Theme 2 – Living Resources

Presentation: The Function of Wetlands

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The largest Black Sea wetlands are situated in the coastal plain areas of Romania, Ukraine and the Russian Federation, in the deltas of large rivers with vast catchment areas: the Danube, the Dniester, the Dnieper, the Don and the Kuban. One of the principal wetlands in the area is the Danube Delta.
The word 'wetlands' spread globally in 1975 when the Ramsar Convention, the world convention for nature protection, proposed the definition of wetlands as habitats of waterfowl, areas of fen, marsh, peatland or water of either natural or artificial origin, constant or temporary, standing or drainage, freshwater, brackish or saline. The accumulation of gregarious birds in these zones is not random. It is the result of an 'edge effect' meaning life concentration on the border of coexistence of two or more ecosystems, terrestrial and aquatic for example or marine and riverine. As a rule there is higher productivity and biological diversity of plants and animals in these zones.
The Danube is the main river in the Black Sea basin and has a considerable influence on its productivity and biodiversity. About 50% of the total volume of fresh water entering the Black Sea comes from rivers of the north-western part, with 36% from the Danube.
The Danube Delta is the widest and richest wet zone in Europe after the Volga delta, the delta and the banks of the Black Sea amounting to 679,000 hectares. The Danube Delta has a classic form, being a very flat triangle with its apex at the point of division of the three branches: Kiliya, Sulina and Sfintu Gheorghe which transport 60%, 21% and 19% respectively at low river discharges. Although more than 78% of its area is situated in Romania, the Kiliya branch forms the newest and most productive part of the delta on Ukrainian territory.
The main physical and chemical factors causing the natural resources and high productivity of the Danube Delta are:

- a high level of irrigation: water and permanently flooded areas constitute about 80% of the Danube Delta, lakes cover not less than 10% of the delta surface and the drainage network is 1km/km2;
- a high content of nutrients: study has revealed that some 58% of the total dissolved nitrogen - 340,000 tons - and 66% of the total dissolved phosphorus - 55,000 tons - flows into the Black Sea from the Danube basin;
- favourable temperature conditions: the average annual temperature is 12.70C; the average duration of water temperature at 50C, is 265 days.

These factors define the extraordinary biological status of the Danube Delta. The reedbeds, Phragmites australis, are the largest closed unit of reeds in the world, covering an area of 284,000 ha. The total intensity of organic matter production in the Danube Delta is 1.8 times higher than in the Dnieper Delta. The total number of species is above 4,000 including 1,120 aquatic organisms. In comparison with the Dniester and Dnieper Deltas the species composition is 1.7 and 1.2 times higher respectively.

Functions of the Danube Delta

The Danube Delta is a transition zone for aquatic, terrestrial, freshwater and marine communities and acts as a centre for condensing life in the Black Sea basin.

The terrestrial ecosystem

The richness and the high productivity of terrestrial systems of the Danube Delta can be judged by the state of the organisms which represent the top of the trophic pyramid of delta habitats, such as birds. There are 320 bird species in the Danube Delta, a considerably greater number of breeding bird species than in two other large southern European deltas, the Rhone and Guadalquivir. There are large numbers of wetland birds and a substantial proportion of the European, Palearctic or world populations of several species can be found here.
Of special note is the great importance of the Danube Delta for the pygmy cormorant Phalacrocorax pygmeus, the red-breasted goose, Branta ruficollis (over one tenth of the world population, 275,000, of this bird winter here), the white pelican, Pelicanus onocrotalus (the delta is one of the main Palearctic breeding sites for this species), the Dalmation pelican and the white-tailed eagle, Haliacetus albicilla, with eight pairs of the species in the Romanian area and three in the Ukrainian.
There are also significant populations of several species which are not yet in danger of complete extinction, but whose populations have declined drastically, especially in Europe. Of special note are the populations of colonial waterfowls, the glossy ibis, for example. The delta area is also a major wintering area for ducks and geese and it is also essential for migratory birds of northern Europe which fly over the area in tens of thousands on their way to Africa. Birds from Africa come to the delta in the summer to breed.

The delta is an important refuge for the European mink Mustela lutreola, the wild cat Felis sylvestris and the European otter, Lutra lutra. In 1992, 1994 and 1995, after an almost 50 year hiatus, the monk seal, Monachus monachus, has again appeared in the Ukrainian part of the Danube Delta. The Black Sea population of this species is about to become extinct.

The aquatic ecosystem

The Danube river-bed is enriched by plants and animals that live and develop in the river, first of all in the pelagic zone. The total volume of the plankton flow, besides nutrients, determines the efficiency of the mouth of the delta and the scale of influence on the Black Sea. The average annual volume of this flow at the top of the delta is about 1,340,000 tons, of which bacteria make up 80.8%, phytoplankton 11.1% and zooplankton 8.1%.
The zone of direct influence of Danube waters on the Black Sea is selected on the boundary of detection of freshwater algae which continue to grow in marine water. Depending on the estimate of the river runoff, the area of the zone varies and the maximum size of the surface of the pelagic zone reaches 100,000 km2.
The increase in diversity, density and biomass of hydrobionts in the zone of transformation in comparison with adjacent areas is a manifestation of 'edge effect' on the boundary of coexistence of brackish water and marine fauna. In this zone, total biomass and production of hydrobionts are usually higher by two to five times. Regular blooming of the sea in a surface layer up to a depth of ten metres has been noted. The total phytoplankton biomass is more than 400,000 tons in an area of about 40,000 km2 in the summer time.
Among the animal population of the ecotone 'river-sea' there is a prevalence of noctiluca, Noctiluca scintillans, making up to 90% of the density and biomass of pelagic organisms. In 1988 to the south of the Sfintu Gheorghe branch in an area of about 3,400 km2 a super high biomass of this organism (125-560 kg.m-3) was registered.
On average, the biomass of hydrobionts is five to ten times higher in the sea than in the river (phytoplankton - 4.8 times, mesozooplankton - 14.3 times, macrozoobenthos - 8.1 times) and lower numbers and biomass of hydrobionts have been observed in delta water in comparison with adjacent zones such as river branches and the sea-coast. The main reasons for this type of distribution of aquatic organisms is the intensive sedimentation (or silting) and reduction of current in the river delta.
The fish fauna of the delta is remarkably rich, with 91 species belonging to 30 families. Forty-four of these are freshwater species, the other being migratory species that occur in the Black Sea and mainly come to the delta during the breeding season.
After the construction of the Kahovka dam on the Dnieper river (1955-58), the Danube became one of the last rivers where sturgeons (starred sturgeon, Acipenser stellatus, and great sturgeon, Huso huso) continued to spawn.

The Danube Delta as a powerful natural biofilter

One of the most important functions of the delta for the Black Sea is its ability to absorb significant quantities of pollutants. There are a number of ways in which this is done:

- Absorption of pollutants on particles of organic substances. This process is carried out on particles of silt or detritus, taking them out from the water into the bottom sediments during the formation of the front edge of the delta. In this area each kilogram of dry weight of the bottom sediments contains on average two grammes of oil.
- The destruction of pollutants as a result of the functional activity of hydrobionts. In this way destruction and mineralisation of organic substances may be achieved. The microorganisms are the most active in this process (68%). The annual volume of organic matter destroyed by hydrobionts makes up about 1.5 millions tons.
- Absorption of pollutants by higher water plants. The dominating component of the ecosystem of the Danube Delta is higher water and coastal vegetation, which influences the water quality. About 93-99% of the total absorbed pollutants from the Danube accumulates in reedbeds.

The delta functions like the kidneys in filtering capacity in the body. The clearance rate for the main nutrients causing eutrophication in the Danube Delta is 39.7 kg per min for nitrates and 49.6 kg per min for phosphates. The functional productivity of the delta higher plants can be estimated over an annual period as: nitrates - 59,100 tons, phosphates - 20,500 tons, heavy metals - 23,300 tons and about 100 kg pesticides. The intensity of absorption of pollution in the Danube Delta is 13 times higher than in the Dniester and 16 times higher than in the Dnieper.

The Danube Delta as a region of human economic activity

From ancient times man has used the natural riches of the Danube Delta. The first signs of permanent human settlements in the delta go back to the Neolithic epoch, with a centre at Hamangia - now Baia, Romania. The Ukrainian part of the Danube Delta is quite young - about 300 years old.
Today, in spite of its vast natural riches, the density of the population of the Danube Delta is small, with 14 people per square kilometre and a total population of 83,600. The main types of economic activity in the Danube Delta region are:

- Fishing (37.0 %). Fishing in the branches of the Danube has always been closely related to the flood zones upstream and there are only a few species: migratory species (sturgeons - the Russian sturgeon, Acipenser guldenstadti, the starred sturgeon, Acipenser stellatus, and the great sturgeon, Huso huso, and shad, Alosa kessleri pontica) and semi-migratory species (carp, Cyprinus carpio, zander, Stizostedion lucioperca, bream, Abramis brama, and eels, Siluris glanis).
  The annual volume of the fish catch in the Danube Delta for the 1981-1990 period was about 2,020 tons: 59% of this is wild goldfish, Carassius auratus, 38% is shad, 1% is sturgeons. Distribution of the total fish catch on average is about 70% in the Romanian part, and not more then 30% in the Ukrainian part. Today, the spring catch of migratory fish may employ up to 500 fishermen in Romania and 600 fishermen in the Ukraine. The first fish polders were constructed in the 1950s and intensive fish farm production was 338 kg/ha in 1986.
- Reed exploitation (19.9 %). The potential mean yield of natural reeds is 6 tons/ha. The modern level of reed exploitation is not more then 50,000 tons per year. This is about 6% of the possible volumes. This kind of economic activity is widespread in Romania.
- Agriculture (25.9 %). Agricultural land covers about 139,600 hectares with an equal part in Romania and the Ukraine; the polder surface area altogether being about 36,000 hectares. This is about 24% and 8% of the delta area respectively.
- Navigation. In 1989 boats carried about 30 million tons of cargo along the Danube Delta branches, two-thirds of which was from the Black Sea.

Damage to the Danube Delta

Several interrelated factors are responsible for the damage to the functioning of the Danube Delta:

- The high nutrient loads of the Danube River upstream of the delta. Data provided by the research institutes reveal that the delta is subject to eutrophication which during the summer can lead to massive fish mortalities caused by dissolved oxygen deficiency and the release of hydrogen sulphide; another effect of eutrophication is the disappearance of submerged macrophytes which are indispensable for the breeding of certain fish species, pike for example.
- Engineering impoundments, dams, dikes, cut-offs, canalisation, which break the connection between the river and its floodplain. For example, from 1963 to 1967, embankments on the Romanian stretch of the Danube river reduced the area of the floodplain by 290,000 ha, which corresponds to a loss of 4.3 km3 of flood retention capacity.
- Intensive agricultural practices and fish farming. The creation of polders has reduced the flooded area by 25% since 1960 and the water retention capacities of the delta have been reduced to 1.7 billion m3. There has been a decrease in predatory fish to the benefit of non-predators, and a replacement of carp by goldfish.
- Changes in the hydraulic regime of the Danube River. Over the last few years this has decreased the area of flooded land available for the successful reproduction and healthy growth of the young fish.

Looking to the future

In recognition of the significance of the Danube Delta, it was proposed that UNESCO declare the area part of the heritage of humankind. The Biosphere Reserve in the Romanian part of the delta was created on 27 August, 1990, and includes the lake complex and spans an area of the Black Sea extending from the shore to 20 metres in depth. In the Ukrainian part of the delta there is a plan to create a Biosphere Reserve with a total area of 46,403 ha, based on the existing nature reserve, Dunaiskie Plavni.
The setting up of a joint environmental complex in the Danube Delta was proposed by the official representatives of the Man and Biosphere Programme from Romania and the Ukraine at an international forum in Seville in March 1995 at which 324 biosphere reserves from 82 countries around the world were represented. This was supported by the International Committee. The GEF has recently assisted Romania and Ukraine with a World Bank administered grant of some US$ 5 million to improve management of the two parts of the reserve.
With all possible measures being undertaken to ensure that the Danube Delta is protected, it is to be hoped that the saying 'we never value what we have, but cry when we lose it' never comes true for the Danube Delta.