
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

GoogleTM books

<https://books.google.com>



OCEANS
46.2
Mau
.P9453c

Price, Andrew.
COASTAL ASSESSMENT OF PARC NATIONAL
DU BANC D'ARGUIN, MAURITANIA :
UNDERSTANDING RESOURCES,
EXPLOITATION PATTERNS AND MANAGEMENT
NEEDS.

A. CHAUNCEY NEWLIN COLLECTION
OF
OCEANS LAW AND POLICY



LAW LIBRARY
OF THE
UNIVERSITY OF VIRGINIA

Coastal Assessment of Parc National du Banc d'Arguin, Mauritania



A Marine Conservation and Development Report

IUCN
The World Conservation Union

Coastal Assessment of Parc National du Banc d'Arguin, Mauritania

Understanding Resources, Exploitation Patterns and Management Needs

PNBA - PARC NATIONAL DU BANC D'ARGUIN

PNBA - the Parc National du Banc d'Arguin - was the first of Mauritania's national parks. Established by Presidential decree in 1976, the Parc was listed under the Ramsar Convention in 1982 and added to UNESCO's World Heritage List in 1986. Covering some 12,000 square kilometers, and 40% of the country's coastline, the Parc offers protection to a wide range of terrestrial, marine and coastal ecosystems and species, most notably the world's largest concentration of overwintering waders. The Parc has been inhabited for centuries by the Imraguen fishermen who follow seasonal mullet migrations.

FIBA - FONDATION INTERNATIONALE DU BANC D'ARGUIN

FIBA - the Fondation Internationale du Banc d'Arguin, based in Switzerland, works closely with PNBA to enhance its international and national functions. Since its formation in 1986, FIBA has worked to promote recognition of the park, and has been successful in securing international funding for a broad range of projects concerned with conservation and development within the park. The Scientific Committee of FIBA is responsible for promotion and coordination of research activities in PNBA.

WWF - WORLD WIDE FUND FOR NATURE

WWF - World Wide Fund for Nature is the world's largest private international conservation organisation with 28 Affiliate and Associate National Organisations around the world and over 4.7 million regular supporters. WWF aims to conserve nature and ecological processes by preserving genetic, species and ecosystem diversity; by ensuring that the use of renewable natural resources is sustainable both now and in the longer term; and by promoting actions to reduce pollution and wasteful exploitation and consumption of resources.

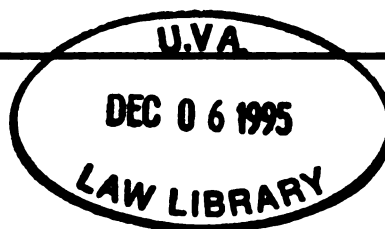
THE MARINE CONSERVATION PROGRAMME

IUCN's Marine Conservation Programme was established in 1985 to promote activities which demonstrate how conservation and development can reinforce each other in marine and coastal environments; conserve marine and coastal species and ecosystems; enhance awareness of marine and coastal conservation issues and management; and mobilise the global conservation community to work for marine and coastal conservation. The Marine Conservation and Development Reports are designed to provide access to a broad range of policy statements, guidelines, and activity reports relating to marine issues of interest to the conservation and development community.

Coastal Assessment of Parc National du Banc d'Arguin, Mauritania

Understanding Resources, Exploitation Patterns and Management Needs

**A.R.G Price , A. Jeudy de Grissac and R.F.G. Ormond
1992**



Published by: IUCN, Gland, Switzerland
in collaboration with Parc National du Banc d'Arguin, Fondation Internationale du Banc d'Arguin
and World Wide Fund for Nature

IUCN
The World Conservation Union

PNBA

FIBA



WWF

Copyright: 1992 International Union for Conservation of Nature and Natural Resources

Reproduction of this publication for educational or other non commercial puposes is authorised without prior permission from the copyright holder(s).

Reproduction for resale or other commercial purposes is prohibited without the prior written permission of the copyright holder(s).

Citation: Price, A.R.G.; Jeudy de Grissac, A. & Ormond, R. (1992). *Coastal Assessment of the Parc National du Banc d'Arguin, Mauritania: Understanding Resouces, Exploitation Patterns and Management Needs*. A Marine Conservation and Development Report. IUCN, Gland, Switzerland. x + 44 pp.

ISBN: 2-8317-0106-6

Printed by: SADAG, Bellegarde-Valserine, France

Cover Photo: Imraguen Fisherman, Parc National du Banc d'Arguin; IUCN/Jim Thorsell

**Layout, Figures
& Editing:** Sarah Humphrey, IUCN

Available from: IUCN
Rue Mauverney 28,
1196 Gland, Switzerland

OCEANS
46.2
Mar
.P9453c

The presentation of material in this document and the geographical designations employed do not imply the expression of any opinion whatsoever on the part of IUCN or of other participating organisations concerning the legal status of any country, territory or area, or concerning the delimitation of its frontiers of boundaries.

The views of the authors expressed in this publication do not necessarily reflect those of IUCN or other participating organisations.

200. A. 1. 12
MAR 11 1993

Contents

List of figures	vi
List of annexes	vii
Summary	viii
Acknowledgments	x
1. Introduction	1
2. The Parc National du Banc d'Arguin (PNBA) and its role in national conservation	3
3. Review of previous coastal and marine research	5
4. Integrated coastal resource management	7
5. Development of coastal research plan for PNBA	11
Figures	13
Annex 1	17
Annex 2	21

Figures

- Figure 1.** Map of Mauritania showing the Banc d'Arguin and the boundaries of the Parc National du Banc d'Arguin (PNBA)
- Figure 2.** Schematic representation showing some of the major ecological components of the Parc National du Banc d'Arguin (PNBA): the producers (ecosystems), associated fauna (fish, shrimps, molluscs etc.) and high-level consumers (birds & humans)
- Figure 3.** Possible planning and management framework, for the proposed research plan for Parc National du Banc d'Arguin (PNBA)
- Figure 4.** Suggested approach for development of coastal and research plan for Parc National du Parc d'Arguin (PNBA)

Annexes

Annex 1. Bibliography of coastal and marine studies (including literature cited)

Annex 2. Components of coastal research plan for PNBA - Draft Research Proposals

- 2.1 Assessment of primary phytoplankton and benthic production in the Park and adjacent areas.**
- 2.2 Assessment of water movements and other oceanographic features.**
- 2.3 Characterisation, delimitation and quantification of the major coastal and marine ecosystems.**
- 2.4 The status of turtles, monk seals and other species of conservational importance.**
- 2.5 The role of the Park as a nursery, spawning, residential and migration area for fishery resources.**
- 2.6 Assessment of the interactions of fish and bird populations.**
- 2.7 Rapid assessment of coastal resources, uses and pressures to determine areas of resource-use conflict.**
- 2.8 Impact of greenhouse gases and sea-level rise on coastal ecosystems and associated resources.**
- 2.9 The national park as a complex, natural system.**
- 2.10 Development of an oil spill contingency plan.**

Summary

This document develops ideas for a research plan for the Parc National du Banc d'Arguin (PNBA), Mauritania. Emphasis is given to coastal and marine research, but within an integrated context to enhance its value to management.

The first section highlights the important features of the Banc d'Arguin, which is a national asset of great biological and economic value. The exceptional rich bird life, fisheries and other marine assemblages, in particular the prevalence of seagrass beds and other productive, shallow-water benthic ecosystems, within and around PNBA are mainly a manifestation of nearshore upwelling. It is of significance that upwelling is a large-scale process that cannot be readily modified by human activity. In contrast, seagrasses, related ecosystems and associated biota (e.g. fish, crustaceans & birds) of the Banc d'Arguin can be easily degraded, for instance by expanding human activities. The role of PNBA in maintaining natural resource production and conservation is also briefly discussed.

This is followed by a review and synthesis of previous and ongoing coastal research programmes, their main conclusions and recommendations, including future research needs. Considerable information on natural resources of PNBA has now built up. However, more emphasis is clearly needed on coastal and marine research, but placed within an integrated context, to accord with (and help define) the needs of management within the Park.

The next section describes the benefits of adopting an interdisciplinary approach to natural resource management, and why a sectoral approach is seldom adequate for dealing with the complexities of complex natural systems such as PNBA. Included is a proposed management or planning framework, into which the vast array of coastal zone management activities, including the proposed research plan, may be placed.

Finally, a suggested outline is given for a coastal and marine research plan for PNBA. This is built up from four main elements, or domains: i) general (oceanography, meteorology etc.); ii) coastal and marine ecosystems and associated biota (e.g. fish, shrimps, and molluscs); iii) birds; iv) humans (e.g. human uses and environmental pressures). Other aspects of the human domain (e.g. socio-economics, anthropology, legislation), lie outside the arena of the proposed research plan. However, these are essential inputs for a full understanding of the Park. It is suggested that whenever possible research is based on simple, but robust methods. Over a 5-year period, research could perhaps be expanded, eventually to consider PNBA as a complex natural system. Using non-linear dynamical models the behaviour of system could be simulated and explored, for instance predicted short-term and long-term future states of the Park under different initial conditions (e.g. management regimes). These models could also be used to assess the overall performance of the Park, including its bio-economic role and value.

During all research, it is proposed that Mauritanian scientists and technicians form an integral part of the study team. Workshops, seminars and training sessions would also be of value, and

these should be held in Mauritania wherever possible.

The research plan, although developed within an integrated context, is presented as a series of discrete proposals. Some of these have been developed in the form of project concept summaries, and are appended as annexes to this document. Following review by WWF/IUCN, these proposals could be developed further, and submitted for consideration by potential funding agencies.

Acknowledgements

We wish to thank, in particular, the following for their assistance: in Mauritania - Hadiya Khan, Abu Ba and staff at the Iwik Scientific Station, the guide of PNBA, and Dominique Mengin. One of us (ARGP) is particularly grateful to D. Mengin and family, for the extensive hospitality extended during the visit to Nouakchott in 1991, in UK - Helen Cormack (secretarial assistance & graphics) and Rowena Morton (preparation of graphics); in Germany - Jacqueline McGlade (for some of the ideas in this report); in France, the Laboratoire d'Ecologie du Benthos, Marseille, which allowed access to the archives on Mauritania of the late Didier Marchessaux.

1. Introduction

During the last 15 years a considerable number of research activities have been undertaken within and around the Parc National du Banc d'Arguin (PNBA), Mauritania. The initial focus was on ornithological studies and extended subsequently to basic natural processes and life history traits of invertebrates and fishes of certain marine habitats. Remote sensing studies on physical features and marine currents are now also underway. However, research to date has mostly had a terrestrial, rather than marine orientation, and has followed a sectoral, rather than integrated approach.

Fisheries are now Mauritania's principle economic resource, accounting for 66% of the national revenue, and the park is under pressure to allow increased fishery activities. It is felt that the integrity of the park can only be assured if its contribution to fisheries and the need for appropriate management are understood. The research results obtained to date have contributed in a limited way to this understanding. A coordinated research programme is therefore needed to investigate the park's role in the production and maintenance of fisheries resources. This will entail a basic understanding of the coastal and marine ecosystems, and more specifically an understanding of the park's role in the life histories of those species of fish, crustaceans and molluscs which are of economic or ecological importance. Since people are an integral component of the park, socio-economic considerations also need to be included in any interdisciplinary coastal and marine research plan.

The first section of the document highlights the important features of the Banc d'Arguin, demonstrating that key biological resources of the region also represent an immense national economic asset. The role of PNBA in natural resource production and conservation is also briefly discussed.

This is followed by a review and synthesis of previous and ongoing coastal research programmes in the region, their main conclusions and recommendations, including future research needs.

The next section describes the benefits of adopting an interdisciplinary approach to natural resource management, and why a sectoral approach is seldom adequate for dealing with the complexities of natural systems such as PNBA. Included is a proposed management or planning framework, into which the vast array of coastal zone management activities, including the proposed research plan, may be placed.

Finally, a suggested outline is given for a coastal and marine research plan. This is built up from four main elements: i) general (oceanography, meteorology etc.); ii) coastal and marine ecosystems and their associated biota (e.g. fish, shrimps, and molluscs); iii) birds; iv) humans (e.g. human uses and environmental pressures). It is suggested that initially research is based on simple, but robust methods. Over a 5-year period, research could perhaps become more complex, with the aim of treating PNBA as a complex and fully integrated system.

2. The Parc National Banc d'Arguin (PNBA) and its Role in National Conservation

BACKGROUND

In 1976 Mauritania's first national park was established: the Parc National du Banc d'Arguin (PNBA). A map showing the location of the Park in relation to the Banc D'Arguin is shown in Figure 1. The Park encompasses approximately 12,000 sq. km, which represents less than 5% of its land surface but a much larger proportion of its sea surface. In terms of linear extent, however, about 40% of the Mauritanian coastline lies within the park. The park offers protection to a wide range of marine, coastal and terrestrial ecosystems. These include open sea (mostly less than 5 m deep), desert and terrestrial vegetation, and also intertidal flats, channels, creeks, small islands and other habitats which together comprise the coastal zone. The PNBA, especially the coastal and marine components, are therefore not homogeneous, rather a mosaic of different interacting ecosystems. A simplified diagram showing the principal ecological components of PNBA is shown in Figure 2.

A key feature of the park, and an underlying reason for its creation, is the extraordinary biological wealth of its coastal waters. The exceptional rich bird life, fisheries and other marine assemblages, in particular the prevalence of seagrass beds and other productive, shallow-water benthic ecosystems, within and around PNBA are mainly a manifestation of nearshore upwelling.

UPWELLING

Upwelling is a large-scale process occurring along some eastern seabords, i.e. western continental margins, including those of Mauritania and adjacent regions of west Africa. It is caused when cold, deep, nutrient-rich waters rise to the surface to replace warm, nutrient-poor surface water moved away from the coast by offshore wind-driven currents. Nutrients are a vital input (and often a limiting factor) for photosynthesis, and hence primary production. As a result of upwelling, nutrients become available to key organisms at the base of food chains (e.g. phytoplankton, algae & seagrass). Nutrients, together with sufficient light, provide the potential for an 'explosion' of primary production. The enriched surface waters support dense populations of phytoplankton, which in regions such as Mauritania are the base of marine food chains culminating in immense populations of fish and fish-eating (piscivorous) sea birds. The fisheries in and around the Banc d'Arguin are among the richest on earth, and some sectors, in particular pelagic species (e.g. tuna) are undoubtedly sustained predominantly by phytoplankton based food chains.

COASTAL ECOSYSTEMS AND ASSOCIATED RESOURCES

Probably of greater biological significance in the coastal shallows of the Banc d'Arguin,

however, are benthic ecosystems, in particular seagrasses and macroalgae. Like other 'critical marine habitats' (e.g. mangroves & coral reefs), the productivity of seagrass and algal ecosystems is disproportionately high in comparison to the area they occupy. Consequently, they may be regarded as coastal food factories. For this and other reasons, the Banc d'Arguin supports remarkably high concentrations of birds and fishery resources.

The park is particularly significant in hosting the world's largest concentrations of wintering waders (> 2 million birds). In addition, the park provides nesting sites for 25,000-40,000 individuals of 15 seabird species, and several migrants (e.g. terns, raptors) make brief stopovers.

Fishery resources include resident species, larvae and juveniles of open water species, and also seasonal migrants. Fish in the park are exploited officially only by the Imraguen, 500-600 of whom inhabit its shores and practise subsistence fishing using traditional methods unchanged for centuries. The Imraguen also inhabit four or five coastal villages outside the national park to the south of Cap Timoris, an area also exploited by the artisanal fishery.

Seagrasses and other critical marine habitats are important not only to birds and seafood species (crustaceans and fish, juvenile and adults), but also a key habitat for other species of economic or scientific importance. Within PNBA these include endangered species (e.g. green turtles, monk seals), as well as less threatened animals such as cetaceans. In addition, many critical habitats are important repositories of biological diversity, functioning as 'gene banks'. Mangroves and seagrasses, in particular, also help stabilise and buffer the shoreline from the destructive effects of heavy wave action. Further details of the social and ecological attributes of critical and related habitats are in the literature (e.g. IUCN/UNEP, 1985; Dugan, 1990).

It is of great significance that upwelling is a large-scale process that cannot be readily modified by human activity, although natural fluctuations may occur. In contrast are features of the Banc d'Arguin that can be modified by human activities, in particular seagrasses and other coastal ecosystems. However, understanding of these coastal systems, and their interactions with the offshore environment is still only very rudimentary, even before human influences are considered. Knowledge of the role of critical habitats and other coastal systems is clearly of paramount if the ecological (and social) integrity of the Park is to be maintained.

THE ROLE OF PNBA IN RESOURCE PRODUCTION AND MANAGEMENT

PNBA clearly represents a renewable resource base of appreciable value. At the same time, conservation measures are in place to ensure that national assets are either utilised sustainably (e.g. fisheries), or else not directly exploited but instead maintained principally for their contribution to the ecosystem and their scientific value (e.g. birds). The park therefore plays a dual role: firstly in resource production, and secondly in resource conservation and management. It is generally recognised that the most effective management regimes for coastal protected areas are those where the specially managed or protected areas, together with policies, guidelines and legislation are established within an integrated management regime covering a much wider area. The function of PNBA in the context of overall national conservation strategies has been considered in previous documents (Verschuren, 1984; IUCN, 1988), and is discussed further below.

3. Review of Previous Coastal and Marine Research

Most research in the Banc d'Arguin falls within the following areas: coastal and marine ecosystems; fisheries; birds; other species of conservational interest. A preliminary bibliography (mostly French literature) is shown in Annex 1, but is by no means exhaustive. It is understood that a more detailed bibliography is present at the office of PNBA at Nouakchott, but this was not available to the consultants during their mission in Mauritania in September 1990.

Studies on coastal and marine ecosystems in PNBA have focused mainly on seagrass beds (e.g. by Boudouresque and co-workers), an ecosystem extending from the intertidal to the subtidal zone. These and related surveys included site descriptions, ecosystem maps and general ecological assessment. Other studies on seagrass and/or algae include Marcot-Coqueugniot & Verlaque (1988) and Pergent *et al.*, 1988). Mangroves, and particularly subtidal ecosystems devoid of seagrasses, appear to have received less attention scientifically. Several biological investigations have included studies on invertebrates (e.g. Francour, 1988). A number of studies on plankton have also been undertaken (e.g. Reyssac, 1978).

A comprehensive socio-economic study of the Imraguen fishermen has recently been published (Mengin & Van Spanje, 1989). This report also provides useful overview of the artisanal and industrial fisheries of Mauritania. Also of significance is the study of Jager (1990), which determined the distribution and abundance of juvenile commercial fish in PNBA. Although sampling was undertaken only during one part of the year (September), the investigation has provided valuable preliminary information on the Park's role as a fish nursery area. Several FAO documents on Mauritanian fisheries are also available, and it is understood that fishery catch statistics are compiled by the Mauritanian Ministry of Fisheries. Plans for development of the national fisheries are given in 'Declaration de Politique de Developpement du Secteur de la Peche' (Ministry of Fisheries & Maritime Economics, 1987).

Knowledge of birds in and around PNBA is now appreciable, primarily as a result of European expeditions to the region (see e.g. Engelmoer *et al.*, 1984). Some studies have included preliminary analysis of the diet of piscivorous species (see e.g. Campredon & Francour, unpublished). The recent work of Ens *et al.* (1990) is a comprehensive account of waders of Mauritania based on the extensive work of Dutch and other ornithologists. It also contains useful bibliographies and represents a valuable biological information base for present and future research workers. Studies undertaken on species and species groups such as the monk seal and dolphins include those of Marchessaux and co-workers.

The main conservation documents to date include Verschuren (1984, 1985) and IUCN (1988), which focus principally on broad, principally terrestrial conservation concerns. A range of conservation issues, including aspects of the marine environment, is addressed in a proposed

5-year development plan (1988-92) for PNBA ('Plan de Developpement Integre', 1987).

It is suggested that the more complete bibliography of research studies is obtained from the PNBA office at Nouakchott. It is, however, apparent that a considerable wealth of knowledge already exists for the Banc d'Arguin area. Equally, it is evident that greater focus is needed on coastal and marine research, but building on and expanding earlier work. Furthermore, to be most useful as inputs to planning and management, future research will need to be formulated within a more integrated context. Similar views are expressed in some of the reports of previous researchers, and in other proposal documents. Ideas for a research plan taking into account these considerations are developed further in chapters 4 and 5.

4. Integrated Coastal Resource Management

The Need for an Integrated Approach

Seagrasses and other ecosystems of Mauritania are a key renewable resource, characterised by complex exploitation patterns. Like other ecosystems, seagrasses may be regarded as a complex natural system, influenced not only by natural processes but also human activities. This concept can be extended to larger areas, such as the Banc d'Arguin, or even to the entire Mauritanian coastal zone and its vast array of interdependencies. Yet despite increasing concern over the state of the world's coastal environments, knowledge of the connections between the non-living, biological and human domains is still far from complete (see McGlade, 1989). Even the workings of just the principal biological elements (e.g. tidal flats, seagrass beds and coastal birds) are ecologically intricate and only poorly known. But when the interactions of the various coastal users (i.e. the human domain) are superimposed, the system becomes truly complex.

Resource use, and also management practices, entail manipulating individual parts of the system, in the case of management through altering (usually limiting) resource access. However, it has been repeatedly demonstrated that altering one part of a system (e.g. mangrove or seagrass removal) can have unforeseen effects (coastal erosion & fishery decline) on another, perhaps only distantly related component. Failure to perceive and analyse the system holistically, and then manage it accordingly, may well be contributing to the overutilisation of natural resources. The problem is often further compounded by increasing demands on resources for local trade and distant international markets. In Mauritania, for instance, high economic returns from the fisheries may soon create pressures that compromise the resilience of its marine and coastal ecosystems.

Management clearly cannot proceed effectively through science, economics, socio-politics or simple intuition alone. Solutions to the problems and issues are seldom straightforward, especially in the coastal zone, and require an integrative approach. A fundamental objective of the Mauritanian government, and indeed of most human societies, is sustainable development. This implies forms of development that enhance nature's contribution to human welfare, for instance from the coastal zone, not just anticipating and preventing undesirable side effects. Strategies need to be developed, in such a way that the needs of conservation and development begin to converge (see IUCN, 1987).

But how should management proceed, recognising the complexities inherent in natural systems? Clearly, a more interdisciplinary approach to research and management is needed. As mentioned (section 3), research in the Banc d'Arguin to date has provided a valuable foundation, which could now be expanded and placed within a broader, more integrated framework. For instance, recent advances have been made in disciplines such as marine sciences, non-linear mathematics, anthropology, maritime law and socio-economics. One promising avenue is to link the scientific and human domains by means of powerful non-linear dynamical models. Possible short-term and long-term future states of the system (e.g. PNBA)

arising from a range of initial conditions (e.g. management strategies or impacts) can thereby be explored.

Experience elsewhere has shown that assessment and management of coastal resources often takes place most effectively with framework of a coastal zone management programme or plan. A possible framework is suggested below, principally as a contextual setting for the proposed research plan, but also for the array of other (present and future) activities associated with resource management in Mauritania.

Framework for the Proposed Research Plan and other Coastal Zone Activities within PNBA

Despite the genuine complexities associated with complex natural systems such as PNBA, a coherent framework into which the array of research, planning and management activities may be placed is clearly desirable. Such a framework can also help provide boundaries for a study which otherwise might seem completely limitless. Figure 3 is a simple framework, comprising 7 areas. This framework would appear to be broadly compatible with existing conservation initiatives (e.g. Verschuren, 1984; IUCN, 1988).

Area 1 - Definition: Here the overall objectives and scope of the project or study are stated. In the present context this would be development of a coastal and marine research plan for PNBA, within the context of (and to help determine) management requirements for the Park.

Area 2 - Assessment: This entails data collection and compilation, to see "what's there", using field surveys, interviews and existing information. The proposed research plan focuses on coastal ecosystems, associated resources and resource uses. However, to be most useful this data will need to be integrated with other information on the human domain (e.g. economics, law, socio-politics). The data captured is usually compiled onto maps, databases or documents, for subsequent analysis (below). At a later date it may be feasible to transfer information to a Geographical Information System (GIS), to allow spatial and temporal updating of information, then reanalysis.

Area 3 - Issues & Options: This entails data analysis, to determine actual or potential problems and opportunities. For integrated assessments, this needs to include analysis not only of ecosystems (e.g. seagrasses & mangroves), but also their connections with the human domain. Three main types of analysis are possible: i) map analysis; ii) statistical and related analysis, including the development of non-linear dynamical models; iii) issue analysis, to help understand issues or concerns that cannot be readily assessed from i) or ii), but which nevertheless may have significant implications to management.

Area 4 - Formulation: This involves data synthesis, using the results of Areas 2 and 3, to develop an action plan and management strategies. These usually involve a series of goals and tasks concerning: policies; plans, activities & projects; institutional arrangements; legislation; training, public awareness and education; monitoring and enforcement.

Area 5 - Adoption: Legislation is normally required for adoption of a management plan, although in some cases voluntary action can be effective.

Area 6 - Implementation: Once a plan has been adopted, or agreed upon, it needs to be implemented. Here practical considerations are important, and detailed workplans are normally necessary.

Area 7 - Monitoring-Evaluation-Enforcement: This includes assessing the effectiveness of management and project initiatives, and also recommendations for modifications, if necessary.

The proposed research plan (chapter 5) falls principally within Area 2 and Area 3 of this framework. The results that emerge represent valuable inputs to subsequent stages of the management and planning process (Areas 4-7).

5. Development of a Coastal Research Plan for PNBA

It is suggested that the research plan is built up from four main domains (Fig. 4):

1. General: to provide an understanding of natural processes (e.g. physical, chemical & biological oceanography; meteorology).
2. Coastal and marine ecosystems and associated resources (e.g. fish, shrimps, molluscs and other biota).
3. Birds (including breeding seabirds, wintering waders and migrants).
4. Humans: Emphasis will be given to human uses and environmental pressures. Other aspects of the human domain (e.g. socio-economics, anthropology, institutional and legislative arrangements), clearly lie outside the scope the present research plan. Nevertheless, these are essential inputs for a full understanding of the Park (see below), and can be provided by parallel studies.

The first level of research would consider each of the above domains separately, but including important interactions within each domain.

The second level of research would consider interactions between ecosystems (including fish etc.) and birds. One important output would be delineation and quantification of 'key' resource areas of the Banc d'Arguin and adjacent areas. This would help to determine if areas of high productivity, biological diversity and fishery resources are confined only to certain areas within the Park.

The third level of research would consider interactions between key resources and major human uses/environmental pressures. This would reveal areas of resource-use conflict (and compatibility), and hence where management needs may be most pressing. Research into the effects of global climate change on the Banc d'Arguin could be included (Annex 2.8).

The fourth, and highest level of research, would address interactions of all four domains, to consider PNBA as an integrated natural system. Using non-linear dynamical models the behaviour of system could be simulated and explored, for instance predicted short-term and long-term future states of the Park under different initial conditions (e.g. management regimes). These models could also be used to assess the overall performance of the Park, including its bio-economic role and value. With the current pressures to expand Mauritania's fisheries, it may well become increasingly necessary to justify the Park's existence. For this reason, it is also considered important for future research to include comparisons between areas inside and outside the Park.

Because of the genuine logistical constraints within Mauritania, it is suggested that whenever possible research is based on simple, but robust methods. At a later date, more sophisticated techniques and equipment can be employed.

During all research undertaken it is proposed that Mauritanian scientists and technicians form an integral part of the study team. Workshops, seminars and training sessions would also be of value, and these should be held in Mauritania wherever possible.

The research plan, although developed within an integrated context (Figs 3 & 4), is presented as a series of discrete proposals in the form of concept summaries (Annexes 2.1-2.10). Following review, these proposals could be developed further and submitted for consideration by potential funding agencies. It is tentatively suggested that research progresses from lower to higher, more complex levels (i.e. integrated studies). Clearly, integrated research requires inputs from several different domains, and this takes time. On the other hand, there can be a danger of research being too fragmented and becoming too protracted: managers often must make decisions using information available at the time. Hence, it may be desirable to determine the overall status of the coastal environment of PNBA, early on rather than at a later date, for instance by rapid assessment (Annex 2.7). It is essential that the various research components are well integrated and not undertaken as a series of uncoordinated, sectoral activities. It should be emphasised that research in the Park would be of a non-intrusive nature, designed to minimise disturbance to or interference with ecosystems, communities and species.

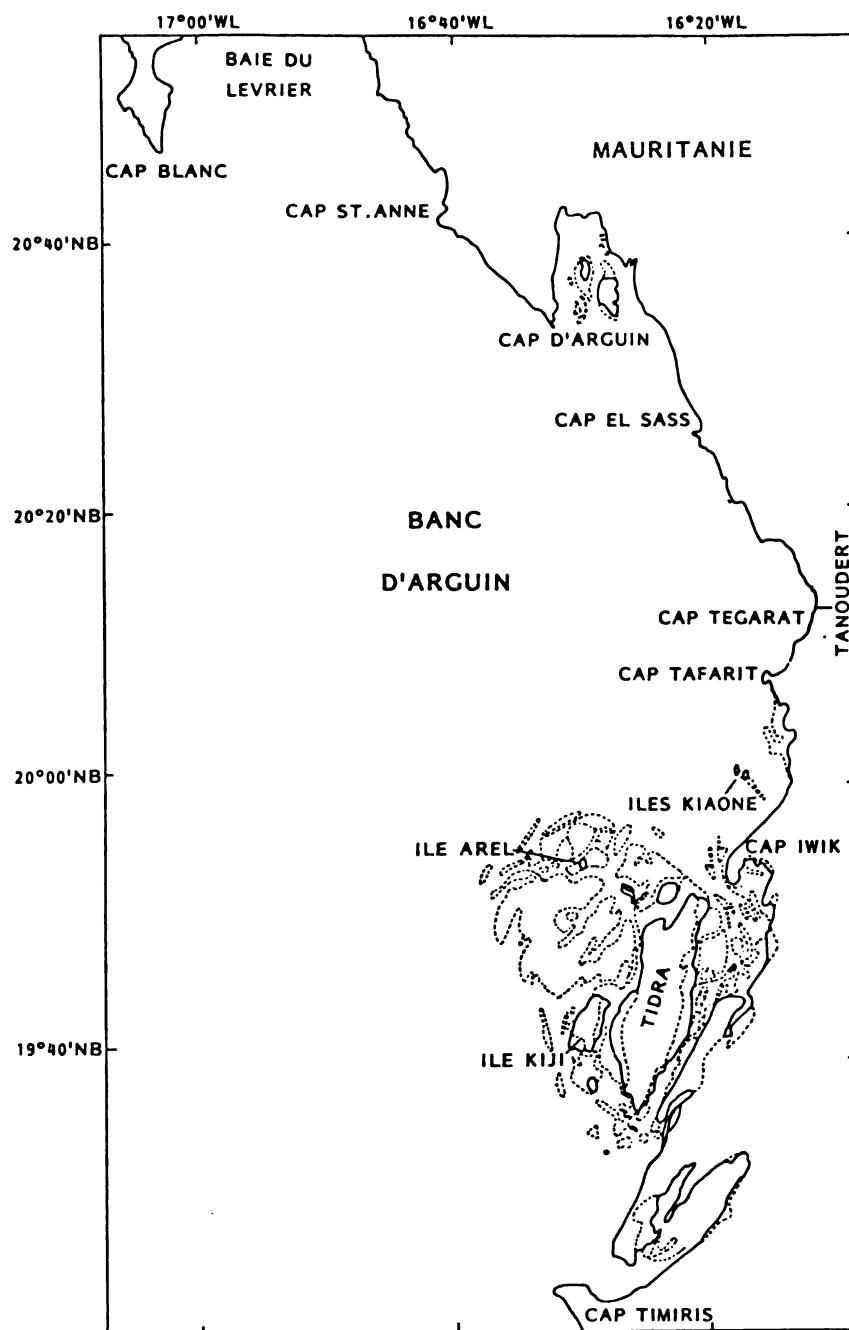


Figure 1

Map showing the Banc d'Arguin and coastal features of the Parc National du Banc d'Arguin (PNBA).

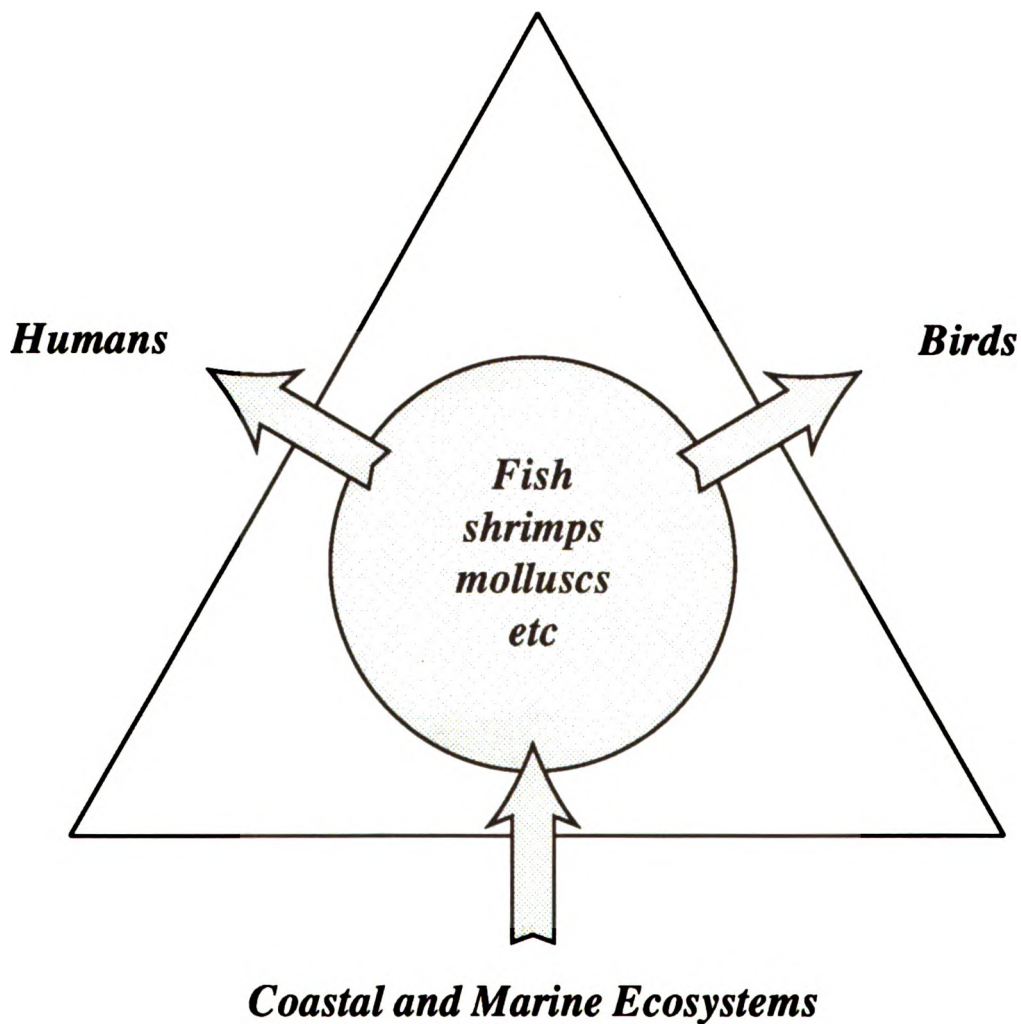


Figure 2

Schematic representation showing some of the major ecological components of the Parc National du Banc d'Arguin (PNBA): the producers (ecosystems), associated fauna (fish, shrimps, molluscs etc.) and high-level consumers (birds and humans).

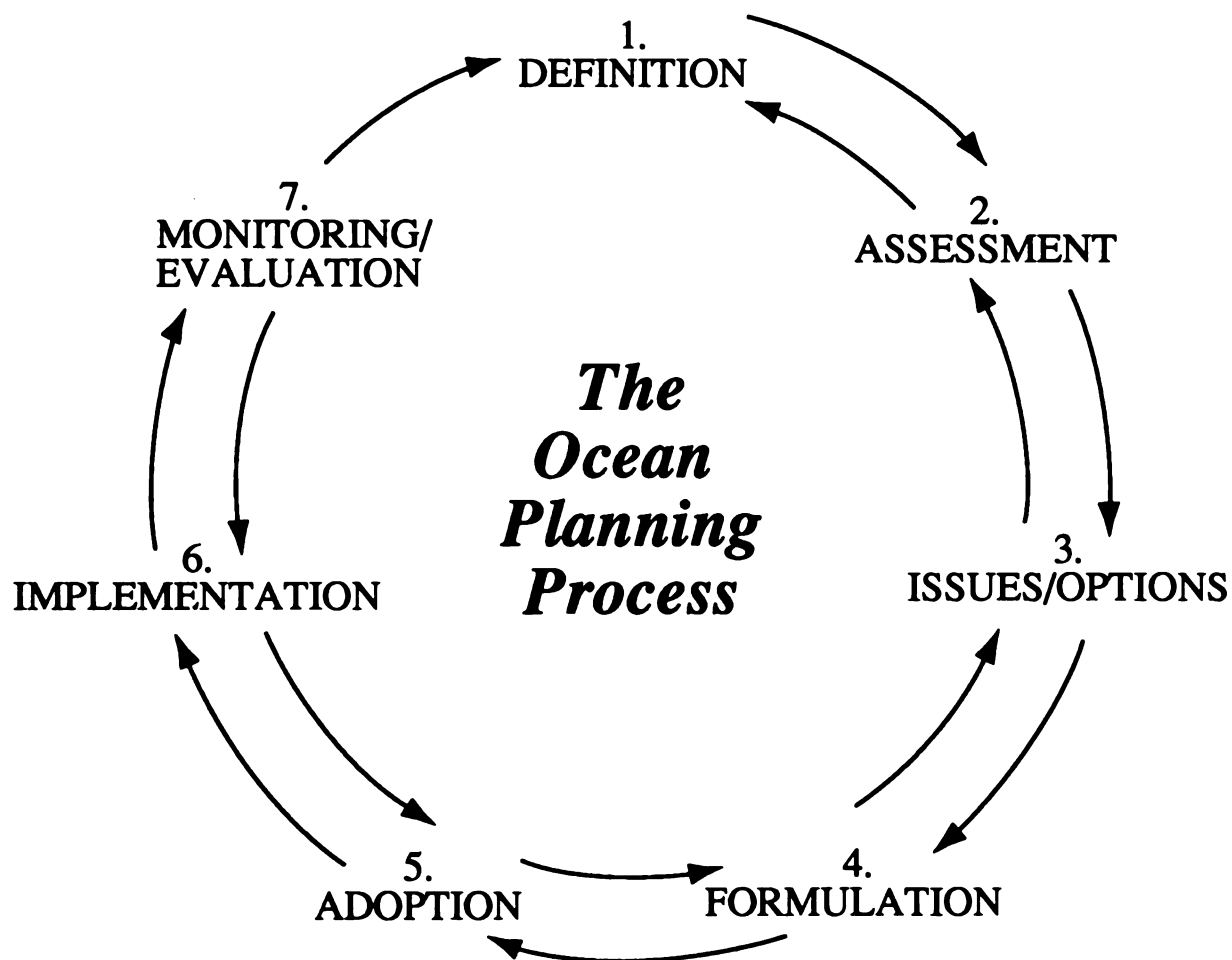


Figure 3

Possible planning and management framework for the proposed research plan for Parc National Banc d'Arguin (PNBA) (D. Elder, IUCN Marine Conservation Programme).

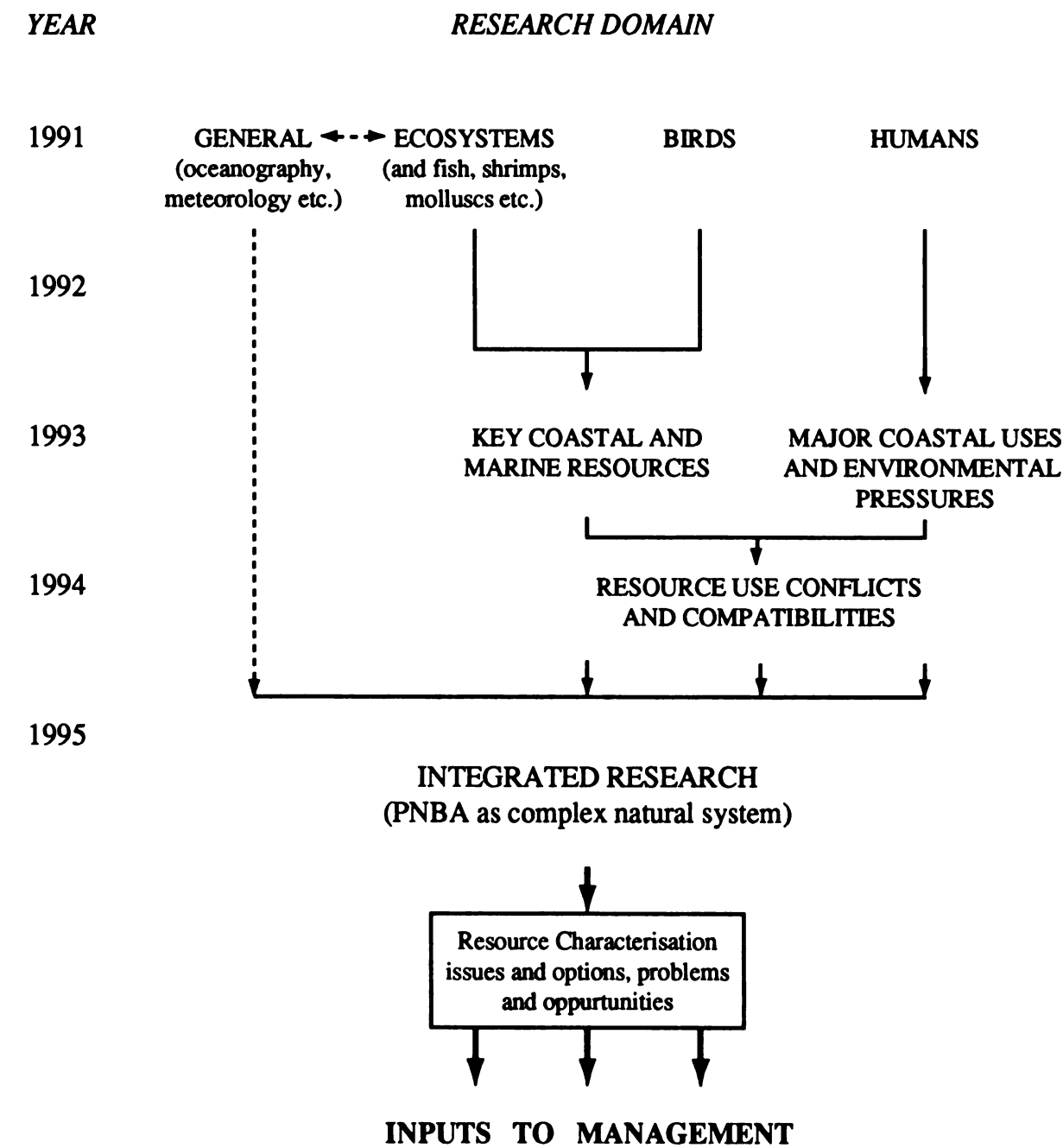


Figure 4
Suggested approach for development of coastal and research plan for the Parc National du Banc d'Arguin (PNBA).

Annex 1

BIBLIOGRAPHY OF SELECTED COASTAL AND MARINE STUDIES INCLUDING LITERATURE CITED

- BARBAULT, R., 1980. L'analyse de l'organisation des peuplements, étape capitale dans l'étude des écosystèmes. *Acta Oecol.*, 1(3) : 237-247.
- BASILEWSKY, P., 1952. Contribution à l'étude du peuplement de la Mauritanie : Coléoptères Carabidae. *Bull. I.F.A.N., sér A/14(4)* : 1170-1190.
- CAMPREDON, P., 1987. Le Reproduction des oiseaux d'eau sur le Parc National Banc d'Arguin (Mauritanie) en 1984-1985. *Alauda* 55:187-210
- DICK, W.J.A. & P.J. KNIGHT, 1975. *Oxford and Cambridge Mauritanian Expedition 1973. Report.* Univ. Cambridge.
- DUGAN, P.J., 1990. *Wetland conservation. A review of current issues and action required.* IUCN, Gland, Switzerland, 96pp.
- ENGELMOER, M., T. PERSMA, W. ALTERNBERG, & R. MES, 1984. *The Banc d'Arguin, Mauritania (Mauritania).* In: P.R. Evans, J.D. Goss-Custard, & W.G. Hale (eds). *Coastal Waders and Wildfowl in Winter.* Cambridge University Press, pp. 293-310.
- ENS, B.J., T. PERSMA, W.J. WOLFF, & L. ZWARTS, 1990. Homeward Bound: Problems Waders Face When Migrating from the Banc d'Arguin, Mauritania, to Their Northern Breeding Grounds in Spring. *Ardea* 78 (1/2), 364 pp.
- FRANCOUR, P., 1988. *La macrofaune et le peuplement ichthyologique du Banc d'Arguin (Mauritanie).* Mission d'octobre 1987, 30pp.
- GAUDECHOUX, J.P. & B. RICHER DE FORGES, 1983. Inventaire Ichthyologique des eaux mauritaniennes. *Bull. Cen. Nat. Rech. Océano-Pêches, Nouadhibou*, 11(3) : 22p.
- GAYRAL, P., 1959, Compte rendu d'un voyage scientifique en Mauritanie. *C.R.Soc.Sc.Nat.(et Phys.) due Maroc*, 1^{er} dec./8 : 112-114. (algologie Cap Blanc et Banc Arguin).
- GRUVEL, A. & R. CHUDEAU, 1909 & 1911. *A travers la Mauritanie occidentale (de Saint-Louis à Port-Etienne).* Larose Paris Ed., in octavo, t.1 : 281p, & t.11 : 383p.
- HEBRARD, L., 1973. *Contribution à l'étude géologique du Quaternaire du littoral mauritanien entre Nouakchott et Nouadhibou (18'-21'LN).* Thèse Univ.Lyon Claude Bernard, 32, : 485.
- IUCN/UNEP, 1985. Management and conservation of renewable marine resources in the Indian Ocean region: Overview. *UNEP Reg. Seas Rep. Stud.* No. 60, 78pp.

- IUCN, 1987. *Saudi Arabia: An assessment of national coastal zone management requirements*. MEPA/IUCN, 41pp.
- IUCN, 1988. *Préparation d'une stratégie nationale de la conservation en République Islamique de Mauritanie*. Vol. II. Case Studies 1. Le Parc National du Banc d'Arguin. IUCN, 19pp.
- JAGER, Z., 1990. *Investigation de la fonction du Banc d'Arguin (Mauritanie) comme nourrisserie pour les peuplements nectoniques en septembre 1988*. RIN Contributions to Research on Management of Natural Resources. Research Institute for Nature Managment. WWF, 41pp.
- KLEIN, J.M., A.R.POLLET, & E. SIMONKOVICH, 1975a. Observations écologiques dans une zone enzootique de peste en Mauritanie. I. Les Rongeurs, et en particulier *Gerbillus gerbiulus* Oliv., 1801 (Rodentia, Gerbillinae). *Cah. ORSTOM, sér. Ent. méd. et parasito.*, 13(1) : 13-28. [environs du puits de Chami].
- KNIGHT, P.J. & W.J.A. DICK, 1975. Recensements des limicoles au Banc d'Arguin (Mauritanie). *Alauda*, 43 : 363-385.
- MAHE, Eric, 1985. *Contribution à l'étude scientifique de la région du Banc d'arguin (Littoral mauritanien: 21°20' / 19°20' LN). Peuplements avifaunistiques*. 2 fasc., 579 + 6pp dessins, photo. coul. Thèse Doctorat d'Université: écologie. Montpellier USTL.
- MAIGRET, J., 1981b. Inventaire ichtyologique des eaux côtières mauritaniennes. *Feuil Liais.Assoc.soutien. PNBA*, 6 : 3-14.
- MAIGRET, J., 1983. Répartition des tortues de mer sur les côtes ouest-africaines. *Bull.Soc.Herpéto.Fr.*, 28 : 22-34.
- MAIGRET, J., J. TROTIGNON, & R. DUGUY, 1977B. Le phoque moine, *Monachus monachus* HERMANN 1779, sur les côtes méridionales du Sahara. *Mammalia*, 40(3) : 413-422.
- MARCOT-COQUEUGUIOT, J. & V. VERLAGNE, 1978. *Inventaire des algues et des phanérogames marines du Banc d'Arguin*. Parc. Nat. du Banc d'Arguin, Ministère Français de l'Environnement et GIS Posidonie, 7pp.
- MARCHESSAUX, D., 1989. *Récherches sur la Biologie, l'Ecologie et la Statut du Phoque moine, Monachus monachus*. GIS Posidonie Publ., Marseille, Fr., 280pp.
- McGLADE, J.M., 1989. Integrated fisheries management models: Understanding the limits to marine resource exploitation. *Am. Fish. Soc. Symp.* 6 : 139-165.
- MENGIN, D.F.G. & T. VAN SPANJE, 1989. *Les pêcheurs imraguens du Parc National du Banc d'Arguin en République Islamique de Mauritanie. Aspects socio-économiques*. Etude d'Aide de Développement. FIBA.

- MONOD, Th., 1933a. Notes bibliographiques sur le Sahara occidental. *Journ. Soc. Afr.*, 3(1) : 129-196.
- MONOD, Th., 1933b. Sur quelques Crustacés de l'Afrique occidentale (Liste des Décapodes mauritaniens et des Xanthidés ouest-africains). *Bull. Com. Et. Hist. Scient. A.O.F.*, 2932/15(2/3) : 456-548.
- MONOD, Th., 1933c. Notes bibliographiques sur le Sahara occidental. Premier supplément. *Journ. Soc. Afr.*, 3(2) : 335-340.
- MONOD, Th., 1935. *Ibidem*. Deuxième supplément. *Journ. Soc. Afr.*, 5(1) : 117-124.
- MURAT, M., 1939. Recherches sur le Criquet pèlerin (*Schistocera gregaria* Forsk, Acrididae) en Mauritanie occidentale (A.O.F.) et au Sahara espagnol, années 1937-1938. Deuxième rapport sur les recherches de la Mission d'Etudes de la biologie des Acridiens au Sahara occidental, précédé d'une description générale de la contrée. *Trav. Com. Et. Biol. Acridiens & Bull. Soc. Hist. Nat. Afr. du Nord, Alger*. 30(3) : 105-204, . [p: 110-128, 130-137, 143, 144, 156, 162, 163, 183, 185].
- NAEGELE, A., 1960. Contribution à l'étude de la flore et des groupements végétaux de la Mauritanie - IV. Voyage botanique dans la presqu'île du Cap Blanc, 1 ère note. *Bull. I.F.A.N., Dakar, sér.A/22/4* : 1231-1247.
- NAUROIS, R. de, 1969. Peuplements et cycles de reproduction des Oiseaux de la côte occidentale d'Afrique, du cap Barbas (Sahara espagnol), à la frontière de la République de Guinée. *Mém. Mus. Natn. Hist. Nat., Paris, sér.A, Zool./56* : 312p. [p : 34-112].
- N.O.M.E. (Altenburg G., Engelmoer M., Mes R., Piersma T.) 1982. *Wintering waders on the banc d'Arguin, Mauritania. Netherlands Ornithological Mauritania Expedition 1980*. Wadden sea working group (Stichting veth tot steun aan Waddenonderzoek, Leiden), comm. 6 : 283p.
- PERGENT, G., C. PERGENT, & G. VIVIGNIER, 1988. *Donnees preliminaires sur les herbiers de Phanerogames Marins du Banc d'Arguin (Mauritanie)*. PNBA, 54pp.
- PETIT-MAIRE, N., et al., 1979. Le Sahara atlantique à l'holocène, peuplement et écologie. *Mém. Cent. Rech. Anthro. Préh. Ethno.*, 28 : 340p, 55 figs, 23 tblx, 76 pls. chap X, XI et XII : 117-290.
- REYSSAC, J., 1978. Hydrologie, phytoplancton et production primaire de la baie du Lévrier et du Banc d'Arguin. *Bull. I.F.A.N., Dakar, 1977, sér.A/39(3)* : 487-554.
- THIOLLAY, J.M., 1977 Distribution saisonnière des rapaces diurnes en Afrique occidentale. *L'Oiseau et R.F.O.*, 47(3) : 253-294.

- TROTIGNON, J., 1977. *Les oiseaux du PNBA, Les Mammifères du PNBA*. In *Richesse du Parc National du Banc d'Arguin*, Ass. soutien PNBA : 51-74.
- TROTIGNON, J., 1976. La nidification sur le Banc d'Arguin (Mauritanie) au printemps 1974. *Alauda*, 44(2) : 119-133.
- TROTIGNON, J., 1980. *Rapport des activités scientifiques de Parc National du Banc d'Arguin, 1977-1979*. PNBA, Nouadhibou, 70pp.
- VERSCHUREN, J., 1984. *Republique Islamique de Mauritanie. Parc National du Banc d'Arguin. Plan Directeur Preliminaire*. WWF/IUCN, Gland, 139pp.
- VERSCHUREN, J., 1985. Mauritania: Its wildlife and a coastal park. *Oryx* 19(4): 221-224.
- ZOLOTAREVSKY, B. & M. MURAT, 1935a. Rapport scientifique sur les recherches de la Mission d'étude de la biologie des Acridiens en Mauritanie (A.O.F.) *Bull. Soc.Hist. Nat. Afr. Nord, Alger*, 29 : 29-103. [p31-50, 55-66, 77-81, p.3-6.]
- ZOLOTAREVSKI, B. & M. MURAT, 1935a. Divisions naturelles du Sahara et sa limite méridionale. *Mém. Soc. Biogéogr.*, 6 : 335-350.

Annex 2.

COMPONENTS OF A COASTAL RESEARCH PLAN FOR PNBA DRAFT RESEARCH PROPOSALS

Annex 2.1

TITLE:

Assessment of primary phytoplankton and benthic production in the Park and adjacent areas.

OBJECTIVES:

To determine the relative importance of phytoplankton and benthic (e.g. seagrass/algae) primary production, and to assess the contribution of PNBA to coastal productivity.

BACKGROUND AND JUSTIFICATION:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow additional fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

APPROACH:

The research, built on earlier studies, would include estimates of both benthic and phytoplankton primary productivity. Sampling would be conducted seasonally along north-south transects, to make comparisons between primary productivity inside and outside the Park; and along east-west transects to determine how far into the park the effects of upwelling are manifest, and the extent to which benthic systems (e.g. seagrasses and algae) contribute to offshore productivity. Correlative oceanographic data would be collected during a parallel study (Annex 2.2. below), for which separate funding would be sought.

MATERIALS AND METHODS:

Water samples would be taken, pumped through millepore filters to concentrate phytoplankton cells present. Chlorophyll would be extracted using acetone (or similar solvent). Concentrations of chlorophyll would be estimated using standard laboratory methods (e.g. spectropho-

tometry), and converted to production rates. Samples could be either analysed in Mauritania, or deep frozen and shipped overseas for analysis. Seagrass productivity would be estimated from studying incremental changes in growth (by tagging), and hence in biomass, to determine annual productivity rates.

DURATION:

12-18 months.

OUTPUTS:

- i) summary of raw data;
- ii) spatial and temporal analysis of data, to determine relative importance of phytoplankton : benthic primary production in different areas;
- iii) spatial and temporal analysis of data, to assess the overall importance of PNBA in respect of primary production;
- iv) 'contour' maps showing magnitude of primary production (phytoplankton & benthic) at different times of the year.

STUDY TEAM AND COLLABORATORS:

two marine scientists, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 1-2 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2.2

TITLE:

Assessment of water movements and other oceanographic features.

OBJECTIVES:

To determine the nature and magnitude of natural processes, water movements and other oceanographic features, and their overall influence on biological systems within PNBA and adjacent areas.

BACKGROUND AND JUSTIFICATION:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

APPROACH:

The research, built on earlier studies, would probably be undertaken in parallel with the research on primary productivity (Annex 2.1 above), for which separate funding would be sought. A high priority is to obtain an understanding of water movements in the region. For instance, it has been suggested that effluents and solid wastes entering PNBA might originate from areas north of the National Park. If so, ecological effects and social repercussions of such pollution transport could be considerable. Reliable information on water movements would help to test this assertion. Other oceanographic features of PNBA would also be determined, in particular sea temperature, salinity and turbidity. If sufficient funds were available, the concentrations of nutrients, heavy metals and hydrocarbons would also be determined. Sampling would be conducted seasonally along north-south, and along east-west transects.

MATERIALS AND METHODS:

Current meters would be deployed at up to 12 stations inside and outside PNBA to determine water movements. Marked floating objects (current drifters) released from several localities would also provide useful information on net water movements. Sampling of oceanographic parameters would be undertaken at coastal and offshore stations. Turbidity could be measured

using a secchi disc, sediment traps and by estimates of suspended particulate matter. Surface temperatures would be taken using a standard mercury thermometer, and salinities determined using a hand-held refractometer. Water samples would also be taken, and deep frozen for subsequent analysis of nutrients (e.g. silicate, ammonium-N, nitrate + nitrite-N & phosphate), selected heavy metals (e.g. copper, vanadium) and hydrocarbons. Samples could be either analysed in Mauritania, or shipped overseas for analysis.

DURATION:

12-18 months (in first instance).

OUTPUTS:

- i) summary of raw data;
- ii) spatial and temporal analysis of data, to determine correlations between oceanographic factors and primary productivity (phytoplankton & benthic) in different areas;
- iii) 'contour' maps showing magnitude of oceanographic factors, inside and outside the Park, at different times of the year.

STUDY TEAM AND COLLABORATORS:

two marine scientists, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 1-2 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2.3

TITLE:

Characterisation, delimitation and quantification of the major coastal and marine ecosystems.

OBJECTIVES:

To map the dominant intertidal and subtidal ecosystems in and adjacent to PNBA; to quantify the linear and/or areal extent of each ecosystem; and to characterise each ecosystem according to its physical features (i.e. substratum type, grain size) and dominant biota.

BACKGROUND AND JUSTIFICATION:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

APPROACH:

Ecosystems represent the foundations of a vast array of interdependencies in PNBA, including fisheries. An understanding of the ecology is therefore vital to the establishment of a successful management regime. The proposed research would build on earlier studies (e.g. using remote sensing), which have provided a preliminary understanding of the distribution and biomass of seagrasses and associated ecosystems in the Park. The present study would, in addition, consider other ecosystems such as subtidal sand and mud.

The study would aim to delineate and quantify the extent of each ecosystem. Sampling of biota would provide information on the dominant associates, although exhaustive taxonomic surveys would not be attempted. Sampling would be undertaken at least twice per year, to determine seasonal differences. Since the Park comprises a mosaic of highly heterogeneous habitats, it is suggested that it is zoned, by dividing it into grids, probably 10 km x 10 km (or 20 km x 20 km). (Grids can later be subsumed into larger units, if necessary, for instance to accord with the fishing zones). Information would be compiled for each grid. The same grid system could be adopted outside the Park, so that comparisons can be made between ecosystems inside and

outside the Park. Ecosystem information for each grid, together with fisheries and socio-economic data, are key inputs for considering the Park as a complex, integrated system. (Separate funding is being sought for this research study.)

MATERIALS AND METHODS:

The investigation would involve a range of methods, including remote sensing (SPOT/LandSat) and aerial survey, in conjunction with ground-truthing and in-situ quantitative sampling along transects (e.g. using quadrats, core samplers, simple trawls).

DURATION:

18-24 months.

OUTPUTS:

- i) summary table showing linear and areal extent of each intertidal ecosystem, and areal extent of each subtidal ecosystem;
- ii) table showing above data for each 10 km x 10 km (or 20 km x 20 km) grid, inside and outside the Park;
- iii) table showing dominant fauna and flora within each ecosystem;
- iv) maps showing distribution of each ecosystem;
- v) maps showing ecosystems and areas of high biological diversity (see also Annex 2.7).

STUDY TEAM AND COLLABORATORS:

two marine scientists, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 1-2 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2 .4

TITLE:

The status of turtles, monk seals and other species of conservation importance.

OBJECTIVES:

To determine the current status of marine reptiles, marine mammals and other species of conservation importance, and to assess the relative importance of PNBA to these species.

BACKGROUND AND JUSTIFICATION:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of an integrated research plan, to help define the needs of management.

APPROACH:

Sea turtles (Green, Hawksbill, Loggerhead & Leatherback), cetaceans (e.g. Common Porpoise, Hump-backed Dolphin, Bottle-nosed Dolphin), Monk Seals and birds are among the fauna of conservation importance in Mauritania. All are key biological components of PNBA and play a role in its diversity, integrity and economy. In view of their migratory habits, assessments of turtles should be linked to international programmes. The turtle species important in Mauritania are classified as endangered (Green, Hawksbill and Leatherback) and vulnerable (Loggerhead) in the IUCN Red Data Books. With exceptions (e.g. birds & Monk Seals), little information is available on the status of populations of many of these species. Building on previous studies on Monk Seals, observations would be made at coastal and offshore sites and should form part of a national programme. (Birds have already been the subject of intensive investigations and would not be included here; however, see also Annex 2.6). Observations would be undertaken during different seasons, at sites both inside and outside PNBA. Use would be made of information from a parallel study (Annex 2.7), to determine details of habitat requirements of these (and other species), and also details of the actual and potential environmental pressures.

MATERIALS AND METHODS:

From observations and counts made at the study sites, and from aerial surveys, estimates of the population size of each species of conservation importance would be made. The status of each species would also be assessed.

DURATION:

12-18 months.

OUTPUTS:

- i) summary table showing data on abundances of species at each site;
- ii) table showing estimated population size of each species, inside and outside the Park;
- iii) map showing distribution of each species, inside and outside the Park;
- iv) details of conservation status of each species.

STUDY TEAM AND COLLABORATORS:

one or two marine scientists, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 1-2 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2.5

TITLE:

The role of the Park as a nursery, spawning, residential and migration area for fishery resources.

OBJECTIVES:

To assess the role of the Park and associated coastal ecosystems with respect to fishery production and maintenance.

BACKGROUND AND JUSTIFICATION:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

APPROACH:

The proposed research would build on existing studies (e.g. catch statistics and experimental fishing) to identify the Park's role as a nursery, spawning, residential and migration area for fishery resources. Specific emphasis needs to be given to understanding the seasonal migration patterns of mullet. This species is of much importance to the Imraguen who hunt the fish with assistance from dolphins. Despite only modest levels of fishing by the Imraguen, mullet catches have declined severely in recent years. It has been suggested that this decline may be a consequence of activities occurring outside the park. The biggest change affecting the park is the increased fishing within and, above all, around the park from the Atlantic coast of Western Sahara to the north to the Senegal river mouth to the south. In addition to mullet, sharks and guitar fish are the species fished most heavily in the park. A research proposal that considers possible impacts of the pelagic fisheries outside PNBA on the park is given in Annex 2.6.

Observations would need to be undertaken both within PNBA and in areas outside the Park. Sampling would be undertaken at sites within different ecosystems along the shore, using several techniques including a simple beach seine (or similar net).

MATERIALS AND METHODS:

Semi-quantitative hauls would indicate the abundance and size composition of small fish, shrimps and other crustaceans (juveniles & adults), as well as large fish (principally juveniles). This could be supplemented by offshore studies, using a simple trawl net and from visual censuses carried out by divers. Population estimates of adult stages of large fish would be obtained primarily from catch statistics of the Imraguen fishermen. Plankton sampling would also be undertaken to identify shrimp and fish spawning areas and seasons.

Sampling would be undertaken at least twice per year to determine seasonal differences. Since the Park comprises a mosaic of highly heterogeneous habitats, it is suggested that it is zoned, by dividing it into grids, probably 10 km x 10 km (or 20 km x 20 km). (Grids can later be subsumed into larger units, if necessary, for instance to accord with the known fishing zones). Information would be compiled for each grid. The same grid system could be adopted outside the Park, so that comparisons can be made with ecosystems inside and outside the Park. Ecosystem information for each grid, together with fish catch and socio-economic data, are key inputs for considering the Park as a complex, integrated system. (Separate funding is being sought for this research study.)

DURATION:

2-3 years.

OUTPUTS:

- i) summary table showing abundance (e.g. biomass and size-frequency data) for each species/species group of fish and crustacean;
- ii) table showing above data for each major ecosystem;
- iii) table showing above data for each 10 km x 10 km (or 20 km x 20 km) grid, inside and outside the Park;
- iv) summary maps showing centres of abundance of juvenile/adult shrimp and fish, and major migration routes;
- v) summary map showing main shrimp and fish spawning centres.

STUDY TEAM AND COLLABORATORS:

two marine scientists, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 2-4 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2.6

TITLE:

Assessment of the interactions of fish and bird populations.

OBJECTIVES:

To determine the likely impact of increased fishing and loss of intertidal habitat on the populations of resident and migratory birds.

BACKGROUND AND JUSTIFICATION:

(A) Parc National du Banc d'Arguin (PNBA)

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

(B) Birds in the PNBA

Three groups of marine and coastal birds are dependent on the marine environment of PNBA for food:

- i) sea-birds (terns, gulls, cormorants);
- ii) large shore birds (herons, spoonbill and flamingo);
- iii) waders (plovers, sandpipers, godwits, curlews).

These groups are functionally distinct: seabirds are principally piscivores; waders feed on benthic invertebrates, on or in mud and sand; and, except for flamingoes which feed exclusively on planktonic algae and diatoms, the larger shore birds principally take fish and free-swimming crustaceans and insect larvae.

Two issues require priority consideration:

- a) what impact would increased fishing pressure (by artisanal or industrial fisheries) in or near PNBA have on the population of birds? Would reduction in the size of fish stocks

- lead, as might be expected, to a decrease in the populations of birds dependent on them?
- b) what impact would reduction in area of intertidal habitat (e.g. through coastal development pressure) have on the waders and larger shore-birds that feed there? If a proportion of the intertidal habitat is lost, can the birds move elsewhere to feed?

Research on other sea-bird populations dependent on heavily fished stocks suggests that sea-bird populations may show drastic decline when stocks of pelagic fish on which they depend collapse as a result of overfishing. This appears to have happened following decline of pilchard stocks in Peru (see e.g. Jordan & Fuentes, 1966) and of pilchard stocks in Southern Africa (see e.g. Crawford & Shelton, 1978). More recently, collapse of sea-bird populations in the north of Scotland has been associated with large increase in fishing pressure on sandeel, on which these birds principally feed their young (see e.g. Furness, 1982).

However, in theory, increased fishing could increase the food available to sea-birds if the fish exploited were either predators, or competitors, of the species on which the birds depend. Indeed, evidence suggests that North Sea sea-bird populations increased during the earlier part of this century as increased fishing of herring and similar species allowed other fish species (including sand-eel) feeding on similar food, to increase their numbers. In a similar way, increased fishing of demersal fish predators of macro-invertebrates could increase the stocks of intertidal invertebrates available to migrant and wintering waders.

APPROACH:

The effects of increased fishing pressure can only be predicted by modelling the food chain interactions between the principal species and species groups involved. To achieve this it will be necessary to determine for each species, or group of comparable species: a) catches taken by fishing; b) population size and turnover; c) food taken (amount and species composition). A simple model would need to include the main trophic levels within each of birds, fish and crustaceans: for instance, terns, gulls, cormorants, large, medium and small waders, small and large pelagic fish, small and large crustaceans, polychaetes, etc.

Studies would need to consider several factors which may influence or drive the system.

- i) Waders numbers might be limited by breeding success (on arctic and sub-arctic breeding grounds), or migration mortality, rather than by feeding and survival on winter feeding grounds in PNBA;
- ii) seabirds may feed young either on one or a few preferred species, or at least on a different species-mix than is taken by adults themselves;
- iii) seabirds, in particular, may be able to breed successfully after switching to less preferred species that may not otherwise be a significant food;
- iv) recruitment of pelagic fish species may be highly variable, depending on climatic and oceanographic factors.

Assessment of the likely impact of habitat loss on migrant waders may also be based on the above data. Estimates of food requirements of waders enable comparison of total food consumption over winter with available stocks of food invertebrates. Estimates of food requirement may be based on either recorded feeding rates, or estimated energy requirement, based in turn on measurements of basal metabolic rate and energy consumption of captive birds.

The study of Engelmoer et al. (1984) provides a valuable initial comparison of food availability and estimated feeding requirements. It suggests that invertebrate biomass is low compared to that on wader feeding grounds in northern estuaries, and barely meets the food requirement of the wader population. Thus habitat extent may already be limiting the overwintering wader population. However, this study was undertaken in February, and studies on European estuaries (e.g. Goss-Custard, 1977) have shown that feeding waders consume a significant proportion of the invertebrate stock during the course of the winter. Also, estimates of feeding requirement were based on presumed basal metabolic rate, and may be an over-estimate if metabolic rates on tropical wintering grounds are significantly less than those expected in temperate regions. On the other hand, direct observation of food consumption is handicapped by the need of waders over-wintering in PNBA to feed by night, as well as by day.

MATERIALS AND METHODS:

The data required to model the impact of fishery development, elements of which are already available from studies to date, may be generated by the following research activities:

1. Analysis of fish catch data and estimates of fish stocks, including the pelagic fisheries outside the park: Available fisheries data would be used, but additional catch and effort data are needed and could be obtained through research officers placed on selected industrial fishing vessels. It is suggested that selected cooperating vessels should be permitted to fish within the Park boundaries for short trial periods, both to provide data for stock assessment, and to investigate the impacts of these fishing techniques.
2. Fish diet: this would be investigated by gut content analysis of fish taken in both artisanal and industrial fisheries. Research staff would work on board larger industrial vessels, or in association with artisanal fishermen.
3. Bird diet: sea-bird diet should be investigated, especially during the breeding season, by analysis of pellets, observations on fish brought to young, and samples obtained by forcing nestlings to disgorge crop contents. Shore bird diet should be investigated by direct observation of feeding behaviour and study of faeces collected on roosting grounds. The studies of Engelmoer et al. (1984) and Campredon & Francour (unpublished) provide valuable initial data, but these need extending through the breeding or winter season, and replicating, in order to assess degrees of spatial and temporal variability.
4. Abundance of benthic invertebrates: sampling of epifaunal and infaunal macrobenthos through visual counts, cores, grabs and dredges. Sampling needs to be undertaken throughout the year, to identify annual patterns, and each separate habitat and sub-habitat should be sampled. The extent of habitats should be assessed through aerial survey, and ground-truthing site visits and this is the topic of a separate study for which funding is currently being sought.
5. Estimates of bird populations: in general sufficient information appears to be available to provide values of population size for the above model, but continued background monitoring of sea-bird colonies and over-wintering wader numbers is desirable. To extend the work on wader habitats more accurate estimates of both feeding rates and

metabolic requirements are needed. Part of the data will accrue from studies 3-5 (above). In addition, the following are proposed:

6. Laboratory studies: in particular energy requirements and metabolic rates of key species, under relevant conditions of temperature and humidity.
7. Comparison of feeding rates of waders: for instance, in different study sites with contrasting benthic invertebrate densities, linked to observations of wader foraging behaviour and distribution of birds between sites.

DURATION:

2 years.

OUTPUTS:

A model to examine interactions between fish, fisheries and birds.

STUDY TEAM AND COLLABORATORS:

four marine scientists and two ornithologists, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 2-4 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2.7

TITLE:

Rapid assessment of coastal resources, uses and pressures to determine areas of resource-use conflict.

OBJECTIVES:

To obtain site-specific information on biological resources, resource uses and impacts along the coastline of PNBA.

BACKGROUND AND JUSTIFICATION:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

APPROACH:

A simple, rapid method for preliminary assessment of coastal management needs of PNBA is advocated, based on semi-quantitative data on coastal resources, uses and environmental impacts. The method has already been used successfully in similarly rigorous, tropical environments. If available, a simple computer database and statistics program would be used to manipulate and analyse the data, although these are not essential.

MATERIALS AND METHODS:

Observations would be made at 100-200 coastal sites in and around PNBA. Each site comprises a quadrat 500 m x 500 m (estimated) bisecting the beach, thereby covering both the intertidal and immediate subtidal zones. Within each quadrat the abundance or magnitude of the following are estimated and recorded semi-quantitatively: biological resources (flora - mangroves, seagrass, halophytes, algae, freshwater vegetation; fauna - birds, turtles, mammals, fish, invertebrates); resource uses and impacts (construction, fishing/collecting, pollution - oil, other pollution, driftwood).

The above attributes are scored using a ranked 0-6 scale. For uses and impacts, the scores simply represent the estimated relative magnitude (0 : nil, 6 : greatest impact). In the case of resources, abundance scores are based on estimates of areal extent (m²) for flora, or of estimated number of individuals for fauna, both within each sample area of 250,000 m² (500 m x 500 m) as follows:

Abundance Scale (log scale)	Areal Extent (m ²) Flora or No of Individuals Fauna (equivalent arithmetic range)
0	0
1	1-9
2	10-99
3	100-999
4	1,000-9,999
5	10,000-99,999
6	100,000+

In addition, certain features features (e.g. salinity, temperature, meteorology) are recorded at each site, together with general details of coastal topography, depth, substrate and habitat. Information at each 'site assessment quadrat' can normally be collected and recorded within a 1-hour period. (Recording of information is facilitated by special waterproof pro-forma data sheets). The approach described is considered to be most effective when combined with more detailed coastal zone management studies.

DURATION:

6 months.

OUTPUTS:

- i) summary of data, to indicate overall state of the coastal environment;
- ii) major areas of concentrated resources, including areas of high biological diversity (see also Annex 2.3);
- iii) areas associated with heavy uses/impacts;
- iv) areas in which concentrated resources overlap with heavy uses/impacts, to denote principal conflict areas, and hence where management may be needed most urgently;
- v) grouping of sites according to environmental conditions using cluster analysis;
- vi) associations between environmental variables by means of correlation;
- vii) database of raw data.

STUDY TEAM AND COLLABORATORS:

one marine scientist, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 1-2 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2.8

TITLE:

Impact of greenhouse gases and sea-level rise on coastal ecosystems and associated renewable resources.

OBJECTIVES:

To determine ecological and related effects of predicted sea-level rise on coastal resources of PNBA.

BACKGROUND:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

JUSTIFICATION:

Global temperatures have gradually risen over the past century, in a manner consistent with the predicted effects of the increased presence of 'greenhouse gases'. There is a general consensus that global warming will be accompanied by a rise in global mean sea level owing to thermal expansion of sea water. Calculations have indicated that this may lie in the range of 17-25 cm by 2030, corresponding with the estimated temperature rise of 1-2°C. The effect may be exacerbated in areas where coastal subsidence is occurring.

Rising levels in CO₂ concentrations may alter productivity, biomass and physiology (e.g. changes in water flow, rising leaf temperatures and leaf stress caused by stomatal closure) of coastal vegetation. Increased ambient temperatures may cause latitudinal displacements of vegetation zones and plant assemblages and impair larval development of certain marine organisms such as penaeid shrimps. Sea level rise, apart from the obvious effects of flooding, could adversely affect shallow-water coastal ecosystems (e.g. seagrasses, tidal flats and mangroves). Higher sea levels could render some shorelines more vulnerable to the effects of

flooding from storm surges, and increase the intrusion of saltwater into surface and groundwater systems. Long-term ecological effects may include disruption of life cycles of animals (e.g. birds, fish & shrimps) dependent on coastal vegetation. Disturbance of coastal ecosystems in turn could affect the socio-economic structure of low-lying areas like the Banc d'Arguin.

Acute effects arising from episodic events must be considered together with the longer-term changes such as in sea level. Among these events are an increase in the frequency and magnitude of storms, strong winds and flash floods. Of particular significance is the frequency of such episodic disturbance relative to the rate of ecosystem recovery. If such events are rare there is time for an affected ecosystem to recover to its previous state, but where disturbance events become more frequent there may not be time for full recovery to take place. In some cases the loss of defence provided by a healthy system such as mangal will lead to an even greater impact when the next episodic event, such as a storm surge occurs.

APPROACH, MATERIALS AND METHODS:

The study would be undertaken principally using existing information and computer simulation, possibly augmented by field/experimental work at selected monitoring sites in PNBA (funding permitting). Detailed topographic maps would be used to assess expected changes (recession) in coastal ecosystem distribution, coastal and land use patterns. The effects would be predicted for incremental rises (e.g. 5 cm) in sea level. Possible biological effects on structure and function of key coastal ecosystems would also be explored. In addition, the wider implications of ecosystem disturbance would be examined, using inputs from socio-economic and other studies. The latter form the basis of separate research studies for which funding is being sought. The result would provide a valuable input for a parallel study which aims to assess PNBA as an integrated natural system using non-linear dynamic models (Annex 2.9).

DURATION:

18-24 months.

OUTPUTS:

- i) series of maps showing distribution of coastal ecosystems, coastal and land uses for incremental rises in sea level;
- ii) analysis of effects of changing concentrations of greenhouse gases, increased temperature and rising sea level on the structure and function of coastal ecosystems;
- iii) the effects of the above on birds, marine life and other interdependencies;
- iv) wider ecological and socio-economic implications of the above on PNBA, including the possible effects of an increase in the occurrence and severity of storms and other episodic events associated with global warming.

STUDY TEAM AND COLLABORATORS:

two marine scientists and one computer modeller, probably from overseas, with two Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 2-4 week training period, for the Mauritanian team to become familiar with the methodology.

Annex 2.9

TITLE:

The national park as a complex, natural system.

OBJECTIVES:

To understand the behaviour and performance of PNBA as a complex, integrated, natural system.

BACKGROUND AND JUSTIFICATION:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

APPROACH, MATERIALS AND METHODS:

A non-linear dynamical model would be developed using inputs from several parallel studies, for which independent funding is being sought. These inputs would include spatial and temporal data on ecosystems, fisheries, birds and other interdependencies. Socio-economic information, (e.g. behaviour of fishermen, bioeconomics) are also important requirements.

Since the Park is very heterogeneous, both ecologically and socio-economically, it is suggested that it is zoned, by dividing it into grids 10 km x 10 km (or 20 km x 20 km). (Grids can later be subsumed into larger units, if necessary, for instance to accord with the known fishing zones). Information would be compiled for each grid. The same grid system could be adopted outside the Park, so that comparisons can be made with ecosystems inside and outside the Park.

DURATION AND WORKPLAN:

18-24 months.

OUTPUTS:

- i) Characterisation, performance and economic value of PNBA as an integrated system;
- ii) exploration of possible short-term and long-term future states arising from a variety of simulated initial conditions (e.g. impacts or management regimes);
- iii) analysis to consider whether existing legal and institutional frameworks can respond in sufficient time to avoid long-term degradation of PNBA;
- iv) analysis to determine if existing management practices are compatible with temporal and spatial scales of key coastal ecosystems and associated species within PNBA.

STUDY TEAM AND COLLABORATORS:

one marine scientists and one or two computer modellers, probably from overseas, with one or more Mauritanian biologists

TRAINING:

The research would commence with a 1-2 month training period, for the Mauritanian team to become familiar with the computer modelling and related methodology.

Annex 2.10

TITLE:

Development of an oil spill contingency plan.

OBJECTIVES:

To develop the framework for an oil spill contingency plan for PNBA and Mauritania.

BACKGROUND:

The Banc d'Arguin is of both national and global significance. In 1976 the Parc National du Banc d'Arguin (PNBA) was created, to manage and protect a large portion of the Banc. The Park harbours the world's largest concentrations of wintering waders (> 2 million birds annually), and a highly diverse community of nesting fish-eating birds. In addition, the region is host to other species of conservational importance (e.g. green turtles, monk seals & cetaceans). Adjacent to the Park lies one of the world's richest fishing grounds. Fisheries within the park are exploited by Imraguen fishermen using artisanal methods; they are an integral component of the Park. The abundant bird and marine life within the Park is a manifestation of upwelling along the west African coast, and the prevalence of seagrass beds and other shallow-water benthic habitats, or ecosystems. The focus of research to date, however, has been predominantly terrestrial.

Fisheries are the number one economic resource and the park is under pressure to allow increased fishing. A research plan is therefore needed to increase understanding of the coastal ecology of the park, and to assess its role in the production and maintenance of fishery resources. The present proposal seeks funding for research that forms one component of integrated research plan, to help define the needs of management.

JUSTIFICATION:

Mauritania lies in close proximity to heavy oil tanker traffic. Several oil spills have already occurred off the west African coast, including a major spill off Banc d'Arguin in early 1992. Consideration may therefore need to be given to an appropriate response in the event of a serious oil spill in the future. The mosaic of environments comprising PNBA could be at particular risk.

APPROACH, MATERIALS AND METHODS:

Acquisition of emergency equipment (e.g. booms, skimmers, vac trucks) and training of local personnel in different methods of oil spill combat is an important requirement for any oil spill contingency plan. Knowledge of the pros and cons of different methods of dealing with oil spills (e.g. booms, detergents, 'do nothing approach') is also a major consideration. Coastguards or fishermen might form the basis of any oil spill combat team.

It would also be of value to compile an ecosystem vulnerability index, to determine which ecosystems and resources are most vulnerable and sensitive to oil pollution. From other studies it is known that mangroves and intertidal flats, both of which are prevalent in PNBA, are particularly vulnerable and sensitive to oil pollution, as are associated species (e.g. birds & fishery resources). This information, together with socio-economic considerations, can be used

to assign a system of priority for clean-up of different areas of PNBA in the event of an oil spill.

DURATION:

3-6 months.

OUTPUTS:

- i) analysis of existing institutional and other infrastructures, and identification of groups/ individuals that could form core group of oil spill combatance team;
- ii) development of overall framework for oil spill contingency plan;
- iii) map showing locations of coastal habitats most sensitive to oil pollution;
- iv) list and map of priority areas for clean-up;
- v) details of appropriate clean-up methods and equipment needed for different habitats.

STUDY TEAM AND COLLABORATORS:

one marine scientist and one oil spill specialist, probably from overseas, with one or more Mauritanian biologists/technicians.

TRAINING:

The research would commence with a 1 month training period, for the Mauritanian team to become familiar with oil spill assessment and cleanup.

UvA Law Library



3 5007 00219065 4

IUCN - THE WORLD CONSERVATION UNION

IUCN - The World Conservation Union brings together States, government agencies and a diverse range of non-governmental organisations in a unique world partnership : some 650 members in all, spread across 120 countries.

As a union, IUCN exists to serve its members - to represent their views on the world stage and to provide them with the concepts, strategies and technical support they need to achieve their goals. Through its six Commissions, IUCN draws together over 5,000 expert volunteers in project teams and action groups. A central secretariat coordinates the IUCN Programme and leads initiatives on the conservation and sustainable use of the world's biological diversity and the management of habitats and natural resources, as well as providing a range of services. The Union has helped many countries to prepare National Conservation Strategies, and demonstrates the application of its knowledge through the field projects it supervises. Operations are increasingly decentralised and are carried forward by an expanding network of regional and country offices, located principally in developing countries.

IUCN - The World Conservation Union - seeks above all to work with its members to achieve development that is sustainable and that provides a lasting improvement in the quality of life for people all over the world.

This book is part of
THE IUCN CONSERVATION LIBRARY

IUCN
The World Conservation Union

For a free copy of the complete catalogue please write to:
IUCN Publications Services Unit,
181a Huntingdon Road, Cambridge, CB3 0DJ, UK
or
IUCN Communications Division,
Rue Mauverney 28, 1196 Gland, Switzerland

