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BIOLOGICAL DIVERSITY IN NIGER

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Consultants

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TERMS OF REFERENCE

The terms of reference, scope of work and conditions for carrying out this study and report are presented in Appendix 5. Work was carried under a USAID Purchase Order N° 683-0261-0-00-1004-00.

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BIOLOGICAL DIVERSITY IN NIGER

EXECUTIVE SUMMARY

This preliminary assessment of the biological diversity in the Republic of Niger is presented in four parts.

PART I: THE STATUS OF BIOLOGICAL DIVERSITY AND ITS CONSERVATION

Niger contains a number of distinct biotic zones, ranging from true desert in the northern Saharan zone through Sahelian grasslands to a relatively small area of Sudanian woodland in the extreme south. Mountain massifs, notably the Air, a variety of wetlands and plateau woodlands also represent distinct biotic zones. Vegetation density and diversity generally increases from north to south. Niger is not a biodiversity hotspot but contains internationally important populations of several mammal and bird species, some endangered. These are mostly located in the north of the country and include Addax, Dama Gazelle, Cheetah and Ostrich. The Sahel is an important wintering and passage area for Palaearctic migratory birds and Lake Chad has held high concentrations of migratory waterfowl. Niger's fauna and flora has suffered greatly in recent years from the combined effect of drought and habitat loss through increased human settlement. The most important protected areas are "W" National Park, the last refuge in Niger of the Sudanian flora and fauna, and the Air-Ténéré National Nature Reserve. "W" National Park suffers from several serious problems, including illegal encroachment and grazing, poaching and insufficient staff. Unprotected areas of high biodiversity interest include Termit and the wetlands, particularly along the Niger river.

PART II: THE ECONOMIC VALUE AND USES OF BIODIVERSITY

The economic value of biological diversity manifests itself in many ways. These include:

The gathering of plant products for food, medicinal and other household purposes. Wild food crops play a very important role in the rural economy and women are especially involved in this domain. Wild food crops contain critical nutrients essential to child health.

The provision of forage for the livestock upon which many rural producers depend. Both woody species and grass species are critical, and have suffered because of drought and local overexploitation.

The provision of fuel and construction. Although preferred species are increasingly scarce, recent initiatives in natural forest management hold much promise.

The presence of agroforestry species which provide a variety of benefits on agricultural lands.

The economic effects of pest species. Pest species in Niger range from elephants raiding sorghum stores to locusts and the disease-carrying blackfly. Pesticides are used widely and the effects on biological diversity are little known in Niger. Also several exotic pests threaten to become established in the country.

The value of crop genetic resources, including landraces and wild relatives of crop species that have potential to increase agricultural production, increase resistance to pests and diseases and reduce risks. The Sahel is a centre of crop diversity and domestication for a number of important species, including sorghum, pearl millet and cowpea.

The value of fisheries, which has much declined in recent years in the Niger river due to changing hydrological regimes, affecting breeding and migration, and localized overexploitation.

The value of non-consumptive uses such as tourism, currently underexploited.

PART III: THE INSTITUTIONAL ASPECTS OF BIOLOGICAL DIVERSITY

CONSERVATION

Niger is undergoing an important evolutionary development with regard to formulating a coherent national natural resource management strategy,

incorporating national anti-desertification plans and a new rural code. Legislation relative to natural resource management often dates from the colonial era and is in urgent need of revision, to provide incentives for local populations to sustainably manage natural resources, including biodiversity. Technical capacity in the Ministry of Water and Environment, the principal ministry involved with biodiversity issues, is limited. The private sector, including local NGOs, is more or less non-existent, and training and research in biological diversity conservation issues is inadequate. Nevertheless, significant opportunities do exist to improve the institutional environment for biological diversity conservation in Niger.

PART IV: RECOMMENDATIONS

A series of fifteen recommendations to improve biological diversity conservation in Niger are listed. These are:

- 1) Fully incorporate and integrate biological diversity concerns into the national natural resource management (NRM) strategy;
- 2) Assure the maintenance of a representative sample of Niger's biological diversity through the integrity and continued functioning of a system of protected areas;
- 3) Produce a strong policy statement, backed by appropriate legislation, for banning of hunting of large mammals and birds by the military and other influential groups;
- 4) Review the options for developing an effective program of research in biological diversity conservation, involving INRAN and the National University;
- 5) Incorporate biological diversity concerns into agricultural research, e.g. consideration of wild plant species in local farming systems;
- 6) Inventory vulnerable areas valuable for biological diversity conservation;
- 7) Incorporate biological diversity concerns into the Rural Code;

- 8) Support selected interventions on a pilot basis to optimize biological diversity conservation while decentralizing rights and responsibilities to local user groups;
- 9) Explore opportunities to support local environmental NGOs;
- 10) Investigate the possibilities for involving the private sector in commercial enterprises favouring biological diversity conservation;
- 11) Support an information and documentation centre on biological diversity;
- 12) Support the inclusion of biological diversity concerns in NRM projects;
- 13) Develop a methodology for environmental impact assessment and encourage its adoption;
- 14) Encourage the phasing out of those pesticides having serious negative effects on biological diversity and promote the application and storage of pesticides in such a way as to minimize negative effects on biological diversity;
- 15) Support education and training in ecology and biological diversity conservation at the University and training establishments.

BIOLOGICAL DIVERSITY IN NIGER

INTRODUCTION

This report is a biological diversity assessment for the Republic of Niger, carried out by the Niger Representation of WWF, the World Wide Fund for Nature, on behalf of USAID-Niger. It is not meant to be a comprehensive statement of biological diversity in Niger. That would take far longer than the two months of this study. Rather, it is meant to serve as a starting point, a "document de base", providing a springboard to further consideration of biological diversity concerns and issues in Niger and encouragement to integrate biological diversity conservation in the economic and cultural development of the country.

The full implications and ramifications of the conservation of biological diversity are only just beginning to be understood, at a time when biological diversity is severely threatened all around the world. Niger is no exception. The series of recent droughts and the increasing pressure put on the country's natural resources by a rapidly expanding human population have adversely affected its biological diversity. However, the picture is not all negative. Despite severe economic problems, there are signs that the Government of Niger is showing a heightened awareness of threats of environmental deterioration and the inextricable links between the conservation of its natural resources and its economic and social development. The development of a national natural resource management plan and the formulation of new rural code are evidence of this. The increasing involvement of local, rural populations in improved natural resource management initiatives, perhaps precipitated by a greater awareness of the dependence of their welfare on an increasingly degraded natural resource base, is another encouraging sign. It is to be hoped that this assessment will encourage a closer dialogue between the Government, the international development community and the farmers, herders and fisherman of Niger on biological diversity conservation.

Definition and Goal of Biological Diversity Conservation

Biological diversity refers to the variety of living organisms. This variety stems from genetic make up of individual organisms. It is impossible to fully document genetic diversity and so, for the sake of convenience, biological diversity is measured at various levels, such as races, species, communities and ecosystems. Some groups of organisms are more interesting and useful to man, and hence better known, than others and the level at which biological diversity is generally categorized reflects this disparity of knowledge. Thus, for valuable food crop species, genetic diversity within populations is important for human welfare and much effort has focused on research at this level. In contrast, poorly documented ecosystems exist within which many species are unknown. This is why in Niger biological diversity documentation includes crop genetic diversity and gallery forests. They are different ends of the same spectrum and reflect variation in knowledge. There are species in the gallery forests that may be potentially as important as millet, for human welfare, but, because that potential has not yet been discovered, those species remain poorly known.

Biological diversity is the key to maintaining the integrity and functioning of ecological processes upon which production depends. Stability of such production systems depends on the full range of biological diversity and its reduction can have unpredictable repercussions, as in "simplified" human agricultural systems with their vulnerability to pest species. Biological diversity has an array of consumptive and non-consumptive uses for human populations, many of them unrealized. It is for these reasons that it is difficult to apply traditional economic valuations to biological diversity conservation, quite apart from its inherent value as part of a national and global heritage.

The conservation of biological diversity thus refers to the optimal management of biological diversity to maximize its multiple benefits to human populations while assuring its potential to continue to provide those benefits for future generations.

PART I: THE STATUS OF BIOLOGICAL DIVERSITY AND ITS CONSERVATION

1. LANDSCAPE PATTERNS

1.1 Classification of Biotic Zones

The classification of the biogeographical zones present in Niger has typically taken into account isohyet distribution and defined various "belts" as Saharan, Sahelian or Sudanian, or some mixture, such as Saharo-Sahelian. This is useful up to point. Niger certainly contains areas of Saharan desert where rainfall is not annual, and it contains a small area of Sudanian woodland in the extreme south (average rainfall over 800 mm.). However, the distribution of biotic zones in between is very variable, and in a sense, "mobile", as long-term rainfall patterns shift.

The classification that follows is one of several that could be adopted and is presented in a more or less north to south progression.

1.1.1 Desert

This formation includes characteristic sandy erg formations (classic desert with dunes) and more gravelly reg formations, as well as extensive sandy plains, where vegetation is often inexistant except along the desert edge or near mountain massifs. Rainfall is typically very low and erratic in its temporal and spatial distribution. However, when it occurs, an annual vegetation appears, characterized by *Stipagrostis* spp. and *Tribulus longipetalus*, which may last two or three years without further rain. Sand-filled desert wadis, which may only receive rain every 10-20 years, and are often only distinguishable by a line of trees (*Acacia raddiana*), will respond to rainfall with a rapid herbaceous growth (*Panicum turgidum*, *Astragalus pseudotriginus* and *Chrozophora brocchiana*).

1.1.2 Saharo-montane

These high mountain chains, of which the Air and Termit massifs are the most conspicuous, may reach an altitude of over 2000 m. (Mt. Bagezane), and receive a higher rainfall than surrounding areas because of their elevation.

Ravines, wadis and temporary and permanent pools exhibit a relatively rich variety of plant species. The high plateaux are refuges for relict populations of Mediterranean (e.g. wild olive, *Olea lapperinei*) and Sudanian (e.g. *Anogeissus leiocarpus*, *Grewia tenax*) origin. *Acacia ehrenbergiana*, *A. laeta*, *Rhus tripartita* (another Mediterranean species) and *Ficus salicifolia* are characteristic woody species and *Aerva javanica*, *Lavandula stricta* and *Solenostemma olseifolium* are prominent herbaceous species. Along wadis, a more varied vegetation is present, dominated by such woody species as *Acacia raddiana*, *A. albida*, *Balanites aegyptiaca*, *Ziziphus mauritiana* and *Salvadora persica*. Around pools, vegetation types are very variable but include *Tamarix* spp. and *Phoenix dactylifera* as well as typical wetland genera as *Phragmites*, *Typha* and *Cyperus*. Because of the permanent humidity, species of Mediterranean and Sudanian affinities are found here also.

1.2.3 Wadis and Oases

Rainfall in the mountain areas results in runoff often far from the place of origin. Wadis and low-lying areas benefitting from this concentration of rainwater have relatively well-developed vegetation formations with *Acacia albida*, *A. raddiana*, *A. nilotica*, *Balanites aegyptiaca* and *Maerua crassifolia* and a herbaceous layer including *Panicum turgidum*, *Aerva javanica* and *Cymbopogon schoenanthus*. The type of substrate and infiltration rate determines to a large extent the type and persistence of the vegetation. Temporarily flooded areas are often dominated by dense stands of *A. raddiana* with a characteristic herbaceous stratum including *Astragalus pseudotrigonus* and *Bubonium graveolens*.

Oases are areas where surface or near surface water is permanent and vegetation is typically palms (*Hyphaene thebaica*, *Phoenix dactylifera*) or tamarisk (*Tamarix* spp.), with or without emergent waterside vegetation such as *Phragmites* and *Typha*. Examples of such oases can be found at Bilma, Kawar and Fachi.

1.1.4 Sahelian Grasslands (the "pastoral zone") 150-350 mm. rainfall

The vegetation of this zone varies according to latitude, rainfall patterns, soil type and fertility and topography, and, increasingly with patterns of use. Large areas may be dominated by grass cover, with very few trees and shrubs whereas other areas, particularly towards the south have the appearance of a relatively wooded savanna.

In the northern areas, vegetation can be similar to that mentioned for the wadis of the Sahelo-saharan zone. Perennial grasses dominate the herbaceous cover, notably *Panicum turgidum*. On clay soils, other species predominate, e.g. *Sorghum aethiopicum*. In the "steppe" areas, primarily on deep sandy soils, annual grasses are characteristic, notably *Cenchrus biflorus*, *Aristida mutabilis*, *A. funiculata* and *Schoenefeldia gracilis*. Trees are generally rather dispersed, except where local conditions favour more dense stands (e.g. *Acacia nilotica* around depressions). Species include *Acacia raddiana*, *A. laeta*, *A. senegal*, *Maerua crassifolia* and *Balanites aegyptiaca*. Towards the south and east, particularly, the landscape becomes more wooded with areas dominated by *Commiphora africana* on the more lateritic soils, and *Sclerocarya birrea* on the sandier plains. *Guiera senegalensis*, *Boscia senegalensis* and, especially further south, *Combretum glutinosum*, also occur. Grass cover is mainly annual species but some perennials such as *Aristida pallida* and *Cyperus conglomerata* occur (although these are more common further north). In depressions, that retain moisture, vegetation is generally more abundant, including *Acacia* spp. and grasses such as *Panicum laetum* and *Eragrostis pilosa*. In degraded areas, grasses tend to be sparse or absent and the principal plants are invasive species such as *Calotropis procera*, *Zornia glochidiata* and *Mollugo* spp.

1.1.5 Plateau Woodlands

On the lateritic soils of the plateaus of the Sudano-sahelian zone, vegetation is characterized by a shrub woodland, or brush ("brousse tigrée") dominated by several species of Combretaceae, notably *Combretum micranthum*, *C. nigricans*, *Guiera senegalensis* and *Combretum glutinosum*. *Boscia*

angustifolia, *B. senegalensis*, *Cadaba glandulosa*, *Acacia ataxacantha* and *A. macrostachya* are characteristic species of these areas. The herbaceous layer consists of a variable species mix, including *Eragrostis tremula*, *Diheteropogon hagerupii*, *Pennisetum pedicellatum*, *Alysicarpus ovalifolius* and *Tephrosia* spp.

1.1.6 Sudanian Woodlands

On the richer, deeper soils of the higher rainfall areas of the Sudanian zone a well-developed woodland appears, often dominated by *Terminalia avicennoides* with *Anogeissus leiocarpus*, *Pterocarpus erinaceus*, *Prosopis africana*, *Adansonia digitata*, *Bombax costatum* and *Isobertinia doka*. Perennial grasses include *Andropogon gayanus* and *Hyparrhenia involucrata*. Gallery forests along watercourses may have a canopy height of up to 25 m. and characteristic species include *Mitragyna inermis*, *Detarium microcarpum*, *Khaya senegalensis*, *Daniella oliveri* and *Nauclea latifolia*. Some gallery forests (notably in "W" National Park) contain stands of *Cola laurifolia* and *Kigelia africana*. In some areas, notably the Dallol Mauri in south Dosso department, there are fairly extensive stands of *Borassus aethiopicum* palms.

1.1.7 Wetlands

The principal wetland areas in Niger are the Niger river, which runs through the southwestern portion of the country over a distance of 550 km., its floodplain and tributaries, and Lake Chad, which, in good rainfall years, extends into Nigerien territory. A number of permanent lakes exist, including those at Tabalak, Kao and Madarounfa, as well as the oases in the desert areas. Seasonal rivers, streams and ponds are widespread during the rainy season. The most important of these is the Komadougou-Yobe river, which forms the international boundary with Nigeria in the southeast for 150 km. of its length.

1.2 Changes in Landscape Patterns

Historically, the landscape of Niger has gone through many changes as a result of global climate changes. This is evidenced by the presence of relict

populations of Mediterranean and Sudanian species in the Saharo-montane massifs. In the Pleistocene, much of Niger was covered by a huge lake, which then retreated, only to reappear 10,000 years later. During the drier spells before and after the appearance of the lake, the country was probably dominated by savanna and woodland even north to areas now in the Sahara desert. This is attested to by cave paintings in the Air dating back to Neolithic times which represent animals unrecorded from the area in modern times, such as rhinoceros, elephant, buffalo and lion (Lhote, 1979). Even 6,000 years ago, Lake Chad was estimated to cover 320,000 square km. and to be 40 m. deep. About this time the environment again became more arid, eventually leading to the predominance of steppe and desert present today. Lake Chad has diminished to the point where its surface area in recent years has been as low as 3,000 square km. (Kindler et al., 1989).

Currently the Sahara desert dominates the northern portion of the country. Centuries of human use have altered the landscape, from the establishment of favoured tree species such as the date palm *Phoenix dactylifera* along traditional caravan routes to the advent of crop (principally millet) cultivation in more southerly regions. Traditionally the clearing of croplands for millet was accompanied by extensive fallow periods (now much reduced, even inexistant in some areas). Certain tree species were favoured by the advent of cultivation, most notably *Acacia albida*, which is presently the characteristic tree species of cultivated areas in Niger. The presence of other species in some areas may also be linked to human occupation, e.g. *Balanites aegyptiaca*, *Sclerocarya birrea* and *Adansonia digitata*.

In recent years, there is evidence of a much more radical change in the landscape of Niger due to two factors. The first is the series of droughts that has hit the Sahel since the late 1960s, being especially severe in 1968-74 and 1983-84. The second factor is the concomitant increase in the human population (now 7.2 million and increasing at 3.2% annually) with an increased trend towards sedentarization. The high rainfall years of the 1950s and early 1960s saw an influx of farmers and pastoralists into southern Niger. At the onset of the

drought, many remained. The result has been an increase in the area of land under cultivation, often through extension onto marginal lands, decreasing fallow periods, increasing sedentary livestock populations and greater pressure on woodland resources for fuelwood and grazing land. In the pastoral zone, increased sedentarization has occurred with the northward spread of agriculture and the settling of certain sections of the pastoralist community. The northern limit of cultivation is calculated to have advanced about 110 km. over the past thirty years, resulting in an estimated reduction of overall range production potential of one third (Weber, 1987). The size of the population living north of the 350 mm. isohyet increased eightfold between 1960 and 1985, to 2.3 million.

1.2.1 Effects of Recent Climate Changes

The effect of the drought has resulted in a number of changes in the vegetation of Niger. This can be linked to the fact that isohyets have been displaced 70-100 km. to the south. There has been:

- a) a net loss of woody species, particularly noticeable in northern areas where woody cover is less;
- b) a shift in species composition of rangelands from perennial grasses to more annual grasses and forbs;
- c) a southward extension of certain saharan species, e.g. *Leptadenia pyrotechnica*, a characteristic species of sand dunes;
- d) the restriction of certain species, formerly more widespread, to favoured microhabitats such as depressions (especially for species on the northern edge of their range). Carrière (1989) noted in Mauritania, for example, the restriction of the grass *Schoenefeldia gracilis* to microdepressions, and its replacement over wide areas of the northern Sahel by *Cenchrus biflorus*. However, *Schoenefeldia* remained dominant in areas of the southern Sahel.

Data from the forest of Fayra, near Torodi, in the southeast of the country indicate about a 50% mortality after the 1984 drought for *Prosopis africana*, *Anogeissus leiocarpus*, *Pterocarpus erinaceus* and *Combretum nigricans* (Mochi and Rapant, 1989). Other species severely affected were *Grewia bicolor*,

Dichrostachys cinerea and *Crateva adansonii*. *Lannea microcarpa* and *Butyospermum paradoxum* disappeared entirely from certain areas. Similar declines were noticed elsewhere. Other tree species such as *Balanites aegyptiaca*, *Sclerocarya birrea* and *Diospyros mespiliformis* were relatively unaffected by the drought.

The classified forest of Bakabe, known as the Kapokeraie de Bakabe for its abundance of Kapok trees (*Bombax costatum*) now contains no Kapoks.

In the Sahelian zone, large expanses of *Acacia senegal* and *Commiphora africana* have perished. A consequence of this die-off is that herbaceous species that depended on the favourable microclimate and increased organic matter provided by living trees have also suffered.

However, some species have shown remarkable powers of regeneration soon after the drought, notably *Combretum nigricans* and *Guiera senegalensis*. Others have been very slow to recover, though the good rains of 1988 saw the emergence of seedlings of a number of hard hit species, e.g. *Prosopis africana*.

1.2.2 Effects of Recent Human Activity

Increased population and settlement patterns emphasizing sedentary agriculture have had a marked effect on the Nigerien landscape. Those lands suitable for cultivation have largely been cleared of natural vegetation, except for certain species valued for their products (fruits, leaves, bark) and shade. In the Sudanian zone, these include the following tree species:

- *Acacia senegal*
- *Adansonia digitata*
- *Balanites aegyptiaca*
- *Diospyros mespiliformis*
- *Ficus spp.*
- *Parkia biglobosa*

- *Tamarindus indica*
- *Butyospermum paradoxum*

Among grasses, *Andropogon gayanus* is particularly valued, and often managed for production.

In the Sahelian zone, *Acacia albida* is the dominant tree species of cultivated areas, although other species such as *Balanites aegyptiaca* are also retained. In land left in fallow, a grass and forb layer will return, along with woody species such as *Guiera senegalensis* and *Piliostigma reticulatum*.

As the areas most suitable for cultivation are cleared, population pressure and declining yields lead farmers to cultivate increasing areas of marginal land (on slopes and poor soils). This trend has been exacerbated by drought so that extensive agriculture has become a risk-minimizing strategy on the part of the farmer, adapted to spatially erratic rainfall patterns. The removal of vegetative cover on marginal lands increases the tendency towards soil degradation (nutrient leaching, loss of organic matter, acidification) and increases the risk of soil erosion.

The zones that are not generally exploitable for agriculture, such as the plateau woodlands, have also suffered from the effects of increased human populations. The principal sources of degradation are their exploitation for fuelwood and the large numbers of domestic livestock using the forests. Transhumant herds traditionally exploiting these zones have been augmented by the increasing numbers of livestock owned by sedentary agriculturalists. The composition of local herds has, moreover, evolved towards a greater proportion of goats relative to cattle and sheep. This perhaps puts a greater strain on forest resources due to the wider range of forage species utilized by goats relative to cattle and sheep. These effects are most severe around urban centres where fuelwood demand is high but the need for

fuelwood and grazing have led locally to zones of degradation around small villages.

The extensive rangelands of the southern Sahel have decreased markedly in area due to their conversion to agriculture. The effective northern limit of cultivation (NLC) has moved further north by about 100 km. in the last thirty years, whereas the 350 mm. isohyet (the official NLC, beyond which pastoralists would theoretically not be liable for damage caused by their animals to cultivated areas) has been displaced 70-100 km. to the south. In the northern rangelands, the increase in settlements around water points has resulted in sometimes total loss of existing vegetation, to be replaced by weedy species such as *Calotropis procera*, or even totally barren areas. These areas can extend up to 30 km. from settlements and have increased with the installation of government-constructed boreholes. Increasingly, dry-season gardening is replacing natural vegetation around water bodies and low-lying areas. Finally, the scarcity of trees brought about by the drought has put increased pressure on the remaining woody vegetation for use as fuelwood, construction and forage. In areas with few trees, this pressure is severe, accelerating the disappearance of woody vegetation as regeneration is threatened.

To summarize, the trend of lower and more erratic rainfall patterns with drought years has resulted in a southward shift of the northern limits of vegetative species and communities with isolated pockets remaining in favoured, buffered localities. This phenomenon is not new in this region. Periodic droughts are a feature of the Sahel (National Research Council, 1983a). In the past, vegetative communities have recovered to take advantage of relatively high rainfall periods, as in the 1950s and 1960s, either through regeneration through a dormant seed bank in the soil, or dormant trees (Warshall (1989) mentions an *A. nilotica* forest "coming back from the dead" after several leafless years), or from seed dispersal from surviving individuals (through wind, water, wild and domestic animals). However, the recent droughts have coincided with an unprecedented increase

and sedentarization of the human population on Nigerien territory. This has reduced many of the options available for the potential recovery and recolonization of former and present vegetative communities, should rainfall patterns improve. It is not known whether rainfall patterns will improve, either in the short-term or in the long-term. What is certain is that, barring mass emigration, the population of Niger will significantly increase in the coming decades, and at current rates of increase, will double in 25 years. Yet these people will be largely dependent on the land, its ecological processes and its biological diversity. The landscape of Niger will never be the same as it was thirty years ago. The primary goal of biodiversity conservation is to preserve, enhance and manage vegetative (and animal) communities to continue to provide sustainable benefits to the human population.

2. SPECIES DIVERSITY

2.1 Plants

Niger is not a biodiversity "hotspot". It contains no regions of exceptional species diversity or endemism. Two relatively depauperate biogeographic zones cover over 90 % of the country. These are the Saharan zone, which contains about 1,600 plant species, only 100 (?) of which are endemic (i.e. confined to that zone) and the Sahelian zone, which contains about 1,200 plant species, of which only 40 are endemic. By comparison, the tropical rainforests of the Guineo-Congolian zone contain approximately 8,000 plant species, of which more than 80 % are endemic (IUCN, 1988). This is to say that the vast majority of plant species found in Niger are widespread, not only in the Saharan and Sahelian zones, which themselves stretch across Africa from the Atlantic Ocean to the Red Sea, but also elsewhere in the world where similar habitat is found. The remaining biogeographical zone represented in Niger is the Sudanian zone in the extreme south and southwest of the country. This is a rather richer zone, with about 2,750 plant species, 900 of which are endemic (IUCN, 1988). This zone is also extensive, however, spanning the continent, and Niger is on the extreme northern boundary and probably does not contain many species of a more southerly distribution. To summarize, Niger probably contains very few truly endemic plant

species (four, according to IUCN, 1989) , but certain habitats such as gallery forests and Saharo-montane massifs contain plant communities that are threatened on a regional scale, as well as nationally. The Wild Olive *Olea laperrinei* is listed in the IUCN Plant Red Data Book (Lucas and Synge, 1978).

No comprehensive inventory of the flora of Niger currently exists and knowledge of the status and distribution of rare and threatened species, especially outside of protected areas, is poor. The flora of Niger north of 16 degrees is covered by the "Flore du Sahara" (Ozenda, 1977) whilst that south of about 18 degrees is covered by the "Flora of West Tropical Africa" (Hutchinson and Dalziel, 1927-36). Distributional data on the Saharan region has been computerized in Frankenburg and Klaus (1980). The total number of species recorded for Niger is 1,178 (Peyre de Fabregues and Lebrun, 1976; Lebrun et al., 1983). The principal botanical surveys in Niger include the floral inventories of "W" National Park, mainly carried out by Peace Corps volunteers. A total of 454 species has been listed. The Air-Ténéré NNR contains 350 species. The recently-completed study by Mahamane Saadou of the upland vegetation of Niger east of the Niger River (and hence excluding most of the Sudanian zone) counted 860 species, including 70 species "new to Niger". Documentation on abundance and distribution is even more urgent considering the effects of drought and exploitation of natural lands and vegetation on Niger's flora. An initial step would be the publication and distribution of Saadou's thesis work.

2.2 Fauna

Just as the vegetation in Niger can be considered to advance and retreat according to climatic trends, the fauna can also be considered as a dynamic entity responding to long- and short-term fluctuations in climate and habitat availability. Faunal changes may be easier to monitor and be more immediately responsive to these changes than changes in plant communities. For example, one observer considers that the large mammal fauna in Niger has declined in numbers by about 90 % over the last twenty years (Anada, 1990). Several species have become extinct in this time (see Table 1.). Whether they would reappear in more

Table 1.

CONSERVATION STATUS OF LARGE MAMMALS IN NIGER
(Source: WWF-Niger, 1990)

SPECIES	STATUS	NUMBER	DECLINE	PRINCIPAL AREAS
Elephant	H	5-600	P, T, H	"W", Tamou, Madarounfa
Hippopotamus	H	200	A, H, G, D	"W", Ayorou
Giraffe	H	<100	P, H, D	Boboye, Dallols
African Buffalo	H	5-600	P, F, H, G	"W", Tamou
Roan Antelope	T	7-800	P, H	"W", Tamou
Addax	H	<200	P, D	Air, Ténéré, Termit
Scimitar-horned Oryx	E	Extinct	P, H, D	Sahelo-Saharan zone
Topi	H	<100	P, H, G	"W", Tamou
Hartebeest	T	4-500	P, H	"W", Tamou
Defassa Waterbuck	T	<300	P, H, G, D	"W"
Kob	T	<400	P, H, D, G	"W", Tamou
Bohor Reedbuck	T	<1000	F, H, G	"W", Tamou, Sirba
Bushbuck	T	1-2000	P, F, H	"W", Tamou, Sirba
Dorcas Gazelle	S	?	P, D	Sahelo-Saharan zone
Dama Gazelle	H	<1000	P, H, D	Air, Termit, Azouak
Red-fronted Gazelle	T	?	P, H, D	Sahelo-Sudanian zone
Common Duiker	S	?	F, H	Sudanian zone
Red-flanked Duiker	H	<100	F, H, D	Mekrou Valley
Barbary Sheep	T	1-2000	P, D	Air, Termit, Djado?
Lion	H	<100	E, H	"W", Tamou, Sirba
Leopard	E	Extinct	P, T, E	Sudanian zone
Cheetah	H	<200	P, T, E, D	Air, Termit
Spotted Hyena	H	<50	E, D	"W", Tamou
Striped Hyena	H	<500?	E	Sahelian zone
Common Jackal	S	?	E	Sahelo-Sudanian zone
Hunting Dog	E	Extinct	E, H	Sahelo-Sudanian zone
Manatee	H	<100?	A, P, H	Niger river
Warthog	S	?	E	Sahelo-Sudanian zone
Spot-necked Otter	E	Extinct	A, H	Rivers and streams
Clawless Otter	H	?	A, H	Rivers and streams
Patas Monkey	S	?	H, D	Sahelo-Sudanian zone
Green Monkey	T	?	F, H	Gallery forests
Olive Baboon	S	6-700	H, D	"W", Tamou, Air

Conservation Status: E: Extinct within last thirty years, T: Threatened
H: Highly threatened, S: Stable

Number: Based on censuses, studies and observations made during the past five years (1985-1990)

Causes of decline: A: Accidental mortality (esp. fishing nets)
P: Poaching/hunting
T: Trade in the animal or its products, e.g. ivory, skins, etc.
E: Eradication or poisoning
F: Brush fires
H: Loss of habitat through human occupation
G: Illegal grazing in protected areas
D: Drought and desertification

favourable times is debateable. There would at least need to be a source pool for recolonization and sufficient available habitat to maintain populations.

An example of the complexity of the Nigerien fauna can be gauged by examining the components and movements of its avifauna. During and after the wet season, there is a net northward movement of certain components of the bird fauna, with Sudanian species invading the Sahel and Sahelian species being found in the Saharan zone. Some of these species stay to breed. There is a corresponding retreat in the dry season. In addition, there is an influx of Palaearctic migrants during the northern winter, some of which remain in Niger and others of which pass through to spend the winter in more southerly latitudes. Superimposed upon this pattern are the intra-African migrants, some of which, such as the familiar Abdim's Stork (*Ciconia abdimii*), arrive to breed in Niger during the rains but subsequently migrate to southern Africa, and at least one Palaearctic species (*Apus pallidus*) that is a summer visitor breeding in Niger. However, despite the mobility of birds, the availability of appropriate habitat in Niger and elsewhere may be critical to certain populations. For example, the British population of the Whitethroat (*Sylvia communis*), a species wintering commonly in the Sahel, declined by at least 60 % between 1968 and 1969, coincident with the major drought in the Sahel that year. A similar, though less drastic decrease coincided with the 1984 drought. Such declines, often temporary, have been noted elsewhere in Europe for a number of species characteristically wintering in the Sahel (Fuller et al, 1989). It is known that such migrants often remain faithful to discrete wintering sites and migration routes so such areas are critical to the continued survival of certain populations.

2.2.1 Mammals

At least 127 species of mammals have been recorded from Niger (Appendix 3). Of these, 28 are bats and 27 are small rodents. Most of these species have been recorded in either "W" National Park or the Air and Ténéré National Nature Reserve. Table 1. shows the status, principal areas occupied and reasons for decline of the larger mammals. According to the IUCN categories, Cheetah, West African manatee, Barbary Sheep and Dorcas, Dama

and Red-fronted Gazelles are listed as "vulnerable" and Addax and Scimitar-horned Oryx are considered globally endangered. Another, little-known gazelle, the Slender-horned Gazelle (*Gazella leptoceros*), a true Saharan species, has also been recorded in the Nigerien desert.

The Scimitar-horned Oryx has undergone a precipitous decline in recent decades, and if any survive in the wild, it will be in the Ouadi Rime-Ouadi Achim Faunal Reserve in Chad. The last individuals seen in Niger were noted in 1986. The Addax is undergoing a similar decline and none have been seen in Air-Ténéré NNR since 1986 (tracks have been found in each of the last three years), although four were seen at Termit in 1990 (Newby, J., pers. comm.). The Dama Gazelle should probably also be classed as endangered, with a population estimated at 170 individuals in the Air-Ténéré NNR. More disturbingly, the species has shown no recovery in the relatively good rainfall years since 1987, in contrast to the more sedentary Dorcas Gazelle, whose population has doubled in the Air-Ténéré NNR, to about 12,000 individuals (Magin, 1990a). For the Oryx, Addax and Dama Gazelle, a variety of factors has led to the demise. These species traditionally undergo long migrations in search of seasonally available pasture. Drought, and occupation of marginal lands by pastoralists and their herds has placed them under great pressure and hunting from motorized vehicles from wealthy and influential people and from the military is threatening their existence. Poaching by the military is the principal threat to Dama Gazelles in the Air-Ténéré NNR (Magin, 1990a). It is clear that any effort to protect these species requires action from the very highest level to effectively prohibit poaching by these groups. Barbary sheep have seemingly increased spectacularly in the Air-Ténéré NNR since 1986, with a doubling of the population to about 3,500 individuals. Significantly this species is not threatened by hunting by the military because of the inaccessibility of its mountain habitat (Magin, 1990a).

Compared to the domestic livestock using the Air-Ténéré NNR (over 90,000 head, mostly sheep and goats), the wildlife forms a very small proportion of

the overall biomass (less than 6 %, even in favoured habitats), but more information is needed on seasonal habitat use by both domestic stock and wildlife to assess the effects of potential competition and effect on pasture resources. It should be noted, however that the presence of pastoralists and their herds can prevent wildlife exploitation of favoured habitats even if potential competition with livestock is minimal (Magin, 1990b).

In March, 1990 a workshop on the conservation of Addax and Scimitar-horned Oryx in Niger was organized by the DFPP, WWF and the Zoological Society of London. As well as raising the profile of these two species in Niger and raising the profile of Niger as possibly the last potential stronghold of these species in the wild, the workshop came out with recommendations on their conservation, including plans for captive breeding and reintroduction. For Addax, the reintroduction site would be the Air-Ténéré NNR. For the Oryx, Gadabéji was originally considered but the degraded ecological conditions and level of human occupation led to its rejection in favour of a possible site at Ekrafane. There is no doubt that the presence of a semi-captive herd of Oryx could focus increased attention on wildlife among Nigeriens as well as attract international attention, even if eventual reintroduction proves problematical.

The small population of Giraffes in Niger, estimated at 50 animals, concentrated in the Kouré/Dallol Boboye area of Dosso department is the remnant of what used to be a much larger population. These animals cause very little crop damage and provide revenue to local villagers acting as tourist guides (Ciofolo, 1990).

The Elephant population in Niger seems to be divided into two groups, the larger centred around "W" National Park and a smaller group of 70-100 animals south of Madarounfa. Both groups are mobile and circulate outside Niger (in the case of the Madarounfa herd, in Nigeria). The Madarounfa herd has (re)appeared only in the last few years, and now occupies a largely

agricultural landscape, with the attendant problems of crop damage. Several proposals have been forwarded to attempt to minimize such damage and these are currently being evaluated.

The Manatee population is unknown, but thought to be small. A census would be useful.

2.2.2 Birds

Almost 500 species of birds have been recorded from Niger, about a quarter of which are Palaearctic migrants. None are endemic (one species of debatable taxonomic status, the River Prinia, *Prinia fluviatilis*, occurs around Lake Chad and possibly along parts of the Niger river) and most are represented in the two principal protected areas. A few species characteristic of the Sahelian grasslands do not occur, or occur rarely, in these protected areas. Most of these are poorly known and some, such as birds of prey and bustards, may be vulnerable. Wetlands represent the other major habitat type critical to birds in Niger. Several breeding species are found along the Niger River that are not included on the "W" National Park list, although they may occur there. The Niger River and Lake Chad are important habitats for migratory Palaearctic species, notably wildfowl and shorebirds. An aerial survey in January 1984 counted over 36,000 Garganey (*Anas querquedula*) and 13,000 Pintail (*Anas acuta*), both Palaearctic duck species, along the length of the Niger River. At the same time, the numbers of these two species on the northern part of Lake Chad (mostly in Nigeria) were a staggering 520,000 and 220,000 respectively (Roux and Jarry, 1984). Perhaps up to 20,000 shorebirds, mostly Ruff (*Philomachus pugnax*), winter along the Niger River, often in association with irrigated perimeters.

As previously mentioned, the oases, mountain massifs and vegetation stands of the Saharan and Sahelian zones are very important for migratory birds crossing the Sahara desert. The southward migration coincides with the end of the rainy season, so that normally, food, in the form of insects and other invertebrates, is available. However, the return migration is at the

end of the long, dry season, when food supplies would seem to be at their lowest. In fact, at this time of year, many Sahelian shrubs and trees are flowering and fruiting, and migrant birds rely on this resource to build up fat supplies to enable them to overfly the Sahara Desert. *Salvadora persica*, *Maerua crassifolia* and *Balanites aegyptica* all produce fruits much favoured by birds at this time. The drought has had a negative effect not only in terms of the disappearance of trees through increased mortality and susceptibility to damage but also in terms of fruit production, which was much reduced or inexistant for some species. However, the picture is not all negative. The development of Arlit, in the Saharan zone, as a mining town has resulted in the appearance of well-watered residential gardens with trees which are attractive to migrant birds in an area that once was desert (by contrast, however the presence of acid evaporation ponds here are responsible for the death of a number of birds each year).

The Air and Ténéré National Nature Reserve contains the largest remaining population of the West African race of Ostrich (*Struthio camelus*), estimated at 1600 individuals in 1990, and increasing (Magin, 1990a), despite some poaching and harassment by tourists. The endangered Nubian Bustard (*Neotis nuba*) also has a healthy and increasing population in this reserve. The threat of hunting parties organized by Saudi royalty has not materialized in the reserve, although such exploitation has occurred in nearby Mali (Newby, J., pers. comm.).

It is noteworthy that, in areas fairly recently converted to agriculture, the continued presence of a number of bird species, particularly large birds such as birds of prey and ground hornbills is linked to the availability of remaining large trees, indicating that nest sites may be a limiting factor in their distribution. By far the most important tree species for such birds is *Khaya senegalensis*. Considering the beneficial ecological role played by these bird species (control of rodents, locusts) and the cultural significance of others (such as the Ground Hornbill, a symbol against witchcraft and associated with traditional hunting), this relationship needs

to be considered in environmental planning. Although *Khaya senegalensis* is a protected species, considerable mortality has occurred because of bark-stripping for medicinal purposes. A stronger incentive for the preservation of this species on agricultural lands needs to be instated, e.g. through education and awareness campaigns and encouragement of regeneration and rational exploitation by forestry agents.

2.2.3 Reptiles

The small numbers of Nile crocodiles along the Niger river are threatened. The African Spurred Tortoise, on IUCN's Red Data List presumably occurs in Niger, and IUCN has suggested a survey of its status and conservation needs (IUCN, in prep).

3. PROTECTED AREAS

3.1 Description

There are a number of protected areas in Niger which are designed to preserve and protect ecosystems and to prohibit or control the exploitation of their constituent plant and animal species. These include:

3.1.1 "W" National Park (220,000 hectares) in the southwestern part of the country. This represents the Nigerien portion of a tri-national Park extending into Burkina Faso (330,000 ha.) and Benin (502,000 ha.). All consumptive exploitation and settlement is prohibited in the park. The Tamou Reserve (76,000 ha.) abuts "W" National Park to the northwest. Although settlement here was originally prohibited at the time of its creation in 1962, recognition of considerable occupation led to the declassification of part of the Reserve (which originally covered 143,000 ha.) in 1976. Considerable settlement has occurred in the Reserve. The Dosso Partial Reserve (306,500 ha.) to the northeast of "W" Park was set up as a buffer area to "W" Park. No provisions regarding settlement, farming and grazing were included in the classification, and it is now widely

settled. Activities of farming villages in these two reserves are supposedly monitored by Park personnel.

3.1.2 The Air and Ténéré National Nature Reserve (7,736,000 ha.) in the Department of Agadez in north-central Niger. This is a recently-gazetted, (1988), multiple use reserve accommodating the customary rights of human populations living in the area, but subject to certain restrictions regarding the exploitation of the natural environment. An area comprising approximately 12% of the National Nature Reserve is classed as an Integral Nature Reserve (Addax Sanctuary) in which access is strictly limited.

3.1.3 Gadabéji Faunal Reserve (76,000 ha.) located in the southern pastoral zone (Dakoro arrondissement) has similar status to the Tamou Reserve and is subject to rather heavy use by pastoralist groups. It has been a reserve since 1955.

3.1.4 Classified natural forests number 79 in Niger, and cover an area of 212,000 ha. (not including restored perimeters and state plantations) scattered throughout the country (only one in Agadez Department). Only two are larger than 10,000 ha., these being Mounouk (61,000 ha.) in Diffa Dept. and Tera (44,000 ha.) in Tillabery Dept. With the exception of a few managed forests such as Guesselbodi, no exploitation of these forest is permitted (except the collecting of dead wood for personal use in some forests) but in reality many are very degraded and some have almost disappeared (including Mounouk, where the trees, principally Acacia senegal, died as a result of the drought).

3.1.5 Protected forests comprise the rest of the forest estate in Niger (note that forest is defined as any natural vegetation stand other than agricultural land - "*donnant des fruits autres qu'agricoles*"). In 1980, "forested land" was estimated to cover nine million ha. (six million ha. in the sahelo-Saharan zone, 2.6 million ha. in the Sahelian zone and 300,000 ha. in the Sudano-sahelian zone). Local populations may have certain use

rights in protected forests that cannot be taken away without compensation. In reality, many protected forests are less degraded than the classified forests, but factors other than legal status, e.g. ease of access, effectively determine the degree of exploitation of a given forest. Small forest stands traditionally protected for cultural and religious reasons ('bois sacrés') occur in the extreme southwest, but their number and extent is thought to be small.

3.1.6. Several Government ranches are scattered throughout the pastoral zone with the object of semi-intensive livestock raising. Because of the exclusion of settlement and pastoralist pressure, the natural vegetation is in better condition than is found generally in the pastoral zone. The largest of these ranches, Ekrafane (110,000 ha.) is located in the west of the country, on the border with Mali.

3.2 Analysis of Needs

3.2.1 "W" National Park

In terms of biological diversity, "W" National Park is undoubtedly the most important area in Niger. Yet, despite its status it is faced by a series of problems threatening its integrity and continued role in the conservation of representative ecosystems. These include the following:

- a) Poaching. Poaching of large mammals for meat and other valuable products (skins from reptiles and ivory from elephants) is a serious problem in the park, especially along the rivers which offer ease of access for poachers, and attract wildlife in search of water. Yet the boundaries of the park are marked by such watercourses over 250 km. of their length. Poaching is probably worst along the Mekrou where poachers take refuge across the river in Benin. Poaching is particularly serious during times of drought when animal numbers are reduced and those remaining are forced to concentrate around well-watered areas. Poaching by the military is a regular and serious threat to the Park's wildlife, against which Park authorities have little

recourse. In addition to wildlife, certain tree species have also suffered from illegal exploitation, notably *Borassus* ("ronier") palms (*Borassus aethiopicum*), which have been decimated along the Mekrou river.

b) Illegal grazing. Large herds are regularly grazed in the park. These belong to transhumant herders and newly-installed populations in areas around the park, who often hire locals to look after their herds. After the 1984 drought there was an invasion of herders (mostly Peuls) into the area, with an estimated 10,000+ head inside the park. The problems raised by this practice are multiple, and include:

- the destruction of vegetal resources, through grazing and browsing. This includes young seedlings and palatable species now rare outside of the park due to livestock pressure. Herders also cut trees for forage. This extends beyond lopping to the actual felling of live trees. Livestock pressure is worst in the remaining gallery forests which are the last refuges of rare and distinctive communities and species.

- prevention of access to favoured pasture and to water points by wild animals. The fertile floodplain of the Niger river, for example, has been more or less totally pre-empted by livestock, so that wild animals traditionally relying on this resource have been forced to seek other, more marginal habitats. This further concentrates animals, thus facilitating poaching.

- the degradation of natural resources. Erosion is becoming a serious problem in the park and is caused principally by livestock. The situation is particularly acute along riverbanks, where animals congregate. Vegetation is removed, ravines form and increased sedimentation of rivers and streams results, threatening their capacity to retain water and affecting the fish and other aquatic

animals dependent upon a steady supply of water of adequate quality. Aquatic vegetation is also negatively affected. In addition, trampling of the vegetation causes soil compaction, thus altering the plant community to favour hardier but less succulent species (which are of course the predominant species of degraded land over large areas of the country outside the park).

• the transmission of livestock diseases to wild animals. In 1981-82, 75 % of the park's Buffalo population died of rinderpest.

- c) **Brushfires.** Each year, one third of the park is burned, on average. In 1988, 70-80 % was burned. These fires are mostly started by herders to stimulate regrowth for pasture. Some may be started by poachers. Firebreaks and attempts at fire management (e.g. early season fires) have had little success in controlling these fires.
- d) **Increased settlement around the park.** The reserves of Tamou and Dosso have seen a rapid colonization, not just from neighbouring regions but from less productive lands further north, such as around Ouallam. In addition to destruction of vegetation as land is cleared, settlement also puts pressure on animals using the reserves (mainly Tamou) as a wet season refuge. Illegal hunting has certainly increased. Several islands in the Niger river that clearly fall within the park boundaries are occupied illegally by fishermen. Fishing in the National Park is itself illegal and the nets used also threaten aquatic birds and mammals, such as cormorants and manatees.
- e) **The presence of significant deposits of rock phosphate in the park** have led to periodic calls for its exploitation. On economic grounds, however, extraction is not considered worthwhile. Such exploitation would clearly be incompatible with the area's status as a National Park.

- f) The threat of dams on the Mekrou and Gambou rivers still exists although no immediate plans are under consideration. The potential to severely affect the Park's important gallery formations would be very high.

What are the solutions to these problems? Newby (1985) suggests three approaches. He points out that the legislation in place for the park is adequate (a management plan was drawn up in 1982). However, it is not enforced. People using the park illegally are perfectly aware of the fact that what they are doing is illegal, but park guards are so few (two in 1990) that the risk of getting caught is very low. There is a need to increase the numbers, training and motivation of park guards. At present guard patrols are frequently abandoned because of lack of fuel or parts for vehicles. Poaching patrols could take place on foot but fire-fighting requires vehicles for prompt and proper attention. In addition, morale among park staff is very low and "W" National Park is regarded as a hardship post by field agents. This is in part because of the support difficulties, but also reflects the low priority accorded the park by higher levels of authority. What is needed is a concerted effort to convince authorities, at all levels, of the importance, nationally and internationally, of "W" National Park and of the extent and seriousness of the threats to it. The GON allocation for the park in fact dropped 10% (from 5.0 to 4.5 million francs CFA - \$US 18,000) from 1989 to 1990, although the French Office Nationale de Chasse has contributed 10 million francs CFA (\$US 40,000) for park improvement.

The EEC has, since 1987, been developing a major regional project aimed at addressing the problems of the protected areas along the national frontiers of Burkina Faso, Benin and Niger. For Niger this covered "W" National Park and Tamou reserve. In 1988, an extensive "feasibility study" was carried out, investigating the status of biological and socioeconomic information, various zoning possibilities and management options, infrastructure and maintenance needs, and training and research needs. Unfortunately, since

that time, the starting of the project has been delayed by lack of agreement among the Governments of the three countries and the EEC upon administrative structure and location. Another project, to be implemented by Peace Corps and supported by USAID, is planned to start in February, 1991 and continue for three years. Peace Corps has a twenty year history of working in the park and is responsible for much of the data collected on its fauna and flora. Research and monitoring in the park will continue, but the focus of activities will be in the adjacent reserves of Tamou and Dosso, where a program of conservation education and the development of small-scale natural resource and agricultural activities is intended to help local populations better manage their natural resources while respecting the integrity of the park.

However, the immediate problems noted above still remain. Recurrent costs are always a serious problem for protected area management that need to be taken into account because just one or two years lack of surveillance can have disastrous consequences for the fauna and flora. Small populations can quickly be wiped out. Therefore, there is a need for resources to bridge the gap until the EEC project gets underway. Logistical and equipment support to park personnel, training of guards and trackers, including reward and other incentive systems and campaigns to increase awareness at various levels and to increase tourism are all immediate needs. A couple of years neglect could take a significant amount of time and effort to reverse in terms of environmental degradation, of which biological diversity is such a critical part.

3.2.2 Air-Ténéré National Nature Reserve

Although this reserve was only gazetted in 1988, a great deal of the work that led to this was achieved under a joint IUCN/WWF/DDA project (Conservation and Natural Resource Management in the Air and Ténéré) with the GON, which started in 1982 and is in a second phase, planned to continue until the end of 1993, with Swiss and Danish support. The goal of the

project is sustainable development of the region based on the rational utilization of all of its natural resources and has three principal components - protection, rehabilitation and rational use of natural resources. Much valuable inventory, monitoring and research work has been done on the animals and plants of the region and a lot of effort has gone into conservation education at all levels from pastoralists to schoolchildren, and to support local populations and Government services to encourage a better natural resource management. Activities include reforestation, soil and water conservation, improved stoves, protection of gardens as well as woodless construction. This has been accompanied by a diverse training program varying from basic first-aid education to well-digging and solar dryers for vegetables.

The project is still experimental. A great deal has been learned about the ecology of the region and a number of approaches have been tried to improve local natural resource management and environmental protection (see the project evaluation report, 1989). This has undoubtedly resulted in a greater appreciation of the opportunities and constraints to an integrated environmental management of the region on a global scale. The area is used by a variety of transhumant and nomadic herders and locally by groups practising small-scale gardening. It is, of course, fundamental to fully understand the ways in which these various groups interact with the environment and their perception of the environment in order to build on traditional use patterns to achieve better environmental protection and management. Active participation of all groups using the area will be critical to success. The current phase of the project will continue research on the ecology of the region, including the effects of different land use management strategies on this ecology, setting effective monitoring and evaluation criteria and developing a management plan for the area based on zoning according to various ecological and land-use categories. Success will ultimately depend on the involvement of local populations, but the legal framework of the reserve and the political framework of the proposed Rural Code offers an opportunity to establish rights and responsibilities

for local groups practising sound and sustainable environmental management. This project is providing some important precedents in the incorporation of local populations in the management of protected areas, and should be supported.

3.2.3 Termit

The Termit massif and surrounding areas have for some time been recognized as sheltering important populations of several wildlife species. Surveys have been relatively few due to the inaccessibility of the area but indications are that conditions may be rather more favourable to the maintenance of these populations than the harsher environment of the Air-Ténéré. The region may hold the last viable population of cheetahs in Niger and be the final stronghold of Addax, and if they still exist, Scimitar-horned Oryx, in the country. A recent reconnaissance mission in July, 1990 confirmed the existence of Addax in the region and noted the presence of considerable areas of pasture land in relatively good condition. The migration of desert antelopes is very poorly understood and it may be that the populations of the southern Air-Ténéré and Termit share common grazing lands. Thus the Addax sanctuary in the Air-Ténéré NNR may be relatively ineffective if other critical parts of the animal's range are not also protected. Clearly the primary need at Termit is further research and exploration and better understanding of human/environment dynamics in the region. This could benefit from the experiences gained in the Air-Ténéré.

3.2.4 The Ranches

The Government ranches scattered through the pastoral zone represent probably the best remaining pastoral resources in the country due to the lack of encroachment by agriculture and their relative freedom from some of the abusive environmental practices found elsewhere. The fauna is in reasonably good shape, although, as elsewhere, a number of the larger species have disappeared. The largest of these ranches is Ekrafane, which was run by the government parastatal SONERAN for semi-intensive meat production and has been "offered" to the Ministry of Water and Environment

by the Ministry of Agriculture and Livestock due to the upcoming liquidation of SONERAN. Proposals for exploitation include ostrich ranching (for a variety of body parts) and tourism. The latter profits from proximity to Niamey. It has also been suggested as the best option for a captive breeding centre for the eventual reintroduction of Scimitar-horned Oryx into Niger. The presence of Oryx, even in a semi-captive state would undoubtedly add to the area's tourist potential. A multiple use solution is probably most viable, with, in addition the above-mentioned features, the potential for research on pastoral systems (particularly as a control site), trials on forage and browse species and as a reserve for the conservation of ecological communities now poorly represented in the pastoral zone (including important crop genetic resources). Ecological inventories of Ekrafane and the other ranches would be a useful first step.

3.2.5 Gadabéji

Gadabéji has been the object of a Dutch-financed project implemented by SNV since 1989 aimed at environmental restoration. Actions include awareness-raising, brush fire control, anti-poaching measures, improvement of ponds, soil and water conservation works, natural regeneration and planting of native tree species. Several studies - socioeconomic, silvopastoral and biodiversity - have been carried out (see, for example, Hassane (1990) and Ibro (1990)). A management plan is envisioned in 1992 and will have an interesting impact on what is a fairly heavily occupied area.

3.2.6 The Extreme Southwest

This region, stretching from the Mali border, north of Ayorou, south along the Niger river and its tributaries (notably the Sirba) down towards the Tamou Reserve is one of the best-endowed areas of Niger in terms of natural resources, though it is largely occupied by agriculture. The area is still relatively well forested and contains several small wetland areas in addition to the river and its tributaries. A recent study (Sani Ado, 1990) looked at four sites in the region with a view to limited and local wildlife exploitation. The Gourmantché populations in the region have more of a

tradition of hunting than other ethnic groups in Niger. Large mammals have mostly disappeared from the region, with the exception of hippos around Ayorou and possibly Manatees in some parts of the river. Small game is still relatively abundant. Although the creation of protected areas per se is probably not feasible, these cases offer very good possibilities for pilot projects for the development of local land use plans, based on popular participation of local communities (*aménagement des terroirs*) and involving protection and management of natural resources, including biological diversity. An example might be the Sirba, where the various demands on seasonally flooded land by fishermen, pastoralists and agriculturalists could be harmonized for a better resource conservation. The State would have an important role to play since this region represents an important breeding ground for fish that support many of the fisheries along the Niger river. Similarly, it may contain significant wildlife concentrations of importance, e.g. colonies of waterbirds.

3.2.7 Wetlands

The Niger river is one of Niger's most valuable resources. Competing demands on its multiple resources may pre-empt, permanently or temporarily other uses. Irrigated perimeters, principally for rice production, have been given a high priority by the GON. However, the apparent economic benefits need to be weighed against alternative options foreclosed by this use, especially if areas reclaimed had traditional uses such traditional rice culture and grazing. The Rural Code needs to examine the multiple demands on riverside areas to establish a framework of user rights and responsibilities. In reclaimed areas that are not traditionally flooded, the problems are less complicated. Biodiversity may be increased or decreased by various management alternatives. In many irrigated perimeters, small marshes, left intentionally (for fishing, harvesting of reeds, etc.) or unintentionally, can provide oases of biodiversity in fairly uniform habitat. At least two bird species are more or less confined to these microhabitats in Niger. Experimental land use plans around Ayorou (along the Niger river near the Mali border) have included planted 'bourgoutières'

and management for the resident Hippopotamus population (Ciofalo, 1990). These should be followed up and the economic and social implications evaluated (e.g. harvesting of bourgou for supplementary hippo fodder and for commercial sale, impacts of restricted grazing of domestic livestock, etc.)

Water levels in Lake Chad have declined to such an extent that the lake no longer lies within Nigerien territory for much of the time, and during those periods that it does occupy Niger, it does so for shorter periods of time. The Komadougou-Yobe river, because of drought and upstream dams in Nigeria, now flows only 130-140 days per year, as opposed to 250-260 days in the past, and the flow has decreased by half. Fisheries and recessional agriculture and grazing have been severely affected and vegetation types have also changed, including the loss of wild rice cultivars. A recent study of environmental degradation in the Lake Chad basin (Kindler et al., 1989) came out with a series of recommendations (see Appendix 1.), but most those specific to biodiversity issues concerned areas outside Niger. The Diffa Forestry "cellule" has been inventorying forests in the area. A preliminary survey of the biological diversity of the region with a view to actions to maintain the ecological integrity of the area is suggested.

An inventory of the many small wetland areas in Niger, to establish priorities for biological diversity conservation is strongly recommended.

PART II: THE ECONOMIC VALUE AND USES OF BIOLOGICAL DIVERSITY

1. GATHERING OF PLANT PRODUCTS FOR FOOD, MEDICINAL AND OTHER HOUSEHOLD PURPOSES

The role of native plant products in the Nigerien household economy should not be underestimated. It is particularly important in southern regions. Wilson (1989) found 63 species of wild plants important in the diet of villagers at Boula, a site near Niamey. These were critically evaluated by villagers (principally women) according to a number of criteria including commercial value

(70% of species) and storability. They provided an important nutritional contribution to villagers diets, especially during the period prior to the millet harvest when other foods are in short supply. Wild plants contain several essential nutrients in sufficient quantity to satisfy over 50% of the daily needs of a 4-6 year old child, including Vitamins A and C (nevertheless Vitamin A deficiency, leading to child blindness is widespread in Niger), calcium and iron, as well as protein. This is especially significant considering that some of these nutrients are poorly represented, or lacking in the staple food, millet. This includes the essential amino acid, lysine, which is found in important quantities in two species (*Amaranthus spinosa* and *Moringa oleifera*) consumed in the village. Wild foods are especially important for children, who are only able to consume small quantities of millet relative to their nutritional requirements.

Almost all of the wild food crops studied by Wilson were found close to the village in a fairly intensive agricultural system and were actively incorporated in the farming system and collected by women during the regular agricultural cycle. Much of this exploitation does not reach the market economy but the sale of gathered products ('*produits de cueillette*') can provide substantial family revenue (see Table 2). In the case of gum arabic or *Parkia biglobosa* fruits, this may reach 5,000 cfa (20 \$US) per week. Oil made from *Vitellaria paradoxa* sells at up to 2,500.cfa/litre. This collection and commerce is principally practised by women (though children help in collection) and for certain valuable species, individual ownership discourages harvesting by outsiders and Wilson notes that *Ceratotheca sesamoides*, a herbaceous species, cannot be harvested without the permission of the owner of the field in which it grows. The drought has had a severe effect on valued plant species, notably baobab (*Adansonia digitata*) and *Parkia biglobosa*, which not only have disappeared from some areas but have also stopped or reduced their fruiting. Certain edible species associated with marshes, such as water lilies *Nymphaea* spp. and *Ceropegia* spp. are also much scarcer. Similarly, the removal of bark of some species for medicinal purposes, has resulted in the weakening of trees so that they are unable to withstand the stress brought about by drought. *Khaya senegalensis* is a conspicuous example, and one species, *Boswellia odorata* is now very rare in Niger

Table 2. MARKET VALUE OF SOME FOOD PRODUCTS FROM NATIVE PLANTS
(Data mostly from Torodi market)

SPECIES	PRODUCT	QUANTITY	PRICE (CFA ¹ francs)
<i>Acacia senegal</i>	gum arabic	¼ liter	250-350
<i>Adansonia digitata</i>	leaves	50 kg. sack	250-1500
<i>Adansonia digitata</i>	fruits	one fruit	10-25
<i>Balanites aegyptica</i>	fruits	15 fruits	5
<i>Combretum nigricans</i>	gum arabic	¼ liter	250-350
<i>Crateva adansoni</i>	fruits	?	?
<i>Diospyros mespiliformis</i>	fruits	¼ liter	25
<i>Grewia bicolor</i>	fruits	one handful	5
<i>Gui</i> (parasite) ²	leaves	sack of "salt"	300-500
<i>Hyphaene thebaica</i> *	fruits	three fruits	5
<i>Lannea microcarpa</i>	fruits	three "bunches"	5
<i>Moringa oleifera</i> *	leaves	handful (cooked)	5
<i>Parinari macrophylla</i> *	fruits	one fruit	5
<i>Parkia biglobosa</i>	fruits	¼ liter (powder)	25
<i>Sclerocaryea birrea</i>	fruits	15 fruits	5
<i>Tamarindus indica</i>	fruits	one handful	25
<i>Vitellaria paradoxa</i>	fruits	3 fruits	10
<i>Vitex doniana</i>	fruits	12 fruits	5
<i>Ximenia americana</i>	fruits	7 fruits	5
<i>Ziziphus mauritiana</i>	fruits	one handful	5

Footnotes

Data adapted from Mochi and Rapant (1989)

* Data from Wilson (1989)

¹ 250 cfa = 1 \$US

² *Tapinanthus globiferus*?

(M. Saadou pers. comm.) because of such overexploitation. Some species are valuable drought fallback foods, e.g. *Boscia senegalensis* (known as 'graine du mil' - millet seed, among the Gourmantché of southwest Niger) which provides edible seeds and leaves. A rather more esoteric case concerns the blue-green algae *Spirulina* sp. (not technically a plant) that are consumed as biscuits along the Lake Chad shoreline and which contain 70% protein and are high in vitamin B 12 (WWF, 1989)

The implications of the role and importance of the harvesting of wild plant species for household use lie in its effect on agricultural systems and women's roles. Attempts to promote agricultural packages including intensification of millet yields, pesticides, herbicides and animal traction need to take into account their possibly disruptive role in traditionally diverse, risk-minimizing, farming systems and their effect on women's economy. This is not to say that improved millet production is not a laudable goal but that it should be integrated into production and conservation of wild plant resources. Wild plant species and species diversification in general also have an important ecological role in soil conservation and fertility etc. (see agroforestry section). It also re-emphasizes the importance of forested or brush areas, which invariably contain economically important food and medicinal species.

Another aspect involves the active promotion of wild plants, including re-introductions, research on improving production of fruits, adaptability (e.g. resistance to drought) and incorporating wild plants in natural resource management initiatives, such as soil and water conservation practices. In Boula, ease of storage and ease of preparation were two important criteria on which women based their selection of wild food species. Research on improved storage and processing would enhance the value of these species.

2. FORAGE PLANTS

One of the most obvious economic links between humans and wild plant resources in Niger lies in the dependence of pastoralists on their herds which are in turn dependent on natural pasture and browse availability. Transhumant and nomadic

herders have adapted their lifestyles to take account of the temporal and spatial variability in the availability of these resources. Thus, traditionally, herders move north in the rainy season to take advantage of the seasonal flush of grass species and then return south as the dry season progresses to utilize southern pastures and crop residues. This represents a simplistic picture since different groups use different rainy and dry season pastures. Some groups may occupy a fairly restricted area, grazing favoured areas in the rainy season and dispersing to nearby areas in the dry season. However, all groups depend on the available plant resources. Palatability to various livestock and nutritional value varies between species and, within species, between seasons. Livestock cannot exist on grasses or trees alone. They require both, and trees are normally exploited increasingly as the dry season progresses. Drought has put a tremendous pressure on woody plant resources in the Sahelian zone, not just through direct mortality (after all drought is a recurring phenomenon in the Sahel) but as a result of the increasing pressure put on the remaining vegetation

by livestock in search of forage following failure of annual grasses to germinate. This pressure also affects the perennial grasses that offer forage for a relatively long period. Thus there has been a decline in the woody and herbaceous perennial vegetation. Under the right conditions they can regenerate. However, for trees in particular, this process is slow. Meanwhile the pressure on the remaining trees is intensified, and not only for forage, but also for fuel and construction wood. Where livestock has concentrated during drought periods, such as marshy areas and ponds, and wells, the effect on the vegetation has been particularly severe. Here there is potential for some pond improvement and rehabilitation of degraded areas, using forage species. User rights and responsibilities would need to be clearly defined, but pilot efforts should be attempted in promising areas.

Acacia albida is probably the most popular forage tree species, but *Maerua* spp., *Balanites aegyptiaca*, *Cadaba farinosa* and *Boscia angustifolia* are other preferred species. Cutting for forage is thought to be the principal reason for the disappearance of *Pterocarpus erinaceus* in the Fayra area, and the increased scarcity of other species (Mochi and Rapant, 1989). *Acacia raddiana* and *Ziziphus mauritiana* have also suffered from their popularity in more northern zones (Rodrick, 1990).

Another very important forage species is 'bourgou' (*Echinochloa stagnina*), a prolific grass species found in inundated lands. It used to be very widespread along the Niger river but has drastically declined in recent years due to reduced river flooding and reclamation for irrigated perimeters. Nevertheless it is sold in Niamey and may come from as far away as the Malian border, indicating its value as a preferred forage species. It is extensively grazed by cattle along the river.

3. FUELWOOD AND CONSTRUCTION NEEDS

The principal fuelwood species in southern zones are three members of the Combretaceae family - *Combretum nigricans*, *Combretum micranthum* and *Guiera senegalensis*. The popularity of these species may in part reflect their relative

abundance, but *C. nigricans* is also valued for charcoal and *G. senegalensis* is especially favoured in the rainy season because the wood is flammable even when wet. The chief criterion for choice lies in the length of time the wood keeps burning (Rodrick, 1990). Other popular fuelwood species include *Acacia macrothrysa*, *Anogeissus leiocarpus*, *Combretum glutinosum*, *Cordia sinensis*, *Dichrostachys cinerea* and *Ziziphus mauritiana*, and particularly in northern areas, *Balanites aegyptiaca*. As previously noted, *C. nigricans* was severely affected by the droughts. *C. micranthum* was also affected, but to a lesser extent. However, both species have shown good regeneration, from resprouting, since 1985. Regeneration on formerly denuded areas was said to be good at Fayra (Van Halsema and Salma, 1988) -through seeds or resprouting ?) but Dennison (1990) found little evidence of regeneration from seed at Guesselbodi. Some of the reasons behind the degradation of the natural vegetation of Niger have been previously mentioned. To these can be added the exploitation of woodlands for fuelwood, and especially commercial exploitation. Fuelwood demand in the urban centres, especially Niamey (estimated at 110,000 tons per year), has led to a considerable commercial trade by transporters in the surrounding areas. For Niamey, this includes a radius of up to 150 km., along the principal routes of access (the paved roads southwest to Burkina Faso, east to and beyond Dosso, and the laterite road south beyond Say). This exploitation is largely uncontrolled and benefits local populations only to a small extent, since woodcutters are often brought in from elsewhere by the traders. Realization of the extent and rate of this degradation combined with an awareness that traditional methods of reforestation, typically using "fast-growing", exotic species, were meeting with limited success in the Sahel, led to the first experiments with natural forest management in the region in the early 1980s. These efforts, based on the assumption that natural forests could be managed on an economically and ecologically sustainable basis, primarily for controlled fuelwood exploitation around urban centres, have spawned a new generation of forestry projects, focusing on natural forest management, in Niger and elsewhere. This is not the place for a detailed review of these projects and for this the reader is referred to the proceedings of the National Seminar on Natural Forest Management in Niger, held at Torodi in February 1990. Nevertheless, it is pertinent to note a few

implications of natural forest management activities from a biological diversity viewpoint.

- a) Any activity that reduces the pressures on natural vegetation stands will increase overall biodiversity, providing it does not lead to increased exploitation elsewhere. Natural forest management initiatives typically involve a rotational exploitation of plots ('parcelles'), based on the regeneration time of the principal fuelwood species. Thus areas of forest are protected from grazing and human exploitation and brushfires for a number of years, encouraging natural regeneration. This in turn encourages the return of wildlife populations, already noted at Guesselbodi and Gourou-Bassounga, with the reappearance of giraffes, warthogs and bustards.

- b) Activities often include the restoration of degraded sites through soil and water conservation measures and the planting of native plant species. At Guesselbodi, the most successful tree species planted were *Acacia laeta*, *A. senegal* and *A. nilotica*. *Prosopis africana* and *Adansonia digitata* were not very successful there but had the best survival of all species planted at the more southerly forest of Gourou-Bassounga (Dennison, 1990). At Hamadide, *Acacia* spp. were planted most frequently (*A. nilotica*, *A. sieberiana*, *A. senegal*) with good numbers of *Balanites aegyptiaca*, *Ziziphus mauritiana* and the non-native *Prosopis juliflora*. The perennial grass, *Andropogon gayanus*, is planted at most sites, often in association with soil and water conservation measures.

- 3) Although the principal economic incentive is fuelwood, other forest products are, to a greater or lesser extent, also being managed for greater production. This refers principally to pasture (hay and straw) for animal fodder. This is critical because some forests are heavily used by herders for part or all of the year. At Guesselbodi, cut-and-carry hay exploitation has been very popular, and is predicted to become more lucrative than fuelwood commercialization (Dennison, 1990). The

value of hay and straw varies with season and species composition but may be 40-50 cfa/kg. *Zornia glochidiata*, an annual legume of bare, open areas, harvested after the rains in October and November sells at 74 cfa/kg. in Niamey.

These are some of the more direct effects on biodiversity of natural forest management schemes. However, in order to achieve sustainable management of natural areas by local populations requires that many more conditions be satisfied than merely the technical and economic solutions touched on here. Natural forest management activities are a concrete example of the interdependence of biological diversity conservation and economic development and a good example of how biological diversity conservation objectives can be met while at the same time promoting economic development.

Although natural forest management initiatives represent a promising direction, they are very few in number. By far the majority of fuelwood collection is carried out by women (and to a lesser extent, children) around rural villages. There is a widespread appreciation of the increasing scarcity of fuelwood among rural women, who have to spend an increasing proportion of their time in this activity. In Chim Berkouan, a village in the northern Dallol Bosso, north of Filingué, a return trip to collect fuelwood takes women six hours (Rodrick, 1990)

Certain tree species are highly valued for construction and service wood, for a variety of products ranging from hoe handles and drums to furniture and canoes (for uses of various species, see von Maydell, 1983; Ford, in prep.; Rodrick, 1990). Some of these products clearly require trees of a certain size. Such trees are becoming hard to find. Favoured species have become scarce enough in many areas that less-preferred species are now commonly utilized. The problem is particularly severe in areas where there are few trees at all, let alone of sufficient stature to supply the requisite amount of wood. This is the case in the northern Sahel, for example, where most trees are small, as a result not only perhaps of poor growth and excessive browsing, but also their lack of suitability for service needs.

A number of grass species are also much in demand for construction of fences, granaries, etc. and house repair, including thatch. The most popular species is *Andropogon gayanus*, which, like other favoured species such as *Cymbopogon giganteus*, *C. schoenanthus*, *Ctenium elegans* and *Heteropogon contortus*, is much less abundant now than twenty years ago, to the extent that it is now actively cultivated on agricultural land in some areas. The relatively good rains of the last few years has seen a reappearance of some of these favoured species in areas where they had disappeared.

In Dosso department, the weaving of mats, using leaves from the Doum Palm (*Hyphaene thebaica*), accounts for about half of all non-farm employment activity in rural areas. This activity, practised primarily by women, is also important in Tahoua, and probably other southern departments. However, supplies of palm leaves are apparently declining, despite a local trade (e.g. from Maradi to Dosso), threatening the future of this industry (Mead et al., 1990).

4. AGROFORESTRY

Traditional agroforestry systems have been practised in the Sahel for centuries. The importance of *Acacia albida* in certain traditional farming systems is a classic case. It has already been noted that farmers clearing new lands leave favoured woody and herbaceous species on the land. In addition, fallow periods allow the recuperation of vegetative cover that not only facilitates soil recovery but also provides a source of useful vegetative products. The marked reduction in fallow land over the last twenty years implies decreasing soil productivity and scarcity of gathered plants. The increasing use of manures and fertilizers can counteract the effects of declining soil fertility but does not affect the issue of declining biological diversity on lands converted to agriculture. However, farmers clearing land do actively leave species that are important for restoring soil fertility, notably leguminous species. It is difficult to know how much importance is attached to soil building capacities per se, since these species often have forage value too. *Acacia albida* is an obvious tree species and *Alysicarpus vaginalis* and *Stylosanthes fructosa* are examples of retained annual legumes. In some parts of Niger there seems to be a trend

towards allowing a certain amount of natural regeneration of woody, weedy species such as *Piliostigma reticulatum* and *Guiera senegalensis* on agricultural lands, where their contribution to organic matter through leaf fall and to combatting soil erosion complements their usefulness as sources of fuelwood, medicines, etc. Whether this is related to declining fallow land and decreased availability of many plant species is not known. Incentives for farmers to encourage native species on their lands are very varied, ranging from direct payment for planting or natural regeneration (the "Gao" Projet Agroforestier in Dosso) to providing cash prizes for tree planting (CARE's Maradi Agroforestry Project). In Maradi department, CARE does not provide seedlings to nurseries, rather it encourages farmers to provide their own seed. Since seeds from native species are easier to find than those of exotics, this encourages the use of local species.

5. PEST SPECIES

There are some species for which the conservation of viable populations is not a biodiversity goal. These are primarily disease-causing organisms (to humans, livestock and economically important crop species) and species that habitually cause damage to crop species. These species are often the targets of direct campaigns aimed at eradication or control. Unfortunately, some of these campaigns, notably those involving the use of pesticides, can have serious effects on non-target organisms, including humans. Moreover, the economic viability of certain, extensive crop protection efforts remains to be demonstrated. Rarely are the objects of eradication campaigns species of particular conservation importance. By their nature they are usually widespread and adaptable species. Exceptions occur in the case of large mammals preying on domestic livestock or causing crop losses, and perhaps some migratory, wetland bird species causing some losses to rice crops. However, in the latter case, damage is negligible and control techniques, such as they exist, mostly involve bird scaring devices and actions. For some large mammal species, however, the situation is more serious. Systematic poisoning, using strychnine directed against jackals and hyenas is officially sanctioned. Such poisoning was probably the reason for the extinction of the Hunting Dog in Niger and threatens the future of the Striped Hyena, which was recently exterminated in the Air and

Ténéré NNR through poisoning. Other, non-target species attracted to poisoned bait are also affected. These include beneficial species that mainly prey on pest species such as rodents, and include small carnivores such as mongoose, and birds of prey. The important relic populations of cheetah in Niger are still persecuted by herders because of their threat to young livestock, and face extinction in the country (and West Africa). The Madarounfa elephant herd also causes significant crop damage, notably to stored sorghum. Action should be taken to minimize damage without killing the small populations involved in these two cases, perhaps involving some compensation schemes. A national Elephant Action plan is currently in preparation, supported, at \$1591X1eapart, by CARE. Attempts at agroforestry in Guessebodi suffered serious depredations due to increased populations of warthogs and guinea fowl favoured by forest management. Rabbits are also a scourge of foresters due to the damage they cause to young seedlings.

Terrestrial granivorous birds can be serious pests. In Niger, the potentially most serious pest species is probably the Golden Sparrow (*Passer luteus*), of which up to 100,000 individuals have been noted in just two roosts (near Tillabery). However, a two year study indicated very little damage to millet or rice crops. It has been suggested that damage could be more serious in years when wild grass seeds are scarce (Giraudoux et al., 1988). Localized damage may occur through attacks by much less abundant species, such as Long-tailed Parakeet (*Psittacula krameri*) and Weavers (*Ploceus* spp.).

Pesticides are widely used in Niger for treatment of crop pests, particularly of cash crops, treatment of vectors of human diseases and, especially for locust and grasshopper control. Regular spraying of the Mekrou river to control the simuliid fly that carries onchocerciasis continues, even though the area is a national park and void (theoretically) of human habitation. The fly has been virtually eradicated in the area. Although some pests are of annual occurrence, most species show wide fluctuations in abundance from year to year and locality to locality. Migratory locusts are the extreme example but other insect pests and vertebrates such as rodents and granivorous birds exhibit similar patterns.

In outbreak years, spraying campaigns may cover wide areas. The effects on non-target species in Niger are largely unknown, but recent research in Senegal (FAO, 1990) indicates that it may be significant, particularly for beneficial invertebrates, perhaps including those that help control the original pest. These studies indicate that commonly used locust and grasshopper control pesticides cause significant mortality among birds, fish and freshwater invertebrates. A speculative example from Niger might be the high population of owls, particularly Barn Owls (*Tyto alba*) along the cliffs of the *dallois* (fossil valleys), which subsist almost exclusively on rodents in adjacent cultivated fields. The role of the owls in controlling rodent populations in Niger is not known, though important elsewhere. Yet, like other birds of prey, owls are very susceptible to pesticide poisoning and a decline in the owl population could have serious implications for rodent outbreaks.

Among the most widespread pesticides used in Niger is lindane, one of the most persistent and noxious chemicals of the organochlorine group. Its use in the United States is illegal because of its negative effects on the environment. Another harmful pesticide, of the same group, dieldrin, is no longer used in Niger, although old and unwanted stocks remain. A German study found significant levels of these chemicals in grasshoppers purchased at Niamey market. A Canadian project intends to monitor pesticide residues in soil and water samples this year but no specific studies are planned to test for effects on Niger's fauna. Sensitive areas for pesticide spraying need to be identified. In addition to protected areas, these would include seasonal and permanent wetlands and other areas containing concentrations of vulnerable species (e.g. breeding bird colonies and roosts). USAID is planning to develop a document for personnel of the Nigerien Crop Protection Service on the identification of environmentally sensitive areas and recommendations on appropriate treatment strategies and limitations (USAID/Niger, 1990). USAID has recently issued new pesticide guidelines, emphasizing integrated pest management (IPM) as the preferred method of control, thus minimizing pesticide use. From a biological diversity perspective this would also be the optimal method but for the moment it is clear that pesticide use will continue on a greater or lesser scale and biological

diversity considerations need to be factored in to decision-making on this subject. It should be noted that INRAN has a biological control program, that in addition to inventorying pest predators and parasites, initiated a control program for White Scale (*Parlatoria blanchardi*), a serious pest of date palms in Agadez department, by introducing the predatory ladybug *Chilocorus bipustulatus*. Infestation rates declined from 80-100% in 1973 to 5-15% in 1987 (INRAN, 1988).

Another area of great concern relates to the problem of exotic pest species, such as the Mango Mealybug and the Greater Grain Borer, the latter having quite a large range of host species. The recently introduced (to West Africa) Yellow Scale insect threatens to undermine many forestry efforts in the region, since it attacks the widely-planted Neem tree (*Azadirachta indica*). Water Hyacinth is already established in Niger. Elsewhere this species has clogged up water bodies, causing extensive losses to fisheries and hydroelectric schemes as well as navigation problems. Finally, the New World Screwworm (*Cochliomyia hominivorax*) has recently become established in Libya, and if not soon eradicated, could spread to Niger's domestic livestock herds, and even endangered wild animals such as the desert antelopes. Because exotic pests encounter few natural enemies, they can predominate over native species, seriously affecting the structure and balance of biological communities. Clearly it is desirable to detect and eradicate such pests as soon as possible. If they are already established efforts need to be made to control their spread to new areas. If allowed to become established and spread, their economic and biological impact could be severe and permanent. Regional coordination and cooperation is called for in these cases, as is the case for locust control efforts.

6. CROP GENETIC RESOURCES

There are an enormous number of species whose potential to provide benefits to humankind is unknown. There are a few species from which the enormous benefits have been realized. Among these are the species (numbering about twenty) that provide the staple food crops throughout the world. The Sahel is a centre of crop diversity and domestication, with sorghum (*Sorghum spp.*), pearl millet (*Pennisetum glaucum*), fonio (*Digitaria exilis*), cowpea (*Vigna spp.*) and African

rice (*Oryza glaberrima*) and their wild relatives being native to the area. Wild Olive (*Olea laperrinei*), now restricted to a few high mountain massifs in North Africa, occurs in the Air mountains of Niger. Because of their value, a considerable amount of effort has gone into documenting and collecting the genetic diversity within these species and their wild relatives with the aim of conserving characteristics useful to the improvement of existing strains. This includes not only increased production, but also resistance to drought and pests and diseases. Their conservation is a critical safeguard. It becomes even more important considering that landraces (local varieties of domestic crop species) and wild relatives have suffered many of the same problems as other native plant species in recent decades. Pre-20th Century reports detail a much greater crop diversity in agricultural systems in past centuries, including wheat and barley, as well as more typically Mediterranean crops such as grapes and figs, and a wide variety of garden crops (National Research Council, 1983b). Drought, introduction of "improved" varieties and habitat loss have all combined to reduce genetic diversity. For example, a local variety of millet, thought to be effective in deterring bird pests by means of spiky awns, could no longer be found by the local agricultural extension agent when requested by villagers (McCorkle et al., 1988).

During the last twenty years, IBPGR, ORSTOM and INRAN have collaborated with other organizations to collect samples of landraces and wild relatives in Niger, concentrating on pearl millet, sorghum, cowpeas and rice. The result is several collections around the world, and in Niger where appropriate storage facilities are available. ORSTOM has specialized in wild relatives of millet. IBPGR has an office in Niamey and is focusing on ecogeographical surveys of several species. This requires that not only data on the plant and its geographical location is obtained, but also that information on the habitat in which it is present, is noted. Not only will this be important in future breeding and introduction programs but it will also provide a documentation for many rapidly changing and disappearing habitats in Niger. IBPGR, in cooperation with ILCA is also interested in looking at the genetic diversity of forage species for improvement trials. A 1984 field mission collected a few *Acacia* species and

intended to collect some *Cenchrus* spp. but the seeds proved too "noxious" (Ingram, 1985). Apart from food crops, the genetics of other useful plants has begun to be investigated. For example, it has been found that *Panicum turgidum* is very variable in terms of its dune-fixation ability.

Conservation of crop genetic resources has mostly been ex-situ, any in-situ conservation being the result of the plants being in protected areas, which are often refuges for wild relatives anyway. In this respect, the Air-Ténéré NNR is a critical area for crop genetic conservation. While in-situ conservation is clearly desirable to allow continued evolution in natural habitat, in practice it is rather difficult to achieve. Nevertheless it is important that local areas of particularly high genetic diversity or wild relatives be documented for inclusion in future reserves or management plans. The Government ranches might offer opportunities in this respect. In addition, in-situ conservation of landraces involves a recognition and encouragement of traditional diverse cropping systems. This is an area that needs a great deal more attention.

7. FISH AND FISHERIES

The Niger River represents by far the most important region of fish diversity and abundance in Niger, by virtue of it being the only permanent water body, except for a few small lakes. The river is characterized by inundation zones along various tributaries, such as the Sirba, in its upper reaches (180 km.) and by inundation of a wide floodplain over its lower 150 km., towards Benin. The central section, from the Sirba to the Mekrou, has virtually no floodplain.

Ninety-eight species occur, representing twenty families, the most important of which are the Cichlidae, Bagridae, Mochocidae, Cyprinidae and Mormyridae. Comparison with earlier surveys has indicated a decline in overall fish stocks, a shift in relative abundance from those species depending on flooded zones to more typically riverine species, and a much higher percentage of small and immature fish in fish catches, notably in the lower reaches (Coenen, 1987). Many fish species typically migrate upstream or laterally to flooded areas to breed during the period of flooding, returning when water levels begin to fall.

However, in recent years, water levels have dropped significantly and flooded areas have correspondingly diminished. Additionally large areas have been taken over for irrigated agriculture and waterside vegetation, particularly 'bourgou' (*Echinochloa stagnina*), has been drastically reduced. All these features have acted to reduce the habitat, particularly the critical breeding areas, upon which all fish depend. The other pressure on fish stocks comes from the approximately 3,000 fishermen living along the river, who have to a large extent abandoned traditional methods of capture for more modern equipment, including fine mesh nets. The result has been that a higher percentage of small fish are now captured. In the Gaya region, 80-90% of captures in 1985 were of immature fish, which clearly represents an unsustainable overexploitation. As a consequence of all these negative changes, fish stocks (as indicated by capture) declined from 4,500 tons in 1960 to 900 tons in 1985, representing a decrease in average daily catch per fisherman from 12.5 to 1.5 kg. (Price, 1987).

8. TOURISM

Tourism is heavily reliant on the maintenance of biological diversity, particularly in protected areas but needs to be reconciled with the needs of the fauna and flora. Tourism in "W" National Park brings in about seven million cfa (\$US 28,000) per year to the 'collectivité' of Say arrondissement, as well as revenue for local guides. In the Air-Ténéré, a permit system to collect revenues from the reserve has not yet been instituted. Locally, guides can earn substantial revenues from, particularly, tourist viewing of large mammals such as giraffes, elephants and hippos. An EEC project offering training, technical assistance and commercial promotion to various private enterprises in Niger, includes tourism, and is training guides in Agadez and "W" National Park. The project aims to then promote the use of these guides.

PART III: THE INSTITUTIONAL ASPECTS OF BIOLOGICAL DIVERSITY CONSERVATION

1. LEGISLATION AND POLICY

1.1 National Legislation and Policy

Most legislation relative to land and resource rights in Niger date from colonial times, in which all land and its resources are the property of the State. However land can be conceded to individuals following certain guidelines relating to "improvement" ('mise en valeur'). Thus agricultural lands are regarded as the property of the farmer. However the "natural" resources on those lands are still accountable to the State, and this includes trees and wildlife and there are various sets of laws ('codes') regulating the exploitation of these resources on occupied land, as well as regulating the exploitation of non-occupied lands, such as forests and water bodies. These consist largely of a list of articles prohibiting specified actions and are enforceable by fines. Thus the Forestry Code defines classified and protected forests and the manner in which they can be exploited. In addition the Forestry Code defines a list of protected tree species which cannot be cut or lopped without specific permission from the Forest service:

- *Acacia senegal*
- *Acacia nilotica*
- *Acacia albida*
- *Adansonia digitata*
- *Balanites aegyptiaca*
- *Bombax costatum*
- *Borassus aethiopicum*
- *Butyospermum (Vitellaria) paradoxa*
- *Hyphaene thebaica*
- *Khaya senegalensis*
- *Parkia biglobosa*
- *Parinari macrophylla*
- *Pterocarpus erinaceus*
- *Sclerocarya birrea*
- *Tamarindus indica*

This applies to the trees on agricultural land, as well as other lands. The occupier of that land is responsible for the trees growing on it, such that if someone else lops the tree and is not apprehended by a forestry agent, the owner can then be subject to a fine for the mutilation of that tree, even though he might not have been present when the infraction occurred. This clearly acts as a disincentive to retain, let alone plant, trees on agricultural land. In principle, occupiers of land can have rights to trees planted on their land, and concessions can be made for individuals and groups to exploit areas in the forest domain provided that they agree to environmental rehabilitation measures, such as reforestation. However, interpretation of these laws is subject to the capriciousness of forestry agents and farmers are reluctant to trust to this.

The various codes relating to natural resources may represent the legislation, but the effectiveness of that legislation depends on the manner and extent to which it is applied and here a number of problems present themselves. The Government agencies responsible for ensuring that the legislation is properly applied and respected have neither the resources nor the manpower to effectively do so. Furthermore, the way the codes are written means that enforcement is often seen as repressive. In order for this to be effective it needs to be consistent, and here lies another problem. Forestry agents (which subsumes a larger category including hunting and fishing agents) are often indiscriminate and arbitrary in the application of fines and permits. All this has meant that the Government services have been unable to control the rapid decline in the natural resource base over the years. Forests are being degraded, wildlife and fish stocks are dwindling and protected areas are being invaded by settlers. A realization of this decline, and its effect on Niger's economy, led, in 1984, to a national debate, entitled the "Engagement de Maradi sur la Lutte Contre la Désertification" which represented an important watershed in Niger's appreciation and thinking about environmental degradation and how to combat it. It proposed three major, long-term goals:

- assuring food self-sufficiency
- satisfying energy needs

- protecting and restoring the environment

Unfortunately, the national drive for self-sufficiency has failed to take into account the role and importance of the natural resource base in assuring continued self-sufficiency, to the extent that lands unsuitable for food production in the long-term have nevertheless been converted to agriculture, encouraged by the Governments overwhelming emphasis on food self-sufficiency. Large areas in the south of the country, particularly in Say arrondissement, have been cleared for agriculture, without full consideration of the potential long-term, multiple use benefits of the land. Dry season gardening has also pre-empted many other potential uses of low-lying areas.

The *Engagement de Maradi* also committed Niger to establishing a National Anti-Desertification Plan and to elaborating a new "Rural Code", each requiring a coordination of efforts between local populations and Government services. A national Anti-Desertification plan was outlined in 1985 and languished until being taken up again in 1990, with UNSO support, as part of the effort to establish a national natural resources management plan. The Rural Code process, a systematic attempt to address problems of land and resource tenure, has culminated in the development of a "framework" document (the "loi cadre") within which the modalities of the interpretation and application of the various "textes" remain to be worked out. The latter would include revisions to the various codes relating to forests, fish and wildlife. IUCN has a program of support to the Rural Code Committee for the development of laws and policies relating to the environment. It is also reviewing environmental laws in Mali and Senegal, as well as Niger, in a comparative study.

1.1.1 Forests

Projects over the last few years aimed at natural forest management involving local populations, notably the USAID-supported Forestry and Land Use Planning project, have led to a recent directive (Arrêté no. 048/MAG/EL/CNCR of 16 May, 1990) allowing local communities usufruct rights (to plant products, including wood) in return for following a prescribed

management plan. This was inspired by the Guesselebodi example, but allows for management of lands other than forests. It should allow forestry agents to adopt a more appropriate technical advisory role, since their traditional policing and regulatory role will be taken over by local communities (through a mutually agreed guard policy). However a relatively small area of forests is currently under such management and large areas are still being overexploited for commercial fuelwood, which will result in much greater rehabilitation costs in the future. The World-Bank sponsored Project Energy II is attempting to address this problem through the regulation of local markets and changes in taxation, pricing and control for the fuelwood catchment areas of Niamey and other major cities.

1.1.2 Fisheries

The Niger River Fisheries Development Project, financed by UNDP, worked with local fishing groups to develop management guidelines for river fisheries. These included regulations on certain types of fishing gear to avoid overexploitation and the establishment of fish reserves to facilitate breeding and recruitment. The second phase of this project, to be financed by the African Development Bank, will further pursue these options. Like any popular management scheme, agreement will have to be required by all parties. An awareness raising component is thus intended to reach new fisherman coming into the area, e.g. from Mali and Benin. Fishing rights in lakes and other wetlands need to be clarified.

1.1.3 Wildlife

Hunting was prohibited in Niger in 1964 on a two year renewable basis, with the aim of allowing wildlife populations to recover. This ban became permanent in 1974. However continued droughts and habitat loss have meant little recovery. The last two or three years have seen a partial recovery in some areas coincident with higher rainfall. Nevertheless there is some pressure to re-open hunting, principally for small game. In practice the ban on hunting has not coincided with an increase in wildlife. Most Nigeriens cannot afford firearms, and continue to hunt small game by

traditional means, particularly pest species such as francolins, guinea fowl and rabbits that destroy crop seeds and seedlings. On the other hand, the military continues to hunt indiscriminately, using vehicles and firearms. The argument for reopening hunting lies in the economic incentives for the conservation of habitats and wildlife for sustainable utilization. This, however would require adequate resources and manpower to regulate such hunting (quotas, species permits etc.), as well as the active involvement of local populations. Nevertheless, within the context of local land use management plans, limited hunting of small game species could be allowed and could be an incentive to develop such plans. The Rural Code Committee and the DFPP, with support from IUCN's Environmental Law Centre in Bonn have commenced a study of the legislation relating to hunting and other forms of wildlife exploitation with a view to developing a legal and institutional framework allowing optimal exploitation ("valorisation") of wildlife.

1.2 International Conventions

Niger has a good record concerning the ratification of international treaties protecting its flora and fauna. In addition to demonstrating concern for the conservation of nature, these conventions allow international cooperation in this field. Niger has signed the following conventions (the year denotes the year the convention was ratified by Niger):

- The African Convention on the Conservation of Nature and Natural Resources (OAU) - 1970
- The World Heritage Convention (UNESCO) - 1974
(accepted, not ratified)
- The Convention on Wetlands of International Importance (RAMSAR) - 1987
- The Convention on International Trade in Threatened Species of Fauna and Flora (CITES) - 1975

- The Convention on the Conservation of Migratory Species
(Bonn Convention) - 1980.

Niger has nominated "W" National Park as a RAMSAR site. Other wetlands could profitably be added. Adherence to RAMSAR and the Bonn Convention offer opportunities for cooperation between conservation organizations (particularly those concerned with birds) in European countries and Niger. Such cooperation has resulted in projects in Nigeria, Ghana and elsewhere in West Africa.

1.3 National Environmental Plans

Despite burdensome economic problems, Niger is undergoing an important evolutionary development with regard to formulating a coherent national natural resource management strategy. There are three simultaneous components to this:

- a) The development of a national natural resource management strategy. This will necessitate the harmonization of several recent initiatives, including the World Bank-supported Integrated Natural Resources Program (PIGRN), the revived National Anti-Desertification Plan (PNLCD) and the Niger Tropical Forestry Action Plan. The precise structure remains to be worked out but it will provide a framework for donor investment in the short, medium and long term.
- b) The continuing Rural Code process.
- c) The national land use planning process ('aménagement du territoire'), led by the Ministry of Plan, and still in its early stages.

It is critical that biological diversity considerations are recognized and incorporated in these developments. The national natural resource management strategy will attempt to avoid being sectorial, thus offering an opportunity to integrate biological diversity into the development process without it being pigeonholed as the protection of the fauna and flora, with the usual connotations of protected areas and species. Nevertheless, an important component of this

process will be a clearer definition of the role of the State in the conservation of the "patrimoine naturel". This applies especially to the Rural Code with its notion of "mise en valeur", how this is defined, and by whom.

Many of the sites that are currently under threat in Niger are precisely those areas where biological diversity is concentrated. Often it is this biological diversity that is responsible for maintaining the integrity of these sites, so that when it is exploited in a non-sustainable way, not only is the biological diversity itself threatened, which is often of great economic and social significance, but also the value of the sites themselves. Seasonal marshes are a case in point. Removal of permanent vegetative cover may significantly alter the microclimate, lowering moisture content and perhaps surface water availability, altering the conditions for the growth of valued herbaceous species and reducing fertility through diminished recycling of organic matter, thus reducing options for future use. In these cases, there is an optimum land use management that will maintain biological diversity and the ecological integrity dependent upon it, while providing maximum benefits to the widest variety of users. There will be users and potential users that do not benefit from optimal management and local land use plans must take this into account. Devolving rights and responsibilities for local management of such resources will require safeguards against their potential degradation. It must be emphasized again that restoring biological diversity in degraded areas is very costly compared to its original conservation, whether this be soil and water conservation measures in degraded forests or the reintroduction of large mammal populations.

Thus, national environmental and land use plans need to take account of areas of high biological diversity. This requires information on their distribution, biological and ecological attributes, and patterns of use by various groups. Protected areas have been well documented and a legal framework exists within which management plans have been or are being elaborated. In the Air-Ténéré, use rights and responsibilities for local populations will be harmonized with biological diversity protection goals through the Conservation and Natural Resource Management in the Air and Ténéré Project. In the natural forests, a

legal framework also exists but it has been successfully modified to allow for decentralization of control to local populations. The success and replicability of the natural forest initiatives remains to be seen. Some substantial conflicts still remain between various user groups. Nevertheless, the shift of management responsibilities to local populations is a very important precedent that will have to be expanded to non-forest areas. Inventories in natural forests should be expanded from fuelwood and pasture inventories to include biological diversity inventories and monitoring to provide indicators of the health of the natural ecosystem. Permanent plots and transects should be set up for this purpose. One area which has been little inventoried, is of significant biodiversity interest and which has a poorly, if at all, defined legal framework is the network of wetlands throughout the country, of which the Niger river is a special example. Wetlands everywhere are under threat, but are especially so in arid countries such as Niger (and especially when it is going through a "dry spell").

There is no systematic environmental impact assessment procedure in Niger. Areas where this should be required include wetland development, particularly for the development of irrigated perimeters. Plans for the damming of the upper reaches of the Niger river, to provide electricity and irrigation (the Kandadji barrage) have been discussed for several years. Damming of tributaries has also been suggested at various times. This is clearly an area where environmental impact studies will be critical. The downstream effects on biodiversity need not be negative (regularizing flow rates could benefit fisheries). However, the serious erosion presently occurring along the river could severely compromise the functioning of the barrage. Another obvious area of environmental impact is pesticide use. IUCN is planning a seminar on environmental impact assessment in Niger in 1991, aimed at high-level Government officials and donors. This will be complemented, in conjunction with IUCN's training support to IPDR, by the exploration of environmental impact procedures at the field level.

1.4 Cultural Aspects

Much of the traditional cultural and religious significance of biodiversity is in regression in Niger, but its effects still persist. In past centuries the

penalties for illegally cutting *Acacia albida* trees were severe (in Zinder, the hands of offenders were cut off). Such measures are no longer practised, but *Acacia albida* trees are widespread in Niger probably, in part, due to earlier protection. Individual trees, too, had religious significance, harbouring spirits and some of the large trees in the current landscape owe their presence to this factor. These trees may be important seed sources for future regeneration. Today there are still occasional sacred forests, principally in the Gourmantche region of the extreme southwest, though many fewer since the advance of Islam. At Tchighazarene, in the Air mountains, a local marabout strictly prohibits the exploitation of trees and animals in the neighbourhood, and his authority is apparently respected.

Traditional medicine and traditional hunting are areas where cultural and social history still play an important role and reflect a wider dependence upon natural resources and biodiversity. Farmers and pastoralists in Niger have an acute knowledge of the value of plants and animals as indicators of environmental conditions and health. The presence or absence of certain plant species can indicate soil fertility, texture, depth or water-retention capacity, thus indicating that it is time to put a field in fallow, recultivate or plant different crops. Often, the disappearance of certain species is the first indication of environmental deterioration, although the concept of general and persistent environmental deterioration may be difficult for farmers and herders to grasp (Ford, in prep.).

2. ORGANIZATIONS

2.1 Government of Niger (GON)

The principal GON technical body responsible for biodiversity concerns is the Ministry of Water and Environment, through the Directions of Environment (which is responsible for forests and forestry issues) and Wildlife and Fisheries (see Appendix 2. for structure). The other technical ministry most relevant to biodiversity is the Ministry of Agriculture and Livestock, including the Office of Irrigated Perimeters (ONAHA) which is implicated through the reclamation of riverside habitat. Many non-technical ministries play a wider role in

biodiversity conservation, notably the Ministry of Plan, which is coordinating national land use plans.

The staff of Environment/Wildlife and Fisheries numbered 383 in 1990, of which 39 possessed a university-level training (cadre A), 286 have two years technical training (cadres B and C) and 58 have high school training (cadre D). This total represents a 17.5% increase over the 1988 figures (data from Smith, 1990). Like most of the Government structure in Niger, the Ministry is highly centralized, with the result that at the field level, resources are extremely scarce, effectively hampering implementation activities. The lack of job classification (and hence training requirements), frequent personnel changes and general lack of incentives (the only way to achieve promotion in the Nigerien civil service is through higher training, and not time spent on the job) seriously hinder the effectiveness of ministry operations. The Government is virtually the only employer for graduating students, yet GON budgetary resources for Environment/Wildlife and Fisheries for 1990 amounted to less than one million dollars (4% of the national budget). At the Departmental level, the operating budget for the Direction of Environment is about \$US 1,500. In fact, well over 90% of all resources come from external sources through loans and grants. The Direction of Environment receives over six times the amount of resources allocated to Wildlife and Fisheries, presumably because of the longer tradition of forestry projects and the recent interest in natural forest management operations. Wildlife projects have traditionally been associated with protected areas. The Service de Participation, an institution attached directly to the Presidency, encourages the voluntary participation of young people, in rural environmental rehabilitation, and represents an additional resource to traditional forestry agents. This Service is, for example, very active in the restoration of Takieta national Forest, in Zinder department.

2.2 Non-Governmental Organizations

The private sector is very poorly developed in Niger with respect to environmental activities. Indigenous environmental NGOs number just one, the *Organisation Nigérienne des Volontaires pour la Protection de l'Environnement*

(ONVPE) and this was only very recently granted such status. Another, *Alliance Niger Vert* (ANV) is awaiting the granting of NGO status. Until 1988, the creation of local NGOs was not permitted. Recent proclamations by the GON have indicated a more sympathetic approach but movement has been slow. Both organizations are comprised mainly of Government officials and are oriented towards an awareness raising and advocacy role in promoting the environment through various media channels and schools, etc. Although local environmental development NGOs do not currently exist, the activities of ONVPE and ANV could act as a catalyst to their creation.

International NGOs are present in Niger, and a number of these work in natural resource management, often with a biodiversity emphasis. Examples are CARE and Lutheran World Relief (LWR) working in natural forest management, ISAID working in incorporation of native plants in farming systems and AFVP and CARE in environmental education. The World Wide Fund for Nature (WWF) has been active in Niger since 1974. It has had a Representation in Niger since 1982 and has been active in wildlife conservation (hippos, giraffes, desert antelopes), protected areas management ("W" National Park, Air and Ténéré, Gadabéji) and technical advice to the Direction des Eaux et Forêts.

2.3 International Organizations

Many international donor organizations work in Niger, an increasing number of them in the field of natural resource management. Biodiversity issues are rarely addressed explicitly but are generally viewed as part of the larger natural resource picture. For some specific projects, such as support to protected areas, biological diversity conservation is seen as a major goal. Other than WWF, which has been active in Niger since the mid 1970s, the two organizations most specifically concerned with biodiversity concerns in Niger are IUCN/Niger and IBPGR. Any work related to biodiversity conservation in Niger should be closely coordinated with IUCN and, for crop genetic diversity, with IBPGR.

3. TRAINING

Two training establishments exist in Niger for the fields of rural development. These are the University of Niamey, which produces graduates from the Faculty of Agronomy (around 20 per year). This used to require that the fifth year be spent at a training centre overseas, but since 1989, the training can be completed in Niger. The French cooperation have supported this program for some time through the provision of teachers. The other institute is the *Institut Pratique de Developpement Rural* (IPDR) at Kollo which trains technical agents (cadres B and C). IUCN is also developing a project to assist IPDR in its training program, aimed at harmonizing various technical and training approaches in an integrated land use management approach. This will include a review of current training at IPDR and a survey to determine constraints and training needs of agents in the field.

University places are assigned according to demand from the ministries and rarely take into account student preferences. The first two years are at the Faculty of Sciences. Subsequently courses are at the Faculty of Agronomy and specialized training is given in a number of fields related to ministry needs. Environment/Wildlife and Fisheries is one such specialization (called "*Eaux et Forêts*"). Natural Sciences suffers from a lack of teachers both at schools and at the University. Places at the University are awarded (by the *Commission de l'Orientation et d'Attribution des Bourses*) based on the students schoolwork. Thus the poor level of science teaching in schools tends to count against those students wishing to specialize in this area, leading to a vicious spiral, since the ministry to which natural science students are oriented is the Ministry of Education (the Secretary General is the leading expert on the flora of Niger's aquatic ecosystems).

As part of structural adjustment, it is assumed that the GON will be recruiting few new personnel in the near future since opportunities in the private sector are also extremely limited, leading to a lack of interest in studying environmental disciplines, the World Bank has opted for a on-the-job training ('*recyclage*') for *Eaux et Forêts* personnel. Through the *Projet Forestier*, such

training has been provided at the Torodi training centre (*Centre de Perfectionnement des Cadres du Developpement Rural*), principally to field agents. The overall theme is land use management and specific topics include socioeconomic considerations, natural forest management and agroforestry.

A number of Nigeriens benefit from scholarships overseas, including four at the regional School of Wildlife Management in Garoua (Cameroon) and one at CNEARC (France) whose thesis is on the potential for wildlife utilization in southwest Niger.

4. RESEARCH

The principal research establishment in Niger is the National Agricultural Research Institute (INRAN), consisting of several departments. The largest department is the Agricultural Research Department, organized along three principal lines - plant improvement, crop protection and general agronomy. It currently has 28 researchers and 23 technicians, in addition to expatriate assistance from a number of organizations, including substantial support from USAID. A Genetic Resources Section, based at Kollo, is involved in the collection and storage of landraces of various crops. These are not bred out by INRAN and facilities are still rudimentary. This section receives support from IBPGR, but needs to develop its own program to store germplasm. At present, most of the germplasm originating from Niger is stored elsewhere. Storage facilities need not be too sophisticated, given the lack of humidity (and hence good storage conditions) in Niger, but some cold storage will be necessary.

Another department under INRAN, the Department of Forestry Research, includes wildlife and fisheries research and is, to be blunt, in very poor shape. There are currently two researchers and two student researchers. Financing in recent years has been heavily dependent on two forestry projects, the Forestry and Land Use Planning Project (FLUP) and the World Bank/French-supported *Projet Forestier*. Both projects are now finished, and despite the relatively large number of forestry projects currently operating in Niger, there is virtually no linkage with INRAN. The main programs, such as they are, relate to the improvement of

local tree species (mainly Acacia species), plant-soil-water relations and natural forest management. The research station at N'Dounga, in Guesselebodi forest, was the site of some interesting and valuable research in the 80s, in association with FLUP, including soil management improvement for increased natural regeneration and seeding and productivity trials with local species. Some of the work underlining the ecological importance of termites in forest regeneration should be followed up (it has been suggested, for example, that the disappearance of perennial grasses has much to do with below-ground termite damage in drought years). Virtually no research on wildlife and fisheries is done at INRAN. Long-term plans include nine researchers and a research station at Tahoua, as well as an agroforestry collaboration with ICRAF (plans for the latter are well under way). Collaboration with ICRISAT on agroforestry and with TROPISOILS on watershed research and management is ongoing. The commitment to increasing research and training in forestry and environmental disciplines that was one of the major resolutions of the Engagement de Maradi that has not been followed through, although the World Bank has just signed a major project with the GON to support INRAN (including forestry research).

The University has a Department of Biology within the Faculty of Natural Sciences. It has two staff members, who spend half their time teaching introductory biology to students later specializing in other disciplines and devote the other half to research topics. One is studying a Bruchid beetle pest of cowpeas, the other has just completed an eleven year study of the upland flora of Niger.

Most research related to biological diversity occurs within the context of projects and is often conducted by expatriates. Peace Corps personnel have conducted research in "W" National Park and in several managed natural forests. This is valuable work and will continue in "W" through a Peace Corps/USAID biodiversity project. However, the future of Peace Corps operations in some of the forests is in doubt. Some excellent research on the biological diversity of the Air-Ténéré NNR has been conducted through the Conservation and Natural Resource Management Project of the Air and Ténéré. Research at the natural

forest management sites is haphazard. The approach is still experimental and data on the silviculture of the harvested species is still rudimentary. Some permanent plots have been set up, mainly for biomass regeneration studies. Outside of the typical "plateau" forests, research on natural forest regeneration in the Sahelian zone is taking place at Guidan Ouhoumoudou, near Tahoua, on a variety of Acacia species, *Balanites*, *Ziziphus*, etc. This work is done through the "cellule de planification forestière" at the DDE, Tahoua, which has also profited from German volunteer support. In the pastoral zone, much research was carried out on livestock-pasture relationships through the USAID-supported Niger Range and Livestock project. More ecological work has been carried out in neighbouring countries. Examples are the long-term ILCA studies in the Gourma region of Mali, the Dutch-supported "Primary Production in the Sahel" studies, also in Mali, and the ORSTOM study of Mare d'Oursi in Burkina Faso. It is very important that research activities in Niger do not duplicate these efforts, but rather build on their experience. Coordination and information sharing are critical themes in improved research.

5. ENVIRONMENTAL EDUCATION

A number of projects include an environmental education, or awareness raising component aimed at rural populations, usually in conjunction with discrete activities such as reforestation. The EF has a regional program (Programme Formation/Information Environnement) aimed at systematically introducing and improving environmental education in schools, through training of teachers and students (focusing on teacher training institutions) and providing educational material. Another program (Programme d'Appui aux Activités Pratiques et Productives) is working with French volunteers (AFVP) and Nigerien teachers in 115 primary schools spread through six arrondissements, focusing on practical and productive environmental activities at the village level. The goal is to link awareness and education efforts in the classroom to the "real world" outside and is aimed at teachers, pupils and parents. Information sheets and manuals (le Sahel Vert), as well as T-shirts and other paraphernalia are produced as part of the project.

As an off-shoot of the Air-Ténéré project, IUCN has begun production of an environmental magazine (*Alam*), based on the success of a similar magazine (*Walia*) in Mali. A two-year pilot phase is just beginning, following a one year study phase. It is also producing a teacher support manual for environmental subjects for schools in Agadez department. It is planned to take this latter component out of the project and use it to reinforce the departmental Direction of Environment as part of a program to support the functioning of this body as a decentralized operating unit. IUCN is also planning to support the national museum in Niamey as a centre of environmental education and promotion, through exhibitions, fact sheets and similar awareness-raising efforts (a successful puppet show by a Malian troupe was organized in December, 1990). For many Nigeriens the zoo at the Museum provides the only opportunity to view examples of the large mammal fauna of Niger. Although many have pointed out the educational value of this, the fact is that the animals are kept under very poor conditions and recent economic cuts have made future maintenance doubtful without external support.

PART IV: RECOMMENDATIONS

- 1) Fully incorporate and integrate biological diversity concerns into the national NRM strategy.

A national conservation strategy (NCS), typically championed by IUCN for many countries, may not be appropriate *per se* for Niger, given the development of a more inclusive NRM strategy (but see Appendix 4. for comment by the IUCN Representation in Niger). Rather the elements of a NCS should be harmonized and incorporated in the NRM strategy. The development of this strategy represents a significant opportunity for the consideration and incorporation of biological diversity issues and concerns into national policy and many of the recommendations that follow will best be pursued through this process. This will require the coordination of the Directions of Environment and Wildlife & Fisheries, INRAN, IUCN and WWF, among others.

- 2) Assure the maintenance of a representative sample of Niger's biological diversity through the integrity and continued functioning of a system of protected areas. This should include studies of the feasibility of incorporating Termit, and possibly Ekrafane, as areas with some kind of protected status. Consideration should also be given to areas along the Niger River. Critical to this goal is a commitment to assuring the effectiveness of "W" as a National Park. This should include interim support until the EEC regional project gets underway.
- 3) Produce a strong policy statement, backed by appropriate legislation for the banning of hunting of large mammals and birds by the military and other influential groups.
- 4) Review the options for developing an effective program of research in biological diversity conservation, involving INRAN and the National University.
- 5) Incorporate biological diversity concerns into agricultural research, e.g. consideration of wild plant species in local farming systems.
- 6) Inventory vulnerable areas valuable for biological diversity conservation, notably wetlands and remaining gallery forests. Also areas of high crop genetic resource potential. Biological diversity inventories of the Government ranches to establish their potential as multiple-use reserves is recommended. Conduct inventories of rare and endangered species, e.g. manatee.
- 7) Incorporate biological diversity concerns into the Rural Code.

IUCN is actively working with the Rural Code committee on the incorporation of biological diversity concerns. Studies could include:

- customary and "legal" rights and responsibilities with respect to

biological diversity;

- conflicts arising from the rights and responsibilities of various parties that negatively affect biological diversity and how they can be resolved;
- the role of biological diversity in the maintenance of the integrity and productivity of ecological systems and how this affects the notion of "mise en valeur".

The revision of the various codes relating to biological diversity (forest, hunting and fishing codes, among others), including measures for their implementation will come under the Rural Code process. Careful consideration of biological diversity concerns needs to be incorporated in the early stages of this process. USAID's planned efforts to change the role of forestry agents from a repressive to a more extension-oriented approach will complement this initiative.

- 8) Support selected interventions on a pilot basis to optimize biological diversity conservation while decentralizing rights and responsibilities to local user groups, including a monitoring and evaluation component. Wetland areas are a suggested focus. High diversity sites in the Pastoral Zone could be another area of concentration. This will be done in the Air-Ténéré NNR through the Conservation and Natural Resource Management Project of the Air and Ténéré. Land and resource tenure studies in the Termit region would be a useful complement to other surveys in that area.

Support to the interventions mentioned above will involve a decentralization component including careful consideration to the needs of potentially under-represented and negatively affected groups such as women and certain herder groups. Note, for example the important role of women in the gathering of wild foods and fuelwood.

- 9) Explore opportunities to support local environmental NGOs. Any interventions that create a more favourable environment for the formation and functioning of NGOs in Niger will benefit environmental NGOs as much as any others. Environmental education is a popular and appropriate vocation for national NGOs and should be encouraged through provision of training and study tours. There are a number of national environmental education NGOs and the African Wildlife Foundation, based in Nairobi, specializes in working with local environmental education NGOs. Opportunities for the development of grass-roots organizations associated with specific biological diversity conservation initiatives should be encouraged.
- 10) Investigate the possibilities for involving the private sector in commercial enterprises favouring biological diversity conservation. Ostrich farming could serve as an example. The feasibility of such an operation should be investigated and WWF is pursuing the idea of rehabilitating the ranch at Ekrafane to this and other ends (reintroduction of endangered species, captive breeding). This could include study tours to similar initiatives in other countries, such as Nazinga game ranch in Burkina Faso.
- 11) Support an information and documentation centre on biological diversity, building on the resources of WWF and other organizations. The principal biological diversity NGO in Niger is WWF/Niger. It has had an enormous influence on biological diversity conservation and awareness in Niger and has amassed a great deal of information on biodiversity, which acts as a very valuable resource for Government, donors and other involved and concerned bodies. However, this representation may soon disappear. For the sake of the continuity of WWF supported initiatives and as technical advisory body and information centre, it is strongly recommended that WWF representation continues in Niger. This could

involve support for training and operational costs for a biological diversity information centre.

12) Support the inclusion of biological diversity concerns in NRM projects. Although biological diversity is implicitly included in many NRM projects in Niger, there remains a need to systematize the conservation and monitoring of biological diversity in projects and programs. Natural forest management projects would be a useful and appropriate focus.

13) Develop a methodology for environmental impact assessment and encourage its adoption. Baseline environmental data is a prerequisite. IUCN is planning to work in environmental impact assessment (EIA) procedures and USAID is planning an environmental impact studies handbook. Clearly the basic requirement for EIA is baseline data against which to measure impact. In addition to physical data (soils, water, etc.) it is necessary to have biological data, and, in fact, information on biological diversity "indicator" species and communities can considerably facilitate environmental impact analysis. A database on areas of high biological diversity importance and the status and distribution of elements of biological diversity (races, species, communities) should be a strong priority for support. Information on vulnerability of areas and elements to various types of environmental changes should be included. Future incorporation into standardized GIS databases for planning purposes should be encouraged. In addition, EIA studies relating to biodiversity need to be supported. Such studies could include:

- pesticide monitoring in various groups, such as fish, and indicator species such as birds of prey;
- effect of indiscriminate poisoning on non-target species;

- effects of irrigated perimeters on biodiversity (and of biodiversity on irrigated perimeters).

- monitoring the occurrence and effects of exotic pests on biological diversity and developing methods to limit their effects.

WWF would be an appropriate organization to establish a database, given the amount of information available there, but in the longer term such an information centre needs to be integrated into the GON structure to ensure its involvement in the decision-making process. WWF would also be the appropriate organization to carry out the various studies.

14) Encourage the phasing out of use of those pesticides having serious negative effects on biodiversity and promote the application and storage of pesticides in such a way as to minimize negative effects on biological diversity. Encourage the adoption of Integrated Pest Management techniques.

15) Support education and training in ecology and biological diversity conservation at the University and training establishments, e.g. IPDR. This could include support to expatriate scholars doing research in ecology and teaching at the National University, study grants in ecology to students and overseas training opportunities. The effect would be to raise the profile and level of interest in biological diversity issues. To this end it would also be useful to assure a wider availability and dissemination of existing studies, such as Saadou's work on upland plant distribution.

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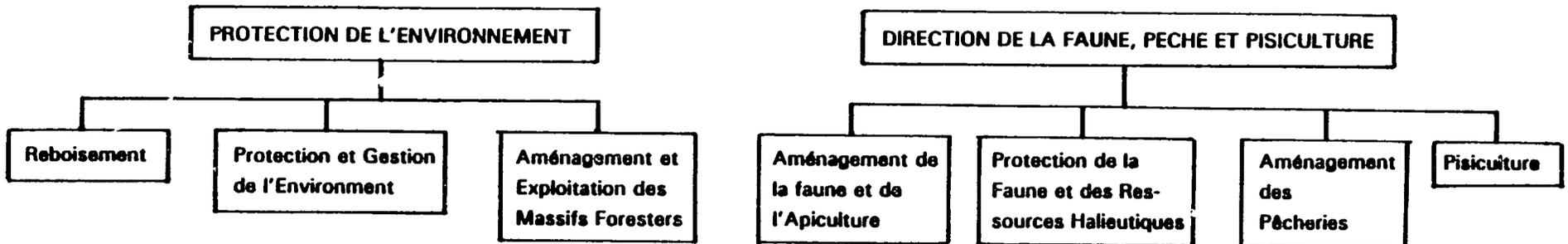
Projet Energie II: P. Montagne, M. Bertrand

U.S. Peace Corps: L. Garden, T. Price

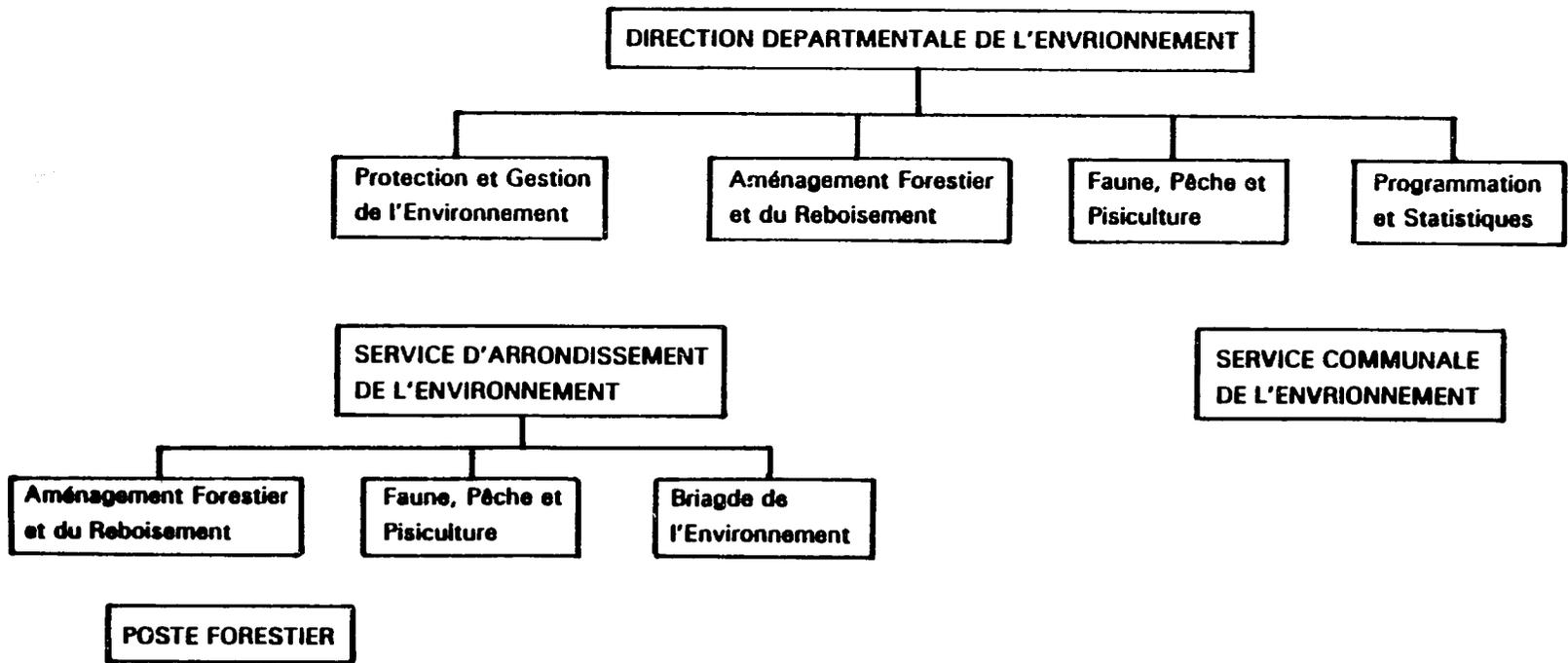
LIST OF ACRONYMS

AFVP	Association Française des Volontaires du Progrès
DDA	Direction de la Coopération au Développement et de l'Aide Humanitaire (Swiss Cooperation)
DDE	Direction Départementale de l'Environnement
DFPP	Direction de la Faune, Pêche et Pisciculture
EEC	European Economic Community
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization
GON	Government of Niger
IBPGR	International Board for Plant Genetic Resources
ICRISAT	International Center for Research in the Semi-Arid Tropics
ILCA	International Livestock Centre for Africa
INRAN	Institut National de Recherche Agricole au Niger
IPDR	Institut Pratique de Développement Rural
IUCN	International Union for the Conservation of Nature
NCS	National Conservation Strategy
NGO	Non-Governmental Organization
NLC	Northern Limit of Cultivation
NNR	National Nature Reserve
NRM	Natural Resources Management
OAU	Organization of African Unity
ORSTOM	Organisation Française
PIGRN	Programme Intégré de Gestion des Ressources Naturelles
PNLCD	Plan National de Lutte Contre la Désertification
SNV	Société Néerlandaise des Volontaires
SONERAN	Société Nigérienne d'Exploitation de Ressources Animales
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNSO	United Nations Sahel Office
USAID	United States Agency for International Development
WWF	World Wide Fund for Nature

**ANNEX 2. ORGANIGRAMME DU MINISTRE DE L'HYDRAULIQUE ET L'ENVIRONNEMENT
(DIRECTION DE LA FAUNE, PECHE ET PISCICULTURE)**



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APPENDIX 3

LISTE DES MAMMIFERES DU NIGER

CHECKLIST OF THE MAMMALS OF NIGER

INSECTIVORA

ERINACEIDAE

Atelerix albiventris (Wagner)
Paraechinus aethiopicus (Ehrenberg)

Hérisson à ventre blanc
Hérisson du désert

Four-toed Hedgehog
Desert Hedgehog

SORICIDAE

Crocidura flavescens (I. Geoffroy)

Crocodile géante

Greater Musk Shrew,
African Giant Shrew
Savanna Shrew
Mauritian Shrew
Black Giant Shrew

Crocidura fulvastra (Sundevall)
Crocidura lusitania (Dollman)
Crocidura odorata (Leconte)
Crocidura pasha Dollman

CHIROPTERA

PTEROPIDAE

Eidolon helvum (Kerr)
Epomophorus gambianus (Ogilby)
Micropteropus pusillus Peters

Rousette paillée
Epomophore de Gambie
Petit microptère

Straw-coloured Fruit Bat
Gambian Epauletted Fruit Bat
Dwarf Epauletted Fruit Bat

EMBALLONURIDAE

Taphozous perforatus E. Geoffroy
Taphozous nudiventris Cretzschmar

Taphien perforé
Taphien à ventre nu

Egyptian Tomb Bat
Naked-rumped Tomb Bat

RHINOPOMATIDAE

Rhinopoma hardwickei Gray

Rhinopome d'Hardwicke

Hardwicke's Mouse-tailed Bat,
Lesser Mouse-tailed Bat

NYCTERIDAE

Nycteris hispida (Schreber)
Nycteris macrotis Dobson

Nyctère hérissée

Hairy Slit-faced Bat
West African Slit-faced Bat,
Dobson's Slit-faced Bat,
Greater Slit-faced Bat
Egyptian Slit-faced Bat

Nycteris thebaica E. Geoffroy

Nyctère de Geoffroy

MEGADERMATIDAE

Lavia frons (E. Geoffroy)

Mégaderme à ailes orange

Yellow-winged Bat

RHINOLOPHIDAE

Rhinolophus fumigatus Rüppell

Rhinolophe

Rüppell's Horseshoe Bat

HIPPOSIDERIDAE

Hipposideros caffer (Sundevall)
Hipposideros ruber Noack
Asellia tridens E. Geoffroy

Phyllorhine de Cafrerie
Asellia à trois indentures

Sundevall's Leaf-nosed Bat
Noack's Leaf-nosed Bat
Trident Leaf-nosed Bat

VESPERTILIONIDAE

Eptesicus rendalli (Thomas)
Myotis bocagii Peters

Sérotine de Rendall
Murin de Bocage

Rendall's Serotine
Bocage's Banana Bat,
Rufous Mouse-eared Bat
White-bellied Schlieffen's Bat

Nycticeius schlieffenii (Thomas & Wroughton)

Otonycteris hemprichii Peters
Pipistrellus nanus (Peters)
Pipistrellus reuppelli (J. B. Fisher)
Scotophilus dinganii (Schreber)

Scotophilus leucogaster (Cretzschmar)
Scotophilus viridis (de Winton)

MOLOSSIDAE

Tadarida aegyptiaca (E. Geoffroy)
Tadarida condylura (A. Smith)
Tadarida major (Troussart)
Tadarida nigeriae (Thomas)
Tadarida pumila (Cretzschmar)

Oreillard d'Henprich
Pipistrelle naine à ailes brunes
Pipistrelle de Rüppell

Hemprich's Long-eared Bat
Banana Bat
Rüppell's Bat
Schreber's Brown Bat,
African Yellow House Bat
Cretzschmar's Brown Bat
Green Vesper Bat,
Lesser Yellow House Bat

Egyptian Free-tailed Bat
Angola Free-tailed Bat
Large Free-tailed Bat
Nigerian Free-tailed Bat
Cretzschmar's Free-tailed Bat

PRIMATES

LORISIDAE

Galago senegalensis E. Geoffroy

Galago du Sénégal

Senegal Bushbaby
Lesser Bushbaby

CERCOPITHECIDAE

Cercopithecus aethiops (Linnaeus)
Erythrocebus patas (Schreber)
Papio anubis Lesson

Singe vert ou Vervet
Singe rouge ou Patas
Cynocéphale

Green Monkey
Patas Monkey
Olive Baboon

PHOLIDOTA

MANIDAE

Manis temminckii Smuts

Pangolin du Cap

Cape Pangolin

LAGOMORPHA

LEPORIDAE

Lepus capensis (Linnaeus)
Lepus saxatilis (de Winton)

Lièvre du Cap
Lièvre de Crawshay

Cape Hare
Crawshay's Hare,
Scrub Hare

RODENTIA

SCIURIDAE

Heliosciurus gambianus (Ogilby)
Funisciurus anerythrus (Thomas)
Xerus erythropus (E. Geoffroy)

Héliosciure de Gambie
Funisciure à dos rayé
Écureuil fouisseur ou
Rat palmiste

Gambian Sun Squirrel
Thomas' Tree Squirrel
Geoffroy's Ground Squirrel

CRICETIDAE

Gerbillus nigeriae Thomas
Gerbillus gracilis Thomas
Gerbillus lacustris Thomas & Wroughton
Gerbillus pyramicum I. Geoffroy
Gerbillus gerbillus (Olivier)
Gerbillus nanus Blanford

Grand gerbille d'Égypte
Petite gerbille du sable
Gerbille naine

Nigerian Gerbil
Slender Gerbil
Lake Chad Gerbil
Large Egyptian Gerbil
Small Egyptian Gerbil
Dwarf Red-soled Gerbil,
Baluchistan Gerbil
Rock Gerbil,
Large North African Gerbil
Brauer's Dwarf Gerbil,
Pouched Gerbil
Fringe-tailed Gerbil
Savanna Gerbil
Giant Gambian Rat
Sunjvall's Jird

Gerbillus campestris Levaillant

Gerbille des champs

Desmodilliscus braueri Wettstein

Gerbille naine à queue courte

Tatera robusta (Cretzschmar)
Tatera valida (Rocagge)
Cricetomys gambianus Waterhouse
Meriones crassus Sundevall

Rat géant de Gambie
Mérieux du désert

Steatomys mirutus Thomas & Hinton		Dainty Fat Mouse, Tiny Fat Mouse
Steatomys pratensis Peters		North-west Fat Mouse, Common Fat Mouse
MURIDAE		
Mus haussa Thomas & Hinton	Souris naine du Nigéria	Hausa Mouse
Praomys erythroleucus (Temminck)	Rat à pelage doux	
Mastomys natalensis (Smith)	Rat à mammelles multiples	Multimammary Rat
Myomys daltoni (Thomas)		Dalton's Mouse
Rattus rattus (Linnaeus)	Rat noir	Black Rat
Acomys cahirinus (E. Geoffroy)	Rat épineux	Common Spiny Mouse, Cairo Spiny Mouse
Acomys cineraceus Fitzinger & Heuglin		
Acomys dimidiatus (Cretzschmar)		Western Spiny Mouse
Lemniscomys barbarus (Linnaeus)		Striped Grass Mouse
Lemniscomys striatus (Linnaeus)		Spotted Grass Mouse
Arvicanthis niloticus (Desmarest)	Rat du Nil	Nile Rat
MUSCARDINIDAE		
Graphiurus murinus (Desmarest)	Loir d'Afrique	Common African Dormouse, Woodland Dormouse
DIPODIDAE		
Jaculus jaculus Linnaeus	Petite gerboise	Lesser Egyptian Jerboa
HYSTRICIDAE		
Hystrix cristata Linnaeus	Porc-épic	Crested Porcupine
THRIONOMYIDAE		
Thryonomys swinderianus Temminck	Aulacode	Greater Cane Rat
CTENOACTYLIDAE		
Massoutiera mzabi (Lataste)	Gondé du Sahara	Mzab Gundi
CARNIVORA		
CANIDAE		
Lycaon pictus (Temminck)	Cynhyène ou Lycaon	Hunting Dog
Canis adustus (Sundevall)	Chacal à flancs rayés	Side-striped Jackal
Canis aureus (Linnaeus)	Chacal commun	Common Jackal
Vulpes pallida (Cretzschmar)	Renard pâle	Pale Fox
Vulpes rüppelli (Schinz)	Renard de Rüppell	Rüppell's Sand Fox
Vulpes zerda (Zimmermann)	Fennec	Fennec
MUSTELIDAE		
Ictonyx striatus (Perry)	Zorille commun	Zorilla, Striped Polecat
Poecilictis libyca (Hemp. & Ehrenberg)	Zorille de Libye	Libyan Striped Weasel
Mellivora capensis (Schreber)	Ratel	Honey Badger
Lutra maculicollis Lichtenstein	Loutre à cou tacheté	Spotted-necked Otter
Aonyx capensis (Schinz)	Loutre à joues blanches	African Clawless Otter
VIVERRIDAE		
Genetta genetta Linnaeus	Genette vulgaire	Common Genet, Small-spotted Genet
Genetta tigrina (Schreber)	Genette à grandes taches	Large-spotted Genet
Genetta pardina (I. Geoffroy)	Genette pardine	Pardine Genet
Viverra civetta (Schreber)	Civet de l'Afrique	African Civet
HERPESTIDAE		
Mungos mungo (Gmelin)	Mangué rayée	Banded Mongoose
Herpestes sanguineus Rüppell	Mangué naine	Slender Mongoose

Atlix paludinosus (G.Cuvier)	Mangouste des marais	Marsh Mongoose, Water Mongoose
Ichneumia albicauda (G.Cuvier)	Mangouste à queue blanche	White-tailed Mongoose

FELIDAE

Felis silvestris (Schreber)	Chat sauvage d'Afrique	African Wild Cat
Felis margarita Lochs	Chat des sables	Sand Cat
Felis caracal Schreber	Caracal	Caracal
Felis serval Schreber	Serval	Serval Cat
Panthera pardus (Linnaeus)	Léopard	Leopard
Panthera leo (Linnaeus)	Lion	Lion
Acinonyx jubatus (Schreber)	Guépard	Cheetah

HYAENIDAE

Hyaena hyaena (Linnaeus)	Hyène rayée	Striped Hyaena
Crocuta crocuta (Erxleben)	Hyène tachetée	Spotted Hyaena

TUBULIDENTATA

ORYCTEROPODIDAE

Orycteropus afer (Pallas)	Oryctérope	Aardvark, Antbear
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PROBOSCIDEA

ELEPHANTIDAE

Loxodonta africana (Blumenbach)	Éléphant d'Afrique	African Elephant
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HYRACOIDEA

PROCAVIIDAE

Procavia johnstoni (Pallas)	Daman de Rocher	Rock Hyrax
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TUBULIDENTATA

TRICHECHIDAE

Trichechus senegalensis (Link)	Lamantin du Sénégal	African Manatee
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ARTIODACTYLA

HIPPOPOTAMIDAE

Hippopotamus amphibius (Linnaeus)	Hippopotame amphibie	Hippopotamus
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SUIDAE

Phacochoerus aethiopicus (Pallas)	Phacochère	Wart Hog
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GIRAFFIDAE

Giraffa camelopardalis (Linnaeus)	Girafe	Giraffe
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BOVIDAE

Syncerus caffer (Sparrman)	Buffle d'Afrique	African Buffalo
Tragelaphus scriptus Pallas	Guib harnaché	Bushbuck
Cephalophus rufilatus Gray	Céphalophe à flancs roux	Red-flanked Duiker
Sylvicapra grimmia (Linnaeus)	Céphalophe de Grimm	Common Duiker, Grey Duiker
Redunca redunca (Pallas)	Cobe de roseaux	Bohr Reedbuck
Kobus ellipsiprymnus (Ogilby)	Cobe Defassa	Defassa Waterbuck
Kobus kob (Erxleben)	Cobe de Buffon	Kob
Addax nasomaculatus (de Blainville)	Addax	Addax
Hippotragus equinus (Desmarest)	Hippotrague	Roan Antelope

Oryx dammah Gretzschmar
Alcelaphus buselaphus (Pallas)
Damaliscus lunatus (Burchell)
Ourebia ourebi (Zimmermann)
Gazella dama (Pallas)
Gazella leptoceros (F.Cuvier)
Gazella dorcas (Linnaeus)
Gazella rufifrons Gray
Ammotragus lervia (Pallas)

Oryx algazelle
Bubale
Damalisque
Ourébie
Gazelle dama
Gazelle leptocère
Gazelle dorcas
Gazelle à front roux
Mouflon à manchettes

Scimitar-horned Oryx
Hartebeeste
Topi
Oribi
Dama Gazelle
Slender-horned Gazelle
Dorcas Gazelle
Red-fronted Gazelle
Barbary Sheep

Liste compilée par John E Newby (WWF-Niger)

JN/19-06-90

APPENDIX 4

COMMENT BY IUCN-NIGER ON A NATIONAL CONSERVATION STRATEGY FOR NIGER

A National Conservation Strategy, as typically championed by IUCN for many countries, may well be suited to NIGER per se. IUCN however believes that two prior conditions are necessary.

The first is a clear commitment on the part of the National Government, at the highest level, to define "Conservation" and introduce it as a central factor in development planning.

This is a question of process rather than product. The work underway with the PNLCD, PAFT, Code Rural (Loi sur l'Environnement), NRM strategy etc. is contributing to the definition of the content of this process. Once enough is known, then the time will be appropriate to assist the government (perhaps through the provision of a Senior Advisor, attached to the office of the Prime Minister or Minister of Plan) in formulating a strategy statement akin to an NCS.

The second condition is a harmonization of Strategic Planning frameworks on Environment and Natural Resources Management. Several donor agencies are involved in the definition of such frameworks. USAID (NRM), UNSO (PNLCD), FAO (PAFT), World Bank (EAP). IUCN believes that one of these agencies should take a leading role with respect to overall strategic planning and that other agencies should then contribute specific elements to this overall strategy.

The principal weakness of NRM strategic planning at this stage in Niger is that the various efforts remain sectorially attached. IUCN sees its work and that of others as contribution pieces of the NRM puzzle. But not until these are brought together under a single hat will there emerge a National Conservation strategy.

Through its sectoral work on training, law, planning, and conservation IUCN hopes to contribute to raising awareness and commitment to a level where the GON will bring the strands together into a coherent national framework for NRM.

ORDER FOR SUPPLIES OR SERVICES

PAGE 1 OF 4 PAGES

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

1. DATE OF ORDER: October 09, 1990
 2. CONTRACT NO. (If any):
 3. ORDER NO.: 683-0261-0-00-1004-0
 4. REQUISITION/REFERENCE NO.:

5. ISSUING OFFICE (Address correspondence to):
 Executive Office
 USAID/Niger
 B.P. 11 201 Niamey, Niger
 6. SHIP TO: (Consignee and address, ZIP Code)
 SHIP VIA:

7. TO: CONTRACTOR (Name, address and ZIP Code):
FOR
 WORLD WIDE FUND NATURE (WWF)
 B.P. 10 933
 Niamey, Niger
 8. TYPE OF ORDER
 A. PURCHASE - Reference your _____
 B. DELIVERY - Except for billing instructions on the reverse, this delivery order is subject to instructions contained on this side only of this form and is issued subject to the terms and conditions of the above-numbered contract.

9. ACCOUNTING AND APPROPRIATION DATA:
 72-110101- 8384-90-21683-K063
 ON 021002 (EN P)-683-0261-0-00-1004
 PIO/T 683-261-3-00027
 10. REQUISITIONING OFFICE:
 11. BUSINESS CLASSIFICATION (Check appropriate box(es))
 SMALL OTHER THAN SMALL DIS. ADVAN-TAGED WOMEN-OWNED

12. F.O.B. POINT
 13. PLACE OF INSPECTION AND ACCEPTANCE
 14. GOVERNMENT B/L NO.
 15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date)
 16. DISCOUNT TERMS

17. SCHEDULE (See reverse for Rejections)

ITEM NO. (A)	SUPPLIES OR SERVICES (B)	QUANTITY ORDERED (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)	QUANTITY ACCEPTED (G)
	The purpose of this Purchase Order is to obtain services of the Contractor to survey and produce a report on biological diversity assessment for Niger. The fixed fee for the report in English, typed, double space, translated into French and typed double space is: Final report: 5 copies in English and 5 copies in French. Performance Period: o/a 10/31/90 to o/a 01/31/91 CONTINUED PAGE 2 Clearance: Mboucar, EKO/BO. ARouedraogo, E. YOUNGKERST, PEO PCallen, CONT/AT/ERands: ASBC/AM				23,700.00	

18. SHIPPING POINT
 19. GROSS SHIPPING WEIGHT
 20. INVOICE NO.
 17(H). TOT. (Cont. pages)
 21. MAIL INVOICE TO: (Include ZIP Code)
 17(I). GRAND TOTAL

22. UNITED STATES OF AMERICA BY (Signature): *[Signature]*
 23. NAME (Typed):
 TITLE: CONTRACTING/ORDERING OFFICER

**ORDER FOR SUPPLIES OR SERVICES
SCHEDULE - CONTINUATION**

PAGE NO.

2

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

DATE OF ORDER

CONTRACT NO.

ORDER NO.

ITEM NO. (A)	SUPPLIES OR SERVICES (B)	QUANTITY ORDERED (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)	QUANTITY ACCEPTED (G)
	<p align="center">STATEMENT OF WORK</p> <p><u>Objective:</u></p> <p>The preservation and restoration of Niger's natural resource base has arisen as one of the most critical factors in the country's development. An essential component to maintaining the productivity of the natural resource base is biological diversity. The proposal will provide an assessment of the status of biological diversity in Niger, highlighting areas in which the Government of Niger and donors could potentially contribute to the conservation of biodiversity.</p> <p><u>Scope of Work:</u></p> <p>The biodiversity assessment will address the following areas:</p> <p>1) <u>Status of biological diversity in Niger</u></p> <p>What is current knowledge of the status and distribution of the elements of biodiversity in Niger? Are there gaps in this knowledge? What are the priorities? Has biodiversity changed significantly over the past few years as a result of increased human pressure of drought-related phenomena? What is the relative importance globally, regionally or nationally of different elements of biodiversity?</p> <p>How can information on the status of biodiversity best be inventoried and systematized?</p> <p>What systems are there, or need to be put in place to monitor biodiversity?</p> <p>2) <u>Status of conservation of biological Diversity</u></p> <p>Which elements of biodiversity are currently protected, for example in parks and reserves, or by national legislation? How effective is this protection? How representative is it in terms of overall</p>					

TOTAL CARRIED FORWARD TO 1ST PAGE (ITEM 17(H))

**ORDER FOR SUPPLIES OR SERVICES
SCHEDULE - CONTINUATION**

PAGE NO.

3

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

DATE OF ORDER

CONTRACT NO.

ORDER NO.

ITEM NO. (A)	SUPPLIES OR SERVICES (B)	QUANTITY ORDERED (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)	QUANTITY ACCEPTED (G)
	<p>biological diversity? Are there major centers of biodiversity that require special attention?</p> <p>What is the status and importance of <u>ex-situ</u> conservation measures (germplasm collections, seed banks, etc.).</p> <p>3) <u>Opportunities/constraints to enhancing the conservation of biological diversity</u></p> <p>a) Legal: Rural Code, hunting, fishing and forest legislation, protected areas legislation, international treaties and conventions.</p> <p>b) Human resources: The numbers of staff trained in ecology, forestry, wildlife management, etc. What are the levels of training and what courses are available in which establishments?</p> <p>c) Institutional: What is the role and mandate, with regards biodiversity issues, of the government services responsible for the use or protection of natural resources? What is the role of research organizations, such as INRAN and ICRISAT, in biodiversity research? What is the role and/or potential of both international and indigenous NGOs?</p> <p>d) Economic: What potential exists of the development of economic activities based on biodiversity conservation - tourism, game ranching, habitat regeneration, desertification control, fisheries development, etc.</p> <p>4) <u>Incorporation of biodiversity issues in DEVELOPMENT projects</u></p> <p>a) Projects with a major focus on biodiversity, e.g. IUCN/WWF funded projects (Air-Tenere, Sahel Programme, Wildlife reintroduction initiatives), CARE, EEC (Park W), Peace Corps etc.</p>					

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**ORDER FOR SUPPLIES OR SERVICES
SCHEDULE - CONTINUATION**

PAGE NO.

4

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

DATE OF ORDER	CONTRACT NO.	ORDER NO.
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ITEM NO. (A)	SUPPLIES OR SERVICES (B)	QUANTITY ORDERED (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)	QUANTITY ACCEPTED (G)
	<p>b) Projects with a direct/indirect biodiversity component. These may be potentially positive (natural forest management, pasture improvement, fisheries management) or negative (pesticide use, land drainage, hydroelectric or mining operations).</p> <p>c) Lessons learned and their implication for biodiversity conservation.</p> <p><u>Method of payment</u></p> <p>By check issued by RAMC Paris upon reception of certified invoice by CONT. Within 4 weeks upon reception of certified invoice.</p> <p><u>Payment schedule:</u></p> <ul style="list-style-type: none"> - 20% or XXX DLS 4,140 upon submission of outline report - 40% or DLS 8,280 upon submission of draft report - 40% or Dls 8,280 upon submission of final report and expense vouchers <p>Technical Officer: Zarry Rands, ASDG/NRM Advisor</p> <p><u>Technical Directions:</u></p> <p>Performance of the work hereunder shall be subject to the technical directions of the Contracting Officer or his Representative (COR). As used herein "Technical Directions" are directions to the Contractor which fills in details, suggest possible line of inquiry, or otherwise complete general scope of work. "Technical Directions" must be within the terms of this contract, and shall not change or change or modify them in any contract, and shall not constitute changes (as describe in 52.243.02), which may only be accomplished by the Contracting Officer.</p>					

TOTAL CARRIED FORWARD TO 1ST PAGE (ITEM 17(H))