



## **Coastal protection and Management in Kaliningrad (Russia)**

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### **Abstract**

The coast of Kaliningrad Oblast shows three distinct segments: two sandy spits, one in the south and one in the north of the Kaliningrad territory, and in between a promontory cliff section. Coastal morphodynamics are dominated by massive retreat along the northern side of the promontory and by longshore sediment transport in a southwestern to northeastern direction. In recent times, almost Kaliningrad's entire coastline suffers from erosion. This is partly due to a relative to sea level rise trend and partly due to man's interference with the dynamics of coastal processes. This interference, which is taking place both in Kaliningrad Oblast and in the neighboring regions of eastern Poland and western Lithuania, is mainly a result of rapid development of coastal tourism. Building up along the waterfront in the region changes the downstream sediment regime and enhances erosional trends even further. The Baltic Green Belt project activities revealed the need and demand for cross-border cooperation in order to cope with the regional challenges.

The enclave of Kaliningrad Oblast, a part of Russian territory, lies like an island within the Baltic Green Belt region. Although serious attempts were made at the onset of the BGB project to integrate Kaliningrad into the group of BGB project partners, these attempts failed due to extended EU-Russian negotiations on regional cooperation in 2009 and a long delay in Russia's signing the INTERREG cooperation agreements. Nevertheless, within BGB project work the BGB partners continued to involve colleagues from Kaliningrad in the discussions of coastal development issues where possible. One major issue that is of importance for all coastal regions in the southern and eastern Baltic is shoreline morphodynamics and coastline changes in a soft-rock geologic environment. A primary concern commonly shared by coastal managers in all countries from Germany to Estonia is the problem of coastal erosion which affects both low-lying sandy coastal segments and soft rock cliff sections. As visits of the BGB lead partner to Kaliningrad and academic information exchange showed, coastal erosion is a rather serious problem both on the western and on the northern coast of the Sambian Peninsula which makes up for the core of Kaliningrad's coastal region (Figure 1).

South of the geologic structure of the peninsula Kaliningrad's coast comprises parts of long, narrow sandy spits which have formed only recently in late Holocene time. Thus, both the north-eastern part of Vistula Spit and the western part of the Curonian Spit are parts of the Kaliningrad coastal system. These sandy coastal stretches form an envelope for the central coastal portion from Primorsk to Zelenogradsk.

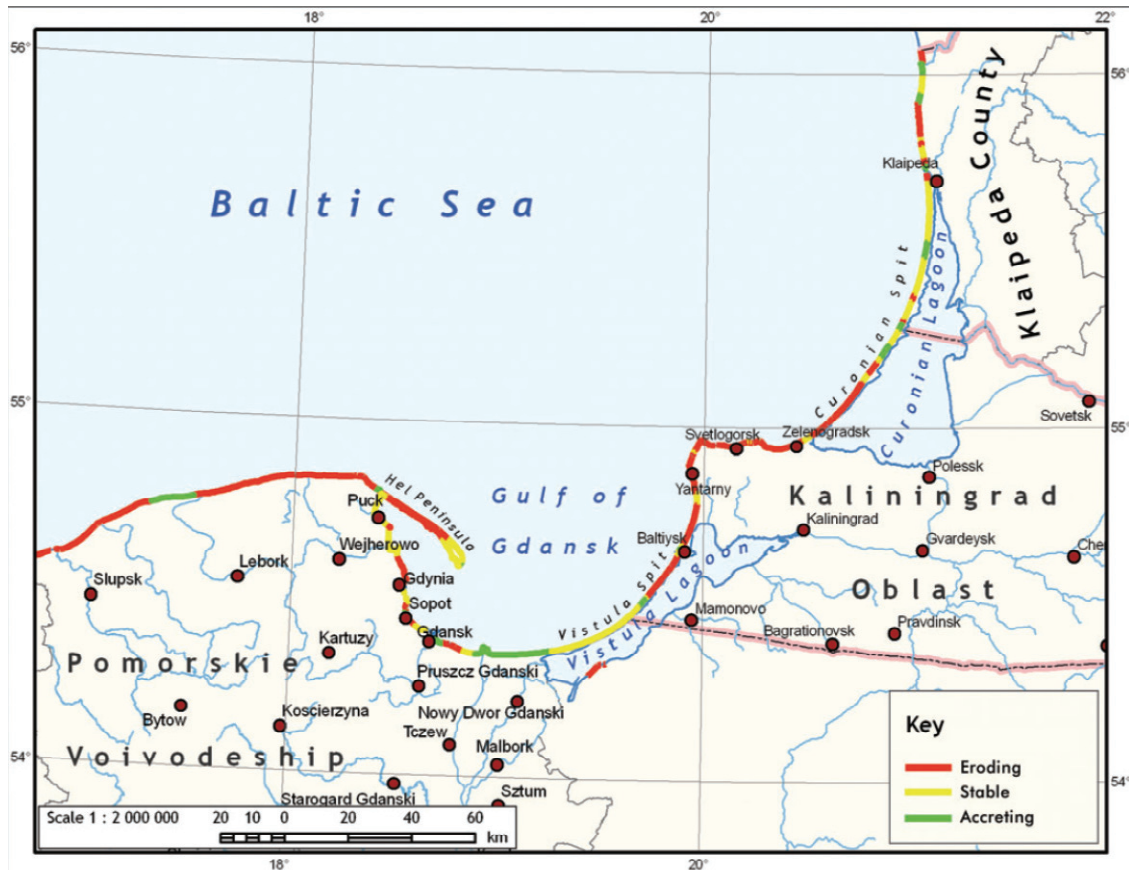


Figure 1: Coastline dynamics from eastern Poland to southern Lithuania (from Gilbert, 2009).

As Figure 1 shows, the larger Polish-Russian-Lithuanian coastal segment is a continuum of coastal cells, dominated by west-east oriented sediment transport, resulting from the dominating westerly wind and wave regime in this part of the Baltic. Due to slow but ongoing post-glacial isostatic subsidence this coastal region experiences a gradual steady sea level rise. In late Holocene times the sediments brought into the southern Baltic Sea by the two major rivers Vistula and Nemunas were used by waves and littoral drift to build up long spit structures which now block off the inner parts of the two bays. As a result most sediments brought by rivers to the coast are now trapped in these newly formed lagoons. In combination these factors lead to widespread sediment deficits and consequently to eroding shorelines. As Figure 2 shows most shorelines are depicted in red, marking erosion with stable shoreline stretches (yellow) and accreting sections (green) marking only shorter parts of coastline. In particular, virtually the entire Kaliningrad coast is undergoing serious erosion, both on the spits at the ends and in the central cliff section. This trend is believed to be enhanced significantly by climate change effects, such as the loss of protective ice covers during winter seasons.

For a long period following the Litorina transgression in the southern and central Baltic basin and, subsequently, the prograding sea levels the cliff coast of the western and northern flank of the Sambian Peninsula has undergone erosion and cliff retreat. The material derived from the eroding cliffs has been integrated into the longshore littoral drift system which is heading northeast across the Curonian Bay and has built up the 40 km long Curonian Spit. The Curonian Spit has diverse geodynamic regimes. As every spit system, the Curonian spit contains an erosive and an accumulative zone. The supplying erosion zone is at northern shore of the Sambian Peninsula and the southern edge of the spit. The middle part of the spit is in a state of equilibrium, where erosive and accumulative patterns, dependant on the direction of the sediment transport, are alternating.



Figure 2: Tourism infrastructure built alongside the eroding cliff coast at Svetlogorsk.

Kaliningrad Oblast has performed an ambivalent approach on the problems concerning the Curonian region. On the one hand, since the beginning of the 20th century, being under Prussian jurisdiction, hydro-engineering specialists tried to prevent the shoreline erosion of the Sambian Peninsula by installing groins in the near shore area. The moderate protective effect lasted only for 50 years. In the last decades the pressure on the coastal zone has been constantly increasing, mainly as a result of extended tourism development and encroachment of urban settlements towards the waterfront (Figure 2).



Figure 3: The picture documents recent approaches by Russian coastal engineers to prevent or reduce ongoing cliff erosion at Svetlogorsk at the northern shore of Kaliningrad.

This trend has been particularly prominent in the vicinity of the city of Svetlogorsk which has become the center of urban and touristic development in Kaliningrad Oblast. Building up valuable infrastructure along an eroding shoreline has recently documented the risks of coastal protection

management that is not really sustainable. Various engineering systems were installed to fix erosion problems, but without long-term local effects as of yet (Figures 3, 4). Distant effects, however, are more noticeable, as the reduction of eroding cliff material near Svetlogorsk is interfering with the sediment balance further to the northeast. Thus, both the Russian and the Lithuanian part of the Curonian spit now show increasing erosional tendencies (Zaromskis & Gulbinskas 2010).



Figure 4: Map showing artificial structures along Kaliningrad coasts, built to provide local shoreline stabilization (from Gilbert 2009). The protective measures along the northern coastal segment near Svetlogorsk and Zelenogradsk result in problematic sand deficits along the Curonian Spit all the way to Klaipeda and beyond (see chapt. 8).

The Curonian Area is a region of great socio-economic, recreational and environmental importance, both for Russia/Kaliningrad and for Lithuania. Here, the Baltic Green Belt project activities revealed the need and demand for cross-border cooperation in order to cope with the regional challenges.

Unfortunately, no official partner from the Kaliningrad region could get involved in the BGB activities. However, mutual visits and discussions on a scientific level suggest that both countries should combine their specific knowledge regarding the Curonian Area and together develop solutions for the problems related to coastal protection and management. Isolated approaches so far have not been beneficial in terms of financial, ecological, or territorial outcomes as they cover only parts of the problems. However, the benefits of a broad interdisciplinary cooperation covering the whole Curonian area are immense. Thus, the BGB project suggests considering the establishment of a Curonian Area Management Institution (CAMI) to launch or support bilateral policy making, planning and management. Such a cross-border ICZM approach could be an excellent good practice example for sustainable coastal development in the core of the BGB region.

## References

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