World Heritage Sites

Protected Areas and World Heritage

United Nations Educational, Scientific and Cultural Organization

In cooperation with UNESCO's World Heritage Centre

DANUBE DELTA
ROMANIA

The waters of the Danube as they enter the Black Sea, form the second largest and the best preserved of European deltas at a meeting point of the Palaearctic and Mediterranean biogeographic zones. It is a dynamic relatively wild ecosystem with a rich diversity of wetland habitats, numerous lakes, ponds and marshes which attract over 300 species of birds and 45 species of freshwater fish.

COUNTRY
Romania

NAME
Danube Delta

NATURAL WORLD HERITAGE SERIAL SITE
1991: Inscribed on the World Heritage List under Natural Criteria vii and x.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE [pending]

INTERNATIONAL DESIGNATIONS
1979: Designated a Biosphere Reserve under the UNESCO Man & Biosphere Programme, extended 1992 (580,000 ha).
1991: Designated a Wetland of International Importance under the Ramsar Convention (647,000 ha).
1998: Designated part of a transboundary Biosphere Reserve with Dunaisky in Ukraine (626,403 ha).

IUCN MANAGEMENT CATEGORY
II National Park

BIOGEOGRAPHICAL PROVINCE
Pontian Steppe (2.29.11)

GEOGRAPHICAL LOCATION
Situated in the Dobruja, on the coast of the Black Sea at the mouth of the River Danube. The site lies between the River Chilia on the Ukrainian border and the Sulina and Sfintu Gheorghe branches of the main stream. The site also includes the Razelm-Sinoie complex of Lakes Razelm, Sinoie, Zmeica and Golovita immediately south of the delta. Central coordinates: 44°25' to 45°28'N by 29°42' to 28°45'E.

DATES AND HISTORY OF ESTABLISHMENT
1938: Letea Forest proclaimed a Nature Reserve by Council of Ministers Decision 645;

1961: Rosca-Buhaiova, Sfintu Gheorghe-Perisor-Zatoane, Periteasca-Gura Portiti and Popina Island proclaimed Nature Reserves by Council Decision 891;

1971: The forests of Caraorman and Erenciuc proclaimed Nature Reserves by Forestry Management;

1975: The Danube Delta protected areas extended to cover 41,500 ha by Council Decision 524;

1979: Rosca-Buhaiova Reserve, Letea Forest Reserve and Lake Hrecisca (totalling 18,145 ha) combined in a designation as Rosca-Letea UNESCO Biosphere Reserve; extended in 1992;

1979-90: The whole delta area was subject to the 'Complex Plan for Economic Development of the Delta;

1990: An area of 442,000 ha including all previous designations, proclaimed a national Biosphere Reserve by Decree 983 with Articles 5 & 6; In 1991 the area was enlarged to 547,000 ha;

1991: Patrimony of the national Biosphere Reserve given to the Delta Authority by Decree 264/91;

1991: The Delta designated a Ramsar Wetland Site;

1998: The Delta designated a transboundary UNESCO Biosphere Reserve including Dunaisky Reserve in Ukraine (46,403 ha);

2000: Awarded the European Diploma for Protected Areas by the Council of Europe.

LAND TENURE

The State in the form of the Danube Delta Biosphere Reserve Authority, Ministry of Water, Forestry & Environment which owns over 90% of the Reserve; the rest is in private hands, though only recently ceded. The Authority administers the Reserve and its staff, including the environment agency of the Tulcea administrative district through its Ecological Management Division.

AREA

312,440 ha (UNESCO World Heritage List, 2008). Protected areas based on the Biosphere Reserve data are noted in the Appendix. The delta in Romania, including the Razelm-Sinoie lagoon complex to the south is some 505,000 ha and with another 120,000 ha in Ukraine covers about 625,000 ha. The World Heritage site excludes less natural areas such as the farmed Pardina polder and fish ponds in the south-west (Vadineanu, pers. comm., 1991). The Ukrainian Ramsar Kyliiske Mouth wetland is contiguous.

LAND TENURE

The State in the form of the Danube Delta Biosphere Reserve Authority (DDBRA) of the Ministry of Water, Forestry and Environment, owns over 90% of the Reserve; the rest is in private hands, though only recently ceded. The Authority administers the Reserve and its institutional, agency and inspectorate staff, including the environment agency of the Tulcea administrative district through its Environmental Management Division.

ALTITUDE

Sea-level to 15m.

PHYSICAL FEATURES

The area is the largest continuous marshland and the second largest and best preserved of European deltas. Its area of over 625,000 ha is almost twelve times the size of the Cota Doňana Reserve in Spain. Except for the even larger delta of the Volga, it is the most natural delta ecosystem left in Europe. Only 9% of the area is permanently above water (EEN, 1990) and it is a vitally important buffer between the hydrographical basin of the River Danube and the Black Sea. The constantly developing landscape of the delta is a labyrinth of waters and land, with numerous freshwater lakes connected by narrow channels, huge expanses of aquatic vegetation and flooded islets *(plaur).* The delta has three distinct zones: the fluvial zone in the upper part of the delta, characterised by sandy levees, and small, densely vegetated lakes; the transitional zone with less sedimentation and numerous larger lakes; and the marine zone dominated by sand-dune barrier beach complexes (Ramsar, 1994). The Razelm-Sinoie complex to the south consists of several large brackish lagoons separated from the sea by a sandbar (Grimmett & Jones, 1989).

The delta's origin can be traced to the end of the Würm glaciation but the present form has evolved in historical times and, although strongly degraded, its hydrological and ecological systems are intact. Historically, thousands of tons of alluvial sediments have been carried into the delta by the Danube every year, resulting in a constant reshaping of the river banks and sandbars. The delta's reed-covered wetlands form the largest natural water purification system in Europe, being constantly refreshed and fertilised by floodwaters and filtering the river's silt, nutrients and pollutants before they reach the Black Sea (UNESCO-MAB, 1998). This still happens despite the extensive recent reclamation works, canalisation and levees which now form some 13-16% of its total land surface. The northern part of the Delta is slowly sinking, resulting in a measurable increase of water flow in the northernmost, Chilia, arm of the delta. There the Rosca-Buhaiova-Hrecisca Nature Reserve (part of the Rosca-Letea Biosphere Reserve) is almost unaltered by man because the shallow water makes access almost impossible. The Perisor-Zatoane-Sacalin Nature Reserve is a mosaic of lakes, ponds and reed beds with long parallel strips of sand dune *(grinduri).* Sacalin Island is composed of alluvial deposits and sand dunes stabilised by tamarix. (Pons & Pons-Ghitulescu, 1990). The main coastal sea currents run from north to south, due chiefly to the prevailing winds, which results in a southward shifting of the Danube river mouths. The current severe coastal erosion is due mainly due to dam construction upstream which has reduced the transport of sediment and resulted in regression of the coastline (Munteanu, 2002).

CLIMATE

The prevailing climate is continental with only 450mm of rain, falling mainly between March and May. This is supplemented by floodwaters from the Danube's headwaters snow melts. The area is influenced by proximity to the sea and the high humidity rising from countless inland lakes and small waterways. The average annual temperature ranges between 0°C in December to 26°C in summer.

VEGETATION

The delta is the largest continuous marshland in Europe and contains what are probably the most extensive reed beds in the world. It has been classified into twelve habitat types: lakes (of 0.80m to 2.50m in depth) covered with floating reedbeds; *plaur* - flooded islets; flooded reeds and willows; riverine forest of willows and poplars and oak forest on marine levees; cane-fields; sandy and muddy beaches; wet meadows; dry meadows; human settlements; sandy and rocky areas; steep banks; and forests on higher ground (Ciochia, n.d.; IUCN, 1990).

The marsh vegetation is dominated by reeds *Phragmites australis* which form floating or fixed islands of decaying vegetation *(plaur)* with some *Typha angustifolia* and *Scirpus* spp. Reeds cover some 1,700 sq. km and *plaur,* 1,000 sq. km. There is a rich aquatic flora including water lilies *Nymphaea alba*, *N. luteus* and *Stratiodes alloides.* The higher ground supports stands of *Salix alba S. fragilis, Populus alba, P. canescens, Alnus glutinosa* and *Quercus* spp. Sandy areas are covered with feather grass *Stipa* sp. and other steppe species. Forest elements are best observed in Letea Forest, occurring in a series of bands along dunes up to 250m long and 10m wide, where trees reach 35m in height. The species present are *Quercus robur, Q. pedunculiflora, Populus alba, P.nigra, Fraxinus ornus, F. angustifolia, F. palisae, Pyrus pyraster, Tilia tomentosa, Ulmus* sp., and the occasional *Alnus glutinosa.* Among the shrubs are *Amorpha fruticosa, Crataegus monogyna, Euonimus europea, Cornus mas, C. sanguinea, Rhamnus frangula, R. catharctica, Viburnum opulus, Berberis vulgaris, Hippophae rhamnoides, Tamarix* spp. and occasional *Corylus avellana.* The distinctive feature of the forest is the abundance of climbing plants including *Periploca graeca, Clematis vitalba, Vitis sylvestris* and *Humulus lupulus.* In spring, the ground is carpeted with *Convallaria majalis*. Particularly rare and threatened plants include *Convolvulus persica, Ephedra distachya, Merendera sobolifera, Plantago coronopus and Petunia parviflora* (IUCN, 1986).

FAUNA

As the major remaining wetland on the flyway between east-central Europe and the Middle East the delta provides critical and exceptionally varied habitat for migratory birds. This is despite recent developments which greatly reduced numbers of waterfowl. Some 312 species of bird have been

recorded, of which 184 are protected by the Bern Convention. Over 176 species breed on the site (Radu, 1979). The most important of these are cormorant *Phalacrocorax carbo sinensis* (3,000 pairs), pygmy cormorant *P. pygmeus* (2,500 pairs comprising 61% of the world's population), white pelican *Pelecanus onocrotalus* (2,500 pairs comprising 50% of the Palaearctic breeding population), Dalmatian pelican *P.crispus* (VU: (estimated at 120 pairs, perhaps now only 25-40 pairs, on the floating islands on Lake Hrecisca, which represented 5% of the world population), black-crowned night heron *Nycticorax nycticorax* (2,100 pairs), squacco heron *Ardeola ralloides* (2,150 pairs), great egret *Egretta alba* (700 pairs), little egret *E. garzetta* (1,400 pairs), purple heron *Ardea purpurea* (1,250 pairs), glossy ibis *Plegadis falcinellus* (1,500 pairs), white stork *Ciconia ciconia* (many), white-tailed eagle *Haliaeetus albicilla* (6 pairs breeding, 30-40 pairs in winter), marsh harrier *Circus aeruginosus* (300+ pairs), osprey *Pandion haliaetus* (3 pairs), Saker falcon *Falco cherrug* (VU: 1-2 pairs), red-footed falcon *Falco vespertinus* (150 pairs), Sandwich tern *Sterna sandvicensis* (1,700 pairs), common tern *S. hirundo* (20,000+ pairs), whiskered tern *Chlidonias hybridus* (20,000+), and black tern *C. niger* (10,000-20,000 pairs). White-headed duck *Oxyura leucocephala* (EN) may still breed (Green, 1990; Grimmett & Jones, 1989).

Midwinter counts in 1988 and up to 1991 recorded the following: whooper swan *Cygnus cygnus* (1,275), mute swan *C. olor* (645), huge numbers of Anatidae with up to 500,000 greater white-fronted goose *Anser albifrons* (but 213.000 in 1988), up to 500 lesser white-fronted goose *A. erythropus* (VU), 25,000 greylag geese *A. anser,* 963,000 teal *Anas crecca*, 178,956 mallard *A. platyrhynchos*, 14,000 pintail *A. acuta*, 40,000 shoveller *A. clypeata*, 7,880 red-crested pochard *Netta rufina,* 173,985 pochard *Aythya ferina*, 26,102 tufted duck *A. fuligula,* 13,000 ferruginous duck *A. nyroca*, and 4,643 smew *Mergus albellus* (Ramsar,1994). Slender-billed curlew *Numenius tenuirostris* (CR) has occurred on passage: 28 in 1971 and one or two in 1989 (Green, 1990).

A total of some 900 vertebrate and 2,500 species of invertebrate animals have been recorded for the delta area. Rather little work has been done on mammals through lack of funding, but coastal waters are known as a last refuge of the Mediterranean monk seal *Monachus monachus* (CR). The population of European mink *Mustela lutreola* (EN), although its size is unknown, is significant. Eurasian otter *Lutra lutra,* stoat *Mustela erminea*, and wild cat *Felis sylvestris* are also to be found on the floating islands (UNESCO-MAB, 1998). The forest areas contain several rare reptiles, including meadow viper *Vipera ursinii moldavica* (EN), Aesculapian ratsnake *Zamenis longissimus*, and the steppe runner lizard *Eremias arguta deserti* (IUCN, 1986). The delta is very important for fish, with 75 recorded species (45 freshwater), including several species of sturgeon. Russian sturgeon *Acipenser gueldenstaedtii* (CR), spiny sturgeon *Acipenser nudiventris* (CR) and European sturgeon *Huso huso* (CR) occur in shallow coastal waters (UNESCO-MAB, 1998).

CONSERVATION VALUE

The site is the second largest delta in Europe and a point within a WWF Global 200 Freshwater Eco-region where Palaearctic and Mediterranean biogeographic zones meet. It is a uniquely dynamic relatively wild ecosystem with a rich diversity of wetland habitats. The site is on a major flyway and is internationally significant for birds, both breeding and migratory, including a number of globally threatened species. It is also a vitally important buffer between the hydrographical basin of the River Danube and the Black Sea. It is a Ramsar Wetland and a transboundary UNESCO MAB Biosphere Reserve.

CULTURAL HERITAGE

The earliest signs of occupation are found on terraces and promontories, especially around lakes Razelm and Sinoie. During the Iron Age, about 3,200 to 2,500 years ago, a series of fortified settlements were established on hills at Sinoie, Enisala, Babadag, Bestepe, Balteni, Malcoci, Tulcea and Somova. Next to these settlements one can find remnants of Greek and Roman settlements (including a lighthouse), evidence of the very long history of trading along the Danube (Munteanu, 2002). Villages surrounding the Delta show a Turkish influence.

LOCAL HUMAN POPULATION

This is estimated at between 12,000 and 16,000 (most being of Ukrainian orthodox Christians of Lipki descent), depending on the definition of the area covered and residence status (EEN, 1990; IUCN-EEP, 1991). The lower figure is half of that of 50 years ago. The population, which includes several other nationalities, is distributed in small villages along the three main waterways, Chilia, Sulina and Sfintu Gheorghe, also the main sources of drinking water. Cases of cholera have been reported, the latest in August 1990 when 66 cases were diagnosed in the Tulcea region (EEN, 1990; Anon., 1990a). Most of the younger generation has left the Delta and old fishing villages of reed huts have been replaced by concrete buildings although individual fishing huts are retained. Some villages lacked electricity. Social problems in 1989 were exacerbated by low incomes due to the low government-set prices for fish. Conditions for state farm workers on the newly created polders were reported to be extremely bad; they lacked basic infrastructure, the work was unpopular (IUCN-EEP, 1991) and the farms were said to be used as prison camps (Pons & Pons-Ghitulescu, 1990).

The local population has depended on small-scale, low-intensity use of the natural resources fairly well integrated with the natural heritage: fishing (10,000 boats are registered), hunting, cattle grazing, subsistence farming and beekeeping, and viticulture supplemented by outside incomes. The centre of commercial activity in the delta is the free port of Sulina. In the late 1980s the town rapidly expanded with 500 new houses being built, an hotel and a shipping centre large enough to handle 3,500 ships annually. Other urban developments occurred at Chilia-Veche, 1 Mai, Unirea, Independenta and Sfintu Gheorghe where in 1990 several incongruous flat blocks and a large commercial complex remained empty (Anon., 1987; Pons & Pons-Ghitulescu, 1990).

VISITORS AND VISITOR FACILITIES

Under the previous regime the development of sea-coast tourism was encouraged and parts of the delta were heavily used (EEN, 1990; Pons & Pons-Ghitulescu, 1990), with up to 100,000 annual visitors, mostly concentrated at two hotels along the Sulina channel. This figure was confirmed by IUCN in 2008. Many people also camp along major channels in the summer (IUCN-EEP, 1991) and there are three campgrounds, at Chilia, Crisan and Murighiol. There is a Biosphere Reserve Information and Ecological Education Centre in Tulcea and a Documentation and Information Centre in Sulina. Riding and hiking, fishing, canoeing and boating (but not swimming) are possible. Eleven tourist trails have been developed (www.coastalguide). Permission is needed to visit the nature reserves which are closed during the bird breeding season (IUCN, 1986). Away from the three main channels the areas are rarely frequented (IUCN-EEP, 1991) and nature tourism has been greatly neglected. A detailed plan prepared in 1982 by the Institute for Research on Ecology for Tourism of the Ministry of Tourism together with the National Council for Scientific and Technical Research and the Academy of Sciences in Agriculture and Forestry was ignored. More recently, the beginnings of indiscriminate commercial tourism organised by numerous tourist agencies is evident (Roman, 1990a), with 40 private agencies springing up in Tulcea (IUCN-EEP, 1991). There is an existing visitors' centre with visitor facilities but new centres are needed with improvements to the drinking water supply and waste management system (IUCN, 2006).

SCIENTIFIC RESEARCH AND FACILITIES

Ecological studies on the river and the delta were conducted by G.Antipa at the beginning of the century (Pons & Pons-Ghitulescu, 1990). Between 1974 and 1978 an intensive programme of investigations on the Rosu-Puiu complex of lakes in the southeast covered morphometric and physico-chemical measurements, the structure and dynamics of communities, energy flows, biomass production measurements (primary and secondary), field and laboratory experiments for oxygen consumption, filtration rates, energy expenditure on anaerobic pathways and the relationship between phytoplankton and submerged macrophytes. Between 1979 and 1982 investigations were carried out on the Matita-Merhei lakes in the north-east and measurements similar to the above were made. An extensive program of investigations throughout the delta identified eight distinct aquatic ecosystems. From each of these one lake was selected as characteristic, and since 1982 investigations have concentrated on these eight ecosystems. After 1987 two lakes from the Razelm-Sinoie complex were added.

Overall scientific data on the delta is being collected by a national group formed from members of the disbanded parliamentary Committee for Ecology. The Ministry of Environment has provided funds to a number of bodies to prepare research reports on past uses and future developments of the delta (IUCN-EEP, 1990). It established the Danube Delta Research & Design Institute (ICPDD) as a regional centre for research, education and training on natural ecosystems and to monitor the delta and enforce conservation activities (IUCN, 1990a). A research programme for the delta, the Black Sea and the Danube was started in cooperation with the then USSR. This was to investigate the cycling of nitrogen, phosphorous, heavy metals and pesticides, the effects of the above on biodiversity and biological productivity, and the role of ecotones in controlling the density of flow of chemical compounds (IUCN-EEP, 1990).

Limited faunal and floral surveys were carried out (IUCN, 1986) but an overall species survey and long-term studies, especially for migratory waders on the eastern European/East African flyway were lacking (Harengerd *et al*., 1990). Owing to the vast area of the Delta, aerial surveys may be the only effective way of conducting surveys (Green, 1990). In 1991, seven research groups were established within a three-year program in preparation for the new regimen (IUCN-EEP, 1991). The national biodiversity survey of Romania includes the delta where a biodiversity research group involving over 70 scientists and 11 institutes is preparing a detailed inventory. A thorough study was published in 1997 into the ecological restoration of island polders in the delta by the Biosphere Reserve Authority, ICPDD and WWF. More recent studies have covered risk assessment, condition surveys, archaeological surveys, wetlands conservation, natural resources sustainability, integrating monitoring systems, visitor management, utilities infrastructure, integration of traditional land use activities and sustainable development. Key indicators used in regular monitoring are air, water, soil quality, the state of biological biodiversity; local waste management, economic balance in sustainable development systems and pollution (IUCN, 2006).

MANAGEMENT

In the forty years before designation of the Biosphere Reserve in 1979, the delta was covered piecemeal by nature reserves. Between designation and 1989, the delta wetlands were subject to a development program under a Decree for the Economic Development of the Delta to reclaim about 120,000 ha for agriculture, reed production, fish farming, mining and canalisation to improve commercial use of the waterways. New construction would have included several new roads, seven industrial plants, a 25,000 animal pig-farm with slaughterhouse, a new harbour and major development of the tourist industry (Anon., 1990). Plans for airport construction were also begun (Schneider, 1990). The program was managed by the *Centrala Deltei Dunarii*, which had 2,000 employees and a 5 million lei budget (IUCN-EEP, 1991). However, in February 1990 after the change of government, Decree No.103 abolished this reclamation program, halting the major projects except for a number of 'strictly necessary works'. In late 1990 the *Centrala Deltei* itself was abolished on the enlargement of the Biosphere Reserve (Schneider, 1990; IUCN-EEP, 1991).

The legislation for this Reserve prohibited damaging and potentially damaging activities and provided for the control of intensive land uses incompatible with the wetland ecosystem. However, under pressure from the *Centrala Deltei*, the Institute of Study and Design for Land Reclamation and the Soil Research Institute, exceptions occurred to obviate the loss of employment and of the 16 billion lei (±US$1 billion) investment in addition to 5 billion lei invested in infrastructure (Pons & Pons-Ghitulescu, 1990; IUCN-EEP, 1991). Against this, direct annual losses due to agricultural operations in the delta were estimated at 18 million lei (Roman, 1990) and the overall economic losses at 300 million lei per annum (IUCN-EEP, 1990). In 1990 the World Bank assisted in the restructuring of 3.5 million ha of agricultural land in the delta and the lower Danube to restore former wetland areas, seriously degraded sites in the polders, and flooding to restore a water regime with low intensity fishing.

In 1991, patrimony of the national Biosphere Reserve was granted to the Danube Delta Biosphere Reserve Authority (DDBRA) in which the Province of Tulcea was represented. This placed all the public domain, and the aquatic and natural resources in the ownership of the Authority, and put all institute, agency and inspectorate staff, including the environment agency for Tulcea administrative district, under

its control. Within the World Heritage Delta site, then covering 679,222 ha, the site nomination document quoted 52,980 ha of strictly protected core zone in 14 sites, 230,200 ha of buffer zone, a 25,500 ha restoration zone plus 267,542 ha of transitional land. To this was added the 88,000 ha Razelm-Sinoie lagoon complex. This totalled 664,222 ha, of which the core zone is only 7.8%. Eight other sites remained open to controlled extractive uses. Their names and areas are noted in the Appendix.

Decree No.103 required a study detailing future economic uses of the delta for the guidance of the Delta Authority (Pons & Pons-Ghitulescu, 1990) which was made by an international mission led by the IUCN East European Programme. A priority action program legally binding on all national agencies and to be overseen by the Ministry of Environment was prepared as part of the Danube Delta Strategy and Management Plan. The first topic developed was a three-year research program. A strategy for international conservation assistance was planned in 1991 with IUCN help, in an integrated management plan for the Reserve. This provided guidelines for each economic sector: forestry, agriculture, fisheries, and tourism; and for immediate practical conservation by individual agencies. The report was accepted in May 1991. The first 10-year draft Management Plan was produced in 1994-5 and and was due for revision by 2006.

A management program was prepared by several agencies: the Romanian Academy, the Ecological Society of Romania, the Brailia Institute of the Romanian Academy of Sciences, Iasi University and the Institute of Tourism Research. The government established the Danube Delta Institute as a regional centre for monitoring, research, education and training on natural ecosystems and to monitor the delta and enforce conservation activities (IUCN, 1990a). Ecological restoration began to succeed in two of the biggest polders in Europe: Babina (2,100 ha) and Cernovca (2,580 ha) on the Ukrainian border, where farming had been abandoned because of salinisation. Babina island was rehabilitated between 1994-6, and Cernovca island between 1996-8. Natural habitat for wildlife returned, and the natural flood regime and biofiltering capacity was restored; the biodiversity and quality of the water and of the trophic state of the ecosystems improved with the removal of excessive nutrients and sediment. Further results were the increase in the quantity of fish, game and reeds; in recreation areas for ecotourism, ecological education and improvement in living conditions for the local people (Anon., 2003). In all, by 2006, almost 11,000 ha of abandoned polder were ecologically restored to wetlands and good condition, supported by the World Bank Project 'Danube Delta Biodiversity' and by the government (IUCN, 2006).

As some 15% of the Danube delta also lies within Ukraine, and faces the threat of a ship canal through the Dunaisky and Kyliiske reserves, this area was included in plans for the delta. In 1998 the Biosphere Reserve was designated part of a transboundary Biosphere Reserve with Dunaisky in Ukraine. In 2005 the Lower Danube Protected Areas Commission led by the DDBRA and funded by the EU, produced a successor Joint Management Plan to the first 1994-5 plan for the area. By this time there was a clear need to develop and adopt common environmental standards, regulations and policies with Ukraine and Moldova. The heads of Delegation to the International Commission for the Protection of the Danube River from Moldova, Romania and Ukraine therefore signed an agreement committing their countries to the development of a River Basin Management Plan for the Danube Delta supporting Sustainable Development. In 2007 the Commission adopted a Joint Statement on inland navigation and environmental protection, which outlined criteria and principles for development of navigation projects in the Basin. This Statement was developed and agreed by the Danube Commission (Navigation) and the Sava Commission and included participation by Ukraine and Romanian officials from the navigation and environmental sectors (IUCN, 2008).

By 2008 the DDBRA was implementing the Master Plan in support of sustainable development in the delta including a common monitoring program and to prevent negative impacts of the development of navigation channels, specifically the Bystroe Arm. Cooperation with the Ukrainian Authority of the Danube Delta (Danube Biosphere Reserve) had been achieved, but not with the Republic of Moldova, where the construction of a petrol terminal at Gjugjurlesti is said to be beginning. An Environmental Impact Assessment for the Danube-Black Sea Navigation Route in Ukraine has been made. Separately

a project on an Integrated Culture and Tourism Strategy for Sustainable Development in the Danube Delta was launched to promote eco-tourism (UNESCO, 2009).

MANAGEMENT CONSTRAINTS

Many of the major constraints affecting the delta area except for upstream works and pollution, originated with the 1979 Decree for the Economic Development of the Delta. The result of this major government-sponsored reclamation program until it was halted in 1990, the degradation and loss of the delta's wetlands by hydraulic engineering works and the imposition of inappropriate land uses had become extremely serious, (Pons & Pons-Ghitulescu, 1990). The previous regime decided to use the area primarily for agriculture, with plans to triple productivity by 1990. 97,000 ha were earmarked, and by 1987 some 42,000 ha had been converted to irrigated croplands by the construction of polders (Grimmett & Jones, 1989). Much of this land proved unsuitable for cultivation because of the peaty soils. Agriculture on some polders which became uneconomic was abandoned, leaving salinised water and soil. By the end of 1987, cereals covered 24,120 ha, other crops 650 ha, vegetables 200 ha, with 580 ha planned as orchards and vineyards. But by 1989, only 17,000 of 42,000 ha of maize were still productive. A particularly damaging construction was the Sireasa polder covering 7,500 ha, which destroyed the eastern levees and riverine forests (Pons & Pons-Ghitulescu, 1990). A large part of the ecosystem was turned into a saline steppe and the heavy salinisation of agricultural polders rendered them almost valueless.

The fishing industry was developed with large scale fish farms: 63,000 ha were said to have been created by 1990, compensating for some of the damage to wetlands by the creation of fish ponds, but they proved unsuitable for breeding local species (Langeveld & Grimmett, 1990). Extensive use of Chinese carp doubled the numbers of farmed fish but the wild carp were driven to virtual extinction. There is a thriving fish poaching industry based on the Delta villages, which makes some official fish-catch figures inaccurate (IUCN-EEP, 1991). However, by 1990 reports suggested that fish pond production had become very low (Pons & Pons-Ghitulescu, 1990). The local fishing industry also suffered, the indigenous fish catch falling by two-thirds between 1980 and 1990. Polluted waters drastically reduced the numbers of migratory fish such as sturgeon; and the resulting algal blooms in the eutrophic water threatened fish life and the macroalgae at the base of the food chain. The decline led to widespread infringements of regulations, and hundreds of actions against illegal fishing.

Reed growing for the paper industry, which had exploited the area since 1956, was developed on a large scale. Almost one third of the delta was to have been transformed for this use, much of it from the most ecologically important central area. The reeds were harvested by heavy mechanised equipment and processed at a cellulose factory built in Tulcea. However, reed production fell from 200-300,000 tons per annum in 1960 to less than 50,000 tons per annum in the late 1980s (Schneider, 1990; Pons & Pons-Ghitulescu,1990). By 1990 only 8% of the total reed surface was harvested (IUCN-EEP, 1991). The burning of reed beds was also practised (Green, 1990). 66,185 ha on the border with Ukraine had been damaged in the past by inefficient reed clearing. Rice cultivation in former salt-marshes was tried (Anon., 1990b) and 12,838 ha was given over to forest plantations. These replaced native species with hybrid poplars and cypresses, but here again production was less than expected due to the salinisation of groundwater (Pons & Pons-Ghitulescu, 1990).

Several 'strictly necessary works' from the previous regime were allowed to continue: maintenance of flood defences; completion of the regulation of the Sf.Gheorghe branch; completion of coastline protection near Sinoe and in the Portita-Sf Georghe-Sulina zone; bank protection of the Sulina branch and maintenance of existing reclamations at Pardina, Sireasa, Fortuna, Rusco, Grindul Island, Chilia and Sulina. The completion of reclamation work at the first two was allowed if no chemicals were applied (Carauscu, 1990). Previous work along the relatively untouched river landscape of the Sf Gheorghe branch bypassed river meanders and reduced use of lateral channels. The straightening accelerated the water flow, increased pollution and sedimentation, radically altering the pattern of alluvial deposition (Grimmett & Jones, 1989). There was exploitation of quartziferous sand from the dunes on the Grindul-Caraorman barrier, and exploitation of minerals at Grindul Saraturile (Pons & Pons-Ghitulescu, 1990) where the site was to be reconstructed (IUCN-EEP, 1991). Continued

agriculture in the polders led to degradation of the soil (Pons & Pons-Ghitulescu, 1990). The embankment and canalisation increased the rate of desiccation of lakes (Busila, 1990) and dried out the depressions between the dunes in Letea Forest, where the water table dropped by 50 to 60cm below summer levels. Saplings died and older trees were stunted, soil erosion increased and trees were attacked by parasites (Kiss, 1990). Four-fifths (some 435,000 ha) of the total network of wet grasslands along the lower Danube which filtered the water were lost (Schneider, 1990).

Water quality in the delta is very dependent on the quality of the water flowing down the Danube, and a high percentage of pollutants originate outside the country. By 1990, nearly 80% of the lower Danube flood plain had been drained and converted to agricultural land, resulting in the virtual elimination of floods in the delta itself (Anon., 1990b). Pollution carried downstream is a great threat, with high levels of toxic pesticides, such as DDT and the cyanide spills from the Tisa in 2000, herbicides and fertilizers, especially phosphorus, which produce dense algal blooms in the delta. The water salt content increased from 150mg/l to 350 mg/l and locally to 800mg/l. Nitrogen, potassium and chlorine contents are increasing strongly. Downstream of Tulcea, the water contains high concentrations of mercury and heavy metals. The connecting of Lake Razelm with the Danube resulted in the pollution of the lake waters with a centimetre-thick algal layer on the surface in summer which threatens the life of fish and submerged vegetation (Pons & Pons-Ghitulescu, 1990). Other sources of pollution include a bauxite smelter and ferrous metals plant at Tulcea (Rank, 1990a), and a sulphur factory in the Ukrainian border town of Izmail (Rank, 1990b). In 1988 it was reported that 4,000 tons of toxic waste, including dioxine, had been dumped at Sulina (Anon., 1988).The construction, noted in 2006, of a petrol terminal at Gjugjurlesti in neighboring Moldova is a new potential source of pollution (IUCN, 2008).

Damming, caused by the construction of the Iron Gates hydroelectric facility on the Romanian-Yugoslavian border, resulted first in heavy erosion of the littoral and the river banks of the river, then in reduced sedimentation which caused severe coastal erosion and resulted in coastline regression of between 20 and 30m a year, even up to 70m a year (Pons & Pons-Ghitulescu, 1990). Of a total Romanian coastline of 288 km, some 100 km then showed active erosion. Of these, 70 km were in the delta. The worst affected sections lie between Sulina, Sf Gheorghe and Partita; also in the area of Sinoe Lake (Anon., 1990d). The coastline has been strengthened and partly protected, and further construction to reduce erosion included the building of a 32 km canal (35m wide and 6-7m deep, with a dam at its eastern end to stop sea surges) connecting Sulina and Sf.Gheorghe to transport delta water into the sea at Cherhana Rosulet (Arhire, 1990). Some degradation can be attributed to water regulation through canal, dyke and channel realignment and agricultural intensification within empoldered areas.

Drainage, water regulation, exploitation for reed growing and pollution all had drastic effects on the waterbirds and fish. They were linked to the population decrease in 20 bird species (Schneider, 1990) though the deliberate destruction of nesting bird colonies which occurred in the past became uncommon (Garnett, n.d.). Certain species (pelicans and raptors) are at risk from collision with the many kilometres of electricity powerlines in the delta. The rare wintering red-breasted goose is dependent on the agricultural lands immediately south of the delta and changing practices may affect its future (Green, 1990). The increase in fish farming also caused some conflict with bird colonies, especially of pelicans and cormorants as at Maliuc on the Sulina waterway. Channels cut from Lake Fortunato to the main Sulina waterway dropped the lake's water level from 2.5m to 1m which caused abandonment of the pelican colony (EEN, 1990). In 2006 there was record low winter flow and record high spring flow in the Danube, hydrological changes which impacted the fauna such as pelicans where nesting sites were affected by variation in water levels and the degradation of floating islands (IUCN, 2008).

Lesser threats to the nature reserves include illegal grazing - vegetation was eliminated on Popina Island due to uncontrolled grazing (Green, 1990), and intensive grazing which took place at Letea, Istria and Murighiol (Anon., 1990c; Kiss,1990). It is estimated that 5,500 head of cattle, some wild, were present in the Delta (IUCN-EEP, 1991). Other threats are the replacement of native woodland by plantations, illegal wood-cutting, and the inflow of fresh water from irrigation schemes (Grimmett & Jones, 1989). There is also evidence that illegal hunting expeditions have been organised by an Italian company (EEN, 1990). Others have noted the increase in intensive hunting tourism (Roman, 1990b).

Increasing tourist visitation brings more noisy motorboat traffic which disturbs wildlife, and increased wave action erosion of river banks and wetlands.

But in 2004 a four-year period of construction was started on one of the potentially most serious intrusions on the delta: the 170 km deep-water Bystroye ship canal in Ukraine. This is to provide a cheaper alternative waterway and port to the old Sulina channel in Romania. It cuts through both the Ukrainian transboundary Biosphere Reserve and the Kyliiske Mouth, a Ramsar wetland. A MAB-Ramsar study granted that it would be the cheapest way to build the canal but was the worst of all the alternative routes. The resulting accelerated water flow would drain the waters of the delta and marshes, reducing the water level, pollute them with oil and noise and adversely affect the coastline. After completion it will need constant dredging. International pressure was being brought to find an acceptable solution to the threat (Kvet & Salathé, 2003; Schiermeier, 2005; Salathé, 2008).

STAFF

The total staff of the Biosphere Reserve Authority in the early 1990s was 470, with 100 in enforcement services and 50 in administration. The present management is effective 122 staff in 2006 and on site management training. It had good access to adequate professional staff in conservation, management, promotion, interpretation, education and visitor management from scientific and ecological centres in Tulcea, Crisan and Sulina. Greater public awareness is needed (IUCN, 2006).

BUDGET

In 1990 this was approximately 100 million lei (US$4,000,000), with the Biosphere Reserve Authority receiving 65m lei; enforcement services 8.5m lei; administration 14m lei and monitoring agency 10m lei. The hydrological programme received 300m lei over three years. The costs to the government of the management of the delta may triple in the short-term, but in the long-term these costs may be recouped through income from tourism (IUCN-EEP, 1990). In 2002-3 an EU Tacis project funded the Lower Danube Protected Areas Commission for a joint management plan. In 2005 the WHC granted US$ 30,000 towards training. However, the present funding is insufficient (IUCN, 2006).

LOCAL ADDRESSES

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The Governor, Danube Delta Biosphere Reserve Authority, 34A Portului St., 820243 Tulcea, Romania.

Website: www.coastalguide.to/danube/main.html

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DATE

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APPENDIX: COMPONENT AREAS

Various conflicting names and areas for the component core protected areas of the Reserve are given.

1) Reserve names, areas and 1991 IUCN category from the original Biosphere Reserve data sheet :

Rosca-Buhaiova		Ia
+ Letea Forest +Lake Hrecisca	18,145 ha	Ia
Sfintu Gheorghe-Perisor-Zatoane	16,400 ha	
Perisor-Zatoane-Sacalin	15,400 ha	Unassigned
Istria	8,000 ha	
Periteasca-Leahova-Gura Portita	3,900 ha	Unassigned
Carorman Forest	840 ha	
Hasmacul Mare	800 ha	
Popina Island	98 ha	Ia
Erenciuc Forest	41 ha	

2) Nature Reserve names and areas in the delta cited in the World Database of Protected Areas (2005):

Sahalin-Zatoane	24,250 ha	Ia
Sf. Gheorghe- Perisor-Palade	15,000 ha	Unassigned
Rosca-Buhaiova	9,625 ha	Ia
Padurea-Letea	5,212 ha	Unassigned
Periteasca-Biscericuta Portita	4,125 ha	Ia
Carorman	2,250 ha	Ia
Histria (Grindul Lupilor Marchelul)	1,410 ha	
Letea-Hasmacul Mare	701 ha	IV
Murighiol	600 ha	IV
Erenciuc	400 ha	Ia
Istria-Sinoe	350 ha	Ia
Saraturile-Murighiol	87 ha	Ia

3) Strictly Protected Areas (categ. Ia) named on an official map of the Danube Delta Biosphere Reserve:

Sacalin Zatoane	21,410 ha
Potcoava	625 ha
Rosca-Buhaiova	9,625 ha
Istria Sinoe	400 ha
Periteasca Biscericuta Portija	4,125 ha
Rotundu	228 ha
Letea	2,825 ha
Capul Dolosman	125 ha
Raducu	2,500 ha
Nebunu	115 ha
Grindul Chituc	2,300 ha
Belciug	110 ha
Carorman	2,250 ha
Popina	98 ha
Grindu Lupilor	2,075 ha
Saraturile-Murighiol	87 ha
Vatafu-Lungulet	1,625 ha
Erenciuc	50 ha