Overseas Development Administration

Sundarbans Forest Inventory Project, Bangladesh

Wildlife conservation in the Sundarban

J H BLOWER

1985

Land Resources Development Centre
Tolworth Tower, Surbiton, Surrey,
England KT6 7DY

Project Report—151

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White-bellied fish eagle ascending from the crown of a sundu tree

LIST OF LRDC REPORTS ON THE

SUNDARBANS FOREST INVENTORY PROJECT

BLOWER J H (1985) Wildlife conservation in the Sundarbans. Project Report 151

CHAFFEY D R (1980) Proposals for a forest inventory of the Sundarbans, Bangladesh. Project Report 101

CHAFFEY D R and MILLER F R (1982) Sundarbans forest inventory project: plan and procedure. Project Record 75

CHAFFEY D R, MILLER F R and SANDOM J H (1985) A forest inventory of the Sundarbans, Bangladesh. Project Report 140

CHAFFEY D R AND SANDOM J H (1985) Sundarbans forest inventory project: a glossary of vernacular plant names and a field key to the trees. Project Record 98

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ABSTRACT

This report presents a review of and recommendations on the subject of wildlife conservation in the Sundarbans Reserved Forest, a saline swamp forest occupying the south-west corner of Bangladesh and having a land area of 4 020 km-2.

As a habitat for wildlife, the Sundarbans is unique. The forest and the numerous waterways by which it is dissected together support a wide range of mammals, birds, Amphibia, reptiles and Crustacea. Certain of the animal species in the Sundarbans, including the Bengal tiger and the estuarine crocodile, are internationally recognised as being in danger of extinction. Several major species of mammal and a species of crocodile are known to have become extinct in the Sundarbans in the present century.

The essential features of the Sundarbans ecosystem as a habitat for wildlife and the threats to the ecosystem are discussed, as also are the administrative aspects of wildlife conservation. These administrative and organisational considerations are emphasised in the recommendations which cover also management, protection, tourism and research.

KEYWORDS

Amphibia, animal ecology, animal protection, aves, carnivora, fauna, game animal, mammalia, predator, reptilia, skin produce, wildlife, mangrove forest, tropical moist forest, Bangladesh.

PREFACE

The study which is the subject of this report was undertaken as a short-term assignment at the request of the Government of Bangladesh. It was a part of the Sundarbans Forest Inventory Project, carried out by the Bangladesh Forest Department and the Land Resources Development Centre of the UK Overseas Development Administration.

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Mr M Atiqullah	Chief Conservator of Forests, Dhaka
Mr A W Akonda	Senior Research Officer (Wildlife), Forest Department Dhaka
Mr S Das	Forest Ranger, Sundarbans Forest Inventory Project, Khulna
Prof K Z Husain	Professor of Zoology, Zoolog Department, Dhaka University
Mr T I M Hasan Imam	Director of Planning, National Tourist Organization, Dhaka
Mr H Loesch	Project Manager, Fisheries Resources Survey System, FAO, Dhaka
Dr S Rahman	Divisional Forest Officer (Working Plans), Forest Department, Dhaka
Mr N M Sarker	Conservator of Forests (Administration and Wildlife), Forest Department, Dhaka

Dr Md S U Sarker	Associate Professor, Zoology Department, Dhaka University
Mr A Taher	Divisional Forest Officer, Sundarbans Forest Division, Khulna
Mr S Uddin	Forest Ranger, Forest Department Revenue Station, Hiron Point
Mr W J Welsh	Project Coordinator, Assistance to the Forestry Sector, Food and Agriculture Organisation, Dhaka

BACKGROUND

With a total land area of 4020 km~2 in Bangladesh (and nearly as much again in India) the Sundarbans is one of the largest remaining areas of mangrove vegetation in the world. As one of the most biologically productive of all natural ecosystems it is of great economic importance as a source of timber, fish and numerous other products. It is especially important to a country such as Bangaldesh with a population now approaching 90 million, where continuing deforestation has already reduced natural forest cover to a mere six percent of the total land area, of which the Sundarbans forests comprise more than half. Apart from its economic importance as a source of timber and other valuable commodities and in providing employment for some 300 000 woodcutters, fishermen and others who find a living there at various seasons of the year, the Sundarbans is of unique value both nationally and internationally as a habitat for wildlife and as an area of both great scientific interest and unusual natural beauty. It is the task of the Bangladesh Forest Department, which has responsibility for managing the Sundarbans Forest, to reconcile the frequently conflicting interests of exploitation and conservation, and to manage this fragile ecosystem in such a way as to maintain its many varied components and values unimpaired.

OBJECTIVES

The main purpose of the Sundarbans Forest Inventory Project is to provide the necessary data on which to base future exploitation of the forest for sustainable production of timber, fuelwood and other forest produce. While recognizing that this must remain the principal management objective, it is also considered desirable to review other aspects of management which will

need to be covered by the new management plan, including wildlife conservation and social amenity values. For this reason a wildlife consultant was engaged for a period of four weeks with the following terms of reference:

1. to review existing information on the environmental, wildlife and social amenity aspects of the Sundarbans Forest Reserve

2. to assess the effectiveness and appropriateness of existing wildlife sanctuaries and reserves

3. to consider the need for any further detailed studies which may be required to be undertaken outside the scope of the current inventory

4. to make recommendations relating to the environment, wildlife and general social amenity aspects of the Reserve, with a view to their inclusion in the management plan

This work was undertaken during October-November 1984, including 8 days in the field and a further 17 days in Dhaka, reviewing the available literature and interviewing officers of the Forest Department and other persons with knowledge and experience of the Sundarbans.

The following report includes a brief description of habitats and wildlife, but to avoid duplication omits any account of climate, geology, flora and other aspects covered in the main forest inventory report. The section on management is based on information from officers of the Forest Department, whose assistance and cooperation is gratefully acknowledged, and on personal observations during the consultant's all too brief visit to the area. Recommendations are confined to those which appear practicable at present, given the very limited resources available. They are, however, somewhat wider than called for under the consultant's terms of reference since consideration of management problems in the Sundarbans in isolation would be unrealistic. A review of available information sources is included as an appendix.

PHYSICAL FEATURES

The Sundarbans covers an area of approximately 10 000 km-2 of land and water, of which the eastern portion (totalling some 4020 km-2 of land) lies in Bangladesh and the remainder in India. Protected as Reserved Forest since 1975, the greater part is covered with tidal swamp forest consisting of a mosaic of mangrove forest types differing considerably in species composition and growth depending on soil, aspect, salinity and other factors. Bounded to north and east by heavily settled agricultural areas and to the south by the Bay of Bengal, it is thus only to the west, where it borders with the similarly forested Indian Sundarbans, that any significant movement of terrestrial wildlife into or out of the area is possible.

The whole area is intersected by an intricate network of interconnecting waterways, of which the larger channels, often a mile or more in width, run in a generally north-south direction. These waterways were originally part of the Ganges delta. But except for the Baleswar River on the eastern boundary, they are now cut off from the Ganges, the outflow of which has in the past two centuries moved eastwards. Consequently, with the exception of the Baleswar, they now carry little freshwater and are, in effect, merely arms of the sea kept open by the diurnal tidal flow. Thus, though still open to the influence of sea and tides and the severe cyclonic storms which are a feature of the Bay of Bengal, and also to a continuing, if much reduced, flow of silt laden fresh water along its eastern edge, the Sundarbans ecosystem is now far more isolated than was the case when it was a living delta, receiving the huge accretions of silt and organic matter brought down to it each year from the vast Ganges catchment.

HABITATS

The Sundarbans contains a wide range of wildlife habitats of which the most extensive is the forest itself, much dissected by meandering tidal channels and creeks into numerous low-lying islands, often with internal swampy depressions known as bhils. These heavily forested swampy islands, subject to periodic tidal inundation, are the habitat of the terrestrial fauna ranging from the larger land mammals such as tiger, spotted deer and Rhesus macaque to the innumerable mud crabs which, though preferring the water's edge, are found throughout the inter-tidal zone.

Along the seaface and the lower reaches of some of the major waterways are stretches of meadow-like grassland, often with scattered clumps of keora trees (Sonneratia apetala), which are important grazing grounds for deer, and are also favoured by certain bird species.

Sand and mud-banks known locally as chars are constantly forming, disappearing and re-forming as a result of silt deposition in the major waterways and, more especially, at their respective outflows along the coast. Provided they remain above water, they are rapidly colonized by grasses and other pioneer vegetation, and usually have a sandy beach along the seaward side in the case of coastal chars. They provide an ideal habitat for the considerable variety of waders and sea birds which frequent them, and also suitable nesting sites both for marine turtles and the endangered estuarine terrapin (Batagur baska).

The great network of tidal waterways themselves totalling some 1 700 km-2 in area and varying in width from a few metres to as much as 4-5 kilometres in the estuaries of the largest, are the habitat of the many species of fish, crustacea, and molluscs found in the Sundarbans; also of the estuarine crocodile (Crocodylus porposus), the estuarine terrapin and other reptiles, of otters and at least four species of dolphin (Khan, 1982).

WILDLIFE

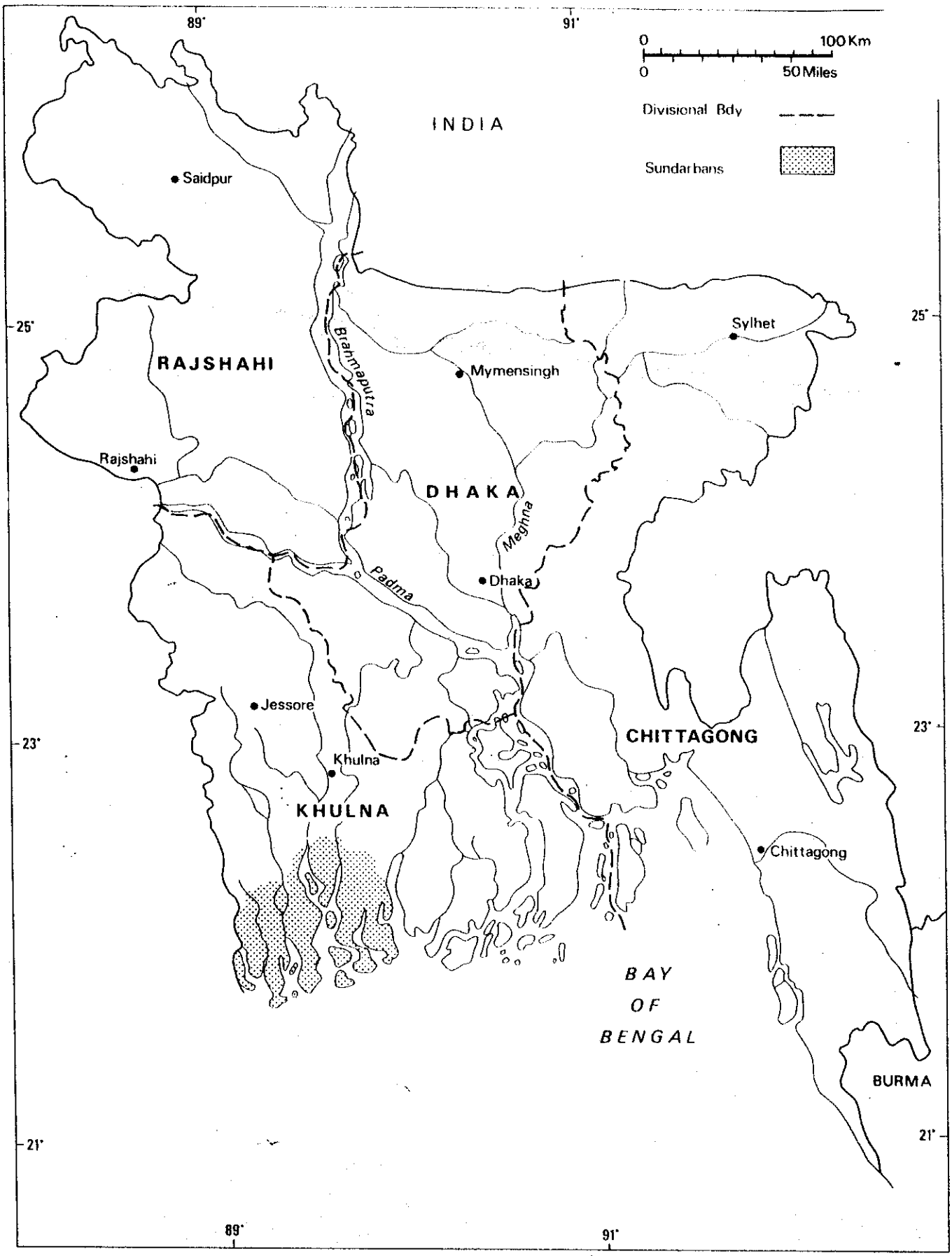
Mammals

Thirty-two mammal species are known to occur or to have occurred in the Sundarbans (Salter, 1984), but of these no less than four major species, the Javan rhinoceros (Rhinoceros sondaicus), wild buffalo (Bubalus huybalis), swamp deer (Cervus duvauceli) and hog deer (Axis porcinus), have become extinct since the beginning of this century.

The larger terrestrial mammals include the spotted deer or chital (Axis axis), barking deer (Muntiacus muntjac), wild boar (Sus scrofa), tiger (Panthera tigris), Rhesus macaque (Macaca mulatta) and smooth Indian otter (Lutra perspicillata). Hendrichs (1975) gives the following rough population estimates:

Spotted deer (chital)	80 000
Wild boar	20 000
Tiger	350
Rhesus macaque	40 000
Otter	20 000

Spotted deer are found in large numbers throughout the Sandarbans but are reported to be most abundant in the south-east, where the forest is generally more open than further north, sometimes with belts of grassland along the sea coast. These deer, together with wild boar are the principal prey of tiger, while they are also heavily but illegally hunted and trapped by man for meat



TEXT MAP 1 Location of the Sundarbans

and skins. Since there is little or no ground herbage in the Sundarbans except in the very limited areas of grassland, they would appear to live mainly by browsing, the foliage and fruits of Sonneratia being reportedly one of their most favoured foods.

Although both swamp deer and hog deer are known to have formerly occurred, the only other deer species now found in the Sundarbans, apart from spotted deer, is the muntjac or barking deer, which is, however, reported by Forest Department personnel to be few in number and confined to the north-eastern part of the area.

Rhesus macaque, the only primate occurring in the Sundarbans, may often be seen in small groups foraging along the edge of the waterways. They may also frequently be found in close association with spotted deer (Hendrichs, 1975; Salter, 1984).

The tiger is an internationally endangered species of which the Sundarbans (Bangladesh and Indian combined) contains one of the largest surviving populations. It is, however, completely isolated and there can therefore be no genetic interchange between it and other populations. There being no leopard in the Sundarbans, it is only through predation by tiger that numbers of spotted deer and wild pig are controlled. Without this predation their numbers would soon increase to a level where they could cause serious damage to the forest. Conservation of the tiger and maintenance of a viable population should therefore be a prime objective of management. Unfortunately the Sundarbans tigers have gained a well justified if somewhat exaggerated reputation as man-eaters, a problem which will be dealt with in a later section of this report.

Among other mammals are three species of otter, of which one, the smooth Indian otter (Lutra perspicillata) is domesticated by fishermen and used to drive fish into their nets; the flying fox (Pteropus giganteus), of which there are several colonies; three species of wild cat: Felis bengalensis, F. viverrina and F. chaus (Hendrichs, 1975), and the Gangetic dolphin (Platanista gangetica) which occurs in some of the larger waterways and is quite commonly seen even among the busy shipping at Khulna.

Birds

The varied and colourful bird-life to be seen along its waterways is one of the Sundarbans greatest attractions. At least 186 species have been so far recorded, but the list is incomplete and it is likely that many more will be added with further work (Salter, 1984).

Among the many species which may be readily seen by the visitor are no less than nine species of kingfishers, including the large brown-winged and storkbilled kingfishers (Pelargopsis amauroptera and P. capensis respectively); the magnificent white-bellied sea-eagle (Haliaeetus leucogaster) which is quite common, also the much rarer grey-headed fish-eagle (Ichthyophaga ichthyaetus), Pallas's fish-eagle (Haliaeetus leucoryphus) and several other raptors. Herons, egrets, storks, sandpipers, whimbrel, curlew and numerous other waders are to be seen along the muddy banks and on the chars or sandbanks which become exposed during the dry season. There are many species of gulls and terns, especially along the seacoast and the larger

waterways and apart from those species particularly associated with the sea and wetlands, there is also a considerable variety of forest birds such as woodpeckers, barbets, shrikes, drongos, mynahs, minivets, babblers and many others.

Reptiles and Amphibia

At least 35 reptile species and eight frogs and toads have been recorded from the Sundarbans (Salter, 1984). Of these the mugger or marsh corcodile (Crocodylus palustris) is now extinct, probably as a result of past over-exploitation, though the estuarine or saltwater crocodile still survives as the largest predator apart from tiger. But its numbers have been greatly depleted through hunting and trapping for skins, and although the area offers ideal habitat with ample supplies of food in the shape of fish, this species is now rarely seen and could, like the mugger, soon become extinct in the Sundarbans unless more effectively protected. There are also three species of monitor lizard which are extensively hunted for their skins, as also is the rock python (Python molurus), listed by the International Union for the conservation of Nature and Natural Resources (IUCN) as vulnerable to extinction.

Five species of marine turtle-the olive ridley, green, loggerhead, hawksbill and leatherback - have been recorded from Bangladesh waters in the Bay of Bengal and can be presumed to occur along the Sundarbans coast. However, no sign of nesting was observed on several suitable beaches during the consultant's recent visit, while enquiries among fishermen elicited no positive response, all claiming that they knew of no marine turtle nesting sites in the Sundarbans.

The estuarine terrapin (Batagus baska), another species listed by IUCN as endangered, occurs in the Sundarbans, also two fresh water turtle (Hendrichs, 1975), the black mud turtle (Trionyx nigricans) and roof turtle (Kachuga tecta). The eighteen recorded snake species include the king cobra and spectacled cobra, three vipers and six sea-snakes.

Of the reptiles occurring in the Sundarbans several are specifically protected under the Bangladesh Wildlife (Preservation) Act 1973, including inter alia the black mud turtle, estuarine crocodile, rock python and all three species of monitor lizard. Most are, however, extensively exploited as may be readily seen from the large number of skins openly on sale in Dhaka.

Fish and Crustacea

There are reported to be over 120 species of fish commonly caught by commercial fishermen in the Sundarbans (Seidensticker and Hai, 1982). According to Mukherjee (1975) only brackish water and marine forms are found in the Indian Sundarbans, fresh water species being totally absent. This may be assumed to apply also to the Bangladesh Sundarbans, except possibly in the eastern portion where there is fresh water in the Baleswar River.

Crustacea account for by far the largest proportion of animal biomass with an estimated 40 million kilogrammes of fiddler crabs and 100 million kilogrammes of mud crabs (Hendrichs, 1975). The nutrient-rich waters of the Sundarbans also yield a considerable harvest of shrimp, prawn, and lobster, which, together with fish, provide a livelihood for the several thousand fishermen who operate in the area during the dry season. Mention should also be made of the mud-skippers or gobys which, though of no commercial importance, occur in large numbers and are a characteristic feature of this and other mangrove swamps.

Insects

The area supports a varied insect population including large numbers of honey-bees, honey and beeswax being among the economically important products of the Sundarbans forests. Mosquitoes and sandflies are abundant and can make life extremely uncomfortable at certain seasons. The Working Plans (Curtis, 1933; Choudhury, 1968) mention the larvae of a moth, Hymenoptychis sordida, which destroy most of the sundri fruits each year, and another moth larva which attacks passur seeds. There are also some colourful butterflies. It appears, however, that the insect life of the Sundarbans has so far been little studied, and few data are therefore available.

CONSERVATION VALUE

The Sundarbans is obviously of great economic importance to Bangladesh as a prime source of valuable natural products ranging from building timber to prawns and from honey to golpatta leaves for thatching; commodities which, unlike finite resources such as oil or minerals, the area can with wise management continue to produce indefinitely.

It also has an important buffer function, protecting the densely settled agricultural areas to the north from the full force of the periodic cyclonic storms and tidal waves for which the Bay of Bengal is notorious, thereby mitigating their destructive effects.

But apart from these direct local values, the Sundarbans is a natural area of outstanding scientific and educational interest, with which there is nothing else quite comparable. For while there are other extensive areas of mangrove swamp elsewhere in South-east Asia, they differ appreciably in both flora and fauna, and none can offer such variety of scenery and wildlife as the Sundarbans.

With its maze of tidal waterways, coastal meadows, sand-dunes and beaches, its spotted deer, tiger, crocodiles and other reptiles, and nearly 200 bird species, the Sundarbans is not only a unique national asset to Bangladesh, but is also of international significance as one of the world's

outstanding wild places. It is important that these values should be recognized, also the fact that they could easily be destroyed through over-exploitation or other forms of mismanagement. In this connection it is well to reiterate that at least five major species-wild buffalo, swamp deer, hog deer, rhinoceros and marsh crododile-have been lost from this area since the beginning of this century alone.

SOCIO-ECONOMIC VALUE

The Sundarbans provides a livelihood at certain seasons of the year for an estimated 300 000 people working variously as wood-cutters, fishermen, honey-gatherers and in the collection of golpatta leaves and thatching grass. Fishermen come from as far as Chittagong with their boats, nets and household utensils, establishing temporary encampments at various sites along the coast, where they remain based until the approach of the monsoon season in April when they return to their homes. Fish and prawns are sun-dried and shipped to Chittagong and other local centres, while there is also an economically important export trade in frozen prawns to Japan and elsewhere.

Apart from the large numbers of people employed by contractors in the commercial exploitation of sundri and other tree species, the local people are themselves dependent on the Sundarbans forest for such necessities of life as timber for boats, poles for house-posts and rafters, golpatta leaf for roofing, grass for matting and reeds for fencing. Other products of the Sundarbans of special importance to local communities include fuelwood, tannin made from goran bark which is used for tanning fishing nets, lime used with pan (betel leaf), made by burning shells collected from the waterways, and both dried and fresh fish for their own consumption.

The season for collecting honey and wax is limited to two and a half months commencing annually on 1st April. Thousands of people, having first obtained their permits from the Forest Department, then enter the forest in search of bees nests which are collected and then crushed to extract the honey and wax. The total quantity of these commodities collected during the 1983 season was 232 tonnes, which at a market price of 30 Tk per ser (approximately 0.9 kg) represents an appreciable source of income to local communities.

TOURIST POTENTIAL

The Sundarbans is mentioned in promotional literature as one of Bangladesh's major tourist attractions. But under present circumstances it is parctically

impossible for any ordinary tourist to go there due to the difficulty and cost of arranging transport, and to lack of suitable accommodation and other facilities. The infrequent foreign visitors are usually limited to occasipnal members of the local diplomatic community, visiting scientists, or film crews making nature films. Those who do go there are often disappointed at seeing none of the tiger or crocodile for which the Sundarbans is famous, and probably only very few of the abundant spotted deer.

The area has no potential for mass tourism which would, in any case, be inappropriate in view of its inevitably disruptive effects. It does, however, offer obvious possibilities for limited special interest tourism involving groups of bird watchers and others with a serious interest in nature and wild unspoilt areas. There are increasing numbers of such people who prefer to avoid the popular tourist circuits, who would be attracted by such an area as the Sundarbans, and would, subject to availability of facilities of a reasonable standard, be prepared to pay comparatively high fees for the privilege of going there.

However, they would expect to see some larger forms of wildlife, even if they did not see tiger - which would hardly be possible without baiting. Apart from birds, the spotted deer should, in view of their abundance, be easily seen on the sea-face meadows where they have been reported sometimes to congregate in herds of several hundred. But few can now be seen because they are being frequently hunted and disturbed by poachers. This will obviously need to be stopped for tourism to have any chance of success in the Sundarbans.

Tourism would probably only be practicable in the dry season months from October to April or May. For this and other reasons the use of self-contained launches with their own catering facilities and sleeping accommodation would appear more practicable than permanent land-based facilities, and would also provide greater flexibility. There is, however, a large well-equipped resthouse belonging to the Port Authority at Hiron Point, and a smaller but more attractive Forest Department rest-house at Katka in the Sundarbans East Sanctuary, either of which could be utilized by visitors wishing to stay for longer periods. But they would need to take their own food and bedding and would also need a suitable launch for local travel.

THREATS TO THE ECOSYSTEM

Concern has been expressed at recent indications of apparent deterioration in the flora of the Sundarbans, including localised die-back of sundri, the most commercially valuable tree species. There is some evidence that these changes may be due to increased salinity resulting from the upstream diversion of up to 40 per cent of the dry season flow of the Ganges following completion in 1975 of the Farraka Barrage in India. While deterioration in the vegetation is already well documented (International Engineering Company Inc., 1977, 1980) and is the subject of continuing study, no attention has yet been given to the possible effects which these changes might have on the fauna. It is, however, perhaps significant that the stocking of spotted deer appears lower

in western areas, where salinity is highest, than in the east where it is lowest. Hendrichs, hypothesis that there is a correlation between salinity and the incidence of man-eating in tigers should also be noted (Hendrichs, 1975).

Oil spills are another potential threat to the Sundarbans ecosystem and could cause immense damage, especially to aquatic fauna and seabirds, but probably also to the forest itself into which oil from a heavy spill could be carried by high tides. Apart from the possibility of accidental spills, steps should be taken to guard against vessels flushing out their fuel tanks or discharging other forms of noxious waste while passing through the Sundarbans by the north-south shipping route.

Agricultural encroachment has already occurred to a limited extent on the eastern and western boundaries, and with increasing population pressure in surrounding settled areas, could reach serious proportions unless checked by rigorous action on the part of the Forest Department. But the most immediate threat is of overexploitation, both of timber resources, which there are indications may already be taking place, and also of the fauna. Apart from the several major species which have been lost in the recent past, presumably due mainly to over-hunting (Javan rhinoceros, wild buffalo, swamp deer, hog deer and marsh crocodile), the estuarine crocodile, rock python, monitor lizards, estuarine turtle and marine turtles could also be at risk unless more effective measures are taken to prevent their continuing illegal exploitation.

Cyclones and tidal waves cause some damage to the forest along the sea-face, and are reported occasionally to result in considerable mortality among spotted deer (Forest Dept. staff, pers. comm.).

LEGAL STATUS

The whole of the Sundarbans forest within Khulna District (i.e. the Bangladesh Sundarbans) has been reserved rorest since 1875. There are no recognized local rights of any kind, and entry is subject to permits issued by the Forest Department, except for ocean-going vessels which have right of passage through the Sundarbans by way of the Passur River to Mongla Port. Fishing and the collection of forest produce are also subject to Forest Department permit. The Department has authority to issue hunting licences under the Bangladesh Wildlife (Preservation) Act 1973, but in practice none is issued and the whole Sundarbans is thus effectively closed to legal hunting.

Three wildlife sanctuaries in the southern portion of the Sundarbans were declared under Article 23 of the above Act in 1977. Under the provisions of this Act various activities are prohibited within any sanctuary, including inter alia residence, cultivation of land, damage to vegetation, hunting, introduction of domestic animals and the setting of fires. There is however, an added proviso that Government may relax all or any of these prohibitions when deemed desirable "for scientific purposes or for aesthetic enjoyment or betterment of scenery".

WILDLIFE SANCTUARIES

The three existing sanctuaries are as follows:

Sundarbans West (9 069 ha), lying between the Raimangal and Malancha rivers

Sundarbans South (17 878 ha), lying between the Malancha and Kunga rivers, and including Putney Island

Sundarbans East (5 439 ha), consisting of that portion of Compartment 6 lying between the Katka and Supati Khals

All three Sanctuaries are bounded to the south by the Bay of Bengal and therefore include stretches of shoreline with some beach, sand-dune and estuarine habitats and, in the case of Sundarbans East, some fairly extensive sea-face grassland.

Of the three, Sundarbans East appears to be the most valuable in terms of diversisty of habitat and scenic attraction, while spotted deer also appear to occur at a higher density than in the other areas. Off the mouth of the Supati Khal there is a small island known locally as Putkadya which provides good habitat for waders and other birds and would also seem to be a suitable nesting site for marine turtles. Though it is reported to have first appeared only six to seven years ago, it is already well colonized with reeds and grasses. It is unclear whether or not this island, which lies about 2 km off-shore, is included within the Sanctuary, but it should be.

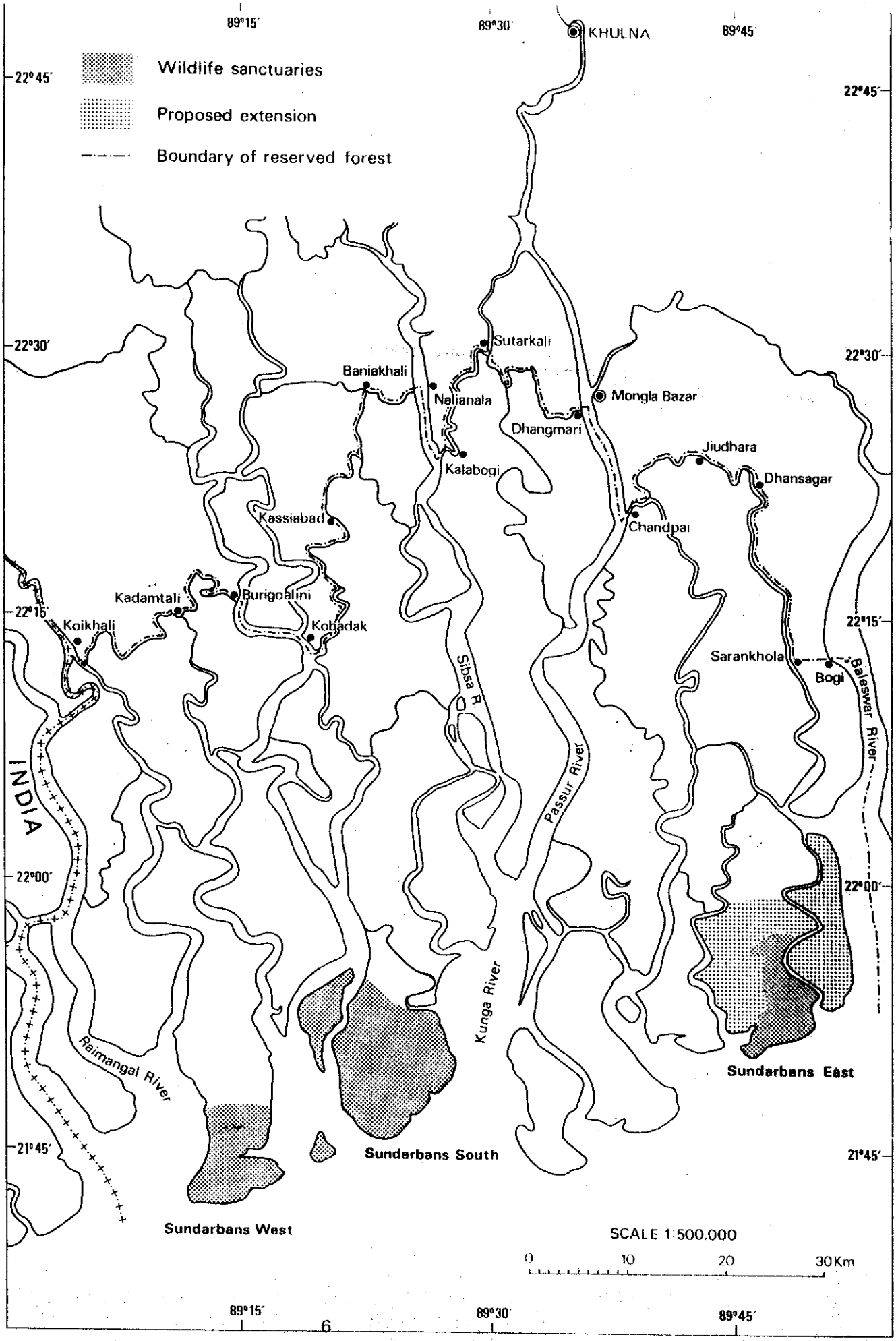
Sundarbans West and South would seem to be of adequate size, but Sundarbans East is too small to be effective and should be enlarged. In this connection it may be noted that in the most recent working plan (Choudhury, 1968) it is mentioned that a game sanctuary was in process of establishment at the time the plan was prepared, incorporating Compartments 3, 4, 5, 6 and 7, a total area of some 52 320 ha, whereas in the event only part of Compartment 6 was included, with the result that the actual area of the existing sanctuary is only about one-tenth of that originally proposed.

ADMINISTRATIVE RESPONSIBILITY

Wildlife conservation incluuding the management of national parks and wildlife sanctuaries is the responsibility of the Forest Department. The Bangladesh Wildlife (Preservation) Act, 1973 provided for establishment of a Wildlife Advisory Board which was brought into being in 1976 under the chairmanship of the Minister of Agriculture. At the same time a Wildlife Working Circle was established within the Forest Department with specific responsibility for wildlife matters, under the charge of a senior Conservator of Forests responsible directly to the Chief Conservator of Forests.

This was a promising development, but it is disappointing to learn that this embryonic organization has now been largely dismantled, allegedly in the interests of economy. The Wildlife Working Circle has been abolished and the staff reassigned elsewhere, and although the Wildlife Advisory Board still exists on paper, it has not met for two years. The post of Conservator of Forests (Administration and Wildlife) also still exists, but the incumbent has many other administrative duties unrelated to wildlife, and his sole responsibility in this field now appears to be to deal with correspondence, particularly from international conservation organizations such as the World Wildlife Fund. Since officers holding the post are frequently reassigned to other duties (there have been five in the past eight years), there can be little continuity of policy or incentive for those concerned to take a serious interest in the subject.

There was formerly a Wildlife Development Scheme with a budget for various field projects, including protection and development of the Sundarbans Wildlife Sanctuaries, but this also was abolished in July 1982. Following the general down-grading of wildlife conservation as a Forest Department activity and dismantling of the headquarters organization, it has now become the



TEXT MAP 2 Wildlife sanctuaries

theoretical responsibility of the various divisional forest officers. In the case of the Sundarbans this is the Divisional Forest Officer, Khulna, who is responsible for management of the Sundarbans Reserved Forest.

ORGANISATION

For administrative purposes the Sundarbans Reserved Forest is divided into four Ranges with either an assistant conservator of forests or a forest ranger in charge of each. Since boundaries between ranges run in a generally north-south direction following major waterways, the three wildlife sanctuaries are each in a separate Range:

Wildlife Sanctuary	Range
Sundarbans West	Shatkhira Range: HQ at Burigoalini, approx 80 km north of the Sanctuary. Range Officer in charge
Sundarbans South	Khulna Range: HQ at Nalianala, approx 112 km north of the Sanctuary. A.C.F. in charge
Sundarbans East	Sarankhola Range: HQ at Sarankhola, approx 40 km north of the Sanctuary A.C.F. in charge

The following staff are assigned to the Sanctuaries and are theoretically responsible for their protection. However, they are, in fact, involved primarily with collection of revenue and other normal Forest Department duties.

Staff Category	Sundarbans West W.S.	Sundarbans South W.S.	Sundarbans East W.S.	Total
Forest Rangers	-	1		1
Deputy Rangers	1	-	1	2
Foresters	-	-	-	-
Forest Guards	1	2	1	4
	2	3	2	7

In addition to the range headquarters, there are also a number of revenue stations within each range to facilitate revenue collection and the issue of permits, and a coupe office for each felling coupe in which timber extraction is currently taking place. At Hiron Point (i.e. within the Sundarbans East Sanctuary) there is, in addition to a forest revenue station, also a small contingent of the Bangladesh Navy and a Port Authority pilotage station to service ships proceeding upriver to Mongla Port.

The Forest Department staff responsible for the three sanctuaries have a number of sampans or other local craft and a total establishment of 17 boatmen. There are, however, no motor launches or other powered craft suitable for patroling, nor any form of radio communication.

MANAGEMENT PLANS

The most recent working plan for the Sundarbans Reserved Forest (Choudhury, 1968) expired in 1980. It contained no prescriptions concerning wildlife conservation apart from a very brief reference (para 213) to the proposed establishment of a "Game Sanctuary" to include Compartments 3, 4, 5, 6 and 7 in the south-eastern portion of the reserved forest. As previously noted, this sanctuary when it was eventually declared in 1977 included only a part of Compartment 6, a mere fraction of the area originally envisaged in the working plan.

It is understood that a new working plan will be prepared shortly, based on the data collected by the Sundarbans Forest Inventory Project. This new plan is expected to include detailed prescriptions concerning conservation of wildlife and management of the sanctuaries.

A plan relating specifically to wildlife conservation entitled The Sundarbans Wildlife Management Plan: Conservation in the Bangladesh Coastal Zone (Seidensticker and Hai, 1983) was prepared under the joint sponsorship of the World Wildlife Fund and the National Zoological Park, Smithsonian Institution, and published by the International Union for the Conservation of Nature and Natural Resources in 1983.

This comprehensive plan contains much useful background information and also discusses mangrove ecology and the general principles of conservation at some length. It includes general management prescriptions, but does not provide any financial estimates nor offer any practical suggestions as to how the very considerable cost of the personnel, equipment, training, research, visitor facilities and other proposals contained in the plan might be met. It is also somewhat unrealistic in that, while its prescriptions are theoretically admirable, few are capable of implimentation under present conditions in Bangladesh, given the lack of trained staff, equipment, financial and other resources necessary to put such an ambitious plan into effect.

The general objective of management as stated in the most recent working plan (Choudhury, 1968) is:

"Maintenance of the forest and its gradual conversion into a regular selection forest with a balanced distribution of all age classes, thereby -

a) ensuring possible protection of the cultivated lands in the interior from the devastations caused by periodic cyclones, storms, and tidal waves

b) guaranteeing an annual sustained yield of timber, firewood, pulpwood, thatching materials and other minor forest produce as far as practicable for meeting the demands of people and the existing and developing industries

c) applying such silvicultural practices as are considered correct from the existing data, that will promote increased yields in future

For the purposes of management the reserved forest is divided into eight blocks, which are in turn subdivided into compartments, of which there are a total of 55. Exploitation is on the basis of a 20-year cutting cycle, with three working circles for the three major commercial species (gewa, sundri and keora), each divided into a series of coupes which are felled every 20 years subject to a prescribed minimum girth limit. Coupes are further subdivided into smaller lots, their size depending on site quality, of which the cutting rights are offerred by public auction. Other species such as goran, which is used extensively for fuelwood and houseposts, and golpatta, used for thatching, are subject to detailed felling rules for the species concerned, and are sold on the basis of permits purchased from the various forest revenue stations.

While major activity and consequent disturbance is concentrated in the coupes currently being exploited, there is also a lesser degree of disturbance throughout much of the forest during the dry season by people cutting fuelwood and thatching material, and towards the end of the dry season (1 April-15 June) by honey gatherers.

Under Section 23 of the Bangladesh Wildlife (Preservation) Act 1973, entry into and damage or destruction of vegetation within a wildlife sanctuary are prohibited. However, from the author'sown observations it is apparent that these prohibitions are largely ignored and that there is little, if any, attempt by Forest Department staff to enforce them. For example, as many as thirty large 'country boats' were seen loading goran poles in the Sundarbans West Sanctuary, while a considerable number of people and boats were also engaged in similar activities in the Sundarbans East Sanctuary.

It is understood that the Forest Department does not issue permits for collecting forest produce in the sanctuaries, except for cutting thatching grass on the sea-face meadows. But people having obtained permits to cut goran poles elsewhere often cut in the sanctuaries in the knowledge that they are unlikely to be apprehended. Apart from disturbance and damage to the habitat, control of poaching under such circumstances is clearly impossible.

FISHING CAMPS

Many thousands of fishermen operate during the dry season both in the Sundarbans waterways and along the sea coast. The latter are mostly people from Chittagong and elsewhere who base themselves in temporary villages or camps for the dry season and then return to their homes in April when the sea becomes too rough for fishing. All these fishermen require Forest Department permits for entry into the reserved forest and are also required to pay both a per capita toll and royalty on fish caught.

Curtis in his Working Plan (1933) mentions that the sea fishermen, at that time numbering 1 500 - 2 500, settled for the dry season on the coast of Dubla Island. But today their camps are to be found scattered all along the coast, including several within the wildlife sanctuaries where they are legally prohibited under the Bangladesh Wildlife (Preservation) Act. These camps are a major source of disturbance and probably also of poaching within the sanctuaries.

POACHING

While the Consultant saw no direct evidence of poaching during his comparatively brief visit to the Sundarbans, the extreme nervousness of the spotted deer wherever encountered was a clear indication of human disturbance and probably hunting pressure. That fairly extensive hunting and trapping take place was confirmed by several Forest Department staff, the main culprits being reportedly naval and military personnel from Hiron Point (i.e. within the Sundarbans South Wildlife Sanctuary) and the Bangladesh-India border area, and also people from the settled areas beyond the Baleswar River to the east.

Poaching is reported to be carried out both with firearms and, in the case of spotted deer, by snaring, using rope foot snares set over a hole in the ground camouflaged with leaves, and also nooses set to catch an animal by the neck. Trapping by such means could easily be done by the numerous woodcutters and fishermen, and, with a poached animal hidden in a boat beneath a pile of wood or golpatta leaves, there would be little risk of detection.

In response to enquiries in Dhaka the consultant was shown tiger skins in several different tourist shops, all of which appeared of recent origin and were said to have come from the Sundarbans. Some shopkeepers had several skins, and one said that, though difficult to get, he was able to obtain up to perhaps ten in the course of a year. Prices after some preliminary bargaining averaged about US$ 1 200 for a mounted skin complete with head or $ 800-1 000 without a head. All the leather goods shops where enquiries were made had an abundant supply of spotted deer skins at about US$ 15 each, which could only have come from the Sundarbans since this species no longer survives elsewhere in Bangladesh. Monitor lizard and python skins, in which there is reported to be an extensive export trade, were also in plentiful supply in the Dhaka shops, as also were ladies handbags made of tiger and

crocodile skin, despite the fact that all these species are fully protected by law.

The scale of the trade in lizard skins, a high proportion of which must come from the Sundarbans, was indicated by the results of a survey of the reptile skin trade in Bangladesh (Gilmour, 1984) recently punlished by the Wildlife Trade Monitoring Unit of the International Union for the Conservation of Nature and Natural Resources. For example, 1 890 559 monitor lizard skins valued at US$ 3 818 930 were exported in 1978-79, and an estimated 450 000 - 600 000 lizard skins were confiscated by the customs authorities between August 1981 and March 1982.

THE MAN-EATING TIGER PROBLEM

According to Hendrichs (1975) the Sundarbans has been notorious for its man-eating tigers since at least the 17th Century. Curtis in his Working Plan (1933) gives details of the numbers of people killed by tigers between 1912 and 1921 in the whole Sundarbans area (i.e. the present Bangladesh and Indian Sundarbans combined), totalling 427, and also the number of tiger killed by hunters during the same period (452) in an effort to reduce man-eating. While this proved effective, reducing the number of human fatalities from an average of 43 per year between 1912 and 1921 to only six per year between 1922 and 1930 it also resulted in an inordinate increase in the populations of deer and wild pig with a consequently serious increase in damage to regeneration of various tree species. The payment of a bounty for each tiger killed was therefore suspended.

Hendrichs (1975) gives some interesting data on man-eating and develops the hypothesis that there are four distinct categories of tiger in the Sundarbans:

"A" tigers	generally give way in encounters with man, and do not deliberately attack
"B" tigers	attack man if molested but do not feed on the victim
"C" tigers	hunt man like any other prey, but once driven off the prey, do not return
"D" tigers	specialize in man-killing in preference to all other prey and, even if driven off a human kill, will always return

He suggests that while "D" tigers may occur anywhere, "C" tigers are found only in the south and west, which coincides with the areas of highest salinity. He therefore suggests a possible linkage between a high level of salinity (and consequently no fresh water) and man-eating.

Man-eating, or to be more accurate man-killing, is still a problem but appears to be less serious than formerly. The following details were provided by the Divisional Forest Officer, Khulna:

Numbers of men killed by tiger 1980 - 83

Year	Fishermen	Golpatta cutters	Honey collectors	Other	Total
1980	5	-	2	-	7
1981	-	-	2	6	8
1982	6	2	9	13	30
1983	1	1	6	9	17
Total	12	3	19	28	62

This shows an average of 15.5 persons killed per year over a period of four years, which is not very high in relation to the total of some 300 000 people who it is estimated now enter the Sundarbans in the course of a year, and is probably lower than the normal incidence of fatalities due to traffic and other accidents in an urban population of similar size.

It should also be noted that these figures relate to people who died as a result of encounters with tigers, but were not necessarily either deliberately hunted or, once killed, actually eaten. While there are tigers which deliberately kill man as prey (Hendrichs' Category "C" and "D"), and these appear more prevalent in the Sundarbans than elsewhere, the majority do not.

Most of the Sundarbans forest is unusually dense and visibility limited to a few yards. Inevitably some of the many honey-collectors and others who wander about in it come suddenly on a tiger, perhaps a tigress with cubs, which reacts with instinctive aggression to what it perceives as a threat, lashing out and perhaps inflicting severe wounds but not necessarily killing the victim. He may survive, but more probably dies either from the direct effects of his wounds or from secondary complications and lack of medical treatment. This type of incident, though regrettable, cannot be regarded as "man-eating", but rather as an accident which the victim has brought on himself by venturing unwarily into tiger habitat.

The only means of stopping such fatalities altogether would be either to exterminate the tiger or to prevent human access to the tiger's habitat, both obviously unacceptable solutions. It should, however, be possible to minimize human fatalities by a combination of wise precautions and provision of effective sanctuaries of adequate size where wildlife, including tiger, is free from constant human disturbance.

POLICY AND PRIORITIES

The very low priority apparently now accorded to wildlife conservation in Bangladesh is reflected by the Forest Department's recent abolition of the former Wildlife Working Circle and Wildlife Development Scheme, and the reassignment of staff to normal departmental duties; also by the fact that there is no longer any separate provision in the Department's budget for wildlife conservation, and that the Wildlife Advisory Board, though it still exists on paper, is now moribund and has not met for about two years.

Wildlife is a valuable natural resource and a national asset which Bangladesh can ill afford to lose. But it is being steadily depleted through habitat destruction and over-exploitation. Several important species have become extinct in recent years and others will certainly be lost also unless the few remaining natural areas and the wildlife they contain are more effectively managed.

Recommendations

1. There should be a published and officially recognised national policy on conservation of the natural environment, including forests and wildlife, with clearly defined objectives

2. The first priority should be effective protection and management of forest reserves, national parks, wildlife sanctuaries and game reserves against encroachment and illegal exploitation, including poaching

3. The Wildlife Advisory Board should be revitalized, with the addition of more scientifically qualified members from the universities and representatives of the Ministry of Defence and the Tourist Advisory Board. Its responsibilities could with advantage be broadened to cover environmental conservation in general, rather than merely wildlife, and its title changed accordingly

4. Bangladesh, having ratified the Convention on International Trade in Endangered Species (1981), should make greater efforts to ensure that its provisions are effectively enforced

There is extensive commercially inspired poaching in the Sundarbans involving reptiles, especially monitor lizard, crocodile and python, but also including tigers and spotted deer. Apart from the fact that they are being illegally hunted either in the reserved forest or in the wildlife sanctuaries, all these species are fully protected under the third schedule of the Bangladesh Wildlife (Preservation) Act. Therefore the Forest Department has clear legal grounds for action against both the poachers themselves and the merchants who openly trade in the skins of these protected species. Action against poachers in the field will not be effective unless steps are also taken to reduce the demand by putting a stop to the present large scale commercial trade in illegal skins.

Recommendations

1. Amendment of the Bangladesh Wildlife (Preservation) Act to provide greatly increased penalties for illegal possession of or trade in protected species, including skins, whether or not part of a manufactured article

2. Concerted action by the Forest Department and Customs to seize skins of protected species and articles manufactured therefrom in the possession of dealers, especially in Dhaka and Khulna, and bring the offenders to court

3. The display of posters in airports, hotels and tourist offices warning visitors against the purchase of skins of protected species or articles manufactured therefrom, with more effective enforcement measures by Coustoms and/or Forest Department personnel at Dhaka airport

4. Provision of sufficient trained field staff in the Sundarbans together with the necessary equipment, including patrol boats and firearms, to protect the area effectively

5. The cooperation of the Ministry of Defence in stopping illegal hunting by Navy and Army personnel stationed in the Sundarbans and elsewhere

ENVIRONMENTAL PROTECTION

There are indications that reduction of the dry season flow of Ganges water as a result of the Farraka barrage may be causing serious changes in the Sundarbans ecosystem due to consequent increase in salinity. Other threats to the environment include over-exploitation of the forest and its

wildlife, encroachment from neighbouring settled areas, and the possibility of oil pollution by ocean-going ships on passage through the Sundarbans to Mongla Port and Khulna.

Recommendations

1. Continuing long-term studies to monitor ecological changes due to increasing salinity or other causes, with a view to taking whatever remedial action may be either desirable or practicable

2. Consultations between the Forest Department and the Port Authority to ensure that masters of all ships passing through the Sundarbans are warned against discharging fuel oil or other noxious materials; that offenders are apprehended and treated with appropriate severity; and that there are suitable arrangements for dealing promptly and effectively with any oil spill which may occur

3. Monitoring of effluents from pulp mills and other industrial plants at Khulna and other up-stream locations to guard against possible pollution hazards

TOURISM

There is potential for limited tourism by special interest groups such as bird watchers and others with a particular interest in natural history, or those with a liking for travel in wild places. However, it would be premature to attempt development of tourism until the sanctuaries have been brought under more effective protection so that it is possible for visitors to see wildlife undisturbed by hunting.

Recommendations

1. Tourism should be based initially on one or more suitably equipped selfcontained launches operated by the Tourist Development Board, offerring 3-4 day tours from Khulna. This would involve fewer logistical problems and would permit greater flexibility than a land-based operation

2. Nature trails should be developed in selected areas where visitors could go ashore and walk through the forest. This would require small jetties for landing, raised board-walks, occasional viewing towers or machans, and appropriate interpretive facilities

3. One of the major multinational companies operating in Bangladesh should be approached with a view to their funding a popular handbook on the Sundarbans from their advertising budget. This should include information on the flora and fauna, including chapters on birds, fish, man-eating tigers, cyclones, history, archaeology, forest products and other subjects of interest, and could be sold at a modest price for the benefit of some appropriate charity

FIELD RESEARCH

There have been no in-depth studies of the Sundarbans fauna apart from Hendrichs' work on the tiger, which was of only three months duration and mainly concerned with the man-eating problem. More detailed long-term studies are needed.

Recommendations

1. Inventories should be made of major species, including tiger, spotted deer, estuarine crocodile and Rhesus macaque, leading to systematic monitoring of population trends

2. There should be a detailed study of the ecology of the Sundarbans tiger over a period of at least two years, preferably by an experienced wildlife biologist who has worked on tiger elsewhere

3. All significant observations of wildlife should be recorded, detailed species lists prepared and data collated on distribution, habitat preferences and seasonal movements

4. Consideration should be given to possible establishment of a small field study centre in one of the sanctuaries (e.g. at Katka in Sundarbans East), with accommodation for perhaps six persons and basic facilities including a small laboratory and reference library, as a base for multidisciplinary research in the Sundarbans by both local and visiting scientists. Financial support for such a project might be sought from, for example, an aid agency or an overseas university, with joint management by the Forest Department, Dhaka University and the donor agency

EXTERNAL ASSITANCE

Technical Assistance will be required until there are sufficient trained local personnel to manage the country's wildlife resources and protected natural areas unaided. While the Sundarbans is a high priority, it would be a mistake to concentrate on it in isolation, without at the same time providing the basic organisational infrastructure needed for effective planning and management of a national conservation programme.

Recommendations

1. Technical assistance should be sought from an appropriate multilateral or bilateral agency in the form of a project of at least three years duration, including the provision of an experienced technical adviser and project manager, a wildlife ecologist and twelve man-months of specialist consultancies; overseas fellowships for at least two MSc courses in wildlife management/ecology and provision for regional study tours; equipment including vehicles, marine diesel engines (for use in locally built patrol boats) and single side-band radio transceivers

   The main objectives of such a project should be:

   a) To establish an effective professionally staffed conservation Directorate/Working Circle within the Forest Department

   b) To review the present system of national parks, wildlife sanctuaries and other protected areas, and to bring them under effective management

   c) To use the Sundarbans as an in-service training area for field staff, to complete inventories of wildlife and other necessary studies, and prepare detailed management proposals for incorporation in the new management plan; demarcate boundaries of wildlife sanctuaries, and develop an effective system of guard posts, patrolling and law-enforcement throughout the area

Assistance should also be sought from the International Union for the Conservation of Nature and World Wildlife Fund in preparing, in collaboration with the appropriate government agencies, a detailed national conservation strategy for Bangladesh; also in carrying out a two-year ecological study of the Sundarbans tiger.

APPENDIX 1 INFORMATION SOURCES AND REFERENCES

There are numerous references to the Sundarbans and its wildlife in early literature, government publications and in certain modern travel books. The following are the most useful sources of information which have come to the consultant's attention:

FOREST WORKING PLANS

Since its declaration as reserved forest in 1875 the Sundarbans forest has been the subject of a series of successively more comprehensive working plans prepared by various forest officers. These contain a great deal of detailed information on the configuration of the area, its climate, geology, tides, water supplies and, in particular, its forest flora and data on distribution of the timber producing species.

Information on wildlife in the working plans is scanty though the plan for the period 1931-1951 (Curtis, 1933) describes the damage caused to regeneration of certain tree species by spotted deer, and also goes in some detail into the problem of controlling man-eating tigers.

The most recent working plan for the period 1960-61 to 1979-80 (Choudhury, 1968) includes a section on the fauna of the Sundarbans with summarized lists of the major species and some remarks on management of wildlife, pointing out the importance of the tiger in controlling the deer population and the need to maintain the ecosystem in a state of equilibrium. It is interesting to note that there is mentioned the intention of establishing Compartments 3, 4, 5, 6 and 7 as a game sanctuary. In the event only part of compartment 6 was so declared, though there have since been repeated recommendations that some or all of the other compartments be added.

Apart from Hendrichs, paper on the Sundarbans tiger (Hendrichs, 1975) there do not appear to have been any in-depth ecological studies of wildlife in the Sundarbans. However, of the various reports and other publications available, the following provide the most useful and factual information:

HENDRICHS H (1975) The status of the tiger Panthera tigris in the Sundarbans mangrove forest (Bay of Bengal). Saugetierkunliche Mitteilungen 23: 161-199

Based on a three-month field study in 1971, this paper contains a brief description of the flora and fauna with detailed lists of reptiles, birds and mammals, and some useful data on human activities in the Sundarbans Reserved Forest with estimated estimated numbers of people involved during different seasons. There are some observations on the social organization and behaviour of spotted deer as the tiger's principal prey species, but the paper is concerned mainly with the tiger (of which a total population of about 350 is estimated) and particularly the problem of man-eating which is discussed in considerable detail. Apart from much data on the incidence of man-eating, there is also a table giving rough estimates of the density and biomass of dominant land mammals and crustacea from which it is interesting to note that by far the largest biomass of any single species is accounted for by crabs.

OLIVIER R C D (1979) Development of the Forest Research Institute, Bangladesh. Wildlife conservation and management in Bangladesh. Field Document, UNDP/FAO Project BGD/72/005, no 10

While this very comprehensive report does not deal specifically with the Sundarbans, it provides a useful if somewhat depressing account of the conservation situation in Bangladesh, including a description of the country's rapidly dwindling wildlife resources, with a brief account of each of the various national parks, wildlife sanctuaries and game reserves.

It also outlines the relevant legislation, the theoretical organization of the Wildlife Working Circle in the Forest Department (since abolished), and the responsibilities of the now moribund Wildlife Advisory Board. The report also covers research, training and the potential for wildlife related tourism, and concludes with a number of detailed recommendations, few if any of which have been implemented.

The main relevance of this report to conservation in the Sundarbans is in the fact that no significant progress will be made in this field, either in the Sundarbans or elsewhere in Bangladesh, until the various organizational and other basic problems described are satisfactorily resolved.

GITTINS S P and AKONDA A W (1982) What Survives in Bangladesh? Oryx 16(3), 275-281

Like the previous report, this short paper does not deal specifically with the Sundarbans, but contains useful background information on the general wildlife conservation situation in Bangladesh. It includes a detailed breakdown showing the areas of natural and scrub forest remaining in the country and their locations, though it does not indicate the source of this information, nor how the authors differentiate between what they term "natural" and "scrub" forest. There are also estimates of the populations of major mammal species including a possibly somewhat over-optimistic 430-450 for tiger in the Sundarbans (in 1979) and an even more surprising total of 126 000 Rhesus macaque in the same area.

SEIDENSTICKER J and HAI M A (1983) The Sundarbans wildlife management plan: conservation in the Bangladesh coastal zone. International Union for the Conservation of Nature and Natural Resources

This document contains valuable data on the Sundarbans ecosystem, much of it drawn from studies carried out with assistance from the International Engineering Company Inc. and other sources. There is a good account of the complex functions of the mangrove ecosystem, its benefits to man and the dangers of disrupting its fragile biological balance; also a section in which the problems of managing the tiger which, being at the top of the terrestrial food web, is seen as a key species particularly sensitive to environmental change.

In discussing management strategy the authors emphasise the importance of identifying and safeguarding areas of critical habitat such as the sea-face meadows, so important for the spotted deer, and therefore also for their predator, the tiger. However, apart from mentioning the nesting and roosting sites of water birds, no other areas of critical habitat are actually identified. Finally, there are detailed management prescriptions covering organization, programme management, staff duties and training, law-enforcement, research, visitor use, interpretation and other aspects of management. There is also a summary of equipment requirements including a considerable number of launches, speed-boats and radio sets.

SALTER R E (1984) Integrated Development of the Sundarbans, Bangladesh: status and utilization of wildlife. Report, Food and Agriculture Organisation. Project FO:TCP/BGD/2309(MF), no. W/R0034

Contains a brief description of the habitat, the main features of resource use (i.e. exploitation of timber and other forest produce and fishing), and conservation measures in force, including the three Sundarbans wildlife sanctuaries. There is a chapter on status and utilization of wildlife species, with a synopsis of previous wildlife studies and surveys and a

useful review of basic information on tiger, spotted deer, wild boar, Rhesus macaque and the smooth Indian otter, including estimated numbers and population densities. There are also sections on the status of reptiles (including the estuarine crocodile, monitor lizards, marine turtles and terrapins) and amphibians, with data on their utilization. There then follows discussion of the potential for commercial exploitation of crocodiles, deer, primates, turtles and frogs, and also of non-consumptive utilization of wildlife through tourism, which the author considers as one of the most promising development options for the Sundarbans. He also stresses the importance of nature conservation as, in itself, a valid form of non-consumptive utilization, with resulting potential for ecological research, the safeguarding of genetic resources and other important benefits.

In his recommendations Salter stresses the inadequacy of the existing data-base for planning management programmes, and the need for an inventory of wildlife populations before any consumptive uses of wildlife are initiated. He also recommends a pilot crocodile ranching scheme with the initial objective of increasing the viability of the wild population by releasing artifically reared young crocodile; development of tourism based on wildlife viewing; re-evaluation of the existing sanctuaries and preparation of management plans, and a detailed study of the ecology of the tiger.

OTHER REFERENCES

Other useful sources of information include the following:

BATEN S A (1971) Working Plan of the Sundarbans Forest Division for the period 1960-1980, Volume 3 Description of the compartments and their histories up to 30 June, 1960. Dhaka: Government Press

INTERNATIONAL ENGINEERING COMPANY INC. (1977) Special studies. Dhaka: Bangladesh Water Development Board

INTERNATIONAL ENGINEERING COMPANY INC. (1980) Southwest regional plan. Dhaka Bangladesh Water Development Board

Curtis S J (1933) Working plan for the Forests of the Sundarbans Division for the period from 1st April 1931 to 31st March 1951. Calcutta: Bengal Government Press

FUGLER C M (1984) The commercially exploited chelonia of Bangladesh: taxonomy ecology, reproductive biology and ontology. Fisheries Information Bulletin, Bangladesh fisheries resources survey system, Food and Agriculture Organisation, Project BGD/79/015, 2(1)

GILMOUR J (1984) The reptile skin trade in Bangladesh. Traffic Bulletin Wildlife Trade Monitoring Unit, IUCN Conservation Monitoring Centre, Cambridge, UK, 5(5-6)

KHAN M A R (1982) On the distribution of the mammalian fauna of Bangladesh. Proceedings of the second Bangladesh national conference on forestry, Dhaka, 560-575

MACRAE W (1968) A general account of the fauna and flora of mangrove swamps and forests in the Indo-West Pacific region. Advances in Marine Biology 6.

MOUNTFORT G (1969) The vanishing jungle. Two wildlife expeditions to Pakistan London: Collins

MUKHERJEE A K (1975) The Sundarbans of India and its biota. Journal of the Bombay Natural History Society 72 (1)

SANKHALA K (1978) Tiger. London: Collins

SARKER N M (1982) Report of the tiger study for the Nilkomal Sanctuary (the Sundarbans), 1982. Bangladesh Forest Department, Dhaka

APPENDIX 2 GLOSSARY OF TERMS

BHIL	A damp or waterlogged depression
CHAR	A shoal or bank of mud or sand, usually without tree growth and below high tide level
GANG	A medium sized water channel of about 300 - 1 000 meters in width
GEWA	Excoecaria agallocha
GOLPATTA	Nypa fruticans
GORAN	Ceriops decandra
KEORA	Sonneratia apetala
KHAL	Small water channel of less than about 300 meters in width
NADI	A river or channel of large width, over about 1 000 meters
PASSUR	Xylocarpus mekongensis
SUNDRI	Heritiera fomes