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Integrated water resources and coastal zone management in European lagoons in the context of climate change

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The Vistula Lagoon, Poland-Russia

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The Lagoons Brief series translate the results from the FP7-funded Lagoons project into practical and useful information for policy makers and water managers

The Vistula Lagoon, Poland-Russia: Facts and Figures

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Abstract

This brief shows some basic facts and figures about the Vistula Lagoon, its environmental problems, some major investment plans and identifies some knowledge gaps in terms of data availability and improved management potentials. Even though the lagoon is monitored regularly, information on main meteorological, hydrological and water quality parameters for both Vistula Lagoon and the river basin is very scarce and incomplete. The transboundary feature of the lagoon with one EU-country (Poland) and one non-EU country (Russia) adds to the complexity of efficient management of the area. Eutrophication is among the most important environmental problems preventing development of tourism and recreation. There is a need to identify the interactions (and possible feedback loops) between the climatic change and socio-economical development jointly for both countries. This in order for efficient management and assessment of the lagoon's future carrying capacity especially in terms of discharge of pollutants, predominantly nutrients.

References

This Brief is based on the following research reports and scientific literature:

Chubarenko, B., Margonski, P. 2008. The Vistula Lagoon. [In] U. Schiewer (ed.) Ecology of Baltic Coastal Waters. Ecological Studies. 197. Springer-Verlag, Pp. 167-195.

Chubarenko B. (Ed.) 2008. Transboundary waters and basins in the South-East Baltic. Kaliningrad: Terra Baltica, - ISBN 978-5-98777-031-3.- 306 p.

Vistula Lagoon in short

The Vistula Lagoon (Fig. 1) is one of the largest inner marine water basins in Europe (second after the Curonian Lagoon in the Baltic Sea) with an area of 838 km^2 and a drainage basin of 23,870 km^2. The Vistula Lagoon is shared between one EU-state (Poland, Warmia-Masuria and Pomeranian Provinces) and one non-EU state (Russia, Kaliningrad Oblast). It has a single inlet, the Baltiysk Strait, located in the Russian part of the lagoon. The total length of the lagoon is 91 km, and the average width is about 9 km; the widest point measures 13 km. The lagoon's coastline is ca. 270 km long, and the volume of water is about 2.3 km^3.

Characteristics of the lagoon

Vistula lagoon is a shallow coastal ecosystem with an average depth of 2.7 m; the maximum natural depth is 5.2 m close to the Baltiysk Strait.

The Vistula Lagoon is separated from the Baltic Sea by the Vistula Spit - a sandy, 55 km long peninsula. The lagoon exchanges water with the Gulf of Gdansk through the Baltiysk Strait, which has a width of approximately 400 m, a length of 2 km and an average depth of 8.8 m.

Fig. 1 Location of the Vistula Lagoon and the main discharging rivers.

A navigation canal (Kaliningrad Marine Canal, built in 1900) leads from the Baltiysk Strait up to the harbour of Kaliningrad. Despite its relative narrowness, the canal plays an important role in transporting sea water from the Baltic Sea into the lagoon.

With respect to salinity, the Vistula Lagoon is considered a transitional area. Average salinity (1950 -1965) for the eastern part of the lagoon (spring-autumn) is 2.5-4.3 PSU, for the central part 3.9-5.0 PSU, and for the southern part 1.0-3.4 PSU. At the Baltiysk Strait salinity may reach up to 7 PSU.

Average retention time of water inside the lagoon, due to the river drain, is about 6-7 months. More than 20 rivers discharge directly into the Vistula Lagoon; the most important ones are: Pregola, Elbląg, Pasłęka, Nogat, Prokhladnaya, Mamonovka, Bauda, Primorskaya and Szkarpawa (Fig. 1). The main part of the annual freshwater inflow (41%) is coming from Pregola River.

Usually, the Vistula Lagoon is covered by ice during several months in winter. Due to recent climate changes this period gets shorter. This implies great changes in ecosystem functioning (Chubarenko, 2008).

Management, laws and institutions

The legal concepts of governance in Polish coastal areas follow the hierarchical order, where EU legal instruments (WFD, Habitat Directive, Natura 2000 instrument, etc.) are incorporated into the national legislation and transmitted for implementation by national, provincial and local authorities. On the other hand, provincial and local authorities voice interests and needs of local communities. In this way, top-down and bottom-up approaches to spatial planning and management are harmonised. The most important piece of national legislation that influences coastal zones (incl. the Vistula Lagoon) is the Coastal Protection Act of the Polish Parliament of 2003.

In the Russian Federation all environmental issues are regulated by the Water Code of the Russian Federation (12.04.2006). In addition, there are a number of regional level documents concerning the environmental policy of Kaliningrad Oblast. These are the "Law on environmental policy in Kaliningrad Oblast", the "Territorial Complex Scheme of spatial planning and development of Kaliningrad Oblast", the "Scheme of environmental protection of Kaliningrad Oblast", the "Strategy for socio-economic development of Kaliningrad Oblast as the region of international cooperation for the period until 2010", to name a few.

The most complex problem for managing environmental issues in the Vistula Lagoon is the limited cooperation between Poland, an EU and

Russia, a non-EU country. A platform alleviating possible conflicts of interest may be the HELCOM convention and the Baltic Sea Action Plan that aims at achieving adequate water quality in the whole Baltic Sea until 2020. Although timely, this measure will not be able to solve other problems associated with the functioning of the Vistula Lagoon, such as free navigation in the entire lagoon, which now is regulated by an Agreement between governments of the Republic of Poland and the Russian Federation on navigation within the Kaliningrad (Vistula) Lagoon (Sopot, 01 September, 2009).

The Kaliningrad Marine Canal is the main transport route into the Vistula Lagoon. A second navigation route between the port of Kaliningrad and Elbląg stretches along the main lengthwise axis of the lagoon, but transportation possibilities are limited by the natural depth of 3-4 m, as well as by visa and other legal problems related to Polish – Russian border passing. These limitations affects the economic situation of Elbląg city and the future of its harbour, which is virtually isolated (as the rest of the Polish part of the lagoon) from the Baltic Sea. Currently, a local visa waiver scheme between Kaliningrad Oblast and the environs of the lagoon, including the tri-city agglomeration (Gdańsk, Sopot, Gdynia) has come into force, but it is only applicable for road traffic. Access through the Baltiysk Strait requires a long notice (1 month). Alternative solutions include the construction of a cross-cut through the spit in order to create an access point that is situated entirely on EU territory. Another option is the revitalisation and extension of the passage from the Vistula River to the lagoon through the Szkarpawa branch; anyhow, both options are costly and economically uncertain.

The area along the northern shore of the Kaliningrad Marine Canal is under permanent development. New oil bunkering, cargo and ferry points are planned. It is expected that intensive development of the canal area will not increase anthropogenic pressure on lagoon ecosystem to any particular degree as the water exchange between the canal and lagoon will be limited by dams bordering the canal. The plan to develop a new deep harbour with container hub in the open part of the lagoon on the continental shore just opposite the Baltiysk Strait will be followed by dredging a new more than 15 m deep canal across the lagoon.

Fishermen highlight the necessity of Polish-Russian cooperation also with regards to maintaining the fish stocks. They consider (joint) stocking of the lagoon with juvenile eel as a means of sustainable fishing.

The Pomeranian and Warmia-Masuria Provinces basically share the same problems: (i) there is a lack of large companies securing jobs and attracting high qualified personnel, (ii) very high unemployment (mostly low-trained and aging farm workers) remains an acute problem. The stagnant economy leads to an escape of young people to the tri-city agglomeration of Gdańsk, Sopot and Gdynia, Warsaw, or abroad; a further rapid depopulation of already scarcely populated areas begins to loom.

The Vistula Spit (situated in the Pomeranian Province) appears virtually isolated from the hinterland in Warmia-Masuria Province. At the spit, tourism is boosted by the nice Baltic Sea beaches, and no incentives exist to expand the movement of tourists to the southern side of the lagoon. Much more frequent and less expensive boat traffic is viewed as a means of partly overcoming this problem.

The Vistula Lagoon and the harbour in Frombork (Photo: Anna Reda).

During the last two decades, waste water treatment facilities have been intensively improved in the Polish part of the lagoon. On the Russian side, the biggest hot spot, the Kaliningrad Sewage Canal, will be closed soon after opening Kaliningrad's new treatment plant in winter 2013. Sanitary conditions are good enough for bathing in the lagoon.

Main environmental and economic problems

The main environmental problems in the lagoon area are mostly a consequence of various anthropogenic pressures:

- Eutrophication is among the most important environmental problems. Low transparency of the water is preventing tourists from using the lagoon for recreational purposes. While the low clarity of the lagoon's water is natural (due to an easy re-suspension of muddy sediments), the very intensive algal bloom during warm conditions is a clear sign for negative anthropogenic influences.
- Desorption of nutrients from sediments is probably the main reason for a limited response of the water quality to nutrient load reduction.
- An increase in salinity occurs due to the continuous deepening of the Baltiysk Strait. Salt intrusions upstream of the Pregola River occur during wind surges and temporarily cause problems for the drinking water supply in Kaliningrad.
- While the Polish part of the Vistula Spit is overused for recreational purposes during summer and the carrying capacity of the resources reaches its limits, the Russian part of the spit, a former military area, is in pristine conditions and could be suitable for eco-tourism.
- Fishing pressure from two sides: the fishermen and the cormorants.
- Alien species appearance.
- Danger of flooding of low-lying areas due to poor technical conditions of anti-flood and drainage infrastructure.

Great cormorant. Photo by P. Margonski

The main economic problems in the Polish part of the lagoon are related to:

- A high rate of unemployment and the small size of farms with a relatively low profit potential.
- The unused potential of the lagoon with regard to tourism due to poor water quality and touristic infrastructure.
- A decrease of commercial fishing activities due to poor water quality and overexploitation.
- The loss of Elbląg's historical role as marine harbour in the Polish part of the lagoon.
- The Vistula Spit cross-cut issue (Fig. 2): How will the cross-cut improve the economy of the Vistula Lagoon area with special focus on Elbląg city? Will it be an economically profitable investment? What will be the impact on the lagoon's environment? How will it affect tourism on the part that will be "cut-off" as well as the communication with the mainland? Could it create political problems? Those and many more questions, high investment costs and uncertain future impacts prevent the final decision on the cross-cut construction.

Transboundary impacts (the whole spectra of aspects) of future major constructions, such as

the planned cross-cut on the Polish side or a new deep harbour on the Russian side, have yet to be assessed.

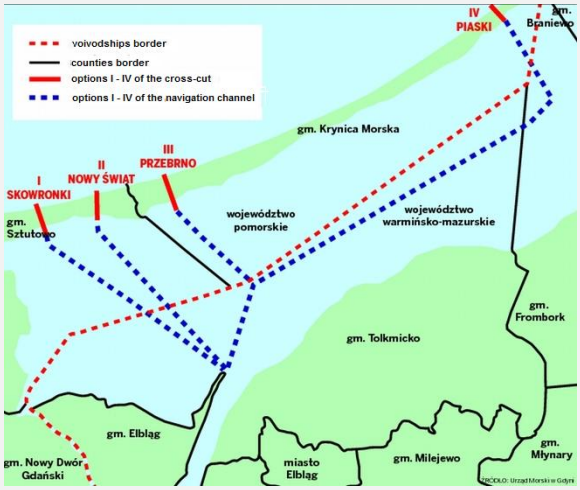

Fig. 2: Possible locations of the Vistula Spit cross-cut. Source: Maritime Office, Gdynia

In the Russian part of the lagoon, loss of jobs in the fishery sector and a slow development in the fields of tourism, recreation and aquaculture are the main problems for the area.

Most of these issues will need to be solved within national boundaries. However, well-functioning transboundary cooperation is vital for the lagoon's future development regarding the whole spectrum of decision making from environmental challenges to economic solutions. Both, the Russian and Polish part of the lagoon could greatly benefit from improved cooperation.

Need for future scenarios

How will climate change influence the lagoon's ecosystem? Will our legislation as well as water and coastal zone management be able to keep pace with the changing climate? What kind of adaptation measures will be necessary in the future? How can we improve transboundary cooperation?

The hottest present issue in the area is the plan to build the Vistula Spit cross-cut. Four different locations - Skowronki, Nowy Świat, Przebrno, and Piaski (Fig. 2) have been taken into account. Based on environmental impact studies and economical analyses, the most appropriate location has been determined (Skowronki), but decisions are a long time coming.

In order to answer the above questions we will define a set of future climate change and socio-economic scenarios, and, with the help of numerical models, will try to assess the following:

- Changes in water quality and eutrophication level
- Variations of salinization level in the Vistula Lagoon as an effect of expected water level rise, and intensification of water exchange with the Gulf of Gdansk
- Increase of flood risks in low-lying areas

Birds a threat to fishery in the lagoon?

The cormorants' nature reserve in Kąty Rybackie poses a big problem for local fishermen. It was created in 1957 on an area of 14 ha to protect black cormorant nesting sites. As a result, the cormorant population increased enormously (from 4000 in 1987 to around 24 000 birds in 2006) representing a real competition to local fishermen in fish catches. According to local fishermen, the cormorants can eat more fish than they would normally catch! This protected species is also posing a threat to local forests contributing to their destruction and changing the local landscape.

- Increase of salt intrusions upstream of the Pregola River
- Consequences on fish assemblages and fishery activities

Knowledge gaps

To describe the current status of the lagoon and its possible response to various climatic and economic scenarios we need to gather all the necessary information as well as understand the key processes driving the lagoon ecosystem functioning. Even though the lagoon area is regularly monitored, the monitoring program is not designed to fit purposes of modelling hydrodynamics and water quality of the lagoon, as well as assessment of climate change impact on the lagoon. Historical records of meteorological, hydrological and ecological parameters include lots of data gaps. Present national monitoring programs (Polish and Russian) are not synchronized in time and space with regard to sampling of hydrological and ecological parameters.

It is very important to consider atmospheric nutrient deposition and nutrient exchanges between the water column and the sediments in the models. In our case, this information is only approximated based on in situ measurements from other areas.

Information on main meteorological, hydrological and water quality parameters for the Vistula Lagoon and associated river catchments is very scarce and incomplete. The number of meteorological stations is not sufficient, type specific nutrient concentrations (as well as nutrient assimilation rates) for soils and land-use types in the catchment are unknown, and the CORINE Land Cover database does not cover Russian territory. These weak points become especially apparent when tackling transboundary problems. There is a need for free data acquisition and improved data access. In addition, a synchronization of sampling campaigns (sampling time, frequency, sampling technique) is necessary. Monitoring programs need to be adjusted to the needs of the modelling tools used for predicting changes in the lagoon's hydrodynamics (changes in salt distribution and assessment of possible salt intrusions into rivers, as well as assessment of currents and water level variations with special focus on flood risk) and water quality (possible intensification of toxic algal blooms). Only then will we be able to achieve reasonable decision making in the fields of water and coastal zone management.

Recommendations

1. Identification of future socio-economic scenarios in both parts of the lagoon coupled with demographic trends to estimate the resulting land use changes and ecological consequences. Special attention should be given to the assessment of the economic feasibility of the cross-cut construction to boost the development of Elbląg harbour.

2. Integration of information regarding current and future socio-economic conditions of the Polish and the Russian part of the lagoon to facilitate a more sustainable transboundary management. Preparation of options for visa-free travel schemes for boat and yacht traffic in the lagoon.

3. Identification of interactions (and possible feedbacks) between the climatic and socio-economic evolution to evaluate the lagoon's future carrying capacity in terms of discharge of pollutants, predominantly nutrients.

4. Identification of options for the integration of the spit with the south coast of the lagoon to facilitate tourism development.

5. Identification of gaps in the harmonization of legislation concerning coastal zone management and nature preservation (NATURA 2000) in order to promote sustainable development in the area. To give an example: The legislation regarding the use of the waters and the coastal zone as well as the protection of natural resources is not consistent.

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