16° E 23° E 30° E 37° E 44° E

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Impact of climate changes on indicator species and predicted socio-economical effects

DRIVERS of wetlands biodiversity

A. Main climate parameters:
- Temperatures and precipitation
- Sea level and salinity, river drainage

B. Land use
- Hydrotechnical constructions
- Changes of crop rotation
- Grazing, hay making, fires

C. Use of nature resources
- Hunting and fishing
- Harvesting of reed and other plants
- Extraction of sand
- Water use

D. Biotic factors
- Population trends
- Predation, competition and parasitism
- Invasion of species

Indicator community - reedbeds

The main factor , impacting on formation of the reed, is hydrological regime. A high and long-lasting flood in spring detains development of the reed while the flood absence or short duration stimulates its accelerated growth. Besides, the reed development in the Danube Delta is influenced by high summer temperatures, especially if they are intensified with low precipitation.

Reed phytomass dynamics in 2007-2011

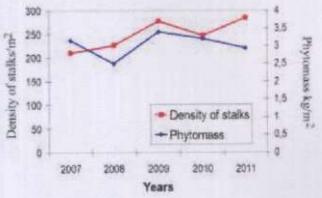

Fig. 1. Reed dynamics in Stensovsko-Zherbiyansky Plavni.

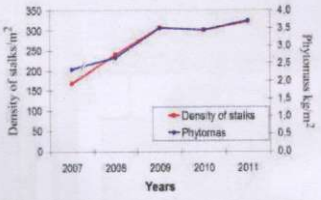

Fig.2. Reed dynamics on Polunochny Island.

Embankment of SZP (artificial hydrological regime and periodical penetration of salt waters) leads to the fact that phytomass drops behind the density of reed growth in some years. Reed harvesting on Polunochny Island contributes to a gradual increase of the reed productivity.

Possible effects

Increase of temperature and humidity will contribute to increase of reed harvesting and indirectly to reed productivity and mosaicity.

Indicator species - the locust Locusta migratoria L.

This species exists in two ecological-morphological forms: ph.solitaria - solitary form and ph.gregaria - gregarious form.

In case of a considerable and steady increase of air temperature and decrease of humidity in the late spring-summer period the locust reacts with a significant growth of numbers (up to the transition from a solitary to gregarious form).

Locust number dynamics within a year

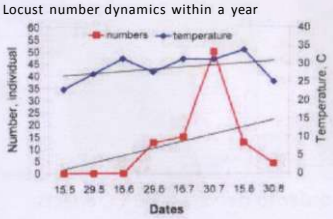

Fig. 3. Dynamics of air temperature and numbers of the locust - Stepanovskaya Spit 2010.

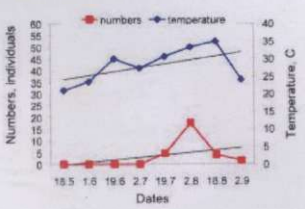

Fig. 4. Dynamics of air temperature and numbers of the locust - Altagir, 2010.

Possible effects

Due to climate trends and economical factors, we can make a prognosis off urther growth of numbers and outbreaks of the locust mass breeding with transition to a gregarious form. This form is dangerous for agricultural crops and can bring a considerable economical loss.

Impact of the above-mentioned factors can be seen on particular representatives offl ora and fauna, communities, landscape elements and elementary associations, and is demonstrated on the example of model species and communities.

Impact of climate factors was studied on the example of numbers, productivity, species diversity and phenology.

Characteristics of hydrological regime in the Danube Delta during 2007-2011.

In the Danube Delta in 2007, 2008, 2011 it was recorded a low water level and the flood was practically absent (or of short duration). The year of 2009 was characterized by an unusually prolonged summer flood, and 2010 - by a prolonged spring-summer flood.

Dynamics of numbers and productivity ofi ndicator fish species

In addition to the above-mentioned factors, the numbers and productivity offi sh is impacted by:
- flow velocity for river ecosystems;
- productivity of water communities.

Indicator species - the round goby Neogobius melanostomus

Over the last 15 years there is a trend of an increasing mean size of the round goby for averagely 0.3 cm a year. This trend coincides with the trend of decreasing salinity in the Sea of Azov. Also, this correlation is proved for the fattening index of the round goby according to Fulton's coefficient (Fig.2).

Indicator species - the golden carp Carassius auratus

Increase in numbers of the golden carp in the Sea of Azov is apparently connected with the decline in salinity of sea waters.

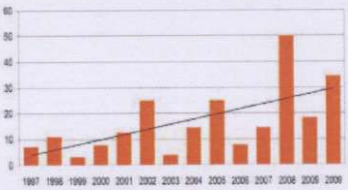

Fig. 5. Occurrence (%) of the golden carp in Azov catches.

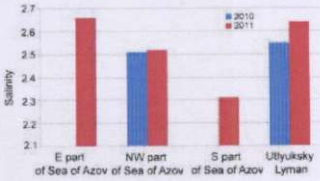

Fig. 6. Dynamics off atness of the round goby

Possible effects for fishery

Changes in temperature and precipitation will bring changes in salinity.

Scenario 1. Increase of salinity (more than 14 g/l). Will lead to decline in stocks of the European anchovy and Azov Sea sprat.

Scenario 2. Decrease of salinity (less than 10g/l). Will lead to number growth off reshwater fish species (golden carp)

Scenario 3. Salinity about 10-13 g/l. Optimal for the Azov Sea ecosystems.

Migration phenology of the White-fronted Goose Anser albifrons

The Black Sea coast of Ukraine is the area of regular wintering of the species and the starting date of migration is hard to establish. Changes in timing of migration, closely connected with spring temperature, can be seen from dynamics of the migration peak (median).

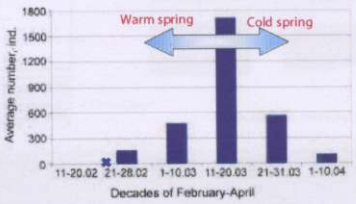

Fig. 7. Mean terms of passage of the White-fronted Goose in the Black Sea area and fluctuation of the date ef peak migrations.

More demonstrative is a spring displacement of the last species registration date in the region to earlier dates (fig. 8). It is an evidence of earlier departure of geese to breeding grounds in tundra zone, where, during last decades, temperature optimums set earlier than usual.

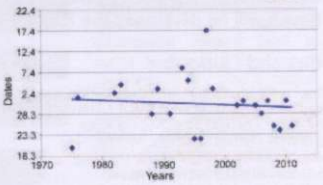

Fig. 8. The last registration date of the White-fronted Geese in spring in the Black Sea area.

Similar to it, the timing of moult and departure of geese on autumn migrations shift to later dates (fig. 9).

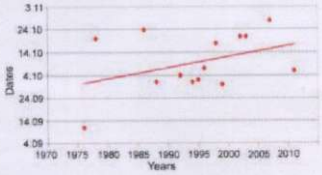

Fig. 9. The first registration date of the White-fronted Geese in autumn in the Black Sea area.

Possible effects

Taking into account that the White-fronted Goose is a composite part of the gamebird resource and also a carrier of 'A' viruses, the observed trends can, on the one part, reduce terms of using the resource by hunters in autumn, and on the other part - give a possibility of additive contagious time for exchange of virus strains on breeding grounds.

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