

## **THE DANUBE DELTA BIOSPHERE RESERVE. GEOGRAPHY, BIODIVERSITY, PROTECTION, MANAGEMENT\***

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### **La Réserve de la Biosphère du Delta du Danube. Géographie, Biodiversité, Protection, Administration**

Le Danube et son delta sont connus depuis l'Antiquité. Hérodote comptait cinq bras au Danube, Strabon, Pline et Ptolémée, accordaient sept bras. Aujourd'hui, le Danube n'en a plus que trois bras. La surface du delta proprement-dit est de 4 455 km<sup>2</sup>, dont la plupart se trouve sur le territoire roumain (3 510 km<sup>2</sup>, soit 82%). Selon les données connues, cette unité géographique s'est constituée par un premier embryon (le cordon initial), environ il y a 12 000 ans, évoluant vers la forme actuelle sous l'action des processus fluviaux et marins. Par sa position géographique, à 45° lat. nord et 29° long. est, le Delta du Danube synthétise dans le paysage les traits des deltas des zones tempérées, étant utilisé par de nombreuses espèces d'oiseaux pour nicher, passer l'hiver ou pour transiter dans leur migration périodique des zones tropicales vers celles polaires du Nord. Grâce à ces particularités, le Delta du Danube se constitue en une région géographique qui exige une attention particulière pour son maintien dans les conditions les plus proches de celles naturelles et pour la protection des espèces d'oiseaux, certains en état de disparition. Malheureusement, les 50 dernières années, le Delta du Danube a été soumis à la pression anthropique par des aménagements du roseau, piscicoles, agricoles et sylvicoles (30% de sa surface), qui ont eu des conséquences négatives sur le fragile équilibre écologique. La déclaration du Delta du Danube comme Réserve de la Biosphère en 1990, légiférée en 1993, l'alignement aux conventions internationales concernant la conservation et protection du patrimoine naturel et culturel a nécessité des actions conduisant à l'identification des principaux objectifs concernant le redressement écologique de cette unité géographique. Conformément à cette loi, la Réserve de la Biosphère du Delta du Danube a une superficie de 5 800 km<sup>2</sup>. Dans les limites sont compris: le delta proprement-dit, le complexe lacustre Razim-Sinoie, les eaux marines côtières, la plaine inondable du Danube entre Isaccea et Tulcea, le lit du Danube entre Cotul Pisicii (le Tournant du Chat) et Isaccea jusqu'à la frontière avec l'Ukraine.

**Keywords:** biodiversity, human impact, protection, Biosphere Reserve, Danube Delta.

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### **GEOGRAPHICAL POSITION AND AREA**

The Romanian Danube Delta Biosphere Reserve (DDBR) is situated in the eastern part of Europe and lies at the intersection of 45° N (parallel of latitude) with 29° E (longitude). The total area of DDBR is of about 5,800 km<sup>2</sup> more than half of which (3,510 km<sup>2</sup>) belong to what is commonly called the "Danube Delta", while the remaining area is shared between the upstream Danube floodplain (Isaccea-Tulcea sector 102 km<sup>2</sup>), the Razim-Sinoie lagoon complex (1,145 km<sup>2</sup>), the neighboring strip from the Black Sea (1,030 km<sup>2</sup>) up to the 20 m isobath, and the Danube river between Cotul Pisicii and Isaccea (13 km<sup>2</sup>) (Fig. 1).

### **SHORT HISTORY**

The first to notice the deltoid shape of the systems was, probably, Herodotus studying Nile Delta nearly 2,500 years ago. His "Histories" provide the first information on the Danube (Istros) and its delta. Interesting descriptions of the mouths of the Danube to the Pontus Euxinus are contained in ancient Greek and Roman sources, for example the writings of Polybius, Strabo, Plinius Secundus (Pliny the Elder), Arrianus and especially Claudios Ptolemaios (Ptolemy) are worth mentioning. A large number of works have been written on this subject in modern times the most important of which are Munteanu-Murgoci 1912; Antipa 1914; Brătescu 1922; Vâlsan 1934, 1935; Lepşi 1942; Pfannenstiel 1950; Zenkovitch 1956; Petrescu 1957; Coteţ 1960; Bleahu 1963; Liteanu, Pricăjan 1963; Banu 1965; Gâstescu 1977, 1985, 1993, 1996; Panin 1983, 1989; Gâstescu and Driga 1983, 1984, 1985; Bondar 1983, 1991; Romanescu 1996.

### **GENESIS AND HYPOTHESIS**

The genesis of the Danube Delta was favoured by the existence of a large continental shelf, a liman-type gulf between the Dobrogean horst and the Bugeac Platform, the big volume of alluvia deposited by the Danube, the configuration of the littoral sea currents, the low tides (7–11 cm) in the north-east of the Black Sea, together with the major climatic conditions which triggered the Black Sea level oscillations, and the tectonic (epirogenetic) movements suffered by the neighboring areas.

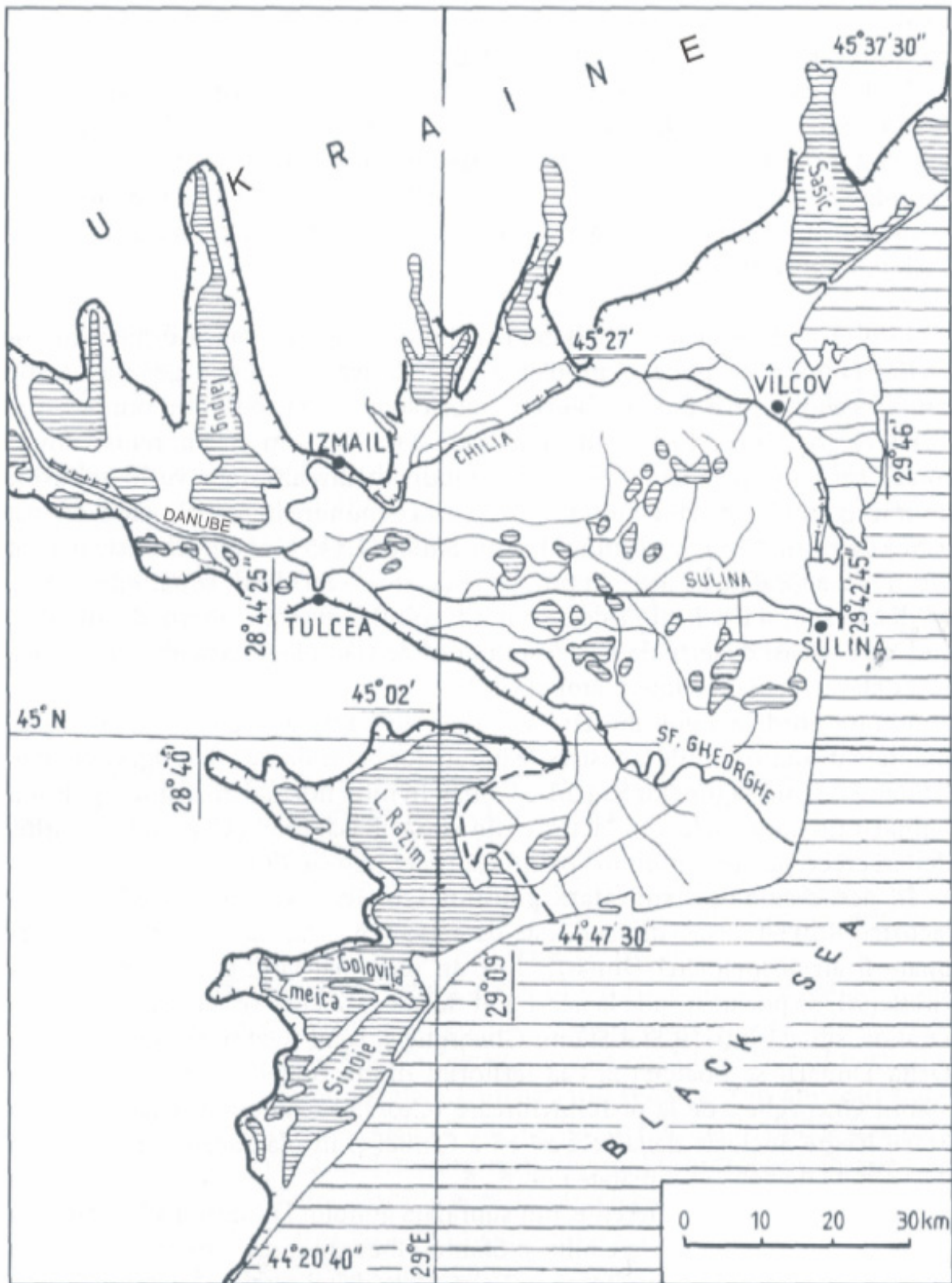
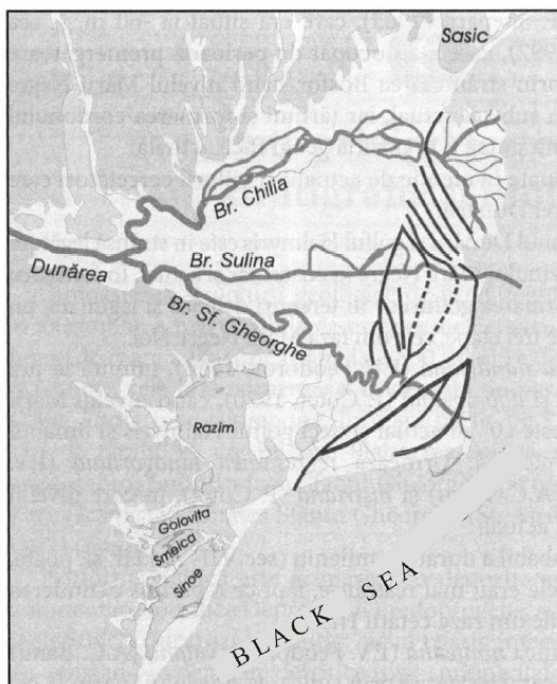


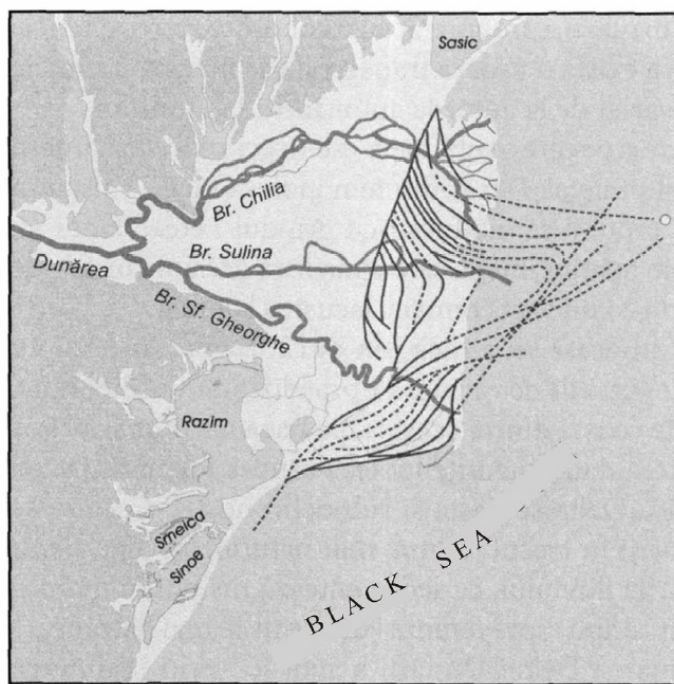
Fig. 1 The Danube Delta and the Razim-Sinoie lacustrine complex (boundaries).

All the hypotheses on the genesis and evolution of the Danube Delta river sector fall into two large categories: one admitting the existence of a liman enclosed by littoral bars, pierced through in several points, and later evolving into the fluvial delta (Murgoci, Antipa, Vâlsan, Panin); the other admitting the formation of the delta by the gradual advance of the river levees as far as the littoral sea current, fact that led to the formation of the coastal bar (Brătescu). The age of the Danube Delta is no older than 10,000–12,000 years (Fig. 2a, b, c).



a)

Fig. 2a – Sketch of the Danube Delta (Brătescu 1912). Thick lines representing stages of the land advancing from west to east, with four successive coastal bars (I–IV).



b)

Fig. 2b – Sketch of the Danube Delta (Vâlsan hypothesis 1934). Broken lines representing levee lines converging towards the Serpents' Island.

## HYPSONETRY

The Danube Delta is a very low flat plain, lying 0.52 m above Mean Black Sea Level (MBSL) with a general gradient of 0,006 m/km. Being close to the Black Sea level, in the case of the Danube Delta, the hypsometry is limited to very narrow range of value. The maximum difference in altitude is 15 m and is given by the highest point (+12.4 m) of the Letea dunes and the lowest lake bottom (-3 m) from the marine part of the delta. Compared to the Black Sea level, only 20.5 % of the delta area is below 0 m. The rest (79.5 %) is above 0 m the most of which (54.6 %) is in the range 0–1 m above MBSL. If the 1–2 range (18.2 %) and that of below 0 m are added to this range, more than 93 % of the delta area is within the 3 m range of hypsometry.

## MORPHOHYDROGRAPHIC UNITS

The main morphohydrographic categories are predeltaic territories, river and marine sand banks, the network of river channels and canals, lakes and swamps.

**Predeltaic territories** are located in the Bugeac area to the north of the Chilia branch of the river. The loess deposits were eroded by water from this area and redeposited to form the basis of the Câmpul Chiliei and Stipoc sand bank. They account for 2.4 % of the delta's area.

**River sandbanks** are located along the margins of the main branches and near crossways. The rate of accretion and sandbar height tends to reduce nearer the sea. Sea currents are primarily responsible for the way in which **marine levees** are formed and they tend to lie parallel to the line of the coast. Many of these banks (or *grind*) were then 'stranded' as additional marine deposits formed beyond them. Maps of the delta show clearly that the larger sand bars were deposited as series of high dunes with slacks between them. The **initial spit** were formed in the Letea, Caraorman and Crasnicol areas. The **network of rivers**, side channels and canals determines the way in which water is able to move through and around the delta.

The **lakes** in the delta are arguably the most important morphohydrographic category, in that some are now strictly protected areas. Drainage of some of the lakes in the Pardina and Sireasa areas since 1980, reduced the total lake area in the delta from some 31,262 ha (9.28 % of the area of the delta) to 25,794 ha (7.28 % of the delta's area). The larger lakes include Dranov (2,170 ha), Gorgova (1,377 ha), Roșu (1,445 ha) and Lumina (1,367 ha). Whereas there were 668 lakes in the Romanian sector of the delta before 1980, drainage has reduced this number to 479 lakes.

*Swamps* lie between – 0.5 to 1 meter above water level and they surround lakes in the depression zones within the delta. They tend to be inundated during early summer, when melt waters from the mountains swell the volume of the Danube as it runs into the delta. Many swamps and marshes were drained during the ill-fated period of agricultural exploitation of the delta. Marsh or swamp vegetation still covers 143,500 ha or 43 % of the delta's are.

In terms of genesis, hypsometry, water relations between the Danube arms and the inland areas, climatic conditions and landscape, two large delta sectors can be distinguished: *the fluvial delta* and *the fluvial-marine delta*. The first sector, which is the oldest, begins at Ceatal Chilia and ends up at the Letea-Caraorman-Crasnicol alignment of sea levees. The second sector extends between the Letea- Caraorman-Crasnicol marine levees in the west and the sea coast in the east, including, besides the Letea, Caraorman and Sărăturile levees, an important lake complex (Roșu – Puiu), and suffers important changes at the contact with the Black Sea. The Danube Delta space contains three large units: *Letea* between the Chilia and the Sulina arms; *Caraorman* between the Sulina and the Sfântu Gheorghe arms and *Dranov* between the Sfântu Gheorghe arm and the Razim Lake (including the Dranov Lake).

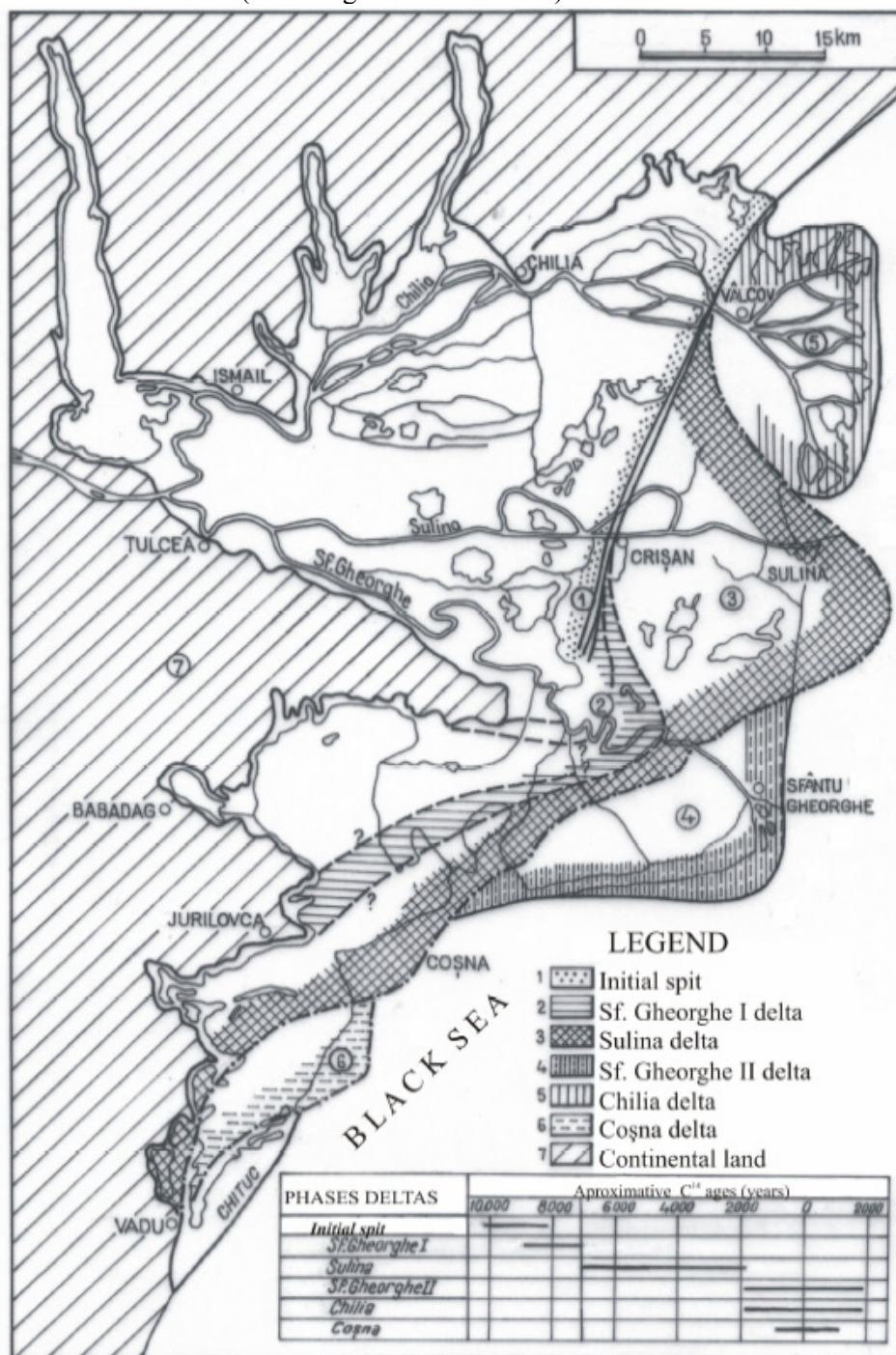


Fig. 2c – Stages and ages in the evolution of the Danube Delta (Panin, 1983).

This water flow, estimated at 538 m<sup>3</sup>/sec (including the quantity of water that reaches the Razim Lake at an average flow rate of 90 m<sup>3</sup>/sec); the quantity of sediment is about 1.5 million tons/year. The water volume from the Danube arms running through backwaters and canals stagnates in the lacustrine complexes between 2 months (1921) and 10–11 months (1926, 1940), changing from river water into lake water.

**The discharge of suspended sediment** load over the 1840-1990 period is estimated at 54.75 mill. t/year (at a rate 1,737 kg/sec.) of which 2.18 mill.t/year would be coarse-grained alluvia (sands). Extreme values of 4,780 kg/sec. in 1871 (141.8 mill./year) and 229 kg/sec.in 1990 (7.2 mill.t/year) with annual decrease trend being 8.3 kg/sec. with oscillation on discharge.

## CHEMISTRY OF THE DANUBE'S WATERS WITHIN THE DELTA

The chemical composition of waters within the delta is relatively homogeneous. The mean value for dissolved minerals varies between 300–500 mg/litre, according to seasonal changes and dilution factors. about a partial transformation, as a result of intense photosynthetic activity. The pH of the water entering the delta tends to range between 7.7–8.5. Values in some of the lakes can be lower, due to the decomposition of organic material in vegetation and detritus.

*Eutrophication* can become a problem in summer, when nitrogen and phosphorous are readily available (some of it having entered the delta as pollutants in the Danube). Algal blooms reduce light penetration and this can have a damaging effect on macrophyte plants. The death and decomposition of these causes deoxygenation of the water and may lead to fish deaths. Some of the blue/green algae produce toxins and these can be particularly damaging in confined bodies of water. The amount of inorganic nitrogen varies between 0.7–3.6 mg/L and the organic phosphorous ranges from 0.02–0.2 mg/L.

## BIODIVERSITY AND ECOSYSTEMS WITHIN THE BIOSPHERE RESERVE

The Danube Delta maintains its enormous biodiversity in a better state than most other deltas in Europe, even in the world. It contains a greater range of habitat types, lower and higher plants, invertebrates and vertebrates than all other deltas in Europe. Many of the species that live within the delta are unique to it, these include plants and animals. The static freshwater ecosystems provide the base for the food chain in much of the delta. The contribution they make „spills over” in canals, rivers and other moving waters. Protozoa, micro-algae, algae and macrophytes are the primary producers, on which zooplankton, oligochaetes, molluscs, insects, fish, amphibia, reptiles, birds and mammals feed in ascending order within the food chain. Terrestrial ecosystems have suffered less than aquatic ones, because they are less easy to pollute and over fish. Exploitation by grazing, arable cropping, forestry, reed cutting is limited to areas where this is possible and in much of the delta these potentially damaging activities are impossible (Fig. 3).

**Flora.** The Dobrogea region that adjoins the Danube Delta provides habitats for 50 % of the 3,800 plant species recorded in Romania. Compared with this, the delta itself and the Razim-Sinoie lake complex supports 1839 species. Their distribution is as follows: euroasiatic (30 %), continental asiatic (15 %), cosmopolitan (10 %). Euroasiatic and cosmopolitan plants dominate the aquatic, swamp and marsh communities. Among these is the reed (*Phragmites australis*), which has a worldwide distribution.

From an ecological standpoint, the most interesting and valuable plant communities occur within the larger dune systems, like Grindul Letea and Grindul Caraorman. There are areas of steppe grassland associated with the sandy soils of Letea and Caraorman and these support a range of interesting grasses more often encountered in the Mediterranean. Many of the plants that survive on these hot and dry soils are xerophilous and therefore drought resistant.

The woodland associated with dune slacks are particularly important in that species of oak, ash and poplar provide the canopy above rich shrub and field layers. Whilst some of the trees and shrubs are commonplace elsewhere in Europe, the fluffy ash and the grey oak are special within this area. A climber with a Mediterranean distribution, Greek liana (*Periploca graeca*) grows within Letea Forest. Also unique to this forest is the rare steppe viper (*Vipera ursinii*). The final plant assemblage is great interest and value, are the salt rich depressions that occur in association with the larger dune systems. Most of the species found in the delta are typical of salt marshes across Europe.

## CLIMATE

The climate of the land that surrounds the Danube Delta is continental, with hot dry summers and very cold winters. *Clear-sky* days average 66 days/year in Tulcea, while Sfântu Gheorghe enjoys an average of 80 such days each year. Tulcea has some 2,260 hours of sunshine and Sfântu Gheorghe averages 2,502 hours of sunshine each year. The influence of cyclonic weather from the Mediterranean tends to result in sudden changes in weather and intensive rainfall, especially in summer. Anticyclonic conditions derive from the Azores and Eastern Europe and Russia. Both have a stabilising effect on the climate, but the latter often brings arctic winds. Temperatures can go below  $-27^{\circ}\text{C}$ , though close proximity to the Black Sea reduces the chill factor.

The *average annual temperature* in Tulcea is  $11^{\circ}\text{C}$ , max  $39.7^{\circ}$  min  $-27^{\circ}\text{C}$ . Similar measurements for Sfântu Gheorghe show an average of  $11.4^{\circ}$ , with maxima of  $36.3^{\circ}\text{C}$  and minima or  $-21.5^{\circ}\text{C}$ . The first date for autumn freezing in Tulcea is around the 31st October, while Sfântu Gheorghe remains frost free until about the 12th November.

*Average rainfall* is higher in Tulcea, with 438.4 mm, whereas Sfântu Gheorghe receives 403.6 mm. Average humidity is higher in Sfântu Gheorghe at 86 % compared to Tulcea's 80 %. The Biosphere Reserve is one of the *windiest zones* in Romania.

## WATERS

*The hydrological regime* basically the water circulation, represents the vital component of the very existence of the delta space. Since the water volume transported by the Danube to Ceatal Chilia is  $205 \text{ km}^3/\text{year}$  at a *multiannual mean discharge* of  $6,515 \text{ m}^3/\text{sec}$  (1921–2000) and with it a quantity of alluvia of 58.75 million t/year (the average for the same period), and 90 million tons of salts/year corresponding to a mineralisation of 350 mg/l. Characteristic flow values: mean discharge  $6,515 \text{ m}^3/\text{sec}$ ; maximum discharge  $16,500 \text{ m}^3/\text{sec}$  (April 2006), and minimum discharge  $1,350 \text{ m}^3/\text{sec}$  (October 1921).

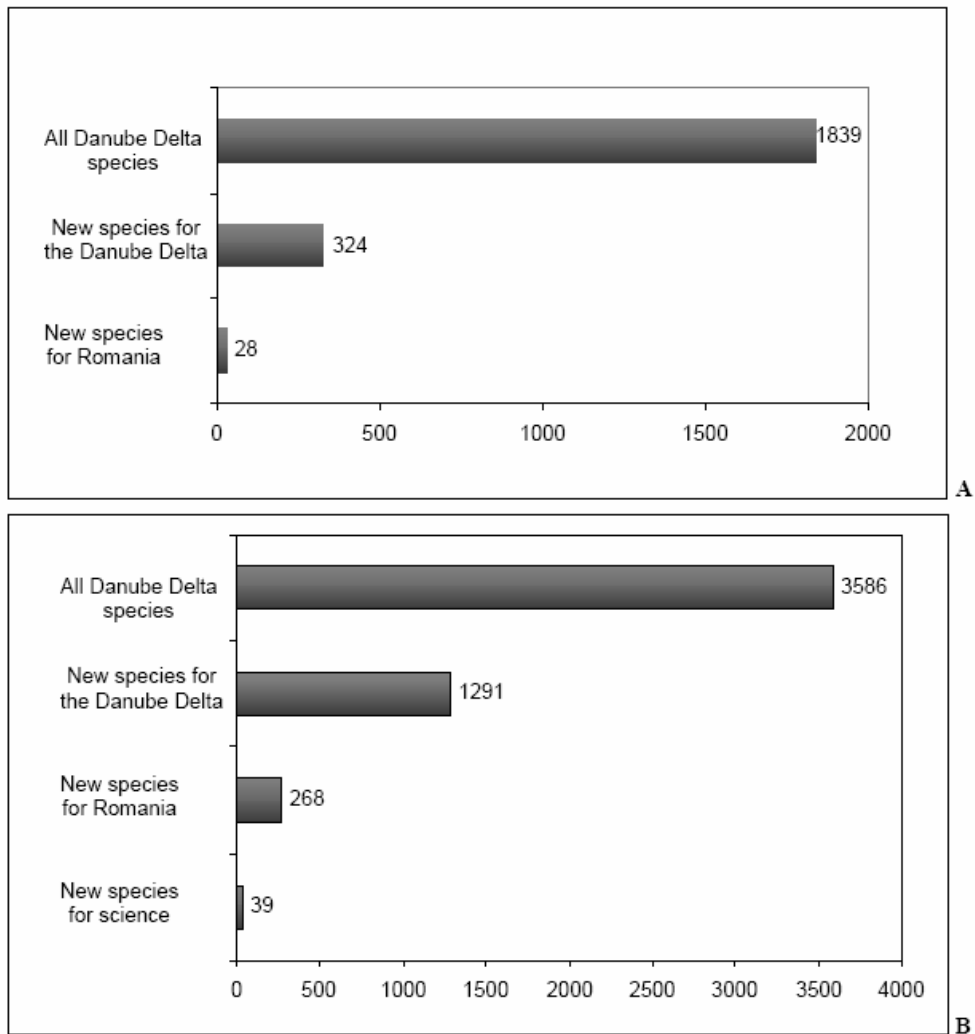
*The distribution of discharge* on the main Danube arms (Chilia and Tulcea, the latter branching out into Sulina and Sfântu Gheorghe) is uneven, with more or less significant variations over the last 150 years. The Chilia Arm registered steady decreases, from 72 % in 1910 to 54.3 % in 1991–2000.

Correction works, permanent dredging and consolidation of the banks (required by maritime navigation) made the Sulina Arm record increases, from 7 % in 1893 to 13.8 % in 1928/1929, 15.4 % in 1970 and 19.5 % in 1978, stabilising at these value (20.1 % in 1991–2000). No significant evolutions on the Sfântu Gheorghe Arm, discharge values fluctuating between 23.0 % in 1893 and 25.4 % in 1991–2000 (Tab. 1.)

**Table 1 The Danube liquid flows (input and output in the Delta) and on the main arms (m<sup>3</sup>/sec.) (after C. Bondar, 2004)**

Water course	Period													
	1921–1950		1951–1960		1961–1970		1971–1980		1981–1990		1991–2000		1921–2000	
	Qm <sup>3</sup> /s	%	Qm <sup>3</sup> /s	%	Qm <sup>3</sup> /s	%	Qm <sup>3</sup> /s	%	Qm <sup>3</sup> /s	%	Qm <sup>3</sup> /s	%	Qm <sup>3</sup> /s	%
Danube Isaccea	6 295	100	6 476	100	6 976	100	6 892	100	6 209	100	6 240	100	6 515	100
Chilia arm	4 018	63,8	4 074	62,9	4 244	60,8	4 076	59,1	3 606	58,1	3 390	54,3	3 901	59,9
Sulina arm	906	11,2	1 060	16,4	1 181	16,9	1 289	18,4	1 235	19,9	1 253	20,1	1 154	17,7
Sf. Gheorghe arm	1 236	19,0	1 293	20,0	1 382	19,8	1 510	21,9	1 399	22,5	1 583	25,4	1 400	21,5
Danube mouth Black Sea	5 986	95,1	6 215	96,0	6 657	95,4	6 534	94,8	5 589	90,0	5 702	91,4	6 113	93,8
Difference Isaccea-mouth	- 309		- 261		- 319		- 358		- 620		- 538		- 402	

Most of the Danube discharge on the three Danube arms flows directly into the Black Sea and only a small quantity passes through the network of backwaters, canals and the lacustrine complexes.



**Fig. 3 – Flora (A) and fauna (B) species inventoried in the Danube Delta Biosphere Reserve (1999)**

**Fauna.** An enormous diversity of species – 3586 – is found within the delta. Over 190 species of copepod and cladoceran crustaceans have been recorded; 418 species of freshwater rotifer, nematode worms and oligochaete worms have been identified, along with 90 species of molluscs (some of these are marine); 18 species of mollusc are endangered.

**Insects** are represented by an enormous diversity (2,244 species), though 196 are listed as endangered.

**Fish** represent the fauna of the delta, more than any other type of animal, 135 species have been recorded within the Biosphere Reserve. The sturgeons are the most primitive type of fish caught in the delta and three species run into the river to spawn. There are 31 species of fish that are able to live in both seawater and freshwater. They come into the rivers and canals to spawn and they include the Danube mackerel (*Alosa pontica*), Black Sea salmon (*Salmo trutta labrax*). Some of the carp, perch, zander and Danube catfish are able to withstand small dilutions of salt water. There are 44 fish species that live exclusively in the freshwaters of the delta. These include pike, tench, rudd, orfe, barbel and bream. Many of these fish are very important commercially and they provide the main source of income for people who live in the delta.

**Amphibia** there are two species of newts, seven species of frogs and four species of toad.

**Reptiles** are well represented in the delta – 11 species – with terrapins (*Emys orbicularis*) and tortoise (*Testudo graeca iberica*). The latter is more common in the south-western sector of the Biosphere Reserve. Four species of lizard are found, as are five species of snake.

**Birds.** There is no other place in Europe where such a great diversity of land and water birds can be found. 375 bird species are recorded in Romania and, of these, 320 live in the delta or migrate to it in the summer or the winter. 166 species nest in the Biosphere Reserve and most of these are summer migrants, which spend the winter in Africa or the Mediterranean. Among these are the common and Dalmatian pelicans, white storks, herons, egrets, spoonbill, ibis, swallows, house martins, sand martins, swift, bee-eater, roller, golden oriole and numerous warblers.

A large number of passage migrants pass through the delta in the autumn, en route from breeding to their winter feeding grounds. Five migration routes from the south cross the DDBR, in the spring, while six migration routes from the north-east pass over the delta in the autumn. These, together with resident and nesting populations of birds, make this a very important area within Europe. A number of bird species have been declared a strictly protected in Romania as „*monuments of nature*”. These are the common and Dalmatian pelicans, raven, spoon-bill, great white egret, little egret, black-winged stilt, shelduck, ruddy shelduck, little bustard, red-breasted goose. The delta provides a habitat for around 60 % of the world population of pygmy cormorant and a significant proportion of the world’s population of red-breasted geese overwinter in the Dobrogea. Of the 325 species recorded within the DDBR, 224 species are currently given strictly protected status.

*Mammals*, 44 species have been recorded within the DDBR. There are large numbers of native rodents, rabbits are commonplace in Letea and Caraorman forests, the otter and European mink are both protected, due to over trapping for their pelts. Amongst the larger predators the wolf is now extinct as a breeding species within the delta, though individuals have been known to move into the territory from Ukraine in particularly cold winters when they are able to cross the ice – this is not a usual event. Three species of dolphin are recorded in the Black Sea and of these, the common dolphin is the most frequent.

## **INFLUENCES OF MAN ON THE SENSITIVE ECOSYSTEMS**

The major influence has been a gradual worsening of water quality during the last fifty years. The creation and dredging of some navigation channels within the delta, and blockage of many side channels, has had a marked effect on the movement of water within the delta. Large areas were made into polders during the former communist regime and the land was used for agriculture, fish farming and forestry. The Pardina polder covers some 27,000 hectares, so the areas involved were large and very significant. These activities disrupted the normal hydrological cycles and it will take years to reverse harmful effects.

## **POPULATION AND SETTLEMENTS**

The first archaeological remains recorded within the delta are burial mounds at Chilia Veche and Murighiol. These date back to the Bronze Age (circa 3,000–500 B.C.). Both the Caraorman and Letea sandbanks were inhabited by the end of first Iron Age, in the 6th and 7th centuries B.C. These settlements continued to be inhabited until the second Iron Age. By the 5th to the 3rd centuries B.C.

Dacians and Getic tribes had moved to the edge of the delta in Mahmudia and Murighiol. At that time, Thracians and the Bastarnae were living on islands within the delta.

The Greeks founded Histria, as an important fortified trade centre by the 7th Century B.C. The Roman legions arrived around the delta in 29 B.C. and by the next year they had subjugated the Geto-Dacians and the Bastarnae. The Romans built a network of roads to allow both garrison movements and trade.

The Byzantine period (a continuation of the Roman period in the east) saw the development of an intense period of navigation and trade within the delta and the surrounding Dobrogea. Important settlements were established and Nufăru is supposedly built on the remains of one of these towns.

Tartar and barbarian invasions lead to the demise of the Byzantine Empire and by the 14th century a series of naval expeditions by the Turks led initially to the capture of the Dobrogean ports and later, in 1484, to the conquest of the whole of the Dobrogea and most of Romania to the south of the Danube.

The majority of the population of the delta were Romanians, during the period of the Ottoman Empire. During the 18th century, the population in / and around the delta was added to by Ukrainians and Lippovan Russians. A proportion of the Turkish and Moslem population also settled in the Dobrogea and some remained when the Turks were finally driven out at the end of the War of Independence (1877–1878).

The Danube European Commission set up the conditions that enabled Sulina to expand into a major port at the mouth of the Tulcea to Sulina arm. People from the Moldavian and Wallachian regions of Romania set up new communities along this arm, places like Partizani, Mila 23 and Crişan. Farming and fishing became important economic activities that enabled this growth. Sulina itself flourished to become a porto franco. The story of Sulina is, like so many other towns and villages in the Delta, one of growth and then decline. It is interesting to note that today Romanians make up 81 % of the population in the DDBR, with 7 % Russian Lippovans, 2 % Ukrainians and 1.7 % Turkish-Tartar. More than fourteen nationalities live and coexist peacefully within the BRDD and it is a good example of multi-ethnic tolerance.



## ECONOMIC ACTIVITIES

Since ancient times, **fishing** has been the main occupation of the Danube Delta inhabitants and although today the supply of fish has diminished and changed in quality, it continues to be basic trade.

The localities where fishing is the main trade are Crişan, Mila 23, Gorgova and Sfântu Gheorghe (the last locality is also involved in sea fishing). A second major occupation has been (and still is) **sheep and cattle breeding**, which, from the temporary condition (being practiced by the shepherds coming there with their flocks in wintertime from the Eastern Carpathians and the Moldavian Tableland), became a permanent occupation in the last decades of the 19th century. The localities with traditions in cattle breeding are Letea, Periprava, C.A. Rosetti, Sfiştofca and Caraorman.

**Traditional agriculture** has been practiced successfully by the inhabitants of the settlements situated on the riverine levees at low risk from flooding (Chilia, Pardina, Plauru, Sălceni, Ceatalchioi and Pătlăgeanca). After 1960, these traditional occupations were drastically modified by the extension of red exploitation (later abandoned), fish ponds, large agricultural polders (also partly abandoned) and forest plantations. The fishing includes the netting and trapping of freshwater fish, netting of migratory fish (like sturgeons, Danube herring and Black Sea salmon) and netting or line fishing of fish in the Black Sea.

**Hunting** is an economically important activity in the winter and it provides an income and food for local people. Fourteen mammals are hunted for fur and food and fifty-four species of bird – mainly ducks and geese are shot.

**Navigation.** The Danube Delta and its mouths have been used for navigation since the Antiquity.

The Persian king Darius the first, sailed with his fleet from Pontus Euxinus (Black Sea) into the Istros (Danube) up as far Noviodunum (Isaccea) during the war against the Scythes (514 BC). Navigation on the Danube was also important during the Stephen the Great's rule (15th century) and under Turkish rule (17–18th centuries). Conditions for an intensified modern system of navigation were created only after the hydraulic engineering works, which involved shortening and deepening the Sulina branch, had been carried out between 1862 and 1902. This allows oceanic ships to enter as far as Brăila harbour (170 km long).

**Tourism.** The Danube Delta is an area with a high reputation in Europe and elsewhere in the world; the number of foreign visitors is very limited and the level of accommodation is still low. However, there is a great potential for developing environmental tourism provided sufficient investment can be found for renovating and bringing existing facilities up to modern standards. Summer tourism is the most popular and the delta's history and archaeology, natural history, sightseeing and angling provide strong incentives for visits. Visitors from Germany, Austria, Hungary, Slovakia, the Czech Republic, Italy, France, Netherlands, Belgium and United Kingdom visit in increasing numbers. Tulcea and another localities (Sulina, Sfântu Gheorghe, Murighiol, Uzlina, Crişan, Mila 23) provides a better selection of good hotels, pensions, touristic complex, camping site and transport links have been improved.

## DANUBE DELTA BIOSPHERE RESERVE ECOSYSTEMS

Taking into account the morphologic-hydrographic configuration of the area, its flora and fauna communities and the long-term human impact, the two main categories of Danube Delta ecosystems associated with Razim-Sinoie lake complex and the Danube flood plain between Isaccea and Tulcea, as part of Danube Delta Biosphere Reserve, have been delimited: 23 natural or partly modified by man ecosystems (ranging from the Danube branches to the beaches); seven anthropic ecosystems (agricultural lands, forest areas, poplar plantations, fish farms, settlements-villages and towns).

## DANUBE DELTA BIOSPHERE RESERVE (DDBR)

**The DDBR** was founded by Government Decision No. 983/1990 and by the Law No. 82/1993.

It covers 5,800 km<sup>2</sup> encompassing, beside the **delta proper**, also the **Razim – Sinoie lagoons**, the **coastal marine waters** up to the 20th m isobath adjacent to the deltaic and lagoon front, the **Danube floodplain upstream the delta** to Isaccea, and the **Danube channel-bed** up to the Ukrainian border. In this area, three categories of functional zones are distinguished: **core areas** (506.0 km<sup>2</sup>), **buffer areas** (2,233 km<sup>2</sup>), **economic areas** and their localities (3,061 km<sup>2</sup>). The biosphere reserve concept does not exclude human activity provided, it is integrated with environment, so that economic actions fall in line with conservation and protection measures. Due to its international importance, the Danube Delta was listed (1990) among the world network of biosphere reserves under the „*Man and Biosphere Programme (MAB)*”. Under the RAMSAR Convention, to which Romania is a party since 1991, the DDBR was singled out as

wetland of international value, and major water bird habitat. Since the Danube Delta and the Biosphere Reserve (covering over 50% of its surface area) belong to the world heritage, the area was placed (1990) on the *List of the World Cultural and Natural Heritage* (Fig. 4). Concerning the secondary delta of Chilia branch in Ukrainian territory, the Government of that country issued a decision (No. 861/1998) establishing a *Ukrainian Danube Delta Biosphere Reserve* over 464 km<sup>2</sup>.

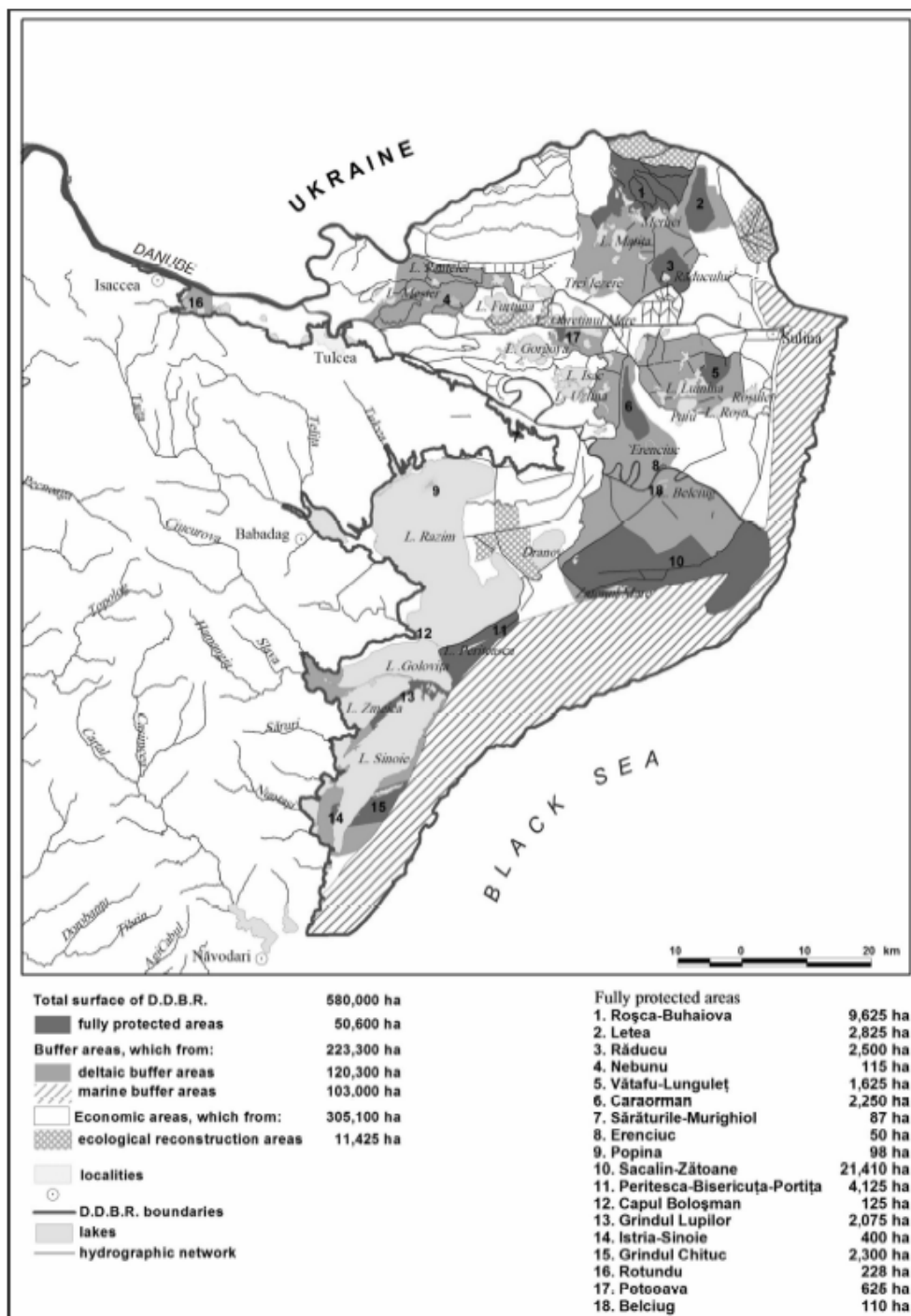


Fig. 4 – The Danube Delta Biosphere Reserve.

## MANAGEMENT OF THE DELTA’S NATURAL AND HUMAN RESOURCES

The role of the Administration of the *Danube Delta Biosphere Reserve (ARBDD)* is to administer the management and protection of the delta’s natural and human resources – an important socio-economic and not just a regulatory role. They also act as the local representatives of the administration and they are called on to provide advice to local people as well as visitors.

Effective management is based on well-informed decisions and data that enables value judgments to be made – not just subjectively, but on sound and reliable data. The ARBDD also needs to have the information available to it, so it can propose proven and necessary changes in legislation, where these affect the DDBDD. The **National Institute of the Danube Delta (INDD)** has been carrying out research for many years, into many aspects of the delta and the ways in which its resources are used. It is a leader in fish population research and in evaluation of the effects of exploitation; in study of ecology, water chemistry and pollution, population and socio-economics, etc.

The Institute works closely with a number inner and foreign partners – *the World Wildlife Fund, the Institute of Water Management and Waste Water Treatment RIZA in the Netherlands, the Auen-Institute based in Rastatt in Germany, International Union of Conservation of Nature (IUCN), Institute of Geography of the Romanian Academy, Institute of Hydrology and Water Management, Institute of Biology – Bucharest, Institute of Marine Research – Constanța, Institute of Marine Geology and Geo-Ecology, etc.*

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