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Morphodynamics of cliffs and beaches of Svetlogorsk Bay (Baltic Sea, Kaliningrad Region, Russia) in XXI Century impacted by human activities in a coastal zone

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Svetlogorsk is a federal resort of Russia. Hence reliable information on coastal zone morphodynamics is necessary for sustainable coastal management. Concave in planform about 6.9 km long coastline segment adjacent to the Svetlogorsk town is unofficially called Svetlogorsk Bay. Dominant and long-inherited mode of coastal dynamics is wave erosion. Cliffs from 5 to 45 m high are composed of loose Quaternary and Neogenic sandy and clayey deposits. Cliffs exceeding 20 m are often affected by landslides. Coastal protection construction with recreation facilities began in late XIXth – early XXth Centuries. Constructions included wooden groynes and coastal promenades. Groynes constructed later in 1920-30s are still observed, but their beach-protective functionality is already long lost. In 1960-80s series of concrete anti-landslide walls at active cliff bases and concrete coastal promenade. These constructions are presently under active degradation at a number of places where landsliding intensified again. In 2008 stepped gabion walls were constructed along bases of several most active cliffs. However, their lower steps have already been destroyed by wave action at a number of locations. In 2015 construction of new sections of a concrete coastal promenade began. Territory of construction works was temporarily protected from wave action by the seaside wall made of metal lists. It was however installed below the sea level, which causes active bottom erosion nearby. Svetlogorsk Bay eastern flank remains practically unaffected by human activities in a coastal zone and can therefore be used as a reference territory for natural coastal dynamics. Wave-protection constructions blocking sediment delivery from cliffs onto beaches has resulted in manifold increase of sediment deficit within a coastal zone in general. According to the 1:25000 topographic map dated to 1936, total area of beaches within the Svetlogorsk Bay was 18.5 ha, mean width –34.2m. During direct observations between 2003 and 2017 area decreased from 14.4 to 3.6ha, mean width – from 32.2 to 15.8m. About 3 km length of the coast is presently completely devoid of beaches. That in turn caused further increase of wave erosion, cliff degradation and coastal protection damage. The last 5 years detailed monitoring program has been carried out involving regular surveys by GNSS, TLS and UAV. New information on coastal dynamics, cliff degradation processes, spatial and temporal patterns of wave erosion and accumulation within the above-water part of a coastal zone has been acquired. Volumes of cliff denudation for its sections with different morphology and structure and total volumes of beach-forming material at different hydrodynamic periods have been quantified. It can be concluded that general impact of existing and recently constructed coastal protections is rather negative and causes a reverse effect of increasing rates of beach erosion and cliff denudation over the last decade. These new data provide additional proof of necessity for regular artificial beach nourishment in areas where deficit of sediment within a coastal zone is evident and of general negative effects of human interference into coastal processes without reliable scientific basis.

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