

FACTS AND REMARKS ON THE DANUBE DELTA

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Abstract: Basic information about the present ecological state of the Danube Delta is presented in the paper. The author - former Governor of the Danube Delta Biosphere Reserve, which was founded in 1990, reviews the general features of this unique biome, the changes in the deltaic ecosystems and their causes, then the present efforts for a better understanding and management of Danube Delta Biosphere Reserve.

Key words: Danube Delta, Biosphere Reserve, ecological management, ecosystems, disturbances.

The Danube Delta representing a key element within one of the largest water systems in Europe (Danube River - Western Black Sea), working as a buffering interface between the Danube River catchment (805 300 km²) and Western Black Sea (5165 km²) has remained, thanks to its structural complexity and the taxonomic diversity of its components, one of the most representative biomes on the European continent. The remarkable beauties and natural assets of the delta, with its variety of biotops, its high biodiversity, its renewable resources as well as the scenery and the cultural heritage of its inhabitants have marked this place as unique, not only in Europe but also in the whole category of deltaic ecosystems. Dangers which have spoiled other deltas have been stopped in time. Thus, nowadays, about 80% of the delta areas is in a natural state; the planned works aimed at transforming large areas in the Danube Delta for agriculture and fish farming did not cause the loss of any natural ecosystem categories, but the changes (the embankment of flooding zones and building of large polders affected the proportion among the ecosystems and reduced the distribution area of almost all species. It is obvious that the direct or indirect anthropic and technogenic pressure attenuated the productivity of ecosystems and consequently, their carrying capacity. The authenticity and the high value of nature in the Danube Delta and its neighbouring wetlands, are indicated by the following features:

1. - a very productive area generating a large range of biological resources used traditionally by the native people; the bioresources obtained in the "cultural-industrial" conditions in polders or in fish ponds, are totally unsatisfactory being energy, and consequently money-consuming; 2. - one of the largest extent of reedbeds (*Phragmites australis*) in the world - 280,000 ha (Rudescu et al., 1965);

3. - a high diversity of the hydrogeomorphological units sustaining a mosaic of natural and man-made ecosystems and ecotones (fresh water, sea water, terrestrial ecotones, running and stagnant waters, marshes, easily flooded zones, river levees, maritime levees, reclamation zones for agriculture, pisciculture, forestry etc.); islands of ancient forest with subtropical species, rare for this geographical latitude: on the maritime levees at Letea and Caraorman the forests formed on the sandy dunes contain a great variety of species: there are oak-trees (*Quercus robur*, *Quercus pedunculiflora*) mixed with other trees of various essences (*Fraxinus angustifolia*, *Fraxinus palissae*, *Ulmus foliacea*, *Populus alba*, *Populus canaescens*, *Populus tremula* etc.) and also bushes (*Prunus spinosa*, *Crataegus monogyna*, *Rosa canina*, *Berberis vulgaris*, *Ligustrum vulgare*, *Hyppophae rhamnoides*, *Thamarix gallica* etc.) and climbing plants (*Vitis silvestris*, *Hedera felix*, *Humulus lupulus*) and an interesting liana 23 metres long (*Periploca graeca*) (Banu & Rudescu, 1965; Botnariuc, 1960; Diaconu & Nichiforov, 1963; Pop & Sălăgeanu, 1963);

4. - by its dimensions, the Danube Delta with the complex of ecological units is the most important wetland area in the South-Eastern Europe, having an important contribution to the regional and global water cycle (IUCN-EPP, 1992);

5. - a zone of maximum diversity for insects, birds and fishes (Table 1); by its geographic position as well as by the ecosystems diversity and food resources, the Danube Delta represents a cross-roads of the migratory birds' routes (Munteanu, 1995; Robert, 1988; Danube Delta Institute, 1992, 1993, 1994);

Table 1. Species diversity in DDBR

Groups of organisms	Number of species			
	Total	New for DDBR	New for Romania	New for science
Algues	213	-	-	-
Macromycetes	32	-	-	-
Lichens	110	19	-	-
Terrestrial macrophyta	734	55	6	-
Aquatic and wetland macrophyta	70	-	-	-
TOTAL FLORA	1.159	74	6	-
Worms	253	75	15	4
Molluscs	72	-	-	-
Arachnida	134	26	4	-
Crustaceans	84	10	-	1
Progoneta	32	9	1	-
Insecta	1.234	135	24	3
Total invertebrates	2.109	255	44	8
Fishes	64	1?	2	1?
Amphibia	8	-	-	-
Reptila	16	-	-	-
Aves	179	-	-	-
Mamifera	34	-	-	-
Total vertebrates	301	1?	2	1?
TOTAL FAUNA	2,410	256	46	9
TOTAL SPECIES	3,569	330		

6. - species of globally threatened birds occur in the delta and three of these - the Dalmatian Pelican (*Pelecanus crispus*), the pygmy cormorant (*Phalacrocorax pygmaeus*) and the red-breasted goose (*Branta rufficollis*) - have a major proportion of their world population in the Reserve at certain times of the year (Munteanu, 1995);

7. - a zone of fisheries: over 90 species of fresh, brackish and salt water fishes, both sedentary and migratory, where some old species, with obviously decreasing populations (e.g. Acipenseridae) are still waiting to be saved from extinction (Gomoiu & Munteanu, 1991);

8. - one of the last European refuge for mammals, such as *Mustella lutreola*, and the otter (*Lutra lutra*) (Danube Delta Institute, 1994);

9. - a zone still sheltering some species of plants and animals which are rare or threatened with extinction in other places. Some of them are considered as monuments of nature (*Pelecanus crispus*, *Tadorna tadorna*, *Tadorna ferruginea*, *Himantopus himantopus*, *Corvus corax*, *Pelecanus onocrotalus*, *Egretta alba*, *Egretta garzetta*, *Platalea leucorodia* etc.);

10. - a zone that can be considered an esthetic resource and a component of the world natural heritage of special value;

11. - a unique ecological system representing a scientific reservoir for the further development of the theoretical fundaments of ecology.

In the last decades, the Danube Delta has been subject to a series of important ecological changes, caused mainly by:

1. - hydrotechnical works in the watershed basin of the Danube: dams, embankment etc., affecting all Danubian flood plains (Stancik et al., 1988):

♦ two large reservoirs were built up (Iron Gates I and II) for hydrotechnical power plants, with a storage capacity of more than 4 km³ of water;

♦ more than 350 000 ha of flood plains along the Romanian side of Danube River Stretch were changed into agricultural land, which corresponds to a loss in a water retention capacity with about 4.5 km³ (Fig. 1)

♦ opening the Danube-Black Sea canal which linked Cernavodă to Agigea; it is sluiced four times daily and discharges about 320 000 m³ of water from the Danube into the Black Sea; we can be lucky that an old plan from the last century, to drage a canal between Turnu Severin and Galati (Fig. 1) has never been realised;

2. - multiple uses of chemicals in agriculture which enrich the Danube waters with fertilisers and pollutants;

3. - industrialisation and urban development along the Danube River system without water purification plants;

4. - modification of the natural hydrological pathways inside the Danube Delta, by building up canals, dams and polders; the example of Pardina zone is illustrative (Fig. 2):

- ♦ about 105 000 ha have been changed (Fig. 3) into agricultural (53 000 ha) and silvicultural (8200 ha) land or into man-controlled water bodies (53 000 ha) for intensive fisheries and reed harvesting; the process was associated with cutting new channels or dragging the former natural or man-made ones; it is estimated that this changes have led to a reduction of water retention capacity of the Delta with more than 1 km² (Bondar, 1994);

- ♦ the regularisation of the Sf. Gheorghe arm to improve the water and solid discharges into the Black Sea with about 5%, assuming that the erosion along the Romanian sea shore will be significantly reduced; the recent data recorded shows that the efficiency was lower, not exceeding 2-3% (Bondar, 1994);

5. - development of navigation in the delta which increases the potential for chemical and physical pollution, poaching etc.;

6. - overexploitation of biological resources (including inadequate harvesting of reed, anarchic and predatory exploitation of the ecosystems);

7. - uncontrolled tourism;

8. - total change of the physiography in some areas for swamp to "cultural" type ecosystems, suitable for agriculture, forestry and fish breeding etc.

Concluding, the most important effects of all direct or indirect man-made pressures upon the Danube River and the Danube Delta are as follows:

- ♦ reduction of the flooding zones along the Danube River and its principal tributaries and consequently, severe damages to the most efficient natural mechanism of controlling nutrients, heavy metals and pesticides, and irremediable losses of the best zones for fish spawning, feeding and growing - flooding zones being natural fish nurseries;

- ♦ increase in direct and indirect input of sewage, industrial waste, pesticides and nutrients in the Danube waters led to the strong eutrophication as the major driving force in the ecosystem dynamics of the Danube Delta and the general process of pollution (Vădineanu & Cristofor, 1987; Vădineanu et al., 1988);

- ♦ simplification, mostly into the aquatic ecosystems of the biocenosis structure through the reduction of biodiversity, decreasing of size population in some instances, the lost of the

equilibrium between plankton - benthos - fish fauna; the algal blooms (**Cyanobacteria**) become cronical phenomenon during the summertime, controlling many other biological processes;

- ♦ decrease in biological productivity in general (Fig. 4) and in fish production in particular; for example the main changes which have occurred in the Danube Delta ichthyofauna in the last decades (Gomoiu & Munteanu, 1991), can be summarised as follows:

- the fish production and productivity are continuously decreasing;

- the drastic decrease, sometimes to extinction of the sturgeon and carp populations;

- the pike and zander populations are menaced to be continuously diminished;

- the populations of the bream and especially of the crucian - the opportunistic forms, have become dominant.

Another example, changes in waterfowl number and distribution (Munteanu, 1995):

A. Breeding species

- ♦ Decrease of breeding populations;

- ♦ Bird spreading in the new man-made habitats;

- ♦ Bird adaptation to non-typical breeding habitats.

B. Non-breeding species:

- ♦ A larger distribution of passage migrants and winter visitors;

- ♦ Decrease of number of wintering waterfowl, during frosty periods;

- ♦ Increase of several species (due to : a global increase; changes in migration routes or winter quarters).

Remedial works in the Delta have been carried on for more than a century. But, we have to keep in mind that in such a complex system as the Danube Delta is, any "remedial" and "improvement" work contains a great risk; without serious studies and researches any human intervention could be, sooner or later a disaster.

First wave concern was for navigation to allow maritime shipping to get access to upstream ports such as Galati and Brăila (Sulina channel 1880-1900). Also, additional waterways have been cut to increase freshwater circulation and overcome the problem of a lack of oxygen; since the second World War, a comprehensive system of channels were created; the cuttings of the new canals for different purposes, some of them without any scientific reason, have influenced the whole hydraulic system in the Danube Delta, changing the natural hydrological philosophy, transforming many ecosystems.

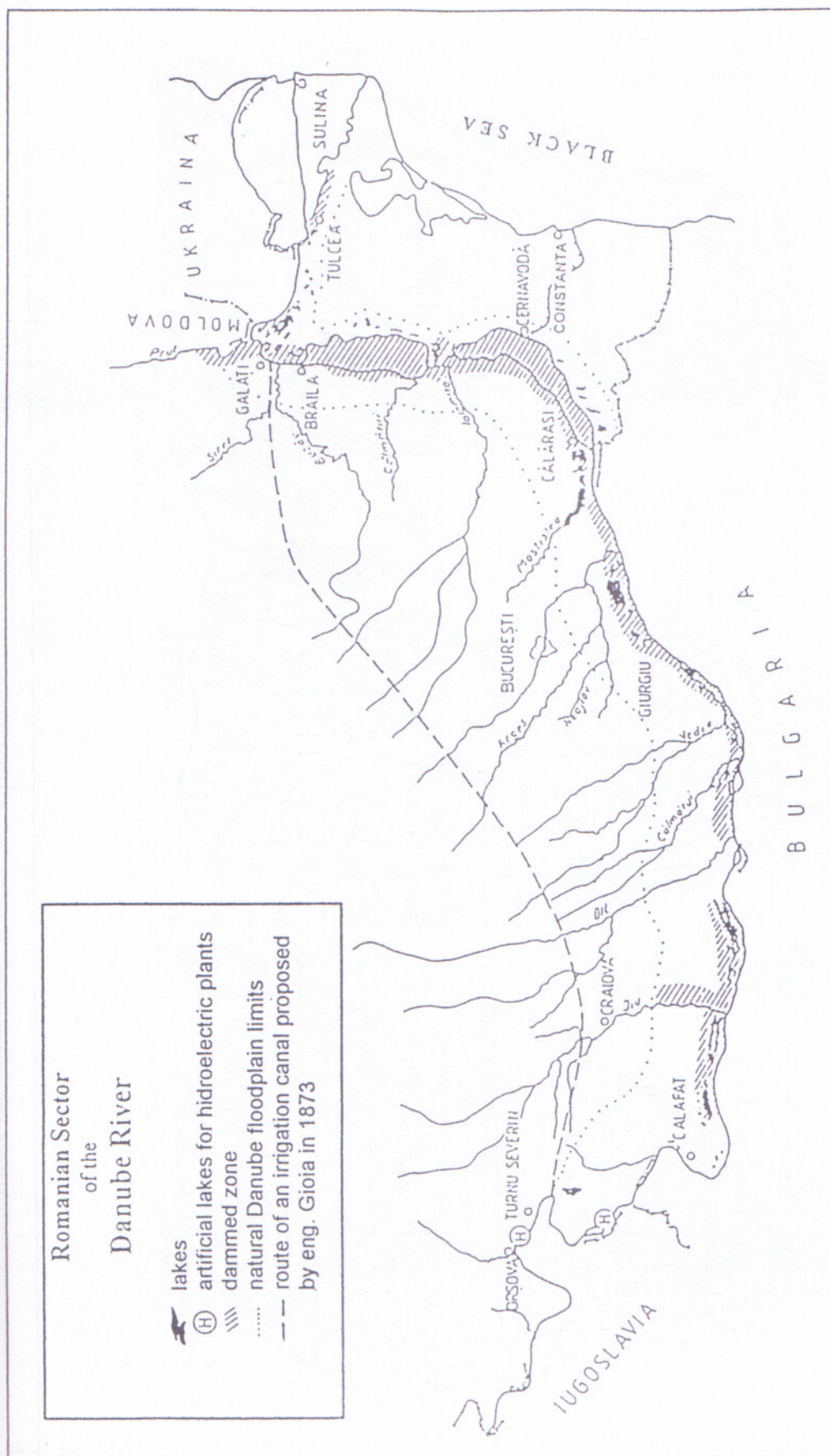


Fig. 1. Romanian Danube Floodplain before and after damming

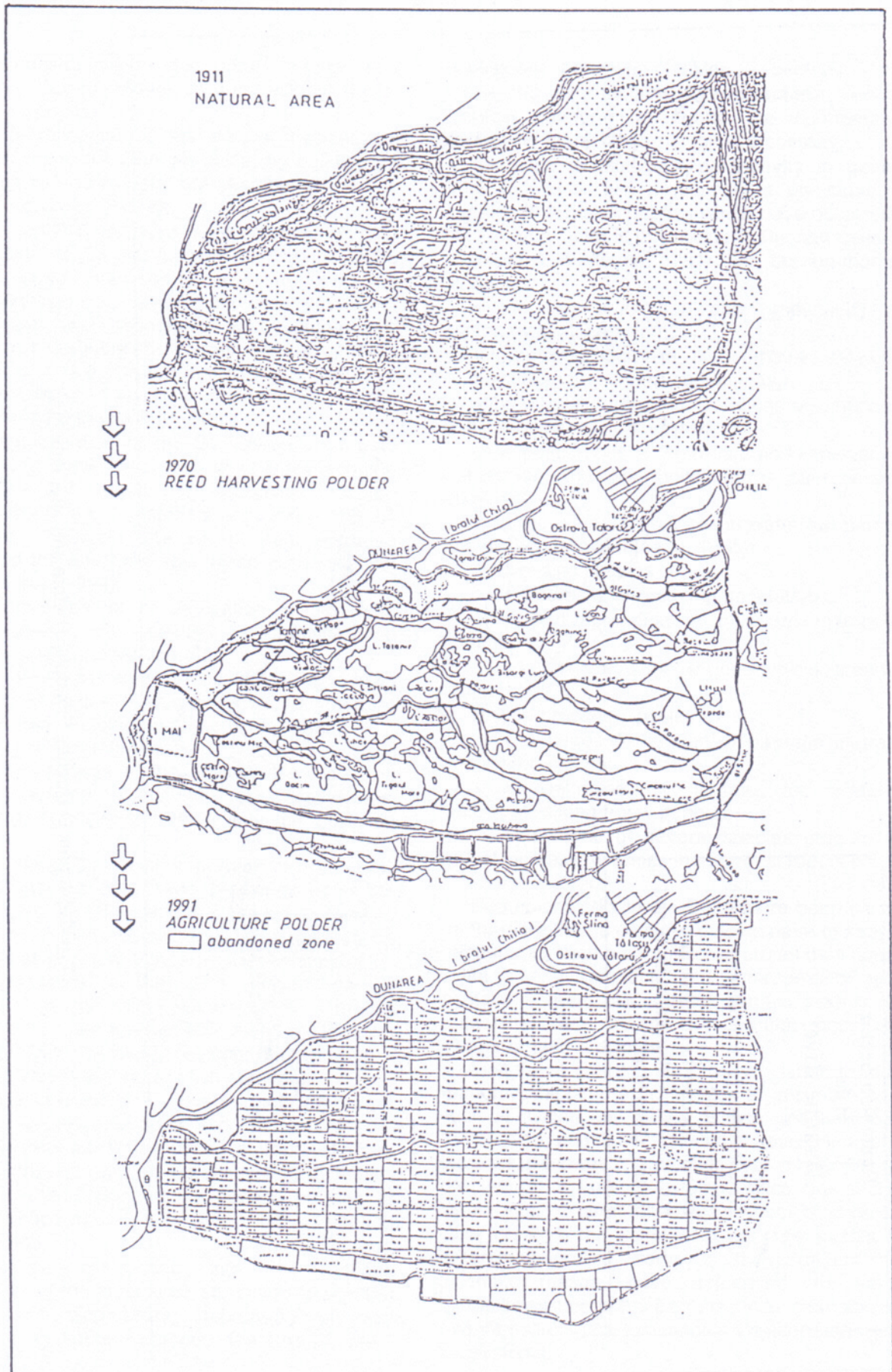


Fig.2 - The evolution of Pardina zone within the Danube Delta between 1911 - 1991

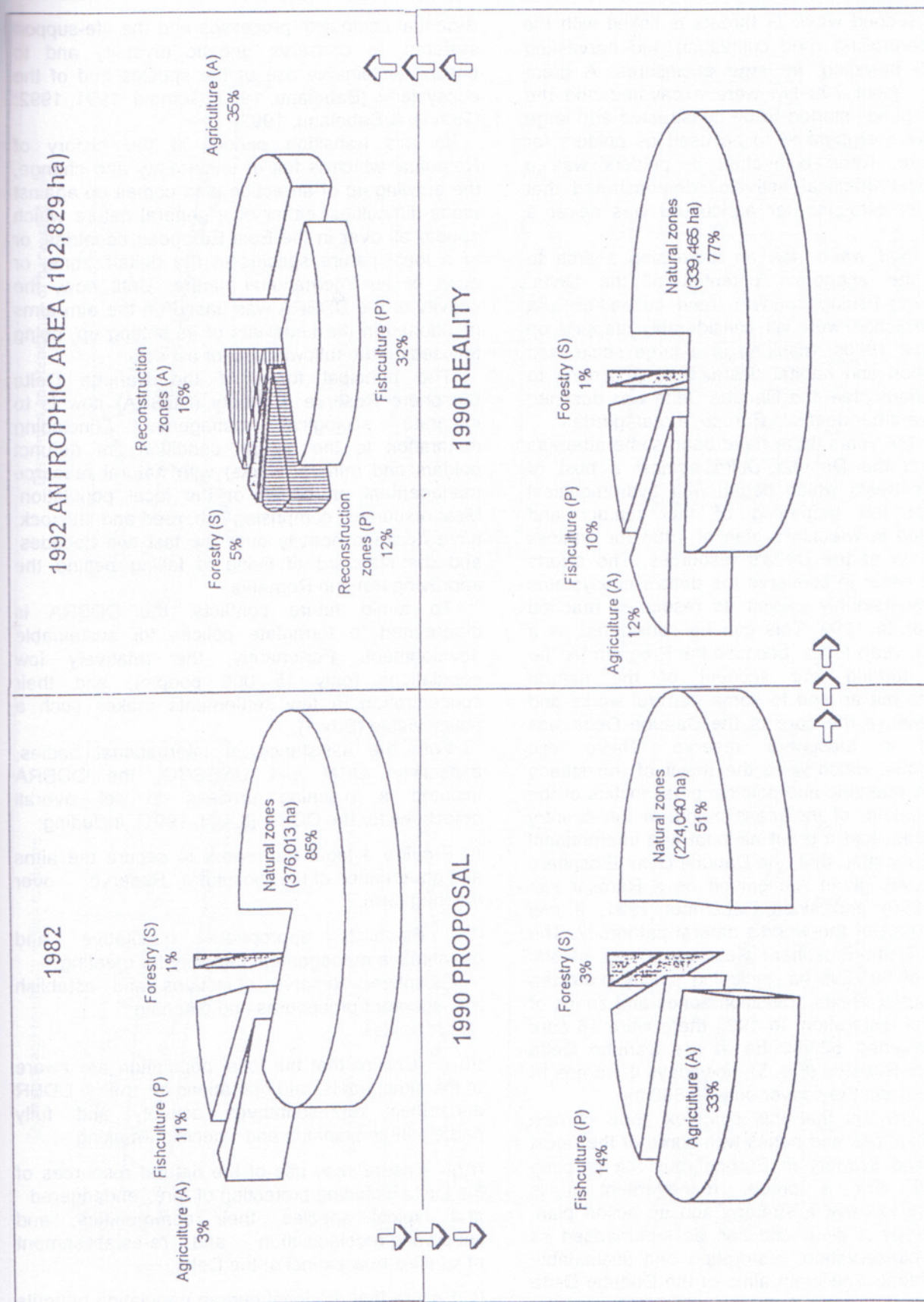


Fig. 3. Natural and transformed areas in the Danube Delta (442,300 ha - 100.00%)

The second wave of threats is linked with the works controlling reed cultivation and harvesting and fish breeding, in large enclosures. A great number, about 700 km were excavated and the first fish ponds started to be constructed and large zones were embanked to be used as polders for agriculture. Reed cultivation in polders was a failure and practical activities demonstrated that polders construction for agriculture was never a success.

The third wave was an increasing search to exploit the economic potential of the Delta. Agriculture, fishing, tourism, reed cultivation and sand extraction were all considerably stepped up during the 1980s, resulting in a large scale land reclamation and habitat destruction. According to an ambitious plan, the Danube Delta was destined to be, like other deltas in Europe, a real "garden".

Over the years there have been some attempts to protect the Danube Delta against a host of anthropic treats which began with hydrotechnical works at the beginning of the century and culminated in wreckless plan of 1983 for ruthless exploitation of the Delta's resources. The efforts made in order to conserve the delta's ecosystems and to sustainably exploit its resources reached their peak in 1990. This can be considered as a reference year: firstly, because the Program for the integral turning into account of the natural resources put an end to some harmful works and then, because the core of the Danube Delta was declared a biosphere reserve. These two declarations, which were the result of the steady efforts of scientific and political personalities of the public opinion, of the mass media in the country and abroad, had a great national and international effect. Soon after that, the Danube Delta Biosphere reserve was given recognition as a Ramsar site (21.09.1990) and since December 1991, it has become part of the world's natural patrimony. The Danube Delta Biosphere Reserve covers a total surface of 591,200 ha, including strictly protected zones, buffer zones, transition zones and zones of ecological restoration. In 1993 there were 16 core areas covering 52,980 ha in the Danube Delta Biosphere Reserve (Fig. 5), nowadays there are 18 such areas but they cover only 50,600 ha.

It is obvious that this complex zone of rare natural beauties and riches with some of the finest wildlife and scenery in Europe must be properly managed. For a proper management it is necessary to have a strategy and an action plan. Our strategy is clear and can be summarised as follows: conservation, restoration and sustainable development. The main aims of the Danube Delta Biosphere Reserve Authority (DDBRA) are the establishment of measures to maintain the

essential ecological processes and the life-support systems; to conserve genetic diversity and to ensure sustainable use of the species and of the ecosystems (Baboianu, 1992; Gomoiu, 1991, 1992; Gomoiu & Baboianu, 1992).

In this transition period, in the history of Romania, which is full of uncertainty and change, the drawing up of an action plan comes up against many difficulties, either of a general nature which appear all over in the East European countries, or of a local nature specific to the deltaic zone, or even of an international nature. Until now, the activity of the DDBRA was based on the aim aims mentioned in the Legal act of its setting up, being focused on the following major aspects:

The principal focus of the Danube Delta Biosphere Reserve Authority (DDBRA) now is to integrate ecological management (including restoration to the natural conditions of defunct polders and mineral works) with natural resource management on behalf of the local population. Most resources, comprising fish, reed and livestock, have declined heavily over the last two decades, and the standard of living is falling behind the improving trend in Romania.

To avoid future conflicts, the DDBRA is determined to formulate policies for sustainable development. Fortunately, the relatively low populations (only 15 000 people), and their concentration in few settlements makes such a policy viable (Box 1).

With the assistance of international bodies, especially IUCN and UNESCO, the DDBRA initiated a planning process to set overall objectives for the DDBR (IUCN, 1991), including:

(I) Provide a legal framework to secure the aims and governance of the Biosphere Reserve over the long term.

(II) Establish appropriate qualitative and quantitative management capacity for meeting

Biosphere Reserve objectives and establish management procedures and planning processes.

(III) Ensure that the local population are aware of the aims, goals, and operations of the DDBR and their representatives actively and fully participate in planning and decision-making.

(IV) Ensure wise use of the natural resources of the Delta including protection of rare, endangered and typical species, their communities, and supporting recolonisation and re-establishment of species now extinct in the Delta.

(V) Ensure that the local human population benefits directly from a sustainable development program.

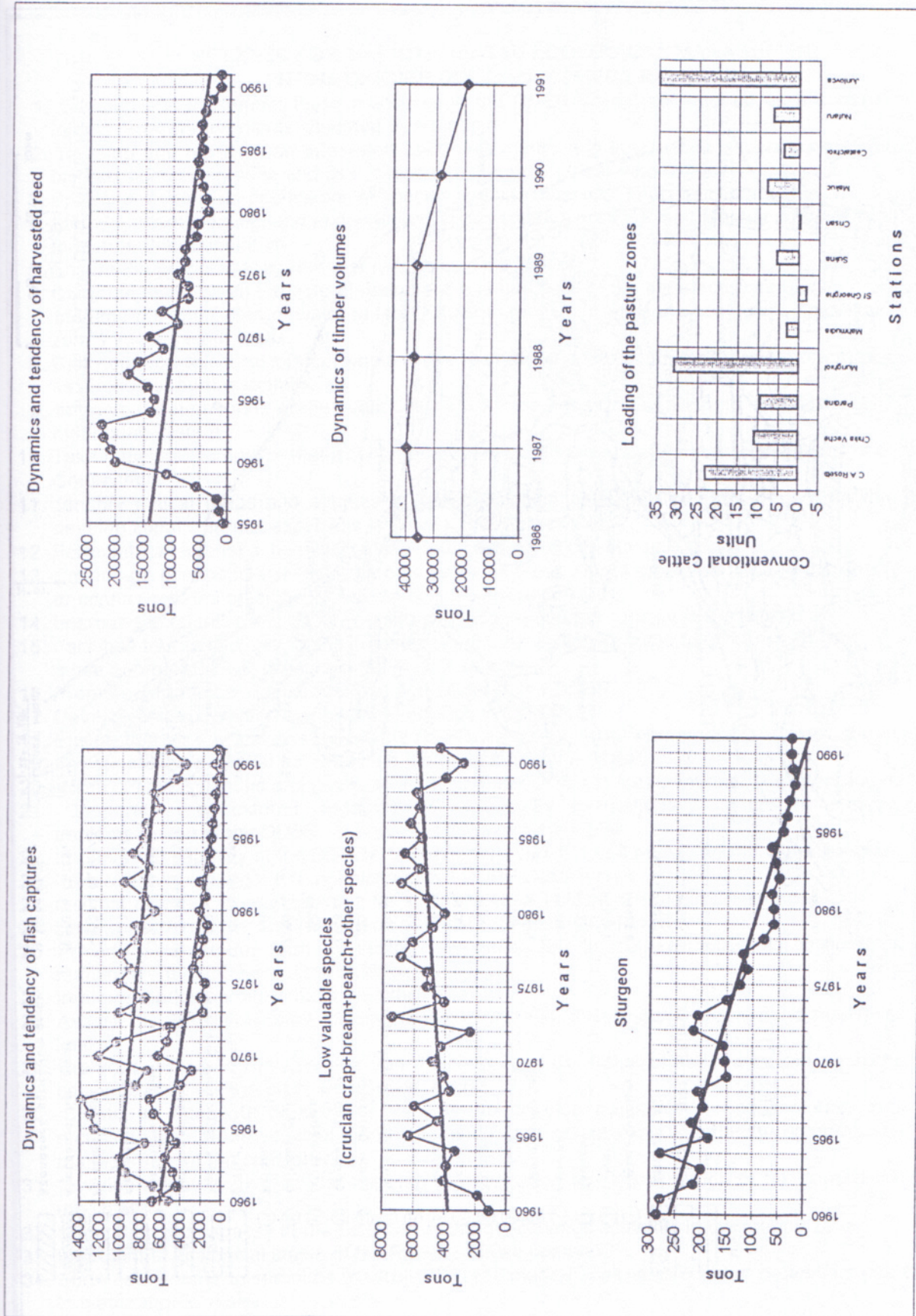


Fig. 4. Biological resources in the Danube Delta: annual fluctuations and dynamics tendencies

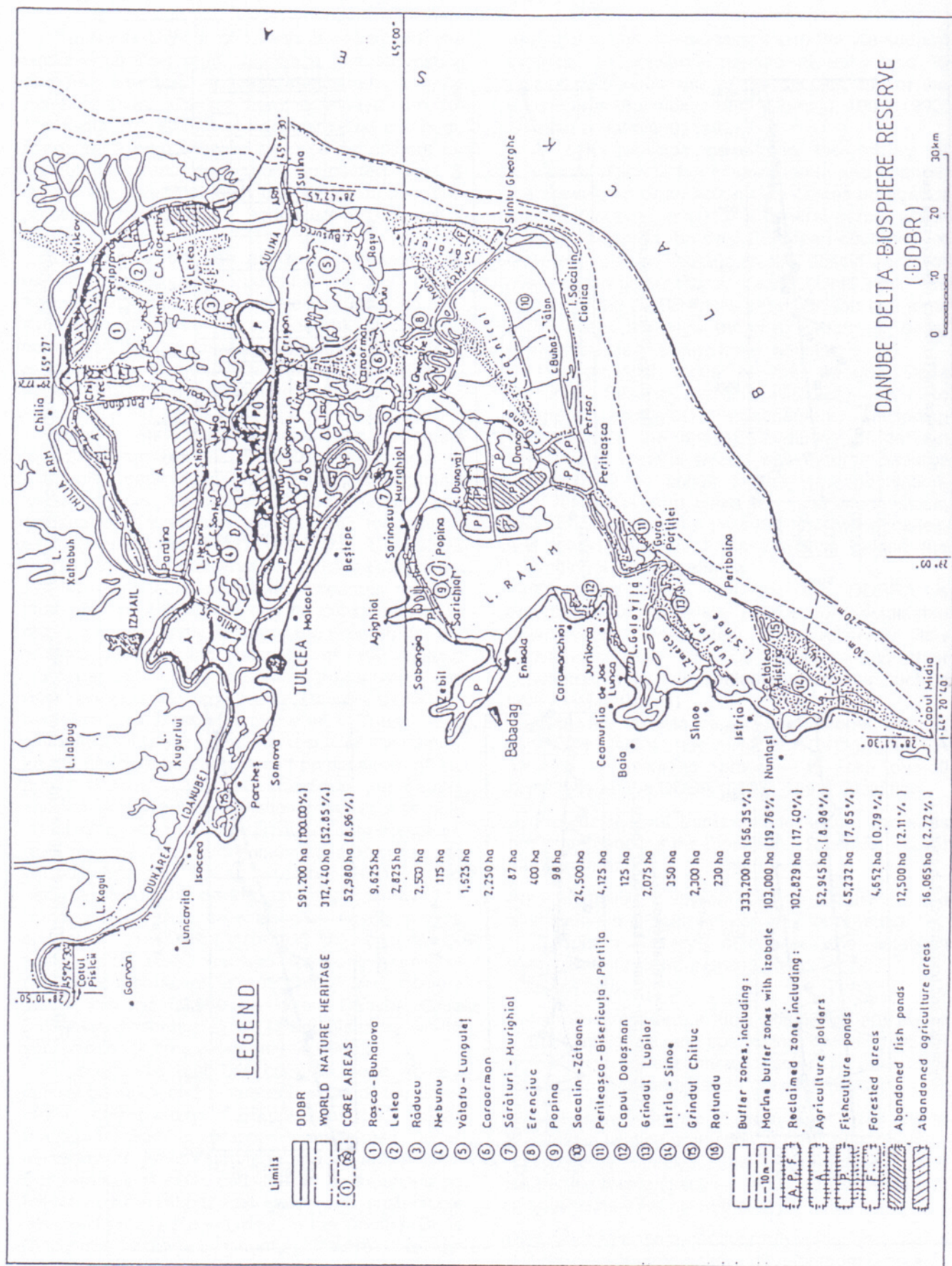


Fig. 5. The map of the Danube Delta Biosphere Reserve (1993)

POLICIES FOR THE INTEGRATED ECOLOGICAL MANAGEMENT IN THE DANUBE DELTA BIOSPHERE RESERVE*

1. Develop and implement those measures in the DDBR which are required as a consequence of the international commitments assumed by Romania.
2. Develop and maintain an integrated data base comprising information necessary for management of biodiversity conservation and use of resources within their carrying capacity.
3. Protect and maintain populations of species and habitants with high ecological value.
4. Identify recently extinct and endangered species within the DDBR and identify suitable habitats in order to restore their population.
5. Ensure the proper management of reedbeds in the DDBR.
6. Carry out research on the natural operations and functions of the delta ecosystem.
7. Manage the circulation of water in the DDBR in order to improve the ecological conditions in lacustrine zones and adjacent areas.
8. Carry out ecological restoration works where the natural or semi-natural character of areas has been lost as a result of human activity.
9. Improve the monitoring of the quality of the environment in the DDBR and integrate it with the national monitoring system.
10. Take measures to ensure that discharges from the Sulina channel meet the obligations of the Bucharest Convention.
11. Identify critical areas and sources of pollution which have an important impact on the DDBR and develop zonal controls, especially in Tulcea and Sulina ports.
12. Formulate a regional action plan to deal with cases of accidental pollution.
13. Encourage economic activities, but only as far as these do not cause damage to the delta's ecosystem or conflict with the objective of maintaining biological diversity.
14. Improve the quantity and quality of data available on tourism activity in the DDBR.
15. Facilitate tourism activity that is in harmony with the ecological objectives of the DDBRA, in particular to guide appropriate investments in the private sector.
16. Promote sustainable development of agriculture in the DDBR.
17. Develop and understand the historical ecology in the DDBR.
18. Ensure that all physical activities in the DDBR are subject to environmental protection standards.
19. Investigate the potential for extending the boundary of the DDBR.
20. Raise official, scientific and public awareness of the DDBR at local, national and international levels.
21. Cooperate with external organisations, especially internationally, to generate support for the implementation of the DDBR objectives and management plan.
22. Improve the capacity of the DDBRA to implement, monitor and revise the management plan.
23. Protect and conserve the morphology of the DDBR coastal zone.
24. Institute a system of management for the sustainable utilisation of natural resources.
25. Develop and improve fish farming on the basis of economic efficiency.
26. Provide guidelines on forms of ecologically sustainable agriculture that would be compatible with the management objectives of the DDBRA.
27. Improve marketing of products from the delta.
28. Assess the effectiveness of existing buffer zones and, if necessary, recommend modifications to their limits.
29. Protect the lake Razim complex from the effects of the influx of sediments and agricultural residues caused by surface run-off from adjacent areas.
30. Create an adequate legal frame in order to develop measures for conservation, protection and reconstruction of the coastal-marine zone through establishing standards regarding the integrated management of the coastal zone.
31. Develop scientific methods for assuring the protection and conservation of the coastal morphology of the DDBR.
32. Strengthen the capacity of the DDBRA to control economic activities in the marine zone.
33. Improve the ecological status of the Razelm-Sinoie complex.
34. Formulate criteria to stimulate mariculture in the marine zone, especially of organisms that have a role in biofiltration of water.
35. Ensure the ecological of strictly protected areas.

*Draft issued in October 1994

RESEARCH PROJECTS OF THE DANUBE DELTA INSTITUTE

1. Assessment and protection of the **genofund** in the DDBR.
2. Characterisation of the **ecological factors** which define the diversity of natural ecosystems in DDBR.
3. Study of the DDBR **fish populations** and establishment of the conditions for their sustainable use.
4. Assessment of **reed resources** in the DDBR and establishment of the conditions for their sustainable use.
5. Assessment of **pastures** in DDBR and establishment of their sustainable use by traditional pasturing.
6. Establishment of ecological conditions for the use of the deltaic landscape for **tourism**.
7. Researches for the reduction of the **impact of economic activities** in the anthropic ecosystems on the natural ecosystems in DDBR.
8. Study of **economic and social issues** in the DDBR and their including in the ecological management.
9. Researches on the ornitofauna of the DDBR.
10. Improvement of ecological state of the natural ecosystems and **ecological restoration** of some abandoned polders in the DDBR.
11. Assessment of the **informatic system** of DDBR Authority including remote sensing and GIS.
12. Supervising of **nutrient contents** in the Danube Delta waters.
13. **Atlas** of DDBR.
14. Researches for the protection and restocking of marine **migratory sturgeons** in the Danube.

Consequently, aid has become available from the European Bank for Reconstruction and Developments (EBRD) and the World Bank (Global Environmental Facility) to implement this objectives. The EBRD program (EBRD 1993) focuses on the strengthening the management capacity of the DDBRA involving local people in the planning process and carrying out investments to promote sustainable development (Box 1). The World Bank / GEF project concerns biodiversity conservation and will focus on staff training (especially of wardens), rehabilitation of abandoned polders, provision of a monitoring system and other projects aimed at improving the ecological state of the DDBR.

Research projects of the Danube Delta Institute (Box 2) represent the doubtless proof that all the actions for an integrated ecological management in the DDBR being based on scientific control must be a success in the near future.

In conclusion, the Romanian government in a very short time has made great progress with reversing the trend of ecosystem destruction in the Delta moving more towards sustainable development based on conservation goals. While there are still many obstacles to overcome (including a general lack of expertise in protected

area management environmental legislation and conservation awareness in the country), nevertheless the government has shown its commitment at the international level by its accession to the World Heritage, Ramsar and Bern Conventions.

Proofs of acknowledging and encouraging Romania's efforts for the protection of the Danube Delta have already begun to appear - see the diplomas awarded by UNESCO and Ramsar Convention Secretariat, lying on the same page with the generous DDBR logo which comprises the pelican flying over the delta and the conservation signs (Fig. 6).

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Danube Delta Biosphere Reserve (DDBR)



Organisation des Nations Unies
pour l'éducation, la science et la culture



Programme sur l'Homme et la Biosphère

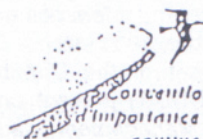
Par décision du Bureau du Conseil International
de coordination du programme sur l'homme
et la biosphère, tenu le 11 mai 1988, par le Conseil,
il est décidé que

Réserve de biosphère du Delta du Danube

est partie intégrante
du réseau International de Réserves de la Biosphère.
Ce réseau, constitué par
des zones protégées représentant
les principaux types d'écosystèmes mondiaux,
a pour objectif la conservation
de la nature et la recherche scientifique
au service de l'homme.
Il servira de système de référence pour mesurer
les impacts de l'homme sur
son environnement.

Donc, Tulcea, 11 mai 1988

Diplôme officiel
de l'U.N.E.S.C.O.



Convention relative aux zones humides
d'importance internationale, particulièrement
comme habitats des oiseaux d'eau

DIPLOME

Ce Diplôme atteste que le site

'Le Delta du Danube'

a été inscrit sur la liste des zones humides
d'importance internationale de

Ungary

[Signature]
Le Directeur Général
de l'U.N.E.S.C.O.

Fig.6 - Danube Delta Biosphere Reserve logo and diploma offered by UNESCO - MAB and Ramsar Convention Secretariat

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