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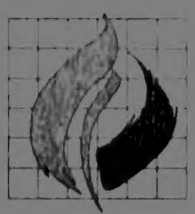
BIOSPHERE RESERVES

Site descriptions

post Compilation 5 (October 1990)



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WORLD CONSERVATION MONITORING CENTRE

July 1992

Programme on Man and the Biosphere (MAB)
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BIOSPHERE RESERVES

Site descriptions

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Descriptions of sites not included in Compilation 5 (October 1990)

Algeria
El Kala

Brazil
Vale do Ribeira and Serra da Graciosa
Tijuca-Tinguá-Orgâos

China
Shennongijia

Estonia
West Estonian Archipelago

France
Mont Ventoux

Germany
Berchtesgaden Alps
Rhön
Rügen
Schorfheide-Chorin
Spreewald
Waddensea

Guatemala
Maya

Kenya
Amboseli

Mongolia
Great Gobi

United States of America
Land between the Lakes

NAME El Kala National Park

IUCN MANAGEMENT CATEGORY II (National Park - Parc national)
IX (Biosphere Reserve)
(Ramsar Convention sites: Lacs Oubeira and Tonga)

BIOGEOGRAPHICAL PROVINCE 2.17.06 (Mediterranean Sclerophyll)

GEOGRAPHICAL LOCATION Parc national d'El Kala is situated on the north-east Mediterranean coast of Algeria next to the Tunisian frontier. It is found in the Wilaya (district) of El Tarf and encompasses the village of El Kala, 500km east of Algiers. The park is limited in the west by Cap Rosa, in the east by Cap Mézira (Roux) and the Tunisian border. In the south-west it extends along the road RW 109 from El Mélah, thence *via* Lac Noir to the main El Kala to Annaba road, 1km east of Bouteldja. Beyond the village of El Tarf the park extends inland to include the Oued Bougos and the Djebel Ghorra (Koudiet Bouaddeb). The eastern limit follows the frontier with Tunisia to the coast by Cap Roux. The northern limit covers 40km of coast line from the Cap Rosa to Cap Roux (marine park are not yet designated). Wilaya (departement) of Setarf and communes of El Kala, El Aioun, El Tarf, Ain Assel, Bouteldje, Ramel Souk, Souarekh, Bougous and Zitouna. Approximately 36°54'N, 08°27'E

DATE AND HISTORY OF ESTABLISHMENT The site received total legal protection when declared as a national park (parc national) under Decree No. 83-462 of 23 July 1983. The site was originally called Réserve de la Calle (Dupuy, 1972). The park includes the natural reserve of Lac Oubeira, the hunting preserves of Lac Tonga and Mélah (Bougazelli *et al.*., 1976; Baba Ahmed, pers. comm. 1987; de Smet, *in litt.*, 1987). Oubeira and Tonga were designated under the Ramsar Convention on 4 November 1983. El Kala was accepted as a biosphere reserve in 1990. Additional ordinance relative to the site includes the Law on the Environment, Hunting Law, and ordinance relating to excavations and the protection of historic and natural monuments.

AREA 95,438ha in 1990, 76,438ha in 1987. The biosphere reserve core zone is 18,514ha, the buffer zone 56,133ha and the transition zone 1,791ha. The peripheral zone is an additional 19,000ha. Lacs Tonga (2,390ha), Oubeira (2,400-2,900ha) and Mélah (820ha).

LAND TENURE A major portion of the park is state-owned although farmland is predominantly under private ownership.

ALTITUDE Between sea-level and 1,202m

PHYSICAL FEATURES The park lies in the plain and foothills below the great Tellian Atlas, locally represented by the Kroumirie mountains. The bedrock in the lowland consists predominantly of an alternation of sandstones and clays of the Tertiary and Quaternary eras, although the mountain foothills comprise acidic Oligocene rocks (Durand, 1954; Bougazelli *et al.*., 1976). The Tertiary deposits of green and brown clays, schists and small banks of sandstones, are of mid-Eocene origin and up to 300m thick. The Quaternary strata consists of ancient river deposits of muds, sands and pebbles. The soils tend to be podsolised derivatives of sandstones and numidian clays upon which vegetation now thrives. The sandstones are covered by humus of 10-12cm (Mezali, 1985). The topography is characterised by a low gentle relief averaging at 100m, although the sections near the Tunisian frontier rise to 1,200m at Djebel Ghorra. A well developed coastal dune system is present between the coast and the mountains. The Baie de Annaba is bordered by long beaches with a series of stable dunes of Pleistocene origi, which extend from the mouth of the Seybouse to Cap Rosa (over

220 sq. km). The dunes lie parallel to the coast and measure up to 177m high. Numidian sandstone also occurs in the park and attains a height of 258m at Kef Trebiche. Groundwater seepage from the dunes results in the formation of several alder carrs and dune lakes such as Lacs Noir and Bleu. Each of the marshes and lakes is situated in shallow basins, overlooked by wooded hills. The lakes Oubeira and Tonga are closed freshwater basins (0.5-1m average depth) with abundant vegetation and little open water; Lac Mélah is a saltwater lagoon connected with the sea (Morgan, 1982). There are many other smaller lakes and marshes which represent a haven for winter migrating birds (Durand, 1954; Bougazelli *et al.*, 1976; Morgan, 1982; Drucker, 1987). The principal permanently flowing rivers are Oued Messida, Oued bou Namoussa, Oued el Kebir, Oued Bougos and Oued Mélah. The largest river, Oued el Kebir, rises in Tunisia and flows north-west through the park and into the Lac des Oiseaux beyond the western boundary. A dam was in the process of being constructed at Mexanna in 1987, near the junction of Oued el Kebir and Oued Bougos in the north of the park (Drucker, 1987).

CLIMATE The park lies in the Mediterranean sub-humid to humid bioclimatic zone (Drucker, 1987). There are average annual temperatures of 15°C. The mean temperature for the coldest month is 8.5°C and the mean for the warmest month, 30.4°C. The average annual precipitation averages at 1300mm, ranging from 879mm to 1191mm and largely depends upon altitude and distance from the mountains (Mezali, 1985). Snow normally falls in winter (January-February) at higher altitudes.

VEGETATION The vegetation communities range from extensive areas of natural woodland, through highly degraded scrub and garigue habitats and cultivated terrain to marsh and lake vegetation. Woodland represents the single largest ecosystem, with a surface area representing 71.4% of the park (Mezali, 1985).

There are seven to eight recognised woodland communities at El Kala including associations of cork oak *Quercus suber*, deciduous oak *Q. faginea*, garigue oak *Q. coccifera* and maritime pine *Pinus pinaster*, as well as of oleo/lentisc, riverine and alder carr habitats (Drucker, 1987). The largest woodland community, however, is the *Quercus suber* series. The most extensive and species-rich areas are found between 400m-900m on the north and north-east slopes of the Kroumirie mountains. The cork oak woodland covers a total area of 34,200ha and has an understorey of *Erica scoparia*, *E. cinerea*, *E. tinnaria*, *E. arborea*, *Arbutus unedo*, *Myrtus communis* and *Phillyrea angustifolia* (Bougazelli *et al.*, 1976). Woodland dominated by Portuguese oak *Quercus faginea* is restricted to Djebel Dyr, Djebel Ghorra (Gourrah) and Nehed where the altitude is over 900m. There is a rich oak woodland ground flora community which includes *Dactylis glomerata*, *Cyclamen africanum*, *Ranunculus ficaria*, *Geranium robertianum*, *Stellaria media*, *Dicranum* spp. and *Sedum cepaea* (Drucker, 1986). The dominant vegetation on the fixed coastal sand dunes consists of maquis vegetation such as of *Juniperus oxycedrus*, *J. phoenicia*, *Quercus coccifera* and *Cistus salvifolius*, which leads into thermophilous communities of *Pistacia lentiscus*, *Olea europea*, *Arbutus unedo*, *Phillyrea angustifolia*, *Genista tricuspidata*, *Pteridium aquilinum*, *Erica arborea* and *Myrtus communis* (Drucker, 1986). Representative ground layer species in the garigue include *Halimium halimifolium*, *Coronilla valentina*, *Viola sylvestris* and *Phlomis bovei*. *Quercus coccifera*, a shrub of 1-2m, is found in very degraded and exposed habitats along the coast and around human settlements. It is most prevalent along the littoral coast between Cap Rosa, El Kala and Cap Roux. There are two littoral pine forest associations; aleppo pine forest and a mixed pine forest of aleppo and maritime pines (only found in the north-east of the country). Maritime pine *Pinus pinaster* is found on the coast of El Kala, to the north of Lac Mélah and at El Tarf. Pine community vegetation on the coastal dunes includes the shrubs *Juniperus phoenicea*, *Daphne gnidium*, *Jasminum fruticosum*, *Genista aspaltathoides* and *Rhamnus alaternus* (Zeraia, 1983; IUCN, 1987). Sand vegetation species include *Euphorbia paralias* (de Smet, *in litt.*, 1987).

Riparian woodland is dominated by *Alnus glutinosa* and *Fraxinus angustifolia*. These riverine alder-ash communities have High-Forest characteristics and appear to represent some of the least

by the lakes are woodpigeon *Columba palumbus*, collared dove *Streptopelis turtur*, black kite *Milvus nigrans*, green woodpecker *Picus veridis*, great spotted woodpecker *Dendrocopus major*, lesser spotted woodpecker *D. minor*, wryneck *Jynx torquila*, Cetti's warbler *Cettia cetti*, blackcap *Sylvia atricapilla*, garden warbler *S. borin*, Bonelli's warbler *Phylloscopus bonelli* and serin *Serinus serinus* (Chalabi *et al.*, 1984; IUCN, 1987). The El Kala waterfowl includes abundant widgeon *Anas penelope*, pochard *Aythya ferina* (up to 9,000), tufted duck *A. fuligula* (approximately 12,000), coot *Fulica atra* (about 35,000), little grebe *Tachybaptus ruficollis* and great crested grebe *Podiceps cristatus*. Other species include the threatened white-headed duck *Oxyura leucocephala* (V), ferruginous duck *Aythya nyroca* and purple gallinule *Porphyrio porphyrio* (Lac Tonga). In winter there are many diving ducks at Lac Oubeira, which feed on and take refuge in the rich aquatic plant communities. Lac Mélah has an established population of tufted duck *Aythya fuligula* uncommon in the rest of North Africa. Birds tend to rest throughout the daylight hours at Lac Melah and move to Lac Oubeira overnight (Skinner and Smart, 1984; Ledant *et al.*, 1985; Mezali, 1985). The lowland areas are also important feeding areas for birds of prey such as the osprey *Pandion haliaetus* and hundreds of marsh harriers *Circus aeruginosus* which winter in the region (de Smet, *in litt.*, 1987).

Mammals include wild boar *Sus scrofa*, otter *Lutra lutra* (V), and scarce species such as caracal *Felis caracal* and Barbary stag *Cervus elaphus barbarus* (V), the latter inhabiting the cork and Portuguese oak forests south of Lac Mélah. Mediterranean monk seal *Monachus monachus* (E) is occasionally found in inaccessible sea caves between River Mafrag, near Annaba and the Cap Roux (Mezali, 1985; Bouzali *et al.*, 1976; IUCN, 1987). Between four and seven seals were repeatedly being observed in 1957, nine seals seen at Cap Roux in 1977 and 12 close to El Kala in 1983 (Boulva, 1975; IUCN, 1987). In 1987 there were sightings of seals off the El Kala to Tabarka coast by fishermen but no estimates of numbers seen had been made (Drucker, pers. comm., 1987).

CULTURAL HERITAGE Several pre-historic and historic sites are found in the park such as Neolithic standing stones and dolmens on Djebel Ghorra, Roman ruins and also a ruined 17th century French garrison, Vieux Calle (established 1628-1633). Throughout the ages there has been much exploitation of the red coral beds. As recently as the late 18th century Abbé Poiret recorded Barbary leopard and lion in the area of Vieux Calle and Lac Mélah (Bougazelli *et al.*, 1976). In 1679 as many as 400 people died in one year at Vieille Calle from malaria (IUCN, 1987). Monuments also mark the sites of the Algerian war of independence battles of the 1960s.

The traditional buildings found within the park are composed of thatch with wattle and daub (Drucker, pers. obs., 1987).

LOCAL HUMAN POPULATION Numerous villages and hamlets are scattered throughout the park. The total population was estimated as 67,246 in January 1990 (Anon., 1990). Their livestock are maintained in an extensive rural meadow landscape across an extensive area of the park. There are an estimated 100,000 residents in the townships of El Kala and El Tarf village (IUCN, 1987). The local rural economy is based on cultivating cereal crops, fruit orchards, livestock herding and small scale industry (agricultural land totals 15,000ha of the park area).

VISITORS AND VISITOR FACILITIES There are estimates of 50,000-100,000 visitors each summer. The main centre for visiting the park is at El Kala town where there are hotels, simple accommodation, camp sites (Cap Rosa, El Kala town and Plage de la Messida), restaurants and banking facilities. Educational activities include guided nature trails around the northern coast of Lac Tonga (IUCN, 1987). Construction of an eco-museum and park centre has been proposed in the derelict Catholic church at the centre of El Kala town (Baba Ahmed, pers. comm., 1987). Educational activities include ornithological workshops, with up to 60 participants in March 1987, and exhibitions in the town of El Kala (de Smet *in litt.*, 1987).

damaged natural woodlands in the park as identified near to El Frine (Drucker, pers. obs., 1987). The dense woodland vegetation closely follows the extensive network of river channels (the area of these linear woodlands has not been calculated and it is suggested here that they may well represent a significant proportion of the woodland cover on the plains). Associated species include *Salix pedicellata*, *Ulmus minor*, *Nerium oleander* and *Populus alba* (Drucker, 1986). Alder carr, the transitional lake and terrestrial vegetation, consists of alder *Alnus glutinosa*, with islets of willow *Salix alba* and *S. cinerea*. Typical ground layer species include *Pteridium aquilinum*, *Phragmites australis* and *Rubus ulmifolius*. In patches of deep water under the alders are shrubs such as *Frangula alnus*, *Rubus ulmifolius*, *Laurus nobilis*, the climbers *Hedera helix* and *Vitis vinifera* and the Algerian endemic plants *Hypericum afrum*, *Campanula alata* and *Laurentia bicolor*. The alder carr is rich in the ferns *Osmunda regalis*, *Dryopteris thelypteris*, *Athyrium felix-femina*, the threatened *D. gongyloides* and *Asplenium oboyatum* on the trees (Thomas, 1973 cited in Bougazelli, 1976). The species-rich alder communities are well represented along the northern edge of Lake Tonga, Bou Redim marsh and in the linear riverine woodlands distributed throughout the low-lying El Kala plains. Extensive poplar plantations exist in association with the alder at Lac Tonga (Drucker, 1986).

The submerged aquatic vegetation in the El Kala wetlands is dominated by *Potamogoten* spp in the eutrophic Lac Oubeira and by *Ruppia spiralis* in the brackish Lac Mélah (Bougazelli *et al.*, 1976). The emergent vegetation in the fresh water lake consists of *Scirpus lacustris*, *Phragmites australis* and *Typha angustifolia* communities along with varying densities of *Iris pseudacorus*, *Nymphaea alba* and *Sparganium erectum*. At Lac Tonga much of the area is covered by emergent vegetation including *Iris* spp. but at the deeper Lac Oubeira the emergent vegetation is restricted to the lake margin. At Lac Noir and Lac Bleu are the semi-aquatic *Mentha rotundifolium*, *Lycopus europaeus*, *Polygonum hydropiper*, *Lythrum junceum* and the uncommon *Nymphaea alba* and *Nuphar lutea* (Drucker, 1987). The biogeographically restricted *Trapa natans* is not uncommon in the centre of Lac Oubeira (Drucker, pers. obs., 1987). In the Bou Redim marshes the ground vegetation includes the tussocky *Carex elata* along with *Nyphaea alba* and other species commonly found in alder carr habitats (IUCN, 1987).

The rocky coast vegetation includes *Inula crithmoides*, *Anthemis maritima*, *Calendula suffruticosa*, *Crithmum maritimum*, *Daucus carota* subspp. *aristidis*, *Elichrysum stoeches* subspp. *rupestre*, *Armeria mauritanica* and *Anthyllis barva-jovis*, as well as *Thymelaea hirsuta* on the summits of the cliffs (Zeraia, 1983). The coastal and sandy beach vegetation is characterised by *Agropyron junceum*, *Euphorbia peplis*, *Salsola kali*, *Cakile aegyptiaca*, *Ipomaea stolinfera* and *Calystegia soldanella* (Bougazelli *et al.*, 1976; Zeraia, 1983; IUCN, 1987). The marine area includes extensive sea grass *Posidonia oceanica* and *Zostera noltii* meadows (the latter also present in Lac Melah).

Other habitats in the park include grazing land, poplar plantations, hedgerows, damp meadows and arable fields, which in total represent a significant proportion of the protected area (Drucker, 1987).

FAUNA The lowland areas of the park are of importance as feeding and breeding areas for wetland fauna. The supra-littoral coastal zone is rich in *Chthamalus stellatus* and *Littorina neritoides*, which is often succeeded in the marine zone by encrusting algae such as *Lithophyllum tortuosum* and also by the mussel *Mytillus africanum* and red coral *Corallium rubrum* (IUCN, 1987). Inter-tidal species include *Pachygrapsus marmoratus*, *Actinia equina*, *Erophia spirifrous* and *Masthasterias glacialis*. Lake fauna is diverse as typified by *Carcinus moenas*, *Cardium edule*, *Palcemoneies varians occidentalis*, *Gammarus locusta* and *Halorchestia deshayesci* of the saline Lac Mélah (Bougazelli *et al.*, 1976).

Birds recorded along the El Kala coastline include razorbill *Alca torda*, puffin *Fratercula arctica*, storm petrel *Hydrobates pelagicus*, Audouin's gull *Larus audouinii* (R), Mediterranean gull *L. melanocephala*, little gull *L. minutus*, cormorant *Phalacrocorax carbo*, shag *P. aristotelis* and Manx shearwater *Puffinus puffinus* (de Smet,*in litt.*, 1987). In the cork woods and scrub vegetation

SCIENTIFIC RESEARCH AND FACILITIES The current number of researchers includes about 100 as well as 10 foreign researchers (Anon., 1990). A major national park feasibility study was carried out in 1976 by Bougazelli and fellow researchers (Bougazelli *et al.*, (1976). Research facilities include a climatological station, field research station and experimental sites such as an arboretum and fish rearing station. Waterfowl counts have been carried out since 1967 by IWRB, the Station Biologique de Tour du Valat, Camargue, and the Institut National Agronomique, El Harrach near Algiers. Vegetation maps and maps identifying the park boundaries have been prepared by the Bureau National des Etudes Forestières (BNEF). There are proposals to extend the park over the border into the neighbouring Tunisian Tabarka woodland and to include a marine reserve area where monk seal may be present (IUCN, 1987; Baba Ahmed, pers. comm., 1987).

CONSERVATION VALUE The El Kala complex is recognised as one of the three most important wetlands in the Mediterranean region. The assemblage of these humid zones is of international importance for threatened breeding birds as well as wintering and resting Palaearctic migratory species. Lakes Oubeira, Tonga and Mélah are each Grade 1 in the Morgan listing of North African wetlands (Morgan, 1982) and certainly the most important areas for waterfowl in Algeria. Invaluable ecosystems at El Kala include the wetlands. The other ecosystems are each important for containing national and international botanical rarities. The alder carrs and pristine riverine woodlands, such as those found at El Kala, are uncommon and under great threat throughout North Africa.

Nationally threatened plants at El Kala include *Polygonum senegalense* and *Paspalidium obtusifolium* at Lac Oubeira, *Spartina batens*, *Lemna trisulca*, *Nymphaea alba*, *Nuphar lutea*, *Ranunculus flammula*, *Cardamine parviflora* and *Trapa bispinose* at Lac Tonga (also see lists in Mathez *et al.*, 1985).

The pristine low-montane cork oak forests contain the last remnants of *Pinus pinaster* ssp. *renoui* in Algeria. The rocky and sandy marine coast has been recommended for inclusion within the park boundary due to its rich Mediterranean biocenosis: important *Corallium rubrum* formations, extensive *Posidonia oceanica* meadows and the presence of monk seal. The Nicha Rirhia alder carr (between the route of Righia and the Lac des Oiseaux) at approximately 800m across is one of the largest and least damaged of such habitats in North Africa. It contains many threatened humidity seeking species such as abundant *Osmundo regalis*. The site has been recommended for total protection (Chelabi *et al.*, 1984; IUCN, 1987; Baba Ahmed, pers. comm. 1987).

The conservation importance of Lac Tonga includes the diversity and numbers of nesting birds, including seven species of heron. It is also the most important nesting area of aquatic birds in the Eastern Mediterranean. It harbours a number of internationally and regionally threatened bird species such as *Oxyura leucocephala*, *Anas angustirostris*, *Aythya nyroca* and *Porphyrio porphyrio*. Other notable species include *Ardeola ralloides*, *Marmaronetta angustirostris* (V), *Aythya nyroca* and *Tachybaptus rufficollis* (Ledant et Jacob, 1982). In the El Kala area there are a number of endemic Mediterranean and localised Algerian bird species and sub-species such as *Puffinus puffinus yelkouan*, *Phalacrocorax aristotelis demarestii* and *Porphyrio porphyrio porphyrio* (Ledant et Jacob, 1982). Bou Redim marshland is believed to have one of the largest heron colonies in the Mediterranean. El Kala is also of major importance as a refuge for some of the last Barbary stag left in North Africa, and an important haven for the otter and caracal (IUCN, 1987).

CONSERVATION MANAGEMENT The park was established to protect the unique wetland complexes and their associated fauna, flora, hydrology and historic monuments, along with the traditional landscape and lifestyles of the region.

Legislation is primarily concerned with nature conservation, recreation and protection of the traditional lanscape of the area. The national park legislation aims to a) preserve the unique terrestrial

and wetland ecosystems; b) prevent environmental destruction by man; c) develop leisure, recreation and education; and d) undertake scientific studies (Baba Ahmed, pers. comm., 1987).

A proposal for a study and a draft management plan has been prepared in association with University College, London and subsequently (1986; Stevenson, Skinner and Smart, 1988). The park of 95,438ha is divided into five zones: Class 1 - réserve integrale (9,292ha), Class 2 - protective ou sauvage (9,122ha), Class 3 - faible croissance (29,859ha), Class 4 - tampon (26,274ha), and a transition zone entitled périphérique (76,438ha) (Anon., 1990).

Regarded as a protected landscape, the area is an inhabited and exploited area where permitted activities include tourism, industry and urbanisation. Permitted activities vary from zone to zone: Zone 1 is restricted to areas where unique or special features may only be used for scientific research; Zone 2 are wild or natural areas where developments including roads are prohibited; Zone 3 comprises areas where modest developments are permitted subject to regulation; Zone 4 buffer zones to protect Zones 1 and 2 and where camping is permitted; and Zone 5 peripheral areas encompass all forms of construction, including roads (Stevenson, Skinner and Hollis, 1988). Zonation will prevent the establishment of major factories in the future but small family businesses can operate within the park. The park authorities considers it important to maintain traditional human activities such as rural agriculture and aquaculture at El Kala. Fishing, forestry and grazing are all currently permitted to take take place in the park (IUCN, 1987). The exploitation of natural resources is controlled. Hunting is prohibited and red coral is protected from exploitation (Anon., 1990).

The park is administered by a resident Director and staff (of the Ministry of Hydraulics, Environment, and Forests) who are guided by a management committee drawn from 11 ministries and local bodies.

Details on an integrated management approach have been identified along with recommendations for sustainable utilisation. Four wetlands outside the park - Mekhada marsh, Lac Fetzara, Lac des Oiseuax and Cheffia Reservoir were recommended for legal protection (Stevenson, Skinner and Smart, 1988).

Ecological improvements to lakes Tonga and Fetzara, which were drained in the 1930s, have recently developed from the operation of the old sluices to hold water back in the lakes (Stevenson, Skinner and Smart, 1988).

MANAGEMENT CONSTRAINTS The principal identified environmental problems are the degradation of the forests due to grazing and fire, cutting of routes through forestland, shooting pressure on the lakeshore, wetland drainage, ground-water pumping, and dredging (Anon., 1990). Other problems include agriculture, human habitation, hunting, overgrowth of semi-natural habitats including wetlands and also coastal destabilisation. In the transition zone major problems include destruction of the terrestrial habitat, wetlands and marine environment along with dredging and land reclamation. Additional recorded harmful activities include fishing, forestry, pasturage, human colonisation, hunting, exploitation of marine products, mineral extraction, poaching, tourism, touristic management, town expansion and water management (Anon., 1990).

In the past, the independence wars of the 1950s and 1960s led to frequent fires and poaching of wildlife; Barbary deer was almost exterminated. Currently, the ensemble of these humid biotopes is menaced by drainage projects and agriculture (Mathez *et al.*, 1985).

Several attempts to drain the wetland area were unsuccessfully initiated in the past but high risks remain with the proposed water resources scheme in the El Kala region. Insufficient equipment and untrained personnel represent the main management problems (Skinner and Smart, 1984). There are also threats to the unprotected Garaet el Mekhada, a large *Scirpus* marsh which is situated just outside

the national park, although it represents an integral part of the ecosystem. A dam was reportedly under construction at Mexenna on the Oued el Kebir in 1987 (Baba Ahmed, pers. comm., 1987; Stevenson *et al.*, 1988). Lac Oubeira has also been proposed as a balancing lake for dammed water. Its ecological character may be changed if this occurs (Mezali, 1985; IUCN, 1987). Further changes to the park character include the gradual loss of traditional culture, as recognised by the replacement of the local thatched huts with modern European-style concrete houses (Drucker, pers. obs., 1987).

Lake Oubeira was shown to be amongst the 22 Ramsar sites that were most likely to suffer major ecological change. In 1987 the Algerian authorities were particularly requested by the Contracting Parties to the Ramsar Convention to safeguard the lake.

STAFF In 1990 there were 25 staff, three in administration, four in education and one in research (Anon., 1990). In 1987 there were 30: one director, four administrative staff, 20 wardens, two researchers and three technicians (IUCN, 1987).

BUDGET The annual budget in 1990 was 1,700,000 Algerian Dinars provided by the Government. In 1987 the budget was 1,400,000 Algerian Dinars (IUCN, 1987).

LOCAL ADDRESSES Direction du parc national d'El Kala, BP 73, Route de la Pepinière, El Kala, wilaya d'el Tarf, El Kala 36200 (Tel: 95 16 14; Tlx: 81 790)

REFERENCES

Anon. (1990). Parc National d'El Kala. Formulaire de proposition de reserves de la biosphere. MAB National Committee.

Baba Ahmed, R. (1986). Quelques données sur l'aménagement d'un parc national (expérience d'El Kala). In: '*Parc Zoologique et des loisirs d'Alger*' 20-22/09: 15-25.

Beniston, N.T. et Beniston, W.S. (1984). *Fleurs d'Algérie*. Entreprise Nationale du Livre, Alger.

Boudy, P. (1948-58). *Economie forestière Nord-Africaine*. Larousse, Paris.

Bougazelli, N., Djender, M. et Thomas, J.P. (1976). Projet de Parc National Marin Lacustre Terrestre de El Kala (Annaba) Algeria. Report presented to the UNEP Expert Consultation on Mediterranean Marine Parks and Wetland, Tunis, 12-14 January 1977.

Bureau National de Etudes Forestières (1983). *Parc National d'El Kala: Carte des limites 1:50,000.* BNEF, Blida, Alger.

Chalabi, B., Skinner, J., Harrison, J. and Van Dijk, G. (1984). Les zones humides du Nord-Est Algérien en 1984. Report No. 8. Stichting Werkgroep International Wad-en Watervogelonderzoek, WIWO, Nederland. 40 pp.

Drucker, G.R.F. (1986) National Parks and reserves in Algeria. Unpublished report, Sussex.

Dupuy, A.R. (1972). L'Urgence de la protection de la nature en Algérie. *Biological Conservation* 4(2): 102-106.

Durant, J. (1954). *Les sols d'Algérie*. Gouvernement General du l'Algérie. Direction du Service de la Colonisation et de l'Hydraulique, Alger. 254 pp.

Hallise, M. et Mostaganem, I.T.A. (1975). Cerf de Barbarie, implantation d'une réserve. Mimeo.

IUCN (1987). A Draft Directory of North African protected areas. Compiled by G.R.F. Drucker for the World Conservation Monitoring Centre, IUCN, Cambridge, UK.

IUCN (1987). Report on the status, the Mediterranean monk seal. IUCN/UNEP/MM-IC/13. 16 October.

Johnson, A.R. and Hafner, H. (1972). *Dénombrement de sauvagine en automne sur des zones humides de Tunisie et d'Algérie*. Station Biologique de la Tour du Valat, le Sambuc, France.

Ledant, J-P. et Jacob, J.P. (1982). Liste rouge des espèces d'oiseaux menacées en Algérie. Rapport préparé pour DPN (Alger)/SEFOR/ICBP/IUCN.

Ledant, J-P., Roux, F., Jarry, G., Gammel, A., Smit, C., Bairlein, F. and Wille, H. (1985). Aperçu des zones de grand interêt pour la conservation des espèces d'oiseaux migrateurs de la communauté en Afrique. Rapport à la Direction Générale de l'Environnement, de la Protection

des Consommateurs et de la Sécurité nucléaire de la Commission des Communautés européennes. Contrat U/84/129.

Lefranc, L. (1965). La Calle, topographie, botanique et climatologique. *Bulletin de la Société Botanique de France* XII: 413-431.

Mathez, J., Quézel, P. and Raynaud, C. (1985). The Maghreb countries. In: '*Plant conservation in the Mediterranean area*'. Gomez-Campo, C. (Ed). Junk publishers, Dordrecht. Pp. 141-157.

Mezali, M. (1985). Les conditions écologiques du Parc national d'El Kala. Symposium International 'Conservation des zones naturelles et des ressources génétiques qu'elles contiennent' - Project 8 du programme sur l'homme et la biosphere. Unesco, 23-28 September 1985. Blagoevgrad.

MHEF (1982). *Parcs nationaux en Algérie, Parc National de El Kala*. Ministère de l'Hydraulique, de l'Environnement et des Forêts, Alger.

MHEF (1985). Rapport National sur la Protection de l'Environment en Algérie, Ministère de l'Hydraulique, de l'Environnement et des Forêts, Alger.

MHEF (1983). *Aperçu sur la faune algérienne et la politique engagée pour sa protection et son dévéloppement*. Ministère de l'Hydraulique, de l'Environnement et des Forêts.

Morgan, N.C. (1982). An ecological survey of standing waters in North-West Africa: II Site descriptions for Tunisia and Algeria. *Biological Conservation* 24: 83-113.

Skinner, J. and Smart, M. (1984). The El Kala wetlands of Algeria and their use by waterfowl. *Wildfowl* 35: 106-118.

Stevenson, A.C., Skinner, J. and Smart, M. (1988). The El Kala National Park and Environs, Algeria: an Ecological Evaluation. *Environmental Conservation* 15(4): 355-348.

Thomas, J-P. (1973). Ecologie et dynamisme de la végétation psammophile de Jijel à El-Kala. Mimeo. Publication prévue fin 1973.

Thomas, J-P. (1975). Ecologie et dynamisme de la végétation des dunes littorales et des terrasses sableuses quaternaires de Jijel a El Kala (Est Algérien). Mimeo INA, El Harrach, Alger. 113 pp.

Van Dijk, G. et Ledant, J-P. (1983). La valeur ornithologique des zones humides de l'est algérien. *Biological Conservation* 26: 215-226.

Zeraia, L. (1983). *Protection de la Flore; liste et localisation des espèces assez rares, rares et rarissimes*. Station centrale de recherche en écologie forestière, Alger.

DATE February 1988, revised July 1991

NAME Vale do Ribeira and Serra da Graciosa Biosphere Reserve

IUCN MANAGEMENT CATEGORY IX (Biosphere Reserve)

8IOGEOGRAPHICAL PROVINCE 8.07.01 (Serra do mar)

GEOGRAPHIC LOCATION Located in Sao Paulo and Parana states. Nearest major cities are Sao Paulo (80km distant), with 12 million inhabitants and Curitiba (20km distant), with 1.5 million inhabitants. 23°50'-26°00'S, 47°00'-49°10'W

DATE AND HISTORY OF ESTABLISHMENT The biosphere reserve contains several protected areas; Superagui National Park was established on 25 April 1989 (Decree No. 97.688) (IBAMA, 1990); Guaraquecaba* on 31 May 1982 (Decree No. 87.222) and re-established on 31 October 1985 (Decree No. 90.883); Cananeia-Iguape-Peruíbe Environmental Protection Area was established on 23 October 1984 (Decree No. 90.347); Carlos Botelho State Park on 10 September 182 (Decree No. 19.499); Chauas Ecological Station on 6 February 1987 (Decree No. 26.719). Ilha Comprimida on 11 March 1987 (Decree 26.881; Serras do Mar* and Paranapiacaba on 21 September 1984 (Decree No. 22.717) and on 30 August 1977 (Decree No. 10.251); Ilha do Mel Ecological Station on 21 September 1982 (Decree No. 5454); Xitue Ecological Station was established on 27 November 1955 (Decree No. 26.872) and 23 April 1976 (Decree No. 28.153); Ilha do Cardoso State Park on 3 July 1962 (Decree No. 40.310) and 11 March 1971; Sao Roque State Reserve was established on 30 August 1978 (Decree No. 12.185); Alto Ribeira Turistic State Park on 19 March 1958 (Decree No. 32.283); Jacupiranga State Park on 8 August 1969 (Decree No. 145); Serra do Mar Environmental Protection Area on 30 June 1977 (Decree No. 10.251 and 6 March 1979 (Decree No. 13.313); Rio da Onca Forest Park was established on 4 June 1981 (Decree No. 3.225); Marumbi I and II on 2 October 1978 (Decree No. 5.590 defined the area), 30 November 1978 (Decree No. 1.182) and 4 October 1978 (Decree No. 5.592) (established as a permanent forestry reserve); Lauraceas State Park was established on 27 June 1979 (Decree No. 729) (Strang *et al.*, 1982). Vale do Ribeira and Serra da Graciosa was accepted as a biosphere reserve in 1991.

*** There are two sites with the same main name, it is unclear at this stage which information refers to which area.**

AREA 1,615,000ha (comprising core area of 730,000ha, buffer zone of 585,000ha, and transition zone of 300,000ha)

LAND TENURE Private ownership primarily, state ownership secondarily

ALTITUDE 0-1,889m. Maximum depth below mean sea level is 10m (Ribeiro, 1990).

PHYSICAL FEATURES The reserve consists of a complex of different formations ranging from an 'inland sea' and coastal plains to scarps in the Serra do Mar range rising to the plateau. The hydrography reflects the predominant characteristics of geosystems in south-east Brazil. The main river basin in the area is that of the River Ribeira do Iguape.

The reserve consists of pre-Cambrian rocks, a gneissic-migmatithic complex and Acungui group, in addition to the Serra Geral formation and Cenozoic sediments. Geomorphologically the area is divided into compartments such as the plateau, the plateau scarp, the coastal range and the lowland plains. In the municipal districts of Apiai, Iporanga and Eldorado Paulista, the Ribeira River basin is a distinguishing feature in relation to the karst topography occurrences. As a result of the

characteristic calcareous topography caused by the dissolution of these rocks (predominantly vertical and subterranean), this region contains the highest concentration of registered limestone caves (approximately 170), many of them of considerable dimension and beauty. Pedologically, the area is characterised by the presence of latosols, cambisols and podsols, besides glazed podsol, alluvia and litholics (Brazilian MAB-Committee, 1990).

CLIMATE Conditions are sub-hot, super-humid with tropical sub-droughts. Spring and summer rains and mild temperatures are caused by the influence of the Atlantic polar front which, together with the orographical convection rains resulting from the incoming sea breeze, lead to the occurrence of torrential rains in summer. The average temperature is 20°C; maximum average temperature is 24°C and minimum average is 16°C. Mean annual precipitation is 1750mm at an elevation of 300m. The wet season is from October to March (Ribeiro, 1990).

VEGETATION There are several main vegetation types: coastal hygrophilous evergreen forest; sub-tropical subdeciduous forest with *Araucaria;* coastal spits; mangroves; beaches, dunes and island sea. In the coastal hygrophilous evergreen forest, which has been intensely disturbed since the discovery of Brazil, species such as *Tabebuia* spp., *Nectandra* spp., *Clyptocarya* spp., *Endlicheria* spp., *Ocotera* spp., *Hymenaea stibocarpa, Cedrela fissilis, Cabralea canjerana, Psidium* spp., *Vanilla* sp., and *Jacaranda* spp. occur, amongst others. The subdeciduous forest, as well as containing the species listed above, is dominated by *Araucaria angustifolia.* Some Myrtaceae, Lauraceae and Leguminosae, Melastomatacae, Myrsinaceae, Cyperaceae, Oxalidaceae, Verbenaceae and Solanaceae occur. Two arborescent ferns are present, *Dicksonia sellowiana* and *Alsophila elegans,* as well as a wealth of epiphytes such as Bromeliaceae, Orchidaceae, Gesneriaceae and Polypodiaceae and mosses.

Coastal spit vegetation has been greatly altered. However, some species still remain, such as: *Labramia bojeri, Hydrocotile umbellata, Hibiscus tiliaceus, Alternanthera maritima, Ananas bracteatus, Schinos terebentifolius, Philodendron martianum, Cereus* spp., *Bromelia* spp., *Miconia* spp. Mangrove species include *Rhizophora manglae, Avicennia tomentosa, Raguncularia racemosa, Hibiscus tilaceous,* and *Acrostichum* spp. Species found on beaches and dunes include *Iresine portulacoides, Ipomea pescaprae, Canavalia obtusifolia* and *Allagoptera arenaria.* In addition, orchids, bromeliads and cactae are found on beaches beyond the reach of the tides. *Paspalum* sp., *Spartina* sp. and Juncacea rushes are characteristic of the submerged prairie area of the lagoon ('inland sea'). A detailed species list can be found in Ribeiro (1990).

FAUNA The fauna is rich and includes several endemic and nationally or globally threatened species. Fourteen species of mammals are considered threatened nationally, more than half of which are considered threatened globally, including brown howler monkey *Alouatta fusca* (V), woolly spider monkey *Brachyteles arachnoides* (E), masked titi *Callicebus personatus* (E), ocelot *Felis pardalis* (V), margay *Felis wiedii* (V), jaguar *Panthera onca* (V), and giant anteater *Myrmecophaga tridactyla* (V). A new endemic species, *Leontopithecus caissara*, has been reported recently.

Thirty-three species of birds are included in the officiai list of threatened species in Brazil, including yellow-legged tinamou *Crypturelus noctivagus* (K), great bellied-hawk *Accipiter poliogaster* (K), white-necked hawk *Leucopternis lacernulata* (K), black-fronted piping guan *Pipile jacutinga* (E), eskimo curlew *Numenius borealis* (E), red-tailed parrot *Amazona brasiliensis* (E), red-spectacled parrot *A. pretrei* (V), blue-throated parakeet *Pyrrhura cruentata* (R) and helmeted woodpecker *Dryocopus galeatus* (E). Reptile species include green turtle *Chelonia mydas* (E), hawksbill turtle *Eretmochelys imbricata* (E), leatherback *Dermochelis coriacea* and broad-nosed caiman *Caiman latirostris* (E). Insects include the butterfly *Moschoneura methymna.* Aquatic species include shrimp *Penaeus paulensis,* octopus *Octopus sp.,* squid *Loligo brasiliensis,* bivalves *Perna perna, Crassostrea sp.,* fishes *Mugil sp., Centropomus undecimalis, Tachysurus sp., Mycteroperca sp.* and *Anchoa mirtchieli* (Ribeiro, 1990).

CULTURAL HERITAGE No information

LOCAL HUMAN POPULATION Approximately 1,000 people live permanently within the core area; 10,000 in the buffer zone and 100,000 in the transition area. Activities include agriculture, artisanal fishing, forest-dwelling, hunting and gathering. Urban and suburban populations are also present. Domestic animals are kept in the reserve and include cattle (8,000), pigs (4,000) and poultry (10,000) (Ribeiro, 1990).

VISITORS AND VISITOR FACILITIES Approximately 100,000 people visit the reserve each year. Access to research facilities is by permit issued by the reserve authorities (Ribeiro, 1990).

SCIENTIFIC RESEARCH AND FACILITIES The general reserve programme focuses on integrated research on land use and management which supports site management and sustainable conservation. Resource information includes aerial photographic surveys, history of scientific studies, risk assessment, topography, various mapping studies such as freshwater, marine, bathymetry, hydrology, limnology and water quality, climate, biological inventories, geological and ethnobiological information. Past studies include pests and diseases, physical oceanography and sedimentation. Main areas of research are agriculture, rural technology, aquaculture/ mariculture, exotic species, forestry/silviculture, genetics, geomorphology, hydrology, comparative ecology, productivity, cultural anthropology, ecology, sea level changes, water pollution, pesticides, population dynamics (fish), limnology and hydrobiology, rare and endangered species, resource mapping, risk assessment, social sciences, soil conservation, traditional land uses, watershed research and wildlife population dynamics. Future research includes ethnobiology. Other research activities in the reserve are agro-ecological zoning of the area immediately south of Alto Ribeira State Tourigtic Park (Petar) in the municipal district of Iporanga; macro-zoning of the coastal region of the state of Sao Paulo; studies for the enlargement of Chauag Ecological Station and the establishment of Xiririca Ecological Station in the State of Sao Paulo. Macro-zoning of the coastal region of the State of Parana has been implemented following research (Ribeiro, 1990).

Research facilities exist for monitoring climate and hydrology. Some permanent monitoring plots for lakes or streams, marine benthos and vegetation are also available, as well as conference, laboratory and library facilities and a small watershed monitoring and research site. Storage and curatorial equipment and logistical support for research vehicles are also available. In addition, a research programme on the production of palm stems and the development of ecotourism is being undertaken by Intervales Farm, owned by the state of Sao Paulo and administered by the state's Forestry Conservation and Production Foundation (Ribeiro, 1990).

CONSERVATION VALUE The main purpose of the reserve is to conserve natural or minimally disturbed ecosystems; to conserve specific genetic resources *in situ*; to carry out research on ecosystem management; to promote local participation in land use and management and to generate and disseminate knowledge about conservation and management of the biosphere. The reserve consists of a complex of different formations ranging from scarps in the Serra do Mar to the inland sea- or coastal lagoon. The region contains the highest concentration of registered limestone caves (approximately 170), of considerable archaeological and palaeontological scientific potential. All habitats within the reserve are examples of rapidly changing coastal environments. In particular, coastal hygrophilous evergreen foregt and coastal spits have already been altered considerably at national level. The fauna includes a considerable number of nationally or globally threatened species, some of which are under serious pressure elsewhere. In addition, there are several wild relatives of economic species such as *Euterpe edulis*, *Attalea dubia*, *Ilex paraquaiensis*, *Tabebuia cassinoides* and *Araucaria anqustifolia*. *Euterpe edulis* was initially extracted by the Indians and is currently cultivated commercially. A number of medicinal herbs originally used by the indigenous population have been incorporated into contemporary use (Ribeiro, 1990).

Benefits to local people include increased employment and financial opportunities, improved food, health and community services, rural development, recreation and tourism opportunities, conservation of resources such as soil and water, maintenance of traditional cultures and resource use practices, and participation in reserve planning and management. Tourism potential is reported to be vast.

CONSERVATION MANAGEMENT The biosphere reserve comprises a number of smaller reserves administered by the federal and state governments. Areas managed by federal government (IBAMA) are: Superagui National Park (21,400ha), Guaraquecaba Ecological station (13,638ha), Guaraquecaba Environmental Protection Area (291,500ha), Cananeia-Iguape-Peruíbe Environmental Protection Area (south portion) (160,000ha). Areas managed by the state government of Sao Paulo are: Alto Ribeira Turistic State Park (35,000ha), Ilha do Cardogo State Park (22,500ha), Jacupiranga State Park (150,000ha), Carlos Sotelho State Park (37,644ha), Sao Roque State Reserve (23,900ha), Chauag Ecological station (2,699ha), Xitue Ecological Station (3,095ha), Serra do Mar Environmental Protection Area (400,000ha), Ilha Comprimida Environmental Protection Area (20,000ha), Serras do Mar and Paranapiacaba (south portion of the area under preservation order) (1,300,000ha). Areas managed by state government of Parana: Lauraceas State Park (23,863ha), Pico do Marumbi State Park (1,974ha), Agudo da Cotia State Park (1,009ha), Graciosa State Park (1,189ha), Rio da Onca Forest Park (118ha), Ilha do Mel Ecological Station 2,240ha), Marumbi Special Turistic Interest Area (66,732ha), Serra do Mar (area under Preservation order) (386,000ha). The area has also been designated as a national and state heritage site (Ribeiro, 1990).

The following activities are undertaken in the core area: scientific collection of plants and animals, biological inventories, long-term environmental monitoring, professional training, conservation management practices (controlled burning, mowing, wildlife population control) and authorised fishing and/or shellfishing. In the buffer zone, main activities are conservation management practices (controlled burning), long-term environmental monitoring, biological inventories, scientific collections, environmental education, development of marine products/aquaculture and minerals, professional training and tourism development. In the transition zone the main activitieg include conservation management practices, fishing and/or shellfishing, and long-term environmental monitoring. Other activities carried out in this zone are agriculture, biological inventories and scientific collection, environmental education, forestry *(Eucaliptus* spp. and *Pinus* spp.), marine products, training, tourism development and transportation facilities. Ten percent of the land in the transition zone is used for permanent crops and 8% for temporary crops such as bananas, maize, sugar-cane, beans, cassava, grapes and strawberries (Ribeiro, 1990).

Ongoing education and training activities include environmental education for school children and students, extension services for local people, demonstration projects in conservation and the rational use of the natural resources, interpretive programmes for tourists, training and workshops for scientists and staff training in protected area management (Ribeiro, 1990). Anticipated future activities include encouraging scientific use of the reserve, participation in national and international monitoring networks, establishing a research station, implementation of research projects, preparation of a plan, merging of reserve objectives into existing planning processes, establishment of mechanisms to improve coordination and participation by local people and the development of a model sustainable development project (Ribeiro, 1990).

There is limited harbour activity in the coastal towns of Antonina, Guaraquecaba and Cananeia, as well as large-scale port activity at Paranagua (Ribeiro, 1990).

MANAGEMENT CONSTRAINTS Lack of coordination between the authorities responsible for administration of the area and encroachment of settlements has been reported in the core area. In the buffer zone, some human settlements, hunting, trapping and poaching have been noted, as well as destruction of terrestrial, wetland and marine habitats, dredging and filling of sites and grazing. These activities are having a greater impact in the transition area (Ribeiro, 1990). Property

speculators and land jumpers have been reported in the reserve (Ribeiro, 1990). There is grazing by cattle on molasses grass, by goats, pigs and horses on *Brachiaria* and 'napié' grasses, maize and sugarcane, and by waterfowl (ducks, teals and geese), chickens and guinea-fowl on a variety of cereals (Ribeiro, 1990).

STAFF A total of 150 employees; 80 involved in administration, 20 in education and training, and 50 in research (32 are technical support personnel for research). Twenty of the administrative staff are university trained. Three of the research team are qualified to doctorate level (or equivalent) and 15 staff have other university degrees (Ribeiro, 1990).

BUDGET Approximately 300 million Cruzeiros annually for three years (started in 1990) (Ribeiro, 1990)

Various international agencies provide financial support, including: WWF (a variety of projects), IUCN (wetland congervation project), The Nature Conservancy (sustainable development in the region), World Bank (National Programme for the Environment) and Kreditangtalt für Wiederaufbau (natural areas protection).

LOCAL ADDRESSES

Secretaria de Estado do Meio Ambiente, Rua Tabapua No 81-14O andar(?), Sao Paulo, CEP 04533, Sao Paulo (Tel: 11 883 3482; FAX: 11 280 5468; TIX: 32621 SMEA)

REFERENCES

Almeida, F.F.M. de (1974). *Fundamentos geológicos de relevo paulista.* Sao Paulo, IG/USP. Serie Teges e Monografias, 14. 102 pp. (Unseen)

Alonso, M.T.H. (1977). Vegetaçao. In: Fundação do Instituto Brasileiro de Geografia e Estatística -IBGE. *Geografía do Brasil: Regiao sudeste.* Rio de Janeiro, SERGRAF - IBGE. Volume 3: 91-118. (Unseen)

Bernades, A.T. *et al.* (1990). *Fauna Brasileira Ameaçada de Extinção.* Belo Horizonte, Fundacao Biodiversitas. 62 pp. (Unseen)

IBAMA (1990). Parques Nacionais-Reservas Biol6gicas, Estacoes Ecologicas do Brasil.

Lepsch, I.F. *et al.* (1990). *Macro zoneamento das Terras da Regiao do Rio Ribeira de Iguape, S.P.* Campinas, SP, Instituto Agronomico. 181 pp. (Unseen)

Mainieri, C. (1970). *Madeiras Brasileiras: Características gerais: Zonas de major ocorrencia, dados botanicos e usos.* Sao Paulo, Instituto Florestal. 109 pp. (Unseen)

Mainieri, C. (1973). *Madeiras do Litoral sul: Estado de Sao Paulo, Parana e Santa Catarina: nomenclatura botanica e vulgar, caracteristicas gerais e usos comunes.* Sao Paulo, Instituto Florestal. Boletim Tecnico No 3. 84 pp. (Unseen)

Negreiros, O. *et al.* (1974). *Plano de Manejo para o Parque Estadual da Ilha do Cardoso.* Sao Paulo, Instituto Florestal. Boletim Tecnico No 9. 56 pp. (Unseen)

Poncano, W.L. *et al.* (1981). *Mapa de Geomorfologia do Estado de Sao Paulo.* Sao Paulo, IPT. Publicacao IPT No 1183. 94 pp. (Unseen)

Ribeiro, G.L.B.R.L. (1990). Vale do Ribeira and Serra da Graciosa Biosphere Reserve Nomination Form. Brazilian MAB Committee. 9 November 1990. 31 pp.

Strang, H.E., Lanna Sobrinho, J.P. and Tosetti, L.D. (1982). *Parques Estaduais do Brasil, sua Caracterização e Essencias Nativas mais Importantes.* Fundação Brasileira para a Conservação da Natureza. Rio de Janeiro. Contribution to the Congresso Nacional sobre Essencias Nativas. Campos do Jordão (SP), 12-18 September 1982. 143 pp.

DATE September 1991

NAME Tijuca-Tinguá-Orgâos Biosphere Reserve

IUCN MANAGEMENT CATEGORY II (National Park)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 8.07.01 (Serra do mar)

GEOGRAPHICAL LOCATION In the municipalities of Rio de Janeiro, Petrópolis, Teresópolis, Duque de Caxias, Nova Iguaçu, Miguel Pereira and Mage, Rio de Janeiro State (Guggenheim, 1991). Tijuca National Park is located in the centre of the city of Rio de Janeiro (Dieguea, 1990). Rio de Janeiro had an approximate population of 6,042,411 in 1990. The population density of the region is 1,779 inhabitants per sq. km. 22°38'S, 43°15'W (Guggenheim, 1991).

DATE AND HISTORY OF ESTABLISHMENT Serra dos Orgâos National Park waa established on 30 November 1939 by Law Decree No. 1.822. Tijuca National Park was established on 6 July 1961 by Federal Decree No 50.925 as Rio de Janeiro National Park; it was renamed on 8 February 1967 by Decree No. 60.183. Tinguá Biological Reserve was established on 23 May 1989 through Decree No. 97.780. Tijuca-Tinguá-Orgâos was accepted as a biosphere reserve in 1991.

AREA 97,600ha comprising core area (16,500ha), buffer zone (24,200ha) and transition zone (56,900ha) (Guggenheim, 1991). Serra dos Orgâos has a total area of 10,000ha (Jorge Padua and Rocha Porto, 1979), and Tinguá 26,000ha (Camara, 1989).

LAND TENURE State ownership mainly and private ownership secondarily. The core area and the buffer zone are protected by national, state and local legislation, and administrative regulations (Guggenheim, 1991).

ALTITUDE 2-2,263m

PHYSICAL FEATURES Situated entirely within the Serra do Mar mountain range, encompassing the Serra dos Orgâos, the Serra do Tinguá, and the Tijuca Maaaif. It is a region of high altitudes, with very mountainous relief and remarkable elevations of diverse shape. Gneissic rocks of Proterozoic origin predominate. The gneiss occurs in association with small granite massifs in the mountain range of Serra dos Orgâos, forming a chain of geological monuments that give the appearance of organ pipes, including the famoua 'Dedo de Deus' (Finger of God) peak. In the Tijuca Massif, granite outcrops emerge as a result of erosion especially at the highest points where the gneiss layer is thinner. There are also dykes of more recent basalt and diabase and veins of pegmatite cutting the geological formations. A rare alkaline rock, 'tinguaito', was first described from the Tinguá region. Erosion is high as a result of the high rainfall, and deep valleys and hills with steep slopes are common. Predominant soils are naturally not very fertile, although some fertile soils, originating from basaltic rocks, can be found. The coastal plain, or 'baixada fluminense', extends from the Serra do Mar to the Atlantic ocean (Guggenheim, 1991).

A large number of streams are found within the reserve and all play a fundamental role in the region's urban water supply. This stream system is part of a series of small basins whose main streams drain into the Atlantic Ocean (Guggenheim, 1991).

CLIMATE Strongly influenced by the relief. In the highlands of Serra dos Orgâos National Park, the lowest areas have average temperatures above 18°C in the coldest months and rainfall higher than 2000mm. Average temperature decreases as the altitude increases (15.3°C-30.4°C at 4.7m; 11.6°C-24.5°C at 1,000m) and the rainfall increases (1746mm at 4.7m; 3295mm at 1,000m) reaching rates

of around 3600mm. The relative humidity is high and there is no dry season. Temperature in the winter can reach -5°C in some places (Guggenheim, 1991) .

VEGETATION Luxuriant and varied due to the wide range of altitudes. Tropical rain forest, rich in lianas, ferns and epiphytes (including orchids and bromeliads), is found on lower elevations. Species include *Sorocea ilicifolia, Cabralea eichleriana, Psycotria* sp., *Ocotea* sp., *Myriocarpa Vochysia* spp., *Cariniana legalis, Aniba viridis, Cabralea cangerana, Tabebuia* spp., brazil wood *Caesalpinia* spp. and *Roupala* sp. The upper slopes have montane grasslands such as *chusquea pinifolia* and *Cortaderia modesta* (Guggenheim, 1991), a notable species being the endemic *Prepusa hookeriana* (Gentianaceae) which occurs on the peak of Pedra do Sino. Brush and small trees occur in sheltered areas in the montane zone, the trees being covered with lichens and mosses. Comprehensive species lists exist for the flora of Tijuca National Park and for the Serra dos Orgâos region (Barcia, n.d.).

FAUNA The area is rich in mammal species, including brown howler monkey *Alouatta fusca* (V), black howler monkey *A. carava,* possibly woolly spider monkey *Brachyteles arachnoides* (E), black-capped capuchin *Cebus apella nigritus*, 'sagui' (common marmoset) *Callithrix jacchus,* collared peccary *Tayassu tajacu,* ocelot *Felis pardalis* (V), cougar *F. concolor,* giant otter *Pteronura brasiliensis* (V), maned sloth *Bradypus torquatus* (E) (Guggenheim, 1991; IUCN, 1977). IUCN (1977) also reported philander opossum *Caluromys philander,* opossum *Didelphis marsupialis,* masked *titi callicebus personatus* (E), (although the titi was not found during investigations under an IUCN/WWF project in 19??), paca *Cuniculus paca,* agouti *Dasyprocta agouti.* La Plata otter *Lutra longicaudis longicaudis (platensis?)* (V) was also reported (Guggenheim, 1991; Jorge Padua *et al.*, 1974). It is possible that woolly spider monkey still occurs, but buffy-tufted-ear marmoset *Callithrix aurita* (E) now appears to have disappeared from the reserve (IUCN/WWF Project 1614).

Birds include grey-throated warbler *Basileuterus culicinorus* (K), Oustalet's Tyrannulet *Phylloscartes oustaleti,* black-goggled tanager *Thrichotraupis melanops, Heliobletus contaminatus* (Guggenheim, 1991), green-winged saltator *Saltator similos,* solitary tinamou *Tinamus solitarius* (R), ornate and black hawk-eagles *Spizaetus ornatus* and *S. tyrannus*, and black-fronted piping guan *Aburria jacutinga* (Jorge Padua *et al.,* 1974); yellow-legged tinamou *Crypturellus noctivagus* (K), mantled hawk *Leucopternis polionota* (I), white-necked hawk *L. lacernulata* (K) and spot-winged wood-quail *Odontophorus capueira* (IUCN, 1977).

Reptiles and amphibians include pit viper *Bothrops sp.,* black and yellow rat-snake *Spilotes pullatus,* colubrid snake *Dryadophis bifossatus,* iguanid lizard *Urostrophus vautieri* and horned frog *Ceratophrys dorsata, Bufo marinus, Hyla clarisignata, Elosia aspera, Throropa miliares, T. petropolitana. Trinchomycterus goeldi* is a fish reported from the Tingua and Serra dos Orgâos area (Guggenheim, 1991). Some of the numerous invertebrates found in the reserve are members of the following families: Diptera *Hemilucilia segmentaria,* Mucidae *Neodexiopsis paulistensis,* Mycetophilidae *Leia paulensis*, Phoridae *Pheidolomyia alpina,* Simulidae *Simulium hirticosta,* Hemiptera *Adaxenetus petiopatus* and *Henicoenemis patellata,* Lepidoptera Adelocephalidae *Adelocephala cadunus* and *A. purpuraceus,* saturnidae *Dirphiopsis wanderbilt* and *Eacles luroi,* Orthoptera Phaneropteridae *Dysania* spp. (Guggenheim, 1991).

Detailed species lists exist for the fauna of Tijuca National Park (Anon., n.d.) and the Tinguá and Serra dos Orgâos areas (Guggenheim, 1991).

CULTURAL HERITAGE No information

LOCAL HUMAN POPULATION Approximately 5,000 people live in the buffer zone in largely agricultural and urban or suburban communities.

VISITORS AND VISITOR FACILITIES Approximately 2.5 million people visit the reserve each year (Guggenheim, 1991). Facilities include footpaths, nature trails, mountain huts and a restaurant. There is good mountaineering in the area.

SCIENTIFIC RESEARCH AND FACILITIES An integrated programme of basic and applied research supports site management objectives and sustainable conservation in the region. Past studies include biological surveys and collections, productivity, comparative research, cultural anthropology, ecological successions, ecosystem restoration, exotic species, effects of fire, forestry and silviculture, geomorphology, hydrology, threatened species, impacts of tourism and recreation, resource mapping, soil studies and watershed research. Current research focuses on comparative ecology and succession, ecosystem restoration, water pollution and the effects of fire and tourism and recreational activities. Proposed research activities will include acidic deposition, effects of atmospheric pollutants, social sciences and wildlife population dynamics. Rio de Janeiro Botanic Gardens is devoted to botanic research in the reserve area and in other parts of Brazil (Guggenheim, 1991).

General resource information is available on the following past topics: aerial photography, bibliography, history of research, maps on risk assessment data. Data on topography and vegetation/land cover, hydrology, water quality, climate and precipitation, biological inventories (plants and animals), geology and soils, socioeconomic and cultural ethnobiological information and history and architectonic heritage. Ongoing activities are risk assessment and climate, while planned activities include ecological data, management systems, geographic information systems, satellite imagery and vegetation and land cover maps. Research facilities include faunal and botanical museums, arboretum, herbarium, carpotheque, xylotheque, laminarium, a climatological and hydrological/watershed monitoring station, conference, laboratory, library, microcomputers, and storage and curatorial facilities. Accommodation for up to 20 visiting scientists is also available.

Current education and training programmes include environmental education for school children and students, extension services for local people and graduate and postgraduate research projects. Future activities will involve interpretive programmes for tourists and training for staff in protected areas (Guggenheim, 1991). Access to research facilities requires authorisation from the srazilian Institute for the Environment and Renewable Resources (IsAMA) (Guggenheim, 1991).

CONSERVATION VALUE A remnant of the remarkable Atlantic tropical rain forest, which has been reduced to no more than 5% of its original area, and which is considered one of the world's most endangered tropical forests, lies within the reserve. The forest survives only on the more inaccessible scarps of Rio de Janeiro, Sao Paulo, Parana and Santa Catarina (Magnanini, 1984). The sources of many of the streams which supply the urban population of the area are situated within the mountainous section of the reserve. These streams have played a fundamental role in the urban water supply for more than two million people in the region since colonial times. In addition, a number of threatened plants and animals occur in the reserve. Some of these plants are *Dalbergia niqra, Aniba firmula, A. viridis, Cryptocarya saligna, Renealmia chrysotricha, Caesalpina echinata, Cattlea* spp. and *Onchidium* spp. Threatened animals include vinaceous parrot *Amazona vinacea* (R), *Oryzoborus maximiliani*, black-fronted piping guan, white-necked hawk, blue-throated parakeet *Pyrrhura cruentata* (R), *P. leucotis*, maned sloth, woolly spider monkey, brown howler monkey, buffy-tufted-ear marmoset, giant otter, *Ozotocerus bezoarticus* and ocelot (Guggenheim, 1991). Ornamental species are *Begonia arborescens, Fuchsia regia,* orchids mainly *Cattlea spp.* Medicinal species include *Pirostegia venusta, Baccharis genistelloides, Strycnos brasiliensis* and *Adiantum* spp. (Guggenheim, 1991).

CONSERVATION MANAGEMENT The objectives of the biosphere reserve are to conserve the natural environment, genetic resources *in situ,* conduct long-term environmental monitoring, promote education, generate and disseminate knowledge about conservation and management of the site, conduct research on ecosystem management, provide the basis for resource protection, promote

regional planning and integrated rural development and local participation in land use and management (Guggenheim, 1991). There is a high degree of cooperation with research institutions, regional planning and development authorities and local communities. There is also a coordinating body for scientific activities at the site. A National Programme for the Environment, a three-year programme supported by the government and the World Bank focusing on conservation bodies, environmental education and the protection of selected ecosystems, exists for the reserve (Guggenheim, 1991).

Main activities and uses in the core area and in the buffer zone include biological collections for scientific purposes, biological inventories, long-term environmental monitoring, environmental education, professional training and public recreation and tourism (Guggenheim, 1991). Other activities in the buffer zone are tourism development, water resource development projects, forestry and restoration or rehabilitation of wetlands. In the transition area activities include agriculture (mainly horticultural products: oranges, coffee, ornamental flowers), biological inventories, environmental education, collection of material for scientific purposes, environmental education, tourist development, long-term monitoring, professional training and restoration or rehabilitation of terrestrial natural habitats (Guggenheim, 1991).

The establishment of the reserve is expected to benefit local people by increasing opportunities in education and training, recreation and tourism and for soil and water conservation. Other opportunities include employment, financial benefits and participation in the planning and management of the reserve (Guggenheim, 1991).

A management plan for Tijuca National Park exists, its main objectives being: a) to protect a sample of the recovering Atlantic Rainforest within a metropolitan region; b) to protect species of fauna, particularly of rare, threatened and endangered birds and marnmals; c) to protect the sources of the rivers that supply the region; d) to provide scientific basis for the management of the area; e) to promote the recovery of areas disturbed by human activity; f) to conserve areas of natural scenic beauty, representatives of landscapes of Serra do Mar; g) to protect the historic heritage of the area; h) to strengthen interpretative, educational and recreational programmes, with a view to the better appreciation and understanding of the environment by the general public; and i) to facilitate and encourage scientific research and general studies compatible with park objectives (IBDF, 1981).

MANAGEMENT CONSTRAINTS In the core area and the buffer zone these include forest fires caused by festive balloons, religious practices, uncontrolled visiting and poaching. Extraction of trees for wood and firewood, and encroachment of settlements have also been reported to occur in the buffer zone (Guggenheim, 1991). A great deal of activities appear to be occurring in the transition zone, including the destruction of terrestrial natural habitats, most likely as a result of human settlements and the development of urban centres, poaching, transportation facilities (road building?), dredging and filling, industrial, recreation, tourism, mining and residential developments and grazing by extensive cattle herds. Gathering of ornamental plants is also a problem (Guggenheim, 1991).

STAFF The reserve has a total of 266 staff; 181 are involved in administrative control and resource management (31 university trained). Nine staff are involved with education, demonstrations and training, while research staff number 76, three qualified to doctorate level (or equivalent) and 43 with university degrees. Thirty are technical support personnel for research (Guggenheim, 1991).

BUDGET The budget amounted to Cruzeiros 2 million in 1981. Present budget comes from international sources, mainly the World Bank (National Program for the Environment). The current annual operating budget for the reserve is Cruzeiros 400 million (US$ 2 million) (Guggenheim, 1991).

LOCAL ADDRESSES

IBAMA/Superintendencia Estadual do Rio de Janeiro, Av. Presidente Antonio Carlos 607, 120 Andar, CEP 23328, Rio de Janeiro-RJ (Tel: 21 2G2 3113/224 3242)

REFERENCES

Anon. (n.d.). Tijuca National Park. List of Fauna. 9 pp.

Barcia, J.C.C. (n.d.). Flora of the 'Serra dos Orgâos' region. *Flora Brasiliensis*. 21 pp.

Diegues, A.C.S. (1990). *Inventario de areas úmidas do Brasil*. Programa de Pesquisa e conservação de Areas Umidas no Brasil. Sao Paolo University/IUCN/Ford Foundation. Versâo preliminar (preliminary version). 450 pp.

Guggenheim, T.M. (1991). Tijuca-Tinguá-Orgâos Biosphere Reserve Nomination Form. Brazilian MAB Committee.

IBDF (1980). *Plano de Manejo do Parque Nacional da Serra dos Orgaos*. (Unseen)

IBDF (1981). *Plano de Manejo do Parque Nacional da Tijuca*. 113 pp.

Jorge Padua, M.T. and Rocha Porto, E.L. (1979). *Plano do Sistema de Unidades de Conservação do Brasil*. M.A. - Instituto de Desenvolvimiento Florestal/Fundaçãco Brasileira para Conservação da Naturaleza. 105 pp.

Magnanini, A. (1984). The Atlantic Forest. Brazilian Committee of the Mab and Biosphere Program. Rio de Janeiro Biosphere Reserve. 3 pp.

DATE May 1981, revised September 1991

NAME Shennongjia State-level Natural Reserve

IUCN MANAGEMENT CATEGORY IV (Managed Nature Reserve)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.15.05 (Oriental Deciduous Forest)

GEOGRAPHICAL LOCATION The reserve is located on the north bank of the upper reaches of the Yangtze River in the west of Hubei Province, 2km from Muya town. To the north-east is the Shennongjia Forest Region, while to the south the reserve borders Xingshan County. In the south-west the reserve is contiguous with Badong County. The west side borders Wuxi County, Sichuan Province and Zhusan and Fang counties, Hubei Province. The reserve is accessible by road from Songbai town and Xujiazhuang. 31°21'-31°37'N, 110°03'-110°34'E

DATE AND HISTORY OF ESTABLISHMENT Established as a nature reserve in 1978 by the Provincial Revolutionary Committee (Anon., 1990). Other legislation applicable to the reserve are the "Rules of the Protection for Shennongjia Natural Resources", the "Certificate for the Right of the State Mountain Forest" State Document No. 75 (1986), and Hubei Province Document No. 22 (1982). Approved by the Ministry of Forestry as a state-level nature reserve and nominated a biosphere reserve in 1990 (Anon., 1990).

AREA 147,467ha

LAND TENURE State

ALTITUDE 480-3,105m

PHYSICAL FEATURES The tectonic movement of the Himalayas formed the Dabashan Mountain range which is oriented from west to east. The reserve consists of the Dabashan mountain range, of which Shennog Peak (3,105m) is the highest point. The landscape ranges from the gentle rise and fall of a subalpine zone rising to low mountains. In the east, the slopes gently climbs towards the west, where they form deep valleys. Sedimentary rock is the predominant stratum, with some metamorphic rock occurring in places. Slope angles range between 30° and 50°, with an average altitude of 1,700m.

The relative altitudes range between 2,705m and 2,905m. In the Qinba mountain area soils are characteristic of those found under subalpine coniferous forests in the west of the mountain range. Some of the soils found in the reserve display typical subtropical soil properties. Within the confines of the reserve there are five main rivers. The northern region comprises the river basins which empty directly into the Yangtze River further south (Anon., 1990).

CLIMATE A north, subtropical, monsoon climate predominates over the area, influenced by the subtropical atmospheric circulation. Climate can be classified into three vertical zones: subtropical zone (altitude below 1,500m), warm temperate zone (1,500m-2,600m) and a temperate zone (above 2,600m). The maximum average temperature is 28°C, while in the coldest month the minimum average temperature is -14°C. Mean annual precipitation of 2195mm was recorded at an altitude of 1,700m, being seasonally distributed in five wet months: March, April, August, September and October (Anon., 1990).

VEGETATION Three vegetation zones related to altitude occur in the reserve: evergreen deciduous broad-leaved mixed forest of which species include *Quercus glanca* and *Betula luninifera*; temperate coniferous forest and deciduous broad-leaved forest comprising *Fagus engleriana* and pine *Pinus armandii*; and cold temperate evergreen coniferous forest which includes *Abies fargesii* (Ji *et al.*, 1990). The reserve contains a number of threatened flora, including dove trees *Davidia involurata baillon* and *D. involurata baillon var. vilmoriniana*, pines *Picea neoveitchii* and *P. braehytyla*, fir *Abies chinensis*, hazel *Corylus chinensis*, ash *Sorbus amabilis*, magnolia *Magnolia officinalis* and Chinese tulip tree *Liriodendron chinense*. Other threatened plants include *Bretschneidera sinensis*, *Cephalotarus oliveri*, *Ceriodiphyllum japonicum*, *Emmenopterys henryi*, *Eucommia ulmoides*, *Manglietia patungensis*, *Sinowilsonia henryi*, *Tetracentron sinense*, *Amentotaxus argotaenia*, *Dipteronia sinensis*, *Eupelea pleiospermum*, *Kolowitzia amabilis*, *Phoebe zhennan*, *Pterostyrax psilophyllus*, *Pleroceltis tatrinowii*, *Sterwartaia sinensis*, *Tapiscia sinensis*, *Coptis chinensis*, *Dysosma versipellis*, *Gastrodia elata*, *Paeonia papaveracea* and *Trillium tschonoskii* (Anon., 1990).

FAUNA The reserve contains 69 species of mammal, of which several are globally threatened, and include tiger *Panthera tigris* (E), leopard *Panthera pardus* (T), Asiatic golden cat *Felis temmincki* (I), wild dog *Cuon alpinus* (V), Sichuan golden snub-nosed monkey *Rhinopithecus roxellanae* (V) and European otter *Lutra lutra* (V). Other important mammal species under national protection comprise Asiatic black bear *Selenarctos thibetanus*, rhesus macaque *Macaca mulatta*, large Indian civet *Viverra zibetha*, forest musk deer *Moschus berezovskii*, goral *Nemorhaedus goral* and serow *Capricornis sumatraensis*.

Within the reserve, 192 species of bird have been identified and include threatened species such as cinereous vulture *Aegypius monachus* (V), oriental white stork *Ciconia ciconia bocyciana* (R) and Reeves' pheasant *Syrmaticus reevesii* (R). Other threatened birds at the regional level include Eurasian spoonbill *Platalea leucorodia*, black kite *Milvus migrans*, northern goshawk *Accipiter gentilis*, Chinese sparrowhawk *A. soloensis*, northern sparrowhawk *A. nisus*, besra *A. virgatus*, common buzzard *Buteo buteo*, upland buzzard *B. hemilasius*, European hobby *Falco subbuteo*, common kestrel, *F. tinnunculus*, Temminck's tragopan *Tragopan temminckii*, koklass pheasant *Pucrasia macrolopha*, golden pheasant *Chrysolophus pictus*, wedge-tailed green pigeon *Treron sphenura*, brown fish owl *Ketupa zeylonensis*, tawny fish owl *K. flavipes*, northern eagle owl *Bubo bubo*, brown hawk owl *Ninox scutulata*, collared scops owl *Otus bakamoena*, collared owlet *Glaucidium brodiei*, Asian burred owlet *G. cuculoides*, common tawny owl *Strix aluco* and golden eagle *Aquila chrysaetos*. Thirty species of amphibians and reptiles occur in the reserve including Chinese giant salamander *Andrias davidianus* (I), and 35 species of fish. A complete inventory of the fauna is given in the biosphere nomination form and appended species list (Anon., 1990).

CULTURAL HERITAGE No information

LOCAL HUMAN POPULATION The reserve has a total population of 7,780 involved mainly in agricultural activities, such as the cultivation of potato, maize, soya bean, citrus, walnut, chestnut and *Actinidia chinensis*, and animal husbandry (Anon., 1990).

VISITORS AND VISITOR FACILITIES The total number of visitors to the reserve each year is 10,000 people (Anon., 1990). An ongoing interpretive programme for tourists currently exists, with further programmes being planned (Anon., 1990).

SCIENTIFIC RESEARCH AND FACILITIES Agricultural research and biological surveys have been undertaken, and flora and fauna specimens collected (Anon., 1990). Studies have been made of ecosystem restoration, the effects of pesticides, forestry and silviculture, geomorphology (soils and hydrology), resource mapping, ecology and social science. Further research activities are planned and include surveys of flora and fauna, biogeochemical cycles, ecological studies, effects of

pesticides, effects of fire, forestry and genetic resources, studies in pests and diseases, resource mapping, soils, wildlife population dynamics and social studies. Other research activities include the ecology of Sichuan golden snub-nosed monkey, investigations into amphibians and reptiles, and research on the utilisation of Shennog wild chrysanthemum. Research facilities include air pollution and climatological monitoring stations, conference rooms, a hydrological monitoring station, laboratories, library, accommodation for scientists, and storage areas (Anon., 1990).

CONSERVATION VALUE The reserve comprises varied forest ecosystems with 32 species of flora and 39 species of fauna under national protection, and threatened animals such as Sichuan golden snub-nosed monkey (Wenhua and Xianying, 1989).

CONSERVATION MANAGEMENT The reserve is administered by the Shennongjia Forest Region which is under the Ministry of Forestry. A management bureau is located at the town of Muyu, with a number of smaller management "institutes" in various locations within the reserve.

A management plan exists for the reserve and is within the People's Republic of Shennongjia Forest Region. Current management activities include the preparation of biological inventories, the collection of plants and animals for scientific purposes, conservation management, environmental education, forestry activities and silviculture, the gathering of natural products, environmental monitoring, tourist development, the development of transport facilities, the restoration of terrestrial habitats, and water resource development projects such as hydroelectric power generation. The biosphere reserve has a core area used purely for scientific research, while buffer zones and transition areas have multiple uses, such as scientific research, agriculture and other human activities. The administration intends to extend services for the local people and provide professional training and workshops for scientists, resource managers and planners, and training for reserve staff in protected area management (Anon., 1990). The reserve also has a logistical role in that it aims to allow cooperation between regional planning and the development authorities, cooperation with local communities and representatives of populations living in and around the biosphere reserve, and cooperation with institutions involved in basic or applied research or monitoring with other biosphere reserves. A coordinating body for integrating scientific activities at the site is under development. Proposed management activities include: cooperative agreements or other coordinating mechanisms to encourage scientific use; participation in regional, national or international monitoring network; establishment of a biosphere reserve research station and preparation of a biosphere reserve plan; and the devising of a mechanism to improve coordination with the local people (Anon., 1990).

MANAGEMENT CONSTRAINTS Damage of natural habitats has taken place within the buffer zone and transition areas. Hunting and poaching occur within the reserve. In the transition area, uncontrolled industrial, residential and transportation development is taking place. The production activities of farmers outside the reserve, such as the gathering of medicinal herbs, is reported to have a detrimental effect on the reserve (Anon., 1990).

STAFF The biosphere reserve has a total staff of 142 of which 101 are involved in administration and reserve management and 29 involved in education, demonstration and training (Anon., 1990).

BUDGET The annual operating budget for the biosphere reserve in 1990 was US$ 134,048 (500,000 yuan).

LOCAL ADDRESSES

Shennongjia Forest Region, Muyu Town 442421, Hubei Province

REFERENCES

Anon. (1990). Shennongjia State-level Natural Reserve biosphere reserve nomination form. Man and Biosphere Programme, National Committee for China. 24 pp.

Ji, Z., Guangmei, Z., Huadong, W. and Jialin, X. (1990). *The natural history of China*. Collins, London. P. 58.
Wenhua, L. and Xianying, Z. (1989). *China's nature reserves*. Foreign Languages Press, Beijing. P. 171.

DATE July 1991

between July and September. Snowfall is greatest in spring and reaches a peak of 2000mm at an altitude of 1,560m in April (Kral and Rall, 1990).

VEGETATION About 80% of the area is forested and there is a distinct altitudinal zonation (Duffy, 1982). Vegetation types include submontane, montane and subalpine forests, alpine limestone grassland and distinct plant communities occur in cracks and on rocky debris (Anon., 1990a). The forests include species such as mountain pine *Pinus mugo*, *P. cembra*, larch *Larix decidua*, sycamore *Acer pseudoplatanus* and Norway spruce *Picea abies*. Areas of bilberry *Vaccinium myrtillus* and sedges *Carex* spp. also occur (Wörnle, 1985). A number of plants which occur here are on the Red List for Bavaria, including slender gentian *Gentianella tenella*, a coltsfoot *Homogyne discolor*, *Myricaria germanica*, *Primula clusiana*, umbellate wintergreen *Chimaphila umbellata*, *Doronicum columnae*, *Leontopodium alpinum* and *Lomatogonium carinthiacum* (Anon., 1990a).

FAUNA This is an important area for birds including breeding species such as honey buzzard *Pernis apivorus*, golden eagle *Aquila chrysaetos*, peregrine falcon *Falco peregrinus*, ptarmigan *Lagopus mutus*, black grouse *Tetrao tetrix*, capercaille *T. urogallus*, eagle owl *Bubo bubo*, pygmy owl *Glaucidium passerinum*, Tengmalm's owl *Aegolius funereus*, kingfisher *Alcedo atthis*, grey-headed woodpecker *Picus canus*, black woodpecker *Dryocopus martius*, white-backed woodpecker *Dendrocopus leucotus*, three-toed woodpecker *Picoides tridactylus*, ring ouzel *Turdus torquatus*, Bonelli's warbler *Phylloscopus bonelli*, red-breasted flycatcher *Ficedula parva* and citril finch *Serinus citrinella* (Grimmett and Jones, 1989). The fauna also includes red deer *Cervus elaphus*, chamois *Rupicapra rupicapra*, marmot *Marmota marmota* and white hare *Lepus* sp. with ibex *Capra ibex* having been introduced in 1936. The subspecies *bartholomaeus* of Apollo butterfly *Parnassius apollo* and clouded apollo *P. mnemosyne* also occur here (Wirth, 1979).

CULTURAL HERITAGE The area's isolation led to the development of an autonomous political unit in the area in the 12th century which lasted until 1803. This local identity and resistance to outside influences is still recognisable. Salt mining in the area has a long tradition and the forests have been extensively used for several centuries in connection with this. However, even in the early 19th century the need for sustainable use was recognised and during a period of high demand some forest areas were closed to exploitation (Zierl, 1983).

LOCAL HUMAN POPULATION The surrounding population is partly agricultural and involved in some hunting and collecting of natural products with other people being urban or suburban dwellers. Within the transition areas are about 25,000 people who are the traditional inhabitants of these mountainous areas and now mainly earn their living from tourism (Anon., 1990a). A Friends of Berchtesgaden National Park Association was set up in April 1990 to promote the national park concept and raise funds, using the Friends of the Bavarian Forest National Park organisation as an example (Anon., 1990c).

VISITORS AND VISITOR FACILITIES The only recreational facilities within the core area are for walking, mountaineering and skiing tours (Zierl, 1980). The area has been popular as a summer resort since the 19th century (Duffy, 1982). Tourism is the main source of income in the area. There is an interpretive programme and extension services for local people (Anon., 1990a).

SCIENTIFIC RESEARCH AND FACILITIES This is an important site for long-term studies of changes in climate and forests which is a sensitive issue in this part of Europe. Ten scientists are currently engaged in research, half of whom are German, the rest foreign. MAB Project 6 aims to assess the impact of man on high mountain ecosystems. Most research is involved with management, land use and sustainable conservation practices and many aspects of the area are well documented. Climatic and hydrological monitoring stations have been set up together with permanent monitoring plots of various kinds. The reserve has meeting facilities, accommodation for visiting scientists, library and laboratory facilities. Both graduate and postgraduate studies are carried out here and there

NAME Berchtesgaden Alps National Park

IUCN MANAGEMENT CATEGORY V (Protected Landscape or Seascape)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.32.12 (Central European Highlands)

GEOGRAPHICAL LOCATION In Bavaria, 150km south-east of Munich on the border with Austria; the Austrian Nature Protection Area Salzburger Kalkalpen is contiguous. The town of Berchtesgaden (population 7,000) is 5km from the core area and within the transition zone (Anon., 1990a). Approximately 47°36'N, 13°00'E

DATE AND HISTORY OF ESTABLISHMENT The national park was established on 1 August 1978 by the order of 18 July 1978 but protection has a longer history; the area became a royal hunting reserve for the Bavarian kings in the early 19th century (Duffy, 1982). An alpine nature reserve was established in 1910, covering about 8,300ha and called the Botanic Conservation Area of the Berchtesgaden Alps. In 1910 a plantation zone was set up and in 1921 the botanic conservation area was extended to 21,000ha and renamed Nature Reserve Königssee; this area corresponds almost to the present day national park of 20,800ha (Zierl, 1983). The Vorfeld, immediately to the north of the national park, corresponds to the transition area and includes three landscape protection areas of over 1,000ha in size. It was accepted as a biosphere reserve on 2 October 1990 (Haarmann and Pretscher, 1988; Anon., 1990a).

AREA The national park covers 20,800ha; the biosphere reserve has a total area of 46,800ha and a core area of 17,500ha, a buffer zone covering 3,400ha and a transition area of 25,900ha. There is also traditional land use in an area of 430ha (Anon., 1990a).

LAND TENURE Most of the area is owned by the state or provincial government (Anon., 1990a).

ALTITUDE 471m-2,713m

PHYSICAL FEATURES The area is mountainous and has been heavily glaciated, producing sharp ridges of bare rock and some deep, picturesque U-shaped valleys. Three main valleys, oriented north-south separate four upland massifs: Jenner-Hoher Göll (2,523m), Watzmann (2,713m), Hochkalter (2,607m) and Reiteralm (Wirth, 1979). The area contains the headwaters of several rivers draining into the Danube, many of the streams being oligotrophic. It includes the Königssee, a lake about 8km long and 188m deep, and the Obersee, a smaller lake nearby in the same glacial trough (Anon., 1990a). Many of the valleys contain morainic deposits. There are also a number of very small lakes, many formed in depressions in the limestone, partly through faulting; one of these is Funtensee which has been well studied (Wörnle, 1985). The rocks are predominantly dolomitic limestone of middle Triassic age and there is a range of karst features including limestone pavements, dolines and deep underground caves (Wunder and Hertzog, 1985). Mainly rendzina soils occur (Dittrich and Hermsdorf, 1990; Kral and Rall, 1990).

CLIMATE This is transitional between Atlantic and the Continental climate of the Central Alps. The maximum average temperature of the warmest month is 22.1°C and the minimum temperature of the coldest month is -11.6°C. At an elevation of 542m there is an annual total of 1514mm of precipitation (Anon., 1990a). On higher peaks an annual precipitation of 2700mm is more usual. Precipitation is at a maximum in June and July and above 1,600m altitude snow is not infrequent

STAFF There are nine staff, equally divided between administration and management, education and research. In addition, nine persons are temporarily employed and another 22 work as part of their civilian service (Anon., 1991).

BUDGET DM 1 million for Unterspreewald and DM 1.5 million for Oberspreewald in 1991 (Anon., 1991)

LOCAL ADDRESSES

Oberspreewald Nature Conservation Station, Hauptstrasse 136, 7502 Burg-Dorf (responsible for administering the biosphere reserve)

Unterspreewald Nature Conservation Station, 7551 Schlepzig am Nordrand

REFERENCES

Anon. (1987). Spreewald. Wanderkarte 1:50 000. VEB Tourist Verlag, Berlin/Leipzig.

Anon. (1990). National Parks for Germany. *Nature and National Parks* 28(107): 10-11.

Anon. (1991). *Biosphere Reserve Spreewald*. GDR National Committee of the MAB, Berlin.

Gorner, M., Haupt, R., Hieckel, W., Niemann, E. and Westhus, W. (1984). *Handbuch der Naturschutzgebiete der Deutschen Demokratischen Republic Band 4.* Institut für Landschaftsforschung und Naturschutz Halle der Akademie der Landwirtschaftswissenschaften der Deutschen Demokratischen Republik, Bonn.

Haeger, E. (1982). *Handbuch der Naturschutzgebiete der Deutschen Demokratischen Republik 2. Die Naturschutzgebiete der Bezirke Potsdam, Frankfurt (Oder) und Cottbus sowie der Hauptstadt der DDR, Berlin*. Uberarb. Aufl. - Leipzig; Jena; Berlin: Urania-Verlag.

Krausch, H.D. (1961). Pflanzen und Tiere des Spreewaldes. In: *Natur und Heimat* 10: 188-191.

Succow, M. (1990). Verordnung über die Festsetzung von Naturschutzgebieten und einem Landschaftsschutzgebiet von zentraler Bedeutung mit der Gesamtbezeichnung "Biosphärenreservat Spreewald". *Gesetzblatt der Deutschen Demokratischen Republik.* Sonderdruck, Berlin 10 = 1473.

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FAUNA The forested low moor supports birds such as black stork *Ciconia nigra* and white-tailed sea eagle *Haliaeetus albicilla*. The wet grassland fauna includes white stork *Ciconia ciconia*, crane *Grus grus*, fire-bellied toad *Bombina bombina* and moor frog *Rana arvalis* and otters *Lutra lutra* use the watercourses. Drier forest and grassland is noted for hoopoe *Upupa epops*, sand lizard *Lacerta agilis* and slow worm *Anguis fragilis* (Krausch, 1961; Anon., 1991).

CULTURAL HERITAGE Traditional farming methods are continued to some extent. The area includes several towns inhabited by a local ethnic group, the Sorbs, and there are a number of buildings and sites of historical interest (Anon., 1987).

LOCAL HUMAN POPULATION The local population is mainly agricultural and also carries out some traditional fishing. The core area is unpopulated but about 50 people live in the buffer zones, 32,000 in the zone of harmonious and uncultivated land and 38,000 in the regeneration zone (Anon., 1991).

VISITORS AND VISITOR FACILITIES It is planned to extend the existing interpretive programme for tourists. In the buffer zone there are cycle and foot paths, and fishing and sports are permitted at certain sites (Anon., 1991).

SCIENTIFIC RESEARCH AND FACILITIES Past research has been concerned largely with land use and management. There is at present no organised research programme but scientific projects are carried out from time to time, primarily on a voluntary basis. A biotope mapping programme began in 1990 and an investigation of the otter population in 1991. Research will also include the ecology of small bodies of running water and the succession of natural forests. The core areas are used primarily for long-term environmental monitoring and biological inventories. Facilities for monitoring air pollution, climate and hydrological factors and some permanent vegetation monitoring plots exist and a library and laboratory facilities are planned for 1991. Conference facilities and accommodation for 50 persons are available. Educational facilities are concerned with the local community and include postgraduate studies (Anon., 1991).

CONSERVATION VALUE This site includes a variety of relatively undisturbed forest habitats characteristic of this type of moraine landscape. There are also species-rich meadows which are unintensively used and have conservation value, inland water bodies, swamp forests and traditionally cultivated fields. It is a wetland of national importance. The reserve supports a number of species identified as endangered or threatened at the national level, including animals such as otter, black stork, white-tailed sea eagle, *Plecotus austriacus* and *Myotis nattereri* and plants such as marsh gentian *Gentiana pneumonanthe*, Siberian iris, *Polygonum bistorta*, gratiola *Gratiola officinalis* and *Inula brittanica* (Anon., 1991).

CONSERVATION MANAGEMENT The waterways are managed with dams and weirs for drainage and irrigation purposes. The low-lying wet grasslands are managed non-intensively as hay meadows and pastures using cattle, sheep and goats for grazing. In the almost natural low moor forest and dry dune communities densities of game species are regulated; in the core areas the hunting of red deer *Cervus elaphus*, wild boar *Sus scrofa* and roe deer *Capreolus capreolus* is permitted. All areas are maintained according to the relevant nature reserve guidelines and habitat restoration is being effected in buffer and transition zones. Transition areas are used for forestry and agriculture and dredging or filling can take place; hunting, tourism and water development projects also occur (Anon., 1991).

MANAGEMENT CONSTRAINTS Until now there have been too many visitors for the core areas to support. Military aircraft also cause some disturbance (Anon., 1991).

NAME Spreewald Biosphere Reserve

IUCN MANAGEMENT CATEGORY IV (Managed Nature Reserve) (parts)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.11.05 (Middle European Forest)

GEOGRAPHICAL LOCATION Spreewald lies about 100km south-east of Berlin in the Spree valley, both upstream and downstream of the town of Lübben, in the federal land of Brandenburg in the rural districts of Cottbus, Calau and Lübben. The nearest large town is Cottbus (population 13,000), 12km away. Approximately 51°57'N, 13°54'E

DATE AND HISTORY OF ESTABLISHMENT The ordinance on the establishment of the biosphere reserve is dated 12 September 1990 (Anon., 1991). The site includes several existing nature reserves: Luchsee (81ha, established 1941); Gross Wasserburg (28ha, established 1961); Buchenhain (281ha, established 1961); Kriegsbusch (230ha, established 1938); Börnichen (19ha, established 1961); Biebersdorfer Wiesen (5ha, established 1961); Ellerborn (19ha, established 1961); and Schützenhaus (168ha, established 1961) (Haeger, 1982; Succow, 1990; Gorner *et al.*, 1984).

AREA Total area 47,600ha; core area 920ha; buffer zones 9,800ha; transition areas 22,745ha; regeneration zone 14,135ha (Anon, 1991)

LAND TENURE Different areas are owned by the state government, local government, the church and private individuals (Anon, 1991).

ALTITUDE 44m-144m

PHYSICAL FEATURES This is an area of the typical "Schorfheide", or moorland landscape, which occurs on the glacial moraines of this region. Pleistocene deposits cover much of this relatively flat landscape and there are glacial features including an end moraine and a number of depositional features formed of outwash sands such as terraces, islands, inland dunes and alluvial fans. The valley was a meltwater channel in the Weichsel stage of the last ice age. The River Spree in this area is extremely braided, forming more than 300 separate small natural channels, due to its low gradient and meandering nature, and there are many man-made canals. The water table is high and there are also numerous lakes. Soils are a complex of humus fen soil, turfy moulder, humus gley, rusty gley and brown podsols and there is also forest peat with 30-70cm of turf cover (Anon., 1987, 1990, 1991).

CLIMATE Climate is of a moderate warm humid type with a continental influence. The maximum average temperature of the warmest month is 18.6°C and the minimum average temperature of the coldest month -0.8°C. Mean annual precipitation at an altitude of 140m is 560mm and it is fairly evenly distributed all year round (Anon., 1991).

VEGETATION A low moor type of vegetation occurs on lower and less well drained areas and is either forested or grassland. The former is dominated by alder *Alnus glutinosa*, *Salix viminalis* and *Carex* spp., while the grasslands include reed canary grass *Phalaris arundinacea*, purple moor grass *Molinia caerulea*, Siberian iris *Iris sibirica*, perennial rye-grass *Lolium perenne* and cabbage thistle *Cirsum oleraceum*. On drier soils there is inland pine forest and dry grassland with plants such as scots pine *Pinus sylvestris*, silver birch *Betula pendula*, alder buckthorn *Frangula alnus*, bilberry *Vaccinium myrtillus*, *Peucedanum oreoselinum*, thrift *Armeria maritima*, creeping fescue *Festuca rubra* and *Carex arenaria* (Krausch, 1961; Anon., 1991).

LOCAL ADDRESSES

Southeastern Rügen Biosphere Reserve, Bollwerkstrasse 2, 2356 Sellin

REFERENCES

Anon. (1990a). *Biosphere Reserve Rügen*. German National Committee of the MAB, Bonn.

Anon. (1990b). National Parks for Germany. *Nature and National Parks* 28(107): 10-11.

Bochnig, E. (1957). Die Pflanzengesellschaften des NSG Insel Vilm bei Rügen. *Neue Mecklenburger Monatshefte* 2: 98-103, 158-162.

Goethe, F. (1980). *Handbuch der Naturschutzgebiete der Deutschen Demokratischen Republik 1. Die Naturschutzgebiete der Bezirke Rostock, Schwerin und Neubrandenburg 2*. Uberarb. Aufl. Leipzig, Jena; Urania-Verlag, Berlin.

Goethe, F. (1989). *Der Greifswalder Bodden*. Stralsund, 1989. (Meer und Museum: Schriftenreihe des Meeresmuseums Stralsund; 5).

Grimmett, R.F.A. and Jones, T.A. (1989). *Important Bird Areas in Europe*. ICBP, Cambridge. 888 pp.

Jeschke, L., Klafs, G., Schmidt, H. and Starke, W. (1980). *Die Naturschutzgebiete der Bezirke Rostock, Schwerin und Neubrandenburg Band 1*. Urania-Verlag, Berlin.

Messner, U. (1986). Naturschutzobjekte auf der Halbinsel Mönchgut. *Natur und Umwelt: Beitr. aus d. Bez. Rostock* 9: 36, 50-51.

Messner, U. (1990). *Mönchgut. Eine Landschaftsstudie*. Göhren, Greifswald.

Wegner, O. (1990). Verordnung über die Festsetzung von Naturschutzgebieten und einem Landschaftsschutzgebiet von zentraler Bedeutung mit der Gesamtbezeichnung Biosphärenreservat Südost-Rügen vom 12, September. *Gesetzblatt der Deutschen Demokratischen Republik*. Sonderdruck. Berlin 1472. 7 S: 1 Kt.

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FAUNA Griefswalder Bodden, of which this site is a part, supports thousands of waterbirds and is particularly important for passage waterfowl, with 1,000 shag *Phalacrocorax carbo sinensis* in spring and autumn and 600 breeding, avocet *Recurvirostris avocetta* (12 pairs breeding); mute swan *Cygnus olor* (7,000 in autumn), Bewick's swan *C. columbianus* (600 in spring and autumn), bean goose *Anser fabalis* (8,000 in autumn), white-fronted goose *A. albifrons* (70,000 in autumn), greylag goose *A. anser* (10,000 in autumn), wigeon *Anas penelope* (20,000 in autumn), gadwall *A. strepera* (3,000 in autumn), teal *A. crecca* (10,000 in autumn), scaup *Aythya marila* (30,000 in spring), long-tailed duck *Clangula hyemalis* (50,000 in autumn), and lapwing *Vanellus vanellus* (10,000 in autumn) (Grimmett and Jones, 1989). The shallow inland waters support common mussel *Mytilus edulis*, common cockle *Cardium edule*, herring *Clupea harengus*, *Platichthys flesus* and eel *Anguilla anguilla*. The site also supports a number of threatened or endangered reptiles and amphibians including fire-bellied toad *Bombina bombina*, sand lizard *Lacerta agilis*, adder *Vipera berus* and grass snake *Natrix natrix* (Jeschke, 1980; Anon., 1990a).

CULTURAL HERITAGE Traditional land uses and fishing are maintained within the reserve (Anon., 1990a).

LOCAL HUMAN POPULATION Most people in the area earn their living from fishing, shellfishing, agriculture and tourism or recreation, with some living in urban or suburban areas. There are no permanent inhabitants in the core area and fewer than 20 in the buffer zones, but the transition area has a population of 13,000 (Anon., 1990a).

VISITORS AND VISITOR FACILITIES About 500,000 people visit each year. There is an interpretive programme for tourists (Anon., 1990a).

SCIENTIFIC RESEARCH AND FACILITIES Twenty German scientists are involved with research and resource information is available on a wide range of topics, including biological inventories, ecosystem management and sustainable uses of the area. Climatological and hydrological monitoring stations exist and there are permanent vegetation recording plots. Facilities for meetings and accommodation for 50 people are available, together with vehicles and boats for transportation which are used in particular by the Nature Conservation Academy on the largest island of Vilm. Student research projects are carried out here and there is a range of training programmes (Anon., 1990a).

CONSERVATION VALUE A major function of the biosphere reserve is to conserve natural and minimally disturbed ecosystems and to promote environmental awareness locally. It supports over 30 Red Book species of plants and 20 such threatened animals, including many bird species and a number of reptiles and amphibians. Many more species occur here which are threatened at the national level. The diversified farming in this area is also of interest (Anon., 1990a, 1990b).

CONSERVATION MANAGEMENT The core areas are mainly used for research, training and recreation although there is no tourist development, fishing or hunting. Buffer zones are similarly little exploited but some agricultural usage and controlled management, is undertaken. In transition areas there is fishing, hunting, forestry (mainly beech, oak and Scots pine), water resource development projects, human settlement, tourist developments and a greater predominance of agriculture, the main crops being cereals, potatoes and oil crops. Coastal protection schemes are maintained (Messner, 1986; Anon., 1990a).

MANAGEMENT CONSTRAINTS No information

STAFF A total of 13 including 12 involved in administration and management. One is university trained and one researcher is employed (Anon., 1990a).

BUDGET DM 368,000 in 1991 (Anon., 1990a)

NAME Rügen Biosphere Reserve

IUCN MANAGEMENT CATEGORY V (Managed Nature Reserve) (part)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.11.05 (Middle European Forest)

GEOGRAPHICAL LOCATION Wholly within the administrative area of Sellin, in the rural district of Rügen, Mecklenburg-Vorpommern Land. The reserve comprises the south-eastern region of the island of Rügen, including the peninsula of Mönchgut, the Granitz River, shallow inland waters and the island of Vilm. It lies 20km from Straslund (population 70,000), the nearest large town (Anon., 1990a). Approximately 54°20'N, 13°39'E

DATE AND HISTORY OF ESTABLISHMENT The site includes Insel Vilm Nature Reserve (94ha, established in 1936) and a number of other nature reserves: Mönchgut mit den Teilflächen; Neuensiener und Seliner See mit den Teilflächen; Neusienersee; Granitz; Quellsumpf Ziegensteine mit den Teilflächen; and Wreechener See. The biosphere reserve was establised on 29 October 1991 by Art. 6.6 Nr. 1 of 29 June 1990 (Goethe, 1980; Jeschke *et al.*, 1980; Anon., 1990a; Wegner, 1990).

AREA The biosphere reserve covers a total area of 22,800ha with core areas of 360ha; buffer zones of 3,800ha and a transition area of 18,640ha. It is included in a Ramsar site of 28,500ha (Anon., 1990a).

LAND TENURE National government is the principal land owner, with small areas owned by provincial and local government and private individuals or groups (Anon., 1990a).

ALTITUDE Land area up to 106m above sea level; inland waters to depths of 16m (Anon., 1990a)

PHYSICAL FEATURES This highly indented coastline includes areas of ground moraine and end moraine hills deposited after the last ice age and more recent Holocene depositional features including sand bars. Much of the substratum is formed of unconsolidated deposits, such as boulder clay, sandy moraines, meltwater sand deposits and dune sand. The inland waters, which are part of the Griefswalder Bodden, are shallow and interrupted by peninsulas, Holocene deposits formed into bars and hooked spits plus a number of islands. Other surface deposits comprise unconsolidated lower Pleistocene deposits. Soils include humus fen types and saltmeadow peats. The inland waters are shallow (Goethe, 1989; Anon., 1990a; Messner, 1990).

CLIMATE Moist and moderate in type with a slight maritime influence. The maximum average temperature of the warmest month (July) is 17.5°C and the minimum average temperature of the coldest month (January) is -0.2°C. At an altitude of 60m above sea level there is a mean annual precipitation of 540mm which is fairly evenly distributed throughout the year (Anon., 1990a).

VEGETATION Moraine areas are dominated by red beech *Fagus sylvatica*, oak *Quercus robur* and scrub; parts are cultivated or pastures and there are low productivity grassland areas. Along the coast are found beach sand communities, including *Hockenya peploides* and *Lactuta tatarica* with Scots pine *Pinus sylvestris* further inland. Salt meadows and salt reed banks support *Juncus gerardii* and *Bolboschoenus maritimus*. In the shallow inland waters fennel pondweed *Potomageton pectinatus*, eel grass *Zostera marina* and *Fucus vesiculosus* are found (Bochnig, 1957; Jeschke, 1980; Anon., 1990a).

and spruce *Picea abies*) and agriculture (predominantly grassland and cereal crops) are permitted in both buffer and transition zones (Anon., 1991).

MANAGEMENT CONSTRAINTS The biosphere reserve is divided between three Länder which are autonomous in areas such as nature protection and land use planning and the joint biosphere administration had to be set up by a special treaty, passed by all three Länder parliaments. The three Länder have also had different historical, political, economical and ecological development (W. Goerke *in litt.*, 1991). Within the core areas, various activities have an adverse influence; these include cross-country skiing, intensification of land use by fertilisation and drainage, abandonment of grassland and gliding and there is afforestation with non-native pines (Anon., 1988, 1991).

STAFF A total of 13 including eight involved with administration and management, six of whom are university trained. Six staff are concerned with education and training (Anon., 1991).

BUDGET Thuringia: DM 190,000 for the second half of 1990; amount not finalised for Hessen and Bavaria (Anon., 1991). In 1987, the following budgets were needed: Lange Rhön ca DM 435,000; Bauersberg und Weinberg DM 44,000; Thürmleinswiesen ca DM 11,000; Sinnquellgebiet DM 36,000; and Mühlwiesen DM 2,000 (Anon., 1988).

LOCAL ADDRESSES

Bavaria: Regierung von Unterfranken, Peterplatz 9, 8700 Würzburg
Hessen: Hessische Biosphärenreservatsverwaltung, Oskar-Seifert-Strasse 3, 6414 Hilders/Rhon
Thuringia: Biosphärenreservat Rhön, Mittelsdorfer Strasse, 0-6101 Kaltensundheim

REFERENCES

Anon. (1988). *Pflege und Entwicklungsplan Lange Rhön*. Planungsbüro Grebe Landschafts- und Ortsplanung, Munich.

Anon. (1991). *Biosphere Reserve Rhön*. German National Committee of the MAB, Bonn.

Bandorf, H. and Pfriem, U. (1986). Die Vögel des Naturschutzgebietes "Lange Rhön". *Schlussbericht Naturwissenschaftlicher Verein Würzburg zu den Grundlagenerhebungen zum Pflege- und Entwicklungsplan Lange Rhön*. Unpublished.

Beck, P. (1986). Amphibien und Reptilen (Naturschutzgebiet Lang Rhön). *Schlussbericht Naturwissenschaftlicher Verein Würtzburg*. Unpublished.

Gorner, M., Haupt, R., Hieckel, W., Niemann, E. and Westhus, W. (1984). *Handbuch der Naturschutzgebiete der Deutschen Democratischen Republic Band* 4. Institut für Landschaftsforschung und Naturschutz Halle der Akademie der Landwirtschaftswissenschaften der Deutschen Demokratischen Republic, Bonn.

Grimmett, R.F.A. and Jones, T.A. (1989). *Important Bird Areas in Europe*. ICBP, Cambridge. 888 pp.

Haarmann, K. and Pretscher, P. (1988). Naturschutzgebiete in der Bundesrepublik Deutschland, Ubersicht und Erläuterungen. *Naturschutz aktuell* 3. Kilda Verlag, Greven.

Kudrna, O. (1986). *Erfassung der Tagfalterfauna des Naturschutzgebietes Lange Rhön und angrenzender Gebiete*. Unpublished.

DATE June 1991

1100mm and at 480m altitude it is 760mm. Three months have significantly more precipitation and fog occurs on about 200 days per year (Anon., 1991).

VEGETATION Three main types occur: natural montane and submontane broad-leaved deciduous forests, mainly of beech *Fagus sylvatica* with ash *Fraxinus excelsior* and sycamore *Acer pseudoplatanus*; semi-natural montane and submontane dry till grasslands on siliceous and calcareous soils with plant associations of Nardetum, Mesobrometum, Geranio-Trisetetum and Calthion; and locally distributed waterlogged habitats including bogs, acid and calcareous fens with *Eriophorum vaginatum* and *E. angustifolium*, wooded bogs with birch *Betula carpatica*, willow *Salix aurita* brush, alder *Alnus glutinosa* swamps and alluvial alder forests. Threatened Red Data Book species it supports include arnica *Arnica montana*, *Tollius europaeus*, martagon lily *Lilium martagon*, carline thistle *Carlina acaulis*, green-winged orchid *Orchis morio* and lady's slipper orchid *Cypripedium calceolus* (Gorner *et al.*, 1984; Anon., 1988, 1991).

FAUNA The biosphere reserve supports 73 bird species including 15 on the Bavarian Red List. Red Data Book species include birds such as black grouse *Lyrurus tetrix*, snipe *Gallinago gallinago* (45-60 pairs breeding), meadow pipit *Anthus pratensis*, green sandpiper *Tringa ochropus*, eagle owl *Bubo bubo*, black stork *Ciconia nigra* and butterflies including clouded apollo *Parnassius mnemosyne*, swallowtail *Papilio machaon*, cranberry fritillary *Boloria aquilonaris* and moorland clouded yellow *Colias palaeno* (Bandorf and Pfriem, 1986; Beck, 1986; Kudrna, 1986; Grimmett and Jones, 1989; Anon., 1991).

CULTURAL HERITAGE The area has a long history of farming and traditional land use and farming practices are maintained within the biosphere reserve (Anon., 1991).

LOCAL HUMAN POPULATION The local population is mainly agricultural with some living in urban or suburban areas. The main sources of income are agriculture, tourism and trade. Core areas are uninhabited, while about 15,500 people live in the buffer zone and about 78,000 in the transition area (Anon., 1991).

VISITORS AND VISITOR FACILITIES There are about 550,000 visitors annually and facilities for walking and skiing (Anon., 1988, 1991).

SCIENTIFIC RESEARCH AND FACILITIES There are to be one foreign and ten German scientists taking part in research at the site. Research will primarily be concerned with land use, management, integrated sustainable conservation and long-term monitoring; a wide range of research has already been conducted here. Monitoring of air pollution, climate and hydrological factors are carried out and facilities for meetings, accomodation for ten visiting scientists and a soil laboratory and library are available. Graduate and postgraduate research is carried out here and there are also professional training programmes (Anon., 1991).

CONSERVATION VALUE The biosphere's main purpose is to maintain a variety of minimally disturbed ecosystems. It supports a number of threatened Red Data Book plant and animal species (Anon., 1991).

CONSERVATION MANAGEMENT There is a policy of preserving and restoring natural and semi-natural forest types at a variety of altitudes and sites. Grasslands are maintained by non-intensive mowing and grazing but the use of fertilisers is avoided. Bogs and marshy habitats have their water balance maintained or rehabilitated and natural succession is generally allowed, although some non-intensive mowing is carried out. Core areas have a variety of scientific and educational uses; artificial management practices are allowed to maintain particular ecosystems as is authorised hunting. Grazing, small-scale tourism activities, forestry (mainly of beech *Fagus sylvatica*

NAME Rhön Biosphere Reserve

IUCN MANAGEMENT CATEGORY IV (Managed Nature Reserve) (parts)
V (Protected Landscape or Seascape) (parts)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.11.05 (Middle European Forest)

GEOGRAPHICAL LOCATION Divided between the territories of the Länder of Bavaria, Hessen and Thuringia, 5-10km from the nearest large towns. The largest section is a nature reserve in Thuringia, with five smaller outliers in Hessen and Bavaria (Anon., 1988). Approximately 50°35'N, 10°05'E

DATE AND HISTORY OF ESTABLISHMENT Eastern Länder: a number of nature reserves exist within the Thuringia section of this site: Auewäldchen (26ha, established 1967); Arzberg (132ha, established 1961); Kalkstuff-Niedermoor (4.8ha, established 1967); Sachsenberg (50ha, established 1961); Ibengarten (58ha, established 1938); Bernshauser Kutte (13ha, established 1942); Stoffelskuppe (22ha, established 1961); Rhönwald (53ha, established 1967); and Hembachwald (15ha; established 1967) (Gorner *et al.*, 1984; Anon., 1988).

Western Länder: by an Order of 26 April 1982 Lange Rhön Nature Reserve in Bavaria was established, covering 2,657ha. By an Order of 26 November 1982 Bayerische Rhön Nature Park was established, covering 124,000ha; this area was originally established in 1967. The contiguous Hessische Rhön Nature Park was set up in 1963 and covers 70,000ha. These enclose a number of small nature reserves which are part of Rhön Biosphere Reserve: Mühlwiesen im Elsbachtal (30ha); Steinschlagwiesen am Bauersbergsüdhang mit Weinberg; Basaltblockhalde am Bauersberg (325ha); Steizbrunnengraben mit Thürmleinswiesen und Steizbrunn-Quellbereich (ca 80ha, in two non-contiguous sections); and Sinnquellgebiet mit Arnsberghang (ca 210ha; established by an Order of 10 July 1986) (Anon., 1988; Haarmann and Pretscher, 1988).

The biosphere reserve was created on 11 January 1991 and is managed through a state treaty between Bavaria, Hessen and Thuringia (Anon., 1991).

AREA A total of 130,488ha with core areas of 12,327ha, buffer zones of 33,628ha and a transition area of 84,533ha (Anon., 1991).

LAND TENURE Major land owners are state, provincial and local government and private owners or groups (Anon., 1991).

ALTITUDE Approximately 300m-950m

PHYSICAL FEATURES This hilly and, in parts, mountainous area forms the watershed between the Weser and the Main/Rhine drainage systems and is drained by a number of streams, including the Fulda, Ulster, Brend, Stren and Sinn. The major rock types are Bunter sandstone, chalk and Keuper sandstone, tertiary sediments and volcanic rocks including basalt and phonolite. Soils are predominantly clays, brown earths, rankers and gleys (Anon., 1988, 1991).

CLIMATE Subatlantic to subcontinental in type with a range of microclimates depending on altitude. The maximum average temperature of the warmest month is 13.7°C and the minimum average temperature of the coldest month -2.9°C. Mean annual precipitation at an altitude of 950m is

hunting are permitted. Transition zone: agriculture, semi-pastoral livestock and cereal growing permitted, tourism is concentrated in this zone at Methamis. Throughout the entire area it is obligatory for persons with private forests of 25ha or more to adhere to the "Plan Simple de Gestion", which involves activities such as reafforestation after forest cutting (Anon., 1990).

MANAGEMENT CONSTRAINTS In this decade extensive attacks by pine moths have devastated forested areas. Forestry still occurs within the region as does hunting; both these activities may have an adverse effect upon the wildlife populations of the region.

STAFF Sixteen full time staff; eight part time staff; eight administration officers; 11 (5 part time) (Anon., 1990)

BUDGET Section de fonctionnnement FF 9,515,600, valeur approchée hors service de la dette FF 5,491,000. Nett FF 4,024,600. FF 1,935,000 sources of funds from the region, department and communes.

LOCAL ADDRESSES

Syndicat Mixte d'Aménagement et d'Equipement du Mont Ventoux (Directeur Délegué pour la Réserve de la Biosphère), 23 rue d'Annanelle, 84000 Avignon (Tel: 90 85 05 59; Fax: 90 82 22 07)

REFERENCES

There are 380 references classed by themes, based on history, archaeology, tourism, human geography, agriculture, physical environment, fauna, vegetation and aromatic plants and medicinal species.

Anon. (1990). Réserve de la Biosphère du Mont Ventoux. Sydicat Mixte d'Aménagement et d'Equipement du Mont-Ventoux, Avignon. 300 pp.

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such as those at the Maison de Pays de la Vallee du Toulkourenc at Savoillans and information centres as at Mont Serein and summit of the Ventoux. Gites are available at Mont Serein (36, plus 83 tent places), Savoillans (36), Monieux (35) and Malaucene (25). The ski station of Ventoux, established in 1985, has had up to 450,000 skiers in total. Education is organised by the Centre Permanent d'Initiation à l'Environnement de Vaucluse, with courses ranging from one day to one week. Publications include the revue "Les carnets du Ventoux" and the annually produced "Guide Pratique".

SCIENTIFIC RESEARCH AND FACILITIES There are 30 research staff. The first scientific documents of the area were by Frère Platter at the end of the 16th century, followed by others of 1664 onwards (Anon., 1990). The first publication relating to natural history, by Charles Martins who produced a profile of the Ventoux, was produced in 1838. Geological work started at the end of the 18th century, and Guerin described the region in depth in 1807. The first geological maps were prepared in 1866 and the first thesis on the geology of the area in 1882 (Anon., 1990). The fields of research currently undertaken in the region include geology, social science, climatology, bioclimatology, hydrology, silviculture, botany, invertebrate studies, mammalogy and archaeology. The Station de Bioclimatologie de l'Institut National de la Recherche Agronomique d'Avignon undertakes research on agrometeorology and satellite imagery. Eleven meteorological stations were set up between 1971 and 1978. Archaeological research has been undertaken on Neanderthal man by the University of Quebec since 1987 in the Bau de l'Aubesier (Anon., 1990). Research work is undertaken below Ventoux such as at the Ferme Saint Agricol at Savoillans, with the Centre d'Experimentation Agriculture Montagne Seche. The laboratories of the Institut National de la Recherche Agronomique (INRA), which undertake studies on forest management, are located at Malaucene. Libraries are being set up at Mormoiron, assembling documentation on the Ventoux region. Other centres are at INRA, Avignon, Museum of Natural History at Avignon, and university facilities at Avignon (Anon., 1990).

CONSERVATION VALUE Mont Ventoux is noted for its isolated position on the northern limits of the Mediterranean region, at the crossroads of the southern and continental influences. The area is important as a transition zone of orophilic mountain species and Mediterranean species. At least 130 species of plant found in the reserve are totally absent from the rest of the department. Species numbering 110 of the Ventoux have their distributional limit in France. Floristically the species normally uncommon in the Alps but frequent in this region include *Papaver rhaeticum* and *Eryngium spina-alba*. Species recorded in the *Red list of threatened species in France* include 24 bird, two species of reptile and amphibians, two mammals and 10 species of plant (Anon., 1990).

CONSERVATION MANAGEMENT Land is principally under the administration and management of the Office National des Forêts and the Syndicat Mixte d'Amenagement et d'Equipement du Mont Ventoux. The Syndicat consists of the members of the Comité Syndical and members of the Comité de Pilotage Scientifique. The area is managed under forestry practice and divided into a series of zonations with varying regulations: hunting is practised for 3-4 months of the year in the core area. A hunting plan with regulations has been established. Usage and activities in the buffer zone include hunting (species include hare, rabbit, boar, pheasant, partridge), permitted from September until January. Livestock grazing was largely forbidden (under the Code Forestier) following replanting of trees on the ancient grazing transhumance lands in the 19th century. Remaining areas cover 15,143ha and include 3,765 head in 1989. Truffle collecting is permitted within specified lots, covering 13,711ha in 1989. The wooded areas cover 13,550ha (13,510ha of production forest and 40ha other than production). Releasing of game is permitted solely by communal societies. Fox, badger and stone marten are the main animals considered pest species. Their destruction by cyanide is forbidden. Five hundred licences are permitted per year by the Office National de Chasse, primally within tha domaniale reserves of 1,900ha. Hunting societies involved include: Société de chasse d'Aurel, de Brantes 'Vallée du Toulourencv', de Bedoin, de Flassan, de Saint Trinit and de Sault. The Service Environnement du Conseil Général manages a botanical trail to the Source du Groseau from Ventoux. In the Gorges de la Nesque human intervention is limited. Hiking, trout fishing and

On the north slope are typical French mountain species including: *Dryopterus villarii*, *Phleum alpinum*, *Agrostis alpina*, *Poa chaixii*, *Carex brachystachys*, *Luzula nivea*, *Moehringia muscosa*, *Aconitum anthora*, *Thalictrum aquilegifolium*, *Draba aizoides*, *Alyssum cuneifolium*, *Viola calcarata* and *Rosa pendulina*. Representative mountain species found on the southern slopes include: *Currania robertiana*, *Asplenium viride*, *Carex montana*, *C. refracta*, *Gagea lutea*, *Polygonatum verticillatum*, *Goodyera repens*, *Chenopodium bonus-henricus*, *Daphne mezereum*, *Viola ruprestris*, *Ribes uva-crispa*, *Oxalis acetosella*, *Asperulla odorata*, *Sambucus racemosa* and *Phyteuma spicatum*. Other notable communities include *Genista villarsi* found at altitudes of 800m (Anon., 1990).

Threatened species include *Androsace chaixii*, *A. villosa*, *Heracleum minimum*, *Iberis candolleana* and *Eryngium spina-alba*. Commercially threatened species include the truffle *Tuber melanosporum*.

FAUNA The fauna of the area is typical of the mid-European, alpine and Mediterranean region. Sixty-one per cent of the birds nest in the forests. Notable species include the raptors *Circaetus gallicus*, and the owls *Bubo bubo*, *Otus scops*, *Aegolius funereus*, *Athene noctua* and *Tyto alba*. Other representative species include *Upupa epops*, *Jynx torquila*, *Alectoris rufa*, *Sylvia communis*, *Lanius excubitor*, *Emberiza hortulana* and *Alcedo atthis* (Anon., 1990). Up to 14 main mammal species occur including *Sciurus vulgaris*, *Glis glis*, *Castor fiber*, *Mustela nivalis*, *Martes foina*, *Meles meles*, *Ovis musimon*, *Rupicapra rupicapra*, *Cervus elaphus*, *Capreolus capreolus* and *Sus scrofa*. Typical amphibians and reptiles include *Salamandra salamandra*, *Bufo bufo* and snakes *Vipera ursinii* and *Malpolon monspessulanus*. Extensive work has been undertaken on the invertebrates of the region (Anon., 1990; Luquet, 1977; du Merle, 1978). There are 250 species of arachnids. A number of species, such as *Gnaphosa lugubris* spp. *occidentalis*, are at the southern limit of their temperate cold distributional range. There are 64 species of ant, the most numerous species include members of the genera *Leptothorax*, *Camponotus*, *Formica* and *Lasius*. Threatened species include *Carabus aurus ventouxensis* and *Circaetus gallicus*.

Archaeological studies identified that there were Neanderthal man, chamois, horse, rabbit, beaver, auroch, bear and rhinoceros in the area in the past (Anon., 1990).

CULTURAL HERITAGE Archaeological studies have indicated that the area covers 20,000 years of human occupation. The area is noted for representing the transition between *Homo neanderthal* and *Homo sapiens* in the Bau de l'Aubesier. The Gorges de la Nesque include habitations from the Paleolithic period especially in the communes of Methamis and Monieux. In the Methamis commune are objects dating from the Mesolithic period (-10,000 to -5,000 years BP). The first literary record to the Mont Ventoux dates from 1336, Père Francois Denis's ascent of the summit. The real exploration of the area started in the 18th century, with Père Laval's ascent in 1711. A paper mill was established in the area of Malaucene in 1545. Transhumance livestock grazing died out by the 19th century and was replaced by intensive forestry (Anon., 1990).

LOCAL HUMAN POPULATION There are no inhabitants in the core area, 30 in the buffer zone and approximately 14,000 in the 45,000ha of the transition zone. The population of the region is rural and agricultural. The population density of the region is 122 people per sq km. Sheep are stocked at the level of 4,000 head on 15,000ha in 11 communes. Activities within the area include paper manufacture, timber and saw mills, hunting, tourism, sand extraction, vineyards, distilleries, fruit growing and other forms of agriculture along with lavender, cereal and vegetable growing. Timber and wood production is based on exploiting *Cedrus atlantica*, *Pinis nigra*, *P. sylvestris*, *Fagus sylvatica* and *Quercus pubescens* (Anon., 1990).

VISITORS AND VISITOR FACILITIES About 1 million visitors reach the summit per year. A maximum of 30,000 vehicles was recorded in the area in July 1985 by the Direction Departementale de l'Equipement. Facilities and activities include nature trails to the Source du Groseau, hiking trails, horse riding, motorcycling, golf, tennis, swimming, camping, hotels, traditional events, exhibitions

principally oriented west to east in the form of an arc advancing towards the north (characterised by the pre-alpine western mountains). A secondary axis is aligned in a north-south direction.

The Gorge de la Nesque, near Monieux, dates from the Quaternary. It cuts through the limestone plateau massif and between the Monts de Vaucluse and the Ventoux, extending for over 20km with cliffs up to 400m in height (Anon., 1990). The River Nesque with its source in to the south-west of Aurel, crosses the depression of Sault, goes underground in the limestone near Monieux then reappears 189km downstream near Venasque. The Gorges de la Nesque, at Methamis is at 300m in height, rising to 600m at Monieux where it continues to the extremity of the Fosse d'Efondrement at Sault.

Soils are sparse, often 50cm deep. Two main systems exist and are described in further detail in the biosphere reserve nomination (Anon., 1990).

CLIMATE Essentially Mediterranean bioclimate. Southern slopes are Mediterranean sub-humid to per-humid with a precipitation range from 700-1600mm per year. The northern slopes range from Mediterranean sub-humid to per-humid climate with continental influences, winters are extreme and longer than in the south. The maximum mean temperature in the hottest month is 29.6°C at low altitude of 100m (at Carpentras) dropping to 14.4°C on the summits at 1,400m; minimum mean temperature of the coldest month 1.4°C at Carpentras to -5.9°C at the summit. There are an average 86 days of rain per year, mostly falling between 6-8 days per month. Limited or no rain occurs over the summer months. Average rainfall ranges from 708mm (Carpentras) to 1600mm at the summit. Snow does not fall with regularity below 1,000m. Above this altitude the average number of days per year with snow is 59 (2.9 days in the plains). Maximum evaporation is in July with a mean of 4.6mm/day at 700m and 3.9mm/day at 1,400m in the south. At 1,400m on the north slope the evaporation attains 2.7mm/day (Anon., 1990).

VEGETATION The vegetation ranges from woodland, to pasture, oak woods and beech along with planted forest of introduced species. There are 13,550ha of wooded land, 440ha devoid of woods, 1,930ha of garigue and 1,760ha of resinous reafforestation plantations. Pubescent oak *Quercus pubescens* makes up 3,000ha, holm oak *Quercus ilex* 1,300ha, beech *Fagus sylvatica* 880ha, Scots pine *Pinus sylvestris* 1,500ha, black pine *P. nigra* 3,000ha other pines 1,600ha, fir *Abies* spp. 80ha and atlas cedar *Cedrus atlantica* 830ha (Anon., 1990). Natural forests include holm oak forests from the base of the massif to 900-1,000m and pubescent oak from 1,300-1,400m. Yew and beech is locally found up to 800m mixed with oak. Yew *Taxus baccata* and box *Buxus sempervirens* are found at Mont Serein on the north slope at 1,450m. Between 1,200m-1,500m beech forests occur, with diverse ground flora, and centred along the Col de la Frache where it is found in association with fir *Abies* spp. Cedar forest of *Cedrus atlantica* dates from plantations of the 19th century.

The natural vegetation is very degraded and the vast majority was completely replanted on former pasture from 1861 onwards (following the 1860 Law on Reforestation). More than 950 species of vascular plants have been identified (Anon., 1990 based on papers by Gontard, 1957, Girerd, 1976, Girerd, 1978). Natural zonal communities are represented by assemblages of the following: at altitudes of 1,800m the vegetation is dominated by alpine type flora as typically represented on Mont Ventoux and includes: *Poa cenisia, Festuca halleri, Ranunculus seguieri, Papaver rhaeticum, Saxifragas oppositifolia, S. exaratas, Lotus alpinus, Astragalus australis, A. danicus, Oxytropis gauidini, Douglasia vittaliana, Valerianma saliunca* and *Crepis pygmaea*. Subalpine species found at 1,500m are typical of those found in the Alps and the pyrenees and include such reprsentative species as: *Avena montana, A. versicolor, Trisetum distichophyllum, Poa alpina, P. violacea, Festuca pumila, F. violacea, Carex* species including *C. rupestris, C. ferruginea, C. firma, C. sempervirens*, also other species such as *Luzula spicata, Sedum atratum, Alchemilla hoppeana, A. flabellatsa, Potentilla crantzi, Trifolium thalii, Polygala alpina, Heracleum setosum, Myosotis alpestris, Androsache villosa, Linaria alpina* and *Veronica aphylla.*

NAME Mont Ventoux Biosphere Reserve

IUCN MANAGEMENT CATEGORY VIII (Managed Nature Reserve)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.17.06 (Mediterranean)

GEOGRAPHICAL LOCATION The site falls within 25 communes in the Massif Central, regions of Provence and Cote d'Azur, Département de Vaucluse. The nearest town is Avignon. The Rhône is to the west, the Durance to the south, the Calavon to the east, the Toulourenc and the Aigues to north. Approximately 44°10'N, 5°17'E

DATE AND HISTORY OF ESTABLISHMENT Six orders "Arrêtés de protection de biotope" correspond to the six zones forming the central zone of the reserve. The site consists of the forêts domaniales of: Beaumont du Ventoux, Saint Leger du Ventoux, Brantes, Blauvac and the Foret Communale Soumise de Bedoin.

AREA 2,126ha core zone (divided into 534ha forêt domaniale, 1,042ha communal soumis and 550ha communal non soumis); 26,830ha buffer zone and 44,000ha transition zone.

LAND TENURE State (Office National des Forêts). The transition zone includes private and common land.

ALTITUDE 200-1,909m (Mt Ventoux summit)

PHYSICAL FEATURES Situated between the Massif Central and the subalpine zone, the region is a transition between temperate mid-European of the north and the Mediterranean of the south. Up to 45% of the area is represented by plains and the rest by mountainous relief. The main massif extends 24km west to east and 165km north to south, with the highest point at Mt Glandasse (2,041m), which is beyond the reserve boundary. The massif is adjoined by the Luberon chain of mountains in the south, which attains a maximum height of 1,125m.

The massif consists of Cretaceous limestone affected in the past by erosion from river water and by ice, accumulating into drifts and alluvial deposits of various dimensions. Rocks date from the early Cretaceous (Valanginien) and the mid-Miocene (Helvetian). The majority of the massif dates from the Hauterivien to the Bedoulien (Lower Aptien). The base of the massif is almost entirely Bedoulien limestone (Anon., 1990). Water erosion has resulted in a major gorge and cave system through the limestone as represented by the Gorge de la Nesque and the Karst area in the Sault depression. The Massif of Ventoux consists of the following subdivisions: Northern slopes (Col du Comte and Mont Serein, including important faults dating from the mountain folding of the Pyreneo-Provencaux period. The eastern sector is represented by important cliffs and a waterfall which drops 1,500m in 3km, from the summit of the Toulourenc valley. The Plateau of Mount Serein (1,400m) consists of valleys parallel to the crestline: Southern slopes - the line of the secondary crest develop outwards from the Col de la Frache and is divided into two sectors: one western and another eastern, fractured by north-south folds. To the east a piedmont extends for 6.5km and forms an extension to the north of the Monts de Vaucluse and the Plateau d'Albion. The western sector includes numerous combes orientated north-south and then east-west (Du Merle and Guende, 1978). An anticline in an east-west direction is a result of tectonic activity, the tectonic Pyreno-Provencales phase. A monocline lies in a southward direction. The configuration of the tectonic area has two perpendicular axes: one

REFERENCES

Estonian SSR MAB Republican Committee (1990). Biosphere Reserve Nomination Form and review document.

DATE October 1990

cover maps, aquatic ecosystems, fresh and marine bathymetric maps, hydrological data on surface and groundwater, as well as limnological surveys, water and air quality and climatological data. Biological inventories exist for fish, mammals, other vertebrates, invertebrates, phytoplankton, macrophytes (aquatic) and non-vascular plants. There is also information on coastal geomorpology and geological and soil maps. Socio-economic and cultural information includes ethnobiological data, land/water use history and land/coastal use maps. The site is well equipped with facilities including an air, climatological and hydrological monitoring stations, laboratories, library, conference facilities, lodgings for 25 visiting scientists, research vehicles and office infrastructure. Ecological data management systems already exists, and it is planned to introduce an automated geographical information system and use of satellite imagery. There are also permanent monitoring plots for marine benthic communities and vegetation.

CONSERVATION VALUE Includes eutrophic mires, with *Carex hostiana, Juncus subnodulosa* and *Rhinantuns osiliensis*, juniper shrubs and species-rich dry wooded meadows and pine forests.

CONSERVATION MANAGEMENT The site is divided into core areas covering 119,000ha and buffer zones covering 357,000ha. There is also a transition zone of 1,084,078ha. Legislation covering the site is state, provincial and local, with administrative regulations and ownership rights also applying. National legislation is secondary. A number of activities take place in the core zone, including authorised hunting and/or trapping. The area includes two state nature reserves and 65 other reserves covering 7,993ha. There are plans to create 20 new reserves. A biosphere reserve board will be established as a state enterprise, with representatives from all districts. The budget will be raised from the state allocation, economic relations and a special fund. The board's activities will be directed by a council delegated from the members of participating organisations, and a scientific council will consist of research associates. There is also an enterprise council. A regional development plan for the reserve will be prepared, together with socio-economic guidelines. Professional training is carried out on site and workshops are organised for reserve managers and planners. It is envisaged that services will be provided for local people and staff training.

MANAGEMENT CONSTRAINTS Sea-shore halophilous meadows and alvas are grazed by sheep. Game animals, such as wild boar *Sus scrofa*, moose *Alces alces* and roe deer *Capreolus capreolus* are hunted in the buffer and transitional zones, and some hunting is authorised in the core zone. Destruction of terrestrial habitats, wetlands and natural marine habitats occurs in the buffer zone as well as grazing, forestry exploitation, industrial, mineral and tourist development, shipping and aircraft activities. Human activity is much greater in the transition zone and includes fishing, forestry, gathering of natural products, grazing, hunting and trapping, industrial and residential development and poaching. Natural ecosystems on several islands have been damaged by human activity and surface and underground water and sea areas, particularly in the bays, are polluted by chemicals and biological substances. On the social side, traditional agricultural practices are disappearing, leading to loss of soil fertility, and accumulation of pesticides and heavy metals.

STAFF Totals 50 including state and local government nature protection and forestry specialists and a further 12 administrative, control and resource management personnel. Five staff are responsible for education and training and 15 for technical support for research.

BUDGET 260,000 roubles, supported 70% by the national nature conservation fund, 5% by local authorities and 25% by government budget.

LOCAL ADDRESSES

West Estonian Archipelago Biosphere Reserve, P O Box 209, Kuressaare 203 300, Estonia SSR (Tel: 7(0142)(245)579-75/Tlx: 173816)

VEGETATION There are three main vegetation types: on the islands, seashore halophilous meadow, alvars, and broadleaf forest and wooded meadow. Seashore halophilous meadows comprises species such as *Eleocharetum parvulae*, *Triglochinetum maritimi*, *Bolboschoenetum maritimi*, *E. uniglumis*, *Salicornetum europaeae*, *Puccinellietum maritimae*, *Spegularietum salinae*, *Glaucomaritimae-Juncetum gerardii*, *Festucetum arundinaceae*, *Seslerietum caerulae*, *Arrhenatheretum elatioris*, *Carcetum distichae*, *Hierochloetum odoratae* and *Elytrigietum repentis*. Alvars comprise species such as *Juniperus communis*, *Lonicera xylosteum*, *Rhamnus catharctica*, *Ribes alpinum*, *Rosa* spp., *Sorbus aucuparia*, *S. intermedia*, *Cotoneaster integerrima*, *Viburnum opulus* and associations of *Thymus serpyllum-Galluna verum-Ditrichum flexicaule*, *Filipendula vulgaris-Trifolium montanum*, *Carex flacca-Sesleria caerulea*, *Festuca ovina-Thymus serpyllum*. Broadleaf forest and wooded meadows comprise species such as *Quercus robur*, *Tilia cordata*, *Ulmus glabra*, *Acerplatanoides*, *Fraxinus excelsior*, *Populus tremula*, *Ribes alpinum*, *Lonicera xylosteum*, *Swida sanguinea*, *Coryllus avellana*, with meadow associations of *Scorzonera humilis-Melampyrum nemorosus*, *Filipendula vulgaris-Sesleria caerulea*, *Carex pallescens-Scorzonera humilis*, and 20 orchid species. Fifty per-cent of the region is woodland, with some of the best preserved broadleaf forests to be found on the islands of Saaremaa, Hiiumaa, and Abruka. There are also a number of rare species and species that are at the limit of their area of distribution, namely *Pinguiguicula alpina*, *Juncus obtusiflorus*, *Hedera helix*, *Cladium mariscus*, *Cypripedium calceolus*, *Gymnadenia odoratissima*, *Taxus baccata*, *Sorbus rupicola*.

FAUNA The islands are poorer in animal species compared than the neighbouring mainland. Three areas are set aside specifically for bird conservation, with six species of Estonia SSR Red Data Book status present, namely *Anser anser*, *Cygnus olor*, *C. cygnus*, *Pandion haliaetus*, *Haliaetus albicilla* and *Grus grus*. Other notable species are *Parnassius mnemosyne osiliensis*, *Helix pomatia*, *Bufo calamita*, *Lacerta agilis*, *Halichoerus grypus* and *Myotis dasycneme*. Of the fish species recorded, three are of economic interest: Baltic dwarf herring *Clupea harengus membras*, flatfish *Pleuronesus flesus* and pike-perch *Lucioperca sandra*.

CULTURAL HERITAGE Remains of ancient settlements, with further traces of Palaeolithic settlements, are found on the hills surrounding the meteorite craters of Kaali. There is a castle at Kuressaare dating back to the Middle Ages.

LOCAL HUMAN POPULATION The major settlement within the reserve is Kuressaare (population 15,000) on the southern coast of Saaremaa Island. Land use includes agriculture, fishing and shellfishing and urban development. Of the total population of 51,000 (a decrease of one-third on the pre-war figure), 20% lives permanently within the buffer zone (with 35% in Kuressaare) and 80% in the transition zone. Barley, rye, wheat, oats, potatoes, foraging vegetables and fruit are currently grown. Cows, sheep and horses are grazed predominantly. The commercial forested areas are planted mostly with Scots pine and Norway spruce. Benefits provided to the local population by the biosphere reserve include employment, educational and training opportunities and a range of other benefits including recreation and the maintenance of traditional cultures and resource-use practices.

VISITORS AND VISITOR FACILITIES Visitor numbers vary between 180,000 and 250,000 annually, and interpretive programmes are provided. Environmental education is provided for school children and students (graduate and post-graduate).

SCIENTIFIC RESEARCH AND FACILITIES It is estimated that some 70 scientists participate in research on site, with a further 15 visiting foreign scientists. Research relates to land use and management issues and is used to support site management and sustainable conservation. Although no permanent monitoring or research programme exists, the site is being considered for development of more long-term monitoring and research activities in association with other national and international programmes. Research material available includes aerial photographs, bibliography, history of scientific study, with assessment data and maps, topographic maps, vegetation and land

NAME West Estonian Archipelago Biosphere Reserve

IUCN MANAGEMENT CATEGORY I (Strict Nature Reserve)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.10.05 (Boreonemoral)

GEOGRAPHICAL LOCATION The biosphere reserve comprises an archipelago in the Baltic Sea, some six nautical miles off the coast to the west of the town of Haapsalu. The archipelago comprises the islands of Abruka, Hilumaa, Muhu, Ruhnu, Saaremaa and Vormsi, and is within the administrative districts of Kingissepa, Hiiumaa and Haapsalu. The boundary follows the sea borders of these districts seven nautical miles from the coast. Approximately 58°30'N, 22°50'E

DATE AND HISTORY OF ESTABLISHMENT The biosphere reserve was created by decision of the Supreme Soviet of the Estonia SSR on 6 December 1988 and by decision of the Council of Ministers of the Estonia SSR on 27 December 1989. The final boundary of the reserve is to be approved by the Council of Ministers of Estonia with the approval of the local authorities.

AREA 403,778ha terrestrial and 1,156,078ha marine. The biosphere reserve includes Vilsandi SNR (10,689ha) and Viidumäe STVR (1,194ha), adjoins Matsula SNR (39,697ha) in the north, and is separated from Slitere SNR (15,037ha) in Latvia SSR by 25km of the Irbenskii Strait.

LAND TENURE The land is primarily owned by provincial and local governments, and the core areas (50 in total) are under state protection. There is also land under national government ownership and a total of 43 other land users.

ALTITUDE 0-63m

PHYSICAL FEATURES The islands lie in a region which is still rising following the last ice-age (3mm per year), and the generally flat landscape is broken by steep banks, beach barriers and cliffs. The underlying quaternary sediments (2-7m thick) consist of Ordovician and Silurian limestone plateaux, marl, dolomites and Devonian sandstone. Glacial deposits cover much of the area. The relief is strongly influenced glacial and seashore processes, with the high ground comprising weathered limestone. The oldest islets rose from the sea some 5,000-2,000 years ago and have been moulded by wave action, wind and hummock ice, whilst the cores of several islets consist of formations of end moraines and sedimentary rocks, with a surface cover of sandy gravel, shingle or ryhk-till, and some small swampy lakes. Most of the land area is covered by geologically young soils consisting of thin, weakly-developed horizons, saline sea-shore and shingle on limestone, with remaining areas covered by podzol-type (ryhk) glacial sediments (moraine, varved clay) and sea bottom deposits. Moonsand Strait has a maximum depth of 22m (deepest point 64m), with 49% of the area at less than 5m, and a salinity of 5.9-6.0%.

CLIMATE Conditions are temperate continental Atlantic, with local Baltic Sea influences. The average temperature is 6°C, with maximum average temperature 19.6°C (the warmest month is July) and minimum average temperature -13.9°C (coldest month is February). The warm period from April runs for 240-250 days, with maximum annual solar radiation of 85 ccal/cm^2 and a vegetation period of 170-185 days. Snow cover lasts 80-120 days with a depth of 30-40cm in February. Mean annual precipation is 510mm (at 1.5m). Winds are greater than 15m/sec. on 23-39 days in the year. Seawater temperature varies from 12°C in January to 16°C in June.

management (KWS, 1991). Today, high priority activities within the national park and biosphere reserve buffer zone areas are biological inventory, environmental monitoring, environmental education, and conservation management practices (KWS, 1991). Tourist development and water resource development projects have also been encouraged in the buffer zone, while agricultural activities, the promotion of recreation/tourism, and local infrastructural development are prominant in the transition area (KWS, 1991). Training for staff, resource managers and scientists, environmental education for students, and extension services for local people are both ongoing and planned, while provision is to be made for interpretive programmes for tourists (KWS, 1991). Benefits accruing to the local people from activities in and around the national park include employment opportunities, financial benefits, educational opportunities, health and community services, rural development assistance, and recreation and tourism opportunities, among others (KWS, 1991). The Kenya Wildlife Service is in the process of sharing 25% of total revenue realised from foreign tourist gate receipts to the Masai group ranches for allowing wildlife to use their land (KWS, 1991).

KWS has recognised that it may be necessary to fence selectively around the swamps to discourage elephants from overgrazing these areas and to place fences around small-scale agricultural projects in the buffer zone to protect crops against invading animals (KWS, 1991). In allowing a return to former migratory patterns in the buffer zone, and by implementing a planned corridor to Mt. Kilimanjaro, pressure will be reduced on the park and elephant populations will be maintained at a sustainable level (KWS, 1991).

MANAGEMENT CONSTRAINTS From the 1960s, tourism thrived and harassment of some species such as cheetah occurred. Other ongoing problems include destruction of habitat by off-road driving, the use of only a small portion of the viewing area, lodge concentration in the national park and garbage disposal (KWS, 1991). This has resulted in severe stress on certain wildlife species, unnecessary habitat destruction, and deteriorating visitor satisfaction (Western, 1982). Recently, however, tourist impact in the national park has been drastically reduced by upgrading and improving the viewing roads network, and in reducing off-road driving from a high of 150,000/km per year to less than 20,000/km per year (KWS, 1991). Many habitats have changed over the past 25 years, swamp areas have expanded and shifted, and woodland areas of acacia *Acacia xanthophloea* have been destroyed due to the impact of increasing numbers of elephants in the park area (Western, pers. comm., 1991). Further, rising groundwater levels have contributed to increased salinity of the soil, encouraging the replacement of woodlands by salt-tolerant shrubs. The creation of the park may have altered the balance maintained by pastoralism over thousands of years. Reduction of grazing competition between livestock and wildlife was marked by increase in numbers of zebra, wildebeest and elephant. The population dynamics of predators and other large herbivores may show complex responses to these changes in the large mammal and plant communities.

In the 1970s, the local Masai, whose cattle were excluded from a 8,000ha wildlife viewing area, received no compensation or financial benefits from park entrance fees. In protest, they killed rhinoceroses and elephants with spears and were largely responsible for reducing the population of the former from 120 animals to about eight. In 1977, a new agreement was made (see above). However, the water scheme completed in 1979, was badly managed and underfunded, and to date, the Masai have not been included as fully as they might in the benefits of Amboseli (Western, pers. comm., 1991). Consequently, some livestock grazing reoccurs during the dry season in the park and Amboseli is currently being threatened by subdivision of land around its boundaries (Mburugu, pers. comm., 1991). Recently, the Amboseli Water Project has been rehabilitated to provide water for the Masai and their cattle in the biosphere reserve buffer zone (KWS, 1991).

STAFF A warden and staff of about 100 for administration, control and resource management (KWS, 1991). Local Masai are employed on anti-poaching and other surveillance activities in the biosphere reserve buffer zone.

and long-term baboon, vervet and elephant studies by the Altmanns (since 1971), Seyforth and Cheney (since 1976), and Moss (since 1972), respectively. At present, there are three national and four foreign scientists participating in research at the site (KWS, 1991). Facilities currently available at Amboseli include a climatological monitoring station, conference/meeting rooms, library, storage facility for biological collections, and lodges which may be used by visiting scientists (KWS, 1991).

Proposed research activities are to include watershed and hydrological studies, ecosystem restoration, fire history and effects, forest research/silviculture, rangeland research, soil conservation, recreation/tourism impacts, traditional land use systems, appropriate rural technology, and resource mapping (KWS, 1991). This is to be supported by ecological data management and geographic information systems, and satellite imagery (KWS, 1991). Ongoing and proposed research at Amboseli, therefore, represents an integrated programme of basic and applied research supporting site management objectives and sustainable conservation in the region.

CONSERVATION VALUE The permanent swamps of the Amboseli Basin fed by Kilimanjaro form the heart of the Amboseli ecosystem and are a focal point for wildlife in the region, particularly during the dry season (FAO/UNEP, 1978).

CONSERVATION MANAGEMENT Dating from 1948, Amboseli National Reserve was intended to protect migratory wildlife from hunting, with Kenya National Parks acknowledging the status quo between wildlife and pastoralists who used the area (Western, 1982). In 1961, the colonial government handed administration over to the Kajiado County Council, with the hope that local responsibility would promote conservation in the reserve. Shortly thereafter, 7800ha were set aside as a stock-free area. Subsequently, however, competition between wildlife and increasing numbers of livestock, the growth of tourism, and lax planning by the Council resulted in the central Government imposing a plan on the Council to create a national park under government jurisdiction (Western, 1982). This resulted in Amboseli National Park being established in 1974. Today, the park is managed by the Kenya Wildlife Service, while the buffer zone of the biosphere reserve is managed by group ranches, the provincial administration, and Kenya Wildlife Service (KWS, 1991).

As early as 1973, provisional development plans for Amboseli were presented to the Ministry of Tourism & Wildlife (Thresher and Western, 1973). These were followed by the IBRD Wildlife and Tourism Project, which emphasised integration of different land uses, particularly wildlife-based tourism and agriculture, outside the park boundaries. In allowing wildlife to use Masai lands (buffer zone), the Masai would benefit from employment and planned tourist developments on their land (FAO/UNEP, 1980; Western 1982). It was estimated that when the park reached its projected visitor capacity, the Masai ranchers would be able to earn 85% more than through a fully developed livestock economy (Western & Thresher, 1973; FAO/UNEP, 1980). In 1977, the Masai group ranch landowners agreed to vacate the park area in return for guaranteed water supplies outside the park, and compensation payments for wildlife grazing on their lands. Following earlier initiatives, the goal of the Wildlife Extension Project, begun in 1984, has been to work with the Masai people on group ranches to develop modern land use systems which include wildlife and support the national park (Berger, 1990).

An official park management plan was approved for implementation in 1981. Recommendations included management zones; no expansion of tourist accommodation; introduction of an education/interpretation programme; a new camp ground outside the park; control of off-road driving, stock encroachment and poaching; reconstruction and closure of roads; and training programmes. The three zones described were: intensive use, extensive use, and low use (Thorsell et al., 1981).

The purposes of the biosphere reserve are to conserve a natural ecosystem, to allow for research on ecosystem management and conservation, and to promote local participation in land use and

VEGETATION There are four types of semi-arid vegetation: *Commiphora/Acacia* bushland (10%); saline/alkaline plains (50%) with *Suaeda monoica* and *Salvadora persica*; *Acacia* woodland with yellow-barked acacia *A. xanthophloea* and *A. tortilis*; and the remaining 10% swampland, which supports sedges *Cyperus* spp., including *Cyperus papyrus*. Grasses include needlegrass *Aristida*, fingergrass *Digitaria*, the salt-loving dropseed *Sporobolus* sp., stargrass *Cynodon dactylon*, and *Phragmites mauritianus* (Mepham & Mepham, in press). Oilseed *Balanites aegyptiaca* is important as a source of edible fruits, while the pods of *Acacia tortilis* are eaten by livestock (KWS, 1991).

FAUNA The park contains 56 species of mammal including baboon *Papio cynocephalus*, vervet monkey *Cercopithecus aethiops*, lion *Panthera leo*, cheetah *Acinonyx jubatus* (T), leopard *Panthera pardus* (T), elephant *Loxodonta africana* (T), zebra *Equus burchelli* (several 'negative' examples have been observed), hippopotamus *Hippopotamus amphibius*, black rhinoceros *Diceros bicornis* (T), Masai giraffe *Giraffa camelopardalis tippelskirchi*, buffalo *Syncerus caffer*, fringe-eared oryx *Oryx gazella callotis*, wildebeest *Connochaetes taurinus*, gerenuk *Litocranius walleri*, impala *Aepyceros melampus*, Grant's gazelle *Gazella granti*, spotted hyena *Crocuta crocuta*, and bat-eared fox *Otocyon megalotis*. Over 425 recorded bird species include southern banded snake eagle *Circaetus fasciolatus* and Taveta golden weaver *Ploceus castaneiceps* with three species of sandgrouse visiting the permanent waters in the dry season. These waters also support waterfowl such as the migrant squacco heron *Ardeola idae* from Madagascar, which is infrequently seen in Kenya. Taita falcon *Falco fasciinucha* is widespread but locally scarce, and lammergeier *Gypaetus barbatus* has also been seen.

By 1977, elephant populations in the park had declined to less than 480, while only 7 rhino remained from 44 in 1972 (FAO/UNEP, 1978; Western, 1982). Since then, numbers of both species have increased, such that an estimated 750 elephant are now present in the park (KWS, 1991). Swamps in the Amboseli Basin are used sequentially as the dry season progresses, with large herbivores such as buffalo and elephant penetrating the swamps first (FAO/UNEP, 1978). During the dry season, the park acts as a focal point for some 95% of the biomass of water-dependent wildlife species in the region (Thorsell *et al*, 1981). With the onset of the wet season, wildlife disperses to areas of open grassland or sparse bushland outside park boundaries (FAO/UNEP, 1978; Western, 1982). The direction followed by migrants such as elephant, buffalo, zebra, wildebeest and gazelle from the basin ranges from north-west to east, depending on the location of the earliest rains (FAO/UNEP, 1978).

CULTURAL HERITAGE Until 1977, Masai pastoralists used the Amboseli park area traditionally and communally.

HUMAN POPULATION While no traditional settlements are found in the park, there are approximately 300 park staff who live permanently in the park area, 2-3,000 residents in the biosphere reserve buffer zone, and 3-4,000 people living in the biosphere reserve transition area (KWS, 1991). The buffer zone comprises four major group ranches owned by the local Masai (KWS, 1991). There are also about 40,000 cattle and 30,000 sheep and goats found in the Amboseli ecosystem, owned by the Masai (FAO/UNEP, 1978). Other land uses in the surrounding areas (and within the biosphere reserve buffer and transition zones) include subsistence pastoralism, horticultural farming, meerschaum mining and tourism based on wildlife viewing (FAO/UNEP, 1978; KWS, 1991).

VISITORS AND VISITOR FACILITIES From an estimated 79,607 visitors in 1979, the park now receives about 150,000 visitors per annum (KWS, 1991). There is a well-developed network of tracks and game viewing areas. Accommodation within the national park is available in three lodges, one self-help banda facility and one campsite (CNPPA, 1979; KWS, 1991). Currently, there are four lodges/camps outside the park on Kimana Group Ranch (KWS, 1990).

SCIENTIFIC RESEARCH AND FACILITIES Past studies include: ecology of the Amboseli basin by Western and tourist use patterns by Henry. Others include: a monitoring programme by Western

NAME Amboseli National Park

IUCN MANAGEMENT CATEGORY II (National Park)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 3.14.07 (Somalian)

GEOGRAPHICAL LOCATION On the border with Tanzania, north-west of Kilimanjaro, west of the volcanic Chyulu Hills and east of Namanga (Oldonyo Orok) Hill. Amboseli is located in Rift Valley Province, District of Kajiado, Loitokitok Division. Closest towns are Namanga and Oliotokitok, Nairobi being 240km to the north. 2°33'-2°45'S, 37°06'-37°24'E

DATE AND HISTORY OF ESTABLISHMENT The park is a remnant of the Southern Game Reserve (27,700,000ha) established in 1906. 326,000ha were established as a national reserve in 1948 by Government Notice 1233, and administered by the National Park Trustees. The African District Council of Kajiado by-laws of 14 June 1961 established this area as a County Council game reserve, administered by Kajiado County Council. A Presidential Decree, issued in 1971, declared that an area be set aside exclusively for use by wildlife and tourists. Subsequently, Government Notice 264 of 1972, set apart lands for national park purposes (FAO/UNEP, 1978). On 1 November 1974, national park status was given to a 39,206ha area by Legal Notice 276. As of March 1991, Amboseli National Park and some of the surrounding region was accepted by the Unesco-MAB Bureau as a biosphere reserve. The Kenya Wildlife Service (KWS) is considering proposing Amboseli as a World Heritage and Ramsar site (KWS, 1991).

AREA 39,206ha. Biosphere reserve: core area (national park), 39,206ha; buffer zone, 244,000ha; transition area, 200,000ha. A corridor to allow elephant migration to Mt Kilamanjaro National Park (75,575ha) in Tanzania has been planned (KWS, 1991).

LAND TENURE Government. Previously administered by Kajiado County Council, which owns the Ol Tukai area. The Masai have legal title for land outside the national park (Western, 1982).

ALTITUDE 1,000-1,300m

PHYSICAL FEATURES Low undulating basement plain with a closed drainage system. Amboseli comes from the Masai word meaning 'salty dust' and most of the park is a dry lake basin of 60,000ha occupied in the Pleistocene by a saline lake. The area is now usually dry with shallow seasonal flooding. The Longinye, Enkongo Narok and Ohukai Orok swamps in the park are fed by underground springs from Mt Kilimanjaro. Together with Namalog Swamps located outside the park, these are the only sources of permanent water in the region and constitute major watering points for animals. Most of the Amboseli area is very flat with soil types ranging from red sandy basement soils to the north and north-east, brown lavas to the south and south-east, and whitish alkaline soils derived from the ancient lake, the remnant of which forms the western aspect of the basin (FAO/UNEP, 1978). A few prominent hills of volcanic origin rise about 100m above the surrounding area near the southern border, and a noticeable fault line forms the north-east shoreline of the seasonal lake.

CLIMATE The maximum average temperature of the warmest month is 33°C during the day, while that of the coldest is 27-28°C. An annual rainfall of 300mm per annum is distributed in two seasons: April/May and November/December. Recurrent droughts and potential evaporation of 2200mm per annum typifies the region (KWS, 1991).

LOCAL ADDRESSES

CONAP, Santa Elena Petén (Tel/FAX: 518951)

REFERENCES

Anon. (1973). Tikal National Park, Guatemala. A master plan for protection and use. United States National Parks Service, AID. (Secretaria de Planificacion Economica, Apendice: factibilidad economica 1973).

Curley, M.A., Dary, M. and Morales, P.A.H. (1973). Inventario Preliminar de los Recursos Naturales Renovables de Guatemala. 343 pp.

Government of Guatemala (1990). Congressional Decree 5-90. El Congreso de la República de Guatemala. Guatemala, Consejo Nacional de Planificación Economica (1973).

Lehnhoff Temme, A. (1990). Biosphere Reserve Nomination Form. National MAB Committee of Guatemala.

Lehnhoff, A. and Perez A.N. (1990). *Reserva* de *la Eliosfera Maya.* 8 pp.

Powell, D.R. (1970). A report on the development and management of the Tikal National Park. National Park service, US Department of the Interior, Division of International Affairs. Mission to Guatemala. 218 pp.

DATE June 1981, revised September 1991

The main objectives of the reserve are to conserve the natural environment, to provide the legal basis for resource protection and management, to conserve specific genetic resources in situ, to promote local participation in land use and management, to promote regional planning and integrated rural development, to disseminate knowledge about conservation and management of the reserve, to conduct scientific research and to promote environmental education and training (Decree No. 5-90; Lehnhoff Temme, 1990).

Activities taking place in the core area are biological inventories, long-term environmental monitoring, environmental education and professional training. In the buffer zone forestry, agriculture, biological inventories and collections, fishing and environmental education are undertaken. In the multiple use area main activities include conservation management, environmental education, forestry, fishing, gathering, long-term monitoring, agriculture, professional training, restoration of wetlands and terrestrial habitats, biological collections, tourist development and crafts (Lehnhoff Temme, 1990).

Extensive grazing by cattle (multiple use area), hunting, fishing, forest clearance for agriculture (small plots of maize, beans, sweet potato, citrics, ('malangu' and 'guicoy'), the use of various forest resources (chicle *Marilkara achrag*, pepper *Pimenta dioica*, cedar, mahogany *Swietenia humilis* and 'ramón' *Brosimum alicastrum* and the use of leaves and flowers for ornamental purposes (*Chamaedorea* spp. and Araceae) occur within the reserve (Lehnhoff Temme, 1990). There are annual burnings of grazing areas, either before or at the beginning of the rainy season, for the regeneration of pasture lands.

Ongoing education and training activities include extension services for local people, demonstration projects in conservation and rational resource use, graduate and postgraduate studies, professional training and workshops and staff training in protected area management. Eighty park guards have been trained. Environmental education for school children and interpretive programmes for tourists are planned (G-MAJB Committee, 1990).

MANAGEMENT CONSTRAINTS The annual burning of pasture land affects some nesting birds in the area, particularly the endangered ocellated turkey (Lehnhoff Temme, 1990). Poaching takes place within the core area. In the buffer zone, the destruction of natural terrestrial habitats, hunting and trapping and residential development have been reported. In the multiple use area activities include grazing, human settlements, hunting and residential and industrial development (G-MAJB Committee, 1990). The theft of archaeological remains has been reported.

STAFF Total staff of 344. Seventeen are engaged in administration and resource management (eleven are university trained), seven in education-related activities, two in research (university trained) and eight in research support (G-MAB Committee, 1990).

BUDGET Support is forthcoming from a variety of sources including CATIE (conservation and sustainable use of resources within the core area 'El Zotz' Biotope); IUCN Yaxhá (sustainable use of resource in the buffer zone and multiple use area); AID-The Nature Conservancy (support to CONAP for basic protection and field personnel, Programme Parks in Danger, Manual for the Guards and their training); wildlife Conservation International (ecology of species in El Peten and their use and possible management alternatives); The Peregrine Fund (monitoring raptors in Tikal National Park); WWF (support for the management of biotopes administered by CECON); Conservation International (ethnobotany); Unesco (Tikal World Heritage site) (Lehnhoff Temme, 1990).

In previous years the budget was as follows: US$ 185,000 in 1978 from the government of Guatemala; US$ 500,000 in 1979 from the Central American Bank for Economic Integration to finance an archaeology programme.

land/water use and use of the fauna. Current information exists on geographic information systems, satellite imagery, hydrological and limnological surveys, climate, biological inventories and ethnobiology (G-MAJB Committee, 1990).

Research has centered on the evolution of the Mayan culture. Other studies have been conducted on the protection of the endangered ocellated turkey, sedimentation, and social sciences. The Instituto de Antropología e Historia is leading archaeological research in the reserve. Studies are ongoing on aquaculture, limnology and hydrology, pests and diseases, and soils. Other current research includes forestry, impacts of recreation and tourism, resource mapping, traditional land use systems and wildlife population dynamics (Lehnhoff Temme, 1990). CATIE and IUCN are cooperating in demonstration projects in the multiple use zone east of Tikal.

There is a climatological monitoring station, conference, laboratory and library facilities (G-MAJB Committee, 1990) and a museum containing over 10,000 religious and domestic artifacts. Three hotels in Tikal provide accommodation for visiting scientists. Access to the reserve is through CONAP in Guatemala City or San Benito City (63km south of Tikal) (Lehnhoff Temme, 1990).

CONSERVATION VALUE Together with Sierra de las Minas Biosphere Reserve, Maya is the most important reserve in the country, because of its archaeological and bio/ecological interest. As well as the magnificent ruins of the Maya culture, rivers, lakes, swamps and flooding savannas are important for biodiversity and for migratory birds. The reserve contains the largest area of tropical rain forest in Guatemala and central America, with a wide range of unspoilt natural habitats. A large area of the reserve still comprises dense broad-leaved forests with more than 300 species of trees useful to man, such as cedar, mahogany, 'ramon' (Lehnhoff and Perez, 1990), Araceae (osier for furniture), chicle, pepper and others (Lehnhoff Temme, 1990). Palms, epiphytes, orchids and bromeliads are abundant. In addition, a considerable number of threatened and CITES listed species are found within the reserve.

CONSERVATION MANAGEMENT The reserve is administered by CONAP (Congressional Decree No. 4-89), through its executive secretariat, with the participation of varioua institutions. The reserve incorporates Tikal National Park, administered by the Instituto de Antropología e Historia, Los Biotopos Protegídos (Protected Biotopes) of San Miguel La Pelotada, Dos Lagunas y Laguna del Tigre-Río Escondido, administered by the Centro de Estudios Conservacionistas (CECON), and the national parks of Mirador-Río Azul, Sierra del Lacandón y Laguna del Tigre, administered by CONAP. The biosphere reserve will have a core area, cultural areas, areas of multiple use, a recovery area and a buffer zone (Lehnhoff Temme, 1990).

The Comite Coordinador de la Reserva Maya (Maya Reserve Coordinating Committee) was created to ensure coordination between the administrative entities within the reserve and other authorities. It consists of members of CONAP, who preside over it, the Instituto de Antropología e Historia, the Centro de Estudios Conservacionistas de la Universidad de San Carlos and the National Army, through the Commandant of military zone No. 23 and the Commandant of the Air Base of Santa Elena, who jointly coordinate a special system of patrolling the borders of the reserve (Congressional Decree No. 590, Article 4; G-MAJB Committee, 1990). There is a high degree of cooperation between the site and the MAB authorities, as well as between regional planning and development authorities, local communities around the reserve, and the coordinating body for integrating scientific activities at the site Lehnhoff Temme, 1990).

The core area consists of the existing Tikal National Park and the protected biotopes, the new areas include the national parks. The buffer zone consists of a 15km-wide border surrounding the reserve and within Guatemalan territory. The remaining areas will be defined in the reserve's master plan (Lehnhoff Temme, 1990).

VEGETATION The rich vegetation includes; species of savanna such as nance *Byrsonima crassifolia;* high altitude forest with chicle *Manilkara achras,* 'ramón' or bread-nut tree *Brosimum alicastrum,* West Indian mahogany *Swietenia macrophylla,* cedar *Cedrella odorata,* palma de botán (palm) *Sabal morrisiana* and palma de escobo *Chrysophylla argentea; 'tinto'* lowland forest with *Hematoxylon campechianum;* wetlands with tule *Typha* sp. around water bodies (Lehnhoff Temme, 1990). Other common tree species include cedar *Cedrela angustifolia, Vitex guameri, Aspidosperma megalocarpon, Guarea exelsa, Calophyllum brasiliense,* the palm *Sabal mayarum, Sursera simaruba, Protium copal* and *Acacia farnesiana.* The botanist L. Lundell identified over 2,000 plant species in the park area.

FAUNA Fifty-four species of mammal occur, including mantled howler monkey *Alouatta palliata nigra,* spider monkey *Ateles geoffroyi* (V), giant anteater *Myrmecophaga tridactyla* (V), lesser anteater *Tamandua tetradactyla,* dwarf anteater *Cyclopes didactylus,* three-toed sloth *Bradypus tridactylus,* nine-banded armadillo *Dasypus novemcinctus,* squirrel *Sciurus yucatanensis,* pocket gopher *Heterogeomys hispidus,* raccoon *Procyon* sp., brown coati *Nasua narica,* kinkajou *Potos flavus,* tayra *Eira barbara,* paca *Agouti paca,* long-tailed weasel *Mustela frenata,* hooded skunk *Mephitis macroura,* otter *Lutra annectens,* puma *Felis concolor,* margay *F. wiedii* (V), ocelot *F. pardalis* (V), jaguarundi *F. yagouarundi,* jaguar *Panthera onca* (V), Baird's tapir *Tapirus bairdii* (V) which is limited by water availability, collared and white-lipped peccaries *Tayassu tajacu* and *T. albirostris,* white-tailed deer *Odocoileus virginianus* and red brocket deer *Mazama americana sarterii.*

The avifauna comprises 333 species, representing 63 of the 74 families in Guatemala, and includes the threatened ocellated turkey *Agriocharis ocellata* (K), *Saracorhamphus papa, Crax rubra, Penelope purpurascens,* macaw *Ara macao,* jaribu *Jaribu mycteria* and many others, including crested eagle.

Reptiles and amphibians include the endangered Morelet's crocodile *Crocodylus moreletii* (E), the central American river turtle *Dermatemys mawii* (V), *Claudius angustatus,* nine families of amphibian and six genera of turtles, as well as 38 species of non-poisonous and poisonous snakes including coral snake *Micrurus diastema sapperi,* four species of *Bothrops* and two sub-species of rattlesnake *Crotalus.* Fishes include *Petenia splendida,* the cichlids *Cichlasoma melanorum, C. bifasciatum, c. heterospilum, C. lentiginosum, C. margaritiferum, C. champotonis, C. affine, C. hyorhynchum* and *C. pasionis* (Lehnhoff Temme, 1990). A rich invertebrate fauna, especially arthropods, also occurs.

CULTURAL HERITAGE The park's main attraction is the ruined city of the Maya Indians reflecting the cultural evolution of Mayan society from hunter-gathering to farming, with an elaborate religious, artistic and scientific culture which finally collapsed in the late 9th century. There are over 3,000 separate buildings dating from the period 600 BC to 900 AD, including temples, residences, religious monuments decorated with hyeroglyphic inscriptions and tombs. Excavations have yielded remains of cotton, tobacco, beans, pumpkins, peppers and many fruits of Precolumbian origin. Large areas are still to be excavated.

LOCAL HUMAN POPULATION Five municipalities are located within the reserve, with an approximate population of 8,000. Agriculture, artisanal fishing, forest dwelling, gathering and hunting are the main activities. It is expected that the reserve will benefit local people by increasing opportunities in training and education, recreation and tourism and by maintenance of their traditional cultures and resource use practices. The road network will also facilitate the movement of local people in the area (Lehnhoff Temme, 1990).

VISITORS AND VISITOR FACILITIES There are three hotels in Tikal (Lehnhoff Temme, 1990).

SCIENTIFIC RESEARCH AND FACILITIES An integrated programme of basic and applied research supports site management objectives and sustainable conservation in the region (Lehnhoff Temme, 1990). Information is available on past aerial photography, bibliography, history of scientific studies, hydrology, biological inventories, geology, socioeconomic and cultural ethnobiology,

NAME Reserva de la Biósfera Maya

IUCN MANAGEMENT CATEGORY II (National Park)
X (World Heritage site - Criteria: ii, iv, cultural)
IX (Biosphere Reserve

BIOGEOGRAPHICAL PROVINCE 8.01.01 (Campechean)

GEOGRAPHICAL LOCATION Within the municipalities of La libertad, Flores, Melchor de Mencos, San Andrés and San José, Petén Department, north-eastern Guatemala. The nearest major town is Santa Elena in the municipality of Flores. The reserve borders Mexico to the north and west, and is adjacent to Calakmul Biosphere Reserve in Mexico. To the south-east it borders the Usumacinta River, while the eastern boundary forms the frontier with Belize. The ruins are located at 17°13'N, 89°37'W. 17°06'-17°20'N, 89°30'-89°44'W

DATE AND HISTORY OF ESTABLISHMENT Declared a national park on 26 May 1955, having originally been established as a national monument in 1931. Tikal National Park (accepted as a World Heritage site in 1979) and Laguna del Tigre (a Ramsar site) are located within the biosphere reserve. Declared a biosphere reserve on 30 January 1990 by Congressional Decree No. 5-90, based on Article 12 of Congressional Decree No. 4-89 of the Protected Areas Law (Lehnhoff Temme, 1990).

AREA 1,400,00Oha approximately

LAND TENURE State ownership primarily, research institution secondarily

ALTITUDE 60Om

PHYSICAL FEATURES The soils of El Petén-Caribbean form a sedimentary basin with deposits from the Mesozoic and the Tertiary periods. They contain limestone and dolemites showing Cretacic characteristics of karst formations with a broken relief. Soils are clayey and slightly permeable, with internal drainage, and easily compactible (Lehnhoff Temme, 1990). Two types are found in the reserve: the Yucatán shelf to the north, formed by small hills, and the Lacandon mountain chain in the centre, consisting of rounded hills of calcareous origin, mountain chains, lagoons and alluvial plains (Lehnhoff Temme, 1990). In the Lacandón area, soils are poor and there are abrupt cliffs. In the Tikal, Uaxactún and Dos Lagunas areas, the topography is undulating and soils are well drained (Lehnhoff and Perez, 1990). Laguna del Tigre and Laguna de Yaxha are the main lagoons found in the wetland area, where there are a large number of 'aguadas' or superficial swamps. The various rivers in the reserve are part of the drainage basin of the Usumacinta River in the Gulf of Mexico. This is one of the most extensive wetland systems in central America (Lehnhoff and Perez, 1990; Lehnhoff Temme, 1990). The underwater potential has not been evaluated, but it is believed that geological faults canalise water in a disorganised fashion in limestone subsoils such as this (Lehnhoff Temme, 1990).

CLIMATE Conditions are warm and humid, with mean annual precipitation of 2000mm. The rainy season lasts from May to December and it usually rains for approximately 150 days of the year. During the rainy season the winds are from the north, north-east, south and south-east, and blow in a north to south direction during the dry season. The mean annual temperature is 24°c (MAB committee, 1990).

LOCAL ADDRESSES

Aufbauleitung Biosphärenreservat Schorfheide-Chorin, Joachimschater Strasse, 1294 Gross-Schönbeck

REFERENCES

Anon. (1990a). *Biosphere Reserve Schorfheide-Chorin*. German National Committee of the MAB, Bonn.

Anon. (1990b). National Parks for Germany. *Nature and National Parks* 28(107): 10-11.

DATE June 1991

Fraxinus excelsior and smooth-leafed elm *Ulmus carpinifolia* with a variety of understorey herbs. Locally, on wetter sites, alder-birch forest occurs of predominantly common alder *Alnus glutinosa* and silver birch *Betula pubescens* with *Carex acutiformis*, yellow iris *Iris pseudacorus* and *Sphagnum* spp. Drier locations support xerophilous oak forest dominated by sessile and English oaks and Scots pine *Pinus sylvestris* with yellow pheasant's eye *Adonis vernalis* and *Potentilla arenaria* in the understorey. There are also plantations of Scots pine and silver birch which include wild raspberry *Rubus idaeus* and bilberry *Vaccinium myrtillus*. Water-related habitats support common reeds *Phragmites communis*, bulrushes *Typha latifolia*, water lilies *Nuphar lutea* and *Nymphae alba* and pondweed *Potomogeton* spp. The reserve also includes areas of semi-natural steppe vegetation (Anon., 1990a).

FAUNA A variety of fish inhabit the lakes and streams (Anon., 1990a).

CULTURAL HERITAGE No information

LOCAL HUMAN POPULATION The people of the area are involved in agriculture, fishing and a number are town dwellers. The core zones are uninhabited but about 300 people live in the buffer zones and 40,000 in the transition zones (Anon., 1990a).

VISITORS AND VISITOR FACILITIES There is an interpretive programme for tourists (Anon., 1990a).

SCIENTIFIC RESEARCH AND FACILITIES Thirty German scientists are engaged in research and foreign researchers are beginning to get involved. Much of the research is applied and connected with management, and the site is part of a long-term national monitoring programme. A variety of resource information is already available. Hydrological, watershed, air pollution and climatological monitoring stations, permanent vegetation monitoring plots, laboratory and library facilities are available; there are facilities for meetings and accommodation for 50 visiting scientists together with transportation. Educational and training programmes are varied and include facilities for local schoolchildren and adults, professional scientists and managers and research students (Anon., 1990a).

CONSERVATION VALUE The various forest types and steppe vegetation have important conservation value (Anon., 1990a).

CONSERVATION MANAGEMENT The core area is mainly used for research and education; authorised fishing and hunting are permitted and controlled management practices carried out. In the buffer zones additional activities include forestry (mainly with beech, pine, oak, douglas fir and larch) and recreation, and there is rehabilitation of terrestrial and wetland habitats with some water resource development. Minor tourist and transport development occurs. Transition zones contain more forestry; agriculture (mainly cereals, vegetables, rape, fodder crops and pasture) and tourism are more dominant and there is more human settlement. In general, forested areas are left to regenerate naturally but some relevant management is carried out, particularly outside core areas. Some of the agricultural areas in the transition zone are intensively managed with high applications of fertilizers, herbicides and pesticides. Some water bodies are used for fish farming (Anon., 1990a).

MANAGEMENT CONSTRAINTS The size of the core area is unusually small (about 3% of the total area). As yet there is no management plan, but there is a legal guarantee that one will be formulated (Anon., 1990a; J Nauber *in litt.*, 1990).

STAFF A total of nine staff involved in administration and management; five of these are university trained. None is at present assigned to education and training or research (Anon., 1990a).

BUDGET DM 800,000 (projected) (Anon., 1990a)

NAME Schorfheide-Chorin Biosphere Reserve

IUCN MANAGEMENT CATEGORY IV (Managed Nature Reserve) (parts)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.09.05 (Atlantic)

GEOGRAPHICAL LOCATION In the northern part of the Middle European Lowland near the border with Poland, just to the west of the River Oder; the old Oder forms part of the southern boundary. It is situated in the federal state of Brandenburg in the districts of Prenzlau, Templin, Gransee, Bernau, Angermünde, Eberswalde and Bad Freienwalde in the counties of Uckermark and Barnim. The nearest large town is Eberswalde-Finow (population 54,000) which is only 1km from the reserve boundary (Anon., 1990a). Approximately 53°40'N, 13°40'E

DATE AND HISTORY OF ESTABLISHMENT The reserve includes a number of nature reserves: Bollwinwiesen/Grosser Gollinsee; Buchheide; Endmoränenlasndschaft bei Ringenwalde; Krinertseen; Winkel; Reiersdorf; Poratzer Moränenlandschaft; Arnimswalde; Labüskewiesen; Grösser Briensee; Suckower Haussee; Melzower Forst; Eulenberge; Breitenteichische Mühle; Hintenteiche bei Biesenbrow; Torfbruch be Polssen; Grosser Plötzsee; Fischteiche Blunberger Mühle; Kienhorst/Köllnseen/Eicheide; Rarangseen; Grosser Lubowsee; Wacholderjagen; Grumsiner Forst/Redernswalde; Tiefer See; Breitefenn; Pimpinellenberg; Plagefenn; Niederoderbruch; Kanonen und Schlossberg, Schafergrund; Fettseemoor; Tongruben Neuenhagen; and a number of total reserves including Krinertseen. An International Biological Programme Research Site is located here. The biosphere reserve was established on 23 October 1990 by an order of 12 September 1990 (Anon., 1990a).

AREA Total area 125,891ha (including core areas of 3,502ha, buffer zones of 23,082ha and transition zones of 99,307ha). There is also a restoration area of about 4,200ha (Anon., 1990a).

LAND TENURE Most of the site is owned by national, provincial and local government, with a lesser area owned by private individuals and bodies (Anon., 1990a).

ALTITUDE 2m-138m

PHYSICAL FEATURES The area is dominated by moraine deposits which have a strong influence on the "Schorfheide", or moorland, landscape of this area. It has generally low relief with undulating plateaux dissected by minor rivers, lakes and small hills. The surface geology was laid down in the Weichsel period of the last ice age and includes deposits such as end moraines, fluvio-glacial valley deposits and outwash sands. Soils are predominantly brown earths, gleys, humic calcareous soils, low and high moor soils and alluvial soils (Anon., 1990a).

CLIMATE Transitional between maritime and subcontinental types. There is a summer (July) maximum of rainfall, with February being the driest month. Snow settles only occasionally. The maximum average temperature of the warmest month is 17.9°C and the minimum average temperatue of the coldest month is -1.1°C. At an altitude of 45m there is a mean annual precipitation of 551mm (Anon., 1990a).

VEGETATION Several types of forest are present. The most widely distributed natural type is temperate deciduous forest dominated by sessile oak *Quercus petraea* and beech *Fagus sylvatica* and including English oak *Q. robur*, small-leafed lime *Tilia cordata*, sycamore *Acer platanoides*, ash

sterile. Eutrophication is also becoming more of a problem (Common Waddensea Secretariat, 1990). Oil exploration is generally not permitted, but an exception lies in the region of Mittelplate and Hakensland, and a licence for a drilling platform has been issued at the latter, but strict precautions are taken against oil spills. However, the recent cutting off of the Nordstrand Bay (3,400ha) and installation of the oil platform 'Trischen' have affected water birds, particularly the moulting area of shelduck *Tadorna tadorna* (Anon., n.d.).

STAFF A total of 24 of which eight are university trained and three involved in training and education but none is employed in research (Anon., 1990).

BUDGET DM 3 million in 1990 (Anon., 1990)

LOCAL ADDRESSES
Nationalparkamt, Am Hafen 40a, 2253 Tönning

REFERENCES

Andresen, F.H. (1986). Wattenmeer National Park, Schleswig-Holstein. *Nature and National Parks* (24): 26-27.

Anon. (n.d.). National report - Federal Republic of Germany.

Anon. (1979). *Naturschutz aktuelle. Katalog der Naturschutzgebiete in der Bundesrepublik Deutschland*. Institut für Naturschutz und Tierökölogie der Bundesforschungsanstalt für Naturschutz und Landschaftspflege, Bonn.

Anon. (1988). News briefs. *Federal bulletin* 26(98): 37-38.

Anon. (1990). Biosphere Reserve Waddensea of Schleswig-Holstein. German National Committee of the MAB, Bonn.

Carp, E. (1980). *Directory of Wetlands of International Importance in the Western Palaearctic*. UNEP, Nairobi, Kenya and IUCN, Gland, Switzerland.

Common Waddensea Secretariat (1990). *The International Waddensea*. Common Waddensea Secretariat, Wilhelmshafen, Denmark.

Duffy, E. (1982). *National Parks and Reserves of Western Europe*. Macdonald and Co., London. 288 pp.

Grimmett, R.F.A. and Jones, T.A. (1989). *Important Bird Areas in Europe*. ICBP, Cambridge. 888 pp.

Haarmann, K. and Pretscher, P. (1988). Naturschutzgebiete in der Bundesrepublik Deutschland, Ubersicht und Erläuterungen. *Naturschutz aktuell* 3. Kilda Verlag, Greven.

WWF (1989). *Project No. 1411. The Waddensea, Netherlands, Germany and Denmark Conservation Programme*. World Wildlife Fund Yearbook 1978-1979.

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The natural character of this ecosystem has largely survived, human interference being largely restricted to construction of sea defences (Carp, 1980). An estimated 80% of plaice, 50% of sole, and 40% of herring caught in the North Sea use the international Waddensea as a spawning ground. Every year it is used by 10 million migratory birds, mainly on passage or over-wintering (Common Waddensea Secretariat, 1990). The major purpose of the biosphere reserve is to conserve an area of little disturbed coastal ecosystems. The area supports a number of species which are threatened nationally including ten plant species, three mammals (common seal, common porpoise and bottle-nosed dolphin) and 32 bird species (Anon., 1990).

CONSERVATION MANAGEMENT The national park is managed by a regional authority, the Landesamt für den Nationalpark Schleswig-Holstein Wattenmeer, but two local councils are involved in an advisory role and decision-making, enabling local inhabitants to participate. In the core area, all farming, except restricted grazing of benefit to maintaining coastal defences, is prohibited and only traditional fishing is allowed. There is no public access. This zone is important for nesting, moulting and roosting seabirds and basking seals. It includes various sites of geomorphological interest. The buffer zone can be farmed as long as this is sympathetic to wildlife. The public is excluded from some sensitive sites. In transition areas, certain types of economic activity such as sand extraction, harbour development and recreation are permitted (Andresen, 1986). Breeding birds are protected from disturbance by wardening. In the core area fishing is controlled. Salt marsh management includes grazing by sheep which are constrained by fences. The three North Sea conferences to date have recognised the need for international cooperation to reduce pollution. At the third, in 1990, the phasing out of PCBs and other harmful substances as soon as possible was recommended. In 1987, the Waddensea states established a common secretariat for cooperation in the protection of the Waddensea (Common Waddensea Secretariat, 1990). Land reclamation in front of the Hattstedter Marsh began in 1982 as part of the coastal protection measures and is now complete, but no new reclamation measures are planned, apart from a dyke to protect the Wadden area and Pellworm and a dyke around 90ha of Okholm. In 1987, a new nature reserve was developed to compensate for interference due to the dyke construction and is to be accompanied by a 10-year ecological study. There have been efforts to establish a high foreland in front of all sea dykes to break the force of the waves and establish salt marsh zones (Anon., n.d.). The National Park Act, effective from October 1985, prohibits hunting in the core areas and controls it in the buffer and transition areas by a system of regulations and licences. Seal hunting is only permitted for scientific purposes. In connection with maintaining the seal population, water pollution and habitat use of seals is monitored (Anon., n.d.).

MANAGEMENT CONSTRAINTS Only a small part of the international Waddensea is covered by the biosphere reserve, and management would be improved if a joint biosphere between the three nations could be set up. A number of activities are having an adverse effect on the core areas including grazing, fishing, hiking and passing ships and smaller boats. Motor boats and sailing craft are putting increasing pressure on core areas and, in 1988, efforts to introduce regulations were made (Anon., 1988). Mussel culture is carried out in the tidal flat areas but until recently did not cause problems in core areas, being on a traditional scale. Recent increases, however, in large-scale fishing, mainly by Dutch firms, has led to a need for regulation (Anon., 1988). Sheep are grazed and hunting occurs on the salt marshes. Fisheries in the area harvest shrimps, mussels, cockles *Cerastodoma edule* and plaice *Pleuronectes platessa*. The number of visitors is considerable. Tourism has increased considerably during recent years and other human activities, such as air traffic, military activity and fishing, disturb the birds and seals and may affect global populations of migratory bird species. Dyking, mainly for coastal protection and acquiring fertile agricultural land, has reduced the area of saltmarshes, an important element of the ecosystem. Over 161,872ha have been embanked since 1950 (Common Waddensea Secretariat, 1990). In general, current human activities in the Waddensea as a whole can be supported, although some extinctions have been caused by pollution and overexploitation (WWF, 1989). However, contamination from inflowing rivers and the atmosphere by heavy metals, other toxic substances and overloading of nitrogen and phosphate is becoming a problem. Accumulation of toxins in the food chain has caused some seals to become

CLIMATE A temperate maritime climate with maximum average temperature of the warmest month 17°C and minimum average temperature of the coldest month 1°C. At an altitude of 5m there is an annual precipitation of 650mm (Anon., 1990).

VEGETATION The tidal mudflats are locally rich in eel-grass *Zostera* sp. (Carp, 1980). Newly formed areas support glasswort *Salicornia herbacea* and rice grass *Spartina townsendii* (Carp, 1980). Salt marsh areas are dominated by common salt-marsh grass *Pucinella maritima*, fescue *Fescue rubra* and glasswort *Salicornia europea*. The main sand dune vegetation is marram grass *Ammophila arenaria* with couch grass *Agropyron* spp. The algae, macrophytes, phytoplankton and microphytobenthic organisms are well documented (Anon., 1990).

FAUNA This section of the Waddensea supports thousands of waders all year round. It is of major importance as a stopover area for thousands of wildfowl and waders, especially Bewick's swan *Cygnus cygnus columbianus* (250), greylag goose *Anser anser* (800-1,000), barnacle goose *Branta leucopsis* (40,000-60,000), Brent goose *Branta bernicula* (60,000-80,000), shelduck *Tadorna tadorna* (100,000 moulting; the most important moulting area in north-west Europe), wigeon *Anas penelope* (100,000-150,000; 5,000 wintering), gadwall *A. strepera* (800), teal *A. crecca* (20,000-25,000), shoveler *A. clypeata* (2,000), eider *Somateria mollissima* (100,000; 50,000 wintering), oystercatcher *Haematopus ostralegus* (150,000; 65,000 wintering), avocet *Recurvirostra avocetta* (5,000), ringed plover *Charadrius hiaticula* (10,000), grey plover *Pluvialis squatarola* (25,000), knot *Calidrius canuta* (400,000; 8,000 wintering), dunlin *C. alpina* (400,000), little stint *C. minuta* (1,000-1,500), bar-tailed godwit *Limosa lapponica* (80,000), whimbrel *Numenius phaeopus* (2,000), curlew *N. arquata* (40,000; 15,000 wintering), greenshank *Tringa nebularia* (3000) and redshank *T. totanus* (16,000) (Grimmett and Jones, 1989). The tidal flats support bristle worm *Arenicola marina*, laver spire shell mollusc *Hydrobia ulvae*, common mussel *Mytilus edulis*, shrimp *Crangon crangon* and sandhopper *Corophium volulator* and are used by common seal *Phoca vitulina*. Common porpoise *Phocoena phocoena* and bottle-nosed dolphin *Tursiops truncatus* live in the waters offshore. Zoobenthic and invertebrate nekton have been well documented and marine mammal, fish and bird species in the Waddensea area as a whole have been listed extensively (Anon., 1990).

CULTURAL HERITAGE The Waddensea has long been a mussel fishing area and many of the smaller islands are man-made, with dyking and coastal protection measures influencing the natural ecosystems (Anon., 1990).

LOCAL HUMAN POPULATION The local population is involved in agriculture and fishing, and some populations are predominantly urban. There are no permanent inhabitants in any of the biosphere reserve zones (Anon., 1990).

VISITORS AND VISITOR FACILITIES The biosphere reserve is considered to have great recreational value and tourism potential. There are about 10 million visitors each year (Anon., 1990). A mobile information centre helps with interpretive programmes (WWF, 1989). A series of about 30 information centres are planned to increase public awareness (Anon., n.d.).

SCIENTIFIC RESEARCH AND FACILITIES Research in the area has been wide-ranging, including biological surveys, agricultural and maricultural studies and on the effects of pollution and sea level changes on ecosystems (Anon., 1990).

CONSERVATION VALUE The Waddensea, lying along the coasts of Holland and Denmark, is the largest marine wetland in Europe and is of vital importance for migratory birds, marine mammals and North Sea fisheries (WWF, 1989). It supports thousands of waterfowl all year round and the Norderoog Bird Sanctuary is one of six breeding sites for sandwich tern *Sterna sandwichensis* in Germany (Duffy, 1982). The mudflats have a rich fauna and the salt meadows harbour many invertebrates, providing an excellent breeding site for barnacle goose, in particular (Andresen, 1986).

NAME Waddensea Biosphere Reserve of Schleswig-Holstein

IUCN MANAGEMENT CATEGORY V (Protected Landscape or Seascape)
IV (Managed Nature Reserve) (parts)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.09.05 (Atlantic)

GEOGRAPHICAL LOCATION On the border with Denmark on the north-west coast of the state of Schleswig-Holstein in the districts of Dithmarschen and Northern Frisia. The reserve lies to the north of the Elbe estuary, bordering the North Sea, about 100 km to the west of the town of Kiel. 53°52'-55°04'N, 08°13'-09°00'W

DATE AND HISTORY OF ESTABLISHMENT The site was designated as Wattenmeer (Schleswig-Holstein) National Park in October 1985. Prior to this a number of reserves had already been created within its boundaries: Vogelfreistätte Wattenmeer östlich Sylt (27,000ha); Nord-Sylt (1,790ha, established 1979); Kampener Vogelkoje auf Sylt (10ha); Morsum Kliff (43ha); Baggerkuhle im Rantumbecken/Sylt (14.3ha); Rantum-Becken (560ha); Rantumer Dünen/Sylt (397ha); Hörnum Odde (157ha); Nordfriesisches Wattenmeer (140,000ha, established 1974); Nordspitze Amrum (71ha); Amrumer Dünen (728ha); Vogelfreistätte Hallig Norderoog (23ha); Hallig Suderoog (60ha); Hamburger Hallig (216ha); Hallig Südfall (58ha); Insel Trischen (233ha) (Anon., 1979; Haarmann and Pretscher, 1988). The area was accepted as a biosphere reserve in 1990. It is planned to designate a Ramsar site here (Anon., 1990).

AREA The national park and the biosphere reserve both have a total area of 285,000ha; within the biosphere reserve are defined core areas of 85,500ha; buffer zones of about 6,400ha; and transition areas of about 193,100ha, the boundaries between the latter two zones not having been laid down yet. With the creation of the Nationalpark Niedersächsisches Wattenmeer (240,000ha) and the Nationalpark Hamburgisches Wattenmeer, all the German Waddensea is protected (Anon., 1990).

LAND TENURE Most of the land is owned by the national government with small areas owned by provincial and local government, private conservation organisations and international bodies (Anon., 1990).

ALTITUDE Land area from sea level to 30m with sea areas up to 12m deep (Anon., 1990)

PHYSICAL FEATURES The Schleswig-Holstein section of the Waddensea is merely a section of an international complex of mudflats, coastline and marshes which form a single ecological unit and is the largest sedimentary coastline in Europe. It includes stretches of inland waters between and around the many islands and has extensive tidal mudflats with a tidal range of about 2.5m on a roughly 12-hour cycle. Some islands and banks remain above high tide level. Holocene deposits form most of the area, lying on top of diluvial sediments. Several estuaries are included and tidal flats occur both in the lee of islands and exposed to the open sea. There are areas of sand dunes and geest islands, while salt marshes have developed on some islands and along the estuaries. Sedimentation is occurring continually in calm, sheltered areas. Soils are predominantly sandy although the substrate includes mud in areas sheltered from the sea. Some small marshy man-made islands called Halligen are included, originally created to provide additional fertile land for farming, and the landscape has been influenced by man to some extent for many centuries (Anon., 1990).

Haarmann, K. and Pretscher, P. (1988). Naturschutzgebiete in der Bundesrepublik Deutschland, Ubersicht und Erläuterungen. *Naturschutz aktuell* 3. Kilda Verlag, Greven.

Kral, F. and Rall, H. (1990). *Nationalpark Berchtesgaden Wälder Geschichte, Zustand, Planung*. Forschungsbericht 19. Nationalparkverwaltung Berchtesgaden, Doktorberg.

Reiss, W. and Biebelriether, H. (1984). Administration and management of protected areas in West Germany. Proceedings of the 24th Working Session of IUCN-CNPPA, Madrid, Spain, 3-4 November 1984.

Zierl, H. (1980). National Park Berchtesgaden. *Nature and National Parks* 18(70): 10-12.

Zierl, H. (1983). Environmental education in the Berchtesgaden National Park. Unesco MAB Programme First International Biosphere Reserve Congress 26 September-2 October 1983, Minsk/BSSR-USSR.

Wirth, H. (1979). *Nature reserves in Europe*. Edition Leipzig. 330 pp.

Wörnle, P. (1985). *Der Funtensee*. Forschungsbericht 7. Nationalpark-verwaltung Berchtesgaden, Doktorberg.

Wunder, H. and Hertzog, A. (1985). *Nationalpark Berchtesgaden. Ein Schutzgebiet in Bilden*. Nationalparkverwaltung Berchtesgaden, Doktorberg.

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are training programmes for scientists. The area is one which is involved in the national soil research programme, primarily for studies in mass transport and erosion. There are plans to reintroduce lynx and bearded vulture (Anon., 1990a).

CONSERVATION VALUE The area is important for conservation because of its great natural beauty and the range of relatively undisturbed habitats and the area supports a number of plants which are on the Red List for Bavaria. The forests are also important for soil and water conservation (Anon., 1990a).

CONSERVATION MANAGEMENT Although the administration of the park is constitutionally undertaken by the Landratsamt Berchtesgadener Land, an authority at the county level, the park administration, forms its own division within the Landratsamt (Reiss and Bibelriether, 1984). The core area is used primarily for scientific research and education, with disturbance of natural ecosystems strictly forbidden, but tourist use and authorised fishing also occur. In the buffer zones agriculture and various management practices are undertaken, including restoration of natural habitats and water supply development projects. Additional activities permitted in the transitional areas are collecting specimens of plants and animals, forestry (including spruce, beech, fir and larch), grazing (mainly of cattle), hunting, tourist development, transportation and human settlement. The use of pack animals and boats in connection with research requires special permission (Anon., 1990a).

MANAGEMENT CONSTRAINTS Rehabilitation of forest areas will not be completely achieved without a reduction in numbers of red deer and the removal of forest pasture, which are now underway (Zierl, 1980). Farmers have ancient rights to graze their cattle in the foreest which prevents natural regeneration. Erosion and acid rain adversely affect the trees. Recreation and visitor management are also a problem as tourism is year round (Reiss and Bibelriether, 1984). Military training is thought to undermine the area's importance for golden eagle (Grimmett and Jones, 1989). Water purification plants for inns on the shores of the Königssee at one stage could not cope with the continued growth in visitor numbers and waste started to build up so that DM 1.8 million was invested in improvements. Agriculture here also includes intensive pastoral farming and animal husbandry and there is a long-established salt mine (Anon., 1990b).

STAFF A total of 64 staff including 51 involved in administration and management, six of which are university trained and six of whom are concerned with education. There is a research staff of seven (Anon., 1990a).

BUDGET A total of DM 4.5 million annually (Anon., 1990a)

LOCAL ADDRESSES

Landratsamt Berchtesgadener Land Nationalpark Verwaltung, Doktorberg 6, 8240 Berchtesgaden

REFERENCES

Anon. (1990a). *Biosphere Reserve Berchtesgaden Alps*. German National Committee of the MAB, Bonn.

Anon. (1990b). Waste water treatment for the Königsee. *Nature and National Parks* 28(105): 37.

Anon. (1990c). Friends of the Berchtesgaden National Park. *Nature and National Parks* 28(106): 38.

Dittrich, B. and Hermsdorf, U. (1990). *Nationalpark Berchtesgaden Biomonitoring in Waldekosystemen*. Forschungsbericht 19. Nationalparkverwaltung Berchtesgaden.

Duffy, E. (1982). *National parks and reserves of Western Europe*. Macdonald and Co., London. 288 pp.

Grimmett, R.F.A. and Jones, T.A. (1989). *Important Bird Areas in Europe*. ICBP, Cambridge. 888 pp.

BUDGET The current annual operating budget is approximately 1.2 million Kenya shillings (KWS, 1991). Financial support is received from the central administrative authority, along with support for specific projects from Wildlife Conservation International (New York Zoological Society) and the Eden Trust (London).

LOCAL ADDRESSES The Warden, Amboseli National Park, PO Box 18, Namanga

REFERENCES

Berger, D. (1990). Empowering the keepers of God's creation. *Swara* (13)2: 29-31.

FAO/UNEP (1978). Wildlife management - Kenya - plans for rural income from wildlife in Kajiado District. FAO, Rome. Pp. 75-104.

FAO/UNEP (1980). Wildlife management - Kenya - project findings and recommendations. Terminal Report. FAO, Rome. Pp. 76-79.

KWS (1990). *A policy framework and development programme 1991-96 - Annex 6: Community conservation and wildlife management outside parks and reserves*. Kenya Wildlife Service, Nairobi. 181 pp.

KWS (1991). Biosphere reserve nomination form. Kenya Wildlife Service, Nairobi. 30 pp.

Lindsay, W.K. (in press). Integrating parks and pastoralists: some lessons from Amboseli. In: Anderson, D. and Grove, R. (Eds), *Conservation in Africa: policies and practice*. Cambridge University Press, Cambridge.

Mepham, R.H. and Mepham, J.S. (1992). Directory of African Wetlands. IUCN, Gland, Switzerland/UNEP, Nairobi, Kenya. Pp. 162-188.

Thorsell, J. (1980). CNPPA protected area information sheet-Kenya. IUCN, Gland, Switzerland. 3 pp.

Thorsell, J.W., Dean, P.B., Kamau, C. and Oguya, B. (1981). Amboseli National Park Management Plan. Wildlife Planning Unit, Ministry of Environment & Natural Resources.

Western, D. (1973). The structure, dynamics, and changes of the Amboseli ecosystem. PhD thesis. University of Nairobi. (Unseen)

Western, D. (1982). Amboseli National Park: Enlisting migratory herdsmen for wildlife conservation. Animal Research and Conservation Centre, Nairobi, Kenya. 12 pp.

Western, D. (1984). Amboseli National Park. Human values and the Conservation of the Savanna Ecosystem. In: McNeely, J.A. and Miller, K.R. (Eds), *National Parks, Conservation and Development*. Smithsonian Institution Press, Washington DC.

Western, D. and Thresher, P. (1973). *Development plans for Amboseli*. Report to the International Bank for Reconstruction and Development. WPU Ministry of Environment and Natural Resources. 99 pp.

World Bank (1976). *Republic of Kenya: Appraisal of the wildlife and tourism project*. Tourism Projects Department, World Bank, Washington, DC. 27 pp.

DATE 1984, updated June 1991

NAME Great Gobi National Park

IUCN MANAGEMENT CATEGORY VIII (Multiple Use Management Area)
XI (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 2.22.08 (Takla-Makan-Gobi Desert)
2.30.11 (Mongolian-Manchurian Steppe)

GEOGRAPHICAL LOCATION Located in the south-west of the country on the border with the Republic of China. The national park is split into two parts. The smaller western section lies entirely within the aimag province of Hvod, 280km south of Hvod adjoining the Chinese Autonomous Region of Xinjiang Uygur. The larger eastern section lies two-thirds within the aimag of Gobi Altai centred on the mountain peak of Atlas Bogd and lying 230km south of Altai, and one-third in the aimag of Bayan Khongor; the section as a whole adjoining the Chinese province of Gansu, the autonomous regions of Xinjiang Uygur and Nei Monggol. This section is known as the "A" area. The smaller section, known as the "B" area, also lies in the aimag of the Gobi-Altai, as well as in the aimag of Khorad. Dzungarian Gobi ("B") - 44°50'-45°40'N, 92°00'E-94°20'E; Trans-Altai Gobi ("A") - 42°30'N-44°30'N, 95°30'E-99°10'E

DATE AND HISTORY OF ESTABLISHMENT Established in 1975 (Decree No. 84, on 4 April) and legislated by the Presidium of Great People's Khural of the Mongolian People's Republic in Decree 283/196 in 1976. A secondary level of legislation is covered by administrative regulations and executive decrees. In addition, a series of legal texts has an indirect bearing on the site. These include the MPR Constitution, the MPR Law on State Border, the Land Exploring Code, the MPR Law on Forest, the MPR Law on Water, the Hunting Game Code and the Atmosphere Code.

AREA Total 5,300,000ha. In two sections: the smaller western occupies 881,000ha; the larger eastern occupies 4,419,000ha.

LAND TENURE State ownership (devolved to local government for purposes of administration and to research institutes for scientific investigations).

ALTITUDE Ranges from 850m to 2,695m.

PHYSICAL FEATURES The relief of the area results from alpine tectonics and processes of denudation, the latter giving rise to vaulted ridges and mountains separated by depressions and plains. The broad undulating plains, alternating with ridges, small hills and mountain ranges, are cut by a large number of wet-weather rills, termed sairas and filled usually only in July and August. Ninety-nine percent of the national park is an arid/semi-arid desert of rocks and wind-blown sand and local alkali flats, of which over 70% is semi-arid steppe. Extensive areas are devoid of vegetation particularly on the tops and slopes of some hills and knolls where large deposits of gypsum occur. Soils vary from brown-reddish-yellow gypsum with heavy sandy silt loam through to light loamy, brown and strongly gravelled soils and to skeletal silty-loam carbonate soils. There are no natural springs within the western section and water sources are limited to snow in the winter. Even then snow cover is minimal and only remains throughout the winter along the southern mountain chain. The eastern section of the national park has eight natural waterpoints, two of which (Takhin-Us and Khonin-Us) located in the northern area of the park are most important for wild ungulates. There are a number of temporary salt lakes and associated spring-fed, 100-1500m long streams, as well as a few oases (some covering several sq km) and formed around springs such as at Talhiin us, Gun tamga, Shar Khuls and Tsagaan burgas, Olgon us, Maikhan and Ulaan Chulun. The eastern section

contains all the ecological regions which characterise the Great Gobi system, whilst the western cold desert section has a greater wealth of plant life. The "A" area is divided into a northern sector described as the Baruun-Khangai zone, together with the massif of Bdrengiin and adjoining sloping plains and small hills; the middle (lower part) consists of a series of depressions (being an eastern extension of the Nomym Gobi), whilst the southern part includes the Atas, Chinghis, Tsagaan Bogd massif and the small hills and sloping plains and depressions of the Gobi Tian Shan. The "B" area lies fully within the Baruun-Khangai zone, consisting of the depression of the Baruun-Khuurai and the ridges of the Khautag and Takhiin Shar.

CLIMATE Average annual precipitation ranges from 29-138mm being wettest in July and August (in the north outside the national park it may reach 200mm). Mean annual temperature ranges from -17°C to 37°C but absolute minimum and maximum temperatures greatly exceed these values (between -24°C and 40°C). The climate in the western section is sharply continental with clear skies, low humidity, infrequent rainfall, cold winters, large fluctuations in the daily and annual temperatures and marked charges in the seasons. Rainfall varies from 1.5mm in February to 33.7mm in July. The temperature varies from -26°C in January to 19°C in July. There are on average 90 frost-free days per year and wind velocity averages 24m per second and is predominantly northern and north-western in origin. The climate in the eastern section is broadly similar. The rainfall varies from 0.2mm in December to 9.6mm in July; temperatures from -19.7°C in January to 23.8°C in July; and the wind averages 20m per second from the north and the north-west.

VEGETATION In total 410 species from 49 families and 195 genera have been recorded. The western section has scarce vegetation dominated by grasses. The desert kolls are covered by xerophytic bushes including *Ilyinia regelii*, *Anabasis brevifolia* and *Reaumuria songarica*. The latter dominates the lower areas and the plains as well as the outlying areas of vast, close hollows (toirims). The most widely distributed plant is saksaul bush *Haloxylon ammodendron*. As a result of almost continuous drought over the last decade however, many have died out especially on sandy-loam substrates (Long, 1989). The dry water courses (sayor) with irregular flash floods are dominated by *Tamarix* spp. and *Typha* spp. *Ephedra przewalskii* with *Allium* spp. is mainly abundant on the lower slopes of mountain canyons/valleys . Oases contain *Populus diversifolia*, *Nitraria roborovsky*, *N. sibirica*, *Achnatherum splendens*, *Tamarix sibirimosissima* and *Salix ledebouriana*. General browse species include *Caragena* spp and various legumes, for example, *Amniopipthanus mongolicus*. On sand dunes *Nitraria sphaerocarpa* is predominant. There are basically four types of steppe-pasture which are most widely distributed: 1. Haloxylon-stony pasture often co-existing with *Reaumuria songarica*; 2. *Colocasia antiquorum-Nanophyton erinaceum* pasture found on the mountain slopes and plains; 3. Russian feather-grass pasture present in the desert-steppes and consisting of *Anabasis brevifolia* and *Allium bidentatum*; and 4. *Anabasis brevifolia-Reaumuria songarica-Nanophyton erinaceum* pastures. The eastern section is largely occupied by pastures of the Haloxylon and Reaumuria-Haloxylon types with smaller areas of Haloxylon-sandy and Haloxylon-saline types present. Here the plant cover is dominated by *Reaumuria songarica*, *Anabasis brevifolia* and *Allium polyrrhizum*.

FAUNA A total of 175 species of 120 genera has been recorded. Snow leopard *Panthera uncia* (E) (1,500-5,000 specimens in 1982; in 1985 a new estimate suggested 200 plus or minus 30, the latest figures for 1988 are A: 30, B: 25), ibex *Capra sibiricus*, argali sheep *Ovis ammon* (A: 400, B: 300), goitred gazelle *Gazella subgutturosa* (A: 900, B: 1100), saiga antelope *Saiga tatarica mongolica*, wolf *Canis lupis* (V) (120), Gobi bear *Ursus arctos pruinosus* (known locally as "mazaalai"; A: 50-55), Asiatic wild ass *Equus hemionus* (V) (A: 800, B: 1200), wild Bactrian camel *Camelus ferus* (V) (known locally as "havtagai"; A: 500-525 in 15 grazing areas centred on oases). There is currently a project to reintroduce Przewalski's Horse *Equus przewalskii* (Ex?). In total there are records for one species of amphibian, 14 species of reptiles, 156 species of birds and 44 species of mammals. There are differences between areas "A" and "B", with the former having greater numbers of reptiles (14 compared to 6), fewer birds (133 compared 156) and slightly more mammals (44 compared to

41). Bird species include 12 species of raptor (e.g. *Gypaetus barbatus*, *Aquila chrysaetos* and *Aegypius monachus*).

CULTURAL HERITAGE No information

LOCAL HUMAN POPULATION The nearest town is Altai with a population of 42,000 and the region has an approximate population density of 0.3 inhabitants per sq km. Within the reserve proper there are no permanent residents, but 350-400 people are present in the transition zone. The western section occupies approximately 10% of the territory of the administrative district the main economic activity of which is sheep breeding (numbering 73,000 head in 1975) followed by goats, cattle and camels. In the mid-1970s, in the period from September to the end of May about 50 yurts (Mongolian tent structures) and 40,000 head of livestock were moved across this western section to the Chinese border. In addition there is some winter grazing. Cattle were driven to wintering places during a 40-day period in the spring and the autumn. It is unclear whether these practices are continuing to the same level at present. In the eastern section the national park was occupied in the mid-1970s for a two month period each year, both in the spring and the autumn, and included the movement of some 30-40,000 head of livestock. This practice has apparently now been stopped, but nomads still continue to graze their cattle along the northern boundary. The Ministry of Procurement used to issue licences for trapping fur-bearing animals such as wild cat, polecat, wolf, lynx, two species of fox and hare. This may have now been stopped, at least in the eastern section of the national park. Human activity, generally, is completely prohibited in the eastern section and is strictly limited in the Dzhunzarskaya Gobi section. In areas of extreme 'security' (areas where wild ass, wild camel and bear breed and areas with representative examples of all the flora of the region) permanent car routes are established and no exceptions are permitted. These extreme 'security' zones are marked by trenches and heavy penalties are incurred by anyone who enters them illegally.

VISITORS AND VISITOR FACILITIES A plan to establish a tourist centre at Tsogt (outside the protected area) was well advanced in 1983. Eight wardens have received training in educational work in the Soviet Union and it is planned that camping expeditions into the zone set aside for tourism will eventually be arranged. To date barely 300 visitors are recorded annually. Apparently, sports hunting continues to be licensed and brings in much valued western currency (mainly from West Germany).

SCIENTIFIC RESEARCH AND FACILITIES In the last 50 years 19 expeditions have been organised by the Mongolian government to explore the Gobi; however, by 1979 the central and eastern parts were still relatively unknown. In the past research covered aspects of agriculture, biology (including the collection of flora and fauna) and study of exotic species. Surveys were carried out also on the potential of the grazing lands in the western section in 1959 and 1965 by the Research Institute of the Ministry of Water Economy. A survey in 1974-1977 failed to locate any Przewalski's horses. Research is coordinated by the administration of the park in cooperation with relevant institutions. Since 1979 there has been a joint Mongolian Government-UNEP-USSR project the aim of which is to complete a thorough geological and ecological survey of 50,000 sq km of the area. By 1982, detailed research had been carried out and support equipment (jeeps and light aircraft) had been made available. In total 12 Soviet, 16 Mongolian and one Polish experts have been engaged in this research. The site is running an internationally recognised Unesco-MAB pilot project and is also the location of a national MAB project. There is an international development project on-going, other than the MAB, involving cooperation with institutes dealing with basic or applied research, linked to sites within the same biogeographic province and outside as well as institutes engaged in *ex-situ* conservation. Most recently 11 national and 12 foreign scientists have been carrying out research largely of an integrated nature. Planned activities include research on appropriate rural technology, on biogeochemical cycles and energy flow, on comparative ecological research, ecosystem modelling and ecosystem restoration. Research material available includes general site information, aerial photographs, bibliography, ecological data and geographical information, history of the scientific

studies carried out, topographic and vegetation and land cover maps, data on freshwater and surface and groundwater hydrological resources and water quality. In addition, climatological data is available having been collected over many years at three stations - Toorai, Ekhiin gol and Baitag. The Toorai station covers the arid desert (located outside the reserve) and together with the Ekhiin gol station provides data for the "A" area, while the Baitag station covers the Jungaar Gobi steppe desert and hence the "B" area. There are also inventories of the vertebrates (other than fish and mammals), invertebrates, phytoplankton, non-vascular and vascular plants, and a map of the geology and soils (including descriptions). Research on precipitation chemistry is on-going, whilst that on the socio-economic and cultural ethnobiological aspects of the reserve is planned. Research facilities available include, in addition to the climatological and hydrological stations, conference rooms and lodgings for visiting scientists. There is additional storage and curatorial space for biological and environmental collections. Further research facilities are available at the Ekhiin gol nuclear station. UNEP assisted in the first internationally financed project 'Assistance to the MPR in forming the Great Gobi National Park'.

CONSERVATION VALUE THe site contains classic examples of central Asian deserts particularly in the Gobi and Jungaar sections. The area is geographically isolated, altitudinally significant (averaging 1,400m) displaying continental arid features and supports rare desert and mountain steppe vegetation and populations of wild camel, gobi bear, snow leopard and others. The protection status of the site provides soil and water conservation, assistance in the maintenance of traditional ways of life and resource protection and through the increasing local participation in planning and management further benefits such as employment, education, training, financial assistance, health service and some development aid can be expected.

CONSERVATION MANAGEMENT Management is in the form of long-term programmes and recommendations aimed at maintaining the natural complexes of the reserve. This is manifested in the form of the Budget and Plan of Game Hunting. Precise demarcations of the separate sections have been prepared and 50 metallic notice boards have been fixed along the northern boundary. A number of new wardens have also been appointed and a park centre with 14 beds is to be constructed. The reserve is zoned into core area covering 985,000ha, a buffer zone of 3,172,200ha and a transition zone of 1,142,800ha. Activities in the core are strictly limited to scientific plant and animal collecting, biological inventorisation, long-term environmental monitoring and education. No negative activities have been recorded. The buffer zone is used largely for inventory work, scientific collection of plants and animals and the fulfilment of management practices. The same is true for the transition zone. The hunting of game animals has been banned in the eastern section which additionally has legal prohibitions on economic land use, soil, earth and vegetation removal, construction work and entry into the area without permission. The eastern section is zoned into a strict reserve area and an area which is due to be opened for recreation and tourism. In the western section grazing continues to be permitted but is strictly controlled. The 1979 UNEP-USSR-Mongolian project aimed at preparing a master plan for the park as well as educational, training and ecological monitoring programmes. Staff are trained in protected areas management and in provision of services to the local population, as well as in interpretive programmes for tourists, for graduates and post-graduate researchers. Plans exist to extend the training and education to school children and students through the use of demonstration projects in conservation and rational use of natural resources, as well as the provision of professional training for scientists, resource managers and planners. Two re-introduction experiments are being carried out at the Bayan-Turhoie centre (outside the reserve but closely linked); one for *Saiga tatarica*, the other for *Camelus ferus*. The results are described as quite good (Long, 1989). A plan for the re-introduction of *Equus przewalskii* was envisaged for 1990 with one group of animals going to the "B" area and the other to be based at Bayan-Turhoie (Long, 1989). The Master Plan for Management deals with biotechnological measures such as wolf population reduction, bear feeding from March to October and ungulate feeding in the winter.

MANAGEMENT CONSTRAINTS The site is predominantly undisturbed. Within the buffer zone, grazing and agriculture are the co-dominant activities with less pressure from human settlements, hunting and trapping and poaching and minimal residential and tourist as well as transportation development together with industry such as water resources projects. As in the buffer zone, grazing is the most common activity in the transition zone, together with limited agriculture, gathering of natural products and some visible deterioration of the natural habitats. Some grazing pressure and firewood gathering occurs, which is a particularly acute problem in an area where car-tracks remain visible for five to fourteen years. There is considerable complaint from local herdsmen that their sheep and goats are being attacked by snow leopards and pressure is building to permit these to be controlled. Similarly in the past the local authorities have proposed that livestock units using the winter pastures in the Edergiin Nuruu region be increased from 30 to 100,000, but both suggestions have been quashed by central Government. The herdsmen carry weapons which are used occasionally for poaching, mainly of goitred gazelles and wild ass. The wolf population is considered a strong predator on camel herds, and some control is being exercised with 76 (mostly cubs) removed in 1988 and a further 43 in the first six months of 1989 (Long, 1989).

STAFF Total staff of 35 with six in administration and management. Three have university training and three are full time researchers. The wardens are equipped with radios and motorcycles.

BUDGET Expenses are covered from the State budget and are in the order of 480,000 tugriks per annum (c. US$ 150,000).

LOCAL ADDRESSES

MPR, Gobi-Altai aimak, Tsogt somon, 051501

REFERENCES

Bugayev, K. (n.d.). *Wild Camel of Transaltai Gobi*. Unpublished mss. 10 pp.

Bugayev, K. (n.d.). *Gobi Mountain Bear of the Mongolian People's Republic*. Unpublished mss. 12 pp.

Child, G.S., and Hunkeler, P. (1976). *Establishment and management of protected areas in the Gobi region, Mongolian People's Republic*. FAO/UNEP/IUCN.

Dash, Y., Szaniawski, A, Child, G.S. and Hunkeler, P. (1977). Observations on some larger mammals of the Transaltai, Djungarian and Shargin Gobi, Mongolia. *La terre et la vie*. 31 reproduced in *Tigerpaper* 5(2): 5-10.

Long, G. (1989). *Mission Report on Mongolia*. Final Report. MAB.

UN (1983). Project on environmental protection Project FP (1103-78-01) "Assistance to the MPR in forming the Great Gobi National Park" General plan of the GGNP Vol.1 and Vol 2. (Unseen).

Zhirnov, L.V. and Il'inskiy, V.O. (1985). *Bol'shoy Gobiyskiy Zapovednik - Ubezhishche Redkikh Zhivotnykh Pustyn' Tsentral'noy Azii*. TsMP. GKNT. SSR Moskva (in Russian). This reference contains 121 other references to the Great Gobi Desert NP.

DATE 22 June 1983, revised July 1987, July 1991

NAME Land between the Lakes Biosphere Reserve

IUCN MANAGEMENT CATEGORY IV (Managed Nature Reserves)
V (Protected Landscape)
IX (Biosphere Reserve)

BIOGEOGRAPHICAL PROVINCE 1.05.05 (Eastern Forest)

GEOGRAPHICAL LOCATION Land between the Lakes is situated in south-eastern USA. The site is a narrow peninsula 64km long and 12km wide, between the loweost reaches of the last downstream impoundments of the Tennessee and Cumberland rivers. Shawnee National Forest is situated 60km north-west of the biosphere reserve in southern Illinois. The Land between the Lakes site is included in ten counties of the State of Kentucky (Caldwell, Calloway, Crittenden, Graves, Christian, Livingston, Lyon, Marshall, McCracken and Trigg) and three in Tennessee (Henry, Montgomery and Stewart). Approximately 36°47'N, 88°03'W

DATE AND HISTORY OF ESTABLISHMENT Includes Land between the Lakes (LBL) National Recreation Area acquired in 1964, an area of 68,800ha (Cross Creeks and Tennessee national wildlife refuges were recommended for inclusion but are currently outside the reserve boundary). Part of the area has been designated as a national natural landmark by the National Park Service. Additional designations include the experimental ecological reserve designation of 1980 (Anon., 1991).

AREA Core area 5,725ha, buffer zone 63,072ha (US Tennessee Valley Authority, TVA) and transition zone 1.5 million ha (Anon., 1991)

LAND TENURE There are no privately owned lands. 68,797ha of publicly owned land is administered by the US Tennessee Valley Authority (TVA). The two large reservoirs surrounding the majority of the LBL are administered by TVA (Kentucky Lake) and the US Army Corps of Engineers (Lake Barkley).

ALTITUDE 108m-201m

PHYSICAL FEATURES The topography consists of sloping terrain, which is determined by the proximity of the parallel valleys of the lower reaches of the Tennessee and Cumberland rivers. Narrow ridges and valley with moderately steep slopes form short drainage channels for 900km of intermittent streams and 55km of perennial streams. LBL is at the north-western edge of the highland rim section of the interior low plateaux physiographic division of the United States of America (Anon., 1991). The lower Tennessee River is at the boundary of the Mississippi embayment of the Gulf Coastal Plain and coastal plain deposits veneer much of the area. Soils are low in nutrients and not favourable for cultivation, except in valleys on ridge tops; loess generally overlies gravels of the area. Bottomland soils are fluvial sediment derived fromn erosion of the uplands. Geological periods include the Mississippian, Cretaceous and Quaternary. The only unimpounded sections of the rivers lie just north of the LBL and flow north-west 35km and 48km, respectively, before discharging into the Ohio River, which flows 50km and discharges into the Mississippi River. The entire site is 96% surrounded by water.

CLIMATE The climate is temperate continental. Summers are hot and dry, even though total amounts of rainfall are as great in summer as in winter. Evaporation is great and most streams and springs cease to flow over summer. Thunderstorms occur at an average rate of 45-50 per year and severe rains of 10-15 cm in a day may occur, causing severe flooding. Maximum temperature of the

warmest month is 32.2°C and the minimum of the coldest month -2.2°C. The mean annual precipitation is 1173mm recorded at 122m altitude.

VEGETATION The area is 80% forested, harbouring a diverse range of ecosystems ranging from dry wooded ridges, dry slope forests, wetlands and a variety of anthropogenic communities. The reserve is situated within the western mesophytic forest region, a transition zone where vegetation is a mosaic of types influenced by the more xeric oak-hickory region to the west, and less significantly by the more mixed mesophtyic region to the east. Barrens and prairies to the north, east and west also provide floristic elements. The creation of the reservoirs has resulted in a number of introductions of new species (about 17% of the vascular plants of the reserve are introduced species).

The area comprises 91% of upland mesophytic hardwood, including oaks *Quercus alba*, *Q. rubra*, *Q. stellata* and *Q. prunus*, hickories *Carya* spp, maples *Acer saccharum*, *A. rubrum*, sweetgum *Liquidambar styraciflua*, eastern red cedar *Juniperus virginiana*, shortleaf pine *Pinus echinata* and Virginia pine *Pinus virginiana*. Open lands comprise 8% of the reserve: open grasslands consist of broom sedge *Andropogon virginicus*, little blue stem *Schizachyrium scoparium*, Indian grass *Sorghastrum nutans* and fescue *Festuca* spp. Agricultural lands consist of soy bean *Glycine soja*, corn *Zea* spp., wheat *Triticum* spp. and millet *Panicum* spp. (Anon., 1991).

Tennessee River provides a migratory pathway for a small but significant Appalachian element and the Cumberland River likewise provides a pathway from the limestone areas of middle Tennessee. The diverse flora includes a documented 733 species of vascular plants on a 325ha natural area site within the LBL (Anon., 1991).

FAUNA Fauna occurring in the forested areas includes wild turkey *Meleagris gallo pavo silvestris*, reintroduced bison *Bison bison bison*, coyote *Canis latrans*, along with raptors such as bald eagle *Haliaeetus leucocephalus alascanus*. Eastern cougar *Felis concolor cougaris* is reported to be in the area. The reservoirs include large-mouth bass *Micropterus salmoides*, blue gill *Lepomis macrochirus*, channel catfish *Ictarus punctatus*, common carp *Cyprinus carpio* and gizzard shad *Dorosoma cedpedianum*. Pink musket pearly mussel *Lampsilis orbiculata* is found within the area as is orange-footed pearly mussel *Plethobasus cooperianus*. Alligator snapping turtle *Macroclemys temminckii* inhabits the surrounding reservoirs.

CULTURAL HERITAGE Prior to European colonisation three different cultural groups inhabited the area. Spanish explorers first came to the region in 1540, although permanent settlements were established in 1692 when French trading posts were built on the Tennessee and Cumberland rivers. The English, Scottish and Irish founded permanent settlements between 1779 and 1800. By 1804 a high quality whiskey was being produced and exported all over the country, and was illegally produced until the land was acquired in 1964. In the 1800s there was a thriving iron industry which exploited iron from the area along with large amounts of hardwood for charcoal fuel. Impoundment of the Tennessee River in the 1940s and the Cumberland River in 1960s created Kentucky Lake and Lake Barkley. A 2km canal connecting the two lakes was constructed in 1963.

LOCAL HUMAN POPULATION No people inhabit the core area, nor the buffer zone except for 0-30 intern students. In the transition zone 600,000 people live in 13 counties (Anon., 1991).

VISITORS AND VISITOR FACILITIES In 1990 there were 2.4 million visitors (from 50 states and 30 foreign countries). There are 60 tourist facilities within LBL available for public use. Recreational activities and facilities include horseback riding and cross country vehicle driving, the homeplace-1850 living museum, a woodland nature centre, and the Golden Pond Planetarium and the multi-media theatre. Adult and student groups stay at Brandon Spring group camp. LBL's residential camp houses 120 people, and also provides a variety of environmental education activities (Anon., 1991).

SCIENTIFIC RESEARCH AND FACILITIES Currently there is a total of 32 scientists, from 12 institutions, conducting research on over 40 projects. The total variety of research being undertaken includes: ecological data management systems, GIS, assessment data and maps, vegetation/land cover maps, aquatic systems, bathymetric maps, hydrological data, limnological surveys, water quality data and atmospheric data collection. In addition there are studies on acidic deposition, agricultural research, biological surveys and collection of flora and fauna, biogeochemical cycles, comparative ecological research, cultural anthropology, ecological succession, ecosystem modelling and restoration, effects of sea level change, fire histories and effects, and forestry research, limnology and hydrobiology, mining reclamation studies and rangeland research on tallgrass prairie studies (see MAB Biosphere Reserve nomination for full list, Anon., 1991).

Inventories have been made of mammals and other vertebrates, invertebrates, phytoplankton, macrophytes, geology and soils, land/water use history and continuous forest inventories (Anon., 1991).

The major research facilities are located outside the biosphere reserve such as at Murray State University, and minor research facilities are at the LBL itself. The Center for Field Biology of the LBL is at Austin Peay State University, Tennessee. The Center for Reservoir Research, with an endowed chair in applied ecosystems ecology, is at Murray State University, Kentucky. Both centres are important cooperating elements in LBL's research and environmental education activities. Research facilities include air pollution monitoring stations, climatology monitoring station, conference/meeting facilities, hydrological monitoring stations, lodgings for 16 visiting scientists (accessible from major airports (160km) and minor airfields (70km), permanent monitoring plots for vegetation. Additional facilities for environmental education include one residential group, a nature centre, and an environmental education area. LBL has 145 furnished trailers for use by researchers. In 1971 three research natural areas were established in the LBL followed by the creation of an ecology study and preserve area system. An atmospheric monitoring station was set up in 1971, providing the longest continuous rural air monitoring records in the USA. In 1980 LBL and Murray State University Hancock Biological Station were jointly designated an experimental ecological reserve by the National Science Foundation. The Centre for Reservoir Research was established in 1987 at Murray State University, permitting comparative studies of the nearby Tennessee, Cummberlands and other rivers. In 1986 a Center for Field Biology of LBL was established at Austin Peay State University in Clarksville, Tennessee. Presently 22 studies are being conducted at LBL through this centre. This centre received "accomplished status" in 1989. Another 24 studies are presently being conducted at LBL in cooperation with other institutions. A continuous forest inventory plot system was established for all TVA lands in 1966, including the 157 plots in the LBL. Training for undergraduate and graduate students has been undertaken since 1964 and apprenticeship training in several disciplines is provided for recent graduates. An university consortium was formed in 1974 for training outdoor recreation specialists, park planners, and resource managers (Anon., 1991).

CONSERVATION VALUE Threatened species of note include bald eagle *Haliaeetus leucocephalus alascanus*, red wolf *Canis rufus* (in captive breeding) and eastern cougar *Felis concolor cougaris* (presence reported but unconfirmed). Species under national or regional threat include alligator snapping turtle *Macroclemys temminckii*, orange-footed pearly mussel *Plethobasus cooperianus* and pink musket pearly mussel *Lampsilis orbiculata*. The core areas combined with larger core watersheds present an unique system for studying landscape fragmentation and old growth/managed area issues (Anon., 1991).

CONSERVATION MANAGEMENT The primary purpose of the reserve is for resource management efforts to provide a managed natural landscape for recreation and environmental education. These efforts include diversifying wildlife habitat and providing for multiple-use recreation in the LBL site and the reservoir waters surrounding the site. Restoration of native wildlife and plant species is an important linkage of research and management at the site. The reservoirs surrounding

LBL provide a land/water interface which also act as a form of buffer. The transition area and land adjacent to the reservoirs is a forested landscape, acting as an additional buffer system.

The entire core and buffer area is administered by the TVA which acquired the land in 1964. In 1987 a committee was formed to review possible candidate biosphere reserve sites and in March 1988 the LBL site was identified. A scientific panel formed in May 1988 helped LBL administrators design a core area sytem. Four area development districts have been set up with the intention of cooperation between regional planning and development authorities. The two large reservoirs surrounding the majority of the biosphere reserve are administered by TVA (Kentucky Lake) and the US Army Corps of Engineers (Lake Barkley), adding an aquatic buffer of 55,000ha around the reserve. Addition transitional zones in nearby areas of Tennessee and Kentucky include two US Fish and Wildlife Service national wildlife refuges, one National Park Service national military park, and state parks, state forests, and wildlife management areas. The non-profit LBL Association activities include fund raising, volunteer operations and constituency building.

The Land between the Lakes Resource Management Plan is presently being revised through the Environmental Impact Statement procedures of National Environmental Policy Act of 1969. Lands at LBL are managed to achieve a mosaic of different ages of vegetation to optimise habitat diversity. This requires leaving some lands to progress towards mature forest and to manipulate others. The core area totals 5,725ha, the remaining 63,072ha act as a buffer. The core area consists of 200 dispersed lands set aside in the form of old growth management stands (set aside originally to become old growth forest) and ecology study areas (Anon., 1991). The plan has identified that 5-10% of the total size be core area, including entire watersheds. The remainder serves as a buffer zone and is managed using integrated resource management approaches (Forsythe and Sharpe, 1990). Continued activities include: forestry, fishing, recreation and hunting. No timber harvest or open land maintenance activities are permitted in the core areas. Within the core area continued managed hunting is permitted using quotas for some game species, such as deer and wild turkey. Low impact forms of recreation, such as hiking, are also permitted (Anon., 1991). Agricultural activities are permitted to continue and consist of growing fields of corn, wheat, soybeans and tobacco. Pasture rotation and grass management also occurs. Planted loblolly and Virginia pine occur in the transition area. The forested portion of the buffer zone (57,572ha) is managed for sustainable yield principally by uneven aged management of timber harvests. Timber harvests as practised are considered of minimal disturbance. Livestock include beef cattle with some dairy cattle, sheep and goats.

Kentucky Lake of Tennessee River and Lake Barkley of Cumberland River are managed for flood control, hydroelectric generation, navigation, and the recreation by the TVA and US Army Corps of Engineers, respectively. Water levels fluctuate 1.3m seasonally for storage and flood control purposes. Openland includes an area of 3,885ha maintained by discing, bushhogging or controlled burning. To protect some of the native fauna and flora, the LBL authorities have taken steps to protect 27 unique sites by establishing an ecology study and preserve area network. Several LBL restoration projects have taken place, such as restoring tallgrass prairies and bottomland hardwoods, as well as reintroduction of canada geese, bald eagle, osprey, river otter, wild turkey and ruffed grouse. Two small tallgrass prairie research areas are maintained by fire management (Anon., 1991).

Unesco/MAB training has been conducted at the site since the mid-1970s for international scientists and resource managers in association with the University of Tennessee (Anon., 1991).

MANAGEMENT CONSTRAINTS Timber harvest, recreational area development and tourism have put pressures on native flora and fauna. The impoundment of the rivers to form lakes led to the inundation of prime farmland, bottomland, and wetland habitats in the 1960s. New species have been introduced around the lakes. The iron industry of the 19th century exploited large areas of timber resources and iron ore, resulting in a total lack of virgin forest.

STAFF 120 permanent, 60 seasonal staff (Anon., 1991), consisting of 12 resource management, 21 patrol and eight administrators (Anon., 1991). There are 36 staff for education and demonstration purposes, 18 support and 18 professional staff. There are no full time research positions but there are eight part time employees for the biosphere reserve and 23 cooperating institutions (Anon., 1991).

BUDGET US$ 7.6 million congressional appropriations; US$ 2.2 million user fee and timber sales income (Anon., 1991)

LOCAL ADDRESSES

Land between the Lakes, 100 Van Morgan Drive, Golden Pond, Kentucky 42211-9001 (Tel: 502 924-5602)

REFERENCES

Anon. (1991). Nomination Dossier, Proposed Land Between the Lakes Area Biosphere Reserve. National MAB Committee for USA.

Forsythe, T.D. and Sharpe, D.M. (1990). Selecting core areas in Land between the Lakes for a proposed biosphere. Attachment 3. Pp. 59-60.

DATE July 1991