specific recommendations by energy resource category.

BIOMASS

* Intensify conservation of existing biomass. The resource supply should be assured over the long term through careful management of existing and growing resources, improved watershed management through and in combination with multiple land use policies (e.g., agroforestry), and effective recycling of agricultural process residues.

* Promote integrated land use systems (e.g., agroforestry) and community forestry. This will help make fuelwood resources available on a more widespread basis and thereby reduce the need for charcoal, in light of the latter's lower systemic efficiency.

* Utilize more efficient systems for processing biomass into desirable forms for use. Charcoalers should be encouraged to employ more efficient kilns in converting wood to charcoal. This has often been difficult in many countries because the less efficient earth kilns require very low capital investment and provide much-needed employment. However, metal kilns of a very simple design which are easy to build and maintain can be utilized. They can be constructed of sheet metal by local craftsmen in a workshop equipped with basic facilities for cutting, welding, rolling, and drilling. Two men working a regular five-day work week can produce two to three tonnes of charcoal with the kiln.

In general, the use and sustained production of biomass fuels, in part to displace more costly imported fuels, is obviously an issue of major importance for small island countries and is rarely given the attention it deserves.

GEOTHERMAL

* The viability of geothermal electrical power generation is not assured. Before moving ahead, St. Vincent and the Grenadines should carefully examine the St. Lucia model where a recently installed geothermal well is to be brought on line shortly. Some of the economic risk factors associated with geothermal development need to be weighed against the obvious advantages of reducing the country's dependency on foreign oil; these include:

- Extremely expensive drilling and pipe costs;

- Heavy dependence on specialized foreign technology and equipment.

- Unique and costly maintenance requirements, including exotic materials to withstand the corrosive effects of superheated brine;

- The variable quality of support from outside contractors and consultants.

* There is a wide range of largely unforeseeable negative environmental effects associated with development of geothermal generating facilities, and these also should be carefully reviewed by GSVG. Some of these impacts include:

- Chemical and thermal pollution of stream water and air from the geothermal steam discharge, health impacts on workers from toxic gases, and environmental damage to vegetation and wildlife, all of which have been reported at geothermal plants (e.g. in Sonoma County, California);

- Physical damage to the vegetation and soil erosion in the watershed resulting from development activities and pollution of drinking water supplies by sediment or chemicals;

- The siting of incompatible industries in the area to use the waste heat from the wells.

* If successful, geothermal electrical power generation risks over-dependence on a very fragile producing system. A small geologic shift could sever all of the country's geothermal wells at the same time; this is not unlikely considering the proximity of any site to the known active volcano, Soufriere.

OTHER NEW AND RENEWABLE SOURCES OF ENERGY

* Expand wind power site testing not only for electrical generation but also for mechanical tasks (e.g., water pumping).

* Promote the use of solar power for water heating, water pumps, crop drying, and so forth. Remove existing barriers and disincentives to its use, e.g., import duties on solar equipment.

RESEARCH AND DEVELOPMENT

* In the Caribbean, and especially for countries like St Vincent and the Grenadines, there is insufficient support for research and development by Government, regional institutions and the private sector. This is as true in relation to the energy sector as it is to other activities, and it was a driving force behind Grenada's decision to establish a Science and Technology Council. GSVG should probably follow Grenada's example but should also consider evaluation of alternative models by consulting the Commonwealth Science Council, among others. If technological development is left to foreign concerns, which are generally larger and continentally-focused, then local conditions will be given insufficient consideration and local development patterns will continue to be dominated by outsiders.

The technological developments and innovations created by developed, continental countries tend to be inappropriate to the needs of small island states. In other locations in the region, various efforts to impose continentally-derived strategies on local coastal zone management needs constitute a classic example of this problem. They also provide the best argument for a locally-structured science and technology policy unit (or grouping of applied science advisors) which could provide guidance to Government for determining the appropriateness of resource management technologies and for evaluating proposed development schemes and strategies.

* Additionally, if small island nations are realistically to develop energy systems which are better suited to their environmental

and socio-economic requirements, they must cooperate with each other and pool their scarce research and development resources to maximize economies of scale.

6.2 TRANSPORTATION

6.2.1 Overview

Virtually every economic and development planning study done for St. Vincent and the Grenadines over the past decade has remarked on the constraints posed by the existing transportation sector. Tourism studies, for example, highlight the difficulty would-be visitors have in quickly, conveniently and economically reaching a destination in the smaller Grenadine Islands. Export-oriented manufacturing studies have consistently deplored the weakness of air cargo services and port congestion and have routinely criticized the inadequate container-handling facilities at Kingstown Harbor -- although less so in recent years as some improvements for an upgrade of the harbor were made under a CDB-funded loan and a CIDA-sponsored grant. Even the Prime Minister has noted the need for a new cruise ship pier at Cane Garden, hinting in a speech at the opening ceremonies of the new Japanese-funded Kingstown Fish Market that planning for such a cruise ship facility at the south end of Kingstown Harbor was underway (*The News*, February 16, 1990).

Construction for a new airport at Paget Farm, Bequia has just begun. Originally proposed in 1975 and revived by the Prime Minister in 1985, this undertaking was delayed slightly pending completion of several stages of an Environmental Impact Assessment (EIA), called for by the EEC funding source. According to the Director of Planning, improvements to both the airport at Union Island (reportedly the busiest in the Grenadines with approximately 20 flights a day) and the Arnos Vale Airport, which serves Kingstown, are also being discussed (pers. comm., R. Cato, March 1990). In neither case have impact assessments been completed, but preliminary engineering studies have been done for Union. Present plans call for shifting the airport at Union eastward extending slightly into the sea. Because there are two small ponds adjacent to the existing airport, an EIA will undoubtedly be required.

Additionally, a CDB multi-faceted project for the Grenadines incorporates a variety of road building and upgrading activities as well as construction of several jetties for cargo and boat passengers, all designed to improve the transportation facilities base. No concern has been expressed by the donor about the absence of a national transportation plan.

During the early part of the 1980's, the major outstanding issues in the transport sector focused primarily on financial and administrative constraints relating to the ports and airports sub-sector and to the question of improving agricultural feeder roads. During the early 1980's, with funding support from USAID, the country developed a feeder roads rehabilitation program for St. Vincent which was completed in 1985.

More recently, interest in and discussion about a cross-island highway continues to surface, but the concept is not, according to the Central Planning Division, being seriously pursued. A similar suggestion for a coastal road around the northwest tip of the island has been put forward more than once, but also with no follow-up. In a more practical vein, the notion of a Kingstown by-pass has been proposed, but there are no firm plans for this scheme and even preliminary engineering studies have not yet been completed.

Nevertheless, the continuous maintenance and upgrade of five marine terminals and five airports (see Figure 6.2 (1)) is no small achievement for a country the size of St. Vincent and the Grenadines. However, as the facilities and equipment for air and sea terminals become ever more expensive and technically more complex to maintain, the time is fast approaching for the country to consider development of a national transportation plan. Such an effort would be cost-effective by combining the projected transportation needs of the tourism, manufacturing, agricultural and service sectors with the requirements of citizens for better mobility to form one ratio-

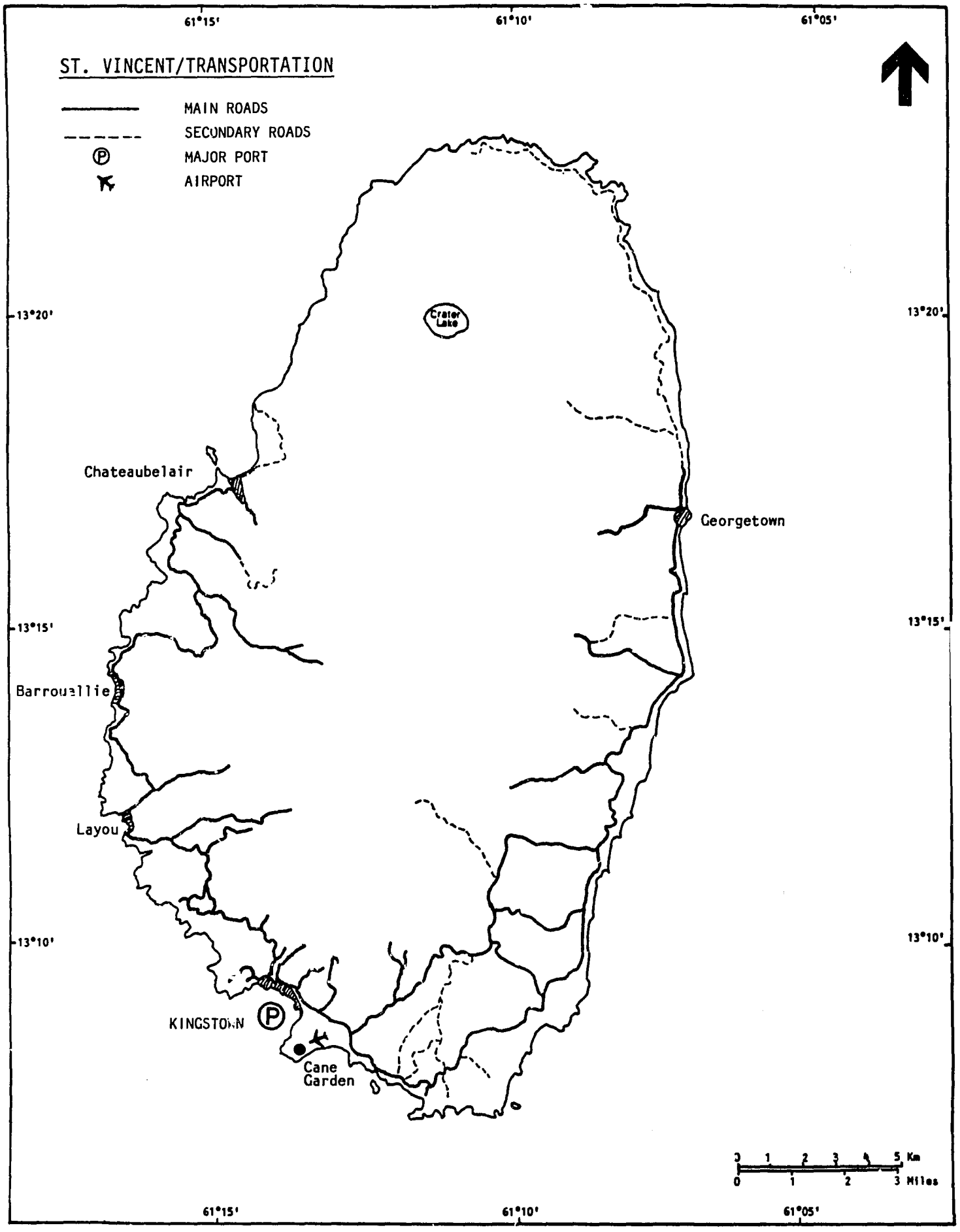


Figure 6.2(1a). Major transportation infrastructure in St. Vincent.

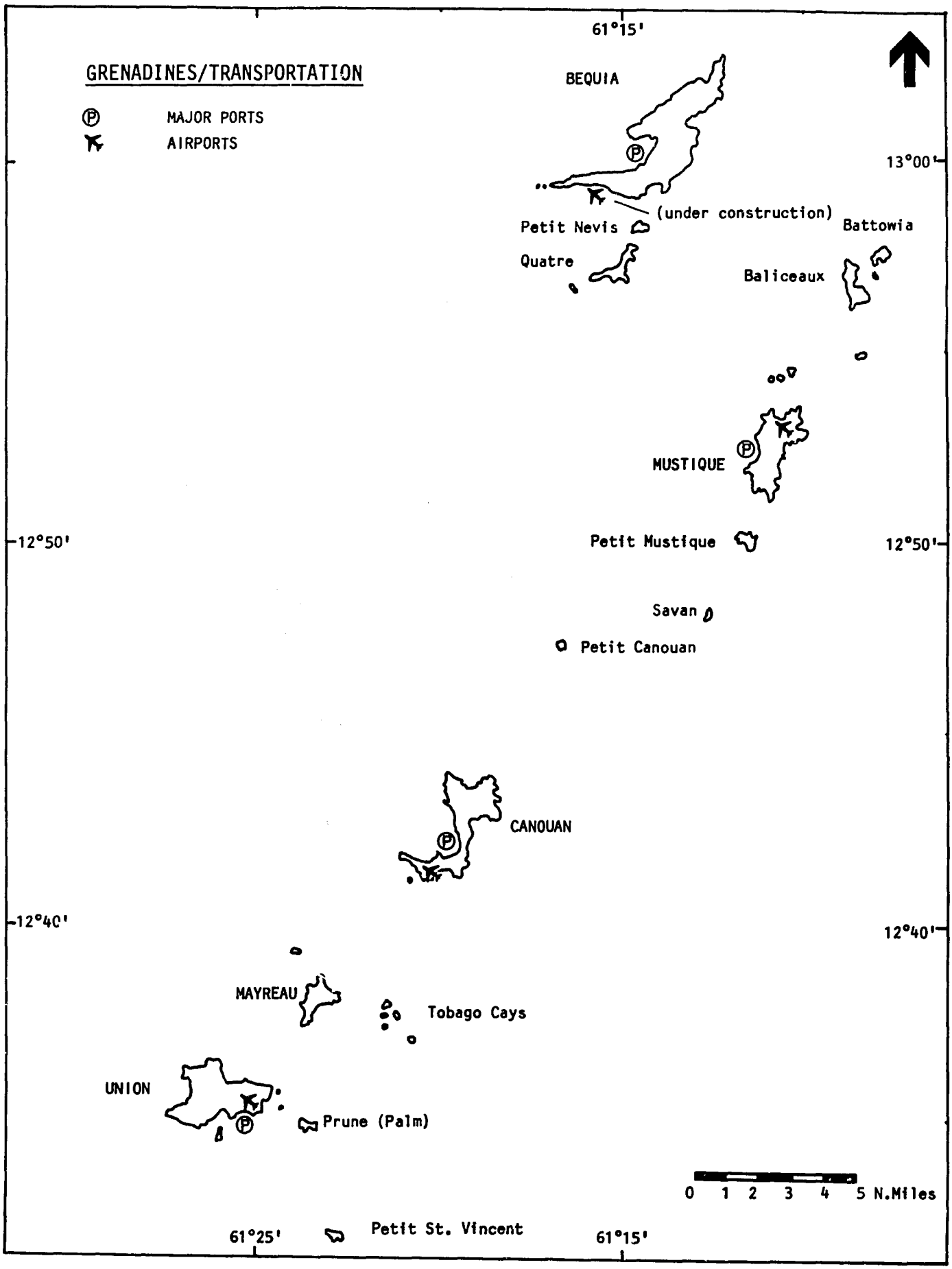


Figure 6.2(1b). Major transportation infrastructure in the Grenadines.

nal transportation system suitable for the decade of the 1990's.

6.2.2 Problems and Issues

It is both obvious and noteworthy that virtually all the major transportation facilities under discussion in this section of the Profile (see Figure 6.2(1)), except for the agricultural feeder road network, are situated in the coastal zone or narrow coastal margin where the sea and land meet and in which most of the citizens of St. Vincent and the Grenadines live, work, and play. It is also noteworthy that since the Government has not yet developed a management plan or strategy for the coastal zone, the transport facilities, coastal highways, bridges, ports, airports, and marinas in that zone are being planned, sited and developed in a vacuum or in isolation. There is no overall coastal resource assessment or management framework and no articulated sense of direction as to how new facilities could or should relate both to anticipated uses in the long term and to the public interest in maintaining a quality environment.

Planning for the rational and orderly growth of the transportation sector in a developing country like St. Vincent and the Grenadines -- with the irregular coastline and landscape of the main island and with a cluster of offshore satellite "dependencies" in the Grenadines -- will be an especially difficult task. Since there is no coastal resource management plan for either St. Vincent or the Grenadines, the would-be transportation system planner must rely entirely on his or her own intuition and the general and slightly out-of-date guidelines as promulgated in the GSVG National Development Plan (GSVG, 1986b and 1987).

This task is made even more difficult by the all-too-common insular dilemma of having to determine what to do with wastes from the transport industry: e.g., waste lubricating oils (from automobiles and marine transport vehicles); accidentally wasted fuel (i.e., oil spills); waste (or discarded) tires; waste (i.e., derelict) automobiles, trucks and boats; and wastes -- both liquid and solid -- from cruise ships, commercial vessels, and even pleasure yachts in coastal waters (see also Sections 5 and 8). These constitute one of the sector's largest, yet mainly unaddressed and nagging problems. Much of the waste flow from the transport industry is highly visible, aesthetically ugly and hard to dispose of. It is simply difficult to find a discreet way to throw away an old bus!

Furthermore, at the core of a sector as decentralized as this -- with some parts run by the private sector and other parts run by Government -- there is a serious structural problem, namely, the difficulty of determining who is in charge and who is responsible when critical environmental issues need to be addressed. This is one important reason to support development of a national transportation plan in order to bring the sector's side-effects or by-product problems out into the open and to identify strategies for dealing with them. Issues such as facilities siting, people and cargo routing, safety and financing are important within the planning process but so are the mostly unintended impacts or secondary effects of transportation activities which tend to undermine the natural resource system.

6.2.3 Policy Recommendations

* Since, at present, the Government of St. Vincent and the Grenadines has not developed -- nor are there plans for developing -- a national transportation plan, alternatives should be explored. For example, persons interviewed for the Country Environmental Profile expressed concern about land use conflicts, pollution and environmental degradation in SVG's coastal zone, at least in the more densely-settled and heavily-used portions of this highly active, economically significant sea-land interface. It is conceivable that a local initiative aimed at reducing resource conflicts and at designing sustainable development strategies for this extraordinarily productive special area will in fact emerge long before a constituency for a national transportation coalesces.

Table 6.3(1). Profile of DEVCO's industrial estates, December 1989.

ENTERPRISE	ACTIVITY	LOCATION	Sq. Ft.	STAFF	YEAR STARTED
World Food Program	Packaging	Campden Park	6,000	15	1985
Venus Enterprises	Garments	Campden Park	3,000	3	1976
St. Vincent Plastics/ Chemical	Plastics	Campden Park	6,000	11	1979
St. Vincent Electronics	Electronic Assembly	Campden Park	3,000	71	1978
St. Vincent Sporting Goods	Tennis Racquets	Campden Park	53,000	469	1974
Pico	Electronics	Campden Park	12,000	55	1981
Children's Wear *	Girls' Dresses	Campden Park	24,000	188	1981
Container Corporation	Cardboard Boxes	Campden Park	45,000	78	1978
Buhler's Yachts	Fiberglass Boats	Calliaqua	6,000	13	1977
East Caribbean Metals	Galvanized Sheets	Campden Park	24,000	33	1979
East Caribbean Group	Flour, Feeds, Rice, Bags	Campden Park	54,500	197	1977
SVG Brewery	Beer, Soft Drinks	Campden Park	28,000	68	1985
SVG Bottlers	Soft Drinks	Campden Park	12,000	35	1980
Cariwear *	Knitted Sports Wear	Campden Park	20,000	93	1988
TOTALS			**296,500****	**1,329**	

* 1,500 persons employed in cottage industry.
** 178,000 sq. ft. at Campden Park owned by DEVCO.

Source: Figures from DEVCO.

* Ideally speaking, a coastal management plan for each of the Grenadine "microcosms", such as Union, should precede any decision on a fundamental infrastructural component like a modernized and expanded airport. Conversely, any move to develop the first stages of a coastal zone management strategy for St. Vincent's densely populated, heavily used, southwestern coast or for the Grenadines could be designed to pay special attention to transportation issues, nodal point siting impacts, and the like, since these have not been previously addressed in a formal, national transport system planning exercise.

6.3 INDUSTRY

6.3.1 Overview

The manufacturing sector in St. Vincent and the Grenadines is still at an early stage of development, but the range of commodities produced is fairly broad. They include garments, packaging, plastic products, assembled electronic components, tennis racquets, boxes, boats, metal products, furniture, building materials, flour, soft drinks, beer, knitted wear and animal feeds. Externally-focused enclave manufacturing activities are responsible for much of this production as the potential for development of domestic-oriented manufacturing activities is limited by the small size of the domestic market.

The private industry sector in St. Vincent and the Grenadines has traditionally been dominated by a small number of firms controlling the distribution trade. In recent years, however, there has been a significant growth of small local manufacturers and a dramatic revitalization of the local Chamber of Industry and Commerce which now has a full time manager and secretariat. The small business sector comprises a number of hotels and guest houses in St. Vincent and especially in the Grenadines; these are mostly locally owned and managed.

Following a major reorganization in the mid-1980's assisted by USAID and CDB, the St Vincent and the Grenadines Development Corporation, (a parastatal known as DEVCO) has had considerable success at promoting and expanding the industrial estates concept begun in the mid-1970's at Campden Park. DEVCO, which is concerned with development promotion in the state, provides loan funding for agricultural, educational and industrial purposes. At present most of the industrial plants are, in fact, concentrated at the industrial estate at Campden Park and in the densely-populated urban/suburban areas of Kingstown and Arnos Vale. The enterprises presently sited at DEVCO's industrial estates are listed in Table 6.3.(1).

Since the Campden Park area is full, a new industrial park is presently planned for Diamond Estates. To be built on Government land, the project has just recently obtained funding from USAID for a water supply, from CIDA for other infrastructure, and from CDB for the construction of the necessary factory shells. An impact assessment will by prepared under the new environmental regulations of CIDA. There is, unfortunately, no zoning plan for the area so the demonstration and clustering effect of the industrial estate with regard to the surrounding area may require special attention.

6.3.2 Problems and Issues

Archer's (1984) estimated quantities of industrial pollutants received by watershed drainage systems and coastal areas in St. Vincent are seriously in need of an update, if only to reflect new industries and to adjust for the growth of outputs by those industries with significant waste streams -- some as effluents and some as solid waste. The sporting goods factory, the breweries (of which there are two), the boxing plant and the steel galvanizing enterprise, among others, have industrial effluents that should be periodically evaluated, quantified and then monitored. But other than Archer's (1984) preliminary report produced for PAHO, no study has been done to determine waste generation by industries or to assess the effects of those wastes on the environment of the nation (see Tables 6.3(2) and 6.3(3)).

Table 6.3(2). Water pollution and waste loads from industrial effluents, St. Vincent (East, Southeast and Southwest areas), 1982.

Industry and Process	Production 10^3 units/yr	Waste Vol. 10^3 m^3/yr	BOD_5 tons/yr	COD tons/yr	SS tons/yr	TDS tons/yr	Oil tons/yr	Total Alk. tons/yr
Sugar cane	7,000	200.2	18.2		27.3			
Molasses	2,100	65.8	5.98		8.97			
Coconut oil, crude	0.560	.280	4.2	30.8	18.5			
Coconut oil, refined	0.560	32.2	7.22	11.8	9.18	494	3.64	
Coconut meal	0.360	0.23	0.41		0.58			
Soft drinks	1,364	9.68	3.41		1.77			
Flour	20,445	12.27	22.5		32.7			5.05
Animal feed	5,000	3.0	5.5		8.0			
Milk processing	2,282	5.48	12.1		5.02	7.53		
Chocolate	0.018	.004	.009		.004	.006		
Fruit juices	0.032	.269	.134		.045			
Arrowroot starch	725	23.93	9.72	15.8	7.03	30.7		
TOTALS	39,118	362.3	89.38	58.4	119.1	532	3.64	5.05

Disposal to land and sea: Sugar cane, 90% via Georgetown River; crude coconut oil, 90% via Greathead River at Arnos Vale; soft drinks, 90% to land, 10% to sea; arrowroot starch, 25% to land via drains, 75% via rivers.

Remarks: There is 25% higher actual waste water recording than the rapid assessment estimate for sugar products. Other small differences in other industries. Heavy BOD pollution on east coast via rivers. Edible oil refinery contributes heavy solid pollution. There appears to be no highly toxic industrial waste discharged onto the coasts.

Source: Adapted from Archer, 1984.

St. Vincent's industrial waste loads are low compared to other CARICOM countries. Its agrochemical and agricultural waste, as well as sewage, are considered more significant water pollution problems. Essentially, there are no major polluting industries in St. Vincent at present, and most of the newer industries such as garment and furniture manufacturing and electronic components assembly use little or no water for industrial processes. Nevertheless, the point can be made that to protect the public from injurious surprises in the future, a careful screening process of new industries and a periodic check on existing production processes are very much in order.

Table 6.3(3). St. Vincent and the Grenadines industrial waste disposal and its impact on the coast and sea.

Types of Industry/ Process	Total Waste Volume 10^3 m^3/yr.	Total Waste Loads/ Contaminants tons/yr.		Air Pollution	Impact On Coast and Sea	Remarks
Sugar cane/ molasses	362.3	BOD_5	89.38	Measurable pollution limited to particulate matter from sugar factory. Limited from burning on refuse dump.	Cane sugar, edible oil, and arrowroot starch industries contribute a large volume of waste to the sea via rivers.	Rivers used for disposal of industrial effluents, which gradually reach the sea.
		COD	58.40			
Coconut oil		SS	119.10			
		TDS	532.00			
Coconut meal		Oil	3.64			
		Alkalinity	5.05			There is need for some code and/or legislation to control the treatment and disposal of waste into rivers and streams
Soft drinks					BOD, COD and solids could have adverse effect on coastal ecosystems through O_2 deficiency in localized areas, and turbidity in areas with coral reefs. No significant toxic discharges except from pesticides and fungicide residues from banana, arrowroot and vegetable agro industries.	
Flour		Total	807.57			
Animal feed						
Dairy products						Study of effect of industrial and domestic waste on coastal ecosystems should be undertaken.
Fruit juices						
Arrowroot starch						Need for trained personnel to enforce control over industrial processing and waste treatment and disposal.

Source: Archer, 1984.

Other than the agricultural fertilizers and biocides discussed in Section 8, the major types of industrial effluents that are potentially harmful to the environment include:

(1) Wastes from food and drink processing plants, e.g., arrowroot starch, coconut meal and oil, flour and rice mills, animal feed, dairy products, fruit pieces, soft drinks, beer brewery and rum distillery effluents, which are discharged into rivers and end up in coastal waters. The organic matter in these wastes has a high nutrient load and exerts a large biological oxygen demand (BOD) during their decomposition, which has a deleterious effect on the biological communities of streams and coastal waters.

(2) By-products from manufacturing, transportation or repair facilities

which are toxic or potentially toxic or create an aesthetic problem, e.g., smoke, dust from quarries, grease and oil from garages, wastes from electrical generation utilities, sheet metal galvanizing factories, garment manufacturing wastes, and boxing plants.

6.3.3 Policy Recommendations

INDUSTRIAL WASTE

* Government policy should be to attract and grant permits only to those industries which are relatively non-polluting.

* Environmental impact assessment reports should be required of all proposed major projects, especially industrial ones, before they are granted construction and operating permits.

* Existing industries discharging toxic and/or high-BOD wastes into the environment should be identified and required to treat their wastes and clean up already polluted areas. A system of fines should be implemented for violators, with the monies collected going into a special fund for environmental clean-ups.

* According to Archer (1984), the former Chief Environmental Health Engineer of Barbados and a PAHO consultant, St. Vincent and the Grenadines and other CARICOM countries would be well served if they worked with CARICOM to develop a regional code of practice for industrial waste disposal to marine and coastal environments, the objective being to ensure protection of coastal ecosystems and amenities. Countries in the region should consider taking this one step further. It would be worthwhile for them to cooperatively set standards on the degree to which effluent and all other forms of industrial pollution must be treated before disposal, and on methods of disposal as well.

In reality such measures would be very difficult to achieve. However, when it is realized that environmental impacts invariably involve opportunity costs, for instance by harming fisheries or tourism amenities, it becomes evident that at least some minimum pollution standards can have economic benefits and can be customized to reduce costs. Furthermore, in the absence of such standards, on-going industrial development in the Caribbean may create a situation in which one country becomes a "polluter's haven" because of minimal regulation and no monitoring. If St. Vincent and the Grenadines does not proceed to set standards for enclave industries and neighboring states do, it poses a special risk for future generations of Vincentians.

St. Vincent's Botanic Gardens, a popular place for residents and tourists seeking a pleasant and informative display of the wonders of nature in an orderly setting. Other specialized protected areas like the King's Hill Forest Reserve might also be developed and opened to the public and to researchers. Sites such as these have educational and recreational value, as well as serving ecotourism.

SECTION 7 TOURISM

7.1 OVERVIEW

DEVELOPMENT TRENDS

Tourism has been a strong growth sector of the economy of St. Vincent and the Grenadines in recent years, but development of the industry has not been without problems, some of which are clearly linked to environmental planning and growth management issues.

The tourism growth curve for St. Vincent and the Grenadines displayed in Figure 7.1(1) shows a solid annual compound growth rate for stay-over tourists of over five percent (5.32 percent) for the five year period, 1984-89. McElroy and deAlbuquerque (1989) estimate total tourist expenditures in the country to be equivalent to 38 percent of GDP. The reader should note that this does *not* mean that tourism accounts for over one-third of GDP, for it is the *net* earnings from tourism which contribute to GDP, perhaps about 10 or 15 percent of GDP. Nevertheless, this is not an insignificant amount, and it is especially important in terms of increasing foreign exchange earnings. McElroy and deAlbuquerque (1989) estimate that in many Eastern Caribbean states, every dollar contribution of tourism to GDP is also a dollar in foreign exchange.

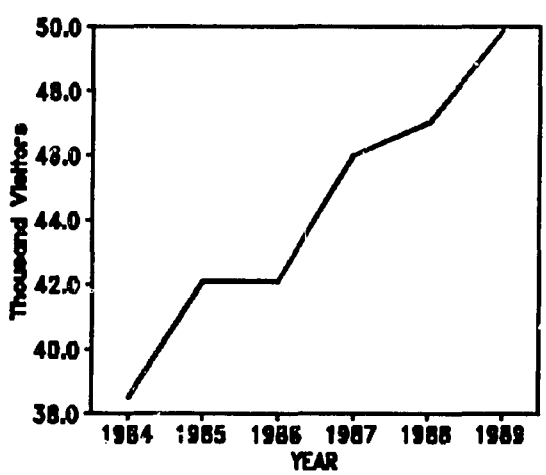


Figure 7.1(1). Tourism growth, adapted from CTO, 1989 and 1990.

In addition to stay-over visitors, cruise ship tourism is coming to assume a more significant role in the country, especially in the Grenadines. This is discussed in more detail below.

There are striking differences in the scale of tourism on the mainland of St. Vincent and in the satellite Grenadine Islands. Figure 7.1(2) shows the dramatic reversal which has occurred in recent years, as the overall leadership in first tourist arrivals has shifted from the main island of St. Vincent to the Grenadines. (It should be noted that these data purport to measure the first port of entry of all visitors to St. Vincent and the Grenadines, not just those who would be classified as stay-over tourists.)

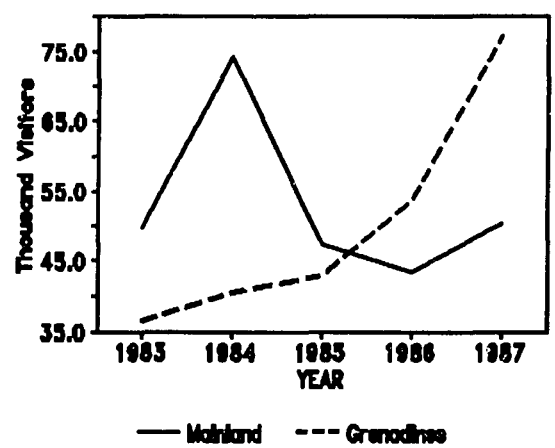


Figure 7.1(2). First tourist entries, St. Vincent vs. the Grenadines, adapted from GSVG, 1989b.

One of the primary explanations for the rising fortunes of the Grenadines has been the abrupt downturn in the number of cruise ship visits to Kingstown on the main island. Perhaps less well appreciated as a causative factor has been the increase in tourist arrivals to the outly-

ing islands by airplane, which has been growing at a much faster *rate* than in St. Vincent. As displayed in Figure 7.1(3), over a five year period (1983-87), air arrivals in St. Vincent and the Grenadines increased about the same amount (i.e., by about 6,000 arrivals in each destination). However, this means that the *rate* of arrival increase is nearly *twice* as high in the Grenadines as in the main island.

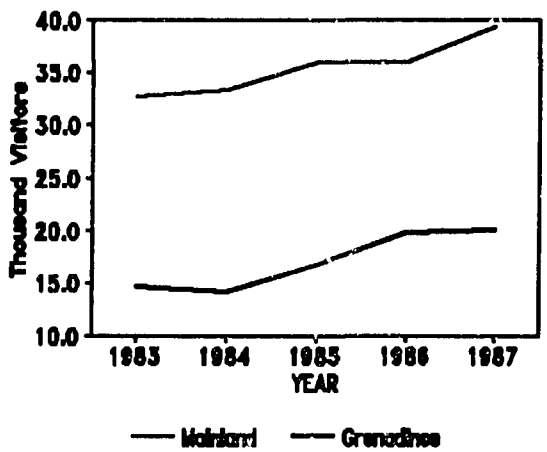


Figure 7.1(3). Entries by air, St. Vincent vs. the Grenadines, adapted from GSVG, 1989b.

When population figures are taken into consideration (i.e., the Grenadines has one-tenth the population of the main island), it becomes clear that the apparently small levels of tourist activity in the Grenadines are really extraordinarily high in terms of per capita impacts. For comparison purposes, if it could be assumed that only half of the air visitors are stay-over tourists, then the measure of tourism density in the Grenadines is among the highest in the Eastern Caribbean (McElroy and De Albuquerque, 1989).

The picture becomes more complicated when the arrival trends of visitors by sea are also examined. In the Grenadines, these arrivals are divided between yacht-based tourism and cruise ships.

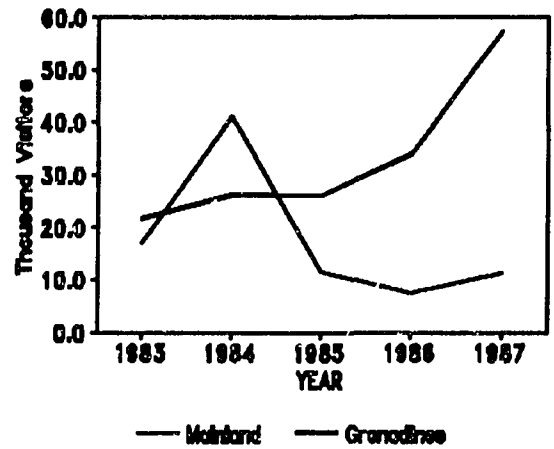


Figure 7.1(4). Changes in sea arrivals, St. Vincent vs. the Grenadines, adapted from GSVG, 1989b.

As is evident from Figure 7.1(4), cruise ships have turned away from Kingstown as a port-of-call and are increasingly seeking ports in the Grenadines. This statistical phenomenon is further reflected in the uneasiness of some Grenadine Island residents, including those involved in the tourism industry, who are voicing concerns about the lack of adequate infrastructure and other services required to support the current level of tourism (see also Section 7.2 below).

Government has undertaken to improve the provision of basic water and sanitation services to the out islands and generally to improve conditions. In addition, the Organization of American States has provided a relatively comprehensive set of policies and specific development proposals for tourism in the Grenadines (Jackson, *et al.*, 1986). These focus predominantly on protecting and enhancing the environmental amenities of the area. Most significant is the proposal, accepted by Government, to establish the Tobago Cays National Park (see also Sections 5 and 9 of the Profile).

A secondary aspect of the OAS development proposals for the Grenadines which has not received as much attention, but which may have more direct developmental impact, is a series of recommendations for increasing local in-

volvement with and earnings from yacht-based tourism -- e.g., various yacht service industries such as marinas, riggers, and sailmakers. As demonstrated by the successful model in the British Virgin Islands, there are a variety of ways to increase the local-value-added component of yacht-based tourism, without unduly restricting investment options.

TOURISM POLICY

The development of a comprehensive tourism policy for this multi-island country is not an easy task. In the first place, St. Vincent and the Grenadines is out of the mainstream of well-established transportation routes in the Eastern Caribbean.

Secondly, and more importantly, any national tourism policy must reflect complementary objectives for two contrasting destination points. Strategies for the first tourism node -- the main island of St. Vincent -- must optimize development opportunities within the context of what is primarily an agricultural island, where tourism is confined to a narrow coastal rim of land and where the industry must compete with other major coastal activities and settlement patterns. Given these restrictions, St. Vincent tourism relies almost entirely on one main tourism enclave in the southwest of the island -- the Kingstown-Indian Bay-Calliaqua area.

The second tourism node -- the Grenadines -- presents a different set of issues for the tourism planner. These off-shore islands are considerably smaller than St. Vincent and have, for the most part, more marginal infrastructure. They are also "out-of-sight," dispersed and lying further from the parent island than most other satellite islands in the Eastern Caribbean -- the most southern of the St. Vincent Grenadines are actually closer to Grenada than they are to St. Vincent proper.

Thus, the challenge for St. Vincent and the Grenadines is to devise a tourism policy (including a marketing strategy) which is suitable for each "node" and which will work for both destinations (the one common denominator which both seem to share is development of the yachting industry). It is a task fraught with difficulties, not the least of which is the high cost of maintaining multiple infrastructure facilities, such as airports. Furthermore, the general Eastern Caribbean experience of parent island/satellite island(s) relationships is not encouraging, particularly given the additional burdens faced by St. Vincent and the Grenadines -- e.g., a poorer country in which the satellite islands are smaller and the distances among the various outlying islands are greater.

TOURISM DEVELOPMENT PLANS

Government is presently rewriting the country's tourism development plan for the next five years. Several sites have been targeted by the Tourism Department in project development proposals (pers. comm., B. Thomas, Dept. of Tourism, March 1990). These include:

- *Mt. Wynne Beach*, the best black sand beach on the island of St. Vincent which is used by visitors en route to and from the Falls of Baleine (another popular tourism site). Current objectives of the Department for Mt. Wynne Beach include its protection and development as a tourist attraction and recreation area for visitors and residents. The site has also been mentioned as a potential cruise ship facility.

- *Access ramp for Falls of Baleine.* The objective is to construct an access ramp in the form of a floating jetty to accommodate boats, ensure safe disembarkation, and increase utilization of the site.

- *Promotion of nature tourism through development of the Petit Wallibou Falls.* The proposed project includes improvement of 2.5 miles of trail from Richmond Vale Academy to the falls. Approximately one mile will be paved for four-wheel drive access with the remainder a four-foot wide path to the falls. Combination tours -- i.e., boat ride to Richmond with four-wheel drive to the falls -- are anticipated.

- *Union Island, Grenadines: beautification and restoration of Old Fort.* The objectives of the two proposals for Union Island are: (1) to enhance the desirability of Union as an attraction by launching a clean-up/beautification campaign which includes an environmental education component and (2) to implement a vegetation clearing and replanting program at the Old Fort to facilitate visitor access to the site and to provide interpretive materials (signs, printed leaflets) for visitor use.

7.2 PROBLEMS AND ISSUES

Appreciation of the pristine beauty and pleasing natural resources of the Grenadines, combined with assistance from external aid agencies such as the OAS as well as local organizations and "celebrity" visitors, has resulted in some attention being given to identifying strategies to protect these islands from over-exploitation by the tourism industry. Less well defined are proposals for more coordinated development of tourism possibilities for St. Vincent proper or for approaches which integrate tourist experiences in St. Vincent *and* the Grenadines.

On the main island of St. Vincent, there are opportunities for developing a more explicit nature-based tourism, which is the stated but unofficial direction of tourism policy for the entire country. Some of these opportunities have already been identified in proposals put forward by the Department of Tourism (see Section 7.1). Unfortunately, the reduction of cruise ship visits to Kingstown has deprived St. Vincent of a chance to more fully "commercialize" visits to the St. Vincent Botanic Gardens, the oldest in the Western Hemisphere.

The issue of tourism "style" is one which confronts all Eastern Caribbean islands, including St. Vincent and the Grenadines. Development projects or development approaches catering to the "mass tourism" market can significantly impact on many aspects (e.g., physical, biological, socio-cultural) of island life, particularly small islands like the Grenadines. But, as has been well documented (e.g., McElroy and deAlbuquerque, 1989), oftentimes the economic benefits of mass tourism are illusory, the result of a failure to account for the social costs to the community and the environmental costs to the ecosystem.

Bequia, the largest of the St. Vincent Grenadines, is only seven square miles in area. Yet, given the small size of the Grenadines, planners have often ignored the *cumulative* impacts of tourism projects (e.g., a proposed 300-boat marina on Union) on the infrastructure of these islands. For example, the OAS action plan for the Grenadines (Jackson, *et al.*, 1986) recommends that the maximum number of rooms for each hotel development in Bequia, Canouan and Union Island be set at 150, and in Mayreau, Palm Island and Petit St. Vincent at 50 rooms. Eight hotels are envisioned for tiny Canouan (three square miles total area), five of which are within a proposed "national park" (see Section 9).

In retrospect, the numbers proposed by the OAS report may seem high, at least to those for whom the assumption that "less is more" is a valid one, meaning that there is an advantage to pursuing the "up-scale" tourism market -- where the number of tourists is fewer but the revenue per room is higher. Whether, instead, a tourist island moves in the direction of the mass tourism market depends in large measure on what the country is trying to optimize: employment, revenue, the resource base or other national concerns.

The dramatic increases in cruise ship visits to Bequia and Mayreau and one-day air excursions to Union Island in recent years have raised local concerns about a diminished quality of life and about the impacts of marketing more and more to a mass tourism clientele. The Bequia Tourist Committee, formed by a group of private citizens involved in the tourism industry, worries that the favored stay-over visitors will leave if the island loses its renowned charm and tranquillity. This group has carried out a survey (Simmons, 1988) to assess the public's perceptions about these issues and its attitude toward the expanding cruise ship market. It has also requested that GSVG take action to lower the

number of cruise ships per year, limit their size and length of stay, and control illegal vendors. However, the Department of Tourism has responded that it does not have the authority to place limits and controls on cruise ships, and it is not clear which (if any) government agency does have jurisdiction.

GSVG tourism officials are not oblivious to the problems associated with mass tourism, as evidenced by interviews with the CEP Technical Team (pers. comm., K. Layne and B. Thomas, Dept. of Tourism, April 1990). Likewise, GSVG planners have included enlightened tourism policy statements in the National Development Plan (GSVG, 1986b) and have prepared reports dealing with these problems (e.g., Browne, n.d.). Nevertheless, the Department of Tourism is not represented on either the Planning and Priorities Committee or the Physical Planning and Development Board (see Section 10), and there does not seem to be any formal mechanism for ensuring that tourism policies are included in the development control process or that the social, cultural, and environmental impacts of tourism developments are addressed.

7.3 POLICY RECOMMENDATIONS

St. Vincent and the Grenadines has a relatively strong and expanding tourism sector, especially in the Grenadines. It is a significant element in the nation's total economy and contributes directly to improving the country's foreign exchange earnings (a significant issue, given the large and growing foreign debt -- see Section 1.3.2 of the Profile).

Over-exploitation of the country's natural resources, especially in the Grenadines, both from yachting and cruise ship visitors (see also Section 5), is a growing problem which needs to be addressed by tourism officials and the tourism industry. High priority attention needs to be directed to the following issues:

- Recognition -- in the development planning process -- that specific areas in the Grenadines have been granted protected area status and therefore certain types of tourism development activities should be excluded from such sites.

- Provision of basic public services and infrastructure in the islands and cays of the Grenadines, including trash disposal, potable water, and supervised anchorages.

- Development of incentive programs to support development of locally-owned or locally-staffed yachting-based enterprises.

- Coordinated development of a larger number of nature-based tourism experiences on St. Vincent proper in order to enhance this node of the national tourism industry, to diversify the nation's tourism market, and to improve opportunities for extending the length of stay and expenditure level of tourists visiting the island.

Kingstown Harbor, although not as naturally deep or protected as Castries in St. Lucia or St. George's in Grenada, nevertheless has been improved by various engineering works and can handle larger cargo vessels. North of the terminal buildings shown in the photo, a new market complex and a new government financial center have recently been completed. A waterfront park or esplanade area should be next, with some portion of the remaining shoreline dedicated to a promenade, park-like recreational area. This, in turn, suggests the need to reduce current pollution loading, perhaps by half in the next decade, especially that derived from agricultural fertilizers and pesticides in upland run-off water and from those suburban and urban domestic and industrial wastes reaching the harbor.

SECTION 8 POLLUTION AND PUBLIC HEALTH

8.1 OVERVIEW

SOLID WASTE

The proper collection and disposal of solid waste is perceived by many Vincentians, including members of the National Environmental Protection Task Force, to be the highest priority issue for improved environmental management in St. Vincent and the Grenadines. Indeed, the solid waste problem confronts visitors as soon as they arrive by air, for the municipal dump for Kingstown is immediately adjacent to the airport and is usually smoldering. Elsewhere in the country uncollected trash and litter, abandoned vehicles, and garbage are common on beaches, in streambeds, on roadsides and around villages and banana plantations (the blue plastic banana bags are ubiquitous in the latter areas). Banana rejects and leaves are dumped in streambeds and rivers and in the sea, and the remains of arrowroot plants after processing are discharged as a slurry from factories into the rivers.

Solid waste is collected daily in Kingstown and once a week in the suburbs by the Public Health Department. In rural areas, collection falls under the jurisdiction of local town councils where these exist; hence, most rural areas have no collection service.

At present the only "official" solid waste disposal site in St. Vincent is at Arnos Vale near Kingstown, mentioned above as immediately adjacent to the airport (Figure 8.1(1)). In Georgetown, a local dump is operated by the Georgetown Town Board and is located between Georgetown and Caratal Village near the mouth of the Caratal River (Shortte, 1990). It is overburdened and in need of relocation. Barrouallie Village once dumped its refuse at Morgan Bay and the "Bottle and Glass" rocks, but since 1986 it has used a site along the river banks at Wallilabou.

Layou uses a dump site at Rutland Vale which is now filled and has no room for expansion. A new site at the Mt. Wynne Estate has been proposed by the Public Health Department, but this estate has also been identified by the Tourism Department for beach recreation development. There is no identified refuse disposal site in Chateaubelair; its trash is dumped on the beach along the road leading to Fitz-Hughes Village. The Public Health Department wants to establish a new disposal site near the southern part of Richmond, but this area also has been proposed by the Forestry Division as a new recreation site.

In the rest of the countryside on St. Vincent, the areas used for solid waste disposal are various *ad hoc* dumps, watercourses, beaches or the sea. In some areas, wheel-barrows are still used for the transportation of refuse to the disposal sites, and in others trucks are used when available, supplemented by wheel-barrows.

In Bequia, the disposal site was formerly located in Port Elizabeth adjacent to the shore on the northern side of the harbor; it has recently been moved to a new location about half a mile from the center of town. This new site appears to be functioning as a sanitary landfill.

There are no designated disposal sites on Canouan, Mayreau or Union Island; refuse is dumped indiscriminately in various unused areas of land. In Mayreau, the village above Saline Bay is particularly littered with plastic waste and refuse.

SEWAGE AND OTHER HOUSEHOLD LIQUID WASTES

A national survey of household sewage disposal was done by the Public Health Department in 1988, but no report was available as of March, 1990. The only areas in the country that are presently sewered are some parts of downtown Kingstown and about

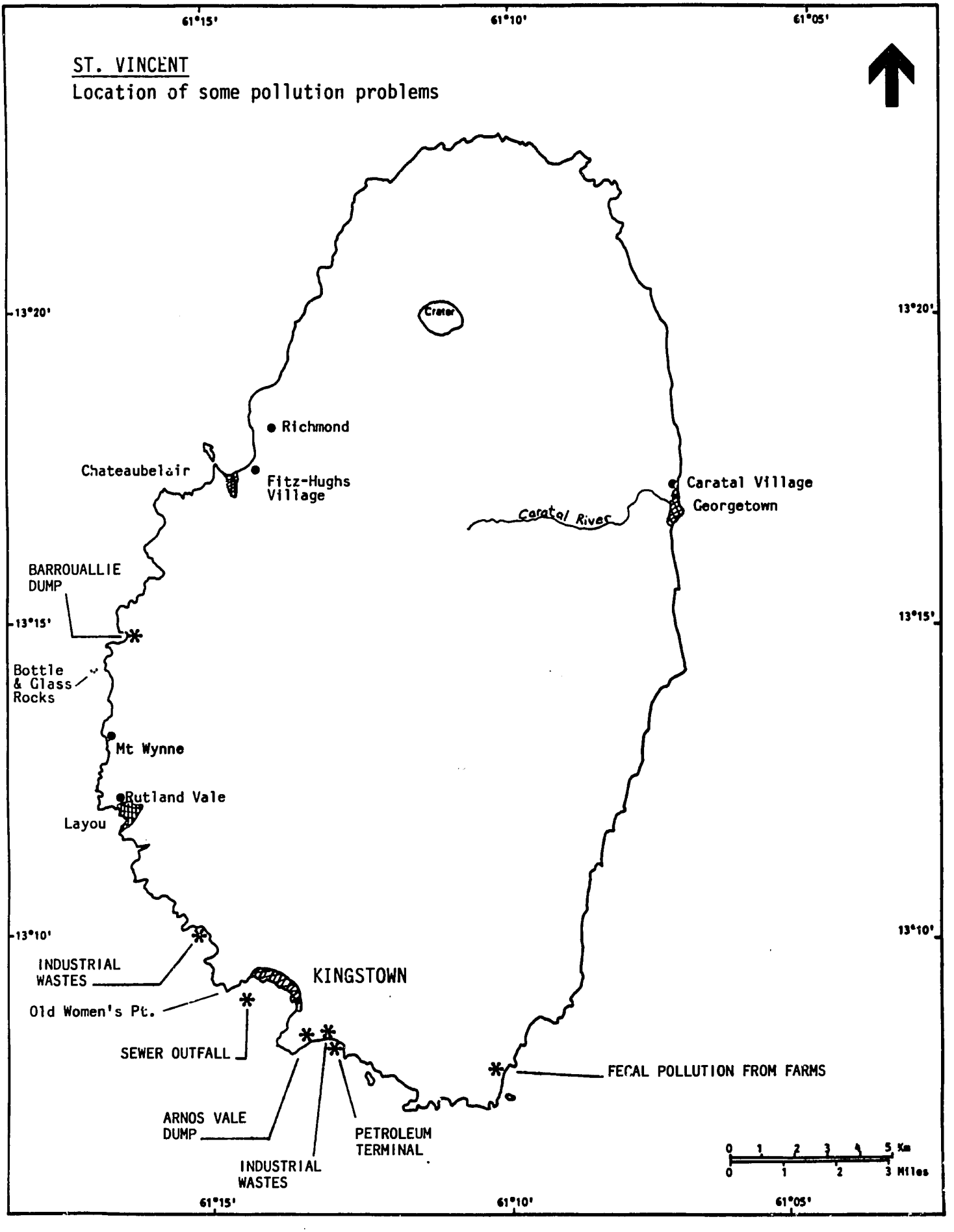


Figure 8.1(1a). Location of some pollution problems in St. Vincent.

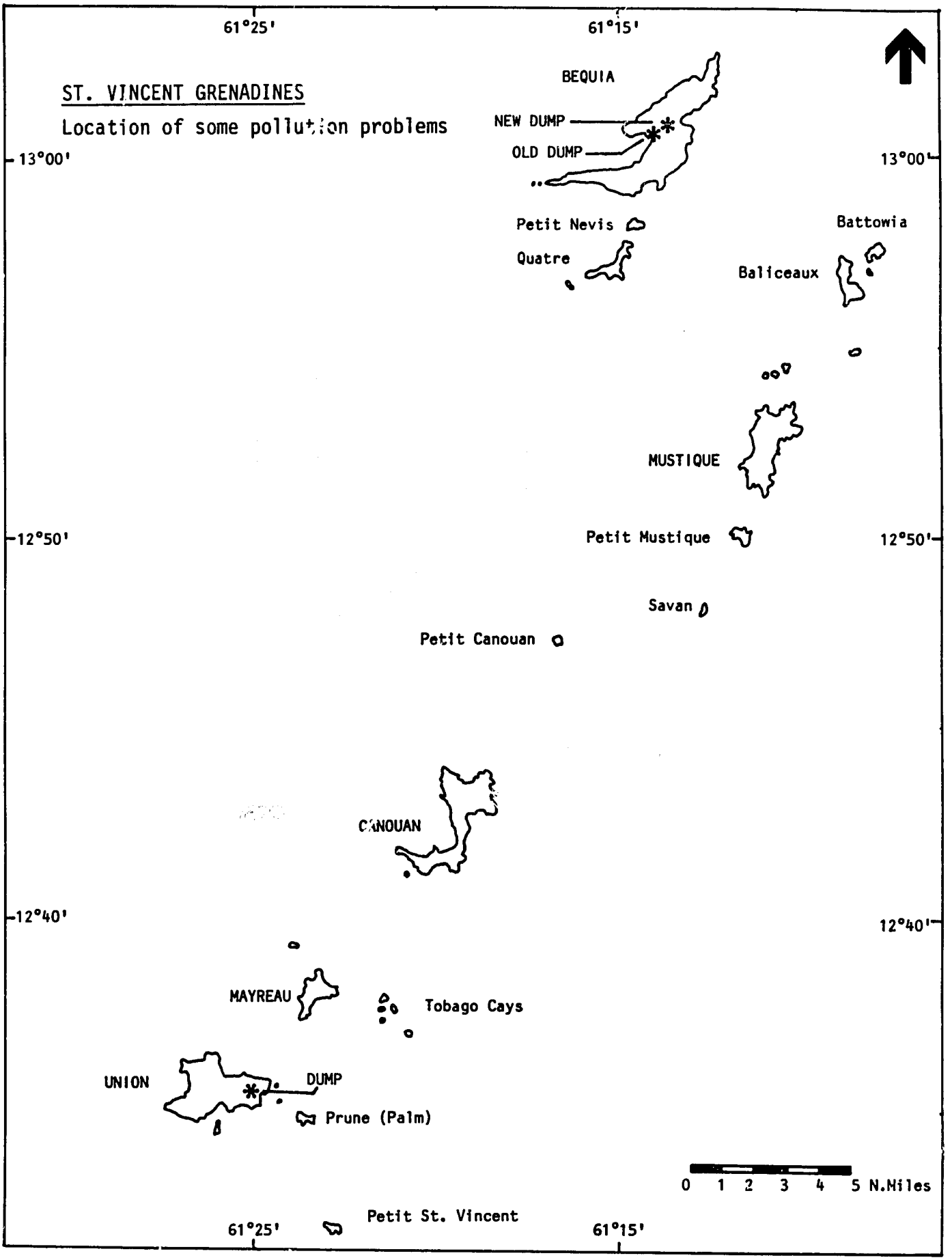


Figure 8.1(1b). Location of some pollution problems in the Grenadines.

40 houses in the Arnos Vale suburbs (near the St. Vincent airport). Most of the population of all islands in the country still use pit latrines, but there is some usage of septic tanks. Pail closets are no longer in wide use, except perhaps in a few rural areas. Approximately four percent of the homes have no facilities at all for the disposal of excreta (pers. comm., CEP National Committee, 1990). In some areas, hard volcanic soils limit percolation and therefore present problems for waste water disposal by septic tanks and soakaways. At some locations along the coast of St. Vincent, high groundwater tables limit the absorption capacity of the soil, creating the risk of sewage pollution; this is the case particularly in Kingstown and Georgetown (Archer, n.d).

The Kingstown sewer system was planned in 1956 but was only partially completed in 1974, with trunk sewers being laid in most of the areas as originally planned. However, branch lines and laterals were completed to serve mainly the reclaimed waterfront commercial area adjacent to Bay Street, mostly west of the market at Bedford Street. Connections to the sewer system are only made from water closets; at least in theory no gray water or industrial effluents are allowed. The current sewer system experiences frequent breakdowns at the Bay Street pumping station, with the result that sewage occasionally backs up and overflows in the streets and sewers. The sewer system has become increasingly inadequate as development in Kingstown becomes progressively more dense, e.g., in the rest of the waterfront commercial sector; in the housing developments north and south of Victoria Park, Stony Ground, and Paul's Avenue; and in the Rose Place fishing village (Bottom Town).

Raw sewage from Kingstown is discharged without treatment in Kingstown Harbor. The sewer outfall is located close to the promontory known as "Old Woman's Point" (Figure 8.1(1)), which is a popular site for SCUBA divers. The outfall pipe has been broken by storms twice and was most recently repaired in the early 1980's with a plastic (PVC) pipe. Although no studies have been done, there are reportedly strong currents sweeping through the harbor which are thought to disperse the effluent quickly (pers. comm., D. Cummings, Manager, CWSA, Feb. 1990 and W. Tewes, dive tour operator, March 1990).

Arnos Vale is an expanding residential and industrial suburb of Kingstown with a high groundwater table that presents problems for septic tank disposal. A small "package plant" sewerage system was installed to treat the sewage via aeration. Originally intended to serve 1,000 houses, the Technical College and the primary school in Arnos Vale, the package plant is no longer functioning. Raw sewage is discharged into a drain leading directly to the sea in Greathead Bay.

There are no regulations for domestic sewage disposal or standards for septic tank design. The Central Water and Sewerage Authority (CWSA) provides specifications upon request from builders, but no enforcement authority exists. Both the Planning Division and the Public Health Department will consult with builders on questions of sewage disposal if asked, but again there are no legal requirements for consultation. Due mostly to economic factors (i.e., more people are able to afford them in the urban area), most of the existing septic systems on St. Vincent are located around Kingstown. Nevertheless, in many of the lower-lying coastal neighborhoods of town, high groundwater levels make the use of septic tanks impractical.

The lower reaches of virtually all streams in densely populated areas of St. Vincent are thought to be polluted by sewage and gray water. In addition to the public health hazard presented by disease organisms in the sewage, nutrient enrichment may be having an adverse impact on stream wildlife. Because the steep hillside slopes cause water to move rapidly to the sea, stream pollution would most likely be more serious during the dry season. Coastal pollution is likely to be a problem in most areas; however, on St. Vincent, the relatively few enclosed and shallow embayments helps to promote mixing and flushing. In some of the Grenadines (e.g., Bequia, Mayreau, Union), shallow reef-enclosed embayments with lower volume for dilution and poorer flushing capabilities are more common.

No studies of stream water quality have been done; consequently no quantitative information on the extent and severity of the suspected pollution problem is available. The following locations have been mentioned by members of the Environmental Protection Task Force as problem areas:

- *Stoney Ground Housing Settlement*: raw sewage disposed in the Kingstown North River (N.B. CWSA is in the process of connecting the Stoney Grounds settlement to the Kingstown Sewerage System);

- *Arnos Vale Housing Development*: raw sewage disposed in the stream at back of Arnos Vale School.

TRENDS IN THE USE OF AGRICULTURAL CHEMICALS

Agriculture generally and banana growing in particular have become increasingly dependent on "inputs", not only of chemical fertilizers but also of pesticides and herbicides (the latter two classes of chemicals are collectively called biocides in this report). The banana-producing Windward Islands are the heaviest users of biocides in the OECS countries. Almost all of the biocides imported in these countries are listed as "restricted" by the U.S. Environmental Protection Agency (USEPA). Chemicals listed as "restricted" require a special permit in the United States which is only issued for certain uses under rigorously controlled conditions.

There are about twelve importers of biocides in St. Vincent; in mid-1989 an attempt was made by the Pesticide Control Board to get figures on the amount of biocides imported by these concerns during the previous year (DeGeorges, 1989). A response was received from only six importers (the remaining six which did not respond included one major importer). The responding companies alone had imported a total of 968,965 pounds of these chemicals (this is a corrected total; due to arithmetic errors DeGeorges gives a figure of 906,679). The imported biocides included eight compounds listed as restricted and two listed as canceled by the USEPA (see DeGeorges, 1989, for a complete listing).

The biocides used in the largest quantities are: Mocap, Furadan, Gramoxone, Vydate and Calyxin, in that order. According to this very incomplete survey, the nine biocides imported into St. Vincent during 1988 in quantities close to or exceeding 2,000 pounds (one ton) are listed in Table 8.1(1). Highly toxic chemicals on this list include the USEPA-cancelled Basudin and the USEPA-restricted Mocap, Furadan, Vydate and Gramoxone (these chemicals were canceled or restricted by USEPA because of their toxicity to humans).

DeGeorges (1989) notes that in 1989 the Banana Growers Association alone brought in 1,211,452 pounds of Furadan, Vydate, and Mocap, more than the total reported by all six respondents in the previous year. The CEP National Committee (pers. comm., 1990) reports that the SVBGA is the sole importer of the nematicides primarily used in banana production. More specific data were not available at the time the CEP was being prepared.

In St. Vincent, many of the biocides used for controlling leaf spot in bananas are applied aerially, including Benlate, Calixin and Tilt, raising concern about the aerial drift of these pesticides into the catchment areas for municipal water supplies (DeGeorges, 1989).

Some of the most intensive biocide usage in St. Vincent takes place in several adjacent valleys of the southeast coast where banana growing is concentrated. In the Mesopotamia Valley, large-scale (illegal) banana cultivation takes place on crown lands in the upper watershed on steep slopes draining directly into the water intakes for the Montreal water treatment plant. Similar situations exist in other valleys. Fertilizer and biocide use in such areas poses a direct threat of drinking-water pollution to some of the major water supply systems on the island. Recognizing this threat, GSVG requested the Organization of Eastern Caribbean States-Natural Resources Management Project (OECS-NRMP) to fund a pilot study of water quality and pesticide residues at this plant.

Table 8.1(1). Biocides imported into St. Vincent during 1988 in quantities close to or exceeding 2,000 pounds (1 ton).

Biocide	Quantity (lbs.)
Basudin (Diazinon)	1,891
Benlate (Benomyl)	5,626
Calixin (Tridemorph)	11,220
Furadan (Carbofuran)	121,000
Gramoxone (Paraquat)	91,963
Mocap (Ethoprop)	684,200
Sevin (Carbaryl)	2,030
Tilt (Propiconazole)	3,432
Vydate (Oxamyl)	40,643

Source: DeGeorges, 1989.

The project was undertaken by the Caribbean Environmental Health Institute (CEHI), with the intention of sampling over at least one dry season and one wet season.

On the basis of a single set of samples taken in May, 1987, CEHI (OECS-NRMP, 1987) stated that the results of chemical analyses for nitrates, nitrites, phosphates, organochlorine pesticides, PCB's and other water quality parameters were "generally within acceptable limits". Sampling was also done for carbofuran and oxamyl, but the values are not given; instead these samples are listed simply as "not yet done". The report noted that the results of the single sampling period as given cannot be taken as representative and conclusions must await the results of future sampling. However, no further work was ever done as the project was canceled by GSVG shortly thereafter, for reasons which are not clear. A subsequent OECS-NRMP Report (1988) stated in relation to this project, "The assumption that the Government of St. Vincent and the Grenadines is supportive of an administrative solution to the problem was evidently wrong."

OIL POLLUTION

The nation's oil and other petroleum products are brought to St. Vincent and the Grenadines by tankers. Location of the petroleum off-loading terminal is shown in Figure 8.1(1). The oil tankers at the St. Vincent terminal during the period 1979-1989 had an average capacity of about 13,000 barrels.

According to a local representative for Shell Oil, this company requires its tankers to carry oil booms and chemical dispersants on board, and they are not allowed to pump any oil from tank washings and so forth into the sea (D. Brewster, Shell Oil Co. local manager; radio interview with C. Connell on "Naturally Yours," National Broadcasting Corp., April 25, 1990).

At present there is no system for the collection and proper disposal of waste oil. Waste oil and grease from garages is simply dumped into storm drains and on the ground, and together with oil from street surface runoff, it is then washed into rivers and coastal waters during rains. The potential problem of underground leakage from older gasoline stations' storage tanks into the water table, which has been commonly reported in many other

areas in the Caribbean and elsewhere, has not been investigated in St. Vincent.

The occurrence of petroleum tar on beaches is common throughout the region, and the problem has been monitored by the CARIPOL Program (Atwood, *et al.*, 1987/88). Windward coasts are the most often contaminated with tar, indicating that the source of much of the tar 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 the beaches commonly report getting tar on their feet. When levels are close to 100 grams per meter, beaches become virtually unusable for tourism. No data are available for the average concentrations of beach tar on St. Vincent and the Grenadines, which did not participate in the CARIPOL study.

INDUSTRIAL WASTES

While manufacturing is still in an early stage of development, its potential for employment creation and export expansion is ranked highly by GSVG economic planners. Only anecdotal information is available to indicate the extent of possible pollution from industrial sources, since no recent quantitative sampling has been done. There is speculation that a fish kill which occurred in the Arnos Vale River about two years ago may have been caused by the dumping of waste oils from one or more of the industrial plants adjacent to the river. Some industries at the Campden Park industrial site reportedly dump waste dyes and high-nutrient wastes into Campden Park Bay. There are suspected nutrient and fecal pollution problems in the Diamond River, attributed to run-off from the cattle farms nearby. Figure 8.1(1) shows the location of some of these alleged industrial waste problems.

PUBLIC HEALTH

The incidence of water- or sewage-related communicable diseases is low compared with the other Windward Islands. No cases of typhoid have been reported in the country for over 20 years (Archer, n.d.; pers. comm., A. Eustace, Medical Of., Dept. of Health and the Environment, Feb. 1990). Gastro-enteritis is still a major public health problem related to poor sanitation, particularly in the low-lying coastal areas of Kingstown and other densely populated locations. However, data on gastro-enteritis are only collected on children under five years of age.

The CWSA has a laboratory which is capable of analyzing water for oxygen, temperature, salinity, chlorine, and bacteria (fecal coliform, fecal streptococcus, total coliform). CWSA monitors drinking water supplies, mainly testing for bacterial contamination and residual chlorine levels, and notifies the Public Health Department when levels are unacceptably high.

A Public Health Department program employs a truck with "fogging" equipment to apply Malathion insecticide in urban areas. The intent is to control the Aedes aegypti mosquito (the vector of dengue and yellow fevers). Regarding this program, the following points should be kept in mind (pers. comm., Dr. A. Eustace, Min. of Health and the Environment, 1990):

- The use of Malathion as an aerosol dispersed in the manner in which it applied in SVG is approved by the World Health Organization;

- Malathion fogging is used sporadically, not routinely, primarily as an emergency measure to reduce the population of adult mosquitos in localized areas;

- The small risk involved in the use of Malathion, which is known to be of low toxicity, must be weighed against the risk and cost of an epidemic of dengue fever;

- The main thrust of GSVG's Insect Vector Control Program in its day-to-day activities is source reduction through the elimination and/or treatment of household breeding

sites, and the education of householders.

8.2 PROBLEMS AND ISSUES

SOLID WASTE COLLECTION AND DISPOSAL

Kingstown's Arnos Vale dump site, although intended to be a sanitary landfill, has operated more often as an open dump, which is its present status. The site was originally between 7.5 and 10 acres in size and was estimated to have a useful life of about 20 years if properly operated, but some of the land has been expropriated for other uses and the available area is now smaller. There are no current projections for the expected lifetime of the dump. No waste reduction or recycling programs are presently in operation.

The inadequate management of the Arnos Vale site is due at least in part to the lack of funding for proper equipment and maintenance. The Environmental Protection Task Force is currently attempting to obtain funding from GSVG for surveying the dump site and fencing it, but thus far these efforts have not been successful. The lack of suitable vehicles for the collection and transportation of solid waste to disposal sites, fencing to contain the refuse, and heavy equipment to bury it are severe limitations throughout all areas of the nation. There is also a need to establish environmental protection criteria for the siting and operation of dump sites, to select suitable alternative sites which meet these criteria at several locations throughout the island, and to close down presently used sites which are overfilled or which constitute an environmental hazard.

TREATMENT AND DISPOSAL OF LIQUID WASTES

There is a pressing need to ensure that household effluents, including gray water, receive proper treatment and disposal. Failure to do so will mean increasingly negative impacts on public health, amenity values, and tourism revenues. Furthermore, the effect of high-nutrient wastes on water quality and coral reef communities is severely detrimental, producing algal "blooms" and stimulating the overgrowth of corals by algae. Degradation of the reef environment, the death of corals and consequent loss of beach sand production and coastal protection from waves, as well as the depletion of reef fish populations are the likely results. To restore and maintain coastal water quality, it will at some point become necessary to provide sewerage systems for the major population centers and to enforce requirements for the installation of grease traps and septic tanks in other areas.

It has been recommended (Archer, n.d.) that urgent action be taken to update the original sewerage plans for Kingstown with extensions where necessary, to construct the extended system as soon as possible and to consider the feasibility of sewage treatment and/or the installation of a longer outfall. Archer also recommends further study of the physical plans for the Arnos Vale area to prepare an adequate sewerage system capable of handling the expanded airport and the residential, industrial and school developments.

Another critical area is the Indian Bay/Villa-Young Island-Calliaqua-Carenage complex, where St. Vincent's best examples of shallow-water reefs, white sand recreational beaches, marinas, yacht anchorages and important tourist hotels are located. The reefs here appear to be under stress, presumably from liquid wastes (see Section 5). Since the continued viability of recreational and tourism activities in this area depends on protecting the health of the reefs, it is clear that action must be taken soon to reduce the wastewater pollution load entering the bay. This will probably require retrofitting existing hotels and houses with septic tank systems and grease traps, imposing and enforcing density controls and strict waste disposal requirements on new developments, and eventually constructing a sewerage system for the area.

A general regional problem has been the failure of sanitary engineers to realize that most tropical marine ecosystems are not adapted to high nutrient levels; for this reason many recently built sewage treatment systems

have tended to follow temperate design standards for the three basic "levels" of treatment. Thus, emphasis has been placed on primary treatment (removal of grease, grit and large particulate matter and maceration of solids); secondary treatment (the preceding plus reduction of organic matter and suspended solids); and lastly tertiary treatment (the preceding plus removal of nutrients). The effluent from any of these levels of treatment is usually chlorinated to ensure the destruction of disease organisms. These three options represent a range of increasing installation and operating expenses and maintenance requirements. Usually, if funds are available following construction of the treatment plant, a short outfall into the nearshore waters -- with minimum concern for marine habitats or currents -- is added.

However, primary- or secondary-treated effluent may still harbor pathogenic viruses even after chlorination. It is not considered safe for disposal in nearshore waters that are used for swimming and bathing, and its high levels of nutrients are certainly detrimental to the marine environment. Only the extremely expensive and technically sophisticated tertiary systems offer sufficient protection to the environment and to public health when the effluents are discharged close to shore, and even these would still benefit from a long outfall as a safety factor when the inevitable breakdowns or seasonal on-shore winds occur.

For these reasons, more recent opinions (e.g., Hunte, *et al.*, 1989) have tended to recommend that the most cost-effective way to protect the environment *and* public health is to build an efficient collection system for both sewage and gray water, with an ocean outfall that is long enough to discharge via a diffuser into deep water and/or strong offshore currents. With this design, only a "preliminary" level of treatment (removal of grease, grit and large particulate matter) is necessary, since the nutrients and other pollutants will be carried away from the coast and will be rapidly diluted to background levels. Such a system has the lowest costs for construction, operation and maintenance and also requires the lowest level of technical skill to operate.

Because of the proximity of deep water to the coastline in most areas of St. Vincent, the type of municipal sewage disposal system described above is well-suited to the urban areas of that island. Environmentally safe disposal is more difficult in the islands of the Grenadines, due to the prevalence of extensive coral reefs on a relatively shallow shelf and to the fact that settlements tend to be in bays which are more sheltered. In the Grenadines, septic tank systems are probably the method of choice for sewage treatment. Tertiary treatment "package" plants may be considered for large new hotel or resort developments, but it needs to be recognized that the lack of skilled operators, Government inspectors and spare parts will probably guarantee substandard operation. (One option which has had some limited success elsewhere is to require that the tertiary effluent be re-used for irrigation water on the grounds of the establishment, with perhaps a large holding tank for emergencies but no bypass to the ocean. When combined with periodic Government inspections this provides a powerful incentive to keep the plant operating properly.)

Although they can be effective when used within their inherent limitations, 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/or in soils with poor percolation characteristics, and (because their effluent is still high in nutrients) will not effectively reduce nutrient pollution in areas of high population density.

One source of sewage which is frequently singled out as a major cause of water quality problems in SVG is the effluent from yachts and live-aboard vessels of all kinds. An area where this is suspected to be a problem is the Indian Bay-Young Island Cut-Calliaqua Bay complex. In the Grenadines, the decline of reef communities around the yacht anchorages on Union Island and in the Tobago Cays has been attributed in part to sewage pollution from boats (Berwick, 1986; see also Section 5 of the Profile).

WASTE GENERATION RATES

Solid or liquid waste generation or discharge rates are not available from any single industry or disposal site or from any area of the country. This makes waste disposal planning and quantitative estimation of impacts difficult. Nevertheless, methods exist for the rapid estimation of such rates (e.g., WHO, 1982).

ENVIRONMENTAL RISKS OF AGRICULTURAL CHEMICALS

Fertilizers. Chemical fertilizers are in widespread use in St. Vincent. NPP (nitrogen/phosphorus/potassium) types of fertilizers are most commonly used. Sulphate of ammonia, a source of nitrogen, is also popular as an input to banana production. The greatest potential risks from such use in the environment are reported to be soil deterioration and nutrient overload in downstream and coastal receiving waters. Coral reef ecosystems are especially sensitive to the effects of overfertilization of the nearshore waters.

At present there is not sufficient information to determine whether there is significant pollution of the drinking water supplies or the rivers and coastal waters by fertilizer residues, although some regard this as likely.

Biocides. The benefits of using biocides are usually straight-forward and immediate, but environmental and health hazards caused by their use are much more difficult to evaluate because they are often delayed in appearance, subtle, undetected or ignored. Properly assessing the risks posed by biocides requires data on the fate of these compounds in the environment and the level of exposure of humans and other biota. The data in the Caribbean are very limited, but alarming in at least some cases. A Jamaican study (Mansingh and Prasad; cited in Larew, 1988) found persistent pesticide residues in soil, fresh and salt water, and vegetables. Very limited sampling in Dominica and St. Lucia (cited in CCA/IRF, 1988) found only low levels of pesticide residues in the environment.

Clearly it would be in the best interests of all concerned with the environment to determine which of the two estimates for biocide importation given in Section 8.1 above is more nearly correct; this could be easily done if GSVG required biocide importers to provide accurate records on the types and quantities brought into the country. Until an accurate estimation of biocide importation and usage is conducted in St. Vincent, it will not be possible to adequately assess environmental or human health risks. Among the different insecticides, nematicides, herbicides and fungicides available, some are more critical than others from an environmental perspective. Each group has its own characteristics and represents a special challenge to the resource manager who must seek to use them with the least possible damage.

One way of clarifying some of the issues involved in the management of agricultural biocide use might be the introduction of a scientific risk-assessment approach. This involves screening all biocide imports and identification of the most hazardous compounds as well as sampling to determine levels of biocide residues and to trace their pathways through the ecosystem (including human populations). Then a quantitative estimate of risk, e.g., in terms of probability of premature death or injury per capita per amount ingested per body weight, can be computed. Finally, on the basis of this information, an evaluation can be made by comparing the quantitative estimate of risk against the economic benefits and the willingness of the public to accept various levels and types of risk. In the final analysis, social and political judgements must be made regarding the costs and feasibility of alternative methods of crop protection and the distribution of risks and benefits among the different sectors of society.

Many technical people in the country feel that it should be a GSVG priority to initiate monitoring for biocide residues. At present there is no institutional capability within the country to monitor the levels of biocides either in the environment or in human tissues. Unlike the other Windward Islands, St.

Vincent does not have a produce laboratory or any chemists trained in the analysis of biocides.

PUBLIC HEALTH

The insecticide fog (Malathion) used to control mosquitoes in urban areas is broadcast indiscriminately; it settles on people, animals, food and any exposed surfaces. In areas where cisterns are used, the biocide is washed by rainwater into cistern water supplies, and some of it is also inevitably inhaled by residents. Although Malathion is supposedly among the most environmentally "safe" biocides, such chemicals are not meant for direct human consumption, and their routine use in this manner may pose a significant public health risk.

Responsibilities of the Public Health Department for pollution monitoring and control overlap broadly with other departments; e.g., the Central Water and Sewerage Authority carries out the actual work of bacteriological monitoring for fresh waters and gives reports to the Chief Public Health Officer. No agency monitors marine pollution on a regular basis, but occasional monitoring of stations in Kingstown Harbor, Greathead Bay and Indian Bay is done by CWSA within a program directed by CEHI.

No regulations concerning specific *standards* for solid and liquid waste management/treatment, water quality in rivers or marine areas, or drinking water quality are in existence for the country. Officers of the CWSA and the Public Health Department make use of PAHO and WHO guidelines, but it appears to be a matter left to the discretion of departmental officials as to which guidelines apply to which projects.

No effort is being made to monitor or document exposure of pesticide workers. The general lack of training in the safe handling of pesticides combined with the toxicity of some of the biocides in use present an unacceptable level of risk. All parties interviewed by DeGeorges (1989) felt that programs to certify pesticide applicators and farmers and to monitor workers and the environment for pesticide residues should have a high priority.

OIL POLLUTION

No oil spill contingency plan now exists for any port or other coastal area in St. Vincent and the Grenadines. Since the country is near the major oil transportation routes from the oil producing and refining countries of Trinidad and Tobago and Venezuela, there is a high risk to coastal areas from marine oil spills. Any spill which deposited a heavy coating of oil on tourist beaches could, depending on the size of the spill, diminish or even destroy the tourist industry for years. The coral reefs of the Grenadines and the Tobago Cays National Park are also very vulnerable to oil spills.

DISPOSAL OF DERELICT VEHICLES AND SHIPS AT SEA

There have been suggestions by various members of the Environmental Protection Task Force and others that the derelict vehicles and ships which are a problem throughout SVG might be disposed of at sea or might be used to form artificial reefs. This proposal is currently being acted on, with the Police Department being responsible for the removal of the vehicles from the roadsides and storing them temporarily at the Arnos Vale dump site. The Fisheries Division has designated certain marine areas between Bequia and St. Vincent as suitable sites for the dumping of the abandoned vehicles.

It is not clear, however, that the vehicles would have substantial benefit as artificial reefs for increasing fish production. If the major reason for declining fish catches is overfishing, then adding more fish habitat in the form of junked vehicles to the sea bottom will not improve production. In fact, if fish populations have declined, there should be an excess of natural habitat. In this situation, the remedy most likely to have a positive effect will be regulation of the fishery, and, therefore, creation of artificial reefs must be viewed primarily as a response to the country's solid

waste problem, i.e., a justification for dumping solid waste at sea.

The National Trust and the Public Health Department have both expressed concern that unless the vehicles are properly detoxified and cleaned before disposal, they will contribute to the degradation of the marine environment. While this is a very legitimate concern, methods of detoxifying derelict vehicles for disposal at sea are routinely used in other countries. At this point, it is not clear whether detoxification is in fact being contemplated by GSVG, that information on how to do it properly is in the hands of the responsible agencies, or that suitable facilities and funds exist for carrying it out. This matter needs to be clarified, and responsibilities for detoxification assigned before the vehicles are allowed to be dumped.

INSTITUTIONAL RESPONSIBILITIES AND LEGISLATION

Solid and Liquid Wastes. There are presently no laws requiring the use of designated sites for solid waste disposal. Legal authority for solid waste management is not vested in any department of Government, and it is not covered in the 1977 Public Health Act. A draft revision of the Public Health Act was reportedly prepared in 1988 to deal with this omission, but so far it has not been enacted. The Public Health Department has assumed *de facto* responsibility for the Arnos Vale dump and for making recommendations about locations for other dump sites, but it has no real legal authority in the matter. A draft Anti-litter Act has been prepared and is undergoing review by GSVG.

Control of Pesticides. A Pesticide Control Act was passed in 1973, but there are no amendments or regulations to give the Pesticide Control Board authority to control import, distribution or use of pesticides. Pesticide regulations were recently drafted by an OAS consultant (pers. comm., W. McCalla, OAS consultant, June 1990) and sumitted to the Attorney General for review.

Oil Pollution Control. No legislation exists.

8.3 POLICY RECOMMENDATIONS

GENERAL

* Financing for all recommended measures in this section is perhaps the most critical element in addressing long-term requirements. The development of new and innovative means of raising revenues is necessary to reduce the burden on the Government treasury. Possible options include: charging a levy to all hotels for waste collection and treatment services; selling franchises to private waste collectors for designated collection areas; charging industrial and commercial users for waste collection and disposal; and billing polluters for cleanup and restoration costs.

* Public education programs directed at both children and adults regarding environmental pollution, proper waste storage and disposal, and general cleanliness should be implemented. An anti-litter act and regulations should also be immediately legislated and then rigorously enforced.

SOLID WASTE

* Collection of garbage should be turned over to private companies which would charge a fee for the service, something which is not presently done. The Public Health Department should license such companies and should have the power to rescind franchises if collectors do not perform satisfactorily.

* A solid waste management plan should be prepared covering a minimum period of twenty years. From a financial viewpoint, in the short term, a properly operated sanitary landfill is likely to be the most attractive option for solid waste disposal. 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.

LIQUID WASTE

* The most cost-effective *and* ecologically sound sewage disposal option needs to be identified and then implemented for all urban areas of St. Vincent as soon as possible. Given the fact that it is crucial to prevent both public health hazards and nutrient enrichment of nearshore waters, and taking into consideration existing technological and financial constraints, that option is likely to be preliminary treatment combined with a long outfall which discharges into deep water in an area of strong currents. Such waste disposal systems should be designed to be easily upgraded to a higher level of treatment should this prove to be necessary later. This solution for sewage disposal may be difficult if not impossible to implement in some places in the Grenadines, due to the shallow shelf area and reefs.

* A long-term water quality and marine biological monitoring program should be implemented immediately in order to: gather baseline data, determine the impacts of liquid waste disposal in urban areas and at industrial sites, and identify areas requiring remedial action. Laboratory and personnel capabilities in the country will have to be upgraded in order to accomplish this, and perhaps additional assistance from CEHI would need to be secured.

* An oil and hazardous materials spill contingency plan should be written and implemented. Legislation is needed to require proper disposal of waste automotive oil and hazardous materials, and facilities to accomplish this must be provided.

BIOCIDES

* As a matter of considerable urgency, regulations should be passed giving the Pesticide Control Board the necessary authority to require permits for the importation and sale of any biocide, to deny permits for the importation and sale of pesticides on the USEPA's (or other suitable agency's) list of restricted or cancelled chemicals, and to require distributors to report quantities sold and major users to report quantities applied in the field. The use of biocides in drinking water catchment areas should be stopped immediately.

* Agricultural extension agents and representatives of local rural development NGOs and farmers organizations should be trained to certify farmers in the safe use of biocides. The training programs should emphasize the use of visual instructional methods (e.g., videos rather than lectures) and should make a concerted effort to involve the children of farmers through schools and youth clubs. 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 biocides (DeGeorges, 1989).

* The Ministry of Agriculture should make arrangements to obtain information and advice from biocide experts by tapping into the manuals, libraries and computerized information systems maintained by USAID/USEPA, FAO/WHO, CIDA and other international donor agencies and health organizations. This information is necessary not only to protect public health but also to assure competitiveness on the international market in producing fruits and vegetables using acceptable biocides, i.e., those that have residue levels which fall within internationally acceptable tolerances (DeGeorges, 1989).

* The Ministry of Agriculture should obtain donor assistance to establish a produce laboratory and to train a technician in extraction of biocide residues from samples (produce, meat, fish, human blood/urine or environmental samples such as water and sediment). Extracted samples can be frozen and stored for weeks prior to analysis (compared to 7-14 hours for an unprocessed sample that is frozen). Monitoring programs should start with sampling for biocide residues in produce and in drinking water. Analysis can then be conducted by the Caribbean Environmental Health Institute at its laboratories in St. Lucia. Donor support to make these facilities functional should be contingent upon the passage of legislation that includes revenue-generating schemes which ensure the self-sufficiency of the produce lab over the long-term, e.g., requiring all produce exporters to have residue analyses conducted

with such fees placed in a specific account to support operational and maintenance costs for laboratory equipment (DeGeorges, 1989).

* Once the produce lab is operational, a chemist could be trained in biocide residue analysis, and a gas chromatograph could be obtained so that the analyses were eventually conducted in-country. At this point, the biocide monitoring program could be expanded to include regular sampling from farm workers and the environment. The environmental sampling capabilities of the Central Water and Sewerage Authority or the Public Health Department would need to be strengthened with support for equipment and training. Donor assistance should be contingent upon enactment of legislation establishing a special environmental monitoring fund with revenues earmarked for the fund. CEHI should consider eventually assuming a quality-control function for all the in-country biocide analysis laboratories in the OECS countries (DeGeorges, 1989).

* GSVG should pursue an official policy to reduce the amount of biocides used in agro-industries and to regulate where and how they are applied. The methods of *Integrated Pest Management* (IPM) should be employed, whereby the objectives of pest control are accomplished by employing a wide spectrum of chemical agents and biological techniques as an alternative to the saturation of crops with toxic compounds.

SECTION 9 GROWTH MANAGEMENT

9.1 PLANNING AND DEVELOPMENT CONTROL

9.1.1 Overview

NATIONAL DEVELOPMENT PLANNING

Interest in planning within GSVG originated with British colonial policy in the early 1960's and 1970's which attempted to tie the approval of grants and loans to the preparation and approval of development plans. During this period GSVG prepared several development plans which focused almost exclusively on economic expansion, with little or no concern for physical planning or social concerns. Most of these plans " ... failed spectacularly to meet their targets", which led to disillusionment with planning as a development tool (GSVG, 1986b). By the early 1970's the economic development planning apparatus within Government was totally defunct. After 1973 the planning process reverted to an annual budgetary exercise, supplemented by the planning activities of various international aid agencies for specific projects, writing of economic reviews and projections, and the preparation of a Public Sector Investment Program.

During the same period in the early 1970's, driven to some extent by heightened environmental concerns in the developed countries and by the pressures of population growth and the increasing complexity of land use decision-making in St. Vincent and the Grenadines, a renewed interest in physical planning emerged within GSVG. The two-volume St. Vincent Tourism Development Strategy (Llewelyn-Davies, *et al.*, 1972), prepared by consultants for the Government and funded by the British Development Division, was one of the first efforts in physical development planning at the national level. In 1976 a Physical Planning and Development Board and a Physical Planning Unit were established under the Town and Country Planning Act. Their stated functions were to institute a study of national, regional and local physical planning; to control all developmental building and subdivisions of land; and to carry out inspections of all buildings in progress (see also Section 10).

The formulation of national, regional and local physical development plans was mandated by the Town and Country Planning Act of 1976. A draft St. Vincent National Plan, 1976-1990 (UNDP, 1976), was prepared as part of a UNDP regional project. The plan was written by a team of outside experts with very little input or commitment from GSVG and no public involvement. It presented maps (Figures 9.1(1) and 9.1(2)) which showed a great divergence between land use and land capability, and it attempted to optimize resource use by proposing a land reform scheme based on the subdivision of some Government estates into five acre plots. According to Browne (1985), this proposal " ... neglected issues related to the crops, suitability and the commercial viability of 5 acre farms"; he believed that a program of this type (which is similar to a reform program now being implemented by GSVG) would only have increased land fragmentation and inefficiency in land use. Although the UNDP plan is now outdated and may have been flawed to begin with, it nevertheless contained valuable base line data, planning maps, and many useful recommendations, some of which might have been of benefit to subsequent planning efforts but were not adopted by Government. Much the same can be said of the 1972 Tourism Development Strategy. Unfortunately, neither of these plans was ever officially accepted, or apparently even used to any extent, by GSVG.

Also in 1976, a St. Vincent National Agricultural Plan (SNAP) was prepared by the Ministry of Agriculture and accepted by Government. SNAP was intended to promote the diversification of agricultural exports, enhance the land management capabilities of GSVG, and build agricultural infrastructure. Although the land tenure system was identi-

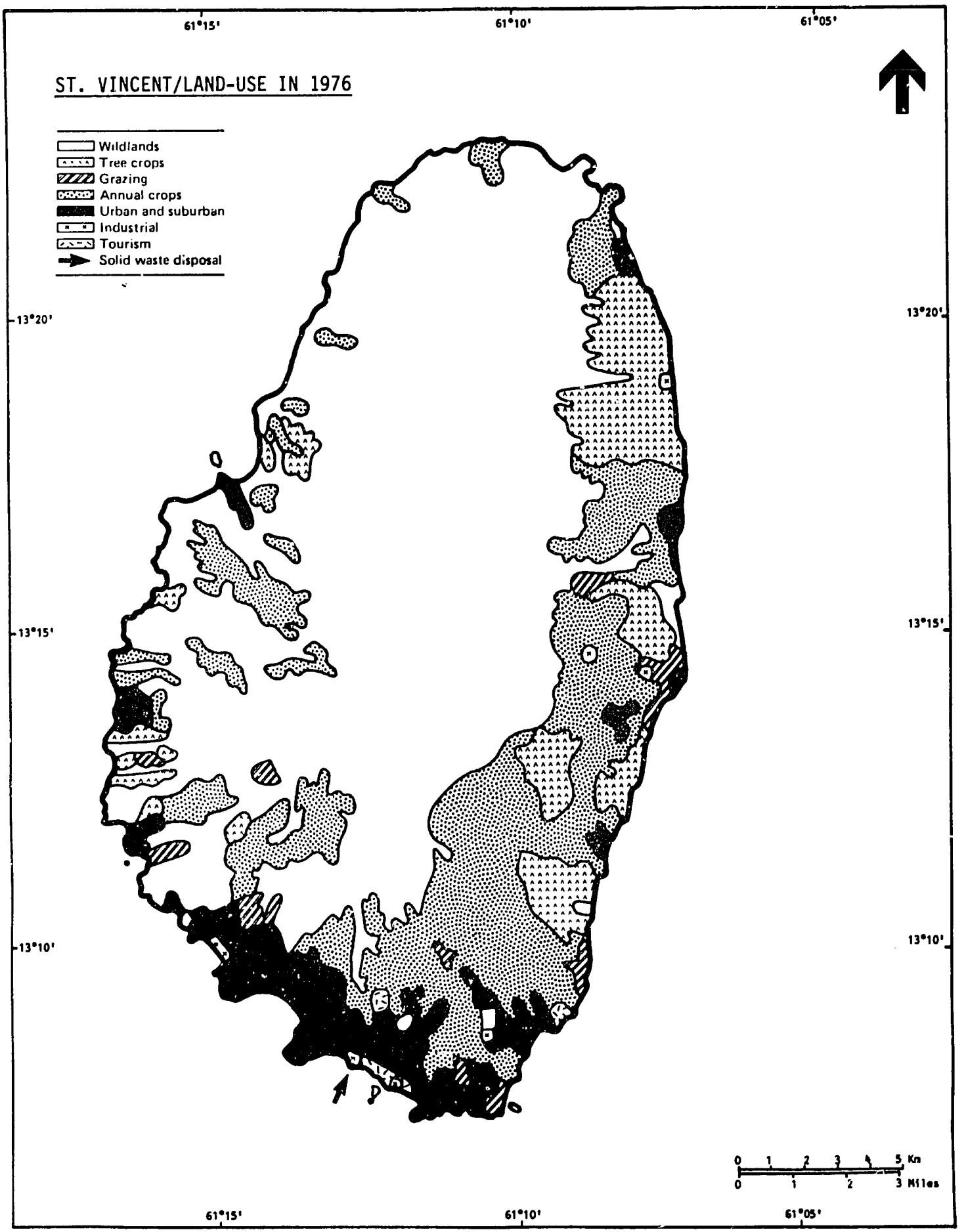


Figure 9.1(1). St. Vincent land use in 1976, as identified in the 1976 St. Vincent National Development Plan (source: UNDP, 1976).

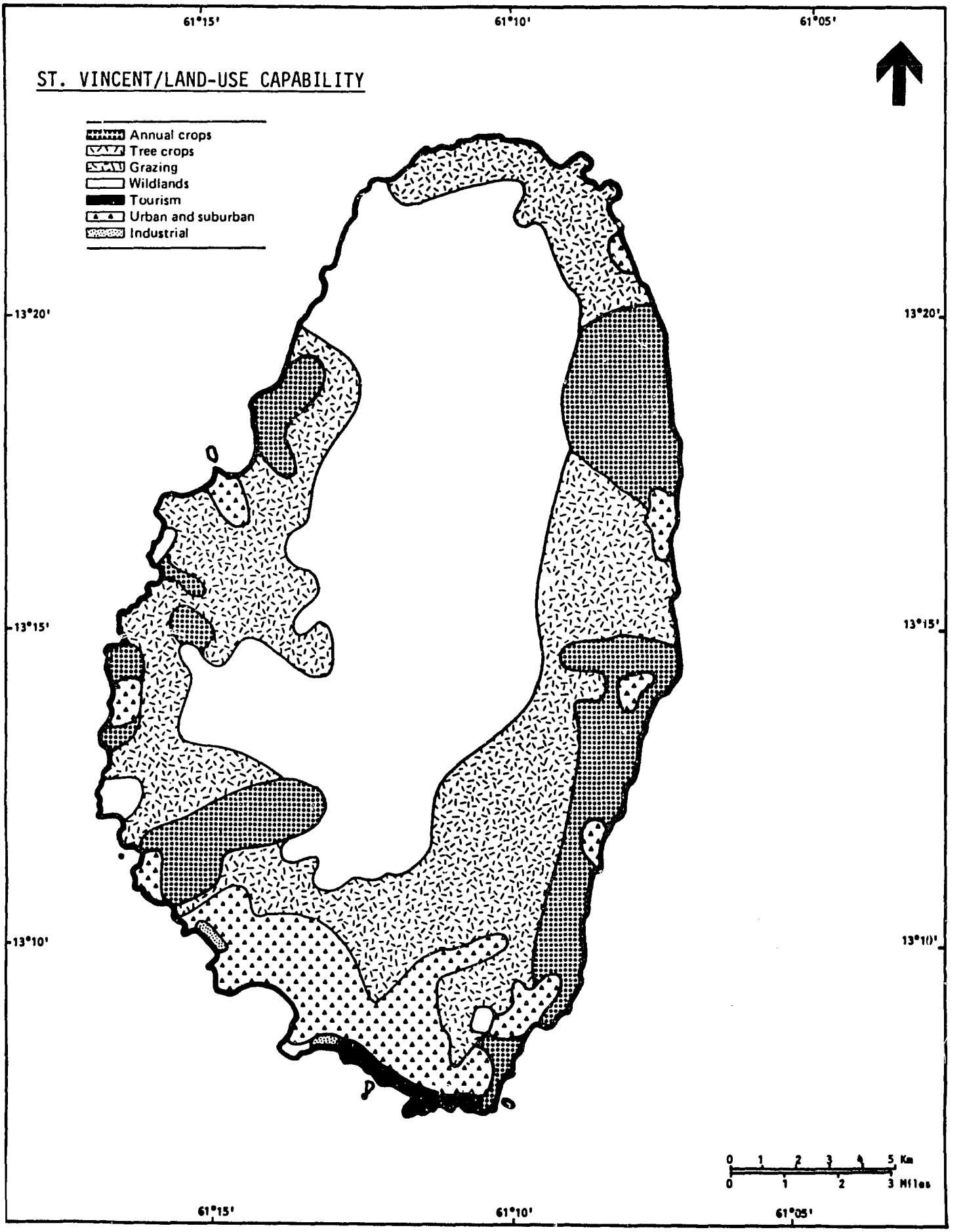


Figure 9.1(2). St. Vincent land use capability, as identified in the 1976 St. Vincent National Development Plan (source: UNDP, 1976).

fied as a fundamental agricultural constraint, SNAP studiously avoided addressing this problem, recommending instead that Government should appoint a committee to study the situation and propose a "limited land reform program". SNAP was hastily prepared with little input or cooperation from other ministries and very little involvement by farmers or the public. Although accepted by GSVG, it was never seriously implemented or updated (Browne, 1985).

In addition to the 1972 National Tourism Development Strategy discussed above, other physical development planning efforts have been specifically carried out for the Grenadines, including plans for Mustique, Prune (Palm) Island and Petit St. Vincent, instituted by the private companies to which these islands have been leased. The OAS Action Plan for Tourism Development in the Grenadines (Jackson, *et al.*, 1986) also included many recommendations for physical development policies and projects.

A Central Planning Unit was established in 1978; initially its main responsibilities were the coordination of donor agency projects and the development and monitoring of public sector projects. With the more recent emphasis on medium-term rather than annual planning, its scope has been considerably expanded, and it has been renamed the Central Planning Division (CPD). The CPD now comprises four units: physical planning, economic planning, manpower planning, and statistics; at one time the Division included an energy unit, but this has been eliminated.

During 1984 the CPD embarked on a major project -- the preparation of a National Development Plan for the three-year period 1986-1988, in the format of a "rolling plan" which would be updated yearly. Because the CPD's institutional capabilities precluded completion of the entire plan by in-house staff, a number of donor agencies (UNDP, IARM, OECS, OAS) provided assistance for writing the plan and also for strengthening the institutional capabilities of the CPD. This document (GSVG, 1986b) is currently the official policy statement guiding development in St. Vincent and the Grenadines. Work on the plan began in 1985, Cabinet approved the final draft in July 1986, and the final document was published in March 1987. The first update for the period 1987-1989 (GSVG, 1987) was prepared and published by CPD in-house, with the assistance of UNDP. A second update, covering 1988-1990 was drafted in 1988, but it has never been released. Work will begin in 1990 on a new overall plan, covering the five-year period 1991-1994.

The Planning and Priorities Committee (PPC), chaired by the Prime Minister (who is also the Minister of Finance, Planning and Development), oversees the National Development Plan and all aspects of planning. It includes the technical and administrative heads of the Ministry of Agriculture, Industry and Labor and the Ministry of Communications and Works, as well as the Director and Deputy Director of the Ministry of Finance, Planning and Development. The CPD functions as the secretariat to the Committee.

The PPC has decided that sectorial planning units will be established in the near future within each of the key ministries responsible for implementation of the Development Plan. These units will receive information on overall development strategies from the CPD, and they will then be responsible for the preparation of sectorial plans, for project development, management and monitoring, and for coordination of external technical assistance. The first of these planning units will be established within the Ministries of Agriculture and Communications and Works.

DEVELOPMENT CONTROL

The Physical Planning and Development Board (PPDB) has authority, under the Town and Country Planning Act of 1976, to regulate all private sector developments by requiring advance approval of development permits. "Physical Planning and Development Guidelines," which provide general criteria and requirements for permit applications, have been prepared by the Central Planning Division, but these have not been legally adopted. Government projects and agricul-

tural land use changes are excluded from the permitting process.

The PPDB, which meets monthly to consider permit applications, theoretically acts as an inter-ministerial coordinating body for development control. Its membership comprises the Director of Planning (who is the *ex officio* Secretary of the Board); the Manager of the Development Corporation; the Chief Engineer of the Ministry of Communications and Works; the Chief Agricultural Officer and the Chief Surveyor of the Ministry of Agriculture, Industry and Labor; the Public Health Superintendent of the Ministry of Health and the Environment; the General Manager of the Housing and Land Development Corporation; the Manager of the Central Water and Sewerage Authority; and three appointed members not in public service.

The PPDB has the authority to require the owner or occupier of land to preserve trees in order to provide amenities, conserve soil and water, or for any other public purpose. Under the 1983 amendment to the Act, fines for violations may be imposed; a form of temporary injunction, under which any act that could constitute an offense must be ceased during the appeal process, is also authorized.

9.1.2 Problems and Issues

PLANNING, ECONOMICS AND THE ENVIRONMENT

The focus of the 1986 National Development Plan was firmly fixed on "economic development" as this terminology has been traditionally (and narrowly) defined. Environmental concerns received short shrift in the Plan; even the latest available Plan Update (1987) contains only the barest passing mention of environmental issues (in relation to water supply, sewerage, solid waste disposal, tourism and forestry). This is in contrast to earlier plans such as the National Tourism Development Strategy and the UNDP Development Strategy, which had a stronger environmental orientation but were undoubtedly weaker in terms of fiscal and economic policy.

The Prime Minister recently proclaimed the 1990's to be a national "Decade of the Environment", reorganized the Ministry of Health into the Ministry of Health *and* the Environment, and established a National Environmental Protection Task Force to recommend environmental policy. If these changes are to have tangible impacts, however, it is clear that the forthcoming National Development Plan (1991-1994) will have to lay much greater emphasis on funding for environmental protection and restoration projects in general. The environmental responsibilities and institutional relationships of all GSVG agencies, particularly the Ministry of Health and the Environment, must be clearly spelled out (see also Section 10). Beyond this, it will be necessary to make some very fundamental changes in the country's approach to national development planning, since *the most important condition for sustainable development is that environmental concerns and economics should be as closely linked in decision-making as they are in the real world* (Macneil, 1989; see also Section 1.3.2).

COORDINATION OF PROJECT PLANNING AND HARMONIZATION OF LEGISLATION

Lack of coordination among Government ministries and agencies in their planning and development control activities is a serious problem. Today the sectorial plans prepared by donor agencies tend to take an *integrated* approach to development; i.e., they attempt to guide development so that activities in each sector will support those in other sectors, or at least will conflict with them as little as possible. In several instances where supposedly "integrated" development projects have been planned by international agencies, GSVG has subsequently followed a piecemeal approach to implementation, which is the very antithesis of an integrated development scheme. This leads to difficulties in avoiding or mitigating even perfectly predictable and obvious environmental and socio-economic impacts or to a failure to link mutually beneficial sectorial programs.

The Government of St. Vincent and the Grenadines, with assistance from an OAS legal consultant, is presently engaged in a review of legislation in the areas of town and country planning, crown lands, forestry, fisheries, beach protection, national parks, public health, and water resource management. The intention is to harmonize these Acts and ensure that GSVG has sufficient enforcement authority in the area of natural resource protection (see also Section 10).

NEED FOR CURRENT CADASTRAL AND LAND-USE INFORMATION

Even with improved, more integrative legislation, GSVG agencies will continue to be seriously hampered in fulfilling environmental management mandates by a lack of basic information on the location, ownership and condition of the country's natural resource base. An up-to-date cadastral map and data base do not exist for St. Vincent and the Grenadines, making planning and development control more difficult because it is often not clear which parcels belong to whom. Although there is an official Lands and Surveys Office, several Government agencies employ their own surveyors, and apparently neither the public nor private sectors are required to register new land surveys and subdivisions. Preparation of an updated cadastral map would be a very difficult and time-consuming task, albeit an essential one; it would undoubtedly require financial assistance and technical support from a donor agency.

The Town and Country Planning Act of 1976 charges the PPDB with the preparation, implementation and constant review of national, regional and local land use plans. Such plans were intended to provide the basis for rational decision-making by the Board in matters pertaining to development control; yet none have been prepared (with the exception of the 1976 UNDP plan, which was not accepted by Cabinet).

There is an immediate need to prepare a current land use map for St. Vincent and the Grenadines. The most recent land use maps now available were compiled in 1976 for the UNDP development planning project. Figure 9.1(1), which is based on the UNDP maps, shows a generalized picture of the major types of land uses in St. Vincent at that time, and Figure 9.1(2) shows land capability. Table 9.1(1) displays the land area in three major land use classes -- agriculture, forest, and urban -- as of 1984, and Table 9.1(2) provides a breakdown of land use and tenure for 1979/1980. The UNDP maps need to be updated by using data from the new aerial photography and surveys of forest reserves, watersheds and crown lands to be carried out by the CIDA Forestry Project in the near future. Much of the information from the existing land use maps (e.g., slopes, soils, land capability) would still be relevant and can be utilized in the preparation of the new maps.

DEVELOPMENT CONTROL

A new planning law with substantive regulations has been drafted by an OAS consultant and submitted to the Attorney General for review (pers. comm., W. McCalla, OAS consultant, June 1990; see also Section 10 of the CEP). Until recently, when a set of physical planning guidelines was administratively adopted by the PPDB, each development was considered on an *ad hoc* discretionary basis. These guidelines now provide information regarding format and content for development applications as well as general standards for plot cover, parking capacity, setbacks from roads and property lines, sewage disposal, and building construction requirements.

Even though GSVG has promulgated many good policies on the conservation and wise use of the physical and biological environment, the lack of legally enforceable environmental standards and regulations makes it difficult to implement them and ensures that *ad hoc* land use decisions will continue to be made. No specific slope standards aimed at erosion control for construction, logging, or road building activities appear to exist. Deforestation and consequent soil erosion (due to agriculture, forestry, fuelwood cutting, road building and construction activities on steep slopes and unsuitable soils) are problems which will become increasingly severe as the

Table 9.1(1). Area by land classes, St. Vincent, 1984.

Land Class	Acres	Percent
Agricultural Land		
Arable lands, cultivated	25,930	30.9
Arable lands, fallow	2,070	2.5
Subtotal, arable lands	28,000	33.4
Pasture (cultivated and uncultivated)	6,000	7.2
Total area, agricultural lands	34,000	40.6
Forest Lands		
Timberlands	22,100	26.3
Other forest lands	9,910	11.8
Subtotal, stocked forest lands	32,010	38.1
Non-stocked forest lands*	6,800	8.1
Total area, forest lands	38,810	46.2
Urban and Non-Cultivable Lands		
Urban areas and roads	8,000	9.5
Non-cultivable and meadows	3,000	3.6
Total, urban and non-cultivable	11,000	13.1
TOTAL LAND AREA**	83,810	100.0

* Land deforested due to natural disturbance and currently not in non-forest use.
** Total land area falls about 1,200 acres short of St. Vincent's total land area of 133 square miles.

Source: cited in Prins, 1986b.

country develops. A coastal setback of at least 150 feet from the high water mark has been recommended by many consultants due to increasing problems of coastal erosion in the country. However, a setback is not specifically recommended in the development guidelines or required by any law.

There is at present no legal requirement for formal environmental impact assessments, even for major projects. There is also a lack of sufficient capability within CPD to properly evaluate the environmental impacts of proposed major projects or to specify appropriate control measures.

Table 9.1(2). Area of St. Vincent by land use/land tenure, 1980.

Land Category	Area (ha)
Crown lands	16,475
New land settlement	2,448
Old land settlement	2,335
Peasant holdings	4,698
Large estates	8,223
Towns/villages	465
TOTAL	34,179

Source: Talbot, 1983.

There is a need to establish an efficient information management system within CPD for tracking and spatial correlation of developments and land use changes, environmental data, and cadastral information. Much useful information on setting up an appropriate system for small Caribbean islands, with options for eventual computerization, may be found in Potter, *et al.* (1988) and Island Resources Foundation (1989).

It is not entirely clear whether either the Department of Agriculture or the PPDB has authority to regulate developments (e.g., marinas) below the tide marks in coastal areas, but this is a question that will need to be resolved. The Department of Agriculture has been assigned the task of implementing the Beach Protection Act and is considering setting up a coastal zone management unit, primarily to control beach mining. However, the implications of coastal zone management are much broader than this; on small islands the entire land mass as well as the nearshore waters are part of a single ecological unit.

The PPDB now deals mainly with regulation of urban and industrial development activities. Although it appears to have the authority as well as the legal mandate to do so, the Board does not generally exercise its powers in regard to natural resource management and land use planning. In ecological terms the appropriate planning unit on small islands is the coastal ecosystem, which may be defined as including an upland watershed, the coastline and the nearshore waters enclosed within a bay. Since erosion or pollution in any watershed will inevitably have an impact on coastal areas, any successful land use management program must include protection of all the critical components -- forests, soils and watercourses in the upland watersheds; mangrove swamps and beaches in the coastal areas; water quality, seagrass beds and coral reefs in the nearshore waters.

An effort is being made by the Ministry of Agriculture, the CIDA Forestry Project, and the Attorney General's Office to build watershed management requirements into various ongoing projects and revisions of legislation relating to the management of public lands. However, overall planning approaches should move beyond these efforts to provide for an integration of watershed land use management into the entire planning and development control process for both the public and private sectors.

Just such an integrated watershed management system has already been proposed to GSVG in an excellent report by an OAS consultant (Prins, 1986b), but it has never been implemented. The major components still lacking are:

(a) town and country planning legislation which specifically recognizes the watershed/coastal ecosystem as the basic unit for land use planning and management; and

(b) a workable watershed management system which would essentially consist of some institutionalized mechanism for coordination among the agencies involved in resource management, planning and development control and the involvement of appropriate private sector interests (especially small farmers).

The pivotal agencies and groups which must be involved in setting up a watershed management system include: the Physical Planning Unit; the Soil and Water Conservation Unit; the Forestry Division; the Agriculture Department; the (proposed) Coastal Zone Management Unit; Engineers from the Public Works Division, VINLEC, and the Central Water and Sewerage Authority; technical representatives from the Ministry of Health and the Environment, the Agricultural Rehabilitation and Development Program, farmers' associations and cooperatives, and community development groups. Since this list includes many agencies already represented on the PPDB, perhaps what is needed is a "watershed technical advisory group" which could be formed from the above-cited agencies to provide input to the PPDB (see also Section 3.3 of the Profile).

9.2 PARKS AND OTHER PROTECTED AREAS

9.2.1 Overview

There is some interest within GSVG at this time to create a system of national parks and protected areas. Provisions for the designation of national parks had originally been included with the new draft forestry legislation which is currently under review by Cabinet; however, an administrative decision was recently made to draft a separate bill for national parks. Such a bill is currently being drafted with assistance from an OAS legal consultant (pers. comm., W. McCalla, OAS consultant, April 1990); see also Section 10.

NATURAL AREAS

The existing and proposed protected areas in St. Vincent and the Grenadines (Figure 9.2(1)) consist of various water catchments, forest reserves, wildlife reserves, and marine conservation areas as also discussed in Sections 2, 4, and 5 of the CEP. There is a designated marine national park for Mayreau and the Tobago Cays for which legislation has been drafted. The OAS has also prepared a feasibility study for the area, including an economic analysis and management recommendations (Heyman, *et al.*, 1988), but this park plan has yet to be implemented. The same site was designated as a marine reserve under the 1986/87 Fisheries Act and Regulations. The Soufriere volcano (Llewelyn-Davies, *et al.*, 1972) and most of the eastern side of Canouan (Jackson, *et al.*, 1986) have also been recommended as national park sites, but no further action has been taken and no management plans have been prepared for either area.

HISTORICAL, ARCHAEOLOGICAL AND CULTURAL SITES

While St. Vincent has a National Trust which dates to the late 1960's, this quasi-governmental body had until very recently been inactive, and the country lacked a strong unifying force for historical resource protection. Within Government, the relatively new Department of Culture has promulgated a "Cultural Policy" for the country, whose objectives overlap somewhat with those stated in the Trust's authorizing legislation. However, as the Department's staff is limited to one Cultural Officer, its effectiveness is considerably diminished.

Historical Resource Surveys. The recently reactivated National Trust (see also Section 10) has set as an immediate priority the establishment of a National Registry to include historic sites, natural features, and cultural objects worthy of protection as part of

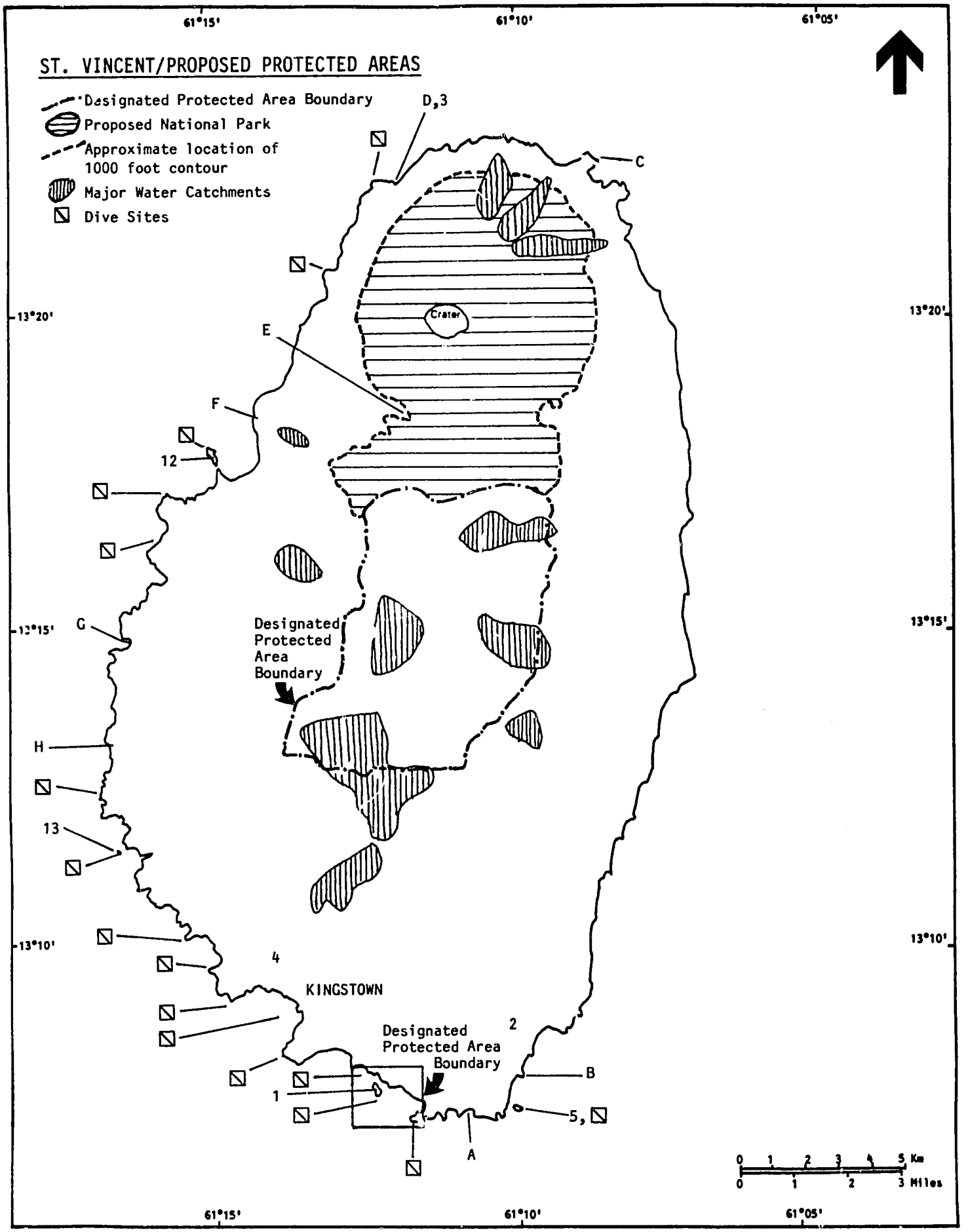


Figure 9.2(1a). Location of designated or proposed protected areas in St. Vincent. Numbers refer to Table 9.2(1), letters to Table 9.2(2).

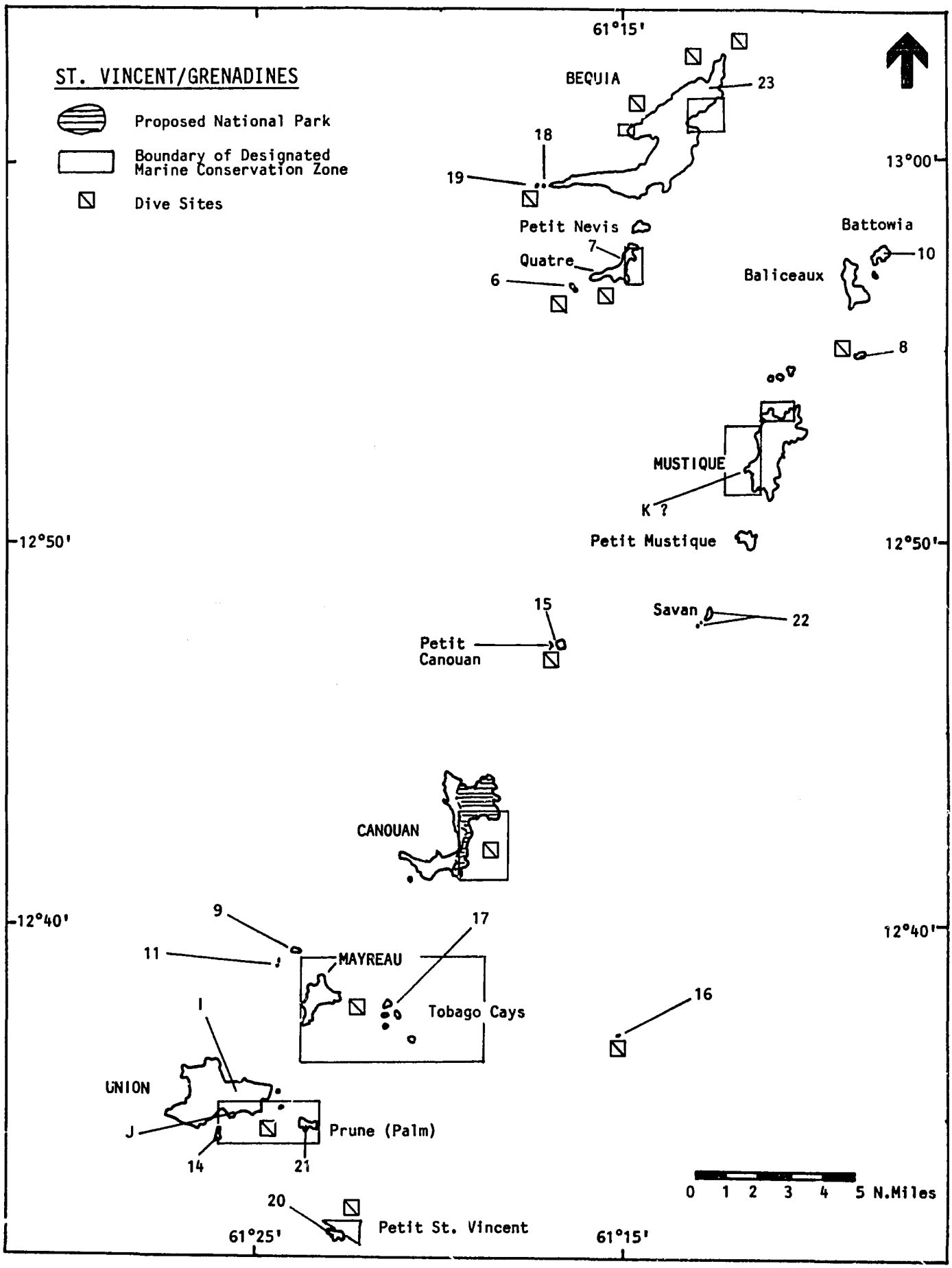


Figure 9.2(1b). Location of designated or proposed protected areas in the Grenadines. Numbers refer to Table 9.2(1), letters to Table 9.2(2).

Table 9.2(1). Designated wildlife reserves as per the 1987 Wildlife Protection Act, St. Vincent and the Grenadines.

	Name of Reserve	Reserve Area
1.	Young Island	Entire island
2.	King's Hill	Boundaries set by Chief Wildlife Officer
3.	Falls of Baleine	Boundaries set by Chief Wildlife Officer
4.	Govt. House Grounds	Including Botanical Gardens
5.	Milligan Cay	Entire island
6.	Pigeon (Ramier) Island	Entire island
7.	Isle de Quatre	Entire island
8.	All Awash Island	Entire island
9.	Catholic Island	Entire island
10.	Battowia Island	Entire island
11.	Catholic Rocks	Entire island
12.	Chateaubelair Islet	Entire island
13.	La Paz Island	Entire island
14.	Frigate Rock (Island?)	Entire island
15.	Petit Canouan	Entire island
16.	Sail Rock	Entire island
17.	Tobago Cays	Entire island group
18.	Big Cay	Entire island
19.	West Cay	Entire island
20.	Petit St. Vincent	Entire island
21.	Prune (Palm) Island	Entire island
22.	Savan Islands	Entire island group
23.	Northern end of Bequia	Beyond "Industry Point"

Sources: Wildlife Protection Act, No. 16, 1987; Butler, 1988.

the national patrimony. A first step was the completion in 1990 of a UNESCO-funded project to inventory national archaeological and historical places. The project report provides a listing of military installations and sugar mill sites (by parish) and a list of historic buildings which have appeared, since 1985, as feature articles in a local press series on historic places. There is also an inventory of historical books, maps, photographs and paintings found in public and private collections on the island. However, no natural areas or archaeological sites have yet been included in the inventory. Other tasks remaining include more specificity as to site location, present condition and use (this type of information is only included by referral to the articles on historic buildings appearing in *The Vincentian*); equally important is the need to evaluate, prioritize and rank sites.

An earlier, very preliminary inventory of historic sites in St. Vincent was carried out by the Trust as part of an American Revolution Bicentennial Project sponsored by the Caribbean Conservation Association and Island Resources Foundation in 1976 (Towle, 1978). A uniform reporting methodology was used for all sites surveyed in St. Vincent and other Caribbean countries. The most comprehensive historical resource survey to date was undertaken on behalf of the now inactive Archaeological and Historical Society and focuses almost exclusively on the sugar mills

Table 9.2(2). Proposed forest reserves/wildlife reserves and recreation areas identified by CIDA Forestry Project.

A. Milikin Bay Forest Reserve/Wildlife Reserve
B. Diamond River Wildlife Reserve
C. Salt Pond Recreation Area
D. Falls of Baleine Recreation Area
E. Wallibou Falls Recreation Area
F. Richmond Beach Recreation Area
G. Wallilabou Falls Recreation Area
H. Mount Wynne Beach Recreation Area
I. Richmond Bay Mangroves/Belmont Bay Salt Pond Forest Reserve/Wildlife Reserve
J. Lagoon Swamp Forest Reserve/Wildlife Reserve
K. Lagoon Bay Salt Pond Forest Reserve/Wildlife Reserve

Source: CIDA Forestry Project Personnel.

of St. Vincent (Kirby, 1973). This publication includes a site-by-site, parish-by-parish brief locational description of extant mills and their remains. Many of these surviving ruins are neglected or abandoned and often can only be viewed at a distance or are inaccessible because of the overgrown terrain.

Military Sites. The most important military site on the island is that of Fort Charlotte, located on the western ridge above Kingstown Harbor. The fort is primarily of local rather than regional importance; nonetheless, it was once a formidable complex of batteries, barracks, moats, powder magazines, draw-bridges and outworks, built some 600 feet above the sea in the closing years of the eighteenth century. It was to have been the chief defence of the island, but the Black Caribs (a mixed group of Carib Indians and runaway African slaves) had been subdued and their French supporters had withdrawn before the fort was completed in 1806. The citadel continues to provide a matchless view of the capital city and its harbor, of the volcanic vertebrae of the island, of the placid leeward coast, and -- to the south -- of the jewel-like Grenadines, from Bequia to neighboring Grenada.

Fort Charlotte is public property, and the Government has given its approval to vest ownership of the site in the St. Vincent National Trust, although it has not yet officially done so. The site is open to the public, but no visitor records are kept, there is no entrance fee, no interpretation, and no sales items. Part of the fort is presently used as a prison facility, and the Port Authority maintains a signal tower.

At its annual general meeting in 1989, the reactivated National Trust set as one of its priorities the establishment of a national museum, possibly at Fort Charlotte. The site has long been under consideration by the Trust for utilization as an office and headquarters (these functions are now centralized in Kingstown) or as a national museum. Restoration and landscaping continue as Government funds are available; the Trust's expenditure budget does not provide for these activities, although it has sought and continues to seek external funding for such assistance.

A development planning study for Fort Charlotte was recently carried out by Arthur Young International for the Caribbean Conservation Association with CDB funding. It was part of a larger regional effort to assess

development strategies for historic monuments in the Eastern Caribbean. In St. Vincent, the study recommends that the entire peninsula incorporating the Fort should be designated as a national park. Furthermore, since the site has tourism potential, the report states boundaries need to be clearly defined, the prison facilities should be transferred to another location, and strict planning controls on future development need to be introduced. The report concludes that Fort Charlotte should be vested in the Trust which could administer and manage the site (Arthur Young, 1989). The Young document does not provide detailed development plans, nor has funding been identified to assist with more comprehensive planning or with restoration/adaptive use activities at the fort.

A second military site, Fort Duvernette, was also selected by the Arthur Young consulting team for potential tourism development. Lying some three miles southeast of Kingstown, the fort is situated on a bare, precipitous rock about 100 yards from Young Island, which is itself some 300 yards from the main island. Built about 1800, this site defended Calliaqua Harbor, then an important anchorage, and also the approaches to the capital of Kingstown. The massive rock on which the fort stands is some 196 feet above sea level. Government has also approved the vesting of Fort Duvernette in the National Trust, but official action has not yet been taken.

In addition to Fort Charlotte and Fort Duvernette, the National Trust's recent report on national archaeological and historical resources (St. Vincent National Trust, 1990) lists over 30 military installations, most of which are difficult to impossible to visit because of vegetation over-growth or distance from the town area.

Architectural Features. Fine examples of vernacular architecture can still be found in the island's capital of Kingstown, which is laid out on a grid pattern with three main streets running parallel to the harbor and intersecting secondary streets leading toward the surrounding hills. Although suburbs have grown around the town, its original center can still be clearly identified. Because development pressures have not been as great in St. Vincent as elsewhere in the Caribbean, the architectural integrity of Kingstown has been substantially retained, including features which are distinctively French (despite the fact that the French occupied the island for only four years). Regrettably, some of the best examples of arched arcaded buildings were destroyed in fires as recently as 1989, while intrusions of incompatible structures continue to threaten the architectural and historical character of the town.

A tourism development plan in the early 1970's (Llewelyn-Davies, *et al.*, 1972) strongly recommended that consideration be given to the renovation of historic towns as part of the island's overall tourism planning. Areas noted, in addition to Kingstown, were Calliaqua, Layou, Barrouallie, Chateaubelair, Georgetown, and Port Elizabeth, all said to possess considerable historic interest and charm which, collectively, create a sense of place and identity. The report also recommended that a list of historic buildings should be established (under the Development Control Authority) and that such buildings should be "safeguarded from destruction," that tax incentive and low interest loans should be made available for restoration of historic buildings, and that community development groups should be encouraged to participate in renovation plans. Little has been accomplished since then to promote the establishment of "urban historic districts" or to protect historic buildings in general. Consideration could still be given to development of an "historic district" conservation and restoration policy, but it must be done before the island's unique architectural character becomes too fragmented by new development.

Museums. The country's only museum is the Archaeology Museum operated by the National Trust from the old Agricultural Officer's building in the 225 year old Botanic Gardens just outside of Kingstown. Government provides a small annual subvention for the Museum, whose volunteer curator is also the Chairman of the National Trust and a regionally recognized archaeologist responsible for putting together the impressive collection housed at the Museum. At present, the building in the Botanic Gardens incorporates

display functions, with relatively limited interpretation, as well as research and storage functions. Space is inadequate for all of these activities in the present structure.

Over time, there has been considerable discussion by Government and the National Trust concerning expansion of the present museum facility and development of additional sites. Options include: improvement of the present museum to add collections other than archaeology (for example, natural history exhibits which would be appropriate in the present or an upgraded Botanic Gardens), development of Fort Charlotte as a National Museum or, alternatively, development of the fort as a military museum, and establishment of a National Museum in a yet-to-be-identified town location.

9.2.2 Problems and Issues

NEED FOR A PARKS AND PROTECTED AREAS PLAN

With the exception of the approved but not implemented Tobago Cays National Park, there have been no management plans written for any protected area. In addition to plans for the management of other specific sites, the country needs a comprehensive and integrated parks and protected areas plan which evaluates all presently designated protected areas, deleting (at least for the present time) those that may be of minimal value and adding other areas which are not presently protected. Figure 9.2(1) displays the distribution of existing and proposed protected natural areas in the nation; the National Trust is in the process of preparing a location map of extant historical, archaeological and cultural sites, but it has not yet been completed. Outstanding sites which are not presently designated as protected areas include many marine sites known for their importance to the dive tourism industry (see Figure 9.2(1)), the proposed Soufriere Volcano national park on St. Vincent (Llewellyn-Davies, 1972; see Figure 9.2(2)), and sites on Canouan and Union Island (Jackson, *et al.*, 1986; see Figures 9.2(3) and 9.2(4)).

NATURAL AREAS

The nation's existing "protected natural areas" are a disparate collection of water catchments, wildlife reserves, forest reserves, and marine conservation areas, under the control of the Central Water and Sewerage Authority, the Forestry Division and the Fisheries Division. These areas were created in an *ad hoc* manner over the years without any overall plan; at present none of them enjoy any real protection. Enforcement in all cases is hampered by the lack of sufficient manpower in designated agencies and by the fact that forest guards and fisheries officers do not have powers of arrest. Some declared "wildlife reserves" (Mustique, Palm Island, Petit St. Vincent) are actually developed tourist resort islands with greatly altered habitats and continuous human disturbance; the value to wildlife of such reserves is not documented.

Some of the best areas for diving along St. Vincent's coasts are found at Old Woman's Point off Fort Charlotte, Questelles Point, La Paz Rock, Milligan Cay, Cane Garden Point, Ottley Hall and Lowman's Point (pers. comm., V. and W. Schoen, S. Halbich and W. Tewes, April 1990; all are members of the National Trust and involved in local watersports industries).

Clearly it would be in the best interests of GSVG to take special precautions to protect these and other dive sites, if only for the reason that St. Vincent and the Grenadines is promoted by the Tourism Department as a SCUBA diving destination. Questelles Point, which some rate as one of the best "wall" dives in the area, is in great danger of degradation from pollution originating from the industrial park at Campden Park Bay, and the Fort Charlotte dive site is threatened by effluent from the municipal sewer outfall. The Lowman's Point dive site is threatened by run-off and sedimentation from the new Government quarry operation at Lowman's Estate, and Cane Garden Point is under threat from rapidly expanding residential development on the Point. There is a proposal for a large-scale hotel development at Ottley Hall which could adversely affect the

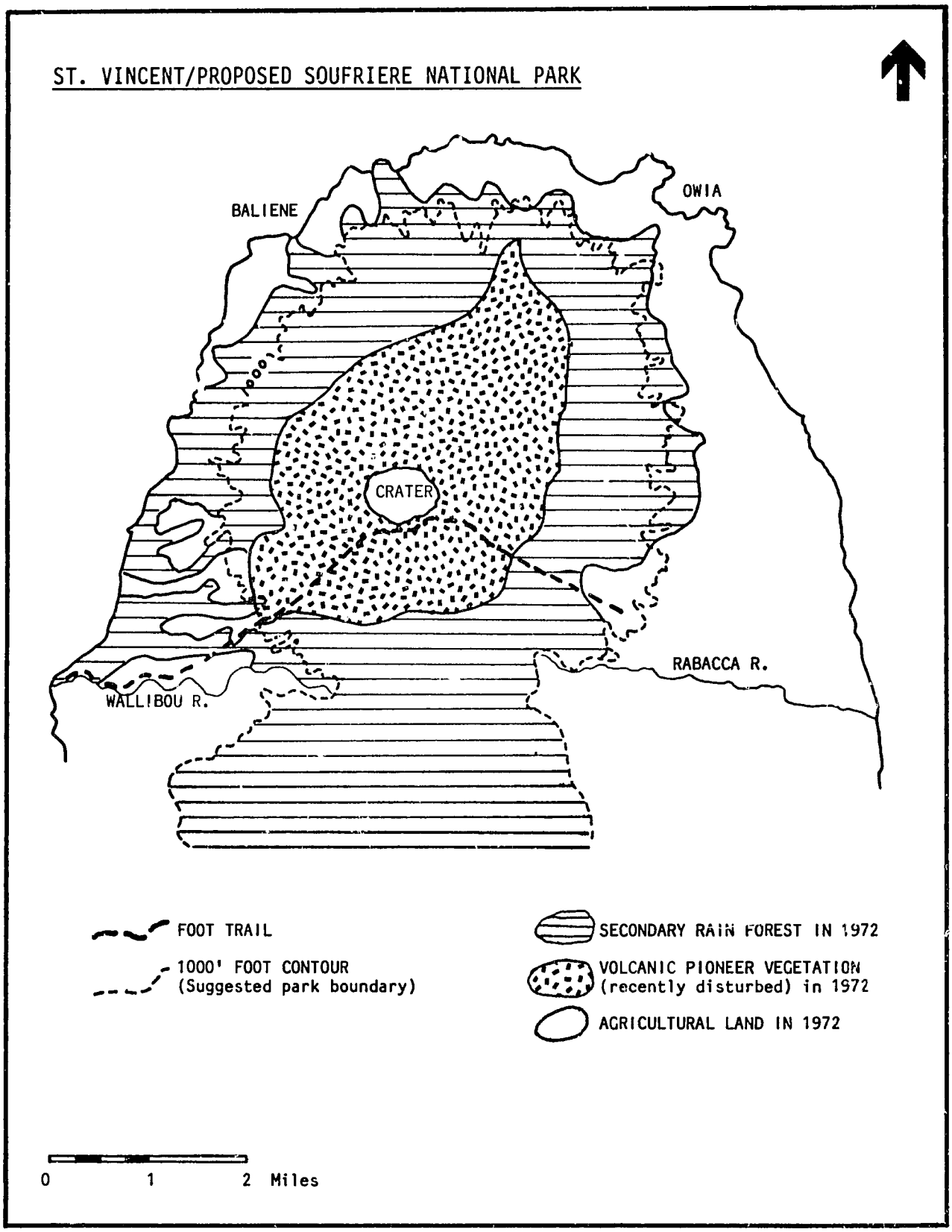


Figure 9.2(2). Proposed Soufriere National Park, St. Vincent (source: adapted from Llewelyn-Davies, 1972).

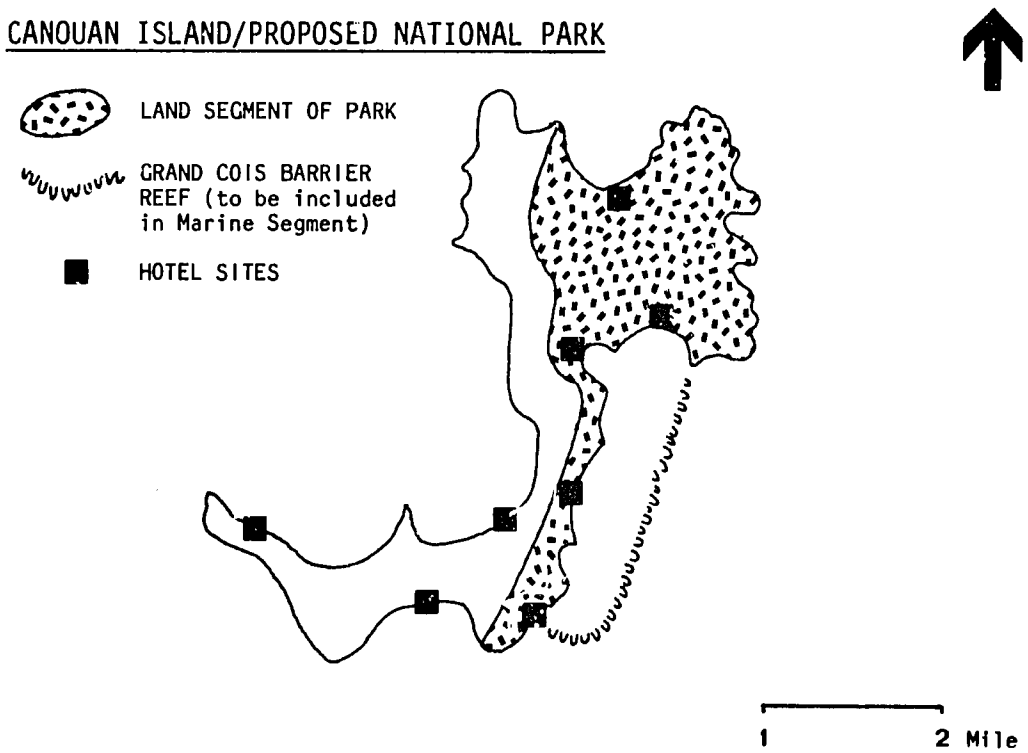


Figure 9.2(3). Proposed Canouan National Park (source: Jackson, *et al.*, 1986).

dive site unless proper precautions are taken. There has already been extensive damage to reefs at Young Island, Calliaqua and Indian Bay.

HISTORICAL, ARCHAEOLOGICAL AND CULTURAL SITES

GSVG has approved vesting of the following properties in the National Trust (SVG Nat'l. Trust, 1989), although official transfer has only been recorded for those sites indicated with an asterisk:

- Fort Charlotte
- Fort at St. Cloud
- Fort Duvernette *
- Fort at Owia
- Fort at Hamilton, Bequia
- Fort at Lookout Point, Union Island
- West Cay/Big Cay *
- Frigate Island [Rock], Grenadines *
- Red Island, Grenadines *
- L'Islot, Grenadines *
- Mong Rouge Islet, Union Island
- Archaeological Museum Building, Botanic Gardens *.

In 1976 new legislation (Act for the Preservation of Historic Buildings and Antiquities) was enacted including procedures which potentially could protect all historic structures and sites, not simply those acquired by the National Trust. Compilation of an official listing of historic buildings is called for, which may be changed from time to time, and provision is made for the acquisition of property on the list, with or without the agreement of the owner. Permission must be obtained by private owners for the further development of listed buildings, and penalties are prescribed

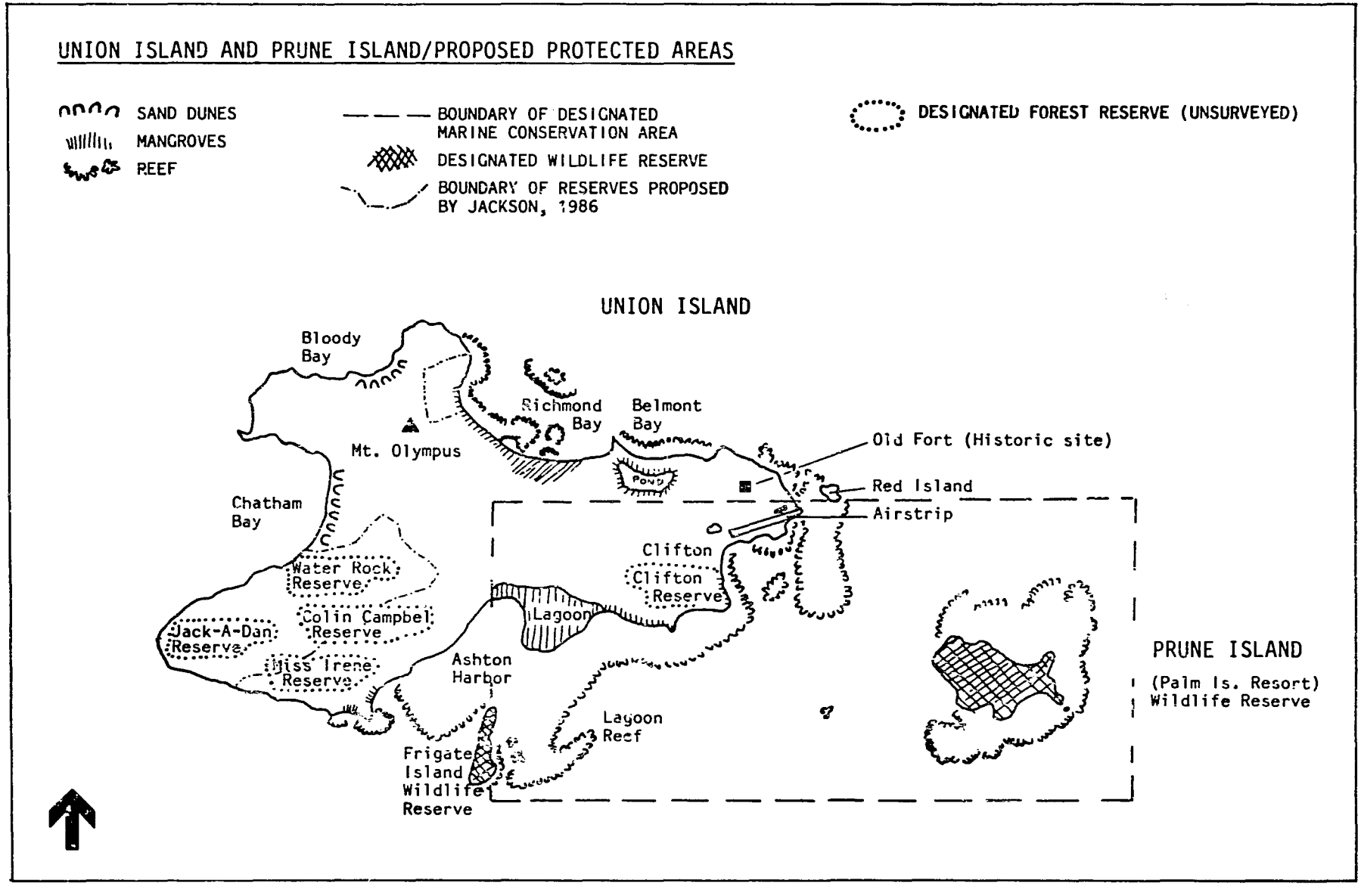


Figure 9.2(4). Designated or proposed protected areas in Union Island and Prune Island (source: Jackson, *et al.*, 1986).

for violations. The exportation of antiquities without proper licenses is also dealt with. There is little evidence this law has been implemented or enforced; the legislation falls under control of the Ministry of Trade and Tourism (pers. comm., W. McCalla, OAS consultant, June 1990).

The Department of Culture (Ministry of Justice, Information and Culture) has developed a national "Cultural Policy" which includes as an objective the preservation and conservation of cultural heritage. Sub-components of this objective define activities similar to those falling under the mandate of the National Trust (e.g., development of museums, acquisition and restoration of historic buildings, acquisition of historical documents and artifacts). However, to date, it does not appear the Trust and the Culture Department have developed strong lines of coordination or even communication, although in 1987 the incumbent Cultural Officer stated his department preferred to cooperate with the Trust in the development of proposals to external agencies and in the establishment of a national museum (Towle, *et al.*, 1987).

The activities of the Department of Culture are presently limited to one staff person, and the St. Vincent National Trust is in an early stage of redefining its mission and programmatic goals. Nevertheless, as each continues to develop institutionally, it will become increasingly important for coordination linkages to be initiated and for the relative roles of each to be more clearly defined and understood.

MANAGEMENT OF A PROTECTED AREAS SYSTEM

The 1969 legislation establishing the St. Vincent National Trust outlined that body's purpose as the conservation of the historical *and* natural heritage of St. Vincent and the Grenadines, defined in an early publication on the Trust to include historic buildings, pre-historic sites and stone age relics, areas of special beauty and interest with their associated flora and fauna, the reefs, shorelines and small islets of the country (Brisbane, 1970). The enabling legislation empowers the Trust to identify, document and preserve buildings, monuments and places of historic and architectural interest, including the acquisition of property and the raising of funds for the management of such property. Executive authority for the administration of the Trust is vested in a Board of Trustees which is elected at an annual general meeting.

While it is desirable to vest title of designated protected sites and property in the National Trust and to formulate long-range management policies and plans with input from this quasi-governmental body, the overall implementation of and responsibility for a parks and protected areas program for St. Vincent and the Grenadines would best be handled at the present time by appropriate GSVG agencies. However, it would be most efficient to designate a single lead agency (probably the Forestry Division) to coordinate management of the parks and protected areas system.

Management of protected areas in St. Vincent and the Grenadines would benefit from an integrated approach. For example, the Fort Charlotte historical site could be combined with a marine component to form a larger and more meaningful protected area which would protect both the leading historical monument in the country and one of its most outstanding dive sites; any project to upgrade the municipal sewerage system in Kingstown would be required to minimize impacts on this site by extending the outfall further offshore. The wildlife reserves at Milligan Cay, La Paz Rock, Sail Rock and some other offshore islets could each be combined with a marine component; the proposed Soufriere National Park could be combined with the existing Parrot Preserve into a single management unit which would also protect many important catchment areas.

A parks and protected areas plan prepared for Grenada by OAS (Government of Grenada and OAS, 1988) proposed the following management categories for protected areas, which might also be appropriate for St. Vincent and the Grenadines:

- *National Parks*: to protect outstanding natural and scenic areas of national or international importance and provide recreational, scientific and educational activities. These are relatively large areas containing a diversity of ecosystems.

- *Natural Landmarks*: to protect natural features of a unique character which are in a near-natural state. These are generally small areas rather than complete ecosystems and provide recreational activities.

- *Cultural Landmarks* (including archaeological and historical sites) *and Recreational Areas*: to protect cultural features of a unique character and to provide public access for educational and recreational uses related to the feature.

- *Forest Reserves, Wildlife Reserves and Marine Conservation Areas*: to protect upland forests, littoral mangrove and island scrub vegetation, wildlife habitats, productive fish habitats, salt ponds, dunes, beaches, seagrass beds and coral reefs which possess special aesthetic and/or ecological qualities.

- *Multiple Use Management Areas*: to manage large areas (e.g., watersheds) which are suitable for sustained production of water, wood products, wildlife, forage, and/or marine products and for soil conservation, outdoor recreation and education. Use of these areas would be primarily oriented to the support of economic activities, but special zones may be established within them for nature protection.

9.3 ENVIRONMENTAL EDUCATION

9.3.1 Overview

The Ministry of Education is in the process of a curriculum upgrade for primary schools which will include an "environmental awareness component" integrated throughout all subjects, particularly in the areas of biology, social studies and agriculture. At present, environmental education programs in primary schools are aimed at sensitizing students to their immediate surroundings (e.g., school ground landscaping, anti-litter campaigns). The environmental education goal of the curriculum upgrade effort will be to create an awareness of how environmental issues affect almost every aspect of daily life (pers. comm., S. Campbell, Deputy Chief Educ Off. and D. Rawlins, Science Organizer for Primary Schools, Min. of Education, April 1990).

The Environmental Education Committee of the St. Vincent National Trust sponsors a short but frequently presented radio show called "Naturally Yours", spotlighting local environmental issues and projects. It also sponsors a monthly environmental award program to draw attention to individuals or groups for significant environmental contributions and submits regular articles to the print media on environmental topics. In conjunction with the Environmental Protection Task Force (Ministry of Health and the Environment), the Trust also sponsors monthly public activities focused on a variety of environmental topics -- forests, rivers and streams, beaches, and so forth; one recent project involved community groups and school children in a cleanup of the North River in Kingstown.

Environmental education in SVG began with initiatives promoted by the Forestry Division in the early 1980's. These efforts were intensified in 1988 in association with the implementation of a parrot conservation and education project sponsored by the RARE Center for Tropical Bird Conservation. More recently, CIDA has included an environmental education component in its Forestry Project for St. Vincent and is carrying out a number of on-going activities:

- Presentation, upon request, of in-school programs on environmental topics.

- Production of a 30-minute children's video which has been shown on national television, with additional copies to be made available through the Ministry of Education.

- Monthly publication of *Vincie's Nature Notes*, focusing on the "issue of the month" as designated by the Task Force and Na-

tional Trust. Each month a different school is responsible for drawings in *Nature Notes*; students also submit articles. The publication, which was originated by the Forestry Division with local funding from the St. Vincent Brewery, is distributed to all schools.

An "adopt-a-tree" program in major watersheds. Under this program, now in the planning stage, children will plant trees near their villages in environmentally sensitive areas which have been cleared, often illegally.

As a tie-in with SVG's *Decade of the Environment*, a public education campaign will be implemented, including preparation of radio spots, a watershed protection poster and a bumper sticker.

Two to three day teacher training workshops in the summer, targeting teachers from major watersheds and the Grenadines, to prepare them for teaching environmental education.

Distributing "What's Wrong/What's Right" puzzle posters to all schools (a cooperative effort with the Environmental Protection Task Force and the National Trust). These address four areas of activity (urban, forest, agricultural, marine) and depict people doing 25 things harmful to the environment; then another picture shows how those 25 wrongs can be made right.

The CIDA Forestry Project recently acquired Can$25,000 worth of video and audio equipment to expand in-house capabilities for video production. Once films are produced, they will be distributed to schools and interested organizations. Additionally, a volunteer specialist with the CIDA project is working with the Ministry of Education's Curriculum Development Director on the environmental education component of the school curriculum.

CIDA has also provided funds (although not through its Forestry Project) for a Vincentian to be trained in Canada as a full-time environmental education specialist, to be attached to the Forestry Division at the conclusion of the training program.

Government is upgrading the Vermont Nature Trail as a joint recreation and environmental education project. New steps and bridges, interpretive signs and a brochure (the latter funded by World Wildlife Fund-US) will be provided. An ultimate goal is to improve the road to the trailhead and add a parking lot and interpretive center.

9.3.2 Problems and Issues

Although the nation is no stranger to public education campaigns on selected environmental topics, a structured and integrated program of environmental education is not yet in place. However, GSVG fully realizes the importance of environmental education to the continued and sustained development of the country. This need is being very capably addressed on several levels, through the joint efforts of the Ministry of Education, the Environmental Education Committee of the National Trust, and the Ministry of Agriculture/CIDA Forestry Project. If the present programs and those now in the planning stage are fully implemented and then expanded, St. Vincent and the Grenadines will have laid the groundwork for a truly impressive and worthwhile effort in environmental education.

9.4 CONTROL OF POPULATION GROWTH

9.4.1 Overview

FAMILY PLANNING EDUCATION

Family planning efforts in St. Vincent and the Grenadines began in the mid-1960's with formation of an NGO called the St. Vincent Planned Parenthood Association (SVPPA), an associate of Caribbean Family Planning Affiliation and the International Planned Parenthood Federation. SVPPA provided the country's only contraceptive services, including counselling, up to 1976. It

continues to supply and distribute some birth control devices, recently embarked on a community-based distribution program, and has plans to re-open its clinic with an expanded range of services. Much of its focus is on education.

An active and well-organized National Family Planning Program (NFPP) is housed within the Ministry of Health and the Environment. NFPP was organized in 1975 to augment the educational efforts of the SVPPA with additional educational and direct medical services in the family planning area. NFPP services are provided through the existing network of 35 primary health care centers throughout the country. A program of "Family Life Education" is taught in all primary schools in the state. When it met resistance from parents at its inception ten years ago, the scope of the program was broadened to include activities to help youngsters set goals and assume personal responsibility as well as learn about reproductive biology and contraception. The program now apparently enjoys strong support country-wide (pers. comm., K. Israel, NFPP Administrator, Feb., 1990), although only recently has there been a systematic attempt to train teachers in this area.

In February 1988, GSVG officially accepted a document produced by CARICOM entitled "A Statement of National Population Policy for St. Vincent and the Grenadines." This is an ambitious proposal, giving an overview of SVG population history and demographics and projecting future trends. It sets out concrete goals, strategies and recommendations for population control. The National Family Planning Program (NFPP) has already implemented many of these and is working on most of the others. A division of NFPP called the National Population and Development Unit, which will be the implementation body for the Population Policy, has been formed.

9.4.2 Problems and Issues

IMPACT OF POPULATION GROWTH ON NATIONAL DEVELOPMENT

Despite very high birth rates, population growth in St. Vincent and the Grenadines has generally been tempered by the emigration of substantial numbers of people over a period of many years. However, emigration is a potentially volatile factor, subject to external influences, and changes could occur at any time (see also Section 1.3.1).

The present population of St. Vincent and the Grenadines is estimated at approximately 113,000. Several studies (Bouvier, 1984; CARICOM, 1988) suggest that the nation's population "carrying capacity" (i.e., the upper limit for a "reasonable" zero-growth population size) may be in the neighborhood of only 125,000 to 150,000 people. If the emigration "safety valve" was no longer effective (other factors being equal), this would cause a corresponding rise in the rate of population growth and the country could soon find itself in a rapidly worsening situation (see Table 9.3(1) and Figure 9.3(1) for various population growth scenarios). Infrastructure problems (e.g., schools, housing, sanitation, water supply, roads) are already serious, and a more rapidly increasing population would place additional stress on the natural and socio-economic resources of the country. Such considerations point to the need to examine strategies for further reducing the birth rate.

In a youthful population such as the one in St. Vincent and the Grenadines, there is a built-in "momentum of growth". Even though fertility rates are decreasing, the number of women now in their child-bearing years is so large that births continue to exceed deaths. If present trends of decreasing birth rates continue, however, this difference will gradually diminish and disappear in about two generations (70 years).

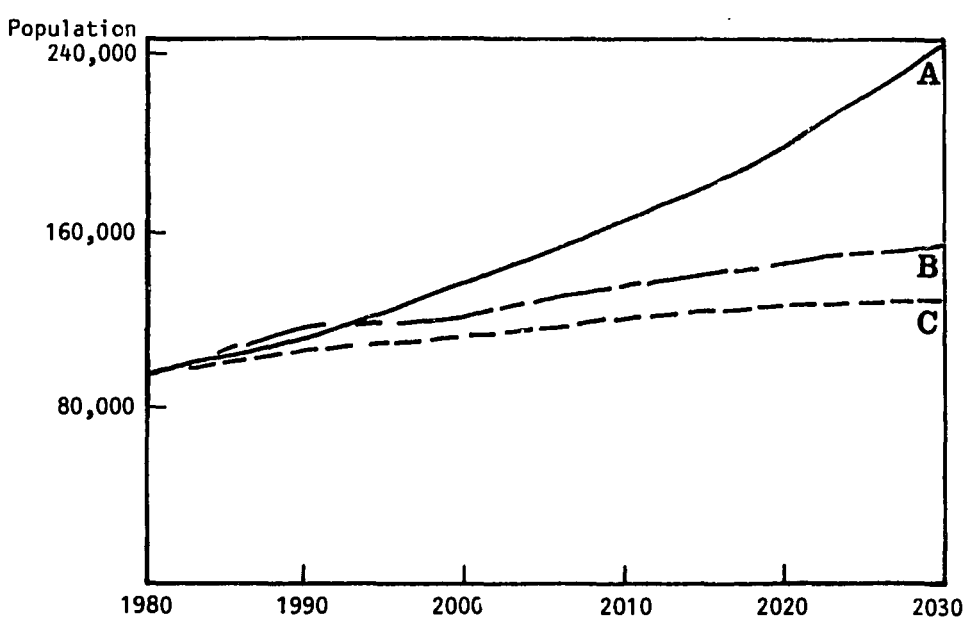
The segment of the population aged 15-44 has increased over the last few decades; it was 33 percent between 1960-1970, rising to 40 percent between 1970-1980. This is a factor based on the number of children born

Table 9.3(1). Population projections, St. Vincent and the Grenadines, 1980 - 2030.

Scenario	1980	1990	2000	2010	2020	2030
A	97,845	114,375	137,137	165,316	201,903	248,972
B	97,845	116,751	126,997	139,149	147,377	150,505
C	97,845	109,058	116,352	123,980	128,079	128,641
D	97,845	123,034	140,275	160,593	177,469	189,256
E	97,845	128,788	174,197	232,382	308,803	408,020

A: TFR of 4.5, net emigration of 1,000
B: TFR of 2.1, net emigration of 500
C: TFR of 2.8, net emigration of 1,000
D: TFR of 2.1, net migration of 0
E. TFR of 4.5, net migration of 0

Source: Bouvier, 1984.



A: TFR of 4.5, net emigration of 1,000
B: TFR of 2.1, net emigration of 500
C: TFR of 2.8, net emigration of 1,000

Figure 9.3(1). St. Vincent and the Grenadines national population projections, 1980 - 2030 (source: Bouvier, 1984).

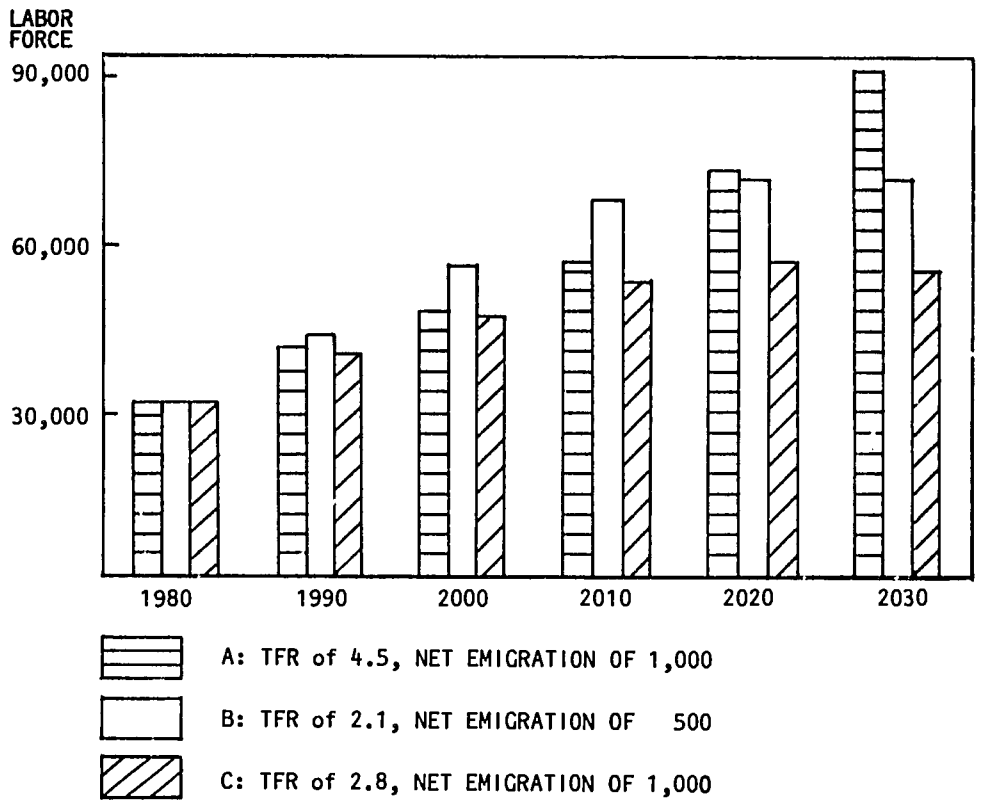


Figure 9.3(2). St. Vincent and the Grenadines national labor force projections (source: Bouvier, 1984).

between 1960-1964, when birth rates were at their highest; children born then are now in prime child-bearing years. Even if this group of Vincentian "baby-boomers" continues the trend of decreasing birth rates, the population will continue to increase due to their numbers; this growth will be more pronounced and prolonged if birth rates among this group do not continue to drop (CARICOM, 1987).

The dependency ratio (proportion of those under 15 or over 64 per 100 persons aged 15-64) in St. Vincent and the Grenadines has been very high in the recent past. In 1970, it was 127:100. Because of declining fertility, the ratio in 1980 was 98:100. Although this meant that fewer working-age people were required to support the young and the old, the ratio remains high when compared with Barbados (78) or Antigua and Barbuda (62) (Bouvier, 1984).

Between 1970 and 1980 the percentage of the population over 65 grew by 33 percent (from 4,190 to 5,613). This trend, which will continue as the present population ages in the face of decreased death rates, will place additional stress on the country's resources, especially in areas of health care and infrastructure.

In the 1980 census, 65 percent of the population met the definition of being "in the labor force" (see Figure 9.3(2) for various labor force projections to the year 2030). Two-thirds of this force were men. Depending on the criteria used, unemployment rates in 1980 were between 19.5 percent and 23.5

POPULATION FUTURES

In order to estimate future growth trends for a nation, various assumptions must be made about rates of fertility, mortality and net emigration. The changes (or lack of changes) in these factors will determine future population size. The problem in St. Vincent and the Grenadines is that hard data regarding the current values of these parameters are not available; the results of the 1990 census will therefore be of great interest to planners. In the meanwhile, any predictions of future population trends are at best tenuous.

For example, Figure 9.3(1) shows the projected population size under three hypothetical scenarios constructed by Bouvier (1984), which make various assumptions about net emigration rates and total fertility rates:

- Scenario A assumes a total fertility rate of 4.5 and a net emigration at the current level of about 1,000 per year.

- Scenario B assumes that the total fertility rate is reduced to the replacement level of 2.1, and that the current level of net emigration would be cut by half to around 500 persons per year, primarily due to an imposition of immigration quotas by popular destinations.

- Scenario C assumes the current (1988) total fertility rate of 2.8 and current net emigration of 1,000 persons per year.

Projected expansion of the labor force (Bouvier, 1984) is presented decade by decade in Figure 9.3(2), under the same three alternative growth scenarios as above. This projection indicates that under all assumptions illustrated, the country's labor force will grow substantially for at least the next twenty or thirty years and that a decline in net emigration would pose major problems of unemployment (all other factors being equal).

Table 9.3(1) presents the numerical results of the above three plus two additional scenarios for different components of the population. (N.B. Although these projections use a 1980 population size of 97,845, this was subsequently adjusted to 102,000 by GSVG [see Section 1.3.1]. Total Fertility Rate (TFR) is the average number of live births per woman.)

These examples from Bouvier are used for illustrative purposes only. However, given the information available on current population size, net emigration and TFR in St. Vincent and the Grenadines, it seems as if scenario C may come closest to the pattern of growth that has actually occurred.

percent. Unemployment rates for teenagers and those 20-24 are significantly higher than for the population as a whole, and increasing unemployment rates have had more impact on those under 30 than any other age group (CARICOM, 1987). Furthermore, since the 15-44 age-group is the most rapidly increasing sector of the population (after the high birth rates of the 1950's and 1960's), the size of the labor force increases with the size of this group.

The continuing loss of skilled laborers, primarily to the United States, Canada, and England, is also a matter of serious concern to St. Vincent and the Grenadines. However, attempts to reverse this trend must also consider the effect which the emigration option has had on population, namely, that

high net emigration has in general reduced the rate of population growth.

NATIONAL GOALS FOR POPULATION GROWTH AND FERTILITY

The goal of the country's national population policy is to reduce the annual rate of population growth from 1.3 percent to 0.7 percent per year so that the total population will not exceed 150,000 in the year 2030. In order to achieve this, the policy sets forth the following fertility goals:

1. Reduce the average number of children per woman to 2.1 so that the TFR will be around 2.8 by the year 2000. The 1988 TFR was already 2.8 according to the Family Planning Department (pers. comm., K. Israel, FPD Administrator, Feb. 1990).

2. Reduce the current fertility rate of teenagers to one half its present rate by the year 2000. Teenage fertility rates, while still high, are on the decline. Among girls aged 10-19, birth rates in 1984 were 124 per thousand (7,063 girls, 874 births). In 1987, the last year for which these statistics are available, the rate was 90 per thousand (7,315 girls, 661 births). In 1988, teenage births accounted for 25 percent of all births in the state (635 of 2,531 total).

3. Increase the proportion of women in the reproductive age group who are contraceptors to 68 per cent. Current contraceptive compliance rate for women is 61 percent.

4. Increase the proportion of male contraceptors to 25 percent. Male contraceptive use is presently at about five percent.

These very specific goals are being addressed by a number of programs discussed in Section 9.4.1, e.g., Family Life Education, widespread and easily accessible contraception services, and special focus on adolescents and their particular needs. NFPP's near-future goals include expanding outreach and services to adolescents and increasing male participation in contraception.

9.5 POLICY RECOMMENDATIONS

INTEGRATION OF PHYSICAL AND ECONOMIC PLANNING

* Perhaps the most important condition for sustainable development is for environmental and economic concerns to be merged in decision-making, otherwise even the best land use planning efforts will meet with limited success. The feasibility of implementing a system of national income accounts which includes natural resource assets should be explored not only by St. Vincent and the Grenadines, but by the OECS countries collectively. Donor support should be sought for an Eastern Caribbean regional feasibility project to study the costs and benefits of implementing such an accounting system and of extending the concept of depreciation to natural resource assets (see Section 1.3.2).

* The *real* (often hidden) costs of resource allocation decision-making need to be accounted for by internalizing environmental costs in prices, e.g., the principle of "the resource user and/or the polluter pay". Additionally, it is increasingly important that national economic policies, budgets and subsidies that actively, if unintentionally, encourage environmental degradation be reformed.

LAND USE PLANNING

* A national land use plan needs to be prepared, incorporating and updating some or all of the many sectoral plans which have been written, and focusing on the means of achieving sustainable development over the long term. The land use plan should attempt to 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. The watershed should be adopted as the appropriate management unit for land use planning.

* The preparation of new land use maps should be the initial step in the process of designing a land use and growth management plan for the nation. The degree of cor-

relation between land *capability* and present land *use* should be determined after new land use maps are generated, and areas in which there are serious discrepancies should receive priority attention for remedial and/or restoration programs.

* Critical areas -- such as habitat for endangered and threatened species, important watersheds and catchment areas, aquifers, wetlands, beaches, marine reserves, major diving sites, forest reserves and recreation areas, wildlife reserves, scenic vistas and roads, historic and archaeological sites, and natural tourist attractions -- should be delineated on the maps for incorporation into a national parks and protected areas system.

DEVELOPMENT CONTROL

* Consideration should be given to updating the institutional structure and legal powers of the Physical Planning and Development Board so that it can require other GSVG agencies to comply with its decisions and regulations; a more effective system of development control, including monitoring and enforcement responsibilities, is also needed.

* Consideration should be given to implementing a nation-wide watershed management program for purposes of development control in these critical areas. A technical advisory group should be created to support the PPDB in decision-making related to integrated watershed management.

* The Central Planning Division needs to create and maintain a functional land use data base and information-management system, including new large scale aerial photographs and land use maps, up-to-date cadastral maps, and land ownership information. There is a need to increase the level of training in information management within the CPD and to provide a capability for ongoing monitoring of land use changes.

* Legislation is needed to require the preparation of environmental impact assessments for major projects, especially within the coastal zone and other critical areas identified in this Profile. A draft revision of the Town and Country Planning Act, prepared by an OAS consultant and submitted recently to the Attorney General for review, makes provision for EIAs (pers. comm., W. McCalla, OAS consultant, June 1990). Appropriate standards for development should be included in the proposed legislation and, when enacted, such standards should be rigorously enforced. An institutional capability for interpreting, and later carrying out, the technical aspects of environmental impact assessment needs to be created within the CPD and other appropriate GSVG agencies.

* The existing "Physical Planning and Development Guidelines" could form the basis for legally adopted regulations to the Town and Country Planning Act, but they would have to be strengthened by the addition of standards for various kinds of developments, the inclusion of environmental impact assessment requirements, and provisions for regulation of public sector, coastal and agricultural developments.

PARKS AND OTHER PROTECTED AREAS

* 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. A single agency should be given the task of coordinating resource management for parks and protected areas. Allocation of manpower resources for enforcement and management activities should be made on the basis of priorities established in the plan.

HISTORICAL, ARCHAEOLOGICAL AND CULTURAL SITES

* The National Trust has set as one of its program goals the establishment of a National Registry and has made some progress toward this objective with funding from UNESCO; the Trust is presently seeking to identify additional support to expand and complete the project. In order to fully implement this task, the Trust will need to:

- include archaeological sites;

- classify and evaluate all sites more systematically and comprehensively;

- establish priorities which assess high risk as opposed to less threatened sites;

- establish the development potential of selected sites (for tourism, educational programs, etc.), perhaps in consultation with other government agencies;

- put in place an acquisition schedule;

- eventually develop management criteria which minimize and regulate intrusions or disturbances to sites included on the Registry.

* Government should give consideration to the establishment of a Kingstown Historic District and to promotion of development control guidelines in the District which reduce non-compatible uses not in keeping with the historical character of the town. Government could encourage adaptive use and restoration strategies by the employment of economic and other incentives and by adoption of design control regulations for new construction, perhaps along the lines of the recently released OAS recommendations for St. John's, Antigua (OAS, 1989).

* GSVG, in cooperation with the National Trust, should review the provisions of the 1976 Act for the Preservation of Historic Buildings and Antiquities to determine why the legislation has not been enforced and what revisions could make its implementation feasible.

POPULATION CONTROL

* Control of population growth has been recognized by GSVG as an important social issue. A decrease in the birth rate is linked to the long-term success of any national environmental protection agenda in St. Vincent and the Grenadines. While encouraging steps have been taken through the provision of family planning education and services, a greater effort will be required to accomplish the stated goals of the National Population Policy. This will involve, among other things, increased efforts to deal with the major underlying constraints which influence efforts to curb high birth rates (e.g., high unemployment, low income levels, illiteracy, poor housing conditions). Underlying cultural factors could be better identified and clarified by carrying out a national "knowledge, attitudes, beliefs and practices" survey to guide family planning policy makers. Educational and outreach activities need to be continued, but other options for facilitating change should not be neglected, such as expansion of facilities for services or efforts to improve the cooperation of medical practitioners.

SECTION 10 INSTITUTIONAL FRAMEWORK FOR ENVIRONMENTAL MANAGEMENT

10.1 GOVERNMENT ORGANIZATION

St. Vincent and the Grenadines is a constitutional monarchy within the British Commonwealth of Nations. The Head of State, the British monarch, is represented by the Governor-General who is appointed on the advice of the Prime Minister. The Governor-General appoints as Prime Minister the elected leader of the majority party in the House of Assembly.

Legislative power is vested in Parliament, which comprises a House of Assembly with 15 representatives, elected every five years, and six senators who are appointed by the Governor-General (four on the advice of the Prime Minister and two on the advice of the Leader of the Opposition). Executive power is vested in the Cabinet.

Government is presently organized as follows:

- Prime Minister's Office, Ministry of Foreign Affairs, and Police
- Ministry of Finance, Planning, and Development
- Ministry of Housing, Local Government and Community Development
- Ministry of Education, Youth, Sports and Women's Affairs
- Ministry of Agriculture, Industry and Labor
- Ministry of Communications and Works
- Ministry of Health and the Environment
- Ministry of Justice, Information and Culture
- Ministry of Trade and Tourism.

The country's legal system is based on English Common Law. For the administration of justice, the country is divided into three Magisterial Districts, and the highest local judicial body is the Court of Appeal of the Leeward and Windward Islands.

10.2 HISTORICAL DEVELOPMENT OF ENVIRONMENTAL MANAGEMENT POLICIES

Local initiatives to protect natural resources developed early in St. Vincent when, almost two hundred years ago in 1791, the King's Hill Forest Reserve -- possibly the first in the Eastern Caribbean -- was established. St. Vincent also boasts the oldest (1765) botanical garden in the Western Hemisphere, a local attraction which is still flourishing today.

Yet, despite this early leadership and even more recent legislative gains at the beginning of this century (e.g., Birds and Fish Protection Ordinance of 1901), substantive changes in the area of environmental management and protection did not develop in St. Vincent -- or in other Eastern Caribbean islands -- until the 1940's, beginning with enactment of the Forests Act of 1945, and followed in the next three decades by legislation governing establishment of a National Trust (1969), soil and water conservation practices (1950's), planning and development control (1976), and regulation of public health (1977). A new Central Planning Unit was created in 1978 on the eve of Independence.

The decade of the 1980's produced even more significant advancements, perhaps best illustrated by a body of approved or proposed legislation designed to strengthen Government's ability to protect and manage resources and to plan and control development. A new Fisheries Act was implemented in 1986 and a Wildlife Protection Act in 1987; draft forest conservation legislation which provides for improved watershed protection is expected to be enacted in 1990; a draft water resources act and regulations were prepared with the assistance of an FAO-supported legal consultant and revised by an OAS consultant; a preliminary design for national parks legislation is under consideration; and the OAS legal consultant has also prepared and submitted a revision of the Town and Country Planning Act as well as draft Anti-litter Act and Pesticide Regulations.

During the same period, with assistance from a North American NGO, the Forestry Division stepped up efforts to expand environmental education programs and to protect the rain forest habitat of the endangered St. Vincent parrot. Over 10,000 acres were set aside as a Parrot Reserve, while Government took steps to control illegal trade by ratifying the global Convention on International Trade in Endangered Species (CITES). More recently, with technical aid from CIDA, the Forestry Division launched a long-term development program to up-grade forest management and conservation in the country.

During the 1980's Government also focused attention on the improvement of national development planning, including (1) reorganization of the Ministry of Finance and Planning with a restyled Central Planning Division as the technical focal point in the planning process and (2) the publication of a three-year development plan in 1986, followed by an up-date the following year. During this period, the emergence of official interest in physical development planning was attributed in part to heightened concern over environmental degradation (GSVG, 1986).

As the decade drew to a close, a marine park plan was prepared for the Tobago Cays in the Grenadines, a new Environmental Protection Task Force to advise Government was created, and the Prime Minister designated the 1990's as the Decade of the Environment in St. Vincent and the Grenadines. Equally important, the long inactive St. Vincent National Trust became once more a viable organization. It sponsored an aggressive membership campaign in 1989 to stimulate interest and growth and had, by early 1990, opened new offices in Kingstown.

Almost as a complement to the rejuvenation of the Trust, a reorganization of governmental departments in 1989 resulted in the creation of a new Ministry of Health and the Environment, making St. Vincent one of the few Caribbean governments to highlight the environment in delegating ministerial responsibilities.

Nevertheless, while the institutional framework for environmental management has been strengthened in the last decade, many challenges still remain. In the first place, several legislative initiatives, while promising, have not yet been officially enacted (e.g., new forestry and watershed management legislation, a draft anti-litter law, a proposed water resources act and regulations, national parks draft legislation, and a revised, consolidated version of Town and Country Planning Laws and Regulations). Other important legislation is seriously outdated, the most critical being the Public Health Act of 1977, which also lacks regulations.

Furthermore, while primary responsibility for the environment has recently shifted, at least symbolically, to the year-old Ministry of Health and the Environment, an organizational basis for the Ministry's new environmental responsibilities has not yet been introduced; nor have clear lines of authority been established to coordinate the environmental mission of the new Ministry with the responsibilities of other, longer-established Government departments. Critical issues of consensus-building, accountability, lines of communication, and coordination functions must still be addressed before the potential leadership role of the new Ministry in the environmental sector can be realized.

10.3 GOVERNMENT INSTITUTIONS CONCERNED WITH ENVIRONMENTAL MANAGEMENT

Responsibility for environmental management in St. Vincent is dispersed among a number of departments of Government. Table 10.3(1) identifies key institutional responsibilities, along with enabling or relevant legislation.

No single agency of Government is charged with responsibility for the environment, although the newly created Ministry of Health and the Environment could potentially assume such a role. Despite the lack of a strong centralized agency for environmental management, St. Vincent has over time:

(1) strengthened the national planning and development control process (which, despite problems discussed below and in Section 9, has been identified by one observer [Lausche, 1986] as among the most functional in the region); and

(2) attempted to structure several forms of inter-agency coordination which have the potential to improve overall environmental accountability within Government and to lessen fragmentation of environmental responsibilities.

A discussion of the key divisions of Government with environmental responsibilities and of important environmental legislation follows.

PLANNING AND DEVELOPMENT CONTROL

Since the mid-1960's, various attempts have been made to institutionalize development planning in St. Vincent. Prior to 1978, physical planning activities were primarily confined to new developments administered by the Central Housing and Planning Authority. In 1966 a Five-Year Development Plan for St. Vincent was drawn up by the Colonial Administration, followed shortly thereafter by enactment of a Land Development Control Act (No. 37, 1968). A Development Control Authority was set up but largely did not fulfill its mandate due to a lack of trained staff (UNDP, 1977).

An embryonic Physical Planning Unit was established within the Ministry of Finance in 1975. However, it was not until after enactment of a new planning law, the **Town and Country Planning Act** (No. 8, 1976), that a full Central Planning Unit (CPU) was established within the Ministry of Finance. The CPU was set up in 1978 and was initially envisioned as a coordinating office responsible for dealing with donor agencies and for the development and monitoring of public sector projects (GSVG, 1986).

A new Draft St. Vincent National Plan (1976-1990) was prepared by a UNDP consulting team in 1976, as part of a statutory requirement of the Town and Country Planning law. This plan reportedly received little support from Government and has been described by one local planner as "a technical document imposed by foreign experts rather than a plan reflecting the views and aspirations of the people in St. Vincent" (Browne, 1985). (Section 9.1 of the Profile provides more details about past and present national planning efforts.)

The role and mission of the CPU were reviewed in a study conducted by the OECS Economic Affairs Secretariat in 1983. Recommendations growing out of that study were primarily accepted by Government and resulted in the current organization of the CPU, which has been renamed the **Central Planning Division** (CPD). The scope of activities of the Division has been considerably expanded, and its sub-units reflect the Government's integrated approach to development planning, now comprising both an Economic Planning Unit (EPU) and a Physical Planning Unit (PPU), as well as a Statistical Office and Manpower Planning Office.

Table 10.3(1). GSVG agencies with resource management functions, with principal legislation and key responsibilities.

AGENCY	RESOURCE MANAGEMENT LEGISLATION	RESOURCE MANAGEMENT RESPONSIBILITIES
MINISTRY OF FINANCE, PLANNING, AND DEVELOPMENT		
- Central Planning Division/Physical Planning Unit	Town and Country Planning Act (No. 8, 1976) Town and Country (Amendment) Act (No. 1, 1981) Town and Country (Amendment) Act (No. 30, 1983) Town and Country Planning Regulations (No. 24, 1980)	Preparation of physical development plans; administration of development control; advise on environmental matters; Secretariat to Physical Planning and Development Board
- Physical Planning and Development Board	Town and Country Planning Act (No. 8, 1976), as amended (No. 1, 1981; No. 30, 1983)	Decision-making authority for development activities
- Planning and Priorities Committee		Review and make recommendations regarding development plans, projects and programs; Central Planning Division serves as Secretariat to PPC
MINISTRY OF AGRICULTURE, INDUSTRY AND LABOR		
Agriculture: - Extension and Advisory Services - Tree Crop Development Unit - Research Unit - Soil and Water Conservation Unit	Agriculture Ordinance (No. 23, 1951) Agriculture Ordinance (Amendment) (No. 21, 1956) Agricultural Small Holdings Act (No. 16, 1957)	Extension services, research, agronomy and soil conservation
- Lands and Surveys	Crown Lands Ordinance (1906); Rev. Ed. Cap. 77 (1926) Crown Lands (Amendment) Ordinance, No. 22 of 1945, No. 19 of 1946, No. 12 of 1947 Crown Lands (Sale) Regulations (No. 24, 1983 Crown Lands (Rent) Regulations (No. 25, 1983)	Undertake surveys for all Government Departments
- Pesticide Control Board	Pesticides Control Act (No. 23 of 1973)	Control of the importation, distribution and use of pesticides

(continued)

Table 10.3(1) [continued]. GSVG agencies with resource management functions, with principal legislation and key responsibilities.

AGENCY	RESOURCE MANAGEMENT LEGISLATION	RESOURCE MANAGEMENT RESPONSIBILITIES
- Forestry Division	Forests Ordinance (Cap. 23, No. 25 of 1945) Crown Land Forest Produce Rules (Cap. 23, No. 1, 1946) Crown Forest Proclamation (Cap. 23, No. 2, 1946) Crown Lands Forest Reserves (Declaration) Order (Cap. 23, No. 3, 1948) Crown Lands (Prohibited Areas) Order (Cap. 23, No. 4, 1948) Wildlife Protection Act (No. 16 of 1987)	Protection and management of the nation's forests and wildlife
	Beach Protection Act (No. 10 of 1981)	Designated as lead agency to coordinate all aspects of beach protection
- Fisheries Division	Fisheries Act (No. 8, 1986) Fisheries Act Regulations (SRO No. 1, 1987) Maritime Areas Act (No. 15 of 1983)	Promotion and management of fisheries; protection of marine reserves Establishes SVG's EEZ
- National Trust	St. Vincent National Trust Ordinance (No. 32, 1969) St. Vincent National Trust Ordinance (Amendment) (No. 29 of 1971)	Protection and preservation of the country's national heritage
MINISTRY OF COMMUNICATIONS AND WORKS		
- Ministry of Communications and Works		Responsible for management of quarries and mining operations
- Central Water and Sewerage Authority	Central Water and Sewerage Authority Act (No. 6, 1978) As amended (No. 11, 1985) Central Water Authority (Water Supply) Regulations, as amended (No. 30, 1973)	Conservation, apportionment and use of water resources
MINISTRY OF JUSTICE, INFORMATION AND CULTURE		
- Department of Culture		Preservation of the nation's cultural heritage

(continued)

Table 10.3(1) [continued]. GSVG agencies with resource management functions, with principal legislation and key responsibilities.

AGENCY	RESOURCE MANAGEMENT LEGISLATION	RESOURCE MANAGEMENT RESPONSIBILITIES
MINISTRY OF HEALTH AND THE ENVIRONMENT		
- Public Health Department	Public Health Act (No. 9, 1977) Public Health (Amendment) Act (No. 6, 1985)	Maintenance of environmental health
- Environmental Protection Task Force		Policy advisory board to Government regarding directions and focus for the Ministry
MINISTRY OF TRADE AND TOURISM		
	Act for the Preservation of Historic Buildings and Antiquities (No. 9 of 1976)	Affords protection to historic structures and sites

The mid-1980's reorganization of the Ministry of Finance, Planning and Development reflected Government's larger commitment to more formal national development planning. In 1986 Cabinet approved a new comprehensive Development Plan, 1986-1988, which was prepared by the CPD with assistance from several donor agencies including UNDP, OECS, OAS, and CDB. An update was issued in 1987, and the CPD is currently at work on a new National Development Plan for 1991-94 (see also Section 9).

To further strengthen the planning process, a new coordinating body at the highest level of Government was created concurrently with preparation of the 1986-88 Development Plan. The **Planning and Priorities Committee** (PPC) was established as an interagency body to review and make recommendations to Cabinet regarding development plans, projects and programs. The Committee is chaired by the Prime Minister/Minister of Finance and consists, in addition, of the Minister of Trade, Industry and Agriculture (now reorganized as the Ministry of Agriculture, Industry and Labor and the Ministry of Trade and Tourism), the Minister of Communications and Works, the technical and administrative heads of these Ministries, the Director of the Ministry of Finance, Planning and Development, and the Deputy Director responsible for Planning who performs the duties of Secretary. The Central Planning Division functions as Secretariat to the Committee (GSVG, 1986).

The First Annual Update to the Government's Development Plan identified the PPC as the institution responsible for the coordination of development in the country. It also pointed out that a recent report from the Caribbean Development Bank had commended the Committee for having succeeded in developing and updating the national plan-

ning agenda in St. Vincent and the Grenadines (GSVG, 1987).

Development control activities in the country are the responsibility of the **Physical Planning and Development Board** which was created by the Town and Country Planning Act of 1976. The Board has broad regulatory powers to control development activities in the state and is still functional today, meeting monthly to consider development applications.

Its membership is comprised of the Director of Planning, Manager of the Development Corporation, Chief Engineer, Chief Agricultural Officer, Chief Surveyor, Public Health Superintendent, General Manager of the Housing and Land Development Corporation, Manager of the Central Water and Sewerage Authority, and three other appointed persons not in public service. At present, there is no representation on the Board from the *environmental* component of the Ministry of Health and the Environment. Because of its broad inter-ministerial base, Lausche (1986) points out that the Board functions like a coordinating body for planning and development control decision-making in the country.

The **Physical Planning Unit** within the CPD serves as the Secretariat to the Board and provides the Board with technical staff. Additionally, the PPU is charged with the preparation of physical development plans and with the administration of development control regulations. In effect, the PPU fulfills the dual functions of development planning and development control. The office also maintains that one of its responsibilities is to advise Government on environmental matters and to assist in environmental management. Although there is no staff position specifically designated for this assignment, a planning technician is presently pursuing a one-year diploma in environmental management and will be returning to the office in mid-1990.

Lausche (1986) points out that one weakness in the planning and development control process in St. Vincent is the lack of substantive regulations which provide better direction to developers about the application/approval process and which specify criteria and conditions for major development activities. Administrative guidelines are currently used by the PPU (see Section 9.1.1), and these could be strengthened, according to Lausche, by the enactment of regulations. A new draft planning law, with regulations, was recently submitted by an OAS consultant to the Attorney General's office for review (pers. comm., W. McCalla, OAS legal consultant, June 1990).

There is no official "national land use plan" for SVG, no update has been completed to the physical development strategy included in the UNDP National Plan of 1976, and the PPU has not scheduled preparation of a comprehensive land use plan for the near future (pers. com., R. Cato, Director of Planning, 1990). Thus, the responsibilities of the PPU are presently carried out in the absence of an accepted physical planning framework.

Lausche (1986) also points out that development activities undertaken by GSVG agencies are not formally submitted to the Physical Planning and Development Board for approval. As an inter-agency body, the Board might informally review such activities (as might the PPC for large-scale projects), but there is no formal procedure requiring that Government development plans be submitted to the Board. One observer reported that as much as 50 percent of all new development and over 80 percent of all land subdivisions and changes of land use may be implemented outside of the current development control framework (Browne, 1985).

Another weakness of the current planning and development control process according to Lausche (1986) is its emphasis on urban and industrial development and the concurrent weakness of the process when dealing with rural land use or natural resource regulation. Browne (1985) also points to a weak data base and a low level of trained manpower as additional problems. Finally, there are no requirements for an environmental impact assessment for development activities or procedures which mandate that such a review be carried out by the PPU before presenting its recommendations to the Physical Planning and Development Board. However, provisions for EIA requirements

have been made in the proposed revisions to the Town and Country Planning Act (pers. comm., W. McCalla, OAS legal consultant, June 1990).

DEPARTMENT OF AGRICULTURE

A **Soil and Water Conservation Unit** (SWCUT) was set up within the Ministry of Agriculture in 1988 in response to growing concern about soil erosion and the need to improve soil conservation techniques among small farmers. At present, the unit is staffed by only three persons, one on temporary assignment. The agricultural officer who heads the Unit is preparing a five-year soil conservation program to include public education, demonstration farms, data collection, and soil erosion surveys.

Legislation relating to soil conservation is also in need of review and revision. The legal authority calling for environmentally sound agricultural practices dates to the 1950's, when ordinances were enacted (see Table 10.3(1)) which require owners and occupiers of agricultural lands to maintain good estate management and husbandry practices in order to prevent soil erosion (Lausche, 1986). Agriculture legislation from this period also provided for the establishment of local-level Agricultural Committees to which landholders may appeal if served with notice for violation of soil and water conservation responsibilities. Additionally, tenants renting crown lands must enter into a contract with Government requiring them to utilize soil and water conservation practices.

However, in his review of legislation, Main (1989) found that soil conservation laws were either not being used or were rarely enforced. Fines are outdated, and the Agriculture Act itself was written for a large estate tenure situation which no longer prevails. Even with revised legislation, however, enforcement would be difficult given the fact that SWCUT is a new government agency in the process of developing programs and priorities with a very limited staff.

The Ministry's **Extension and Advisory Services Division**, in addition to providing customary field services for farmers, operates the Botanic Gardens and supports a small Tree Crop Development Program (which at present includes a BDD-funded project for mangos). The Ministry also supports a small (one person) Research Unit which lends services to the Extension Division, works in collaboration with CARDI's St. Vincent office, and monitors rainfall in the country's eight agricultural districts.

The Ministry of Agriculture has responsibility for administration of the **Beach Protection Act** (No. 10, 1981) which provides for the protection of beaches and the regulation of sand removal. Applications for permission to remove sand from beaches are required, but the law has never been fully enforced. Only recently has the Minister of Agriculture proposed that the Forestry Division be the lead agency for coordinating all aspects of beach protection, and the geologist attached to the Soufriere Monitoring Unit is currently advising the Ministry in this area. The Ministry of Communications and Works is responsible for management of quarries and mining operations, but it is not clear what the institutional relationship between the Ministry of Agriculture and the Ministry of Works will be relative to beach protection and regulation of sand mining. Regulations to the 1981 Beach Protection Act have never been issued, but proposed regulations are under review by GSVG.

Another piece of legislation which falls under the authority of the Ministry of Agriculture but which has not been substantially enforced is the **Pesticides Control Act** (No. 23, 1973), which legislates control procedures for the importation, sale, storage, and use of pesticides. The law also establishes a Pesticide Control Board, but Lausche reported in 1986 that it was unclear how frequently the Board met or how active it was in implementing the law (Lausche, 1986). This situation is due in part, according to DeGeorges (1989), to the lack of regulations which limit the enforcement capacity of the Board. The Ministry has requested assistance from OAS to update the legislation and to provide regulations; the latter have been drafted by an OAS consultant and submitted to the Attorney General for review (pers.

comm., W. McCalla, OAS legal consultant, June 1990). The Pesticide Control Board was recently revitalized and is receiving advisory support from St. Lucia; its chairman is the Chief Agricultural Officer. However, until regulations are enacted, the Board has little or no control over the import, distribution or use of pesticides in St. Vincent and the Grenadines.

COMMODITY ASSOCIATIONS

Two commodity associations in the agricultural sector have responsibilities broadly linked to resource development and resource management functions. Both were created by statute but function as quasi-governmental bodies.

The **St. Vincent Arrowroot Industry Association** (SVAIA) was originally formed in 1930, but more recent legislation (No. 20, 1976) created the present day SVAIA. Its purpose is to encourage production and undertake the processing of arrowroot and the marketing of arrowroot starch. Although it had some 2,600 recorded farmer/members in the early 1960's, current membership has declined to 65 and permanent staff reduced to six persons plus seasonal laborers, both figures reflecting a general downturn in the industry (IICA, 1989).

The **St. Vincent Banana Growers Association** (SVBGA) was created by statute in 1954 (Act No. 44), but that legislation was repealed in 1978 by the **Banana Industry Act** (No. 10, 1978) to form the present SVBGA. The purpose of the Association is to promote and control the banana industry and to provide production and marketing services for growers. In 1987, there were over 11,000 registered growers although only approximately 5,500 were considered active (IICA, 1989). SVBGA does not have specific authority to regulate the cultivation practices of its members, nor does it appear to have a position relative to soil conservation and related environmental issues. It provides aerial and ground spraying services for members as a part of its disease control program.

FORESTRY DIVISION

The staff level of the **Forestry Division** within the Ministry of Agriculture, Industry and Labor is currently at 34, including 2 senior forestry supervisors, 10 forestry officers (5 untrained) and 24 forest guards. However, under a CIDA-funded Forestry Development Project (Can$4.52 million over the period 1989-94), it has been proposed that personnel will increase to approximately 50, and a new headquarters is to be provided. Additionally, a forest management plan is to be developed, environmental education activities implemented, agroforestry and social forestry projects supported, and the boundaries of the forest reserve surveyed and demarcated.

New legislation (proposed **Forest Resource Conservation Act**) is also undergoing final review which, when enacted (anticipated in 1990), will reorganize forestry functions in Government under a new Forestry Department, to replace the current Forestry Division and to be headed by a Chief Forest Officer. The responsibilities of the Chief Forest Officer are detailed in the draft legislation and include management of forests, preparation of management plans, protection of watersheds, and the education of the public (McHenry and Gane, 1988). The new legislation would replace the existing Forests Ordinance which has guided management of these resources since 1945. It is designed to strengthen forestry management and conservation functions by introducing modern forestry concepts such as management plans and conservation "zones" and by providing a more integrated approach to forest management and watershed protection.

The Forestry Division is also responsible for implementation of the **Wildlife Protection Act** (No. 16 of 1987) which, in part, replaced the much earlier (1901) Birds and Fish Protection Ordinance. In the absence of a Wildlife Protection Officer, the Chief Forest Officer is responsible for the management of wildlife, for the establishment and protection of wildlife reserves and for the enforcement of the Wildlife Act. At the present time, there is no Wildlife Protection Officer, although a wildlife specialist from the U.S. Peace Corps is currently assigned to the Division.

A draft national parks law is also under consideration by Government which would provide the legislative base for the establishment of national parks in the country. The overall management of *terrestrial* parks would be placed within Forestry, according to the draft legislation, although there has been some discussion in Government of terrestrial park management being given to the reactivated National Trust. No terrestrial park areas have been designated as yet.

Other activities of the Forestry Division focus on public education. Substantial support for environmental education was provided in 1988 by the U.S. organization RARE Center for Tropical Bird Conservation, which focused its efforts on the endangered St. Vincent Parrot. An aggressive program supported by the Forestry Division brought environmental educational activities to the schools, churches, and community groups and substantially increased local awareness about wildlife conservation in general and the St. Vincent parrot in particular.

Under the current CIDA-funded forestry support program, this emphasis on environmental education will continue. An environmental education specialist has been stationed by CIDA in St. Vincent for a two year period, attached to the Forestry Division. Additionally, a Vincentian counterpart, now receiving training in Canada, will be back on staff at Forestry by the end of 1990 (see also Section 9.3.1 of the Profile).

Given the substantial resource management responsibilities already assumed by the Forestry Division and in view of the proposed leadership role for a reorganized Forestry Department in such areas as watershed management and park development, this unit of GSVG is presently and will continue to be a key resource management agency in the country. Its ability to effectively carry out these responsibilities will depend in large measure on the support it receives for staff training and upgrade. Equally important will be a demonstration by Government that it places a high priority on those environmental concerns and objectives identified for the Forestry Division in the new legislation and program plans discussed above and in Sections 2 and 9 of the Profile.

FISHERIES DIVISION

The management of fisheries, including enhancement of catch productivity, research and stock assessment, and maintenance of marine reserves, is the responsibility of the **Fisheries Division** within the Ministry of Agriculture, Industry and Labor. The Division presently includes a Chief Fisheries Officer, one additional Fisheries Officer and three Fisheries Extension Assistants (one for the Grenadines). That the Division is severely understaffed has been recognized by donor agencies working with the unit (e.g., FAO, CIDA) and by Division personnel. The need for more emphasis on extension work, improvement of data collection and statistical analysis, and expansion of educational programs have also been identified as important components in any restructuring of this GSVG resource management unit.

The Division has put forward a reorganization plan elevating it in status to a Department of Fisheries which would report directly to the Permanent Secretary and would include an Extension Services Section. It has been proposed that personnel of a reorganized Fisheries Department would need to be increased to 25-34 positions including two data collectors and five middle management/professional positions with responsibility for quality control, aquaculture, extension and marketing, conservation, and data analysis. The substantial increase in size is dictated in part by the need to manage and coordinate a significant expansion of infrastructure currently being put into place with Japanese and Canadian foreign assistance.

At the present time, much of the Division's work is focused on the new Kingstown Fish Market (funded with Japanese aid) and the development of new fisheries centers in the Grenadines (Union Island, Canouan and Bequia), to be funded by CIDA. The Division is also currently engaged in setting up a small laboratory for fish market quality control and basic water quality monitoring. With its small staff, the Division has not been able to give a

high priority to management of designated marine conservation areas or to implementation of the Tobago Cays Marine Park Plan, but reportedly funds will soon be available for four park patrol rangers (pers. comm., K. Morris, Chief Fisheries Officer, 1990).

Relevant legislation, the **Fisheries Act** (No. 8, 1986), provides for the management and development of fishing and fisheries in the state. Additionally, it gives the Minister the authority to identify and declare as marine reserves those fishery waters and adjacent land requiring special protective status. It is patterned after a unified draft law prepared by FAO and enacted by many islands in the region (Lausche, 1986). The Act also authorizes the Minister to make regulations for the taking of coral, shells, and aquarium fish, for the protection of turtles, lobsters and conchs, and for controlling the importation and exportation of fish. Regulations were passed in 1987.

In addition to recent donor support from the Japanese and CIDA, the country's fisheries program potentially benefits from the presence of OECS's Fisheries Unit which maintains its regional headquarters in Kingstown. The presence of the OECS unit in St. Vincent helps to focus attention on this resource management sector and could potentially expand the pool of technical expertise available to Government in-country.

ST. VINCENT NATIONAL TRUST

The **St. Vincent National Trust Ordinance** (No. 32, 1969) established the **St. Vincent National Trust** as a statutory body to conserve and protect the historical and natural heritage of the country. The Trust is administered by a Board of Trustees consisting of not less than eight members, including the Minister (presently the Minister of Agriculture), who is an ex officio member.

The potential role of the Trust in resource conservation is substantial under the authorizing legislation. The Trust is empowered to raise funds, to acquire property, and to make regulations governing the use of property it holds (see also Section 9). Nevertheless, after reaching a peak membership of approximately 100 in the 1970's, by the mid-1980's, the Trust was no longer an active organization. It did continue, however, to manage the country's only museum (the Archaeological Museum in the Botanic Garden) and to receive a small annual subvention from Government for the operation of that facility.

In 1989, the period of long inactivity for the Trust came to an end as a small energized group of Trust members, supported by the then Acting Governor General, embarked on an aggressive membership campaign and spearheaded the first annual general meeting held in many years. The Trust is now engaged in an energetic program of institution building and fund raising and has recently (February 1990) set up offices in Kingstown. The St. Vincent National Trust was named as the executing NGO for the St. Vincent Country Environmental Profile Project.

Although, in the early 1970's, the Government approved vesting of several properties in the Trust (see Section 9), the official transfer process has not been completed. Trust ownership and management of such properties as Fort George and Fort Duvernette received support in a recent development feasibility study of these sites (Arthur Young, 1989), and there has been some discussion within Government of the Trust assuming responsibility for the management of terrestrial national parks. To date, regulations on the management of Trust properties have not been issued.

The future role of the Trust in St. Vincent and the Grenadines is predicated at the present time on the organization's ability to demonstrate its long-term viability, on the effectiveness of current plans to build staff and strengthen institutional structure, and on the group's capacity to generate support and commitment within the country for its program goals and priorities.

CENTRAL WATER AND SEWERAGE AUTHORITY

The **Central Water and Sewerage Authority** (CWSA) was established by legislation of the same title in 1978 (**Central Water**

and Sewerage Authority Act, No. 6, 1978) and is governed by an inter-ministerial Board. The Authority was given broad powers to provide for the conservation, control, apportionment, and use of water resources. A laboratory for the monitoring of drinking water quality at public production facilities is maintained by CWSA.

With the assistance of PAHO and FAO legal consultants, the existing water resources legislation and administrative framework have been analyzed, and a **draft water resources act and regulations** are currently under review by the Ministry of Justice, Information and Culture. The draft under review had been further revised by an OAS consultant (pers. comm., W. McCalla, OAS legal consultant, June 1990). Lausche (1986) had pointed out earlier that while the 1978 Act gave the Authority power to make regulations in such areas as water pollution control, soil conservation, and water quality regulation, such regulations had never been enacted.

The proposed new legislation would expand the powers of the CWSA and mandates that the Authority prepare a national water resources development plan; construct and operate sewerage works; regulate private sewers, septic tanks and latrines; regulate commercial and industrial treatment of effluents; establish "protected zones" around water supplies; and impose substantial penalties for violations of anti-pollution laws. A Water Resources Advisory Council would be established to provide periodic, short-term, high-level coordinated advice to those public authorities charged with water management responsibilities.

DEPARTMENT OF CULTURE

The **Department of Culture** is housed within the Ministry of Justice, Information and Culture and is responsible for preservation of the country's cultural heritage and promotion of national art forms. It has no legislative mandate and is currently staffed by only one Cultural Officer.

Some of the Department's responsibilities, as defined in a national Cultural Policy, broadly overlap with those of the St. Vincent National Trust, such as the development of museums, acquisition and restoration of historic buildings, and the acquisition of historical documents and artifacts. Little coordination seems to exist at present between this GSVG department and the quasi-governmental National Trust. Furthermore, implementation of the Preservation of Historic Buildings and Antiquities Act is not the responsibility of the Department of Culture; the Ministry of Trade and Tourism is responsible for the Act, although, as stated in Section 9, this legislation has essentially never been implemented.

MINISTRY OF HEALTH AND THE ENVIRONMENT

In 1989 a new **Ministry of Health and the Environment** was formed. At present, the Ministry essentially comprises the public health services transferred from the former Ministry of Health. No organizational chart is yet available for the environmental functions of the Ministry, nor have these responsibilities been clearly defined. Nevertheless, the Ministry carries primary responsibility for the environment within Government (pers. comm., A. Allen, Jr. Min., Min. of Health and the Env., 1990), and it also offers potential as a strong, centralizing force for environmental concerns within Government.

Within the Ministry's **Public Health Department**, public health responsibilities are carried out under two broad divisions: Environmental Health and Community Health. A Central Board of Health was established under the **Public Health Act** (No. 9, 1977), but it has not been functional since 1979. The Department coordinates some of its responsibilities with the Central Water and Sewerage Authority which monitors drinking water supplies and notifies the Public Health Department when levels of bacterial contamination are excessively high. The Ministry's **Department of Family Planning** provides medical and educational services through 35 district health agencies and is also responsible for implementation of the country's National Population Policy, officially accepted by Govern-

ment in 1988 (see also Section 9.3 of the Profile).

The Public Health Act of 1977 provides a legal basis for pollution control in St. Vincent but carries no regulations for enforcement, although draft regulations were prepared almost a decade ago; these are now seriously outdated. There is no legal authority in any Government department for solid waste management, and the subject is not dealt with in the existing public health legislation.

New public health legislation was drafted under the Caribbean Justice Improvement Project in 1988 but has not yet been officially acted upon. A draft anti-litter act is also under review within Government.

Pollution control under the older public health legislation follows the legal theory of "nuisance" violations, but enforcement is difficult in the absence of regulations and because concepts are outdated and penalties extremely low.

At the time the new Ministry of Health and the Environment was created in 1989, an **Environmental Protection Task Force** was also set up as an interdepartmental coordinating body to advise and assist the Minister in defining directions and programs for the environmental portfolio of the new ministry. The Task Force includes representatives from relevant GSVG departments, such as Health, Agriculture, Forestry, Planning, Education, Tourism, the National Trust, and CWSA, as well as representatives from at least one community group (JEMS). There is no authorizing legislation for the Task Force, nor does it have an operational budget at the present time. It has been meeting on a regular basis since August of 1989.

It is not yet clear the direction which the new Ministry will take and what the long-term role for the Environmental Protection Task Force will be as it continues its liaison role with the Ministry. Legislative authority to strengthen the mandate of the Task Force and to specifically define its responsibilities may be required. A clearer definition of its functions and tasks would improve the efficiency and effectiveness of the Task Force.

The establishment of an Environmental Bureau within the Ministry -- perhaps later to be expanded to a Department of the Environment -- has also been discussed. However, before such a department is institutionalized, it will be important for the Ministry to provide an opportunity for cross-sectorial and interdepartmental assessment and consultation -- probably best handled through the Environmental Protection Task Force -- in order to clearly define the structure, composition, functions, accountability, and operating procedures of the new department.

10.4 THE NON-GOVERNMENT SECTOR IN ENVIRONMENTAL MANAGEMENT

In St. Vincent, until the recent rejuvenation of the National Trust (which, while a statutory body, functions in many ways as a non-governmental organization [NGO]), leadership for the environment in the private sector came primarily from community-based, rural development organizations. Active environmental advocacy from this support base is unlike most other islands in the Eastern Caribbean where private sector leadership has come from more traditional conservation organizations, historical societies, or national trusts.

One recent example of involvement by St. Vincent's non-government sector in promoting environmental awareness was a 1989 seminar on the Preservation and Protection of the Environment sponsored by the local group JEMS, which brought together more than 60 persons from neighboring islands who joined with Vincentians in a week-long, UNEP-funded workshop focused on environmental education and training.

The seminar was only one manifestation of the environmental leadership displayed by JEMS (full title: **JEMS Progressive Community Organization**), a rural development group whose target audience is a 15 village area in the southeast of St. Vincent. Since

1978, it has promoted community self-help programs, many of which have been resource management-focused, for example, development of pipe-borne village water systems with funding support from the OECS Natural Resources Management Project. In recent years, JEMS has explored with Government and with external assistance agencies the feasibility of developing the King's Hill Forest Reserve (which is situated within JEMS' program boundaries) into a natural area visitor site or research center. Members of the JEMS executive board were involved in the recent revival of the National Trust, and a JEMS representative serves on the Environmental Protection Task Force.

Projects Promotion, another St. Vincent community development group, describes itself as a human resource development organization focusing on skills training, organizational development, program planning, and leadership training. This group has also added an environmental focus to its program agenda, and in 1988 it organized a workshop on balanced development and a cleaner environment which resulted in a publication entitled *Putting the Environment First*.

CARIPEDA (for Caribbean People's Development Agency) is a regional umbrella group representing nine local development organizations in Belize, Jamaica, Dominica, St. Lucia, St. Vincent, and Grenada. Its headquarters is based in St. Vincent, and its local member organization is Projects Promotion. It has sponsored educational forums on disaster preparedness and has promoted networking among Caribbean rural development groups on environmental issues such as the use of pesticides and their impacts. Additionally, CARIPEDA recently sponsored publication of *Environmental Journey*, a cartoon booklet on the environment produced in a CARIPEDA-organized workshop on the use of alternative graphic forms for promoting environmental education.

The 14-year old **Organization for Rural Development** (ORD) is the foremost rural development group in St. Vincent. Its status is that of a community-based, voluntary, non-profit organization, and its objective is to provide development services to rural communities through, for example, leadership training, crop development, agricultural marketing, and credit disbursement programs. In one donor report, it was estimated that approximately 2,500 farm families have been reached directly by ORD's activities (Brana-Shute, 1985).

ORD is a well-established organization which, while avoiding a formal organizational structure, is nonetheless sufficiently institutionalized to have attracted substantial external support (Brana-Shute, 1985). Since its beginning in 1976, ORD has received funding and technical support from a variety of donors, including PADF, U.S. Peace Corps, CIDA, Canadian Crossroads International, USAID, Rockefeller Brothers Fund, and the Inter-American Foundation.

The **National Youth Council** is an umbrella organization of over 45 youth groups and secondary school student councils located throughout the country. The Council's affiliates have over the years organized a number of educational fora on environmental issues and implemented practical environmental projects. These have included seminars and panel discussions, construction of garbage collection units, and beautification campaigns. The Council also uses its weekly 45-minute radio program aired on Saturday mornings to promote environmental awareness.

To give recognition to the environmental work being done by its membership, in March of 1990 the Council hosted a weekend "camp-in" conference on the environment in Layou. This activity brought together more than 40 persons representing various affiliated youth organizations, including church, student, and community groups. Using the theme "Youth Environmental Action for Sustainable Development," the sessions examined the environmental implications of the country's industrial, agricultural and physical planning policies and practices. Recommendations in the form of a conference report were distributed to Government departments and non-governmental organizations.

While the organizational objectives of many of St. Vincent's NGOs are not directly related to the environment, their emphasis is

often sufficiently natural resource-focused to link their work with emerging environmental initiatives in the country, both public and private sector. In fact, in the long term, improved communication and association between the country's strong base of grass-roots, community development organizations and the rejuvenated National Trust, which represents a more traditional conservation organization, should be encouraged. The community development groups constitute an established base with confirmed environmental interests and programs which were operational during the Trust's relatively long hiatus of inactivity. Furthermore, one systemic problem throughout the Eastern Caribbean affecting more traditional conservation organizations has been the difficulty of securing a broader base of community support for environmental programs and resource management issues. Outreach programs by traditional conservation groups, which identify and encourage cooperative community-based approaches to resource management issues, offer an opportunity to substantially improve the sometimes "elitist," exclusionary image projected by National Trusts and similar groups. St. Vincent seems an appropriate place in which to pursue such strategies.

10.5 DONOR-SUPPORTED RESOURCE MANAGEMENT PROGRAMS

PLANNING, RESEARCH AND TRAINING

The **Organization of Eastern Caribbean States' Natural Resources Management Project** (OECS-NRMP) was set up in 1986 as a cooperative program of OECS with OAS and GTZ (the German Agency for Technical Cooperation). Its overall program objective is to improve the capacity of OECS member countries to plan and manage natural resource management programs. OECS-NRMP activities in St. Vincent have focused on water resource issues, including a study of the Montreal Water Catchment Area and funding for a self-help project to provide pipe-borne water to the Village of Lower Stubbs. St. Vincent was included in regional surveys sponsored by OECS-NRMP (e.g., environmental legislation [Lausche, 1986] and self-help organizations [Finisterre and Renard, 1987]) and has also participated in OECS-NRMP-sponsored workshops. The OECS regional fisheries desk is located in St. Vincent.

The **Caribbean Agricultural Research and Development Institute** (CARDI) is the agricultural research arm of CARICOM. With primary laboratories in Trinidad, CARDI also maintains representatives and a full program in each member island, including St. Vincent.

The **Windward Islands Banana Growers Association**, known regionally as WINBAN, provides assistance to the respective growers associations in the islands of St. Vincent, Grenada, Dominica, and St. Lucia, through coordination of shipping and marketing for banana exports and the implementation of research activities on banana production. WINBAN operates a research center in St. Lucia, the largest agricultural research unit in the Eastern Caribbean; activities there benefit all participating islands, including St. Vincent.

The **Inter-American Institute for Cooperation on Agriculture** (IICA) is an intergovernmental agency comprised of member states in the Americas and the Caribbean; the Institute enjoys a specialized working relationship with OAS. Its mandate is to encourage, promote and support the efforts of member countries to improve agricultural development and to achieve rural well-being.

In St. Vincent and the Grenadines, IICA's recent programs have focused on: preparation of an agricultural sector assessment for the country, strengthening of plant protection and quarantine capabilities, improving the production/marketing capabilities of farmer organizations, and support for technology generation and transfer systems.

INTERNATIONAL DONOR ASSISTANCE

The **U.S. Agency for International Development** (USAID) maintains a project office in St. Vincent for its HIAMP (High Im-

pact Agricultural Marketing and Production) program. The overall aim of HIAMP is to improve the investment climate for agricultural enterprises (including fisheries) in targeted countries such as St. Vincent, specifically by providing equity investment loans to finance large projects and commercialization grants to support smaller enterprises.

Other resource management-related programs supported by USAID in St. Vincent have included assistance for: the Cumberland Hydroelectric Project; an integrated agricultural management, production and marketing project (through the Pan American Development Foundation); a 1986 study of the forest resources of St. Vincent; and environmental legislation reform (e.g., Public Health law) through the USAID-supported Caribbean Law Institute. Additionally, USAID provides funding to the Island Resources Foundation for institutional development support for St. Vincent environmental NGOs, primarily the National Trust and JEMS at the present time.

Substantial assistance in the natural resource sector is currently being provided by the **Canadian International Development Agency** (CIDA), specifically support for an ambitious five year forestry development program (1989-1994) and a fisheries development project which includes construction of fisheries centers in the Grenadines. Additionally, the Canadians are funding several water supply projects and have supported the Cumberland Hydroelectric Project.

Additional to the aid provided by CIDA and USAID, the Cumberland Hydroelectric Project has been supported by the United Nation's **International Fund for Agricultural Development** (IFAD) and the **European Economic Community** (EEC).

The United Nations **Food and Agriculture Organization** (FAO) has provided assistance to Government for the development of new environmental legislation relative to forests, watershed protection, wildlife, water resources, and national parks. In these efforts, additional support for legislative reform has come from the **Organization of American States** and **USAID**.

British aid in the resource management sector, administered through the **British Development Division** (BDD), primarily has emphasized agricultural support, currently tree crop development projects implemented by the Ministry of Agriculture. Other agricultural support programs are funded by:

- the **International Fund for Agricultural Development** (IFAD);
- major funding from the **Caribbean Development Bank** for land reform, specifically for the Rabacca Farms Development Program (formerly called Orange Hill Development Program) and the more recent Agricultural Rehabilitation and Diversification Project;
- additional support for the Orange Hill Estate/Rabacca Farms land reform program from the **European Economic Community** (EEC) and **CIDA**, and for the Agricultural Rehabilitation and Diversification Project from the **Governments of Japan and Denmark**.

In the fisheries sector, in addition to the support of CIDA, the **Japanese Government** financed the Kingstown Fisheries Market. Development of a national marine park for the Tobago Cays has received support from both the **Organization of American States** (OAS) and the **EEC**. OAS's Department of Regional Development has provided assistance in St. Vincent and the Grenadines through its integrated Natural Resources Management Project. This project, similar to OAS programs in other OECS countries, focuses on technical cooperation with Government in areas related to the management of natural resources and has included, in addition to support for the Tobago Cays, development of an experimental watershed management project at Orange Hill Estate and environmental legislation reform.

Finally, assistance with the preparation of the CPD's Development Plan for 1986-88 was provided by the **United Nations Devel-**

opment Program (UNDP), **Inter-Agency Resident Mission** (IARM), **OECS, OAS,** and **CDB.**

10.6 POLICY RECOMMENDATIONS

* *(1) Strengthening the role of the Ministry of Health and the Environment and the Environmental Protection Task Force.* St. Vincent is presently moving in the direction of concentrating environmental responsibilities in a traditional line ministry, i.e., the newly established Ministry of Health and the Environment. The centralization of environmental functions within a single department of Government has many advantages, including economies of scale, optimization of limited resources, improved coordination, and an increased emphasis on environmental priorities.

In St. Vincent, however, where some resource management responsibilities already reside in departments outside of the Ministry (e.g., Forestry, Fisheries, CWSA, Central Planning Division), Government must additionally develop an integrated approach to environmental management which cuts across sectorial and ministerial lines. It has accomplished this to a limited extent within the membership structure of the Planning and Priorities Committee and the Physical Planning and Development Board which coordinate the planning and development control process in the country. The establishment of the Environmental Protection Task Force is a more recent attempt to address integration and coordination issues with specific reference to environmental concerns.

Nevertheless, at the present time, the institutional base for environmental management within the Ministry of Health and the Environment is weak, primarily because the Ministry is only a year old and has not yet had time to develop its environmental portfolio. At the same time, the Environmental Protection Task Force seems to lack clear guidelines as to its specific responsibilities.

GSVG needs to address as soon as possible the institutionalization of environmental responsibilities within the Ministry of Health and the Environment. In addition to issues regarding structure, composition, and operating procedures, equally important issues of accountability, institutional capacity, environmental monitoring, and regulatory policies must be addressed.

GSVG should also consider strengthening the role of the Environmental Protection Task Force with more substantive responsibilities. For example, as an inter-department body, its coordination role could be strengthened by the addition of review and oversight responsibilities regarding the environmental impacts of development activities.

* *(2) Updating of public health legislation.* In a recent review of natural resource legislation in St. Vincent and the Grenadines, Lausche (1986) points out the need for an up-dating of public health legislation, noting the difficulty of pollution control procedures under the existing law. Not only are its provisions outdated, but extremely low penalties trivialize the best of efforts aimed at pollution control.

New public health legislation was drafted in 1988, and it is important that Government take steps to officially act upon the pending draft and to ensure that adequate regulations are provided to support enacted legislation.

* *(3) Strengthening of planning and development control regulations and procedures.* Lausche (1986) also identified the need to provide more substantive regulations to current planning legislation. Regulations should provide better direction about the development approval process and should specify criteria and conditions for major development activities. With the assistance of OAS, the Town and Country Planning Act has been revised and draft regulations provided; these are now under review by the Attorney General. GSVG should be encouraged to move ahead as quickly as possible in providing more substantive regulations for planning and development control.

The draft regulations now before Government call for the implementation of Environmental Impact Assessment (EIA)

procedures which are not presently required for development applications. The recommendation for the inclusion of EIAs in the planning regulations should be retained by GSVG in its review of the proposed legislative revisions. Formal EIA procedures force a more holistic integration of technical data and environmental expertise across departmental lines while guaranteeing more systematic input of environmental considerations in the project planning process.

Although the Central Planning Division does not anticipate development of a national physical development plan, the lack of a comprehensive land use planning framework will continue to reduce the effectiveness of the development control process. Land use planning provides a structure for assessing the physical and natural features of an area and for suggesting its long-term sustainable uses. The development of a national land use plan, to complement the Government's National Development Plan, should be considered by the Central Planning Division.

* *(4) Staffing for environmental programs within Government.* An ambitious body of proposed legislation is currently under consideration by Government, including the following:

- Forest Resource Conservation Act
- Water Resources Act (redrafted by an OAS consultant as Central Water and Sewerage Authority Act) and Regulations
- National Parks Act
- Laws and Regulations on Town and Country Planning
- Public Health Act and Regulations
- Pesticides Control Regulations
- Anti-Litter Law.

In addition, several environmental laws already on the books, or laws with environmental implications, have not been effectively enforced, although in some cases steps are now being taken to improve enforcement. These include the following:

- Agriculture Ordinance and the Agricultural Small Tenancies Act (relative to soil and water conservation practices)
- Pesticides Control Act
- Beach Protection Act
- Public Health Act
- Preservation of Historic Buildings and Antiquities Act.

The lack of adequate technical, monitoring, and enforcement personnel is often cited for the inability of respective departments to enforce existing legislation (Lausche [1986] and others would add that the lack of supporting regulations to much of the extant body of environmental legislation also diminishes the effectiveness of the legal base). The staffing problem will be exacerbated if the proposed new environmental laws are enacted in the near future (official approval of the Forest Resource Conservation Act, for example, is anticipated in 1990). Therefore, with the assistance of donor agencies, GSVG needs to carefully examine the technical and regulatory implications of the full spectrum of existing and proposed environmental legislation and take steps now to improve both the quantity and quality of staff required for implementation, particularly middle-level management and technical staff. Governmental institutional strengthening was given the highest priority in the Government's most recent National Development Plan; as stated in the 1987-89 Plan Update, "... weakness in this area is at present the binding constraint to development in all sectors" (GSVG, 1987).

* *(5) Public participation.* In an assessment of the planning process in St. Vincent, Browne (1985) emphasizes the need for public involvement if truly self-reliant development strategies are to be sustained. Additionally, the Foreword to the Government's 1986-88 National Plan states that the current

approach to planning provides for a timely response by Government to public reaction to policy issues and that the annual updates to the document will give the public opportunity to comment critically (GSVG, 1986).

How effectively the Government is using a process of public participation and public involvement to inform and expand the planning process is not clear. In all probability, GSVG needs to improve the opportunities for public consultation in its planning process and in its deliberations about resource development and environmental management 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.

The Government of St. Vincent and the Grenadines is to be commended for actions taken in recent years to highlight national planning issues and environmental concerns, most specifically in its reorganization of several ministries of Government including the Ministry of Finance, Planning, and Development and the Ministry of Health and the Environment. With the assistance of donor agencies. Government has also pursued an ambitious program of legislative reform in the environmental sector. Follow-up actions are now required to build on and strengthen these important steps, and never has the time been more appropriate for such a focus -- as St. Vincent and the Grenadines looks ahead to the 1990's, a ten year period which has been appropriately declared the *Decade of the Environment* by the Prime Minister.

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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.