HABIT-CHANGE
adaptive management for protected areas

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Climate change adapted management plan for Danube Delta Biosphere Reserve

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Authors:	Mihai Doroftei Contribution of: Marian Mierlă, Silviu Covaliov, Cristina Nanu, Gabriel Lupu (DDNI)		

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Lead Partner:	Leibniz Institute of Ecological and Regional Development (IOER), Germany		
Project Partner:	▪ University of Vienna, Austria ▪ National Academy of Sciences, Scientific Centre for Aerospace Research of the Earth, Ukraine ▪ Thuringian State Institute for Forestry, Game and Fishery, Germany ▪ Potsdam Institute for Climate Impact Research, Germany ▪ Technische Universität Berlin, Germany ▪ Balaton Uplands National Park Directorate, Hungary ▪ Szent Istvan University, Hungary ▪ Biebrza National Park, Poland ▪ Environmental Protection Institute, Poland ▪ Triglav National Park, Slovenia ▪ University of Bucharest, Romania ▪ Central Institute for Meteorology and Geodynamics, Austria ▪ Danube Delta National Institute for Research and Development, Romania ▪ SOLINE Pridelava soli d.o.o., Slovenia ▪ University of Maribor, Slovenia ▪ European Academy Bolzano, Italy		
Contact:	Marco Neubert, m.neubert@ioer.de, +49 351 4679-274 Sven Rannow, s.rannow@ioer.de, +49 351 4679-274		
Further information	www.habit-change.eu		

CONTENT

1. Objectives of the climate-change adapted management plan (CAMP)

The climate-change adapted management plan (CAMP) is a management plan that answers the urgent question: **How can protected area management respond to climate change and its impacts on protected habitats?** This CAMP in hand provides all information necessary to manage protected habitats towards a Favourable Conservation Status even under changing climatic conditions. This CAMP is a result of the revision of existing management plans, management practices and monitoring activities. It is designed to help enhancing today's management with regard to the best available knowledge about climate change and its impacts on protected areas. In order to reduce existing uncertainties about climate change and its impacts, the CAMP promotes a new management strategy called "adaptive management".

The CAMP is a result of in-depths analyses and assessments that were carried out within the "HABIT-CHANGE" Project as part of the ERDF-funded EU Central Europe Programme. A total of 17 partners and 24 associated institutions from 8 Central-European countries worked together to elaborate state of the art information about projected climate changes, the assessment of potential impacts on protected habitats and appropriate management options.

The CAMP is the basis for a management that is prepared for climate change. It gives detailed advice and concrete recommendations for decision making under conditions of climate change. It supports all management and adaptation processes in protected areas relevant for habitat management. It contains target- and threshold-values that indicate when specific management actions should be taken to mitigate the effects of climate change.

The objective of the climate-change adapted management plan (CAMP) is to enable protected area managers to manage protected areas with habitats according to Annex 1 of the Habitats-Directive under conditions of climate change. It is primarily meant as a supporting document for managers of protected areas.

The CAMP provides information about:

1. How climate might change in the region of the protected area,
2. How sensitive protected habitats are to these changes in climate,
3. What impacts climate change might have on protected habitats and
4. How to manage protected habitats and obtain a favourable conservation status under expected and already observed climatic conditions.

1.1. Purpose and goals of the CAMP

The impacts of climate change on protected areas call for the adaptation of management practices, strategies and measures as they are found in management plans for protected areas. This CAMP is the result of a revision of existing management plans, its goals, strategies and measures and the evaluation of their suitability for changing climates. The purpose of the CAMP is to transfer scientific knowledge about climate change and its impacts into practical on-site management actions in protected areas.

The CAMP has a special focus on Natura 2000 areas, since most of the studied habitats fall under the habitat directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora). The main objective of adapting habitat management in HABIT-CHANGE investigation areas is to maintain or obtain a "Favourable Conservation Status" of protected habitats (FCS) even under the conditions of climate change. The CAMP exemplifies strategies and measures to obtain this objective. It provides rules for decision making, supports all management processes in protected areas and specifies advice on how to implement the concept of "active adapted management" in the protected areas, including frequent monitoring of the achievement of objectives and adaptation of measures and strategies.

The main aims of the CAMP are:

- To analyse and evaluate advanced information about existing as well as expected pressures on protected habitats and about existing as well as projected climatic conditions in the investigation area;
- To assess impacts on habitats and to identify areas and habitats which need immediate and adapted management;
- To enhance existing management plans to make them suitable to address new challenges posed by climate change related-impacts;
- To introduce the concept of an adaptive management that consists of a choice of simultaneously implemented alternative management measures, a monitoring programme to evaluate management effectiveness and to track changes in natural resources and an intensified stakeholder involvement;
- To provide recommendations for communication with relevant stakeholders and their participation in an adapted management of the area.

1.2 Introduction of an adaptive management concept

Management of protected habitats should be based on a profound knowledge about the functional and structural components and the conservation status of the habitat types. It should also be based on knowledge about the effectiveness and efficiency of different management options and their impacts on

the conservation status. Unfortunately, the knowledge about complex natural systems like habitats, about the impacts of climate change on these natural systems and about the effectiveness of different management activities is still insufficient. But the lack of knowledge and understanding and the uncertainties in projected climatic changes and responses to that change must not be an excuse for inaction. Instead of hesitating with adaption, a concept of simultaneously managing and learning about natural systems should be introduced in protected area management: adaptive management.

The introduction of an adaptive management is an answer to existing uncertainties and the lack of knowledge about functions and processes in complex natural systems like habitats. The impacts of future changes as well as possible management measures have to be monitored and evaluated within the management process in order to learn about the managed resource and improve management decisions.

Adaptive management is one of the most recommended strategies to deal with climate change. It "allows managers to determine systematically whether management activities are succeeding or failing to achieve objectives." (Williams et al. 2009, 57)

Main feature of an active adaptive management is the implementation of different alternative management options at the same time and the systematic monitoring of the effectiveness and efficiency of those options. In that way managers can reduce the uncertainty about possible system responses and gain knowledge about processes and functioning of habitats and ecosystems. Basis for an adaptive management is an intensive stakeholder involvement, the precise definition of (measurable) management objectives and the identification of different management responses that shall be tested regarding their effectiveness.

The CAMP contains the basic elements and content necessary for the implementation of an adapted management in the protected area, including frequent monitoring of status and management-effectiveness indicators. The CAMP is designed to be the central information source and working basis for protected area managers (regarding climate change adaptation).

2. General site description

2.1. Basic information about CAMP area

The Danube Delta is situated in the eastern part of Europe and lies at the intersection of 45°N (latitude) with 29°E (longitude) - 45°24`30``N (latitude) and 28°10`50``E (longitude) on Cotul Pisicii, 45°9`30``N (latitude) 29°42`45``E (longitude) on east of Sulina locality, 44°20`40``N (latitude) and 28°41`30``E (longitude) on Capul Midia, 45°27`20``N (latitude) and 29°19`20``E (longitude) on Chilia Veche (fig.1) (Gâștescu and Știucă, 2008).

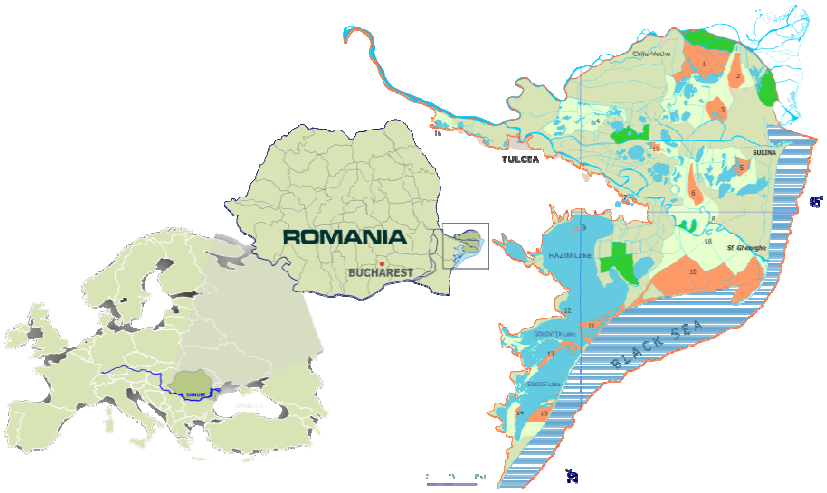


Fig. 1 Location of DDBR in Europe

Danube Delta Biosphere Reserve (DDBR) was founded by Government Decision No. 983/1990 and by the Law No. 82/1993. DDBR area includes two bioregions steppe and pontic (Doniță *et al.*, 2005). The Danube Delta Biosphere Reserve area is estimated at 580,000 ha (table 1). The actual delta, displayed between Chilia, Sulina and Sf. Gheorghe branches, covers 2, 491 km^2 with 29 types of natural or partly man-induced habitats (Natura 2000 habitats classification). Inside this territory, the Danube Delta Biosphere Reserve has structured the following areas: strictly protected areas – 20 (54337 ha); buffer areas (2,230 km^2) situated around the strictly protected zones in order to gradually reduce human pressure and transitional zones enclosing all rural and urban settlements. Referred to the Black Sea "0" level, 20,5 % of the Delta area lies below this point and 79,5 % above it. The greatest extension (54,5 %) has the territory comprised between 0 and 1 meter high. The few marine levees – Letea, Caraorman and Sărăturile, or what has been left of the Bugeac Plain in the south of Basarabia, that is, Chilia and Stipoc which rise up to 1 - 13 m, represent a small percentage of the Danube Delta area (Posea *et al.*, 2005; Gâștescu and Știucă, 2008). 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 (Gâștescu and Știucă, 2008).

Table 1 General description of the CAMP area

Area	580,000 ha
Population: rural/urban	9694 inhabitants (26 villages)/4601 inhabitants (1 town) with an annual average decreasing of 2,5 ‰.
Administrative structure	8 administrative areas and local councils (Maliuc, Crișan, Clilia Veche, Sfântu Gheorghe, Ceatalchioi, C.A.Rosetti, Sulina and Pardina) (fig. 2)
Land transformation rate	The current status of land transformation is moderate. The rate is increasing. From the total area involved (580,000 ha) 58.2 % of the area is in a natural state (river and marine levees with forests and pastures, canals, lakes, swamps - part

	of them protected) and 41.8 % agricultural polders (400 km^2), fish ponds (365 km^2), forest plantations (64 km^2).
Arable lands	The total area is 45773,7 ha. Most of the agricultural lands are unsustainable.
Forest rate	The total area of natural forest is 5262,286 ha. Mostly riparian and sand dunes forests.
Protected area	20 protected areas representing 9.36% (54337 ha) from the total area of DDBR. Roșca-Buhaiova, Letea Forest, Răducu Lake, Nebunu Lake, Vătafu-Lunguleț, Caraorman Forest, Sărături Murighiol, Arinișul Erenciuc, Popina Island, Sacalin-Zătoane, Periteașca-Leahova, Dolosman Cape, Grindul Lupilor, Istria-Sinoe, Grindul Chituc, Rotundu Lake, Belciug Lake, Prundu cu Păsări Island, Ceaplace Island.
Main land use types	Fish polders, agricultural polders, forest plantations and pastures.
Potentially hazardous events	Water shortages, unexpected variations in temperature and precipitations for the same season, increasing presence of invasive species
Waste water treatment	Existing drinking water supply classic solution (filtration & treatment) in Sulina, Maliuc and Chilia Veche. Partially drinking water supply in Pardina and Mila 23. Proposed drinking water supply in Plauru, Sălceni, Tudor Vladimirescu, Ilganii de Sus, Ilganii de Jos, Băltenii de Jos, Uzlina and Periprava.
Waste management	There is no a sustainable waste management activity.
Main economic sectors	Fishing, wood and reed exploitation, tourism, navigation,

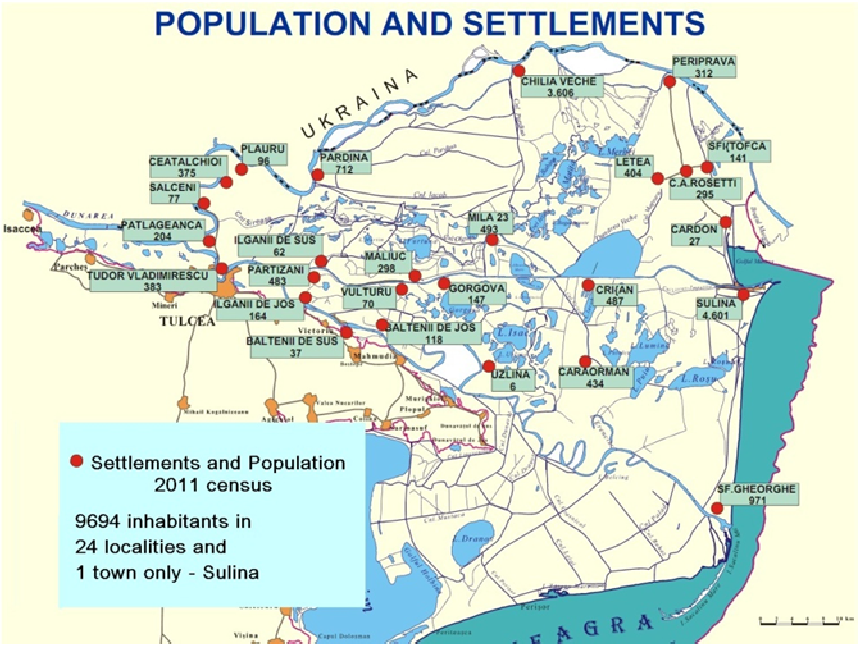


Fig. 2 Population and settlements from the CAMP (DDBR) area

2.2. Ecological and social situation

2.2.1. Land use

The administration and management of DDBR is a complex process but linked to local government structures that operate within the reserve. They comprise DDBR lands under national control, lands under local government control, and lands privately owned, distributed among seven local councils and the town of Sulina (fig.3). According to Law No. 69/1991, the local councils include elected bodies that make all

decisions relating to land under their control, including development planning and control, public works, conservation of historical monuments, recreation facilities and protection and improvement of the environment in order to better the quality of life. The next level of government is Tulcea County Council, which coordinates various communal services on behalf of the local councils, and takes responsibility for land under its own control, town planning, maintaining and improving the infrastructure (roads and water supply). Within the DDBR, the Tulcea County Council controls fish areas, agricultural polders and forest plantations (about 860 km^2) used by companies in which the state holds a majority share (Gâștescu and Știucă, 2008).

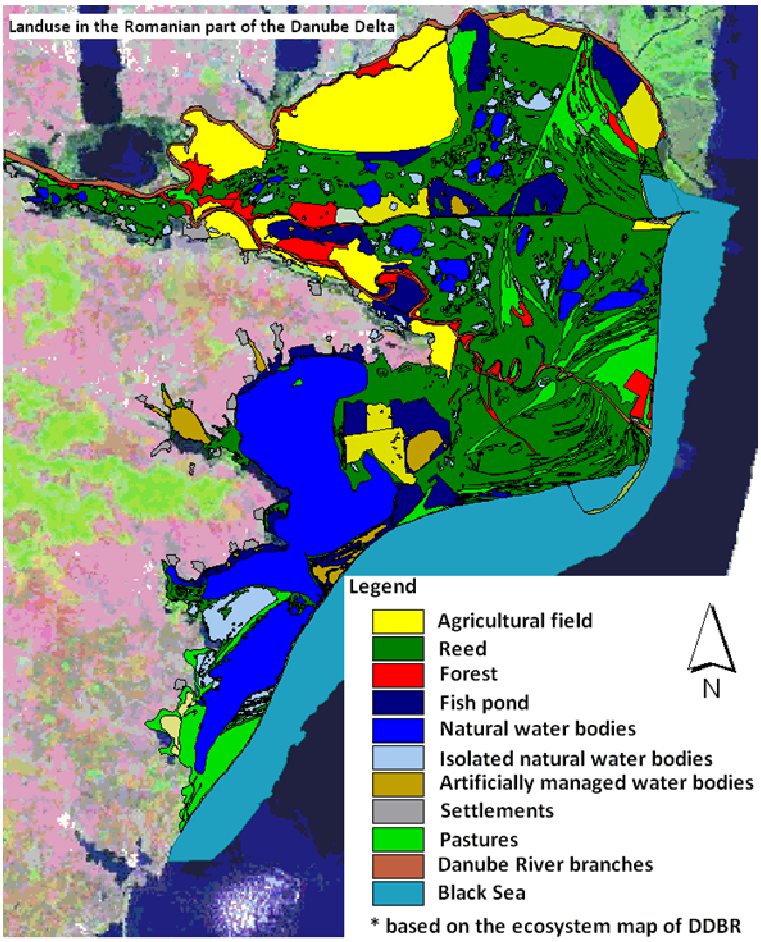


Fig. 3 Land use map of the Danube Delta Biosphere Reserve – Romania

The Danube Delta land-use structure is the following: 58.2 % of the area is in a natural state (river and marine levees with forests and pastures, canals, lakes, swamps - part of them protected) and 41.8 % agricultural polders, fish ponds, forest plantations. Noteworthy, the Danube Delta is to undergo some ecological management. 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. A second major occupation has been (and still is) sheep and cattle breeding. Traditional agriculture has been practiced successfully by the inhabitants of the settlements situated on the fluvial

levees at low risk from flooding. After 1960, these traditional occupations were drastically modified by the extension of reed 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. Catches of fish have declined from around, 15,000 tonnes (10 – 20,000) in the 1960s, to 5 – 6,000 tonnes by 1994 (Posea *et al.*, 2005). The construction of polders in the late 1950s and 60s, to create farm and forest areas, reduced the area of the „Danube meadow" available in the flood season for spawning by carp and other commercially valuable species. Fishing activities are therefore zoned to enable some areas to remain unexploited. These efforts need to be combined with effective controls of poaching and overfishing.

2.2.2. Stakeholder structure

Danube Delta Biosphere Reserve Administration (DDBRA), Romanian National Forests Administration, (ROMSILVA), State Estates Administration, Romanian Waters Administration (ANAR), National Agency of Land Improvement (ANIF), Maritime Danube Ports Administration (APDM), River Administration of the Lower Danube (AFDJ) and Sulina Free Zone Administration (AZL) are national estates of public interest. Other stakeholders are the Tulcea County Council which is an estate of public interest at regional level, local communities and private companies (table 2).

The role of the Danube Delta Biosphere Reserve Administration (DDBRA) 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. The rangers carry out observations and they help to monitor activities. 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.

Tabel 2 Stakeholder structure

Total surface of Danube Delta Biosphere Reserve		**580,000 ha**
	Marine buffer area managed by DDBRA	103, 000 ha
	Continental area of DDBR	477,000 ha
Continental area of DDBR		**477,000 ha**
1. Estates of national public interest		
	Danube Delta Biosphere Reserve Administration (DDBRA)	**345,420 ha**
Natural patrimony (Danube River, branches, channels, lakes, swamps, reed areas, renaturated areas, strictly protected and buffer areas		
	Romanian National Forests Administration, (ROMSILVA)	**6,442 ha**
Natural forests, forest plantations		
	State Estates Administration	**4,500 ha**
Experimental fields (Rusca, Maliuc, Uzlina + Fish Polder Caraorman), agricultural areas		
	Other stakeholders	
ANAR (flooding defence dikes), ANIF (suction basins, irrigation systems, hydro-technical constructions, channel II și channel V), APDM (maritime ports of the Danube), AFDJ (hydro-technical construction on Sulina		

channel), AZL (Sulina Free Zone Administration)		
2. Estates of county public interest		
	Tulcea County Council	**71,292 ha**
Agricultural Polders, Fish Polders		
3. Estates of local public interest		
	Local Council communities	**12585 ha**
Agricultural Polders, Fish Polders, Administrative areas		
4. Estates of private interest		
Tourist resorts, fisheries and land owners		

Effective management is based on well-informed decisions and data that enable value judgments to be made – not just subjectively, but on sound and reliable data. The DDBRA also needs to have the information available to it, so it can propose proven and necessary changes in legislation, where these affect the DDBR.

2.2.3 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. They account for 2.4 % of the delta's area. Sea currents are primarily responsible for the way in which marine sandbanks are formed and they tend to lie parallel to the line of the coast. The initial banks were formed in the Letea, Caraorman and Crasnicol areas (Posea *et al.*, 2005). The network of rivers, side channels and canals determines the way in which water is able to move through and around the delta. Dredging of the main channels, including some of the smaller ones that are used by commercial fishermen and tourists, maintain water flow. The lakes in the delta are arguably the most important morphohydrographic category, in that some are now strictly protected areas. Swamps lie between – 0.5 to 1 metre 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. Marsh or swamp vegetation still covers 143,500 ha or 43 % of the delta's area (Gâștescu and Știucă, 2008).

2.2.4 Hypsometry

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. Situated 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 0m 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 (Gâștescu and Știucă, 2008).

2.2.5 Vegetation units

The main types of vegetation are marshy, aquatic, beach and sea dunes, forests flood lands, steppe and forest dunes (fig.4) (Hanganu *et al.*, 2002). The static freshwater ecosystems provide the base for the food chain in much of the delta. Terrestrial ecosystems have suffered less than aquatic ones, because they are less easy to pollute and over use. 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 (Gâștescu and Știucă, 2008). 29 habitat types, identified in Danube Delta are included in Habitat Directive and represents 39,59 % from total area of Danube Delta Biosphere Reserve.

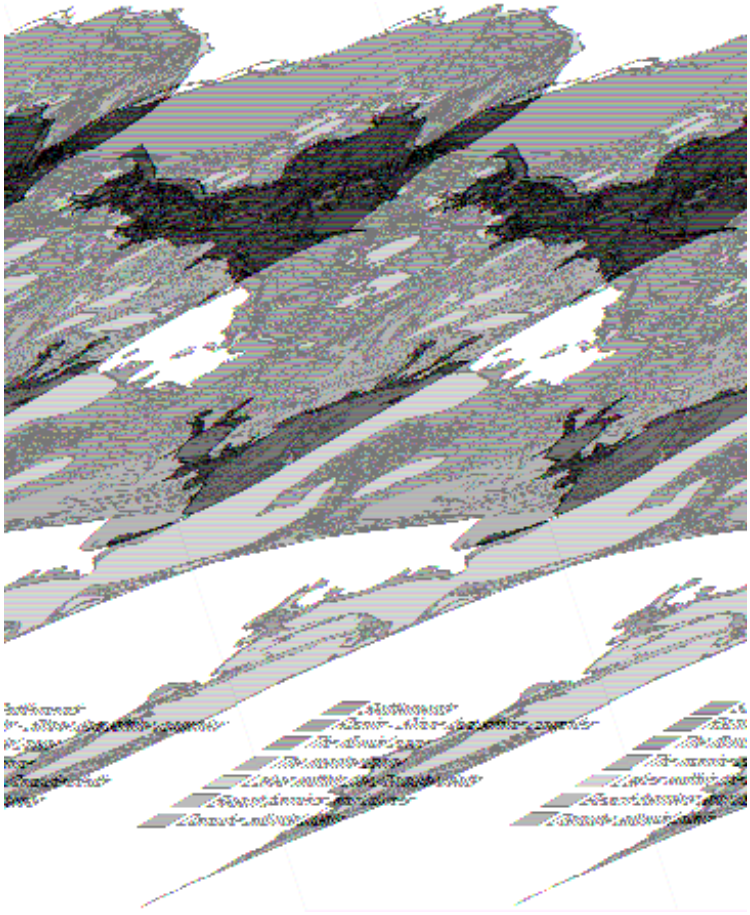


Fig. 4 Vegetation units of DDBR

2.2.6 Soils

The soils found in the delta are largely of riverine origin (fig.5). Alluvial soils are typically young soils that make up the sandbanks in the delta and which receive fresh alluvia during times of flood. These soils are important in farming districts, but they tend to break down to form dusts – leading to the formation of surface crusts (Munteanu and Curelariu, 1996). Limnosols (LM) include lake and lagoon deposits. They consist of fine sediments, organic material and calcium carbonate deposited during the summer. Gleyed soils (GC) are the most important component within the soil cover of land between 0 – 0.5 metres. Most develop on alluvial soils but they have also formed on loess deposits. Psamosols (PS) or sandy soils are

associated with sandbanks and dunes in the marine sectors of the delta. They are ecologically very important, because of the plant communities they support. Soloneac (SC) soils occur in zones typified by salty groundwater and they are particularly well developed in dune slacks in areas. Solonet (SA) soils are very restricted in distribution to areas in the eastern part of Câmpul Chiliei (Munteanu and Curelariu, 1996). These loess-based soils are better drained than soloneac soils, in that salty water lies at 2 – 2-5 metres and not at or just below the soil surface. Grey soils (GA) characteristic calcium-rich steppe soils that have developed within dry continental climate areas. They are well drained and the highest areas are used for arable cultivation, whereas those closer to the water table are used for grazing. Chernozems (CZ) are spread on thick deposits of loess in the southern Câmpul Chiliei and Stipoc dune areas. They tend to be gleyed and the land they overly is used mainly for grazing (Gâștescu and Știucă, 2008). Histosoils (HS) are the most abundant in the delta and they tend to have depths of more than 0.5 metres of organic material, usually unhumified. They are formed when undecomposed roots, rhizomes, stems and leaves of sedges, reeds and reed-mace build up under anaerobic conditions. Anthroposoils (AN) are primarily those that owe their location to mans' activities, like the creation of soil banks during dredging operations. They consist mostly of alluvial deposits, mixed with organic material and plant remains (Munteanu and Curelariu, 1996; Gâștescu and Știucă, 2008).

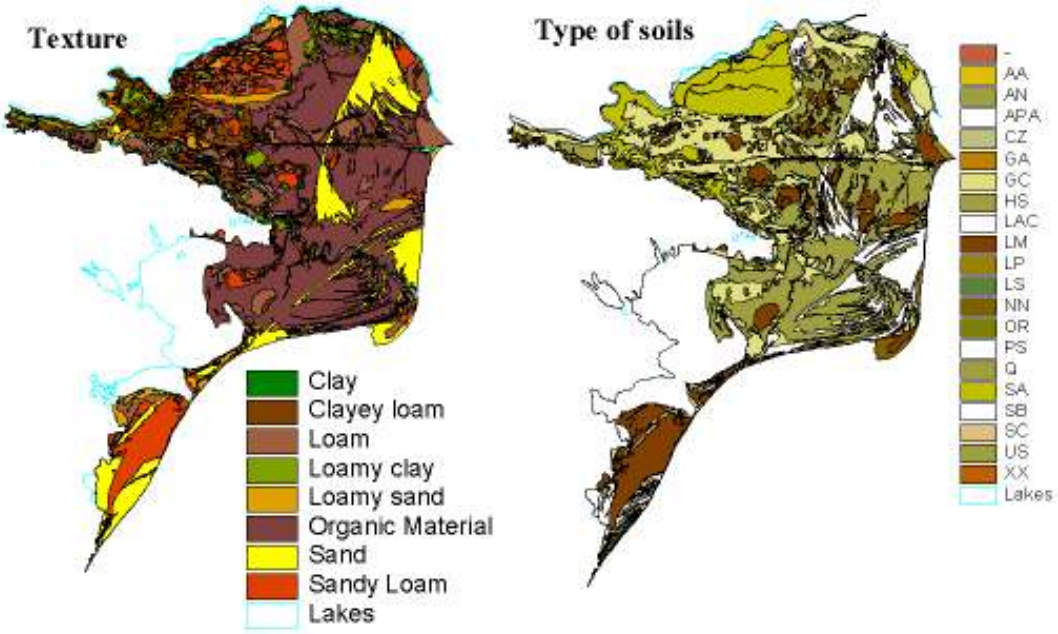


Fig. 5 Texture and type of soils in DDBR

2.2.7 Hydrology

The hydrological regime basically the water circulation represents the vital component of the very existence of the delta space (fig.6) (Driga, 2004; Posea *et al.*, 2005). Since the water volume transported by the Danube to Ceatal Chilia is 205 km^3/year at a multiannual mean of 6,515 m^3/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 and 2,576.1 * 10^{12} Kcal. This sub-system is undoubtedly playing a basic role within the configuration and evolution of the delta space. Of the matter and energy transported by the Danube, 95 % reaches the three arms and flows into the sea, and only 5 % is taken over by the network of backwaters and canals. Characteristic flow values: mean discharge 6,515 m^3/sec; maximum discharge 15,500 m^3/sec (June, 1970), and minimum discharge 1,350 m^3/sec (October, 1921) (Driga, 2004). The yearly Danube flow variations registered at Ceatal Chilia record a winter minimum and maximum, a spring-summer maximum and a much higher minimum in autumn, the cycle ending in a low autumn maximum. The highest discharge was registered in May (11.46 % of the annual value) with lowest rates in October (5.51 %); it can be estimated that nearly 33 % of the annual discharge takes place in the April-June interval, while September – November is left with only 17 – 18 %. 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 (Driga, 2004). The water balance of one lake alone, considering its perimeter to stretch as far as the reed plots or floating reed isles on the edge of the lake, has but a theoretical relevance for practical purposes, the water balance should be estimated for the whole depression, which contains several lakes, that is a lake complex (Gâștescu and Știucă, 2008).

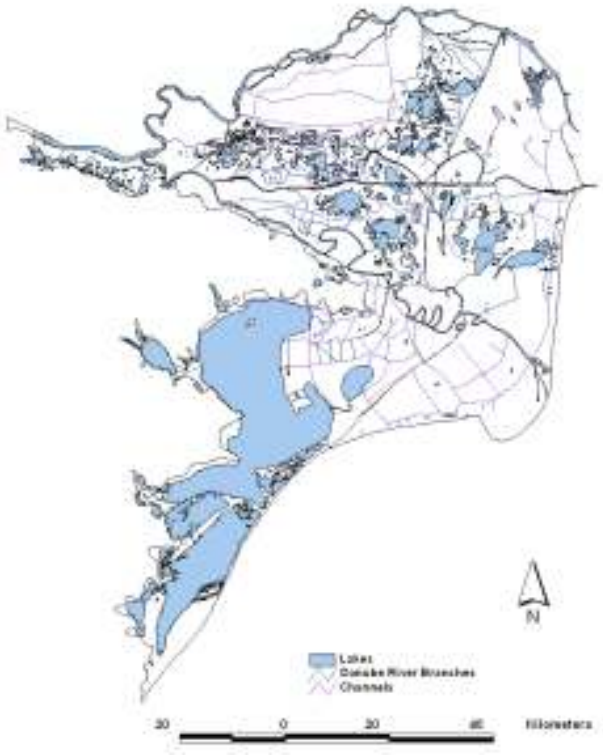


Fig.6 Hydrology system of the CAMP area

3. Habitat types Annex I in CAMP area

3.1. Description of habitat-types

The description of the habitats types was made in accordance with Doniță *et al.* (2005) and Gafta and Mountford (2008) as follows:

1. 1110 Sandbanks which are slightly covered by sea water all the time

Sandbanks are topographical shapes, elevated, elongated, round or irregular, permanently submerse and predominantly surrounded by deeper waters. Over a sandbank, the depth of water rarely exceeds 20m below the hydrographical level zero. Nevertheless, sandbanks can extend deeper than 20m below the hydro graphic level zero.

In DDBR, the sector of the Black Sea area this habitat is present as follows:

- Medium sands under the shape of submarine dunes, with medium-sized druses which, under the action of strong currents and waves, make submerse banks (hydraulic dunes) parallel with the shore. Through the accumulation of sand in time, these banks may become sunk, thus becoming moving islands or permanent sand strips (e.g. Sacalin Island in front of the mouth of Sf. Gheorghe).
- Shallow-water soft sands, mixed with remains of shells and pebbles, displayed from the shore to the 3-4 m isobaths. This type is present from the mouths of The Danube to Constanta, sheltering soft-sands community with *Lentidium mediterraneum*.
- „Camca" from the mouths of The Danube is seen in shallow-watered sheltered areas, on the Danube Delta shore. "Camca" is a dense vegetal-detritus suspension of continental origin, especially made of broken-up reed remains (*Phragmites sp.*). Due to stagnancy and decomposition, either hypoxic or anoxic conditions determine the installation of crustaceous, polychetes worms and nematodes fauna.

Vegetation: *Zosteretum marinae* Borgesen ex van Goor 1921; *Zosteretum noltii* Harmsen 1936.

Presence in CAMP area: sea side area

2. 1130 Estuaries

The downstream area of a river, exposed to tides and extending from the brackish waters limit; Rivers' estuaries are coast's inlets where, unlike the habitat 1160 (sea branches and shallow-watered big bays), there is generally a substantial influence of fresh waters. The mix of fresh water with sea water and the reduced flows of currents within the estuary shelter lead to the deposit of fine sediments, often forming intertidal sand-and-mud deposits. In the places where the currents are stronger than the flow, the most of sediments are deposited and form a delta at the estuary's mouth.

Such processes occur at The Danube's flowing gates and in the Musura and Sacalin's Bay (at the connection with The Black Sea's waters, from the front of them to the 20 m isobaths), where habitats and physical – chemical parameters are features of estuary waters.

Presence in CAMP area: Musura and Sacalin's Bay

3. 1140 Mudflats and sand flats not covered by seawater at low tide

Sand flats and mudflats on connected seas' coasts and related lagoons, not covered by the sea water at ebb time, lacking in vascular plants, usually covered by blue algae and diatoms.

Medio-littoral sands, which occupy the shore sand strip where waves are broken. At The Black Sea, this strip is however limited (from +0,5 to -0,5 m), due to insignificant amplitude of tides. The characteristic species for the Romanian southern-littoral beaches bivalve *Donacilla cornea*, while for the Danube Delta's beaches, the amphipod species *Pontogammarus maeoticus*.
Presence in CAMP area: sea side area

4. **1150* Coastal lagoons**

Lagoons are extents of coastal salty water, shallow-watered, with variable salinity and water volume, either totally or partially separated from the sea through sandbanks or gravel or, more rarely, rocks. Salinity may vary from brackish to hyper-alkaline, depending on the amount of precipitations, evaporation intensity, fresh sea water during storms and the temporary flooding with sea water during winter or flux.
Vegetation: *Ruppietum maritimae* (Hacquette 1927) Iversen 1934.
Because of the impact caused by hydro-technical work, the typical lagoon conditions are met especially in Sinoe Lagoon. Here, the salinity is very variable, the border line between fresh and salty waters being able to move hundred metres more times a day under the wind influence, thus simulating the conditions of a lagoon with tide. The fauna comprises characteristic fish species (*Percarina demidoffi, Pelecus cultratus, Mugil sp., Liza sp., Alosa sp.*) and reptiles (*Emys orbicularis, Natrix tesselata*).
Presence in CAMP area: On the Romanian territory of The Black Sea, this habitat is represented by the lagoon complex of Razelm – Sinoe and Zăton Lake.

5. **1160 Large shallow inlets and bays**

These shallow-watered surfaces are generally sheltered from wave's action and comprise a large diversity of sediments and sub-layers, with well-outlined areas of benthic communities. These communities generally have a large biodiversity. The limit of the shallow water is sometimes marked by the distribution of plant communities of *Zosteretea* and *Potametea*.
Vegetation: *Najadetum marinae* Fukarek 1961.
Along the Romanian coasts of The Black Sea, this type of habitat is represented by: Musura Bay and Sacalin Bay. On the muddy sands situated within the sheltered shallow areas, a flora and fauna with marine and brackish elements are developing.
Presence in CAMP area: coastal areas of DDBR

6. **1210 Annual vegetation of drift lines**

Annual or both annual and perennial plant formations, occupying deposits of coarse material brought by marine currents and gravels rich in nitrate organic matter (*Cakiletea maritimae* p.p.).
Vegetation: *Atripliceto hastatae-Cakiletum euxinae* Sanda *et* Popescu 1999; *Argusietum* (*Tournefortietum*) *sibiricae* Popescu *et* Sanda 1975; *Salsolo-Euphorbietum paralias* Pignatti 1952 *salsoletosum ruthenicae* Pop 1985; *Lactuco tataricae-Glaucietum flavae* Dihoru *et* Negrean 1976.
Presence in CAMP area: coastal areas of DDBR from Musura Island (north) to Midia Cape (south)

7. **1310 *Salicornia* and other annuals colonizing mud and sand**

Formations especially or predominantly made up of annual species, particularly of *Chenopodiaceae*, genus *Salicornia sp.* or grass species, which colonizes the muddy or sandy areas, periodically flooded, of marine or interior salty swamps.

Vegetation: *Salicornietum prostratae* Soó (1947) 1964; *Suaedo-Salicornietum patulae* (Brullo *et* Furnari 1976) Géhu 1984; *Acorelletum pannonici* Soó 1939; *Hordeetum maritime* Șerbănescu 1965; *Suaedetum maritimae* Soó 1927; *Suaedo-Kochietum hirsutae* (Br.-Bl. 1928) Țopa 1939; *Salsoletum sodae* Slavnic (1939) 1948.

Presence in CAMP area: marine sand dunes on Letea, Caraorman, Cardon, Grindul Lupilor, Grindul Saele, Istria, Portița and Sf.Gheorghe.

8. **1410 Mediterranean salt meadows (Juncetalia maritimi)**

Diverse Mediterranean and west-pontic communities (The Black Sea) of *Juncetalia maritimi*.

Vegetation: *Juncetum littoralis-maritimi* Sanda *et al*. 1998; *Juncetum littoralis* Popescu *et al*. 1992; *Juncetum maritimi* (Rübel 1930) Pignatti 1953;

Presence in CAMP area: marine sand dunes and sea side areas on C.A. Rosetti, Letea, Sf.Gheorghe, Câșla Vădanei and Caraorman.

9. **1530* Pannonic salt steppes and salt marshes**

Steppes, depressions, superficial lakes and Pannonic and Ponto-Sarmatic salt marshes, with extreme temperatures and aestival aridity; the soil enrichment with salts is due to intense fresh water evaporation during summer. These types of habitats partially have natural origin and partially determined by the distinct influence of bovine grazing. Halophytic vegetation consists of plant communities in dry salty depressions and steppes, wet salty meadows and annual plant communities win salty lakes periodically flooded.

Vegetation: *Limonio-Aeluropetum littoralis* Sanda *et* Popescu 1992; *Trifolio fragiferi-Cynodontetum* Br.Bl. *et* Balas 1958; *Halimionetum (Obionetum) verruciferae* (Keller 1923) Topa 1939; *Plantaginetum maritimae* Rapaics 1927; *Hordeetum hystricis* (Soó 1933) Wendelberger 1943; *Limonio bellidifolii-Puccinellietum convolutae* Stefan *et al*. 2001, *Taraxaco bessarabici-Caricetum distantis* Sanda *et* Popescu 1978; *Caricetum distantis* Rapaics 1927;

Presence in CAMP area: Sărăturile Murighiol, Caraorman, C.A.Rosetti, Sfiștofca, Sf.Gheorghe, Grindul Lupilor, Grindul Chituc and Sinoe.

10. **2110 Embryonic shifting dunes**

Coastal formations representing the first stages of dune shaping consisted of wavy or elevated sand areas of the superior beach, or by a rim situated towards the sea at the tall dunes' foot.

Vegetation: *Elymetum gigantei* Morariu 1957; *Artemisietum tschernievianae* (*arenariae*) Popescu *et* Sanda 1977; *Secali sylvestris-Alyssetum borzeani* (Borza 1931) Morariu 1959; *Aperetum maritimae* Popescu *et al*. 1980; *Brometum tectorum* Bojko 1934; *Crambetum maritimae* (Șerbănescu 1965) Popescu *et al*. 1980; *Secali sylvestris-Brometum tectorum* Hargitai 1940.

Presence in CAMP area: marine sand dunes and sea side areas on Sacalin Island, between Sulina and Sf. Gheorghe.

11. 2130* Fixed coastal dunes with herbaceous vegetation ("grey dunes")

Fixed Pontic dunes – fixed dunes on The Black Sea coasts; the vegetation may be represented by enclosed meadows, open meadows made up of annual species or may be dominated by moss and lichens.

Vegetation: *Koelerio glaucae-Stipetum borysthenicae* Popescu *et* Sanda 1987; *Scabioso argenteae-Caricetum colchicae* (Simon 1960) Krausch 1965 (including subas. *ephedretosum* Sanda *et al*. 1999); *Scabioso argenteae-Artemisietum campestris* Popescu *et* Sanda 1987; *Holoschoeno-Calamagrostietum epigeji* Popescu *et* Sanda 1978; *Plantaginetum arenariae* (Buia *et al*. 1960) Popescu *et* Sanda 1987; *Argusio-Petasitetum spuriae* (Borza 1931 n.n.) Dihoru *et* Negrean 1976.

Presence in CAMP area: sand dunes Letea, Caraorman, Cardon and Sf. Gheorghe.- Câșla Vădanei.

12. 2160 Dunes with *Hippophaë rhamnoides*

These habitats are formations of white underbrush which is a precursory stage of forest colonization within sand dune depressions, both dry and wet.

Vegetation: *Calamagrostio epigeji-Hippophaëtum rhamnoidis* Popescu *et al.* 1986.

Presence in CAMP area: Sf.Gheorghe, Letea and Caraorman.

13. 2190 Humid dune slacks

The habitats are represented by wet depressions of dune systems. The wet sand dune depressions are specialized habitats rich in species, being threatened by the decrease of surface underground water level. Meadows between sand dunes: humid meadows and bulrush thickets of between sand dunes depressions often with *Salix rosmarinifolia*.

Vegetation: *Salici rosmarinifoliae-Holoschoenetum vulgaris* Mitetelu *et al*. 1973; *Orchio-Schoenetum nigricantis* Oberd. 1957 subas. *plantaginetosum cornuti* Stefan *et al*. 2001.

Presence in CAMP area: Caraorman, Letea, Portița and Sulina.

14. 3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoëto-Nanojuncetea*

The habitat is stand for perennial short vegetation, aquatic to amphibian, oligotrophic to mesotrophic, of lakes, ponds and fens close to the shore and ecotone area belonging to order *Littorelletalia uniflorae*. This type of habitat might develop in humid areas between sand dunes.

Presence in CAMP area: Portița**,** Perișor, Sulina, Leahova, Grindul Chituc and Grindul Lupilor.

15. 3140 Hard oligomesotrophic waters with benthic vegetation of *Chara* spp.

The habitat is found in lakes and fens with very clear blue-green water and poor nutrient content, rich in bases (pH often >7.5). The bottom of these unpolluted waters is covered with charophytes *Chara sp.* and *Nitella sp.*, carpets of algae. This type of habitat includes small peaty lakes, oligomesotropjic, rich in calcium with dense *Chara sp.* carpet, often bordered by eutrophic swamps and peats (*Phragmites australis* - stands).

Vegetation: *Charetum asperae* Corill. 57, *Charetum fragilis* Fijalk. 60, *Nitellopsidetum obtusae* Dambska 61, *Charetum vulgaris* Krause 69, *Nitelletum gracilis* Corill. 57, Moreover are represented by *Potamogeto-Najadetum* marinae Horv.

Presence in CAMP area: Most of the type 3 lakes (small size – clear waters) from the CAMP area – Nebunu, Răducu, Gherasim, La amiază, Chiril, Potcoava Lake, Lunguleț, Porcului, Pojarnia, Bondarului and Rotund from Gorgova-Uzlina lake establishment.

16. **3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation**

These habitats correspond to lakes and ponds with dark-grey to blue-greenish waters, more or less unclear, especially rich in dissolved bases with communities of *Hydrocharition* which freely float on the surface or, in deep waters, open, with associations of *Magnopotamion*.

Vegetation: *Lemnetum minoris* Soó 1927; *Lemnetum gibbae* Miyawaki *et* Tüxen 1960; *Lemnetum trisulcae* Knapp *et* Stoffers 1962; *Lemno-Spirodeletum* Koch 1954; *Spirodelo-Salvinietum natantis* Slavnic 1965; *Lemno-Azolletum carolinianae Nedelcu* 1967; *Stratiotetum aloidis* Nowinski 1930 (syn.: *Hydrocharitetum morsus-ranae* van Langendonck 1935); *Lemno-Utricularietum vulgaris* Soó (1928) 1947; *Potamogetonetum perfoliati* Koch 1926; *Potamo-Ceratophylletum submersi* Pop 1962; *Potamogetonetum pectinati* Carstensen 1955; *Spirodeletum polyrhizae* Koch 1941; *Lemno-Salvinietum natantis* Miyawaki *et* Tüxen 1960; *Lemno-Hydrocharitetum morsus-ranae* (Oberd.) Passarge 1978; *Potamogetonetum crispi* Soó 1927; *Ceratophylletum demersii* Hild 1956.

Presence in CAMP area: most of the lakes type 1 (large size) and 2 (medium size) from Danube Delta.

17. **3160 Natural dystrophic lakes and ponds**

The natural lakes and ponds vegetation with brown water due to peat and humic acids, generally on peaty soils in swamps are similar to description of this habitat type.

Vegetation: *Myriophyllo verticillati-Nupharetum luteae* Koch 1926; *Nymphaeetum albae* Vollmar 1947; *Nymphoidetum peltatae* (Allorge 1922) Bellot 1951; *Trapetum natantis* Kárpati 1963; *Potametum natantis* Soó 1927; *Trapo-Nymphoidetum* Oberd. 1957.

Presence in CAMP area: fish ponds, channels and lakes (type 2) from Danube Delta.

18. **3260 Water courses of plain to mountain levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation**

Water courses in the field area up to the mountain floor, with submerse or floating vegetation of *Ranunculion fluitantis* and *Callitricho-Batrachion* (low level of water during summer). This habitat is sometimes associated with communities of *Butomus umbellatus* on banks. It is important to take into account this aspect in the process of the selection of significant sites.

Vegetation: *Ranunculetum aquatilis* (Sauer 1947) Géhu 1961; *Hottonietum palustris* Tüxen 1937.

Presence in CAMP area: Erenciuc, Dunăvăț-Dranov and Șontea-Fortuna lake establishments.

19. **3270 Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation**

Muddy river banks in the field area up to the sub-mountain floor, with annual nitrophytic pioneer vegetation of the alliances *Chenopodion rubri* p.p. and *Bidention* p.p. In spring and early summer, this habitat presents no vegetation (it develops later during the year.

Vegetation: *Bidenti-Polygonetum hydropiperis* Lohm. in Tüxen 1950; *Polygono lapathifolii-Bidentetum* Klika 1935; *Xanthio strumarii-Bidentetum tripartitae* Timár 1947.

Presence in CAMP area: Șontea-Fortuna, Dunăvăț-Dranov, Gorgova-Uzlina and Roșu-Puiu lake establishments.

20. 62C0* Ponto-Sarmatic steppes

Steppes, plateaus and hills situated west of The Black Sea, sometimes, in association with habitats 40C0 Ponto-Sarmatic deciduous thickets and 91AA Eastern white oak woods.

Vegetation: *Chrysopogono-Caricetum humilis* Zólyomi (1950) 1958; *Stipo ucrainicae- Festucetum valesiacae* Dihoru 1970; *Artemisio austriacae-Poëtum bulbosae* Pop 1970; *Cynodonto-Poëtum angustifoliae* (Rapaics 1926) Soó 1957; *Koelerio-Artemisietum lerchianae* Dihoru 1970; *Agropyro-Kochietum prostratae* Zólyomi (1957) 1958; *Agropyretum pectiniformis* (Prodan 1939) Dihoru 1970; *Taraxaco serotini-Bothriochloëtum ischaemi* (Burduja *et al*. 1956) Sârbu *et al*. 1999.

Presence in CAMP area: Popina Island, Doloșman Cape, Iancina Cape and Tașburun Cape.

21. 6430 Hydrophilous tall-herb fringe communities of plains and of the montane to alpine levels

Hydrophilous and nitrophilous communities with tall herb vegetation along the water courses and forest fringes.

Vegetation: *Schoenetum nigricantis* (All. 1922) Koch 1926.

Presence in CAMP area: Grindul Lupilor and Grindul Sărăturile.

22. 6440 Alluvial meadows of river valleys of the *Cnidion dubii*

These habitats are alluvial meadows with natural flooding regime belonging to the alliance *Cnidion dubii*, under continental to sub-continental climatic conditions. This is a transit habitat between hygrophytes and xerophytes meadows that cover limited areas. This aspect should be taken into account in the process of site selection.

Vegetation: *Ranunculo repentis-Alopecuretum pratensis* Ellmauer 1933; *Agrostietum stoloniferae* (Ujvárosi 1941) Burduja *et al*. 1956.

Presence in CAMP area: Pardina Polder, Mahmudia, Tătaru, Ceatalchioi and Sireasa.

23. 7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*

Dense communities of de *Cladium mariscus* in frequently flooded areas colonized by plants, in abandoned plots (not cropped) or wet meadows in successive stages subsequent extensive exploitation, in contact with types of vegetation of *Caricion davallianae* or other species of *Phragmition.* This habitat may be met in contact with alkaline fens (7230), and with acid swamps, extensively exploited wet meadows and other reeds and tall sedges as well.

Vegetation: *Cladietum marisci* Allorge 1922 ex Zobrist 1935.

Presence in CAMP area: Dunăvățu de Jos, Periprava and Caraorman.

24. 7230 Alkaline fens

Short sedges and other *Cyperaceae* usually dominate the swamps communities that belong to Caricion *davallianae*. Dense communities of tall sedges (*Magnocaricion*), reed formations (*Phragmition*), dense clusters of *Cladium mariscus* (*Cladietum marisci*) may be part of the swamp complex, with communities connected to transition swamps and amphibious or aquatic vegetation or hygrophytes communities that develop within depressions.

Vegetation: *Carici flavae-Eriophoretum latifolii* Soó 1944; *Carici flavae-Blysmetum compressi* Coldea 1997; *Caricetum davallianae* Dutoit 1924.

Presence in CAMP area: Crișan, Gârla Macovei, Fish Polder Agighiol, Gârla Iacub, Litkov-Împuțita and Sf.Gheorghe.

25. 91AA Eastern white oak woods

These habitats are represented by forests dominated by pubescent oaks, with sub-Mediterranean flora, occupying warmer enclaves within sub-continental areas of *Quercion frainetto.*

Vegetation: *Galio dasypodi-Quercetum pubescentis* Doniţă 1970; *Tilio tomentosae-Quercetum pedunculiflorae* Doniţă 1968.

Presence in CAMP area: Băltenii de Jos.

26. 91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)

Riparian forests of *Fraxinus excelsior* and *Alnus glutinosa* water courses in field area. Dendritic galleries formed of tall individuals of *Salix alba, S. fragilis and Populus nigra* along medio – European rivers. All the types occur on heavy soils (generally rich in alluvial deposits), periodically flooded by the increase of the river (or brook) level, at least once a year, but well drained and aired during the period when the water flow is low. *Salicetum fragilis* corresponds to both pure and dominated by exploding cucumber willow communities (without white willow), along which the black alder may frequently occur (*Alnus glutinosa*). *Salicetum albae* comprises white willow communities, pure or mixed in different proportions with *Salix fragilis* and/or *Populus nigra*. While the former association develops on alluvial soils more evolved, the latter has a more pioneer character due to more intense and frequent floods.

Vegetation: *Stellario nemorum-Alnetum glutinosae* (Kästner 1938) Lohmeyer 1957; *Salicetum fragilis* Passarge 1957; *Salicetum albae* Issler 1924.

Presence in CAMP area: Gârla Turcească, Erenciuc, on the right side of the Sf.Gheorghe branch close to locality.

27. 91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)

Forests of species with hard-essence wood situated in the major bed of rivers, egularly exposed to floods during the increase in the water level, or in low areas, exposed to floods caused by water elevation. These forests develop on recent alluvial deposits. The soil may be well drained between floods or may stay wet.

Vegetation: *Quercetum roboris-pedunculiflorae* Simon 1960; *Fraxino pallisae-Quercetum pedunculiflorae* (Popescu *et al*. 1979) Oprea 1997; *Fraxinetum pallisae* (Simon 1960) Krausch 1965.

Presence in CAMP area: Letea and Caraorman.

28. 92A0 *Salix alba* and *Populus alba* galleries

Riparian forests (riverside coppices) in the Mediterranean and The Black Sea catchment dominated by *Salix alba, S. fragilis* or other willow species related to them. Types 91E0 and 92A0 partially overlap, due to the mention of white willow communities in the definition of both habitats. In order to avoid confusion, only white poplar forests have been included in this habitat, pure or mixed with white willow, which develop on alluvial soils.

Vegetation: *Salici-Populetum* Meijer-Drees 1936.

Presence in CAMP area: in Șontea-Fortuna and Gorgova-Uzlina lake establishment, on Sf.Gheorghe and Chilia Branches, Maliuc, Crișan and Mila 23.

29. 92D0 Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae*)

Riparian galleries and red sea buckthorn shrubberies, oleander and chaste tree, as well as shorter ligneous formations situated along permanent or temporary fresh waters and wet areas too.

Vegetation: *Calamagrostio-Tamaricetum ramosissimae* Simon *et* Dihoru (1962) 1963.

Presence in CAMP area: Crișan channel, Gârla Iacub, Busurca channel and Tătaru channel.

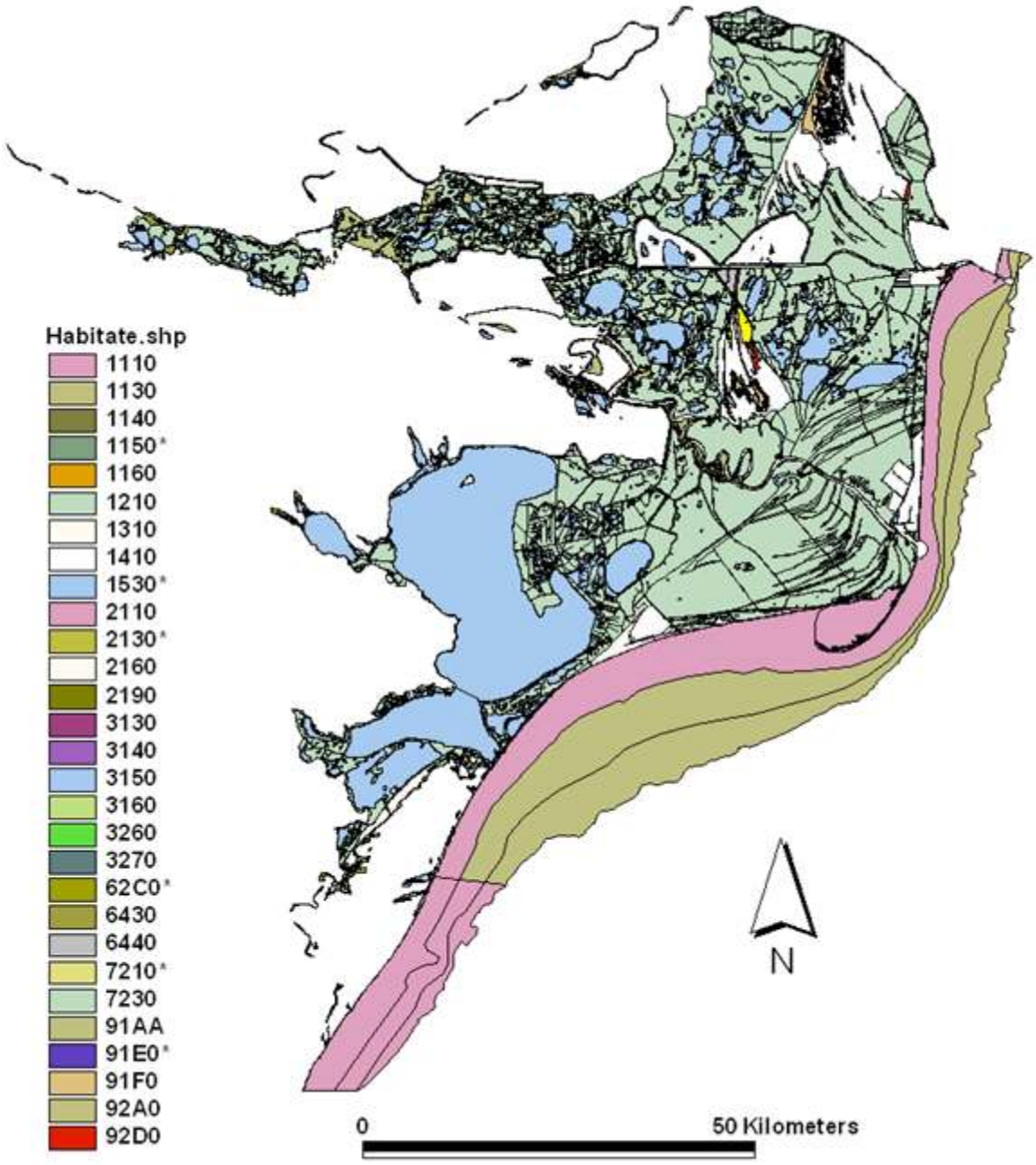


Fig.7 Natura 2000 habitats in Danube Delta Biosphere Reserve

3.2. Evaluation of conservation status: criteria, parameter, existing monitoring activities, indicators and reporting

One of the objectives is to identify the endangered habitats affected by climate change effects. According to Romanian classification system (Doniță *et al.*, 2005; Gafta and Mountford, 2008), out of the 49 habitats

identified (Romanian classification system) in DDBR, so far, 29 habitats have an important status in terms of Habitats Directive 92/43.EEC. Concerning the Natura 2000 habitats with conservation value 71.74% from the total area, should be included in CAMP process (fig. 7). From the latter, 18 habitats are found within strictly protected areas. In order to highlight the climate change impact on protected habitats, which is enhanced by human activities as well, we have measured the areas (table 3). Furthermore, thematic maps representing the vulnerability for flooding and invasive species were designed in the following chapters. Therefore, to assess the impact of climate change, we have chosen to start from the indicator species to the habitats which include these species. The important issue was to select those habitats that are most vulnerable, occupy small surfaces, and are included in strictly protected areas. These types of habitats are represented by coastal formations, sand dune forest, and salt marshes.

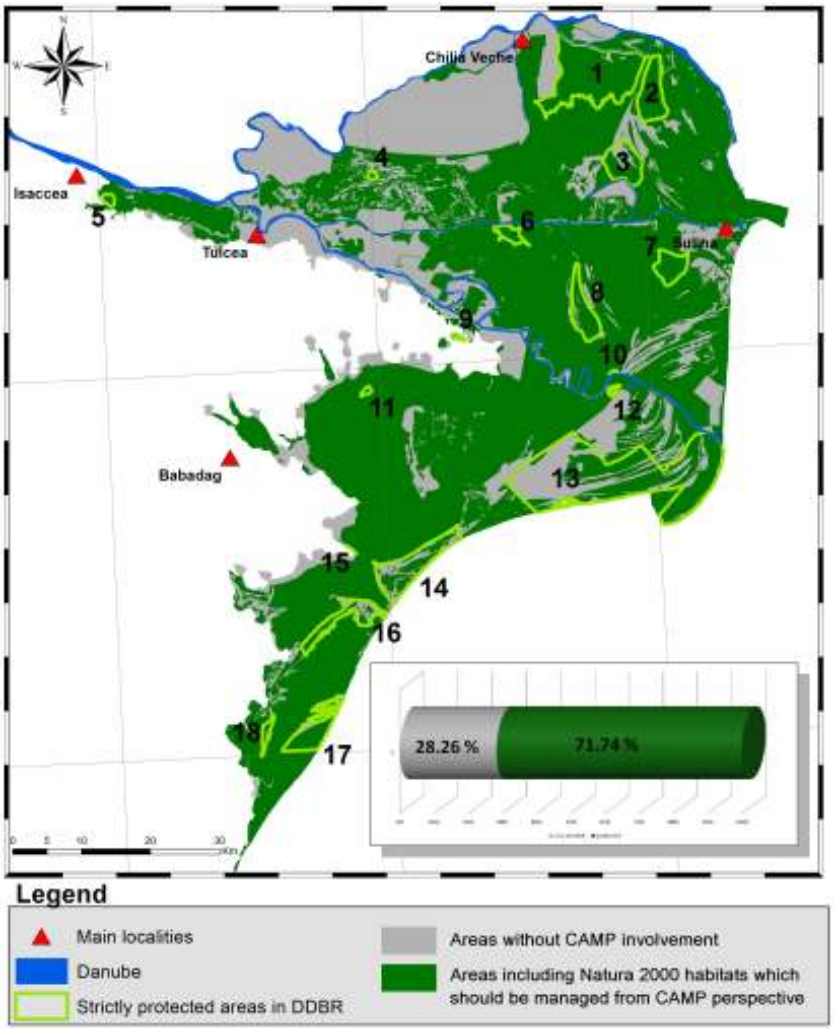


Fig. 8 Areas including Natura 2000 habitats which should be managed from CAMP perspective

All these habitats are theoretically belonging to at least two bio-geographical zones as follows: Steppe bioregion and Pontic bioregion (Doniță *et al.* 2005). The characteristic of the Steppe region lies in that there are few precipitations and the mean temperature is higher than in the other bioregions. The Pontic region has the temperature gap lower than the other bioregions.

Table 3 The Natura 2000 habitat types identified in DDBR

Natura 2000 code	Natura 2000 habitat name	Estimated area (ha)
1110	Sandbanks which are slightly covered by sea water all the time	3
1130	Estuaries	4
1140	Mudflats and sand flats not covered by seawater at low tide	3
1150*	Coastal lagoons	1
1160	Large shallow inlets and bays	30
1210	Annual vegetation of drift lines	1,968.70
1310	Salicornia and other annuals colonizing mud and sand	8,001.59
1410	Mediterranean salt meadows (*Juncetalia maritimi*)	10
1530*	Pannonic salt steppes and salt marshes	22,293.82
2110	Embryonic shifting dunes	11,403.19
2130*	Fixed coastal dunes with herbaceous vegetation ("grey dunes")	3,508.39
2160	Dunes with *Hippophaë rhamnoides*	1,018.20
2190	Humid dune slacks	3
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoëto-Nanojuncetea*	10
3140	Hard oligomesotrophic waters with benthic vegetation of *Chara* spp.	97,876.34
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation	29,398.12
3160	Natural dystrophic lakes and ponds	8,079.18
3260	Water courses of plain to mountain levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	4
3270	Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation	30
62C0*	Ponto-Sarmatic steppes	298.92
6430	Hydrophilous tall-herb fringe communities of plains and of the montane to alpine levels	10
6440	Alluvial meadows of river valleys of the *Cnidion dubii*	60
7210*	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	2
7230	Alkaline fens	179,000
91AA	Eastern white oak woods	10
91E0*	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)	80
91F0	Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)	5,127.74
92A0	*Salix alba* and *Populus alba* galleries	12,500.49
92D0	Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae*)	179.35
	Total area of habitats protected by the Habitats-Directive 92/42	**380914.09**

Considering the Habitats Directive as basis for our goal, namely the entire diversity of the Danube Delta Biosphere Reserve (DDBR), the polygons have been separated into two main categories: protected and unprotected.

As it may be seen in figure 10, 71.74% of DDBR studied territory is covered by habitats included in the Habitat Directive. Only 28.26% represents habitats not stipulated in this Directive. Furthermore, details are revealed in the surfaces occupied by various habitat types expressed in percentage units. It can be seen that more than half of the surface of the DDBR is covered by aquatic and water-based habitats (3110, 3130, 3140, 3150 and 7210*), About 3.24 % of DDBR surface is occupied by dunes and in between dunes habitats, fact that reveals the common influence of the sea in the way of Danube Delta forming process. The forest habitats have a low representation In DDBR surface (3.22%).

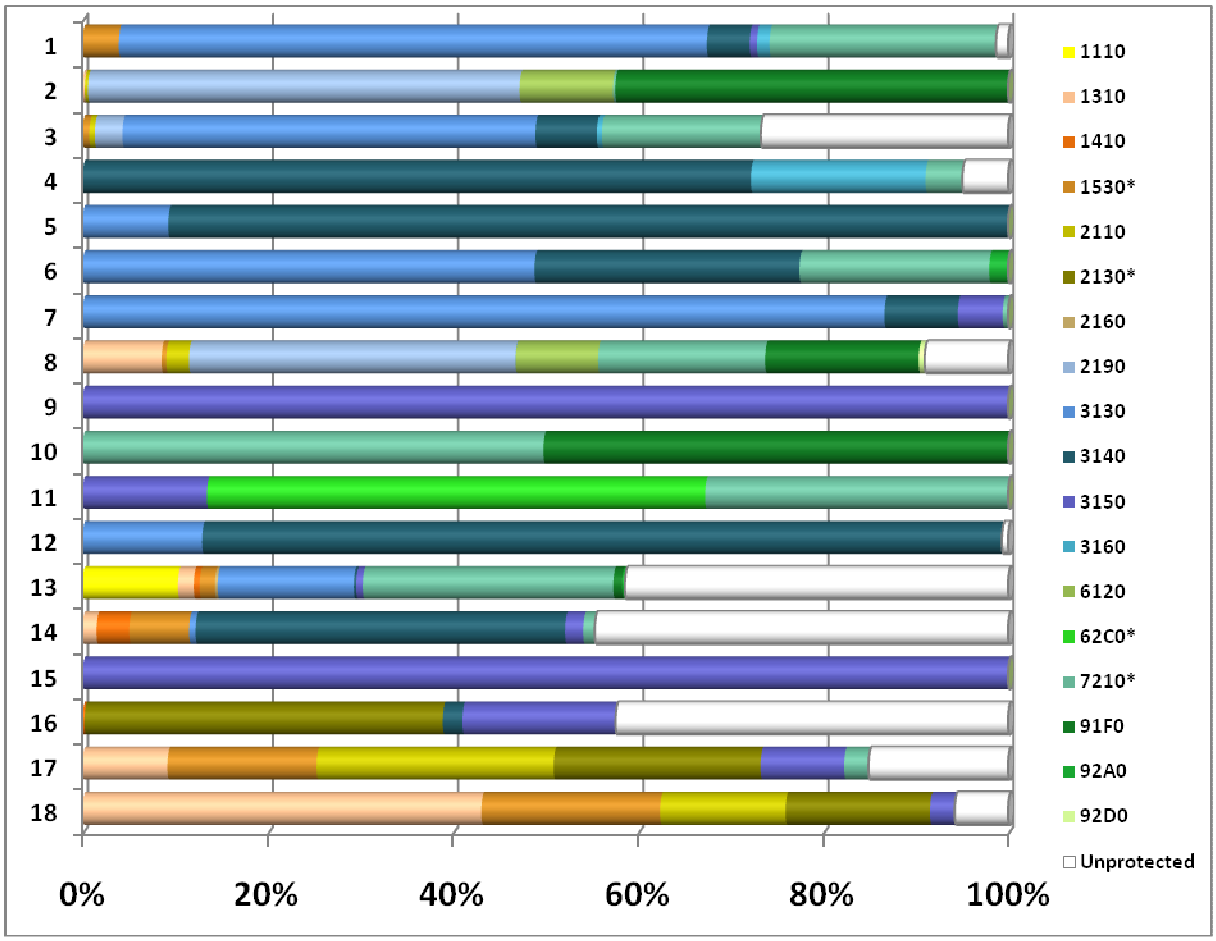


Fig.9 The percentage of Habitats within Strictly Protected Areas in DDBR

(Marian Mierlă – DDNI intern report)

The DDBR habitats within protected areas and their surface percentage (figure 9): **1110 -** 1.46%; **1210** – 1.21% **1310 -** 1.65%; **1410 -** 0.32; **1530* -** 4.34%; **2110 -** 1.55%; **2130* -** 0.62%; **2160 -** 0.22%; **2190 -** 0.85%; **3130 -** 17.72%; **3140 -** 5.37%; **3150 -** 19.74%; **3160 -** 0.85%; **6120 -** 0.20%; **62C0* -** 0.01%; **7210* -** 13.64%; **91F0 -** 0.75%; **92A0 -** 2.45%; **92D0 -** 0.02%; **Unprotected -** 27.04% (the area is included for other purposes – example: bird nesting, feeding grounds).

The codes for the habitats may be understood as follows: **1110** for Sandbanks which are slightly covered by sea water all the time; **1210** Annual vegetation of drift lines; **1310** *Salicornia* and other annuals colonizing mud and sand; **1410** Mediterranean salt meadows (*Juncetalia maritimi*); **1530*** Pannonic salt steppes and salt marshes; **2110** Embryonic shifting dunes; **2130*** Fixed coastal dunes with herbaceous vegetation (grey

dunes); **2160** Dunes with *Hippophae rhamnoides*; 2190 Humid dune slacks; **3130** Oligotrophic to mesotrophic standing waters with vegetation of *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*; **3140** Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.*; **3150** Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - vegetation type; **3160** Natural dystrophic lakes and ponds; **6120*** Xeric sand calcareous grasslands; **62C0*** Ponto-Sarmatic steppes; **7210*** Calcareous fens with *Cladium mariscus* and species of *Caricion davallianae*; **91F0** Riparian mixed forests of Quercus robur, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia* along the great rivers (*Ulmenion minoris*); **92A0** *Salix alba* and *Populus alba* galleries; **92D0** Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae*). Corresponding numbers for strictly protected areas are as follows: **1** Roșca – Buhaiova; **2** Letea; **3** Răducu; **4** Nebunu; **5** Lacul Rotund; **6** Potcoava, **7** Vătafu – Lunguleț; **8** Caraorman, **9** Sărăturile Murighiol, **10** Erenciuc; **11** Insula Popina; **12** Lacul Belciug; **13** Sacalin – Zatoane; **14** Periteasca – Leahova; **15** Capul Dolosman; **16** Grindul Lupilor; **17** Grindul Chituc; **18** Istria Sinoe. It should be mentioned that only 18 from 20 strictly protected areas were selected for this monitoring. The reason for the other two protected areas is the recently inclusion in the conservation management plan and the lack of monitoring data.

Vegetations units have supported the map elaboration for the habitats included in Habitats Directive 92/43/EEC. This allowed the map elaboration for Natura 2000 habitats both included and not included in Habitats Directive, thus being established the surfaces for each category. For a better research of these habitats, considering an adequate management, the map for the habitats within strictly protected areas has been developed by means of the method of intersection in the GIS software. Then the data referring to those habitats have been processed in the table calculating program in order to establish the percentages within the strictly protected areas.

The results are covering information useful in the mitigation process to global changes in general and climate changes in particular. These results offer information about the status of the habitats and also information about the vulnerability of the Danube Delta Biosphere Reserve territory to some consequences of climate changes. From all the consequences of climate changes there have been taken into account the floods and the occurrence of alien invasive species (namely plant species). The number of the climatic changes influence is relatively high and the domains are diverse, but for Danube Delta case the flooding and the invasive plant species are relevant and the present data should support the next adaptation measures to climate change effects.

Table 4 The key data for habitats and species evaluation

Natura 2000 code	Monitoring activities	Plant species indicators	Reporting
1110	No monitoring activities.	*Zostera* sp., *Potamogeton* spp., *Ruppia* spp., *Zannichellia* spp.,	No reports
1130	Data collection, Direct analysis of the species population, Yearly monitoring	Communities of benthic species	Summary reports

1140	No monitoring activities.	*Zostera marina, Zostera noltii*	No reports
1150*	Data collection (aquatic plants, chemical data, water parameters). Seasonally monitoring.	*Chara canescens, Eleocharis parvula, Potamogeton pectinatus, Ruppia maritime*, *Lemna trisulca*, *Najas marina*, *Phragmites australis*, *Potamogeton* spp., *Stratiotes aloides*, *Typha* spp.	Data analysis and reports related with WFD. Statistical comparison in the last 10 years Scientific articles
1160	Data collection, Direct analysis of the species population, Yearly monitoring	*Zostera* spp., *Ruppia maritima*, *Potamogeton* spp. (ex., *P. pectinatus*), *Najas marina*, benthic algae.	Summary reports
1210	Data collection, Direct analysis at the level of species. Yearly monitoring of geomorphologic parameters (erosion, dunes are shifting – Musura Island) and anthropogenic pressures	*Cakile maritima*, *Salsola kali*, *Atriplex* spp., *Polygonum* spp., *Euphorbia peplis*, *Elymus repens, Glaucium flavum*, *Euphorbia paralias, Eryngium maritimum*. *Argusia sibirica*.	Statistical comparison of the data in the last 10 years. Reports on habitat due to regression of surfaces and species decreasing population.
1310	Direct and indirect (satellite images and ortho-photo) monitoring. Occasionally included in other monitoring plans for different reasons (anthropogenic pressure, fluctuation of ground water level)	*Salicornia* spp., *Suaeda maritima*	Summary reports on species and habitats. In some areas there were reported fragmentation of the habitats.
1410	Direct and indirect (satellite images and ortho-photo) monitoring. Important habitat for *Vipera ursinii*. Frequently monitored due strong influence of anthropogenic pressure.	*Juncus maritimus*, *J. acutus, Carex extensa*, *Aster tripolium*, *Plantago cornuti*, *Scorzonera parviflora, Taraxacum bessarabicum, Samolus valerandi H. maritimum, Orchis coriophora* subsp. *fragrans*	Reports on habitats, statistical data and comparison in the last 5 years.
1530*	Direct and indirect (satellite images and ortho-photo) monitoring. Occasionally included in other monitoring	*Artemisia santonicum*, *Aster tripolium*, *Salicornia prostrata*, *Juncus gerardii*, *Plantago maritima, Cyperus pannonicus*, *Achillea collina, Artemisia pontica, Puccinellia*	Summary reports on habitats in regards with status of the pastures for local

	plans for different reasons (anthropogenic pressure, fluctuation of ground water level)	*limosa, Scorzonera cana, Halocnemum strobilaceum, Frankenia hirsuta, Aeluropus littoralis, Limonium meyeri, L. gmelini, Carex distans, C. divisa, Taraxacum bessarabicum, Halimione verrucifera, Hordeum hystrix*	communities. The last report was in 2006.
2110	Indirect (satellite images and ortho-photo) monitoring. Occasionally direct monitoring when is included in other monitoring plans for different reasons (touristic activity and development).	*Elymus farctus, Leymus sabulosus*, *Euphorbia peplis, Medicago marina, Eryngium maritimum*.	Summary reports on species status
2130*	No monitoring activities in the present.	*Bromus hordeaceus, Carex colchica, Cerastium* spp., *Galium verum, Koeleria* spp., *Silene conica, S. otites.*	The last monitoring plan in 2006.
2160	No monitoring activities in the present.	*Hippophaë rhamnoides*	The last monitoring plan was in 2002.
2190	Direct monitoring of species population and data collection (aquatic plants, chemical data, and water parameters). Seasonally monitoring	*Chara tomentosa, Elodea canadensis, Hippuris vulgaris, Hottonia palustris, Potamogeton pectinatus, Juncus bufonius*	Data analysis and reports related with WFD. Statistical comparison in the last 10 years Scientific articles
3130	Indirect (satellite images and ortho-photo) monitoring. Occasionally direct monitoring when is included in other monitoring plans for different reasons	*Littorella uniflora*, *Juncus bulbosus, Eleocharis acicularis, Cyperus fuscus*, *C. flavescens*, *Centaurium pulchellum*.	Summary reports on species status
3140	Occasionally direct monitoring when is included in other monitoring plans for different reasons.	*Chara spp.* and *Nitella spp.*	Summary reports on habitat status.
3150	Direct monitoring of species population and data collection (aquatic plants, chemical data, and water parameters).	*Spirodela spp., Wolffia spp., Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia australis, U. vulgaris, Aldrovanda vesiculosa, Azolla filiculiodes, Potamogeton lucens, P.*	Data analysis and reports related with WFD.

	Seasonally monitoring	*perfoliatus.*	Statistical comparison in the last 10 years Scientific articles
3160	Occasionally direct monitoring when is included in other monitoring plans for different reasons.	*Utricularia spp, Nuphar lutea, Nymphaea candida.*	Summary reports on habitat status.
3260	Occasionally direct monitoring when is included in other monitoring plans for different reasons.	*Ranunculus aquatilis, Myriophyllum spp., Callitriche spp., Berula erecta, Zannichellia palustris, Potamogeton spp.,*	Summary reports on habitat status.
3270	Direct monitoring activities. Occasionally included in other monitoring plans for different reasons (overgrazing).	*Chenopodium rubrum*, *Bidens tripartita*, *Xanthium* sp., *Polygonum lapathifolium*.	Summary reports on habitats in regards with status of the pastures for local communities. The last report was in 2006.
62C0*	Direct monitoring activities in Popina Island (Razelm Lake). Occasionally included in other monitoring plans for different reasons (overgrazing). Usually the data collection is made in spring (for the insects) summer season (for the vegetation).	*Festuca valesiaca, Chrysopogon gryllus, Alyssum saxatile, Agropyron pectiniforme, Koeleria macrantha, Dichanthium ischaemum, Stipa capillata, S. ucrainica, Elymus hispidus*;	Summary reports on habitats and some rare and endemic species.
6430	Direct monitoring activities. Occasionally included in other monitoring plans for different reasons.	*Glechoma hederacea*, *Epilobium hirsutum*, *Aegopodium podagraria*, *Alliaria petiolata*, *Lysimachia numularia*, *Lythrum salicaria.*	Summary reports on habitats.
6440	No monitoring activities in the present.	*Alopecurus pratensis*, *Agrostis stolonifera, Lythrum virgatum*	Summary reports on habitats in regards with status of the pastures for local communities. The last report was in 2006.

7210*	No monitoring activities or a few in the present.	*Cladium mariscus*	Summary reports on habitats.
7230	Direct and indirect (satellite images and ortho-photo) monitoring. Yearly monitoring activities. Data collection is usually made in autumn.	*Schoenus nigricans*, *Carex flava, Blysmus compressus, Phragmites australis* (stands)	Reports on habitats status and species composition.
91AA	Direct monitoring, occasionally indirect (satellite images and ortho-photo) monitoring. Usually in summer period (for vegetation).	*Quercus pubescens, Carpinus orientalis, C. betulus, Fraxinus ornus, Galium dasypodum, Acer campestre*, *Tilia tomentosa*	Reports on habitats and rare species.
91E0*	Direct monitoring, occasionally indirect (satellite images and ortho-photo) monitoring. Usually in summer period (for vegetation).	*Fraxinus excelsior*, *Alnus glutinosa,* înalte de *Salix alba, S. fragilis, Populus nigra, Ulmus minor, Equisetum telmateia*	Reports on habitats and rare species.
91F0	Direct monitoring, occasionally indirect (satellite images and ortho-photo) monitoring. Usually in summer period (for vegetation).	*Quercus robur*, *Ulmus laevis*, *Ulmus minor, Fraxinus excelsior*, *Fraxinus angustifolia, Populus nigra, P. canescens, P. tremula, Alnus glutinosa, Humulus lupulus, Vitis vinifera* subsp. *sylvestris, Hedera helix*	Reports on habitat status.
92A0	Direct monitoring activities. Occasionally included in other monitoring plans for different reasons.	*Salix alba*, *Populus alba, Alnus* spp., *Acer* spp., *Tamarix* spp.,	Summary reports on habitats.
92D0	Direct monitoring activities. Occasionally included in other monitoring plans for different reasons.	*Tamarix ramosissima, Calamagrostis epigejos*	Summary reports on habitats.

4. Habitats under climate change: Exposure, Sensitivity and Potential impacts

4.1. Current climate and expected changes in climate

According to various authors (Blaikie et al. 1994; Kasperson, et al., 2002; Watson et al. 1996; 1998) we have identified, within Danube Delta Biosphere Reserve, as hazards, the flooding, drought, global solar radiation, heat wave, virus and pest, changing the temperature and precipitation, frost, climatic water balance, climate balance on forest vegetation and sand dunes areas and invasive species (table 5).

Table 5. Possible changes of hydrometeorological conditions in the DDBR

Parameter/indicator	Period (years)		Comments
	2011-2030	2031-2050	
Average annual air temperature	+0.5°-*0,7C* ↑	1.0-1.5°C↑	Average land layer air temperature will increase. In DDBR such temperatures seem to be higher due to aridisation, which is expected to be intensive
Maximum annual temperature	+0.8°C ↑	+2.0°-*2,2C* ↑	Greater absolute temperature maximum
Minimum annual temperature	+0.6°C ↑	+1.5°C ↑	Minimum temperature will grow in the coastal areas, while in the advanced delta it may remain at the current level
Summer months temperature	+0.5°C ↑	+1.3°C – *1,5*↑	Mainly due to July – August
Winter months temperature	+0.5°C ↑	+1.2°C ↑	Mainly due to January – February
Number of frosty days	↓	↓	Less. It is expected that in DDBR 2011-2030 till 10 days more. Forecast for 2031-2050 seems to be less developed, but one could assume 12-15 days more (without frosts).
Warm period duration	↑	↑	Faster change of year seasons is possible
Number of days with snow cover	↓	↓	Less
Total annual precipitation	↑ +3%	↑ +6%	General growth of average annual precipitation, but significant redistribution of precipitation during within seasons is predicted. Growth of precipitations seems to be unclear. One could expect 5-7% more during winter time, but during summer 3-5% less.
Extreme precipitation, rainstorms, squalls, thunderstorms, hail	↑	↑	Higher air temperature will be accompanied by higher moisture content in the lower layers of troposphere. It will lead to greater instability of the atmosphere during warm season of the year and higher number and intensity of convective weather events: rainstorms, hail, squalls and thunderstorms
Moisture deficit (droughts)	↑	↑	Due to general warming and higher absolute temperature maximum. Possibly, due to annual redistribution of temperatures. Moisture deficit will grow in DDBR
Soil heating	↑	↑	Due to general warming and higher absolute temperature maximum.
Evaporation, transpiration	↑	↑	Increase due to higher temperatures
Flooding connected with local	↑	↑	Increase due to raised frequency and intensity of

runoff			rainstorms
Intensity and flooding height in the Danube	↑	↑	Calculated hydrological characteristics will change, particularly those of runoff and water level of 1% probability
Minimum runoff of the Danube	↓	↓	Less because of higher temperatures in low-water period
Sediment runoff in the Danube	↑	↑	Stabilization or slight increase due to greater rainfalls in the Middle and Lower Danube. Possible increase of the maximum runoff of sediments
Sea level rise	↑	↑ favourable – by 0,15m, unfavourable – 0,5m	Increase of the sea level of the Black Sea; possible retreat of inland Danube Delta
Flooding at the seaside, partial flooding and under flooding of territories	↑	↑	Increase due to higher sea level and more frequent wind-caused water level fluctuations because of greater number of squalls and tornadoes
Water temperature in delta channels and closed water bodies	+0.7↑	+1.5↑	Increase in all water bodies of the DDBR
Water temperature in lakes in summer	+1.0↑	+2.0↑	Increase substantially in all Danube lakes
Water quality	↓	↓	Deteriorates due to lower dissolved O_2 concentrations. Worse water exchange and eutrophication of the basins. Increasing of TDS for 5-10%
Ice events	↓	↓	Decreased frequency and intensity of ice events
Repeatability of years with low water level in lakes	↑	↑	Due to lower water levels along the Chilia Branch and possible reduction of the minimum runoff
Water exchange processes in lakes	↓	↓	Due to lower water levels along the Chilia Branch and lowering of the minimum levels

4.1.1. Flooding

Giving the fact that we are discussing about a wetland area were floods are normal events we will present the phenomena from the both sides, as an extreme related with human activities and, as annual cycle normal event.

In extreme conditions, flooding is an environmental stress in many natural and manmade ecosystems worldwide (Bailey-Serres and Voesenek, 2008). Temporary floods differ in seasonal timing and with much variation in durations, depths and frequencies (Vervuren et al. 2003). In DDBR, the most important element is the hydrological system (branches, channels and lakes). Fundamentally, this means water circulation and distribution that is to say, the core of this wetland (Driga, 2004). In 1910 - 1911 I. Vidrașcu created the first map of flooding potential by hydro-grades values; currently, this map does not apply because of manmade and natural reshaping. Nowadays, the protection dams ensure security for specific areas, prevent the material losses with important expenses for rehabilitation and prevent human life loss. The liability to flooding of the deltaic space, as a complex hydrologic process, is very important in the evolutionary dynamic of all the natural system's elements. A good way to estimate these hydrological events was to

build up a hazard map, taking into account the maximum and minimum to have a picture of the extremes. This hazard maps, combined with the socio-economical component of the studied area, could give some data regarding risks in the area. The risk is a function that takes into account the hazard component and the vulnerability component from a system. The main premises that condition the process of liability to flooding delta are its hypsometric particularities, amplitude and periodicity of the maximum levels of Danube. To these, the reduction of the surfaces liable to flooding is added at present, as a result of embanking certain areas.

In the present analysis of liability to flooding the deltaic territory, the fact that it is complicating a lot should be taken into consideration, as approx. 30% of Danube Delta surface (namely 1,000 km^2) is embanked, not being subject of liability to flooding (Gâștescu and Știucă, 2008).The value of one hydrograde (1 hg) at a certain point represents 1/10 of the amplitude value of that point during the entire period of observations. In the differentiate estimation of a hydrograde value, the maximum levels have been taken into consideration ratified at present at various hydrometric stations towards "0" surveyor's rod reported to The Black Sea level - r. M.N. (Driga, 2004). Frequent for DDBR, hydrograde 7 – 7.5 corresponds to the medium of large waters maximum (350 - 375 cm r.M.N. at Tulcea); reaching and exceeding these values mark the beginning of the flooding process in the surface on the entire delta territory. When reaching hydrograde 10, delta surface is flooded in proportion of 93.4 % (3,094.7 km^2), the volume of accumulated water being estimated at 6.2 billion m time, having a larger capacity of water retention. As for fluvial-maritime habitats, the most recent observations showed that bushes such *as Tamarix ramosissima*, *Amorpha fruticosa*, *Elaeagnus angustifolia*, *Lycium barbarum* cannot resist more than three months under water (Doroftei et al. 2011).

During the spring time, in normal conditions, flooding is a normal event within the delta's annual cycle and floods normally occur between Aprils – June, when 33 % of the Danube's annual flow may pour into the delta. Before polders were constructed and damming work was carried out within the delta from 1956, flooding of the interior of system would start when the water level in the main Danube at Tulcea reached around 1.5 metres (3 hydro degrees) above the level of the Black Sea (Driga, 2004). Inundation of around 1,000 km^2 (31.2 % of the delta) is now prevented by the construction and maintenance of dams and polders. This has a „pour-on" effect on those areas that are able flood, because the water that cannot flood out over about a third of the delta is either contained within the main channels, or it discharges into the remaining two thirds of the delta's area. It has been calculated that 2752.65 km^2 are inundated when the depth of water reaches 6 hydro degrees (3 metres above Black Sea level). This represents 83 % of the delta that has not been dammed or made into polders. Some of the higher features within the delta, like the Letea, Caraorman, Stipoc dune systems do not flood, whereas Sărăturile and Câmpul Chilia dunes flood occasionally (Posea et al., 2005). The floodwater that inundates such large areas brings huge quantities of organic matter, silt and natural mineral salts. They also provide some nitrates and phosphates from agriculture and treatment of domestic effluents. The net effect is to raise the fertility of the areas that are inundated. This boosts vegetation growth in waters and soils. The huge and complex ecosystems of the delta are the main beneficiary, but growth rates in grazing and cropped areas are also enhanced (Gâștescu and Știucă, 2008).

4.1.2. Global solar radiation

Global solar radiation, as a main genetic factor of climate, reaches on DDBR territory, the highest annual average values in Romania; they increase from west (cca 130 kcal.cm^2), to east (over 135 kcal.cm^2) under the influence of The Black Sea. Its values depend on both total nebulosity and shining duration of the Sun. Total nebulosity has an annual medium which gradually decreases from west (>5, 6 tens) towards east (<5, 2 tens) where the lowest value was registered.

The annual average number of days with clear sky increases from west to east (Tulcea 66 days, Jurilovca 69,4 days, Sfântu Gheorghe 80,1 days), on the other hand, the annual average number of days with cloudy sky decreases (Tulcea and Jurilovca 99 days, Sfântu Gheorghe 90 days), at the same time with nebulosity decrease (Posea et al., 2005).

The annual shining duration of the Sun records a reverse territorial variation towards nebulosity. Its values increase from west to east: Tulcea 2 260 insolation hours, Gorgova and Jurilovca 2 325 hours, Sfântu Gheorghe 2 502 hours, the last being the highest value; it is slightly diminished on the surface of The Black Sea's coast waters, in Sulina (2 475 hours of insolation), where foggy air and fog are a little more frequent.

During the hot semester of the year (interval IV – IX), the effective shining duration of the Sun represents cca $^2/_3$ of the annual average value and it increases towards the same direction, from west to east, reaching the highest values (1 705 hours of insolation) in Sfântu Gheorghe, namely with cca 200 hours more than in Tulcea (1 513 hours).

4.1.3 Changing temperature and precipitation

According to exterior influences, air temperature reaches moderate values, being though, in seashore area, among the highest in the country.

The annual average values gradually increase from west to east, at the same time with both the decrease of land influence and the increase of sea influence: Tulcea and Jurilovca 11,0º C, Gorgova 11,2º C, Sfântu Gheorghe and Gura Portiţei 11,4º C, Sulina-dam (situated over the territorial waters, at cca 6 km at sea) 11,6º C (figure 10) and Platform Gloria (situated at cca. 30 km at sea, next to marine littoral between Sulina and Sfântu Gheorghe) 12º C, as a result of less deep waters which play the part of a thermal reservoir (10 – 20 m) on the continental platform (Bogdan and Niculescu, 1999). The annual average temperature reached non – periodic variations, positive or negative, relatively low, of 1, 5 – 2º C. In the hottest years, it exceeded 12º C (12, 5º C in195 in Tulcea and 12, 7º C in1966 in Sulina), while in the coldest years, it dropped below 10º C (9, 5º C in Tulcea and 9, 7º C in Sulina in 1942).

Absolute extreme temperatures best reflect the three exterior influences which interfere on DDBR territory (continental, maritime and of air in advection). Thus, under the influence of marine aquatory, polar or arctic cold air masses suffer a slight heating up and, therefore, absolute minimum temperatures increase from west to east: Tulcea –27,2º C (18.I.1963), Gorgova –26,2º C (18.I.1963), Sulina-town –25,6º C (9.II.1929), Jurilovca –23,5ºC (10.I.1940) and Sfântu Gheorghe –21,5º C (12.I.1950).

Also, the continental tropical hot air masses suffer a slight amelioration under the influence of sea waters and consequently, absolute maximum temperatures increase more and more towards a reverse direction,

from east to west: Sfântu Gheorghe 36, 3º C (9.VII.1968), Sulina-town 37, 5ºC (20.VIII.1946), Jurilovca 38, 0º C (8.VII.1968), Gorgova 38, 2º C (18.VII.1951) and Tulcea 39, 7º C (20.VIII.1945) (figure 10).

Under the influence of adjacent land and of The Black Sea, atmospheric precipitations gradually diminish from west to east: Within deltaic space: Tulcea 438,4 mm, Gorgova 406,9 mm, Sfântu Gheorghe 403,6 mm, Sulina-dam 330,5 mm; Within The lake complex of Razim-Sinoie: Jurilovca 386,6 mm, Dranov 356,5 mm and Gura Portiţei 327,2 mm.

On Caraorman and Sărăturile Sandunes, they exceed 400 mm (Sfântu Gheorghe 403, 6 mm); as a result of local convect rainfalls (figure 11).

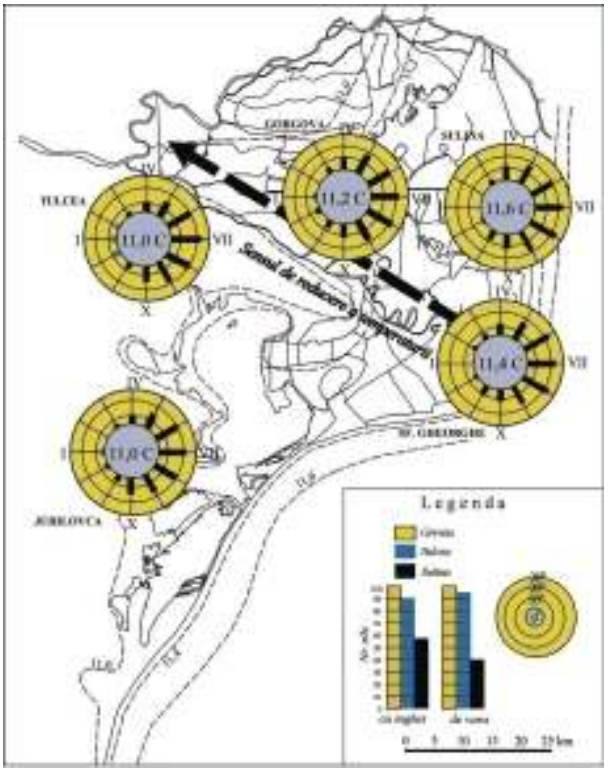


Fig.10 The annual average values in Danube Delta, the arrow indicates the direction of temperature abatement (Posea et al., 2005)

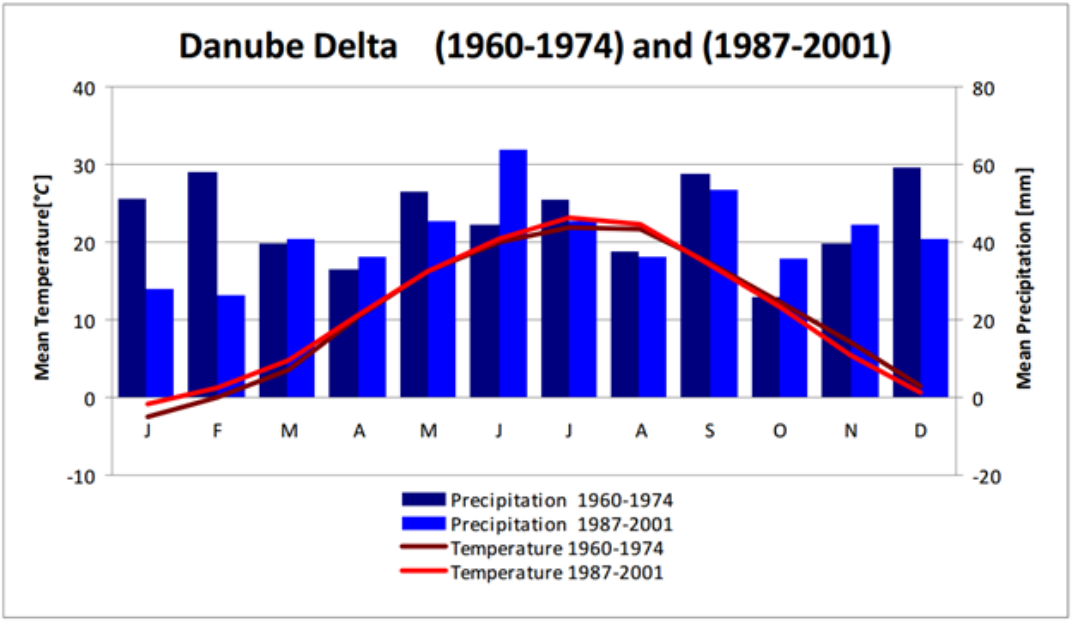


Fig.11 Changing temperature and precipitation in Danube Delta (Ivonne Anders, ZAMG – 2011)

The amount of absolute maximum precipitations within 24 hours were, in all the cases, higher than 90 mm, exceeding a lot more the average value of the months when they were produced, July – August; they also represented ½ up to ⅓ from the annual average amount from the respective station. The highest maximum amount within 24 hours was produced on 29.VIII.1924, in C.A.Rosetti, summing up 530, 6 mm which completed with the rainfall from the previous day 30.VIII was of 690, 6 mm, representing 1 720 % compared to the medium of August; on the same day, 29.VIII, in Sulina 219, 2 mm were registered, representing 2/3 of the annual amount at the same station, produced within a single day.
The annual average number of days with precipitations (≥0, 1 mm) gradually decreases from west to east: Tulcea 104, 1 mm, Gorgova 96, 4 mm, Jurilovca 90, 4 mm, Sfântu Gheorghe 88, 0 mm and Sulina 87, 3 mm.
These quantitative indices of complex topo-climates (table 6) reflect the three exterior influences that exert on DDBR territory, namely continental, marine and of air in advection.

Spatial distribution of dryness index „Emm de Mortonne" shows the fact that dryness degree increases from west (>21) to east (<15). In seashore area and above coast waters on the continental platform, where annual precipitations are the lowest (cca 330 mm), and the annual average temperatures are the highest on the entire Romanian littoral of The Black Sea (11,4 – 11,6° C), the dryness index has the lowest value (15 – 19), which indicates that here is the highest degree of dryness.

Table 6 Quantitative indices of complex topo-climates (Bogdan, 2001)

Climatic parameters	Fluvial delta	Fluvial-marine delta	Razim-Sinoie
Annual average duration of shining of the Sun (hours)	2 300-2 400	2 400-2 450	2 300-2 350
Annual average global solar radiation (Kcal. cm^2)	125,0-132,5	132,5->135,0	130,0-135,0

Annual average temperature (°C)	11,0-11,2	11,2-11,6	10,9-11,4
Average temperature of January (°C)	-1,5...-1,4	-1,4...-0,2	-1,4...-0,3
Annual average temperature of July (°C)	22,5-23,0	23,0-23,5	22,6-23,0
Annual average amplitude (°C)	24,2-24,5	23,0-24,0	23,0-24,0
Absolute minimum temperature (°C)	-27,2 T; -26,2 G	-21,.5 Sf.Gh.; -25,6 S	-23,5 J
Absolute temperature (°C)	39,7 T; 38,2 G	36,3 Sf.Gh.; 37,5 S	38,0 J
Annual average number of winter days	cca 20	cca. 15	cca 20
Annual average number of frost days	cca 85	< 70	cca 75
Average number of summer days	85-80	70-80	cca 70
Annual average number of tropical days	cca 20	< 1	cca 5
Annual average relative humidity (%)	76-80	80-84	80-82
Annual average nebulosity (tens)	5,6-5,2	5,2-5,4	5,2-5,4
Annual average amount of precipitations (mm)	450-400	400-350	385-325
Main pluviometric maximum (mm)	VI (52,9 T; 48,4 G)	VI(46,2 Sf.Gh.; 36,2 S)	VI (46,2 J)
Secondary pluviometric maximum (mm)	XII (36,4 T; 34,0 G)	XI(39,9 Sf.Gh.; 33,1 S)	XI (35,5 J)
Maximum amount of maximum precipitations within 24 hours (mm)	125,4 T; 108,4 G	101,0 Sf.Gh.; 219,2 S	130,2 J
Prevailing winds	NV; N	N; NV; NE; S	N
Calm frequency (%)	23,0 T; 10,5 G	15,9 Sf.Gh.; 1,8 S	21,0 J
Annual average wind speed (m/s)	2,8... >3,0	3 – >7	4 – 4,5... 6
Average wind energetic speed (m/s)	3,5-4,0	4,6-7,6	4,6-5,0
Annual average wind duration with v>3m/s (hours)	4 000-5 000	7 000-8 000	4 000-5 000
Average date of the first autumn frost	31.X- 1.XI	6 -12.XI	5-12.XI
Average date of the last spring frost	1-2.IV	27-28.III	28-30.III
Average duration of the interval without frost (days)	210-220	223-228	218
Average duration of the interval with frost (days)	145-155	135-145	145
Dry months (according to Péguy climograms)	1-3 (VII, VIII, IX)	4 (VI, VII, VIII, IX)	3 (VII, VIII, IX)
Months with dryness phenomena (according to Walter-Lieth cyclograms)	6 (V,VI,VII, VIII, IX, X)	6,5 (V, VI,VII, VIII, IX, X)	6,5 (IV,V,VI, VII, VIII, IX)
Months with drought phenomena (according to Walter-Lieth cyclograms)	2 (VII, VIII)	>5 (V, VI, VII, VIII, IX)	>3 (VII, VIII, IX)

Analyzing these indices from the table 6, it was observed that, on DDBR territory, in the complex topo-climate of fluvial-maritime delta, special values of certain climate parameters are met, with aspect of „climatic record" for entire Romania, such as: the lowest nebulosity (cca 5 tens), the longest insolation duration (>2 500 hours of insolation), the highest amount of global solar radiation (>125 kcal/cm^2 horizontal surface) and, consequently, the highest insolation fraction favorable to heliotherapy and balneotherapy (>85 % of the possible duration), in the seashore area; the highest temperatures in Romania

(11,0 – 12,0º C), the longest annual average interval with daily average temperatures >0º C (325 days) and the longest annual average interval without frost (225 days); the lowest annual amounts of precipitations (330 – 350 mm), and the highest absolute maximum amounts within 24 hours (530,6 mm); the longest dryness periods (6 – 7 consecutive months) and drought (3 – 4 consecutive months) (Bogdan,2001).

4.1.4 Frost

The average date of the first autumn frost is later and later from west (Tulcea 31.X) to east (Sulina-dig, 12.XI), as the sea influence increases and from south (Jurilovca 5.XI), to north (Sfântu Gheorghe 6.XI, Sulina-dam 12.XI), as a result of the station position at 6 km at sea, surrounded by waters. The average date of the last spring frost is later and later in a reverse direction, from east (Sulina 28.III) to east (Tulcea 2.IV) and from north (Sulina 28.III) to south (Jurilovca 30.III) from the same reasons. The average duration of the interval without frost increases from west (Tulcea 211 days) to east (Sulina 228 days – this being the longest in Romania) and from south (Jurilovca 219 days) to north (Sfântu Gheorghe 223 days, Sulina 228 days), at the same time with the increase of the sea influence. In a reverse direction, from east, where it is the shortest (Sulina 137 days) to west, where, because of the continental influence, frost lasts longer (Tulcea 154 days) and from north (Sulina 137 days) to south (Sfântu Gheorghe 142 days, Jurilovca 146 days).

The earliest autumn frost took place within the whole reserve at the same date (Sulina Tulcea, 4.X annually), as the latest spring frost (Sfântu Gheorghe and Tulcea 27.IV annually), due to obstacles absence, being with cca one month earlier and respectively later compared to the average dates. The possible maximum duration of the interval with frost decreases from the west (Tulcea 206 days) to east (Sulina 197 days), while the possible minimum duration without frost increases from west (Tulcea 159 days) to east (Sulina-dam 168 days).

4.1.5 Climatic water balance

The most influenced by climatic water balance are:

- Abandoned branches topoclimates, streamlets with stagnant water, with a little higher temperature, depending on the degree of eutrophication and alluvial deposits;
- Those of the large deltaic lakes, with more intense temperature inversions within the central section, where, due to better insolation and wind, evaporation processes are more intense, unlike the marginal concentric areas protected by reed „green shores", which are heated up at the wrong moment; those of small lakes with advanced eutrophication process and, consequently, with low albedo and high temperatures;

Therefore, during the day, when insolation is high, part of the solar radiation is reflected and another is absorbed and stored as heat beneath the lake; due to the water, maximum and minimum temperatures are unwedged; temperatures are moderate, evaporation is high (>1 mm/1h during the day) and therefore, the relative humidity is high (>80 – 90 %).

Recent observations confirm that the global mean temperature has increased by 0.8 °C compared with pre-industrial times for land and oceans, and by 1.0 °C for land alone. The rate of global warming has increased to 0.17±0.05 °C per decade (IPCC, 2001). This value will probably exceed any 100-year rate of warming during the past 1 000 years. From 1990 to 2100, the global average temperature is projected to

increase by 1.4–5.8 °C and 2°C –6.3°C for Europe (EEA, 2004). For habitat biodiversity, climate change is an additional stress factor. Biodiversity is also affected by factors such as land use changes, overexploitation of natural resources, invasive alien species, and air pollution. However, the role of climate change is expected to become more dominant in the next decades, in particular if the magnitude and rate of climate change is at the higher end of the projected range (IPCC 2001a, b; EEA 2004). As the change in air temperature is generally more pronounced at higher latitudes, the air temperature over Europe has already increased more than the global average for Europe: 1.0 (land and oceans) and 1.2 °C (land alone), especially in the south-west and the north-east of Central Europe as well as in mountain areas (EEA 2004; IPCC 2001).

Already observed trends of climate change in the investigation areas in terms of temperature, precipitation and the climatic water balance are shown in figure 12. To display observed trends in hydro-climatic conditions two periods of 15 years (Period 1: 1960-1974 and Period 2: 1987-2001) have been evaluated. An important phenomenon is that the increase in winter temperature in Europe was higher than the one in summer (EEA, 2004). These trends are visible in all investigations areas particularly in higher average temperatures for January and February. There are also apparent regional differences, especially the southern parts of Central Europe and mountainous areas, show lower increases in temperature than e.g. northern parts Central Europe. In addition, for most areas a temperature rise is clearly visibly for July and August. A general pattern is that the (observed) higher temperatures stimulate the global hydrological cycle. More evapotranspiration leads to more water vapour in the atmosphere and to more intensification of the water cycle. On the other hand, precipitation has a higher regional variability than temperature, because it depends more on regional circulation patterns and local orography. Therefore, trends in precipitation are more heterogeneous.

The observed precipitation trends for the period from 1900 to 2000 show a contrasting picture between increase in northern Europe by 10–40 %, and decrease in some regions of southern Europe, especially in the winter season (IPCC 2007; Klein Tank et al.2002). Across the European continent seasonal precipitation patterns show even more distinct trends than the average annual values. In the winter season many parts of north Central Europe became wetter, and regions in southern Central Europe drier. The changes in winter precipitation can partly be explained by stronger western winds over northern Europe, bringing more clouds (EEA, 2004). The Climatic Water Balance is defined as the amount of precipitation minus the potential evapotranspiration. It indicates the extent of the water yield in an area and provides an indication for the vegetation on-site. If the potential evapotranspiration is higher as the amount of precipitation the climatic water balance turns out to be negative and there is a climatic water deficit. A positive water balance indicates a climatic water surplus the area. On many sites not only warmer conditions are projected, in addition, drier weather conditions could occur especially in the summer season. For wetlands, the reduction of the Climatic Water Balance in summer is crucial for the evaluation of habitat exposure (and finally its vulnerability) to climate change (figure 12). Findings about future impacts of climate change on the water balance relay mainly on future trends in precipitation (regional and seasonal distribution). The other component of the Climatic Water Balance, the potential evapotranspiration, is defined as the release of water vapor from the earth's surface to atmosphere by evaporation and plant transpiration. Generally, potential evapotranspiration demand increases due to climate warming. Thus a temperature driven

increase in evaporative demand, especially in combination with decreasing precipitation, leads to a decrease of the Climatic Water Balance.

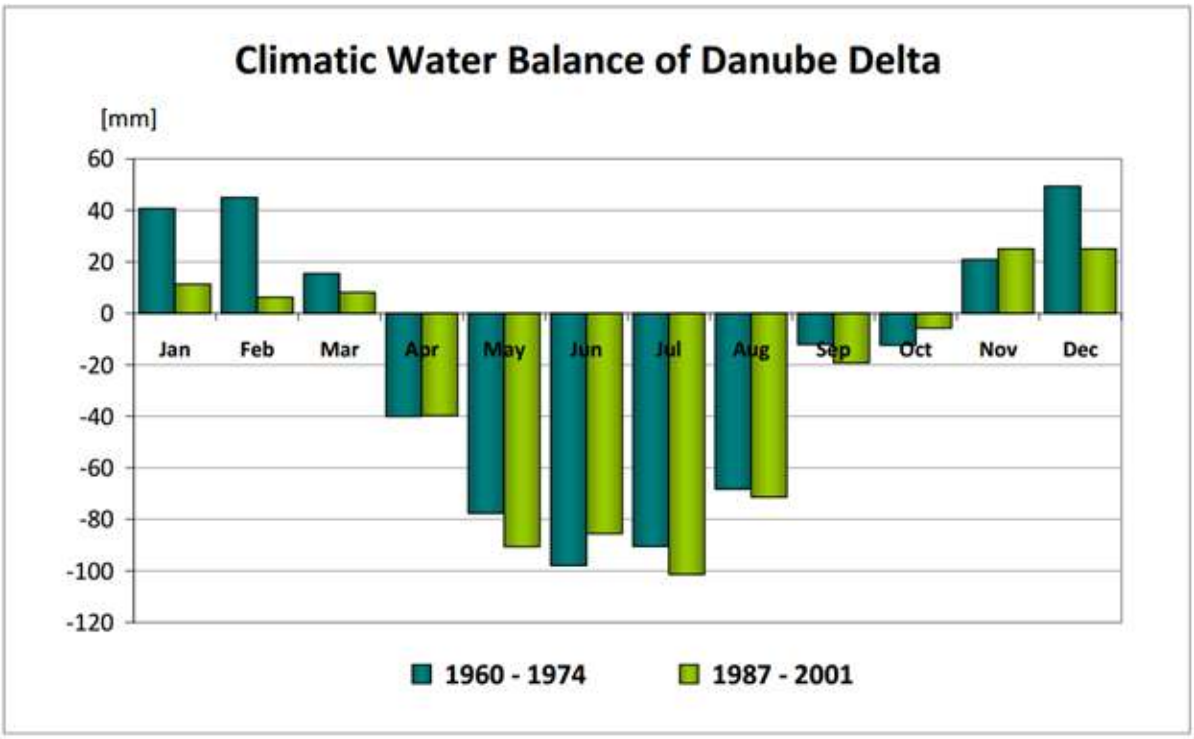


Fig.12 Climatic water balance of Danube Delta (Ivonne Anders, ZAMG – 2011)

In summer a decrease of the Climatic Water Balance can be expected overall, which can lead to seasonal water stress. The highest sensitivity for water stress arises for areas which have already an unfavourable Climatic Water Balance at presence. The region is characterised by a moderate – continental climate with pontic influences.

4.1.6 Climate balance on forest vegetation and sand dunes area (bare areas)

For the forest, the most important disturbing human factors for local climate balance are clear cuttings and grazing. Therefore, a high shading degree is noticed underneath them, which determines a reduced evapotranspiration (cca 0, 2 mm/1h). Normally, the air humidity is high (>80 %). That leads to moderate temperatures, reduced thermal amplitudes (<10^{o} C), temperature inversions or isothermal units, atmospheric calm, greenhouse effect. When the human interventions and low ground water level take effect, some of the ligneous species (especially Alder tree) are disappearing.

As a result, thermal convection, ascendant air currents, air turbulence strongly develop themselves during the *day*; heating processes prevail according to insolation type, while during the *night*, strong radiation of the active surface, descendent air currents, stable thermal stratification with temperature inversions take place. Consequently, vertical thermal gradients are high during the day (15 – 20^{o} C) and lower during the night (<1^{o} C). Temperature may reach high values at ground level during the day (>50 – 60^{o} C) and low

at night (<20° C); thermal contrasts are present between day and night, that is why thermal amplitudes are higher (>25° C in the air and over 75° C at ground level); evapotranspiration is high (>1 mm/1h), while humidity is relatively reduced (<25 – 30 %).

4.1.7 Invasive plants species

Growing number of naturalized alien species is seen as indicator of uniform vegetation. Al the level of Danube Delta Biosphere Reserve, there was elaborated a list of 128 alien plant species (Doroftei & Covaliov, 2009). From this list, 116 species (65 ligneous species, most of them being cultivated in localities) were identified recently in the field (Doroftei and Covaliov, 2009).

Table 7 Establishment site potential of invasive species in DDBR habitats according to G.P.S. points (Doroftei et al., 2011)

Vegetation type	Alien species [x]	%
Forest/bush vegetation of flood lands		**54,45**
Natural flood plain forest	1, 2, 5, 6, 7, 8, 9	42,66
Planted flood plain forest	2, 5, 6, 7, 8	9,58
Seashore vegetation	2, 7, 8, 11	2,21
Marshy vegetation		**29,34**
Tall reed vegetation on mineral soils	2,10	17,87
Mixed reed vegetation on mineral soils	3	7,47
Open water/Reed vegetation and bushes on floating reed beds	4, 10, 12	2,13
Sedge vegetation	10	1,87
River levee grassland		**7,07**
Grassland on medium high river levee	1, 2, 3, 7	3,87
Grassland on high river levee	1, 2, 3, 6, 7, 8, 9	3,20
Beach/sea dune vegetation		**2,40**
Vegetation on flat marine / alluvial deposits slightly salinised	2, 10	1,33
Coastal low dune (0,5 – 1 m) vegetation	2,5, 9, 11	1,07
Miscellaneous		**6,74**
Agricultural polder	1, 2, 3, 7, 9	6,74

Later on there were inventoried 169 alien plant species in a different projects (CNCSIS PNII-IDEI 273/2007 and CNCSIS PNII-IDEI 611/2008) which represents 30% from total 671 alien plant species inventoried at the national level (Anastasiu and Negrean, 2005; Sârbu and Oprea, 2011). Some of the plants included in this list present a higher frequency, being widespread both in natural habitats, and in those controlled by man.
From the list of the alien plants identified in the Danube Delta, the species with the highest impact index (competitive ability index) have been extracted on the basis of ecological features (table 4). Species such as *Ailanthus altissima* [1], *Amorpha fruticosa* [2], *Conyza canadensis* [3], *Elodea canadensis* [4], *Fraxinus pennsylvanica* [5], *Gleditsia triacanthos* [6], *Morus alba* [7] and *Robinia pseudoacacia* [8] are considered the

most widespread invasive plant species from DDBR. Furthermore, other species (*Acer negundo* [9], *Azolla filiculoides* [10], *Lycium barbarum* [11] and *Vallisneria spiralis* [12]) that until now were not considered a threat are observed in new habitats (table 4).

However, the presence of a high number alien species and then expansion of invasive species is a clear indicator of climate change that allowed the emergence of both new species and associations, non-specific to deltaic territory so far (table 8).

Table 8 Invasive ligneous species presence in DDBR (Doroftei and Covaliov, 2009)

Invasive species	DDBR presence
Elaeagnus angustifolia L.	Species introduced in forest cultures from the coastline cordon area and on sand banks in order to fix sand. It has been identified predominantly in the fluvial-maritime delta, in all the localities of the Danube Delta as well as in the fluvial delta, with a reduced frequency though. It is also present on Popina Island, Capul Doloşman, Iancina and Taşburun. Nowadays, it is considered sub spontaneous species. We consider that it has spreading potential and it may eliminate *Hippophaë rhamnoides* species.
Amorpha fruticosa L.	Shrub cultivated in the past along the modified/dragged channels in the Danube Delta. Nowadays, it is considered sub-spontaneous with an invasive character. It is a very frequent species present within all types of habitats, especially within the fluvial delta sector. In the poplar forest plantations, it develops very well, occupying the shrub layer and thus causing damage to these cultures. The actual exploitation management of poplar forest plantations is favouring the development of the *Amorpha fruticosa* shrub layer. Maintaining a high water level within these enclosures during a longer period can be a solution for eliminating the species *Amorpha fruticosa*.
Robinia pseudoacacia L.	Tree cultivated in forest plantations. It is frequently present in the localities within the Danube Delta. It dominates the landscape in localities such as Pardina and Periprava. Species considered sub-spontaneous with invasive character within the most of habitat types in the Delta Danube.
Morus alba L.	Species cultivated in forest plantations and localities from where it became spontaneous within the entire territory of the Delta Danube. The species is considered sub-spontaneous, being susceptible to be invasive.
Fraxinus pennsylvanica Marsh.	Tree frequently cultivated in forest plantations in order to replace the *Amorpha fruticosa* species. It is frequently present in the localities within the Delta Danube. Nowadays, it is considered sub-spontaneous and it is spread in the flooding areas. We recommend the species to be observed regularly considering its invasive character.
Ailanthus altissima (Mill.) Swingle	Cultivated frequently in the most of the localities. It is considered sub-spontaneous species, being present around localities, in forest plantations, on Popina Island, Doloşman Cape, Iancina, Taşburun and sometimes along channels. We consider it is a species to be observed regularly because of its easy spread character. Nowadays, it is catalogued as invasive species.
Gleditsia triacanthos L.	Ornamentally cultivated species in Mila 23, Sulina, Chilia, Gorgova, Sf. Gheorghe, Pardina and Periprava. It is also cultivated in forest plantations from where it has been sub-spontaneously spread within

	drained areas.
Acer negundo L.	Ornamentally cultivated in localities and around these. The species is also cultivated in forest plantations from where it has spread in the rest of the Danube Delta channels, too.
Lycium barbarum L.	Species used in the past to strengthen the soil. Nowadays, it has been observed on the territory of the Danube Delta in spontaneous around Sulina, Sf. Gheorghe, Maliuc, Crişan, Gorgova, Caraorman, Letea and Chilia localities. The species has been encountered during the study are in other locations such: Portiţa, Grindul Lupilor, Taşburun and Periteaşca.

4.2. Sensitivity of protected habitats

In order to evaluate the impact/effects of climate changes it has been carried out an analysis of the land on the basis of the digital vegetation map after Hanganu et al., 2002; the interpretation has been carried out with the help of ARCview 9.0 software. The vulnerability maps on flooding for natural and man-made habitats have been elaborated at the DDBR habitat level taking into account the DDBR ecosystems maps elaborated in 1998. All these maps have the Double Stereographic (1970) projection and coordinate system. Concerning habitat loss indicators, we have focused on existing field data regarding hydrological features and vegetation coverage. Both features have been monitored on the basis of quantitative and qualitative indices for three years (2009, 2010 and 2011). On the basis of all these indicators, we have carried out thematic maps on the entire territory of Danube Delta in order to spotlight the vulnerability level of habitats depending on: regional drivers (economic activities described in the chapter 4*);* flooding; habitat status (invasive plant species, biological indicators) and land use/cover (figure 4).

With a view to develop flooding vulnerability maps, grades have been ascribed to ecosystems from 0 to 9, directly proportional with their vulnerability to flooding, on account of research carried out on prevailing species within. Thus 0 stands for minimum while 9 stands for maximum. When grading, limit preferences of plant species to extreme conditions have been considered. Habitats have been divided into man-induced and natural ones with the purpose to employ specific approaches for each type separately.

Elaborating the map for DDBR habitats' vulnerability to invasive species imposed the taking into account of the scores (Braun-Blanquet) ascribed to invasive species having been identified in field within the studied habitats. The grading scale has been translated to the types of ecosystems investigated in field. Thus the value "-" stands for the absence of an invasive species, therefore a minimum vulnerability, while the value 4 represents high abundance of invasive species, therefore it determines a high vulnerability of the ecosystems where they are present.

Taking into account all the habitats from the Danube Delta Biosphere Reserve, having as basis the map of vegetation unit, the map of habitat status relying on the Habitats Directive could be made up. This map shows the percentage and the distribution of the habitats according to the European Directive abovementioned and the other habitats as well. The other areas mainly consist of: localities, manmade habitats for aquaculture, *Populus sp*., *Salix sp.* and *Robinia pseudoacacia* plantations on floodplain, unclassified Natura 2000 habitats (bushes, reed beds, reed mace and sedges).

As it is stipulated in the concept of the Biosphere Reserve, the Danube Delta BR has some strictly protected areas. The same exercise has also been done for these areas and the results can be seen in figure 13.

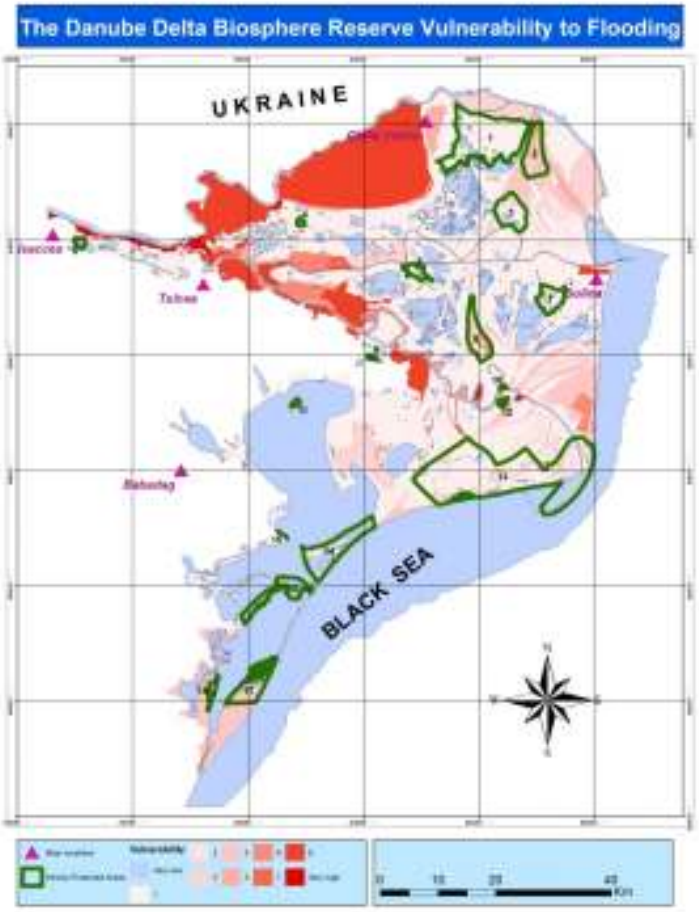


Fig. 13 DDBR vulnerability to flooding (Marian Mierlă in press data)

At this hydrograde, the highest areas on Letea, Caraorman, Stipoc sand dunes remain un-flooded, except Saraturile and Chilia Plain; it has to be mentioned that in Dranov unit only 0.3 % (namely 961 ha) remained uncovered by waters (Driga, 2004).

Strictly Protected Areas have various percentages for surfaces occupied by habitats excluded of Habitats Directive. Thus there are some of them with percentages higher than 28% (Sacalin – Zatoane 41,37%, Periteasca – Leahova 44,64% and Grindul Lupilor 42,38%). The increased percentage is given by wide habitat surfaces populated with reed. On the other hand, there are lower percentages (e.g. Raducu 26,29%, Grindul Chituc 15,06%, Lacul Nebunu 4,93%);some of the Strictly Protected Areas only comprise habitats included in the Directive (Letea, Lacul Rotund, Vatafu – Lunculet etc.). The influence of maritim - featured habitats may be observed within SPA as well, thus Caraorman has 46,78%, Letea 47,24%, Grindul Lupilor 38,94%, Grindul Chituc 73,27, Istria – Sinoe 91,56%.

The habitats most affected by flood events are those which are not protected by Habitats Directive (manmade habitats for agriculture, localities etc.). Among the protected ones, forest habitats can be

counted as having low tolerance to water excess. Among the strictly protected areas with high vulnerability there are Letea and Caraorman, the reason being that they include forest habitats. The habitats not being vulnerable or having low vulnerability to flooding reveal higher vulnerability to drought. Drought within DDBR is caused by the low level of Danube waters and implicitly of channels, streamlets and lakes, being known the fact that the hydric balance is poor (precipitations are lower than evapo-transpiration). Some authors emphasize that arid habitats, which occupy about 30% of Danube Delta area, are the most sensitive with regard to increase of atmospheric CO_2 and associated with global climate change. Increased concentration of CO_2 stimulates succession and dominance in plant communities of annual grasses. Shift in favour of annual grasses, determined by global warming, can accelerate fire cycles, reduce biodiversity and affect the functioning of ecosystems. There is no doubt that the dominance of annual adventives grasses in arid ecosystems can be regarded as an indicator for the steppe habitats of the Danube Delta area.

As people alter the environment through activities like development, construction of dams, flood control structures, and diversions of water, we change the volume and rate that water runs off the landscape, into the ground, and into streams. Increased runoff can result in erosion and sedimentation.

Another consequence of climate changes with long-term effects is produced by the penetration and development of invasive species either animal or plant. The present paper discusses invasive plant species development. Vulnerability to invasive plant species within DDBR is represented in figure 14.

Taking into account the habitats that populate the DDBR surface, the map of vulnerability of DDBR has been completed, as it was mentioned in the specific chapter.

Changing climatic conditions influence three essential elements of invasion: the source location, the pathway and the destination (Dangles et al., 2008). Also, it could determine shifting species habitats and species migration (to higher/lower elevations, to more friendly habitats etc.).

The native species that will not be able to migrate can disappear. Some studies have shown that short-term changing climatic conditions may facilitate the long-term establishment of invasive alien plants (Dragotă et al., 2011). The habitats with highest vulnerability towards invasive plant species are manmade habitats and the neighbouring ones.

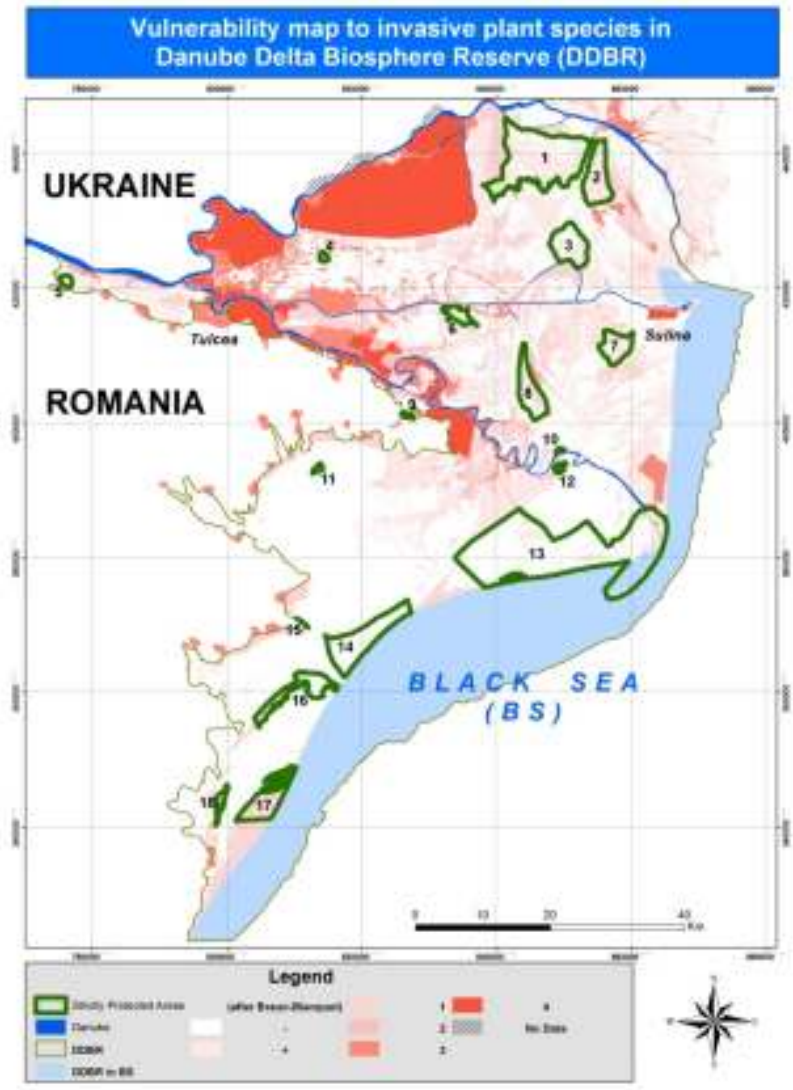


Fig. 14 DDBR vulnerability RBDD towards invasive plant species

(Marian Mierlă in press data)

Among these, agricultural arrangements and other arrangement types, localities etc. can be mentioned. As far as habitats within strictly protected areas are concerned their vulnerability proves to be low. This may be due to the isolation degree in each area. Invasive plants, by definition, have the ability to produce large numbers of viable offspring at considerable distances from parent plants, thus having the potential to spread quickly over large areas (Richardson et al., 2000). Non-native invasive plants may therefore be pre-selected to take advantage of a changing climate because they have the potential to respond to shifting niches more rapidly than natives (Dukes and Mooney, 1999). Furthermore, opportunities for exotic plants in the alien habitat will differ from those in their native habitat because of the lack of competitors, predators, or pathogens that constrained their native ranges. In Danube Delta the identified invasive plant species are found on channels, canals and ponds' banks, localities and riparian forests (Anastasiu et al., 2007), have a preference for gleysols 68 %, alluvial soils 11 %, shifting sand dunes 8 % (Munteanu and Curelariu, 1996); they also require a poor and moderate-drained soil (Gregory and James, 2003), but they

can grow in conditions of a poor soil, and they stand even the floods in the Danube Delta. Although their development needs well-drained soils, they can resist in draught conditions like *Gleditsia triacanthos* and can also tolerate strong winds (Crossman et al., 2011; Huxley, 1992), but cannot adapt on optimum conditions to the coast area (*Ailanthus altissima, Amorpha fruticosa, Fraxinus pennsylvanica*) because of the winds from the sea (Binggeli, 1996), except *Elaeagnus angustifolia* and *Lycium barbarum*. Also the actual frequency of the species is not entirely based on natural spreading knowing that in the past most of the alien species were massively planted. Nowadays, the human interventions in wetlands can haste the spreading of the alien species. On the other hand, the natural vectors of spreading, in the new habitats, are not entirely known. As a natural vector of distribution the studied alien plants are hydrochore and zoochore, the only species mentioned as anemochore plant is *Fraxinus pennsylvanica* (Crossman et al., 2011). Data related to the distribution of species based on natural vectors presents the hydrochoric and zoochoric species that have a much higher distribution (Crossman et al., 2011; Harold et al., 2005; Williamson and Fitter, 1996). In wetlands, the alien species, apart from their capacity to spread through natural and disturbance regime of the habitats, have the dissemination potential in other areas less favourable such as dry areas. It is certain that in such conditions, the species have a lower frequency and they are less competitive compared to the indigene species. This fact is due to: the conditions of high drainage of the soil; the high temperature at soil level; insolation; the distribution way of the plant species in the arboreal floor.

4.3. Expected impacts of climate change on protected habitats

The climate of the land that surrounds the Danube Delta is continental, with hot dry summers and cold winters. Clear-sky days average 66 days/annum 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. Temperatures can go below - 27˚C, though close proximity to the Black Sea reduces the chill factor. The average annual temperature in Tulcea is 11˚C, max 39.7˚C min – 27˚C. Similar measurements for Sfântu Gheorghe show an average of 11.4˚C, with maxima of 36.3˚C and minima or –21.5˚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.

Key climate variables	What is already happening	What could happen
Global temperature (C)	Three independent long records of global average (land and ocean) annual temperature show that the decade between 2002 and 2011 was 0.77 °C to 0.80 °C warmer than the pre-industrial average (end of 19th century). The Arctic has warmed significantly more than the globe as a whole.	The further rise in global average temperature is projected to be between 1.1–6.4 °C by 2100 taking climate model uncertainties into account. The EU target of limiting global average temperature increase to 2 °C above pre-industrial levels is projected to be

		exceeded during the second half of this century and likely around 2050 for scenarios that assume no global mitigation policy. The Arctic is projected to warm more than the globe.
European temperature (C)	The average temperature for the European land area for the last decade (2002–2011) is 1.3 °C above the pre-industrial level, which makes it the warmest decade on record. Heat waves have increased in frequency and length.	Land temperature in Europe is projected to increase between 2.5 °C and 4.0 °C by 2071–2100. The largest temperature increases during the 21st century are projected over eastern and northern Europe in winter and over southern Europe in summer. Heat waves are projected to become more frequent and last longer across Europe over the 21st century.
Regional temperature (C)	The average annual air temperature increased by 0.5^{O}C in Tulcea and by 0.8^{O}C in Sfântu Gheorghe. The amplitude is increased by 0.9^{O}C in the last 30 years.	DCA: 2021-50, summer T – by 1.8-2.1°C, winter T - 1.4-1.5°C. DCA: 2071-2100: an increase of 3°C for all seasons and especially for summer an increase of about 4.1-4.5°C is simulated In 2021-50 periods the prediction's scenarios shows an increasing of air temperature by 1.1^{O}C average. The amplitude and abrupt changes in seasonal temperatures are predicted with an increase of 1.1^{O}C.
Precipitation (C)	The average annual precipitation slightly decreased in the last 30 years. Moreover, the rainfall abundance (water quantity) increased.	DCA: 2021-2050: 5-15% decrease in annual precipitation, less summer rainfall and unchanged or slightly increased winter precipitation. In 2021-50 periods the prediction's scenarios shows a decreasing of annual average precipitation by 5-10%.
Evaporation	In the last decade it has been observed an increase of the average annual evaporation. The assumptions are based on less precipitation combined with an increased air and water temperature.	DCA: Modeling predicts 4% decrease of total evaporation. Present scenarios predict a slightly increase of the evaporation process.
Storms (C)	Between 1990 and 2011 it has been recorded an increasing in intensity and frequency of the storms, especially in the coastal area.	Available climate change projections show no clear consensus in either the direction of movement or the intensity of storm activity. The expectations are unclear. No sufficient data to have a close prediction on storms frequencies and intensities.
Snow cover (C)	In the last decade the snow cover slightly decreased in frequency, duration and quantity.	Model simulations project widespread reductions in the extent and duration of snow cover in Europe over the 21st century. Earlier snowmelt conditions;

		slower/later build up of snow coverage and faster/earlier melting Reduction of the frequency, duration and amount of snow cover.
Runoff	Water runoff during summer months decreased to a certain degree (from 26.9 to 25.6 % of annual discharge), while the total water content of the river increased. It has been observed a slightly decrease in summer period.	DCA: decrease of -5 to -20% until 2020 or rather a decrease of 0 to -23% until 2020 and -6 to -36% until 2070 Decrease by 5-15% in the next 30 years.
Water temperature	Average annual temperature of water in the delta arms during 1961 – 2010 increased by 1^{o}C, and maximum annual T – by $1,9^{0}$C; in the Black Sea northwards of 400 N, water T increased by 1.50^{0}C and even more in coastal shallows, bays, gulfs, deltas, especially in summer time.	DCA: Increase in water temperature of all aquatic systems (rivers, lakes, groundwater bodies); less freezing periods in winter and less ice cover on lakes and rivers Considerable increase of the average annual water temperature mainly in the small lakes with insufficient water circulation.
Water flow	The water flow is related with Danube River connectivity and Danube Delta hydrological inner system. However, water flow is interrelated also with total amount of precipitations from the Danube basin. In the last decade it has been observed a water shortages process.	Irretrievable water consumption will become greater due to higher irrigation needs. Models predictions shows an average annual low water table in the channels and very low water level/or no water in medium or small size lakes.
Drought	In the most dry area of Romania (Dobrogea-Danube Delta) there were recorded slightly increases of drought periods.	Occurrence of droughts, water scarcity, heat waves and dry periods may increase by 10-20% in the period 2020-2025. Increase of drought periods by 10% in the next 30 years.
Wild fires	Frequency of fires is increasing due to increasing intensities of droughts and heat in the Delta; at some parts of the delta fires became common in last years No records of wild fires. Only seasonal, mainly in autumn, man-caused fires on dry reed beds in order to gain large pasture area in the spring time.	Increase of risk of ignition of wild fires due to natural reasons as well as area of spreading of man-caused fires due to intensification of droughts. Possible wild fires in if the conditions are appropriate such as high temperature, long drought period, dry flammable vegetation and wind.
Sea level rise	On the entire coast line the average the rate of sea level rise is 0,25 cm/average. The correlation is made with erosion and sand deposition process.	DCA: Increase of the sea level of the Black Sea; Possible retreat of inland Danube Delta. Black Sea water level increase rate: 0.25 cm/year (long term).
Flood	In recent decades, due to earlier snowmelt in the Danube basin, the spring–summer flood peak begins 10–15 days (on the average) earlier than in previous years[1]. In the last decade more extreme flood phenomena has been recorded with high water table in all hydrological system of the Danube Delta. Already,	Frequency and intensity of floods, caused by local runoff will increase due to higher share of rainstorms in the total precipitation. Intensity and amplitudes of the Danube floods will increase. Role of liquid precipitation in forming of the flood conditions will increase.

	in some parts, the system dykes fail.	Floods in the coastal area will increase due to the rise of the sea level as well as due to increase of frequency and intensity of wind-caused water level fluctuations. Risk of failure of dykes along the Danube as well as dams on the small rivers. Increasing of frequency and intensity of floods. High risk of settlements to be flooded.
Lake and river ice cover	In the last 10 years the frequency of ice cover on the lakes and Danube River decreased.	Frequency and intensity of ice conditions on all water bodies will decrease. Decreasing of ice cover in intensity and frequency.
Hypoxia	Increasing frequency of hypoxia in the bottom layers of the sea caused by sharply pronounced thermo cline.	Frequency of hypoxia in the bottom layers of the sea will further increase. Content of dissolved oxygen will decrease in all water bodies, especially during the summer months. Amplitudes of daily fluctuations of O_2-CO_2 balance will increase. Decreasing of content dissolved oxygen in most of the lakes with low transparency and no water circulation or connectivity.
Coastal erosion	As the World Ocean level rises, a threat of sand coast erosion increases, e.g. of Razelm and Sinoe lagoons in Romania. The delta ecosystems become very susceptible to the higher sea level.	Further rise of the Ocean and the sea levels will increase coastal erosion. Salt sea water will intrude further upstream into the Danube river and wetlands suppressing freshwater fauna and flora. Future climate change, in particular rising sea levels, is expected to accelerate coastal erosion.
Eutrophication	Higher water temperature in summer months is leading to longer periods of algae blooms in lakes and wetlands. Water blooming in the sea surface appeared recently as a phenomenon. RO: Loss of breeding areas and eutrophication are two of the factors that have led to a decline in common carp. Tench have also increased, but these are a valuable species. A general increase in turbidity has led to a reduction in macrophytes, leading to changes in primary production.	Frequency and intensity of water blooming will increase. Share of toxic algae will increase Increasing of algal blooming in frequency because of hypoxia, low water table and high temperature.
Physical damage to habitats	The increased frequency and intensity of extreme weather events led to more damage to vegetation	The risk of larger scale damage to biotopes will increase due to more intense flash floods, wildfires, storms etc.

Loss of biodiversity and mosaic wetlands	Field observations revealed some changes in vegetation structure and distribution such as forest species started to dry (*Alnus glutinosa*) ; in aquatic vegetation certain species, more adapted to the new conditions dominate the lake.	In the central and southern parts of the seaside in DBBR, the delta will grow intensively and fresh-water vegetation will develop here. However, the speed of vegetation formation is very high even now and in future, given the decay rate of the northern channels of the Kiliya arm, it will be still higher. Overgrowing of water basins will take place so that certain stages of the vegetation formation process drop out. This fact will result in degradation of higher water vegetation and appearance and increase of the share of inferior (algae) and adventives plant species. If no hydro land reclaiming works are started, this process will still enhance. Degradation of phyto- and biodiversity which commenced in the 80's will be on-going.
Disappearing rare species on floodplains	Rare species of plants on floodplain ecosystems of the Danube delta are disappearing. Another example is about badgers and European mink that are very rare in this territory. The red list of DDBR contains a number of 382 species. More than 40% are species critically endangered.	Reduction of the Danube runoff accompanied with a temperature rise and more contrast weather events will worsen the water exchange and flushing of the flood plains. The water ecosystem will suffer secondary pollution with organic debris and it will intensify degradation of the floodplain ecosystem. Vegetation will become simpler; communities will fragment so that the share of the higher water vegetation diminishes. Changing the condition of the wetland will led to species disappearing.
Change of vegetation on islands	The changes of marine islands in the delta may be analyzed on Musura Island. Taking into account current considerable erosion process and sea currents.	Temperature rise and less runoff will cause more frequent arid periods, in that way increasing probability of fires on the islands. The higher Black Sea level will not, practically, take a toll on the island flora but, should the salt wedge rise above the island level. The share of plants with of higher capacity of nitrogen fixation (bladderwort) and other kinds of water plants resistant to a considerable eutrophication (meakin and myriad-leaf) will increase.

Declining ground water and plant diversity at sand dunes and ridges	In Danube Delta Biosphere Reserve 128 alien plant species were identified (Doroftei & Covaliov, 2009). Most affected natural floodplain forest, meadows and beach sand dunes.	Further lowering of the ground water level due to less runoff in the Danube and increase of water temperature will increase probability of fires on the ridge.
Change in dominant communities	Share of reed communities in the delta is slightly declining especially at natural wetland areas. Low water level condition, especially in summer time, due to these "obstacles", some channels and lakes get disconnected from their supply channels and can even become dry. This results in a significant modification of flora and fauna species behaviour, mostly negatively impacted from biodiversity point of view.	Higher water level will result in diminishing area of reed communities and more favourable conditions for Mace and Bulrush community in the lower parts of the Delta. An increase of the Black Sea level and more frequent wind-induced events will lead to formation of salt marshes and marsh/grassland communities.
Increase in fire frequencies	Higher frequency of fires stimulates change in vegetation with more of marsh-and-grassland type and a greater share of meadow herbs and lower share of reeds.	This process of "meadowing" will continue in the future as fires become more frequent. A change of the reed wall structure will be the other negative consequence of fires as the ash elements accumulating in soil will make stems weaker, which reduces commercial quality of reed.
Longer growing season	Reed growth and development period is changing, particularly its transition to winter stage. During the last 3-4 years, particularly in winter of 2011, leaf fall stage hardly occurred, and the time of starting commercial reed harvesting was delayed.	The temperature increase by 1.5-2.0 ºC will further lead to changes of the reed development period, particularly its transition to winter stage, which will substantially violate the timing of commercial reed mowing for export.
Salt water intrusion	Increasing level of Black Sea that results in deeper penetration of salt water into the delta fosters development of commercial quality reed communities along the sea front of the delta.	Mineralization of the ecosystem will increase because of the rise of the Black Sea level. Reeds are sufficiently resistant to slight salting of water and soil, and it will lead to an increase of reed-dominated communities and salt-loving species. Besides, the reeds growing in subsaline habitats ripen quicker and its offshoots are much stronger and viscous which improves its roofing quality.
Phenology and lifecycle		Changes in the life cycle and phenology of birds and fish will result in shift of migration timing including important commercial game species. Projections of the phenological responses of individual species are not available, but phenological changes are expected to

		continue with projected further climate change.
Invasive species	Number of alien species is growing in terrestrial ecosystems: Most of terrestrial and freshwater alien species are found on disturbed or altered wetlands or polders. The presence of a high number alien species and then expansion of invasive species resulted in emergence of both new species and associations, non-specific to deltaic territory so far. The introduction and spread of non-native species has also put pressure on less adaptable fish. Crucian carp have expanded their range since 1970 and the impact of the grass carp or silver carp is being monitored. Muskrat was introduced from North America in 1954 and it has established itself as one of the delta's most plentiful mammals.	Non-native invasive plants may be better adapted and take advantage of a changing climate (Dukes and Mooney, 1999). Nowadays, the human interventions in wetlands can foster the spreading of the alien species. On the other hand, the natural factors of spreading in the new habitats are not entirely known. All this will further increase habitat fragmentation in the delta, decline of biodiversity and increase vulnerability of delta ecosystems to changing climate conditions.
Fish lifecycle	The construction of polders in the late 1950s and 60s, to create farm and forest areas, reduced the area of the „Danube meadow" available in the flood season for spawning by carp and other commercially valuable species.	Increase of water temperature in the river and lakes will result in earlier spawning, fasters development of food supply and prolongation of the feeding period. Future climate changes will not trigger a considerable reduction in catches, though their qualitative composition may deteriorate. Fish production in the Danube Lakes can reduce due to worsening of water exchange and lower water quality. In summer greater fish mortality can be expected due to algae blooms.
Agriculture	Overgrazing has been a problem and general spread of weeds has resulted. Grazing meadows vary according to soil conditions, with alluvial material providing the best land, salt flats and dune grasslands being the least productive. Grazing is important, however, because it helps to limit the spread of scrub over ecologically interesting grasslands. In the last decade the arable lands surfaces decreased, therefore the production decrease drastically.	Without any doubt, the longer vegetation period will make it possible to grow this crop within optimal period and reduce the harvest losses caused by its late harvesting. Increased risk of loss of winter crops due to less snow cover. Increased risk of physical damage to crops caused by events of extreme temperature contrast, fires, flash floods. Washing-out of nutrients from arable lands, intense soil erosion due to increased frequency of rainstorms.
Growing season for agricultural crops **Water-limited crop productivity** **Irrigation water requirement**	Present conditions for seasonal crops are suitable from the duration perspective and improper from the humidity and water supply.	There will be some changes in crop species in order to increase the productivity of some adapted species. No efficiency of irrigation system because of the water shortages. In some areas will increase the water salinity because of the soil texture and low water table. Irrigation water system will fail.
Forestry and	Forestry within the delta has enjoyed a rather	There will be changes in forest structure

forest fires	chequered history, mainly due to the use of inappropriate species to create plantations. Natural woodlands do not tend to suffer from the same problems, since they have evolved in balance with nature. Natural forests of willow, oak, ash, white poplar and aspen cover 8,000 ha of the territory. Plantation forests cover 5,400 ha, but this area is set to decline as the trees are cropped and natural forests are encouraged to regenerate for ecological reasons.	and species composition. More adapted species to climate change pressures will be present.
Energy	Some villages (e.g. Gorgova) have no electricity	Need for diversification of energy sources. Better conditions for wind and solar energy production. Increased energy consumption for air conditioning/heating. Increased risk of physical damage to energy infrastructure.
Tourism	In Romanian part of the delta tourism sector is highly developed, while Ukrainian part is still unlikely destination. 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. In the context of the regional expansion of tourism, it sheds light on how a local family adapts to new economic conditions. The local family's life revolves around tourism during the peak season, and unlike other tourist destinations, the members of the family, are the first to benefit from this business.	Even though tourism seems to be an important source of income, this type of activity is close connected to the main subsistence strategy, which is fishing. Furthermore, the tourist season only lasts for two months and so does this particularly work division and organization in the family.
Transport	In most of the areas the terrestrial transport network is improper or inexistent. On the channel system is appropriate in medium or high water table conditions. The transport links to and from the Tulcea to inner delta have been improved in the last decade.	The channel system will remain the main connection transport within DDBR. For the terrestrial transport development there is necessary immense cost. However, the system will enhance the pressure on natural areas.
Fisheries and aquaculture	Anadromous migratory fish are important to the delta fishery and three species of sturgeon and Danube herrings are netted as they move upstream from the Black Sea to spawn in freshwaters. The herring is caught between April – June and catches vary from season to season. The fluctuation may vary between 200 – 2,400 tonnes per annum. Sturgeons are declining in numbers and catches of 300 tonnes in 1960 had fallen to 6 tonnes in 1994. There is no doubt that the construction of dams; Iron Gates in 1970 and Ostrovul Mare in 1984, near Drobeta-Turnu Severin interrupted the upstream migration of sturgeons. But they are able to reproduce below these dams	Decreasing of sturgeons population because of climate changes and human pressure. The diversity and structure of the fish community varied among lakes and can be regarded as a good indicator of ecological state of lakes. The diversity of fish fauna is explained by changing in hydrology and water quality with effects on fish community distribution.

	as well, and a programme of breeding and re-introduction is being carried out to boost their numbers. These efforts need to be combined with effective controls of poaching and overfishing.	
Floods and health	Risk of spread of infectious diseases increased due to inundation of drinking water pumping station in Reni in 2005 and 2011, caused by flash floods. In the last decade there were recorded several infectious diseases with high infecting potential on humans. Most of the viruses are related with wetland conditions and certain host species.	Greater health risks connected with extreme floods (injuries, drowning, heart attacks, consumption of low-quality drinking water etc.) Increased risk of failure of dams on the small rivers may lead to big number of victims in case of severe rainstorm-caused flash floods. Increasing of pandemic frequencies and more resistance or large host's spectrum of the viruses.
Drinking water	Water supply system is inappropriate in some settlements. Most of the consumption is sustained by bottled water broth from outside of the Danube Delta.	There is already a deficit of water supply. Climate change effects will increase the pressure at regional level. The increased water consumption will generate extra costs.
Vector-borne diseases	West Nile virus and other diseases are recorded as present in Danube Delta. According to 2003/99/EC Directive zoonosis is "any disease and / or infection which is naturally transmissible directly or indirectly between animals and humans" and zoonotic agent is "any virus, bacterium, fungus, parasite or other biological entity which is likely to cause a zoonosis". A few decades ago, the reported incidences of human diseases associated with fish pathogens were rare and limited to certain countries, mainly due to their habits and lifestyle and thus little attention was paid to fish pathogens.	Increasing frequency and resistance of the viruses to the wetland conditions.

5. Existing and expected pressures on habitats

5.1. Identification and evaluation of stakeholder dialogue

Relatively low income of local population and living standards (especially in rural areas), high level of latent unemployment and lack of opportunities for employment on the local level make the region crucially vulnerable to climate change and its possible social and economic consequences. At the same, time poor living conditions and significant dependence on natural resources and own labour can characterize local people as more flexible to changing conditions. Most skills of local residents (especially in rural areas) are closely linked to various types of use of natural resources. This can become crucial in the context of adaptation to the climate change in case of severe alterations of availability of these resources. The region is characterized with relatively medium level of education (22,6 % no education or primary education; 51,5% of people have full secondary education and 25,9% – high education).

As vulnerable groups in DDBR it is considered anthropogenic activities: Fish-farms (45.232 ha, 7, 65 %) of which 12.500 ha (2, 11 %) are abandoned, Agricultural (52.945 ha, 8, 95 %) of which 16.065 ha (2, 72 %) are abandoned (arable land, pastures, vineyards and orchards) and forest arrangements 22.520 ha (plantations and natural) (table 9).

1 Table 9. Vulnerability of major groups

Exposure unit	Threat (adverse effect)	Location scale	Notes
Local population			
Farmers	Water scarcity results in reduced crop yields and less employment opportunities	All settlements of the Danube Delta region	Lack of precipitation during vegetation period
	Damage of crops due to cold spells		Physical damage to crops caused by extreme weather events and natural disasters
	Damage of crops due to flash floods		
	Damage of crops due to fires		
	Low productivity because of pests and invasive species		More chemical substances (pesticides, insecticides etc.) are necessary in order to sustain the production.
Fishermen	More frequent droughts events lead to more fish mortality	Danube	Drop in the water level in the Danube, sometimes causing a delayed spawning
	Increasing temperature leads to less fish breeding places	Danube lakes	Reducing the depth of the lakes due to increased evaporation, lack of oxygen
	Increasing water temperature leads to more frequent fish kills	Danube River, Danube Lakes, small inner water bodies	Lack of dissolved oxygen
	Fish mortality in hibernation pits	Advanced Danube Delta and its small water bodies	Salinization of water due to sea level rise and sea water intrusion
	Low water table	The hydrological system of DDBR	Changes of vegetation structure and species composition. Limited fish resource and high pressure on spawning areas.
Local residents	Extreme heat waves lead to mortality and diseases	All settlements of the Danube Delta region	Possible of the growth of cardio-vascular and respiratory diseases because of more days with extreme temperatures
	Increased costs for household maintenance		Increased costs for air conditioning, heating, increased water consumption due to temperature changes
	Injuries, deaths		Harm caused by extreme weather events and natural disasters
	Further decrease of living standards		Decreased local availability of natural resources. Low

			diversification of main economic sectors.
	Diseases, deaths	Riverside settlements	Harm caused by consuming of water contaminated during toxic algae bloom
	Dykes failure	All settlements and economic areas of the Danube Delta region	Physical damage to crops caused by extreme floods events
Owners of buildings in potentially flooded area	Damage to/ destruction of buildings, infrastructure	Banks of all water bodies; areas under risk of flash floods	
Authorities, management bodies and businesses			
Management bodies	Damage of infrastructure	Whole Danube Delta Region	Damage caused by extreme weather events together with the increased resources and energy consumption.
Reed harvesting businesses	Decrease of reed yields due to sea water level rise and intrusion of sea water	Area of Sf.Georghe and Sulina	Increased salinization may lead to lower productivity of reed-beds and lower commercial value of harvested reed
DDBR management	Unsuitable management plans in accordance with climate changes effects	Entire area of the Danube Delta	Low efficiency of applied measures will conduct to the more economic loses.
Navigation	Low water table	All navigable branches and channels of Danube Delta	Reduce traffic of large ships will result a negative impact on the economy.
Forestry managers	Low wood production due to water shortages	All forested areas of Danube Delta	Additional pressure on natural forested areas.
	Increasing of invasive species	All forested areas of Danube Delta	Additional pressure on forested areas and pastures.
Tourist operators	Additional dependable and facilities in order to maintain visitors	All settlements of the Danube Delta region	Extra costs for tourism development and expensive services.

The Danube Delta Biosphere Reserve Administration, Romanian National Forests Administration, Romanian Waters Administration (Apele Române), Fishing and Hunting Administration, Tulcea County Council and local communities are land users/stakeholders of this area. Also private landowners who restrict access on their land are stakeholders.

The stakeholders express difficulties due to climate change, but there is no real awareness or considerations of the future. The Romanian Waters Administration (Apele Române) sees difficulties due to droughts. The channels are inaccessible because of sedimentation or low water levels. There are concerns by the reserve administration due to the decrease of reed beds. According to the new measurements a

slightly decrease of average biomass with 0.25% is registered, especially in the eastern fluvial part of the wetland. Management practices such as burning and cutting can be favourable for reed development in short periods, two or three years. As for the reed on compact floating islet the buoyancy is increasing due to reed dominance and rhizome volume in opposition to other species. For sustainability, economic and biodiversity purpose, it appears that is better to apply the system of crop rotation used on agricultural fields (Covaliov *et al.,* 2010). In forest areas dying trees are reported (especially alder and oak trees). Changes in groundwater levels, especially in spring have negative effects on humid to dry vegetation. The spreading of alien species causes difficulties, too. In fishery and hunting the decrease of species for hunting and fishing is a problem, but the possible reasons for the decline aren't known yet. The communes are concerned about ineffective agriculture and the spread of diseases and pest on crops.

Statistically the main problem for biodiversity in the Danube Delta is the loss of habitats triggered by the spreading of invasive species, forest clearing, dredging, over-grazing, and ditching of marshes for mosquito control (isolate areas), mowing and erosion control activities. In present conditions, natural disturbances, such as fires, floods, bank-slides and tree falls also have impact on the protected habitats. In general, it is unknown if climate change effects or anthropogenic pressures are necessary to reduce by actions in order to protect the habitats. Additionally there are concerns about flood management under the pressure of climate change. The changing weather conditions may provoke hydrological alterations within the waters that affect its ecological and chemical status negatively.

On the one hand droughts lead to a decrease in water flow, a disconnection of wetlands and floodplains, changes in sediment transport, an increase in local pollution and insufficient groundwater recharge. The drought could also lead to difficulties in water supply for various sectors. On the other hand flood events increase the mobilization of pollutants, affect the basic physical and chemical conditions and amplify land erosion with negative effects on aquatic organisms. Salt water intrusion in coastal areas may occur because of sea level rise and/or the lowering of river levels.

The endangered species are subject to protection by special enforcement rules, zones with special restrictions for fishery (saving zones), and strictly protected areas. Fishermen welcomed some protection measures (e.g. the increase in mesh size), but they did not agree with the establishment of some protected areas in the productive fishing zones. The fishermen often disobeyed the latter measure.

One of the main conflicts is the competition between fishermen and fish-eating birds, especially cormorants. They are saying that approximate 30.000 cormorants catch 7 000 tons of fish per year, thereby exceeding fishermen's catches.

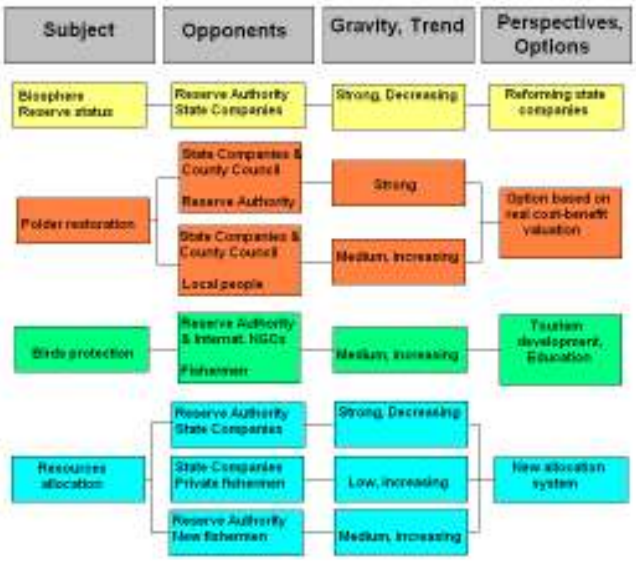


Fig. 15 Conflicts and perspectives (Staraș, 2001)

The actions promoted by DDBRA to protect some endangered species (e.g. sturgeons) are not welcomed by local communities, as long as the protection regime does not cover the whole migration route upstream of the Delta. There is a general awareness that the actions to reduce the local pollution and to participate in regional programmes are pleading for the conservation of biodiversity and for the local economy. There is only insignificant opposition to limiting the use of chemical substances in the Delta's agriculture. The main pollution sources are located upstream of the Delta. So the conflicts between economic development and environmental protection need to be solved at the national and international level.

Table 10 Stakeholders and groups of interest in DDBR

Type of stakeholders or interest groups	Name of the stakeholder
Administration (stakeholders)	Danube Delta Biosphere Reserve Administration, Romanian National Forests Administration, Romanian Waters Administration, Fishing and Hunting Administration, Tulcea County Council, Local Councils from DDBR (C.A.Rosetii, Chilia, Crişan Maliuc, Sf. Gheorghe and Sulina) ANAR (flooding defence dikes), ANIF (suction basins, irrigation systems, hydro-technical constructions, channel II și channel V), APDM (maritime ports of the Danube), AFDJ (hydro-technical construction on Sulina channel), AZL (Sulina Free Zone Administration)
Nature conservation – NGOs (groups of interest)	There are several of national, regional and local NGOs as group of interest for nature protection but they are not involved in the management and decision process. WWF-Romania, SOR, ECOS, Salvați Dunărea și Delta, Mare Nostrum.
Economic interest group (cession contract with DDBRA)	Private companies for resources exploitation Tourism agencies and private tourism facilities
Users (interest groups)	Different private land owners that restrict the access on

	their propriety

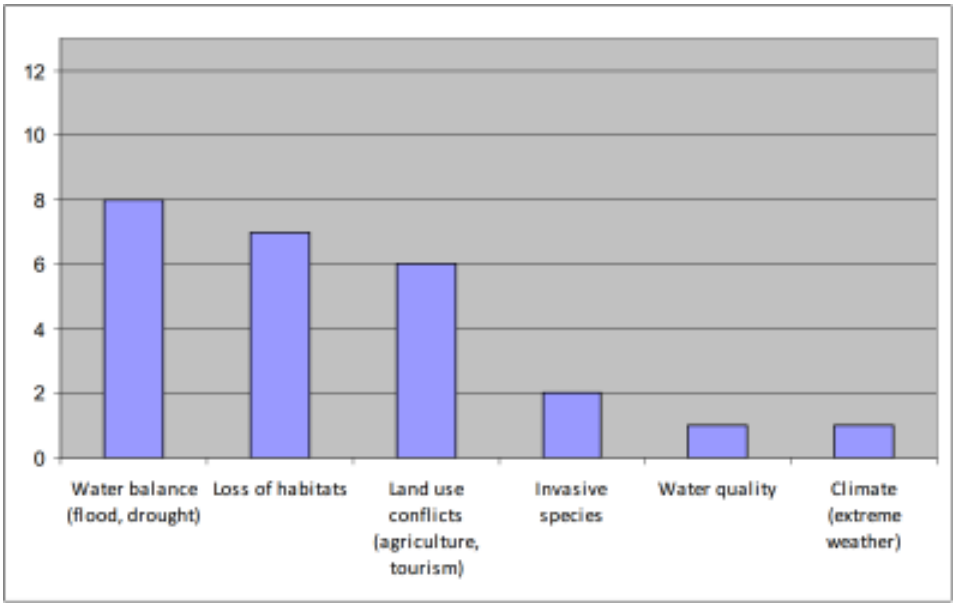


Fig.16 Problems of nature conservation reported from DDBR

Table 11 Identified problems within DDBR according to the main stakeholders

Problems
Problems related to nature protection (ecological): - Degradation of the grasslands areas (overgrazing and damages due to tourism) - Soil erosion and degradation - Noise - Visitors' behaviour: Lighting fire in forbidden areas, throwing garbage, use of ATVs (all terrain vehicles) and SUV (sport-utility vehicles), illegal logging, poaching, park regulations are not respected - Massive garbage problem: visitors throw garbage everywhere, also lack of garbage collection - Lack of environmental awareness of visitors - Construction: tendency to extend the ski area, uncontrolled constructions in the parks' surroundings Managers have to foreseen some activity adaptations due to climate change adopt action plans and present them to land users in the area.
Problems related to social/economic interests/factors: - Little involvement of local communities in the management of the area - Lack of camping grounds - Chaotic economic exploitation of the area - Heavy rainfalls cause damage of access roads of the park - Political will and commitment depends on economical situation - Local inhabitants are a weak stakeholder group (not interested in participation) - Private interest is often put prior to public interest
Impacts of climate change
Romanian Waters Administration: - Droughts - Inaccessible channels due to sedimentation or low water level because of too little rain

Danube Delta Biosphere Reserve Administration: - Reed bed die-back *Romanian National Forests Administration:* - Forest drying, especially alder and oak trees - Changes of type of vegetation from humid to dry because of less available groundwater in spring periods - Increase of existent invasive species or appearance of new invasive species *Fishing and Hunting Administration:* - Less species for hunting and fishing *Local councils:* - Ineffective agriculture and more diseases or pests on crops (cereals) - Extreme rainfall rates and temporary lack of rain cause either surface runoff or drought - Climate change might cause expansion of invasive species - Occurrence of stronger winds, increased winter and summer temperatures and droughts makes wetlands more sensitive and vulnerable, their area will decrease
Awareness
Low awareness, no planned adaptation to climate change.
Low awareness, there is little knowledge and no regular conversation about climate change. Adaptation is not planned; stakeholders just react to present problems. Positive process: water management authority started to approach inundations of fields by retaining water on the grasslands instead of draining fields (benefits wetlands and microclimate). So far no actions involving climate-change scenarios have been taken. Climate-change scenarios can be the crucial aspects of management plans. However, with no statements and analysis done in this matter, none of the impacts and factors can be analysed so far. As there is no general strategy, most of the conflicts are trying to be solved locally and individually. Some awareness of owners, very low awareness of tourists, lack of knowledge and information, no adaptation to climate change yet. Owners have started to take action such as sowing of ski lawns, torrents control, controlled cutting down of trees, making ecological paths in tourist areas, teaching tourists how important environmental protection is.

Table 12 Stakeholder dialogue and communication

Communication structures
Legal dispute: between DDBR Administration and town halls of the settlements from the Danube Delta concerning land use and settlements expanding in natural areas (habitat fragmentation); Between County Council, DDBR Administration and private land owners concerning land use and access
Conflicts (communication)
Romanian National Forests Administration (ROMSILVA) and the inhabitants: poaching and habitat fragmentation (illegal deforestation); DDBR Administration and inhabitants: poaching (fishing and hunting in protected areas) and illegal reed burning in large areas that affects the biodiversity; Property rights in Romania are very strong and the state institutions don't have the authority to interfere in land owners activities **Forestry:** forest calamities (bark beetles on spruce) are accepted in core area of the biosphere reserve, which pressures neighbouring spruce sites Conflicts between forestry and tourism concerning use of forest roads Regeneration of forests with native tree species is difficult due to raised deer population Natural forest rejuvenation with deciduous trees and rare species is threatened by excessive game population that causes damages (stakeholders: hunters, tourists with interests in animal observation), natural rejuvenation makes effective hunting more difficult due to rich forest structure (hunting is limited by topical hunting laws) **Forestry-nature conservation:** Use of tree species that are considered highly productive and adapted to climate

change (neophytes) may conflict nature conservation goals. - Citizens' initiative/local administrations/tourists: tourist use of landscape (walking and hiking trails, rehabilitation of wetlands) - Conflicts concerning tree preservation byelaws between landowners and local nature conservation authority - Farmers/landowners: permissions under building and nature conservation law (building in the landscape, installation of biomass systems, tree protection byelaws) - Fishery and anglers organisation: use of lakes, river systems - Forestry: forest transformation without forestry use, afforestation in sensitive ecosystems
Adaptation of communication strategies under climate change
Climate change is not yet a topic of communication. Starting a dialogue is quite a challenge, because a minimum agreement about economic interests and nature protection objectives is needed in order to achieve something. Regarding the protected areas, the inhabitants are mostly poor or land owners are politically sustained, the state institutions are struggling to maintain, monitor and control the biodiversity and climate change effects in protected areas that are privately owned. Stakeholders show some awareness but little knowledge about climate change and its impacts. The communication structures seem to be weak. Project on measures and strategies to cope with climate change since 2007, activities: Several studies were carried out for regional appraisal of climate change and the development of climate protection and adaptation strategies in the Danube Delta Biosphere Reserve information events with presentation of the study (target group: local stakeholders) Environmental education: information events about climate change, promotion of renewable energy, renewable biomass for municipalities, citizens, local stakeholders and pupils, demonstration of sustainable cropping methods in cooperation with the agronomic research institutes (demonstration of field tests, lectures, guided tours, target group: local farmers) **Round tables:** (target group: local entrepreneurs, politicians, municipality representatives); support of best practice projects (bio energy, renewable energy); Organization of workshops on agriculture and mobility, climate tour, exchange of information and experience, target group: local stakeholders. The purpose is to raise the public awareness. We are searching for new ways for stakeholder dialogues, to involve them and to initiate projects. There is need to expand communication because of low awareness. Stakeholders are involved in the planning process for protected areas (Natura 2000 sites) (working-groups, information events), adaption is not the main topic. Conflicting stakeholders are members of Nature park management board; the majority of members come from agriculture: farmers and land users may have strong influence on Nature Park Law and management plan.

5.2. Description of expected land-use changes and resulting pressures on habitats

Land cover as indicator presents further information about different levels of occupation from the survey units' point of view. However, it can suggest a reduced amount of information about the dynamic process that establishes the decline/degradation of the habitats from the area. The coverage represents the projection of the above ground of the vegetation, water surface, bare areas and settlements on the analyzed surface.

From the analysis perspective the land cover as indicator presents further information about different levels of occupation from the survey units' point of view. However, it can suggest a reduced amount of information about the dynamic process that establishes the decline/degradation of the habitats from the area.

The coverage represents the projection of the above ground of the vegetation, water surface, bare areas and settlements on the analyzed surface. From side to side, its values can quantify the degree of human land use (HLU) and natural land coverage (NLC). Therefore, these areas can be core spots that can highlight

the changes at the local level. The HLU (17, 07%) and NLC (82, 93%) data, obtained from the layer trans-boundary vegetation map, were extracted for each DDBR district using ARCview 3.1. software. We characterized the districts by the relative amounts of natural and human-altered land, which included all land uses, but because we were focusing on changes (manmade or natural), the sites were characterized by low to high land use/cover. The land cover from DDBR was classified in 11 survey units. Each district was separated in human land use and natural land cover as follows: Somova-Parcheş – HLU (23,71%), NLC (76,29%); Şontea-Fortuna – HLU (32,99%), NLC (67,01%); Pardina Polder – HLU (87,18%), NLC (12,82%); Matiţa-Merhei – HLU (0,08%), NLC (99,92%); Gorgova-Uzlina – HLU (24,87%), NLC (75,13%); Razim-Sinoe – HLU (2,91%), NLC (97,09%); Dunăvăţ-Dranov – HLU (0,22%), NLC (99,78%); Grindul Letea– HLU (4,32%), NLC (95,68%); Grindul Caraorman – HLU (4,17%), NLC (95,83%); Roşu-Puiu – HLU (2,81%), NLC (97,19%); Sea side area– HLU (4,51%), NLC (95,49%).

Fig. 17 Danube Delta Biosphere Reserve Districts

As a general image from HLU point of view, the most vulnerable habitats are Pardina Polder, Şontea-Fortuna and Gorgova-Uzlina. The general vulnerability map shown in the figure 4 reveals amounted information about the weakness of the natural and manmade habitats to flooding events, invasive species and biological indicators. The importance of this map is linked to the analyses of the land cover/use that was specified. This map combined with the information related to the land cover/use extracted from DDBR vegetation map will provide complex information focused to the influence of human impact and the level of weakness of the habitats to the natural extreme events. Referring to extreme floods events, even though Somova-Parcheş has a high HLU coverage percentage, this district it has a controlled hydrological regime and therefore is not vulnerable to floods. Flooding average vulnerability on manmade habitats (fig.

1) is higher in and around the settlements, in arable lands and plantations in districts such as: Pardina Polder; Roşu-Puiu (east part), Şontea-Fortuna (west part), Gorgova-Uzlina (east and south part) and Grindul Letea (south part). As for average flooding vulnerability in natural habitats we can say is lower in central part of DDBR, and higher in north at Tatanir and Tătaru area; in south at Grindul Lupilor and Grindul Istria; in east at Canalul Sondei area. Vulnerability to drought is considered to be higher in districts with agriculture areas and settlements (if we take in account the households) such as: Pardina Polder, Somova-Parcheş and east parts of Şontea–Fortuna and Gorgova-Uzlina. Concerning the spreading of invasive plants, we highlight the most exposed areas in and around the settlements, arable lands and plantations. In the same category we can include also branches and channels, which are frequently dredged.

Table 13 Land use/cover units in DDBR

Survey units		DDBR district									
	Somova-Parcheş	Şontea -Fortuna	Pardina Polder	Matiţa -Merhei	Gorgova - Uzlina	Razim Sinoe	Dunăvăţ - Dranov	Grindul Letea	Grindul Caraorman	Roşu - Puiu	Sea side area
Human land use					%						
Settlements	18,94	1,97	0,56	-	1,02	-	-	4,17	2,97	0,21	-
Fish ponds	-	1,20	1,56	0,01	8,25	2,91	0,22	-	0,24	2,09	-
Agriculture areas	-	20,35	83,52	-	6,84	-	-	0,15	-	0,51	-
Planted flood plain forest	4,77	9,47	1,54	0,07	8,76	-	-	-	0,96		4,51
Natural land cover					%						
Natural flood plain forest	4,42	15,78	2,63	1,02	5,61	-	0,31	-	0,78	0,04	-
Natural dune forest	-	-	-	-	-	-	-	9,32	5,62	-	-
Marshy vegetation	54,79	33,88	5,04	76,42	41,73	2,31	74,05	55,43	51,06	22,47	8,5
Lakes	15,58	13,20	0,93	21	20,28	94,66	21,73	3,15	0,07	73,93	1,39
Sea dunes	-	-	-	-	-	-	0,92	15,51	6,57	0,16	85,6
Steppe/dry areas	-	-	-	-	-	0,12	0,14	11,54	31,57	0,24	-
Grasslands	1,5	4,15	4,22	1,48	7,51	-	2,63	0,73	0,16	0,35	-

The Danube Delta land-use structure is the following: 58.2 % of the area is in a natural state (river and marine levees with forests and pastures, canals, lakes, swamps - part of them protected) and 41.8 % agricultural polders, fish ponds, forest plantations. Noteworthy, the Danube Delta is to undergo some ecological management. 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. A second major occupation has been (and still is) sheep, cattle and, after 1990, horse breeding. Traditional agriculture has been practiced successfully by the inhabitants of the settlements situated on the riverine levees at low risk from flooding. After 1960, these traditional occupations were drastically modified

by the extension of reed exploitation (later abandoned, presently small areas are exploited), fish ponds (abandoned after 1990), large agricultural polders (also partly abandoned) and forest plantations (still active).

The fisheries were the most important natural resource of DDBR and comprise all the areas covered with water temporarily or permanently.

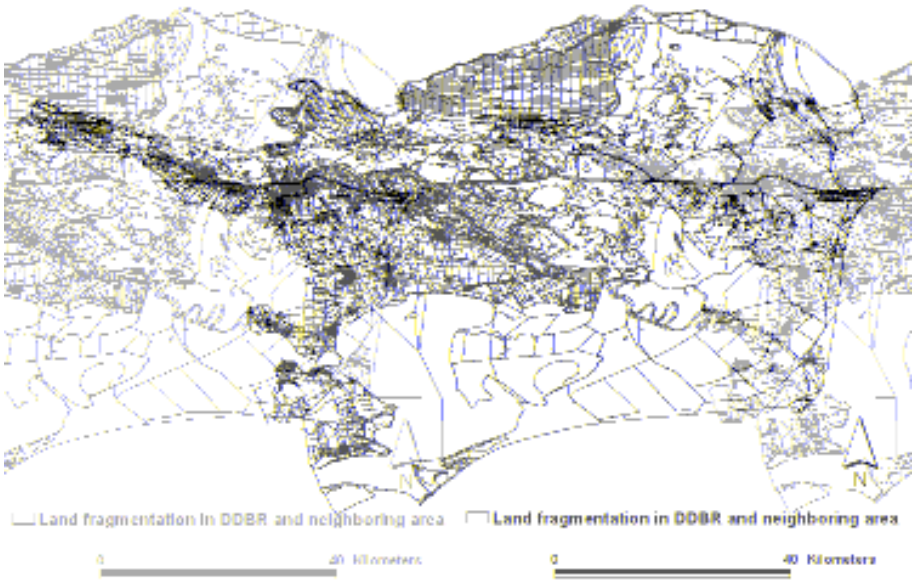


Fig.18 Land fragmentation in CAMP area

The construction of polders in the late 1950s and 60s, to create farm and forest areas, reduced the area of the „Danube meadow" available in the flood season for spawning by carp and other commercially valuable species. Presently, most of the areas are abandoned, because of economic fish stock regress, and developing of exotic fish species less valuable. Catches of fish have declined from around, 15,000 tonnes (10 – 20,000) in the 1960s, to 5 – 6,000 tonnes by 1994. Presently there is no clear evidence in fish catches in Danube Delta. The official reports of the Danube Delta Biosphere Reserve Administration and National Agency for Fishing and Aquaculture (NAFA) mention in 2011 - 2100 tonnes and in 2012 - 1800 tonnes. It can be assumed, according to the general tendencies, the fish catch is still decreasing for a several reasons:

- due to no input of fish offspring in natural system from fish farms;
- the fish exploitation is increased;
- the poaching with illegal methods increased (electric, carbide);
- the authorities (DDBRA and NAFA) are not receiving, intentionally, the clear status of the catches from the private companies.

The inhabitants that are still using the traditional fishing methods are complaining about reduced catches too from qualitative (small individuals, less species, less valuable) and quantitative point of view. Traditional fishing includes the netting and trapping of freshwater fish, netting of migratory fish (like

sturgeons – prohibited, legally, until 2016 by CITES, **Danube herring** and **Black Sea salmon**) and netting or line fishing of fish in the Black Sea. The fisherman from the Black Sea area (Sulina and Sf. Gheorghe localities), additionally, reported in the last years more and more dolphins (mainly *Tursiops truncatus*) caught in the nets. The main issue is the fish resource, either the dolphins get closer to the shore for feeding areas either the fisherman goes further (up to 30-40 km) in the sea. As we may see from the description of the fishing tools and techniques, it is obvious that there is a strong relationship between the fishermen and the nature. First of all they had to know the nature very well so that they can dominate it and use its resources for their life necessities. Also the fishermen of the village have always been aware of the sustainable use of the natural resources. The fishermen had to acquire knowledge not only about the fishing tools that they used but also of the fish species and of the environment where fish species live or migrate. And as we have seen they have to know where they can find the fishes and they have also to know how they can fish them combining environment knowledge with the practical fishing techniques.

Agricultural activities are the split responsibility of the County of Tulcea, town councils and the Central Board of Agriculture, while the ARBDD monitors effects of farming activities on ecosystems. This is not an efficient administrative system and much land has been abandoned by former tenants of the County. Agricultural arrangements started in 1895 and ended in 1898. In 1964 there were 661 lakes of over 1 ha, summing up 31.493 ha (9.49 % of the delta area), in the present there are 479 lakes and 25.794 ha, that is 8, 06 % of the delta area because of drainage and desiccation activities for creation of agriculture lands. Presently, most of the areas are abandoned because of lack of man power, soil salinization, reduction of organic carbon and the input (chemical substances, combustible, fertilizers) larger then output (production). The active agriculture areas are ineffective, because of abundance of alien and anthropogenic species such as *Amaranthus sp., Xanthium sp.* etc.

The natural meadows within the delta cover some 22,500 ha and most of these are „common" grazing, on which local people can graze their animals under licence. Overgrazing has been a problem and general spread of weeds has resulted. Grazing meadows vary according to soil conditions, with alluvial material providing the best land, salt flats and dune grasslands being the least productive.
Grazing is important, however, because it helps to limit the spread of scrub over ecologically interesting grasslands. Statistics on the number of domestic animals kept in the delta are interesting, but rather academic – given the general decline in farming activities within the territory. The number of cattle reached 8,000 head some years ago, of which fewer than 30 % were used for milk production. Local breeds of beef cattle have been bred to provide adaptability to the difficult conditions found within the main delta. Around 60,500 sheep are kept, mainly for milk production. Most are concentrated on the continental sandbanks of Chilia and Stipoc, where of loess type soils tend to be well drained. Other areas were the domestic animals are grazing, are within **strictly protected areas** of Letea forest and sand dunes (91F0, 92D0 habitat types), Sacalin Island (1210, 1310, 1410, 2110 habitat types) and Caraorman forest and sand dunes (91F0, 92D0, 2130*, 2190, 1310, 1410 habitat types). Although the activity is prohibited, it seems an overwhelming situation for the authorities (DDBRA, ROMSILVA).

The reason for this conflict is the low quality and reduces areas of meadows in comparison with real number of domestic animals. In these conditions, the new measures for climate change adaptation can be difficult to apply these areas designed only for biodiversity protection.

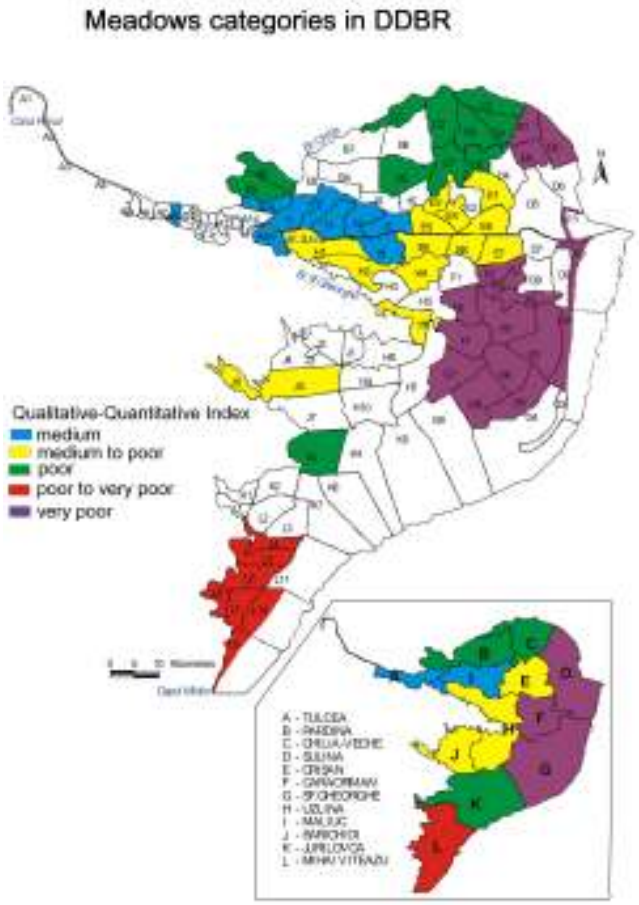


Fig. 19.Meadows categories in DDBR

Reeds (*Phragmites australis*) are ecologically and economically very important in the delta. Seasonally (winter and early spring) can provide a source of income for the inhabitants. Reeds are still cut on a commercial basis and there is now a strong export trade. Locally, they are used for roof making, fencing, matting and wall lining. Reeds were cut for the manufacture of cellulose in the 1960s, but as explained earlier in this synopsis, the machinery used to harvest the reeds damaged or destroyed some of the reed beds (Gâștescu & Știucă, 2008). Presently there is no private local association of reed harvesters; the inhabitants are employed and very poor compensated by outside the DDBR private companies. Ecologically, they provide a vital habitat for invertebrates, amphibian, fish, birds and mammals whilst acting as natural water filters.

The average biomass of Danube Delta reed beds at the beginning of the ’90 (Chifu *et al.*, 1993) was 1.53 Kg/m^2, nowadays following the results of each reed complex area, the average biomass is 1.25 Kg/m^2. New measurements show that it is a slight decline of the reed bed areas of an average of 0.25 % with a particularly high rate in the eastern fluvial part of the delta. An increase in reed area of 0.4 % was observed

only in reed complexes with psamosoils and salinised organic soils, during the 2002-2010 periods. Such an average rate, even though it leads to a 50 % disappearance of the reed bed in a 250 year period (Covaliov *et al.*, 2010). Most major changes observed were related to deep water lakes and floating reed beds. At the edge of the lakes we observed decline but no re-colonization within the study period. Most edges of reed beds around those large lakes are sharp erosion edges rather than colonization margins. We observed that the thickest reed beds with the highest reed dominance and rhizome volumes had been burnt rather recently (burned stumps). Fire seems to favor reed at the expense of other species and particularly willows (*Salix cinerea*) and ferns, both species causing decrease in buoyancy (Nevel *et al.*, 1997). On the short time scale, fire does probably block the colonization by non reed species, favor buoyancy and strengthen floating reed beds. Reed harvesting, when it was done on ice and at a large scale, probably had similar effect. The use of fire as a management tool to block succession would probably decrease this decline. In any case, a monitoring of fires set by local inhabitants would be of prime importance (Covaliov *et al.*, 2010). Taking into consideration the exceptional conditions of the water level, field information have been corroborated with previous year's reference for closer-to-reality estimations. This fact is necessary being given that many fields suffer from flooding with negative or positive influence upon vegetal species development depending on their preference for the hydrological factor (favoring the mezohigrophyte and hydrophyte species, disfavoring the mezoxerophyte and xerophyte species) and for the nutrient amount. At the same time, flooding some field for long periods influences competitive effects between particular species such as the competition reed-bulrush or reed reed-mace (Covaliov *et al.*, 2010).

Sustainable management of reed dominated wetlands requires the conservation of the components of the ecosystem and their characteristics as far as the present climatic and geomorphic conditions are kept. Spatial and temporal fluctuations are part of the characteristics of reed stands, particularly in the temperate zone. So, in order to decide if a management practice must be implemented in a reed dominated wetland, at local scale, it must be defined if the observed characteristics are part of their seasonal and inter-annual fluctuations or are part of a trend which indicates that a degradation process is taking place (Covaliov *et al.*, 2010). The changes in the characteristics of a reed wetland may be artificially induced. Man-made disturbance is the most frequent cause of loss or expansion of common reed stands. The die-back process is responsible for loss of more than 50% of the common reed habitat in many places in north and central Europe (Ostendorp, 1989). However, it has been a common fact also that expansion of the common reed stand in many south Europe wetlands took place mostly because of man regulation, mostly temporal homogenization, of water flow and level.

It may be a general trend of changes of the spatial distribution of habitats in a territory, including expansion or reduction of the common reed beds. *Phragmites australis* is a salt tolerant species which may grow in soils where the salt concentration of the interstitial water reaches 50 psu (Hellings & Gallagher, 1992). The common reed beds become more homogeneous and plant growth may recover if exposure to brackish conditions is short (a few weeks) and flushing with freshwater proceeds later.

Economically, that is why the most appreciated eco-type of reed is on slightly salinised psamosoils or salinised organic soils, which is very compact and thin comparing with the other. Naturally, it is a more sustainable strategy to let the habitat distribution of the territory to evolve under the climatic and geomorphic forces, not directly induced by anthropogenic activities, than try to maintain a constant spatial

distribution of habitats. On the contrary, yearly burning of the same areas can be considered a non-sustainable practice on a 20 years management plan, because it contributes to green-house gas increase in the atmosphere (Brix *et al.,* 2001), and also can contribute to biodiversity reduction, in time. Another aspect of this practice management show, according to literature data, that in the spring period there were identified several bird species nesting on the ground. It appears in some cases that the burning process during the winter, when the soil is frozen can be an advantage in spring time for certain birds species that are usually nest on the ground or in shallow waters (Covaliov, 2003-2007) However, reed beds surfaces design to be harvested in every reed complex can be rotated similar to the crop rotation for common land agriculture. For example, the reed surface designed to be burnt this winter will be the harvest area for the next year, and then it should be cast off for another year in biodiversity purpose.

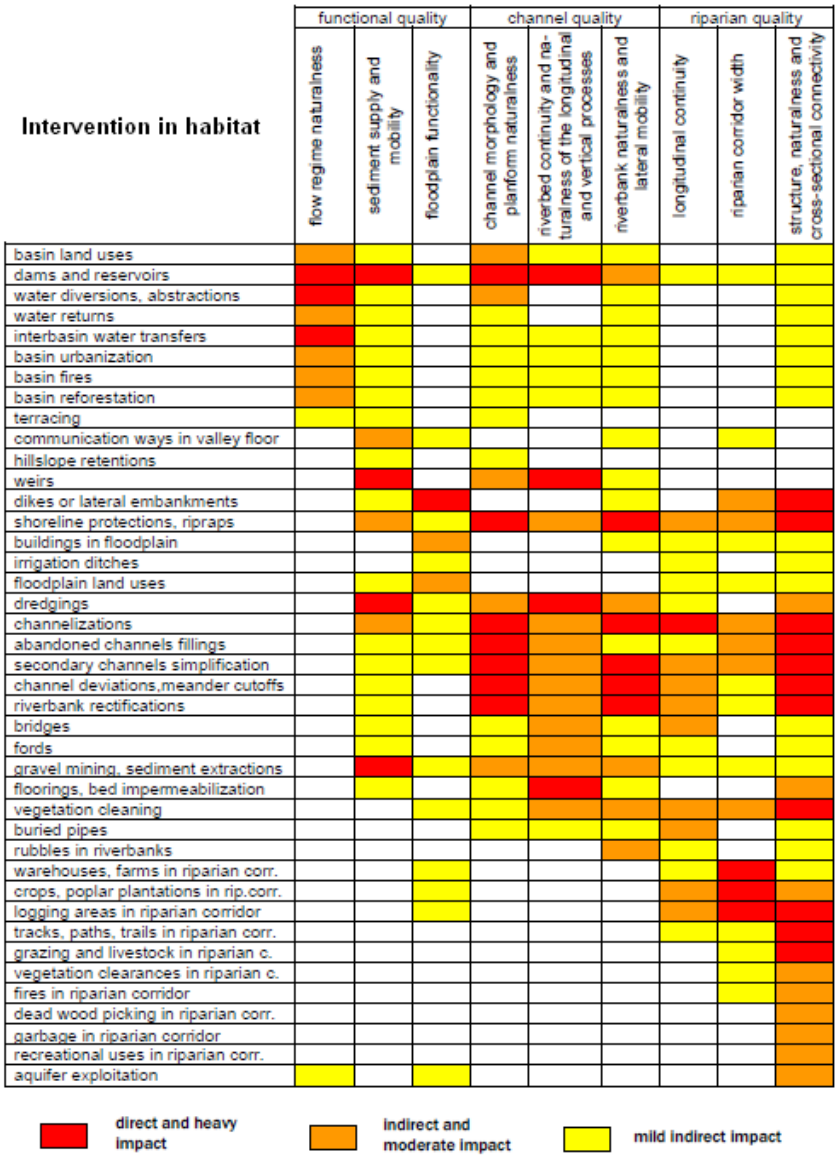


Fig. 20 The habitat state in accordance with human interventions (after Staraș, 2001)

The forest arrangements, apart from 5.075 ha (Letea and Caraorman forests) the rest of the areas are plantations or controlled. In 1975 the forest arrangements where constituted from natural forests, presently, most of the areas are economically (profit) directed. The hybrid poplar plantations, black locust (*Robinia pseudoacacia*) and green ash (*Fraxinus pennsylvanica*) plantations are the most disturbing areas for natural surroundings. The black locust and green ash are alien plant species present in entire delta. The indigo bush (*Amorpha fruticosa*), which is another alien plant species; it develops in shrub layer of polar plantation and from here its spread in natural habitats. From management perspective, this species generate economic losses. The exploitation process is longer, more difficult and expensive; in order to extract the wood (eg. *Populus canadensis*), first, it's necessary to clear/cut the unwanted shrub layer of *Amorpha fruticosa.* Forestry within the delta has enjoyed a rather chequered history, mainly due to the use of inappropriate species to create plantations. Natural woodlands (forest, bushes and glades areas) do not tend to suffer from the same problems or the process is slower, since they have evolved naturally. Natural forests of willow, oak, ash, white poplar and aspen cover 8,000 ha of the territory. Plantation forests cover 5,400 ha, but this area is set to decline as the trees are cropped and natural forests are encouraged to regenerate for ecological reasons.

5.3. Interaction of climate and non-climate induced pressures

The natural designated area Danube Delta Biosphere Reserve, also classified as Ramsar, starting from 1990, and Natura 2000 site (SCI and SPA) has been established in order to reduce the loss of biodiversity by providing and conserving habitat space for important or sensitive species. The worldwide concern has acknowledged that the effects of climate change can disturb habitat diversity by degradation, space reduction and species competition (UNFCCC, 2007), made either by invasive to native species or native to native (Westbrooks, 2001). On the other hand, the human settlements, like everywhere else, confront with economic loss that cannot be coped with. It is worldwide considered that anthropogenic activity is the main issue for on-going habitat loss, thus generating additional pressure on environment and at the same time on humans back again. Throughout Europe, in both rural and urban areas, there is a growing need to manage water, in terms of flood-risk, water supply and water quality. For example, repeated drying and flooding can be highly destructive to habitats, human settlements and their resources. At regional scale, there is a lack of knowledge with regard to policies and management practices adapted to climate change effects. At site level, not all the water-based ecosystems are translated into Natura 2000 habitat maps (Doroftei et al. 2011). Alongside a latitudinal gradient, habitats have to cope with gradually changing climatic conditions in the amount of precipitation, flooding and temperature and contrasts between seasons (Clevering, 2001). On the other hand, the pressure types of different land-use policies, which changed the Danube Delta natural hydro-morphological features, had consequences on the natural habitats (Staras, 2001). The more key habitats are involved in the evaluation process, the more accurate and objective are the results. Habitats have a much greater buffering and are able to mitigate the effects of many changes (Richardson, 2000). Therefore, to assess the impact of climate change, we have chosen to start from the indicator species to the habitats which include these species. The important issue was to select those habitats that are most vulnerable, occupy small surfaces, and are included in strictly protected areas. These types of habitats are represented by coastal formations, sand dune forest, and salt marshes.

All these habitats are theoretically belonging to at least two bio-geographical zones as follows: Steppe bioregion and Pontic bioregion (Doniță et al. 2005). The characteristic of the Steppe region lies in that there are few precipitations and the mean temperature is higher than in the other bioregions. The Pontic region has the temperature gap lower than the other bioregions. Research has been conducted in the entire area covered by the Danube Delta Biosphere Reserve (Romania). Within this protected site, the Black Sea coastline as well as the area between Chilia and Sf. Gheorghe branches has been studied so far. Special focus was on hydrological changes in terms of amount of flooding and its residence, the drought and its duration and temperature and its amplitude. In order to highlight the climate change effects on habitats we have developed thematic maps representing the vulnerability for flooding and invasive species, all of these worsened by human activities.

Table 14 List of climate and non-climate induced pressures (Doroftei and Mierlă, 2012)

Pressures	Topic	Climatic cause	
		Direct	Indirect
Antagonism arising from introduction of species	Climate/ land use		x
Antagonism with domestic animals	Management/ land use activities		x
Artificial planting	Land use		x
Canalisation	Infrastructure		x
Dispersed habitation	Land use/ land use structure	x	
Lack of precipitation/ Drought	Climate	x	
Extreme temperature events	Climate	x	
Erosion	Climate		x
Eutrophication	Management/ land use activities	x	
Flooding	Climate	x	
Grazing/ overgrazing	Management/ land use activities		x
Groundwater level (decline of)	Management/ land use activities	x	
Habitats loss	Land use/ natural development		x
Management of aquatic and bank vegetation for drainage purposes	Land use		x
Management of water levels	Management/ land use activities		x
Modification of hydrographic functioning, general	Management/ land use activities		x
Other leisure and tourism impacts not referred to above	Tourism, Sport		x
Other natural processes	Natural development	x	
Silting up	Management/ land use activities		x
Water level changes	Climate	x	

Table 15. List of identified pressures on habitats (Doroftei and Mierlă, 2012)

Habitat type	Description of the habitat	Conservation status	Antagonism arising from introduction of species	Antagonism with domestic animals	Artificial planting	Canalisation	Dispersed habitation	Lack of precipitation/Drought	Extreme temperature events	Erosion	Eutrophication	Flooding	Grazing/ overgrazing	Groundwater level (decline of)	Habitat /species loss	Management of aquatic and bank vegetation for drainage purposes	Management of water levels	Modification of hydrographic functioning, general	Other leisure and tourism impacts not referred to above	Other natural processes	Silting up	Water level changes
1110	Sand banks which are slightly covered by sea water all the time	B									x									x		
1130	Estuaries	B													x			x			x	
1140	Mudflats and sandflats not covered by seawater at low tide	B					x														x	x
1150*	Coastal lagoons	B									x				x			x			x	x
1160	Large shallow inlets and bays	B																		x	x	
1210	Annual vegetation of drift lines	B	x	x			x		x	x					x				x	x		
1310	Salicornia and other annuals colonizing mud and sand	B		x			x		x			x			x							
1410	Mediterranean	A	x	x			x		x			x	x							x		x

	salt meadows (*Juncetalia maritimi*)																				
1530*	Pannonic salt steppes and salt marshes	B	x				x					x	x	x							
2110	Embryonic shifting dunes	B	x	x			x		x										x		
2130*	Fixed coastal dunes with herbaceous vegetation ("grey dunes")	A					x		x			x	x						x	x	
2160	Dunes with Hippophaë rhamnoides	A	x										x	x							
2190	Humid dune slack	A		x										x	x					x	
3130	Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto Nanojuncetea	A				x	x							x	x	x		x		x	x
3140	Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.	B						x			x					x				x	
3150	Natural eutrophic lakes with Magnopotamion or Hydrocharition	A				x		x	x		x						x	x		x	x	x

	- type vegetation																					
3160	Natural dystrophic lakes and ponds	B				x		x			x					x						x
3260	Water courses of plain to mountain levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	B	x			x	x					x			x							
3270	Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation	B				x							x			x						x
62C0*	Ponto-Sarmatic steppes	A	x	x											x				x			
6430	Hydrophilous tall-herb fringe communities of plains and of the montane to alpine levels	B				x									x		x					x
6440	Alluvial meadows of river valleys of the *Cnidion dubii*	A	x			x			x				x									
7210*	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	B					x							x					x	x		

7230	Alkaline fens	B												x	x							x
91AA	Eastern white oak woods	A		x	x		x							x					x			
91E0*	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)	A	x				x							x	x			x				
91F0	Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)	A	x	x	x			x	x					x	x				x			x
92A0	Salix alba and Populus alba galleries	A	x	x	x									x	x					x		x
92D0	Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)	B	x	x	x							x		x						x		x

6. Management objectives and monitoring

6.1. Conservation and restoration goals specific for each habitat type

1110 Sandbanks which are slightly covered by sea water all the time

Conservation value: 5 (1-5 scale); small areas in DDBR marine perimeter. Unfortunately, there are not yearly monitored. The eutrophication phenomenon probably is caused by the strong upwelling current that contain nutrients favourable for a certain type algae development in conditions of abnormal temperature at the sea water surface. The phenomenon is taking place in calm sea water periods near to mouth of Sulina channel. The colour is given by the dominant species (*Phyllophora sp.* and *Cystosteira sp.*) that bloom due to temperature and phosphorus surplus. This surplus is considered a type of pollution of the Black Sea that produce fish mass mortality. In the last period the algal blooming diminished as frequency and intensity. In 2003 there were observed only increasing of numerical abundance of some species. Also the number of the phytoplankton species with massive development decreased from 106 species in 1991-2000, to 64 species 2001-2003. If we compare these data (64 species) with the year 1960 (38 species registered) the number of phytoplankton species is still high.

Tabel 16. Conservation and restoration goals for habitat 1110

Issue to solve	Required measure	Actions to apply	Goals and objectives
Eutrophication	Decrease of using chemical substances in agriculture	Promoting ecological agriculture among local communities Prohibit in any circumstances the use of fertilizers and insecticides by showing the negative effects (e.g. fish mortality, touristic activity regress)	Projection of scenarios are relevant by matching with the predicted results; Absence of the phenomenon in the expected period. The aquatic plant species frequency and abundance was constant in the last 5 years

1130 Estuaries

Conservation value: 3 (1-5 scale); the overall modification of hydro-graphic functioning is the most threatening pressure for this type of habitat.

Tabel 17. Conservation and restoration goals for habitat 1130

Issue to solve	Required measure	Actions to apply	Goals and objectives
Habitat loss	Habitat protection	Reduce the silting up process by creating new discharge water ways for spring period deepen the present ones	The reduction of silting up process by maintaining the habitat area and species

1140 Mudflats and sand flats not covered by seawater at low tide

Conservation value: 2 (1-5 scale); this type of habitat is important for aquatic birds species from the feeding point of view. There is no presence of vascular plants; the dominant species are yellow-brown algae (diatoms) and blue-green algae. The changes of water level and the silting up process are the main threats for this habitat.

Tabel 18. Conservation and restoration goals for habitat 1140

Issue to solve	Required measure	Actions to apply	Goals and objectives
Dispersed habitation	Finding new areas for habitat development or create green corridors	Map all the artificial areas that can sustain or re-connect the habitat patches and apply the rehabilitation works	New areas or good state of 1140 habitat
Silting up	Maintain the habitats by reducing the sedimentation process	Control the silting up process by de-clogging work at the mouths of the discharging channels.	Indicator species that show stability of the habitat The spawning grounds for some fish species are still active

1150* Coastal lagoons

Conservation value: 4 (1-5 scale); Because of the impact produced by hydro-technical works, the characteristic lagoon conditions are modified (salinity, transparency and sedimentation). The salinity ("demarcation line" between fresh and salt water) can fluctuate daily due to wind conditions, which is similar to lagoon tide. The changing conditions between brackish to fresh and back again shift distribution of the species. Modification of hydro-graphic functioning enhanced the silting up process, also the temperature correlated with low water level and phosphorus create conditions for eutrophication.

Tabel 19. Conservation and restoration goals for habitat 1150*

Issue to solve	Required measure	Actions to apply	Goals and objectives
Eutrophication	Reduce the frequency of eutrophication phenomenon	Hydro-technical works at the mouths of the channels that discharge fresh water in the lagoon.	Frequency and intensity of the phenomenon is significantly reduced. The aquatic plant species frequency and abundance was constant in the last 5 years
	Prohibit chemical substances use in agriculture and	Promoting ecological agriculture among local	Projection of scenarios are relevant by matching with the

	develop scenarios by predicting negative and positive impacts	communities Prohibit in any circumstances the use of fertilizers and insecticides by showing the negative effects (e.g. fish mortality, touristic activity regress)	predicted positive results; Absence of the phenomenon in the expected period.
Habitat /species loss	Maintain the habitat integrity	Monitor the species frequency and abundance and identify the vulnerable ones Control the silting up process by de-clogging work	Data which confirm the species composition stability and distribution

1160 Large shallow inlets and bays

Conservation value: 4 (1-5 scale); this habitat is very abundant in species. Due to habitat position in Danube Delta (at the mouths of the Danube) the alluvial sedimentation is the main process.

Tabel 20. Conservation and restoration goals for habitat 1160

Issue to solve	Required measure	Actions to apply	Goals and objectives
Silting up	Maintain the habitats by reducing the sedimentation process	Control the silting up process by de-clogging work at the mouths of the discharging channels.	Indicator species that show stability of the habitat The spawning grounds for some fish species are still active

1210 Annual vegetation of drift lines

Conservation value: 4 (1-5 scale); this type of habitat is continue diminished by the erosion of sea waves. In the last decades, on the sea side area it was observed an intensified erosion process, enhanced also by the sand deficit. The intensity of the erosion process was analyzed at the interface sea-land area during the measurements made in 1980 – 2003 period. In DDBR sea side area it was determined the most aggressive regression/erosion of the littoral, 4-7 m/year in aprox. 10 - 15 km (Sud Sulina - north Sf. Gheorghe, Insula Sahalin, Zaton, north Portita - lighthouse Portita, north Grindul Chituc); Antagonism arising from introduction of species, antagonism with domestic animals and tourism impacts are the anthropogenic threats for this type of habitat.

Tabel 21. Conservation and restoration goals for habitat 1210

Issue to solve	Required measure	Actions to apply	Goals and objectives
Erosion	Reduce the	Build up in the sea at several km. staphilopods (concrete)	New monitoring data show habitat some stability in

	erosion process	barriers. Develop a monitoring plan of the habitat surfaces for the next 5 years	vegetation structure and surface
Habitat /species loss	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Antagonism arising from introduction of species,	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced

1310 Salicornia and other annuals colonizing mud and sand

Conservation value: 4 (1-5 scale); in some areas, this habitat type is frequently flooded in spring, and in relation to this phenomena the pristine conditions are changed. Certainly, salinity is changed and in this way can appear the facultative resistant plant species. Usually this habitat, ecologically and spatially it develops close to 1410 habitat. Ground water level plays an important role in its distribution. The 1310 habitat is present in small patches (1 to 5 ha) along with 1410 and 1530* in Letea area and in compact large surfaces in Grindul Lupilor. The main species *Salicornia europaea* and *Suaeda maritima* tend to disappear under the pressure of changing substrate moisture and salt content concentration. Antagonism with domestic animals is one of the main anthropogenic threats for the habitat.

Tabel 22. Conservation and restoration goals for habitat 1310

Issue to solve	Required measure	Actions to apply	Goals and objectives
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the	Species composition and surfaces limits of the habitat are preserved

	threats	habitat by key and anthropogenic species composition and abundance.	
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion

1410 Mediterranean salt meadows (*Juncetalia maritimi*)

Conservation value: 4 (1-5 scale); for this type of habitat we can mention along with dry out/accumulation of organic matter, the flooding phenomena and grazing. There is an alternation between dry and flooding periods. After the flooding (in spring) period there are accumulated on the sand soil decomposing organic matter (mostly vegetal remnants brought by floods) that intensify the nitrogen processes, favourable for the appearance of colonial (opportunist) plant species (mainly plant species from *Poaceae* family) in dry (in summer) season. Apart from this phenomenon there is an intense grazing activity due to illegal released domestic herbivores in the wilderness. In present conditions moderate grazing can be a supportive activity in order to maintain the structure of the habitat. The habitat type is crucial for *Vipera ursinii* (meadow viper) population; the pattern of *Juncus sp.* distribution seems to favour species existence. The only habitat areas in good state conditions are found in Periteașca and in north side of Sf. Gheoghe locality. Antagonism with domestic animals is the main threat identified in the habitat.

Tabel 23. Conservation and restoration goals for habitat 1410

Issue to solve	Required measure	Actions to apply	Goals and objectives
Antagonism arising from introduction of species	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced
Grazing/ overgrazing	Maintain a good state of the	Select the herbivores by the way of grazing the vegetation,	The key species and habitat structure is in good state for

	habitat by reducing the number of animals	spectrum and area that cover during one day Maintain a reduce number of herbivores in order to keep the habitat in good state for the vipers population	viper population.

1530* Pannonic salt steppes and salt marshes

Conservation value: 3 (1-5 scale); Due to its pannonic climate with extreme temperatures and summer aridity there is salts accumulation in soil favoured by intense dry out of the ground water during the summer. Also, there is an intense grazing activity due to illegal released domestic herbivores in the wilderness. Antagonism arising from introduction of species and overgrazing are the main anthropogenic threats.

Tabel 24. Conservation and restoration goals for habitat 1530*

Issue to solve	Required measure	Actions to apply	Goals and objectives
Groundwater level (decline of)	Maintain the groundwater stability Provide information for improvements in the planning, policy and management of groundwater resources.	Collect analyze the data as a baseline for assessment of the current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period
Grazing/ overgrazing	Maintain a good state of the habitat by reducing the number of animals	Select the herbivores by the way of grazing the vegetation, spectrum and area that cover during one day Maintain a reduce number of herbivores and rotate the grazed areas in order to keep the habitat in a good state.	The monitored data had shown a good state of the habitat structure and key species composition.
Antagonism arising	Control or	Enlist the anthropogenic plant	Anthropogenic plant species

from introduction of species	eradicate the anthropogenic species	species that interact with key species and elaborate control/eradication measures for each	number and abundance are reduced

2110 Embryonic shifting dunes

Conservation value: 5 (1-5 scale); touristic arrangements and grazing are the main activities that can reduce the habitat. Overgrazing is a strong pressure on vegetation structure and species composition. More opportunist plant species are present thus invading the habitat by forming patches of compact vegetation (e.g. *Cynodon dactylon*).

Tabel 25. Conservation and restoration goals for habitat 2110

Issue to solve	Required measure	Actions to apply	Goals and objectives
Other leisure and tourism impacts	Control on tourist activity	Change the visiting rules of the area for each season Prohibit the tourist facilities development in the vicinity	No presence of tourist facilities Reduced number of tourists
Antagonism arising from introduction of species	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced
Grazing/ overgrazing	Maintain a good state of the habitat by reducing the number of animals	Select the herbivores by the way of grazing the vegetation, spectrum and area that cover during one day Maintain a reduce number of herbivores in order to keep the habitat in sustainable state.	The key species and habitat structure is in good state at least for the last 5 years

2130* Fixed coastal dunes with herbaceous vegetation ("grey dunes")

Conservation value: 5 (1-5 scale); horse and mainly cattle grazing is the main activity that can modify the structure of the habitat. The habitat is present in relatively large areas in Letea and Caraorman along with the forest habitats (91F0). Grazing/ overgrazing and leisure/tourism impacts are the main anthropogenic threats.

Tabel 26. Conservation and restoration goals for habitat 2130*

Issue to solve	Required measure	Actions to apply	Goals and objectives
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species composition and abundance.	Species composition and surfaces limits of the habitat are preserved
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Grazing/ overgrazing	Maintain a good state of the habitat by reducing the number of animals	Select the herbivores by the way of grazing the vegetation, spectrum and area that cover during one day Maintain a reduce number of herbivores and rotate the grazed areas in order to keep the habitat in a good state.	The monitored data had shown a good state of the habitat structure and key species composition.

2160 Dunes with *Hippophaë rhamnoides*

Conservation value: 4 (1-5 scale); Emerald habitats well represented in Romania. Grazing/ overgrazing is the activity that should be kept in control.

Tabel 27. Conservation and restoration goals for habitat 2160

Issue to solve	Required measure	Actions to apply	Goals and objectives
Groundwater level	Maintain the groundwater	Collect analyze the data as a baseline for assessment of the	Soil moisture is stable.

(decline of)	stability Provide information for improvements in the planning, policy and management of groundwater resources.	current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period
Antagonism arising from introduction of species	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced
Grazing/ overgrazing	Maintain a good state of the habitat by reducing the number of animals	Select the herbivores by the way of grazing the vegetation, spectrum and area that cover during one day Maintain a reduce number of herbivores and rotate the grazed areas in order to keep the habitat in a good state.	The monitored data had shown a good state of the habitat structure and key species composition.

2190 Humid dune slacks

Conservation value: 5 (1-5 scale); The habitat is affected mainly by reduction of ground water level and domestic animals that should be excluded from these vulnerable habitats.

Tabel 28. Conservation and restoration goals for habitat 2190

Issue to solve	Required measure	Actions to apply	Goals and objectives
Groundwater level (decline of)	Maintain the groundwater stability Provide information for improvements in	Collect analyze the data as a baseline for assessment of the current state, Anticipate changes and forecast trends in groundwater state due to natural processes and	Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are

	the planning, policy and management of groundwater resources.	human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	the same during the monitoring period
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species composition and abundance.	Species composition and surfaces limits of the habitat are preserved
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion

3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoëto-Nanojuncetea*

Conservation value: 3 (1-5 scale); relatively common in Romania's wetlands. The management of aquatic and bank vegetation for drainage purposes is the main threat for the habitat.

Tabel 29. Conservation and restoration goals for habitat 3130

Issue to solve	Required measure	Actions to apply	Goals and objectives
Dispersed habitation	Finding new areas for habitat development or create green	Map all the artificial areas that can sustain or re-connect the habitat of standing water and apply the rehabilitation works	New areas or good state of habitat due to expansion of ecologically reconstructed

	corridors	by flooding new areas (abandoned agriculture sites)	areas
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species composition and abundance.	Species composition and surfaces limits of the habitat are preserved
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Silting up	Maintain the habitats by reducing the sedimentation process	Control the silting up process by de-clogging work at the mouths of the discharging channels.	Indicator species that show stability of the habitat The spawning grounds for some fish species are still active
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in order to provide a better water connectivity Initiate a long-term monitoring and modeling for direct needs	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low levels.
	Develop and	Pumping stations are currently	By comparing monitored

	maintain the water level control structures	in place in some areas to regulate in times of high and low water levels.	parameters between areas with and without pumping stations the data will show relevant positive results species richness.

3140 Hard oligomesotrophic waters with benthic vegetation of *Chara* spp.

Conservation value: 3 (1-5 scale); Management of aquatic and bank vegetation for drainage purposes is the main anthropogenic pressure.

Tabel 30. Conservation and restoration goals for habitat 3140

Issue to solve	Required measure	Actions to apply	Goals and objectives
Eutrophication	Reduce the frequency of eutrophication phenomenon	Hydro-technical works at the mouths of the channels that discharge fresh water.	Frequency and intensity of the phenomenon is significantly reduced. The aquatic plant species frequency and abundance was constant in the last 5 years
	Prohibit chemical substances use in agriculture	Promoting ecological agriculture among local communities Prohibit in any circumstances the use of fertilizers and insecticides by showing the negative effects (e.g. fish mortality, touristic activity regress)	Projection of scenarios are relevant by matching with the predicted results; Absence of the phenomenon in the expected period.
Silting up	Maintain the habitats by reducing the sedimentation process	Control the silting up process by de-clogging work at the mouths of the discharging channels.	Indicator species that show stability of the habitat The spawning grounds for some fish species are still active

3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation

Conservation value: 5 (1-5 scale); existence of DH2 plant species. The habitat is the most present in the large and medium lakes of DDBR. In some of the lakes the silting up process is evident therefore hydrotechnical works are needed in order to maintain a good status.

Tabel 31. Conservation and restoration goals for habitat 3150

Issue to solve	Required measure	Actions to apply	Goals and objectives
Eutrophication	Reduce the frequency of eutrophication phenomenon	Hydro-technical works at the mouths of the channels that discharge fresh water.	Frequency and intensity of the phenomenon is significantly reduced. The aquatic plant species frequency and abundance was constant in the last 5 years
	Prohibit chemical substances use in agriculture	Promoting ecological agriculture among local communities Prohibit in any circumstances the use of fertilizers and insecticides by showing the negative effects (e.g. fish mortality, touristic activity regress)	Projection of scenarios are relevant by matching with the predicted results; Absence of the phenomenon in the expected period.
Silting up	Maintain the habitats by reducing the sedimentation process	Control the silting up process by de-clogging work at the mouths of the discharging channels.	Indicator species that show stability of the habitat The spawning grounds for some fish species are still active
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in order to provide a better water connectivity	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low levels.

		Initiate a long-term monitoring and modeling for direct needs	
	Develop and maintain the water level control structures	Pumping stations are currently in place in some areas to regulate in times of high and low water levels.	By comparing monitored parameters between areas with and without pumping stations the data will show relevant positive results species richness.

3160 Natural dystrophic lakes and ponds

Conservation value: 4 (1-5 scale); this type of habitat was diminished by the desiccation activities.

Tabel 32. Conservation and restoration goals for habitat 3160

Issue to solve	Required measure	Actions to apply	Goals and objectives
Eutrophication	Reduce the frequency of eutrophication phenomenon	Hydro-technical works at the mouths of the channels that discharge fresh water.	Frequency and intensity of the phenomenon is significantly reduced. The aquatic plant species frequency and abundance was constant in the last 5 years
	Decrease of using chemical substances in agriculture	Promoting ecological agriculture among local communities Prohibit in any circumstances the use of fertilizers and insecticides by showing the negative effects (e.g. fish mortality, touristic activity regress)	Projection of scenarios are relevant by matching with the predicted results; Absence of the phenomenon in the expected period.
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low

		order to provide a better water connectivity Initiate a long-term monitoring and modeling for direct needs	levels.
	Develop and maintain the water level control structures	Pumping stations are currently in place in some areas to regulate in times of high and low water levels.	By comparing monitored parameters between areas with and without pumping stations the data will show relevant positive results species richness.

3260 Water courses of plain to mountain levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

Conservation value: 4 (1-5 scale);

Tabel 33. Conservation and restoration goals for habitat 3260

Issue to solve	Required measure	Actions to apply	Goals and objectives
Antagonism arising from introduction of species	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species composition and abundance.	Species composition and surfaces limits of the habitat are preserved
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism

		Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	activity exclusion

3270 Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation

Conservation value: 2 (1-5 scale); pioneer vegetation with alien species Antagonism with domestic animals, canalisation and grazing/ overgrazing are the main threats.

Tabel 34. Conservation and restoration goals for habitat 3270

Issue to solve	Required measure	Actions to apply	Goals and objectives
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in order to provide a better water connectivity Initiate a long-term monitoring and modeling for direct needs	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low levels.
	Develop and maintain the water level control structures	Pumping stations are currently in place in some areas to regulate in times of high and low water levels.	By comparing monitored parameters between areas with and without pumping stations the data will show relevant positive results species richness.

62C0* Ponto-Sarmatic steppes

Conservation value: 5 (1-5 scale); small areas in DDBR on Popina Island. Antagonism arising from introduction of species and antagonism with domestic animals are pressures for the habitat on the island.

Tabel 35. Conservation and restoration goals for habitat 62C0*

Issue to solve	Required measure	Actions to apply	Goals and objectives
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic	Find new areas for grazing in order to reduce the access or crossing these habitats.	Species composition and surfaces limits of the habitat are preserved

	threats	Monitor the isolation of the habitat by key and anthropogenic species composition and abundance.	
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Other leisure and tourism impacts	Control on tourist activity	Change the visiting rules of the area for each season Prohibit the tourist facilities development in the vicinity	No presence of tourist facilities Reduced number of tourists
Antagonism with domestic animals	Maintain a good state of the habitat by prohibiting the animals on the grassland	Provide some alternatives (new grazing areas, pastures) for the animal breeders Keep in control the strictly protected area for several years	The key species and habitat structure is in good state at least for the last 5 years

6430 Hydrophilous tall-herb fringe communities of plains and of the montane to alpine levels
Conservation value: 3 (1-5 scale); Canalisation and management of water levels are the threats for the habitat.

Tabel 36. Conservation and restoration goals for habitat 6430

Issue to solve	Required measure	Actions to apply	Goals and objectives
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species	Species composition and surfaces limits of the habitat are preserved

		composition and abundance.	
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in order to provide a better water connectivity Initiate a long-term monitoring and modeling for direct needs	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low levels.
	Develop and maintain the water level control structures	Pumping stations are currently in place in some areas to regulate in times of high and low water levels.	By comparing monitored parameters between areas with and without pumping stations the data will show relevant positive results species richness.

6440 Alluvial meadows of river valleys of the *Cnidion dubii*

Conservation value: 3 (1-5 scale);

Tabel 37. Conservation and restoration goals for habitat 6440

Issue to solve	Required measure	Actions to apply	Goals and objectives
Antagonism arising from introduction of species	Control or eradicate the anthropogenic	Enlist the anthropogenic plant species that interact with key species and elaborate	Anthropogenic plant species number and abundance are reduced

	species	control/eradication measures for each	

7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*

Conservation value: 4 (1-5 scale);

Tabel 38. Conservation and restoration goals for habitat 7210

Issue to solve	Required measure	Actions to apply	Goals and objectives
Other leisure and tourism impacts	Control on tourist activity	Change the visiting rules of the area for each season Prohibit the tourist facilities development in the vicinity	No presence of tourist facilities Reduced number of tourists
Groundwater level (decline of)	Maintain the groundwater stability Provide information for improvements in the planning, policy and management of groundwater resources.	Collect analyze the data as a baseline for assessment of the current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period

7230 Alkaline fens

Conservation value: 4 (1-5 scale); In some areas the habitat is strongly affected by groundwater level decline. In these new conditions the key species tend to disappear.

Tabel 39. Conservation and restoration goals for habitat 7230

Issue to solve	Required measure	Actions to apply	Goals and objectives
Groundwater level (decline of)	Maintain the groundwater stability	Collect analyze the data as a baseline for assessment of the current state,	Soil moisture is stable. Monitored parameters shown

	Provide information for improvements in the planning, policy and management of groundwater resources.	Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	good state of the habitat Structure and species composition of the habitat are the same during the monitoring period
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species composition and abundance.	Species composition and surfaces limits of the habitat are preserved
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in order to provide a better water connectivity Initiate a long-term monitoring	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low levels.

		and modeling for direct needs	
	Develop and maintain the water level control structures	Pumping stations are currently in place in some areas to regulate in times of high and low water levels.	By comparing monitored parameters between areas with and without pumping stations the data will show relevant positive results species richness.

91AA Eastern white oak woods
Conservation value: 5 (1-5 scale);

Tabel 40. Conservation and restoration goals for habitat 91AA

Issue to solve	Required measure	Actions to apply	Goals and objectives
Other leisure and tourism impacts	Control on tourist activity	Change the visiting rules of the area for each season Prohibit the tourist facilities development in the vicinity	No presence of tourist facilities Reduced number of tourists
Groundwater level (decline of)	Maintain the groundwater stability Provide information for improvements in the planning, policy and management of groundwater resources. Control of the shallow ground-water level	Collect analyze the data as a baseline for assessment of the current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period
Antagonism with domestic animals	Maintain a good state of the habitat by prohibiting the animals in the forest	Provide some alternatives (new grazing areas, pastures) for the animal breeders Keep in control the forest area for several years	The key species and habitat structure is in good state at least for the last 5 years

91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

Conservation value: 5 (1-5 scale); Modification of hydrographic functioning influence negatively the habitat evolution. *Alnus glutinosa* species tend to disappear by drying out because of the groundwater decline.

Tabel 41. Conservation and restoration goals for habitat 91E0*

Issue to solve	Required measure	Actions to apply	Goals and objectives
Antagonism arising from introduction of species	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced
Antagonism with domestic animals	Maintain a good state of the habitat by prohibiting the animals in the forest	Provide some alternatives (new grazing areas, pastures) for the animal breeders Keep in control the forest area for several years	The key species and habitat structure is in good state at least for the last 5 years
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species composition and abundance.	Species composition and surfaces limits of the habitat are preserved
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Groundwater level	Maintain the groundwater	Collect analyze the data as a baseline for assessment of the	Soil moisture is stable.

(decline of)	stability Provide information for improvements in the planning, policy and management of groundwater resources.	current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period

91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)

Conservation value: 5 (1-5 scale); drying out because of low level of ground water, presence of alien ligneous species and horse grazing.

Tabel 42. Conservation and restoration goals for habitat 91F0

Issue to solve	Required measure	Actions to apply	Goals and objectives
Groundwater level (decline of)	Maintain the groundwater stability Provide information for improvements in the planning, policy and management of groundwater resources. Control of the shallow ground-water level	Collect analyze the data as a baseline for assessment of the current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the	Species composition and surfaces limits of the habitat are preserved

	threats	habitat by key and anthropogenic species composition and abundance.	
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in order to provide a better water connectivity Initiate a long-term monitoring and modeling for direct needs	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low levels.
	Develop and maintain the water level control structures	Pumping stations are currently in place in some areas to regulate in times of high and low water levels.	By comparing monitored parameters between areas with and without pumping stations the data will show relevant positive results species richness.
Antagonism arising from introduction of species	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced
Antagonism with	Maintain a good	Provide some alternatives	The key species and habitat

domestic animals	state of the habitat by prohibiting the animals in the forest	(new grazing areas, pastures) for the animal breeders Keep in control the forest area for several years	structure is in good state at least for the last 5 years
Other leisure and tourism impacts	Control on tourist activity	Change the visiting rules of the area for each season Prohibit the tourist facilities development in the vicinity	

92A0 *Salix alba* and *Populus alba* galleries

Conservation value: 5 (1-5 scale); presence of alien species and illegal wood cutting activities. To estimate future water levels, we need to describe how water enters and leaves the interconnected set of lakes and channels. Water level projections are calculated using three key factors based on water inputs and outputs: evaporation off the lakes and evapo-transpiration from the land; precipitation onto the land and lakes and runoff from the land and channels into the lakes.

Tabel 43. Conservation and restoration goals for habitat 92A0

Issue to solve	Required measure	Actions to apply	Goals and objectives
Groundwater level (decline of)	Maintain the groundwater stability Provide information for improvements in the planning, policy and management of groundwater resources.	Collect analyze the data as a baseline for assessment of the current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period
Habitat /species loss	Maintain the habitat areas by exclusion of all anthropogenic threats	Find new areas for grazing in order to reduce the access or crossing these habitats. Monitor the isolation of the habitat by key and anthropogenic species	Species composition and surfaces limits of the habitat are preserved

		composition and abundance.	
	Habitat protection	Identify new areas were the erosion process is reduced or inexistent in order to shift/transfer the vulnerable species by re-planting Monitor the new areas for the next 5 years Prohibit animal grazing and tourism development near or in the areas that include this vulnerable habitat	Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion
	Maintenance or promotion of old trees Maintenance or promotion of rare tree and shrub species	Map all the important species and monitor the evolution	
Water level changes	Develop risk scenarios Develop tools for stakeholders for risk evaluation	Assess a series future water supply scenarios in order to develop a water regulation plan Build up or raise the dykes and channel de-clogging were the scenarios shows high risks in order to provide a better water connectivity Initiate a long-term monitoring and modeling for direct needs	The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring. Ensuring sufficient and viable stream flow at high and low levels.
	Develop and maintain the water level control structures	Pumping stations are currently in place in some areas to regulate in times of high and low water levels.	By comparing monitored parameters between areas with and without pumping stations the data will show relevant positive results species richness.
Antagonism arising from	Control or eradicate the anthropogenic	Enlist the anthropogenic plant species that interact with key	Anthropogenic plant species number and abundance are

introduction of species	species	species and elaborate control/eradication measures for each	reduced
Antagonism with domestic animals	Maintain a good state of the habitat by prohibiting the animals in the forest	Provide some alternatives (new grazing areas, pastures) for the animal breeders Keep in control the forest area for several years	The key species and habitat structure is in good state at least for the last 5 years

92D0 Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae*)

Conservation value: 4 (1-5 scale); Emerald habitats relatively common in Romania's wetlands. The specific habitats are formed by pioneer, cosmopolite and some alien ligneous species. It is noticed that wood exploited habitats are sparsely distributed and rich in alien plant species. Antagonism with domestic animals and groundwater level decline are the main threats for the habitat.

Tabel 44. Conservation and restoration goals for habitat 92D0

Issue to solve	Required measure	Actions to apply	Goals and objectives
Groundwater level (decline of)	Maintain the groundwater stability Provide information for improvements in the planning, policy and management of groundwater resources.	Collect analyze the data as a baseline for assessment of the current state, Anticipate changes and forecast trends in groundwater state due to natural processes and human impacts in time and space Flood the neighbourhood areas in order to recharge aquifer Prohibit or reduce the grazing activity in order to reduce the soil compaction	Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period
Antagonism arising from introduction of species	Control or eradicate the anthropogenic species	Enlist the anthropogenic plant species that interact with key species and elaborate control/eradication measures for each	Anthropogenic plant species number and abundance are reduced
	Repression of alien species for the	Eradicate or isolate the identified alien species	

	benefit of site or natural landscape native tree and shrub species through extracting or early underplanting (semi) shady tree species to darken the site		
Antagonism with domestic animals	Maintain a good state of the habitat by prohibiting the animals in the forest	Provide some alternatives (new grazing areas, pastures) for the animal breeders Keep in control the forest area for several years	The key species and habitat structure is in good state at least for the last 5 years

6.2. Monitoring of progress in obtaining objectives indicators for development of conservation

Monitoring is the routine tracking of program progress using data that are collected on a regular basis to show that activities are taking place as planned. Monitoring is the tracking system that program managers use to understand how well programs are running on a daily, weekly, monthly or quarterly basis, and where any bottlenecks may exist in overall implementation. Monitoring shows that the program inputs are being used effectively and whether they are leading to expected program outputs. For example, a program designed to raise awareness and reduce climate change effects in a certain area will want to keep track of (or monitor) the level of inputs such as funding, staff time, and material development as well as outputs such as how many times workers went out to speak at community meetings. Changes detected in the expected performance levels in these inputs and outputs will alert program managers to possible problems (USAID, 1996).

Tabel 45. Objectives indicators for development of conservation

Objectives and goals	Indicators (habitat code)
Antagonism with domestic animals	
The key species and habitat structure is in good state at least for the last 5 years	**Species diversity:** *Festuca valesiaca, Chrysopogon gryllus, Alyssum saxatile, Agropyron pectiniforme, Koeleria macrantha, Dichanthium ischaemum, Stipa capillata, S. ucrainica, Elymus hispidus* (62C0*); *Quercus pubescens, Carpinus orientalis, C. betulus, Fraxinus ornus, Galium dasypodum, Acer campestre*, *Tilia tomentosa* (91AA); *Fraxinus excelsior*, *Alnus glutinosa, Salix alba, S. fragilis, Populus nigra, Ulmus minor, Equisetum telmateia* (91E0*); *Quercus robur*, *Ulmus laevis*, *Ulmus minor, Fraxinus excelsior*, *Fraxinus angustifolia, Populus nigra, P.*

	canescens, Alnus glutinosa, Humulus lupulus, Vitis vinifera subsp. *sylvestris, Hedera helix* (91F0); *Salix alba*, *Populus alba, Alnus* spp., *Acer* spp., *Tamarix* spp. (92A0); *Tamarix ramosissima, Calamagrostis epigejos* (92D0); **Habitat fragmentation/patchiness; Total core area (core area analysis)**
Antagonism arising from introduction of species	
Anthropogenic plant species number and abundance are reduced	**Species diversity: key species** - *Cakile maritima*, *Salsola kali*, *Atriplex* spp., *Polygonum* spp., *Euphorbia peplis*, *Elymus repens, Glaucium flavum*, *Euphorbia paralias, Eryngium maritimum*. *Argusia sibirica.* **anthropogenic species –** *Cynodon dactylon, Amorpha fruticosa, Conyza canadensis, Cuscuta campestris, Datura stramonium, Eclipta prostrata, Elaeagnus angustifolia, Xanthium orientale, Xanthium spinosum* (1210); **key species** - *Juncus maritimus*, *J. acutus, Carex extensa*, *Aster tripolium*, *Plantago cornuti*, *Scorzonera parviflora, Taraxacum bessarabicum, Samolus valerandi H. maritimum, Orchis coriophora* subsp. *Fragrans* **anthropogenic species** - *Xanthium orientale, Xanthium spinosum* (1410); **key species** - *Artemisia santonicum*, *Aster tripolium*, *Salicornia prostrata*, *Juncus gerardii*, *Plantago maritima, Cyperus pannonicus*, *Achillea collina, Artemisia pontica, Puccinellia limosa, Scorzonera cana, Halocnemum strobilaceum, Frankenia hirsuta, Aeluropus littoralis, Limonium meyeri, L. gmelini, Carex distans, C. divisa, Taraxacum bessarabicum, Halimione verrucifera, Hordeum hystrix;* **anthropogenic species** - *Chenopodium ambrosioides, Cynodon dactylon, Amorpha fruticosa, Conyza canadensis* (1530*); **key species** - *Elymus farctus, Leymus sabulosus*, *Euphorbia peplis, Medicago marina, Eryngium maritimum;* **anthropogenic species** - *Cynodon dactylon, Amorpha fruticosa, Conyza Canadensis, Iva xanthifolia,* (2110); **key species** - *Hippophaë rhamnoides;* **anthropogenic species** - *Fraxinus pennsylvanica, Lycium barbarum, Amorpha fruticosa* (2160); **key species** - *Ranunculus aquatilis, Myriophyllum spp., Callitriche spp., Berula erecta, Zannichellia palustris, Potamogeton spp.;* **anthropogenic species** - *Lemna minuta, Paspalum paspalodes, Elodea nuttallii* (3260); **key species** - *Alopecurus pratensis*, *Agrostis stolonifera, Lythrum virgatum*; **anthropogenic species -** *Xanthium orientale* (6440); **key species** - *Fraxinus excelsior*, *Alnus glutinosa, Salix alba, S. fragilis, Populus nigra, Ulmus minor, Equisetum telmateia*; **anthropogenic species -** *Fraxinus pennsylvanica, Amorpha fruticosa* (91E0*); **key species** - *Quercus robur*, *Ulmus laevis*, *Ulmus minor, Fraxinus excelsior*, *Fraxinus angustifolia, Populus nigra, P. canescens, P. tremula, Alnus glutinosa, Humulus lupulus, Vitis vinifera* subsp. *sylvestris, Hedera helix*; **anthropogenic species -** *Fraxinus pennsylvanica, Amorpha fruticosa, Lycium barbarum, Xanthium orientale, Conyza canadensis, Cuscuta campestris* (91F0); **key species** - *Salix alba*, *Populus alba, Alnus* spp.,

	Acer spp., *Tamarix* spp.; **anthropogenic species -** *Fraxinus pennsylvanica, Amorpha fruticosa, Populus canadensis* (92A0); **key species** - *Tamarix ramosissima, Calamagrostis epigejos*; **anthropogenic species -** *Cynodon dactylon, Amorpha fruticosa, Conyza canadensis, Cuscuta campestris, Datura stramonium, Eclipta prostrata, Elaeagnus angustifolia* (92D0); **Total core area (core area analysis); Land cover diversity indices - EVI - Enhanced Vegetation Index; Arrival of termophilic/ invasive species**
Groundwater level (decline of)	
Soil moisture is stable. Monitored parameters shown good state of the habitat Structure and species composition of the habitat are the same during the monitoring period	**Soil based indicators; Presence of groundwater** **Species diversity:** *Artemisia santonicum*, *Aster tripolium*, *Salicornia prostrata*, *Juncus gerardii*, *Plantago maritima, Cyperus pannonicus*, *Achillea collina, Artemisia pontica, Puccinellia limosa, Scorzonera cana, Halocnemum strobilaceum, Frankenia hirsuta, Aeluropus littoralis, Limonium meyeri, L. gmelini, Carex distans, C. divisa, Taraxacum bessarabicum, Halimione verrucifera, Hordeum hystrix* (1530*); *Hippophaë rhamnoides* (2160); *Chara tomentosa, Hippuris vulgaris, Hottonia palustris, Potamogeton pectinatus, Juncus bufonius* (2190); *Cladium mariscus* (7210*); *Schoenus nigricans*, *Carex flava, Blysmus compressus, Phragmites australis* (stands) (7230); *Quercus pubescens, Carpinus orientalis, C. betulus, Fraxinus ornus, Galium dasypodum, Acer campestre*, *Tilia tomentosa* (91AA); *Fraxinus excelsior*, *Alnus glutinosa, Salix alba, S. fragilis, Populus nigra, Ulmus minor, Equisetum telmateia* (91E0*); *Quercus robur*, *Ulmus laevis*, *Ulmus minor, Fraxinus excelsior*, *Fraxinus angustifolia, Populus nigra, P. canescens, Alnus glutinosa, Humulus lupulus, Vitis vinifera* subsp. *sylvestris, Hedera helix* (91F0); *Salix alba*, *Populus alba, Alnus* spp., *Acer* spp., *Tamarix* spp. (91A0); *Tamarix ramosissima, Calamagrostis epigejos* (92D0).
Water level changes	
The habitats at risk will no longer suffer changes in structure and composition of species after 5 years montoring.	**Species diversity:** *Littorella uniflora*, *Juncus bulbosus, Eleocharis acicularis, Cyperus fuscus*, *C. flavescens*, *Centaurium pulchellum* (3130); *Spirodela spp., Wolffia spp., Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia australis, U. vulgaris, Aldrovanda vesiculosa, Azolla filiculiodes, Potamogeton lucens, P. perfoliatus* (3150); *Utricularia spp, Nuphar lutea, Nymphaea candida* (3160); *Chenopodium rubrum*, *Bidens tripartita*, *Xanthium* sp., *Polygonum lapathifolium* (3270); *Glechoma hederacea*, *Epilobium hirsutum*, *Aegopodium podagraria*, *Alliaria petiolata*, *Lysimachia numularia*, *Lythrum salicaria* (6430); *Schoenus nigricans*, *Carex flava, Blysmus compressus, Phragmites australis* (stands) (7230); *Quercus robur*, *Ulmus laevis*, *Ulmus minor, Fraxinus excelsior*, *Fraxinus angustifolia, Populus nigra, P. canescens, Alnus*

	glutinosa, Humulus lupulus, Vitis vinifera subsp. *sylvestris, Hedera helix* (91F0); *Salix alba*, *Populus alba, Alnus* spp., *Acer* spp., *Tamarix* spp. (92A0); **Presence of water**
Ensuring sufficient and viable stream flow at high and low levels.	Constant water connectivity or water circulation between lakes and channels in areas with high risks. Parameter: water velocity, water depth, aquatic vegetation presence.
Habitat /species loss	
Species composition and surfaces limits of the habitat are preserved	**Species diversity:** *Cakile maritima*, *Salsola kali*, *Atriplex* spp., *Polygonum* spp., *Euphorbia peplis*, *Elymus repens, Glaucium flavum*, *Euphorbia paralias, Eryngium maritimum*. *Argusia sibirica* (1210); *Salicornia* spp., *Suaeda maritima* (1310); *Bromus hordeaceus, Carex colchica, Cerastium* spp., *Galium verum, Koeleria* spp., *Silene conica, S. otites* (2130*); *Chara tomentosa, Elodea canadensis, Hippuris vulgaris, Hottonia palustris, Potamogeton pectinatus, Juncus bufonius* (2190); *Littorella uniflora*, *Juncus bulbosus, Eleocharis acicularis, Cyperus fuscus*, *C. flavescens*, *Centaurium pulchellum* (3130); *Ranunculus aquatilis, Myriophyllum spp., Callitriche spp., Berula erecta, Zannichellia palustris, Potamogeton spp.* (3260); *Festuca valesiaca, Chrysopogon gryllus, Alyssum saxatile, Agropyron pectiniforme, Koeleria macrantha, Dichanthium ischaemum, Stipa capillata, S. ucrainica, Elymus hispidus* (62C0*); *Glechoma hederacea*, *Epilobium hirsutum*, *Aegopodium podagraria*, *Alliaria petiolata*, *Lysimachia numularia*, *Lythrum salicaria* (6430); *Schoenus nigricans*, *Carex flava, Blysmus compressus, Phragmites australis* (stands) (7230); *Fraxinus excelsior*, *Alnus glutinosa, Salix alba, S. fragilis, Populus nigra, Ulmus minor, Equisetum telmateia* (91E0*); *Quercus robur*, *Ulmus laevis*, *Ulmus minor, Fraxinus excelsior*, *Fraxinus angustifolia, Populus nigra, P. canescens, P. tremula, Alnus glutinosa, Humulus lupulus, Vitis vinifera* subsp. *sylvestris, Hedera helix* (91F0); *Salix alba*, *Populus alba, Alnus* spp., *Acer* spp., *Tamarix* spp. (92A0); **Habitat fragmentation/patchiness; Total core area (core area analysis); Land cover diversity indices - EVI - Enhanced Vegetation Index; Species phenology, length of vegetation season**
Species establishment in the new areas In 5 years the monitoring plan shows that species composition and structure in the habitats is maintained after grazing and tourism activity exclusion	
The reduction of silting up process by maintaining the habitat area and species	**Key benthic species frequency and abundance** remained stable in 5 years monitoring (1130).
Data which confirm the species composition stability and distribution	**Species diversity:** *Chara canescens, Eleocharis parvula, Potamogeton pectinatus, Ruppia maritime*, *Lemna trisulca*, *Najas marina*, *Phragmites australis*, *Potamogeton* spp., *Stratiotes aloides*, *Typha* spp. (1150*); **Habitat fragmentation/patchiness**

Other leisure and tourism impacts	
No presence of tourist facilities	**Infrastructure data:** ortho-plans images, satellite images, field data.
Reduced number of tourists	**Habitat fragmentation/patchiness**
Eutrophication	
Frequency and intensity of the phenomenon is significantly reduced.	**Species diversity:** phytoplankton community's analysis by qualitative and quantitative population indices. The results will indicate: When increasing the numerical abundance is notified, lesser species have the potential to develop. Number of the phytoplankton species with massive development continues to decrease or remain stable. **Total core area (core area analysis)**
Projection of scenarios are relevant by matching with the predicted results	
Absence of the phenomenon in the expected period	
The aquatic plant species frequency and abundance was constant in the last 5 years	**Species diversity:** *Zostera* sp., *Potamogeton* spp., *Ruppia* spp., *Zannichellia* spp. (1110); *Chara canescens, Eleocharis parvula, Potamogeton pectinatus, Ruppia maritime*, *Lemna trisulca*, *Najas marina*, *Phragmites australis*, *Potamogeton* spp., *Stratiotes aloides*, *Typha* spp. (1150*); *Chara spp.* and *Nitella spp.*(3140); *Spirodela spp., Wolffia spp., Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia australis, U. vulgaris, Aldrovanda vesiculosa, Azolla filiculiodes, Potamogeton lucens, P. perfoliatus* (3150); *Utricularia spp, Nuphar lutea, Nymphaea candida* (3160); **Habitat fragmentation/patchiness**
Silting up	
Indicator species that show stability of the habitat	**Species diversity:** *Zostera marina, Zostera noltii* (1140); *Zostera* spp., *Ruppia maritima*, *Potamogeton* spp. (ex., *P. pectinatus*), *Najas marina*, benthic algae (1160); *Littorella uniflora*, *Juncus bulbosus, Eleocharis acicularis, Cyperus fuscus*, *C. flavescens*, *Centaurium pulchellum* (3130); *Chara spp.* and *Nitella spp.* (3140); *Spirodela spp., Wolffia spp., Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia australis, U. vulgaris, Aldrovanda vesiculosa, Azolla filiculiodes, Potamogeton lucens, P. perfoliatus* (3150); **Habitat fragmentation/patchiness; Presence of water**
The spawning grounds for some fish species are still active	
Dispersed habitation	
New areas or good state of habitat due to expansion of ecologically reconstructed areas	**Species diversity:** *Zostera marina, Zostera noltii* (1140); *Littorella uniflora*, *Juncus bulbosus, Eleocharis acicularis, Cyperus fuscus*, *C. flavescens*, *Centaurium pulchellum* (3130); **Habitat**

	fragmentation/patchiness
Grazing/ overgrazing	
The monitored data had shown a good state of the habitat structure and key species composition.	**Species diversity:** *Artemisia santonicum*, *Aster tripolium*, *Salicornia prostrata*, *Juncus gerardii*, *Plantago maritima, Cyperus pannonicus*, *Achillea collina, Artemisia pontica, Puccinellia limosa, Scorzonera cana, Halocnemum strobilaceum, Frankenia hirsuta, Aeluropus littoralis, Limonium meyeri, L. gmelini, Carex distans, C. divisa, Taraxacum bessarabicum, Halimione verrucifera, Hordeum hystrix* (1530*); *Bromus hordeaceus, Carex colchica, Cerastium* spp., *Galium verum, Koeleria* spp., *Silene conica, S. otites* (2130*); *Hippophaë rhamnoides* (2160); **Habitat fragmentation/patchiness; Total core area (core area analysis); Land cover diversity indices - EVI - Enhanced Vegetation Index**
The key species and habitat structure is in good state at least for the last 5 years	**Species diversity:** *Elymus farctus, Leymus sabulosus*, *Euphorbia peplis, Medicago marina, Eryngium maritimum* (2110); **Total core area (core area analysis)**
The key species and habitat structure is in good state for viper population.	**Species diversity:** *Vipera ursinii*, *Juncus maritimus*, *J. acutus, Carex extensa*, *Aster tripolium*, *Plantago cornuti*, *Scorzonera parviflora, Taraxacum bessarabicum, Samolus valerandi H. maritimum, Orchis coriophora* subsp. *fragrans* (1410)
Erosion	
New monitoring data show habitat some stability in vegetation structure and surface	**Species diversity:** *Cakile maritima*, *Salsola kali*, *Atriplex* spp., *Polygonum* spp., *Euphorbia peplis*, *Elymus repens, Glaucium flavum*, *Euphorbia paralias, Eryngium maritimum*. *Argusia sibirica* (1210); Habitat fragmentation/patchiness; **Total core area (core area analysis); Wind and water erosion/ physical degradation of land cover/denudation**

6.3. Monitoring of success of management actions indicators for evaluation of management

Evaluation is used to demonstrate how effective programs have been in achieving their targets and results. The data used for program evaluation will be drawn from a number of different sources, such as program indicators, periodic data collection from surveys, or special studies. The information from program evaluations can be used to revise program practices, to achieve better desired outcomes, as well as to report to donors. Program evaluations require funding, planning and time (USAID, 1996).

Table 46. Indicators for evaluation of management

Natura 2000 code	Type of indicators	Monitoring and evaluation activities
1110, 1140, 1150*, 1160, 1210, 1310, 1410, 1530*, 2110, 2130*, 2160, 2190, 3130, 3140, 3150, 3160, 3260. 3270, 62C0*, 6430, 6440, 7210*, 7230, 91AA, 91E0*, 91F0, 92A0, 92D0	**Species diversity**	Data collection, Direct analysis of the species population, Yearly monitoring; Data collection, Direct analysis at the level of species. Yearly monitoring of geomorphologic parameters (erosion, dunes are shifting – Musura Island) and anthropogenic pressures; Direct and indirect (satellite images and ortho-photo) monitoring. Important habitat for *Vipera ursinii*. Frequently monitored due strong influence of anthropogenic pressure. Direct and indirect (satellite images and ortho-photo) monitoring. Occasionally included in other monitoring plans for different reasons (anthropogenic pressure, fluctuation of ground water level) Indirect (satellite images and ortho-photo) monitoring. Occasionally direct monitoring when is included in other monitoring plans for different reasons (touristic activity and development). Direct monitoring of species population and data collection (aquatic plants, chemical data, and water parameters). Seasonally monitoring Indirect (satellite images and ortho-photo) monitoring. Occasionally direct monitoring when is included in other monitoring plans for different reasons
1130	**Key benthic species frequency and abundance**	Data collection, Direct analysis of the species population, Yearly monitoring
1140, 1150*, 1160, 1310, 1530*, 2130*, 2160, 2190, 3130, 3150, 3160, 3260, 62C0*, 6430, 91AA, 91E0*, 91F0, 92A0, 92D0	**Habitat fragmentation/ patchiness;**	Data collection, Direct analysis at the level of species. Yearly monitoring of geomorphologic parameters and anthropogenic pressures. Land cover analysis Remote sensing satellite imagery, aerial photographs Data collection, Direct analysis of the population, Yearly monitoring;
1140, 1160, 3130, 3140, 3150, 3270, 6430, 7230, 92A0	**Presence of water**	Land cover analysis Remote sensing satellite imagery, aerial photographs Direct and indirect (satellite images and ortho-photo) monitoring.

		Occasionally included in other monitoring plans for different reasons (anthropogenic pressure, fluctuation of ground water level)
1210, 1310, 1410, 1530*, 2110, 2130*, 2160, 2190, 3130, 3260, 62C0*, 6430, 6440, 7230, 91AA, 91E0*, 91F0, 92A0, 92D0	**Total core area (core area analysis)**	Land cover analysis Remote sensing satellite imagery, aerial photographs Direct and indirect (satellite images and ortho-photo) monitoring. Occasionally included in other monitoring plans for different reasons (anthropogenic pressure, fluctuation of ground water level) Data collection, Direct analysis of the population, Yearly monitoring;
1210	**Wind and water erosion/ physical degradation of land cover/** **denudation**	Land cover analysis Remote sensing satellite imagery, aerial photographs Direct and indirect (satellite images and ortho-photo) monitoring. Shore line comparison between several years.
1310, 1410, 1530*, 2110, 2130*, 2160, 2190, 3130, 3260, 62C0*, 6430, 6440, 7230, 91E0*, 91F0, 92D0	**Land cover diversity indices - EVI - Enhanced**	Direct and indirect (satellite images and ortho-photo) monitoring. Occasionally included in other monitoring plans for different reasons (anthropogenic pressure, fluctuation of ground water level) Direct monitoring activities in Popina Island (Razelm Lake). Occasionally included in other monitoring plans for different reasons (overgrazing). Usually the data collection is made in spring (for the insects) summer season (for the vegetation). Land cover analysis Remote sensing satellite imagery, aerial photographs;
1310, 2130*, 2190, 3130, 3260, 62C0*, 6430, 6440, 7230, 91E0*, 91F0, 92D0	**Vegetation Index;** **Species phenology, length of vegetation season**	Direct and indirect (satellite images and ortho-photo) monitoring. Yearly monitoring activities. Data collection is usually made in autumn. Direct monitoring, occasionally indirect (satellite images and ortho-photo) monitoring. Usually in summer period (for vegetation). Data collection, Direct analysis at the level of species.
1410, 1530*, 2110, 2160, 6440, 91E0*, 91F0, 92D0	**Arrival of termophilic/ invasive species**	Occasionally included in other monitoring plans for different reasons (overgrazing). Usually the data collection is made in late spring (for the insects) summer season (for the vegetation). Data collection, Direct analysis at the level of species.
1530*, 2160, 2190,	**Presence of**	Occasionally direct monitoring when is included in other monitoring

7210*, 7230, 91AA, 91E0*, 91F0, 92D0	**groundwater**	plans for different reasons Direct and indirect (satellite images and ortho-photo) monitoring. Occasionally included in other monitoring plans for different reasons (anthropogenic pressure, fluctuation of ground water level);
1530*, 2160, 2190, 7210*, 7230, 91AA, 91E0*, 91F0, 92D0	**Soil based indicators**	Occasionally direct monitoring when is included in other monitoring plans for different reasons

7. Climate Change Adapted Management

7.1. Description of adapted management strategies new and adapted strategies for CAMP area of whole investigation area

The administration and management of DDBR is a complex process, distinct from, but linked to local government structures that operate within the reserve. They comprise DDBR lands under national control, lands under local government control, and lands privately owned, distributed among seven communes and the town of Sulina. According to public local administration law (Law No. 69/1991), the local communal councils include elected bodies that make all decisions relating to land under their control, including development planning and control, public works, conservation of historical monuments, recreation facilities and protection and improvement of the environment in order to better the quality of life. The next level of government is Tulcea County, which coordinates various communal services on behalf of the communal councils, and takes responsibility for land under its own control, town planning, maintaining and improving the infrastructure (roads and water supply). Within the DDBR, the county controls fish areas, agricultural polders and forest plantations (about 860 km^2) used by companies in which the state holds a majority share.

The permanent management objectives are:

- Shaping and improving of hydrological regime;
- Enhancing the knowledge of ecosystems' functioning;
- Enhancing the knowledge of biodiversity;
- Surveillance of coastal morphologic processes;
- Sustainable use of renewable natural resources and regulation of the economic activities, especially the traditional ones;
- Reconstruction of damaged ecosystems;
- Evaluation and limitation of pollution phenomenon and natural and anthropogenic hazards;
- Development of a information system and a integrated monitoring;
- Information and environmental education of public and local population;
- Cooperation with national and international organizations;

It should be noted that there are three levels of priority:

a) Improving the institutional organization: these recommendations form the basis for improving the DDBR's status by training the local authorities' capacity to face the demands for respective area.

b) Interventions in the infrastructure: many DDBR's residents have no access to basic services, including here drinking water, wastewater, etc. The improvement of the access to these basic services is necessary for reducing poverty and to strengthen the human development.

c) Strategies for spreading the economic growth and the promotion of the social development.

The strategy is part of the management plan that deals with the problems of preparation, planning and development of the operations set to achieve the proposed goals. For example: development strategies for integrating the objectives of the biodiversity's conservation with the implementation of the policies regarding socio-economic systems (SES).

The Master Plan regards the integration of the actions for each problem identified in a global strategy that ensure the synergic realization of all the actions to achieve the proposed objectives and goals. The Master Plan's measure of success is given by the implementation degree of the proposed actions. We can, also, speak about a strategy of environment's protection.

Investment works performed during the period 1990 – 2010 as ecological reconstruction:

- Improvements for ecological rehabilitation conditions in natural aquatic complexes from Danube Delta;
- Improvements for environment rehabilitation conditions in natural areas of reproduction for indigene fish species;
- Hydro technical works for improvement of water circulation;
- De-clogging works of the main fishing channels;
- Works for clogging prevention of the channels, streams and lakes in order to maintain an optimal hydrologic regime;
- Ecological reconstruction of abandoned agricultural and fishery polders.

General objectives are the extension of aquatic habitats for fish and birds by wetlands rehabilitation and developing new strategies of ecological agriculture and sustainable grazing;

Subsidiary objectives: Protection of species population and habitats; Reintegration of former agricultural and fish polders in the natural hydrological cycle; Specific function restoration of the wetlands; Rehabilitation of hydrological and ecological equilibrium; Achievement of new habitats for fish and birds; Restoration of traditional economic activities; Tourism development in accordance with E.U. environmental legislation.

Actions:

1. Rehabilitation of channels network in order to improve the water circulation

Aims: Reactivation of water circulation in the channels network; Reshaping of the main (218 km) and secondary (240 km) channels by dredging; Calibration of Uzlina and Caraorman channels; Banks consolidation and fortification 7600 mp

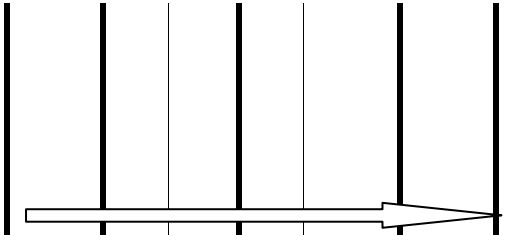
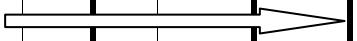
2. Restoration of the areas used for agriculture and fisheries arrangements

Aims: Reactivation of the managed areas in economic purpose in the natural hydrological cycle; Opening breaches in embankments of defences in fixed places for connecting hydraulic modelling of agricultural and fish enclosures in the natural hydrological regime; The total surface is 15712 ha.

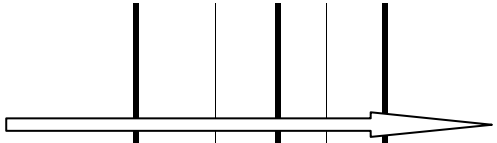
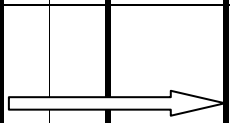
7.2. Time-frame and concept of stakeholder involvement during CAMP implementation

THEME:	A. THE MANAGEMENT OF BIODIVERSITY CONSERVATION									
OBJECTIVES:	Implementation of the action plan for flora and fauna conservation Integrated monitoring of D.D.B.R.									
ACTIONS	LIMITS/ TARGET	PRIORITY	Half of the year; Activity with the priority PRIORITY 1 Assigned actions which MUST be developed in implementation period of the management plan: no excuse for the failure PRIORITY 2 Assigned actions which SHOULD BE finalized. There is flexibility, but must be sustained by a serious motivation if the actions will not be achieved. PRIORITY 3 Actions that will be carried out if there is sufficient time and resources after priority 1 and 2 finalization.						PARTNERS FOR IMPLEMENTATION	NOTES/ BENEFICIARIES
			2013	2014		2015		2016		
			II	I	II	I	II	I		
A 1. Studies on flora and vegetation from D.D.B.R.	Inventory of all habitats and species existent in D.D.B.R. Comparative analysis of plants lists mentioned in literature	2	→	→	→	→			Research institutes, universities, NGOs, professional associations, specialized volunteers	All Natura 2000 habitats/DDBR A

	Report on species diversity and ecological state of different habitats											
A 2. Inventory and description of habitats from D.D.B.R.	Report on habitat types and their ecological state within D.D.B.R.. Drawing of the habitat conservation plan according to climate changes	1									Research institutes, universities, NGOs, professional associations, specialized volunteers	All Natura 2000 habitats/DDBR A
A 3.Studies on diversity and species population in concern with climate changes	Sensitive species inventory present D.D.B.R.. The comparative analysis of species list and extreme phenomena	2									Research institutes, universities, NGOs, professional associations, specialized volunteers	All Natura 2000 habitats/DDBR A and National Agency of Forestry
A 4. Elaboration of habitat conservation plan with respect to climate changes by special protection measures	Report on habitats' ecological state. The conservation of not-endangered and of conservative-interest populations	1									Research institutes, universities, NGOs, professional associations, specialized volunteers	All Natura 2000 habitats/DDBR A, Tulcea County Council and National Agency of Forestry
A 5. The monitoring of fauna	The selection of	3									Research institutes, universities,	

and flora according to the habitat type	the wild species eligible for their inclusion within the monitoring programme. The selection of the key-species within D.D.B.R. habitats. The elaboration of the monitoring plan according to the types of habitats.			NGOs, professional associations, specialized volunteers	
A 6. The integration of the concepts related to biodiversity conservation and to non-alteration of the landscape in the urbanism plans.	Adequate urbanism plans The adjustment of an adequate monitoring system	2		Environment Protection Agency, Tulcea County Council, Local administrations and D.D.B.R.A.	The habitats will be less fragmented/ To urism agencies, local communities, and DDBRA
A 7. The elaboration of an electronic data base for the DDBR biodiversity	Data base	1		Research institutes, universities, NGOs, professional associations, specialized volunteers	The data base will support all the future implemented actions /DDBRA
THEME:	**B. LANSCAPE AND ENVIRONMENT**				
OBJECTIVE:	**Maintaining of geo-morphological elements and landscape features**				

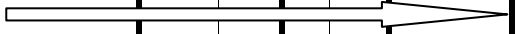
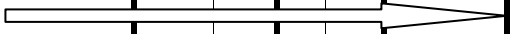
ACTIONS	LIMITS/ TARGET	PRIORITY	Half of the year; Activity with the priority PRIORITY 1 Assigned actions which MUST be developed in implementation period of the management plan: no excuse for the failure PRIORITY 2 Assigned actions which SHOULD BE finalized. There is flexibility, but must be sustained by a serious motivation if the actions will not be achieved. PRIORITY 3 Actions that will be carried out if there is sufficient time and resources after priority 1 and 2 finalization.						PARTNERS FOR IMPLEMENTATION	NOTES/ BENEFICIARIES
			2013	2014		2015		2016		
			II	I	II	I	II	I		
B 1. The identification, mapping and recovery by means of ecological reconstruction of the degraded habitats	The evaluation of the dimension and frequency of the activities with impact on diversity	3				→			Research institutes, universities, D.D.B.R. Administration , Apele Române,	Habitats under climate change pressure/ DDBRA
B 2. Ecological reconstruction within the forest area	Foresting – completing Integral foresting The monitoring of the area	2				→			D.D.B.R. Administration, National Agency of Forestry	Habitats under climate change pressure/ DDBRA and National Agency Forestry

B 3. The detour of the tourist routes out of the sensitive areas with detritus, if possible, or the warning on the area's sensitivity with respect to climate change pressure	Detoured or signaled routes.	2		D.D.B.R. Administration, RNP, Tulcea County Council	Better protection for some sensitive habitats/ Tourist agencies, DDBRA
B 4. The protection of fauna within not-arranged areas through limitation – non-promoting of tourist access, prohibition of fire and garbage deposits.	restricted access, clean areas	2		Research institutes, universities, D.D.B.R. Administration, National Agency of Forestry, Garbage collectors	DDBRA,

THEME:	**C. RESOURCES USE**				
OBJECTIVE:	**Maintaining and promotion of exploitable sustainable activities in designated areas**				
ACTIONS	**LIMITS/ TARGET**	**PRIORITY**	Half of the year; Activity with the priority PRIORITY 1 Assigned actions which MUST be developed in implementation period of the management plan: no excuse for the failure PRIORITY 2 Assigned actions which SHOULD BE finalized. There is flexibility, but must be sustained by a serious motivation if the actions will not be achieved. PRIORITY 3 Actions that will be carried out if there is sufficient time and resources after priority 1 and 2 finalization.	**PARTNERS FOR IMPLEMENTATION**	**NOTES/ BENEFICIARIES**

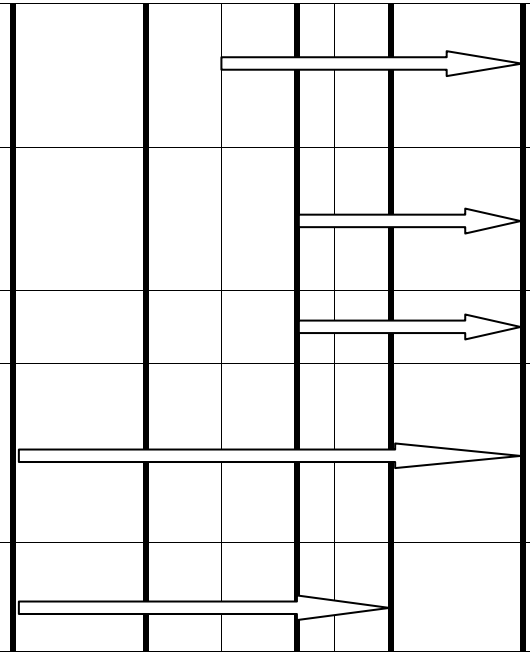
			2013	2014		2015		2016		
			II	I	II	I	II	I		
C 1. The promoting of sustainable techniques for resource usage	Exploitation alternatives with reduced impact on environment	1							Research institutes, Universities, Local communities, Environment Protection Agency	All stakeholders involved in resource exploitation
C 2. The monitoring of evolution of production, quality, biodiversity and forest degrading within the buffing area	Annual report, the negative effects of overgrazing and illicit extraction of ligneous mass disappear	1							Research institutes, universities	DDBRA, Stakeholders involved in forests, fish and agricultural polders.
C 3. The adjustment of the forest and forest-pasture arrangements at the limits, internal area and provisions of the management plan.	Adjusted plans for the forest arrangements.	1							D.D.B.R. Administration, Tulcea County Council and National Agency of Forestry along with research institutes and universities	All natura 2000 habitats from DDBRA
C 4. The regulation of the non invasive methods in agriculture and monitoring of the new plant (invasive) species “provided” by arable lands. The verification of regulations’ implementations.	The promotion of ecological activities in agricultural management	2							Local Administrations, Environment Protection Agency, D.D.B.R. Administration	Local communities and DDBRA along with stakeholder involved in agricultural polders management
C 5. The informing on exploitation methods and resources status and trends with respect to climate changes	Informed local people	3							Local Administrations, APM, D.D.B.R. Administration, All Stakeholders, NGOs	DDBRA, Tourist agencies and Local

										Administrations
THEME:	**D. LOCAL COMMUNITIES**									
OBJECTIVE:	**Participation of local communities in management objectives achievements**									
ACTIONS	**LIMITS/ TARGET**	**PRIORITY**	Half of the year; Activity with the priority PRIORITY 1 Assigned actions which MUST be developed in implementation period of the management plan: no excuse for the failure PRIORITY 2 Assigned actions which SHOULD BE finalized. There is flexibility, but must be sustained by a serious motivation if the actions will not be achieved. PRIORITY 3 Actions that will be carried out if there is sufficient time and resources after priority 1 and 2 finalization.						**PARTNERS FOR IMPLEMENTATION**	**NOTES/ BENEFICIARIES**
			2013	2014		2015		2016		
			II	I	II	I	II	I		
D 1. The organizing and promoting by special events the climate change effects and necessary management for mitigation	Area promotion on short term	1							Local Administrations, D.D.B.R. Administration, Research institutes, universities, NGOs, volunteers specialized on biodiversity	Can be used the celebrating days related with environment/ local communities, schools, private

					companies and resource stakeholders
D 2. The providing in some information points different materials, documentary and other products related with climate change and importance of biodiversity conservation along with traditional products	Visiting centres, information centres, events	1		Local Administrations, D.D.B.R. Administration, tourist agencies and NGOs	Tourist agencies
D 3. The integration of both local communities' values, natural ones within the strategy for climate change effects mitigation	The strategy for climate change management promotion	1		NGOs, D.D.B.R. Administration, Mass media, Tulcea County Council	DDBRA, Local Administrations
D 4. The encouragement of keeping good management practices and developing in partnership with local communities new ones in accordance with European directives for biodiversity conservation	The elaboration of CC mitigation measures	3		Local Administrations, D.D.B.R. Administration, Mass media, Tulcea County Council	DDBRA

THEME	**E. TOURISM**				
OBJECTIVE	**Elaboration of strategic plan for the touristic development**				
ACTIONS	**LIMITS/ TARGET**	**PRIORITY**	Half of the year; Activity with the priority PRIORITY 1 Assigned actions which MUST be developed in implementation period of the management plan: no excuse for	**PARTNERS FOR IMPLEMENTATION**	**NOTES/ BENEFICIARIES**

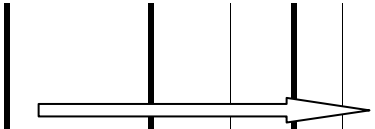
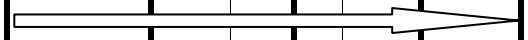
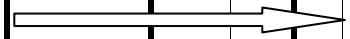
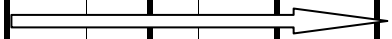
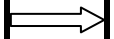
			the failure PRIORITY 2 Assigned actions which SHOULD BE finalized. There is flexibility, but must be sustained by a serious motivation if the actions will not be achieved. PRIORITY 3 Actions that will be carried out if there is sufficient time and resources after priority 1 and 2 finalization								
			2013	2014		2015		2016			
			II	I	II	I	II	I			
E 1. The directing of the tourist access into the protected area depending on the conservation interests and the limitation of accident risk with respect to climate change pressures	The map with the modifications of the tourist route network	1							D.D.B.R. Administration, NGOs	Tourist agencies, local communities, DDBRA
E 2. The materialization in the field of tourist routes depending on the new tourist zoning and potential risk of climate change effects on habitats	Appropriately marked routes, barriers, the reduction of the potential accidents, the conservation state	1							NGOs, volunteers, communities, schools, local administrations	DDBRA, tourist agencies
E 3. Rehabilitation actions with the view to reduce the negative impact of climate change effects on tourist objectives and habitats in general	Partnerships with NGOs, schools, local involved communities	2							NGOs, volunteers, communities, schools, Local Administrations , DDBRA and other stakeholder involved in management of protected areas	Tourist agencies, National Agency of Forestry, DDBRA

E 4. The providing of an appropriate tourist infrastructure (visiting centres and information points, routes, refuges)	Visiting centres and information points, routes, refuges	1		Local Administrations, National Agency of Forestry, D.D.B.R Administration, Tulcea County Council	DDBRA, local Administrations and local communities
E 5. The establishment and arrangement of camping areas, car DDBRs in order to preserve the habitats and species	Camping areas, car DDBRs	2		Local Administrations, D.D.B.R Administration	Tourist agencies, DDBRA, Apele Romane
E 6. The setting-up of climate change educational routes	Routes	3		D.D.B.R Administration NGOs	schools
E 7. The organization of a specialized tourism on various fields (ornithologic, botanical, forest, geological etc.)	Specialised tourist agency	2		Volunteers specialized in biodiversity conservation, NGOs, tourist agencies and DDBRA	All Natura 2000 habitats/ DDBRA, local communities
E 8. The tourism monitoring and pressure on climate change sensitive habitats	Adapted data, maps	2		Local Administrations, D.D.B.R Administration	All Natura 2000 habitats/ DDBRA

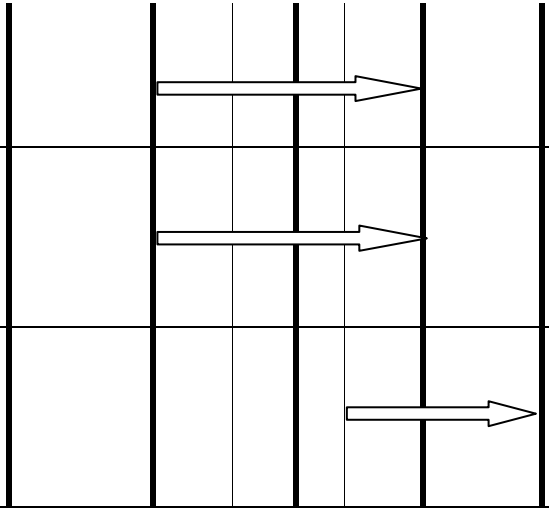
8.

THEME:	**F. EDUCATION AND PUBLIC AWARENESS**				
OBJECTIVE:	**Improving attitudes of local communities and stakeholders with respect to public awareness and consultation**				
ACTIONS	**LIMITS/ TARGET**	**PRIORITY**	Half of the year; Activity with the priority PRIORITY 1 Assigned actions which MUST be developed in implementation period of the management plan: no excuse for the failure PRIORITY 2 Assigned actions which SHOULD BE finalized. There is flexibility, but must be sustained by a serious motivation if the	**PARTNERS FOR IMPLEMENTATION**	**NOTES/ BENEFICIARIES**

			actions will not be achieved. PRIORITY 3 Actions that will be carried out if there is sufficient time and resources after priority 1 and 2 finalization.							
			2013	2014		2015		2016		
			II	I	II	I	II	I		
F 1. The identification of the present educational activities	Report on drawbacks in this field	1	→	→					Research Institutes , universities and schools along with D.D.B.R. Administration	Local communities, schools, private companies
F 2. The elaboration of an action plan	Partners for future activities Recommendations for public awareness and ecological education	1	→	→	→				Research Institutes D.D.B.R. Administration	DDBRA and all stakeholders
F 3. The arrangement of visiting centres and information points	Visiting centres and information points	1				→	→	→	Local Administrations, D.D.B.R.'s Administration, Tulcea County Council, Interior Design Companies	DDBRA
F 4. The emplacement of educational and informative boards in the field and maintenance	Boards, information	1				→	→	→	NGO, volunteers, Local Administration , DDBR Administration	DDBRA, Tourist agencies, all stakeholders
F 5. The editing of educational	Brochures,								Specialized companies, NGOs,	Local

and informative materials about climate changes	leaflets, maps, postcards, posters and other informative materials regarding climate changes			DDBR Administration	communities, tourist agencies, schools, DDBRA
F 6. The elaboration and updating of a DDBRA WEB page	The number of visitors of the WEB page and questionnaire for climate change	1		IT Specialist, NGO	DDBRA
F 7. Actions which offer people the opportunity to take part to the DDBR activities	Programmes with NGOs, schools	2		Schools NGO Volunteers	Local communities, DDBRA
F 8. The promotion of the DDBRA image through the participation to national and international manifestations, mass – media	The number of articles, reports, informative materials	2		Schools NGO Mass media	DDBRA
F 9. The monitoring of the awareness process impact	Questionnaires, less waste	3		NGO Mass media D.D.B.R. Administration	DDBRA and all stakeholders

THEME:	G. MANAGEMENT AND ADMINISTRATION											
OBJECTIVE:	Elaboration of the plan for promotion activities that generate incomes											
ACTIONS	LIMITS/ TARGET	PRIORITY	Half of the year; Activity with the priority PRIORITY 1 Assigned actions which MUST be developed in implementation period of the management plan: no excuse for the failure PRIORITY 2 Assigned actions which SHOULD BE finalized. There is flexibility, but must be sustained by a serious motivation if the actions will not be achieved. PRIORITY 3 Actions that will be carried out if there is sufficient time and resources after priority 1 and 2 finalization.							PARTNERS FOR IMPLEMENTATION	NOTES/ BENEFICIARIES
			2013	2014		2015		2016			
			II	I	II	I	II	I			
G 1. The activity of biological and non-biological values' promotion	Area promotion on short term	2	→	→						Mass media, NGO, Local Administration , DDBR Administration	Species and habitats are promoted in mass media and other methods to public opinion/DDBRA
G 2. The identification of income-generating activities which concords with the D.D.B.R. management	incomes	1		→	→					D.D.B.R. Administration, local administration, NGOs and private companies	DDBRA, local communities

G 3. The adjustment of the DDBR administration's diagram to the necessities of the management plan's implementation	The adjusted diagram, 6 employed field agents	1		Local administration D.D.B.R. Administration,	DDBRA
G 4. The identification of auto-financing sources and the attraction of new- financing sources in order to sustain the new climate change measures	incomes			NGOs, Embassies, EU International and national financing programmes	DDBRA, Ministry of Environment, local communities
G 5. The infrastructure foundation	Visiting centres, information points, refuges, routes, other facilities	1		NGO, D.D.B.R. Administration, Local administration, Communities	DDBRA

Theme	**The implementation monitoring of the management plan**		
Objectives	**Credits which shows the steps implemented systematically with respect to management plan, monitoring and evaluation.**		
	Actions and indicators correspondence	**Frequency Periodic-P Continuous-C As required-N**	**Observations**
5.8.1. The monitoring of natural resources' state			
The completion of flora and fauna	A1, A2, A3,	P	Studies
The foundation of a monitoring sector network associated to the monitoring procedures of the species and habitats	A1, A2, A3, A5	P	Collaborations
The implementation of surveillances-evaluations of the identified target-species (including game)	A3, A4, A5, A7	P	Reports
The annual implementation of the ecological impact evaluation of the tourist routes	A5, A6, B3, B4,	P	Evaluation
The annual checking of the permanent water courses	A6, B1, C1, E3	P	Reports

(vegetation, garbage, discharges)			
The establishment and implementation of a collecting system of volunteers and visitors' suplimentary recordings (information submitted to the visiting centres, rangers' field notebooks)	D1, D3, D4, E1, E4	C	Patrol reports and questionnaires
The establishment and updating of the data base for biological recording corresponding to the geographic information system of the DDBR	A7	C	Workshops evaluations
The monitoring of the accessory produces collecting	C2, C4, D2,	P	Reports
The collection of data with concern to the monitoring on the usage of resources and activities carried out by other agencies within the DDBR area	C1, C2, C3, C5, E4, E6	C	Evaluation
The monitoring of the forest operations within the DDBR in order to follow the effective regulations	C3	C	Reports
Discussions with the local population with concern to waste-dropping	B4, C5, E3, F7	P	Questionnaires
5.8.2. The monitoring of the physical resources state			
Annual checking of the border marks	E1, E2, E4	P	Check
The providing of a three-year checking of all the marked routes, as well as climbing routes. The supplementary checking if necessary	E1, E2, E3, E4, E5, E6, E7	P,N	Evaluation
Equipment inventory	E7, F1	C	Check
The monitoring of waste and visited areas	A5, C5, E3, F9		Evaluation
5.8.3. The monitoring of the attitude and visitors' behaviour			
Data collection subsequent to guard and tourist activities related to the tourist behaviour in the DDBR	E4, E9, G3	C	Evaluation
Annual tourist inventories, with qualitative and quantitative information	E2, E4, E8, F1, F2, F3, F4, F5	P	Reports
Evaluations of awareness and understanding the DDBR goals before and after implementing educational and awareness programmes and activities.	D4, D5, F	N	Workshops meetings evaluations, Letter notification
5.8.4. The monitoring of the elaboration of the work plans			

The completion of the planned works monitoring	E8, F9	N	Reports
The ensurance of the fact that the teams who carry out works and installations in the field present reports, localization maps, photographs etc.	G3, G4, G5	N	Reports
The ensurance of professional design, reports and other necessary reports for large constructions and installations of the DDBR	G	N	Reports
5.8.5. The monitoring of a participative management elaboration			
The monitoring of the official materials and documents, conventions elaborated by the DDBR	F1, F2, F4, F5, F6, F7, F8, F9	C	Evaluation
The recording of small grants programme	G4	C	Fundraising
The providing of some adequate formats for contracts, agreements, and the inclusion of the reporting, reviewing and monitoring ways	G3, G4, G5	C	PR, Collaborations
The production of minutes and reports subsequent to the work meetings, sittings etc.	F7	C	Reports
Report writing and records by the personnel who participate or organize events	F2, F7	C	Workshops meetings evaluations, Letter notification
5.8.6 The monitoring of the internal and external activities, of the documented activities, of the documents			
The maintenance of a map, plans produces' archive and other data produced and updated through GIS and other data bases.	A7	C	Data collection
The ensurance that the official maps of the DDBR are distributed to the interested authorities	F	P	Workshops
The ensurance of accession and inclusion of observations (including The Scientific and Advisory Board) on major studies and reports, ordered or carried out by the DDBR administration	C1	N	Workshops
The maintenance of project proposals' evidence and	G1, G2, G3, G4	C	Collaborations

planselaborated for the objectives of the DDBR or communities, as well as the results of these proposals			
The custody of records with concern to courses and staff's professional training	A7, F2, F7	C	Workshops
The ensurance that the personnel who take part to events, courses, training, study visits, write reports and implements the learned lessons in their own activities	F2, F7, G1	C	Check, Evaluation
5.8.7. The monitoring of D.D.B.R. plans and programmes			
The annual analysis of the management plan elaboration together with the advisory scientific boards, and the subsequent adjustment of the management plan actions	E8, F9, G3, G4	P	Reports
The elaboration of an annual work plan with planned activities (personnel, resources, time etc.)	C3, F2	P	Action plan
The elaboration of the management plan's evaluation in the III rd year and the elaboration of the new plan	C3, F2	P	Action plan

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