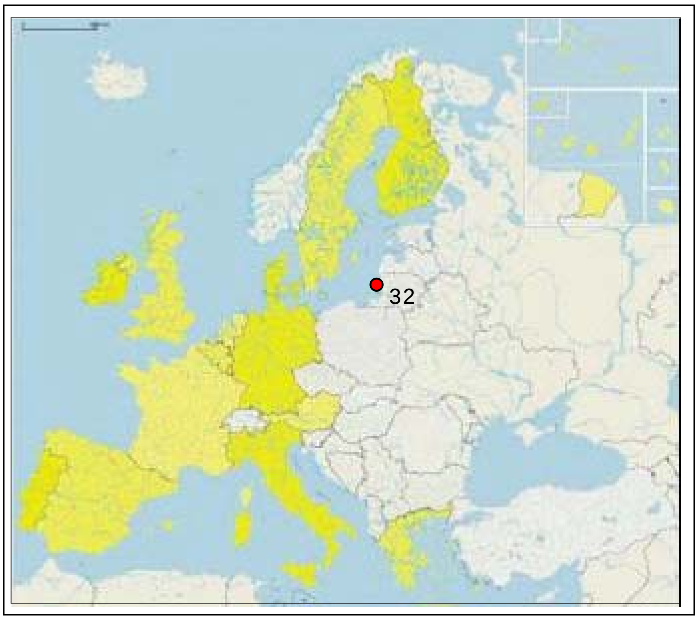
KLAIPEDA
(LITHUANIA)



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1. GENERAL DESCRIPTION OF THE AREA

The Baltic coast of Lithuania extends to 91 kilometres. It is one of the shortest national coastlines in Europe. The case study covers the northern part (46 km) of the Lithuanian Baltic coast within three municipalities: Klaipeda and Palanga urban municipalities (miestas) and Klaipeda rural municipality (rajonas). The study area is located in the west of Lithuania on the south east coast of the Baltic Sea (Figure 1). Klaipeda is the third largest city of Lithuania and its major seaport. Palanga is the biggest seaside resort of Lithuania and one of the biggest ones in the east Baltic region.

1.1 Physical process level

1.1.1 Classification

According to the coastal typology adopted for the EUROSION project in the scoping study, the case study area can be described as a combination of:

3b. Wave-dominated sediment. Plains.
Micro tidal dune coasts.
2. Soft rock coast.

Within these major coastal types coastal formations and habitats of sandy beaches with bare and vegetated sand dunes prevail.

Fig. 1: Location of the case study area.

1.1.2 Geology

The Lithuanian coastal zone belongs to the southeast Baltic region of graded coasts, which took their present shape during Pleistocene and Holocene. Within the strip of coasts, which stretches northwards from Sambian peninsula deposits of glacial drift and marine sand accretion prevail. Recent geological history of the case study area since the end of the latest Ice Age (ca. 10 – 12 thousand years B.P.) is closely related to the development of the Baltic Sea. Several sea transgressions after the deglaciation caused active erosion of Quarternary glacial drift deposits and longshore sediment distribution along the eastern Baltic coast. Grading of the shoreline as well as dune, lagoon and wetland formation in the coastal zone were the key processes featuring the latest geological and geomorphological development of the southeast Baltic coastal region. These processes were the most active during and after the Littorina sea transgression (5 – 6 m above the modern sea level) in the mid-Holocene (8 – 5 thousand years B.P.).

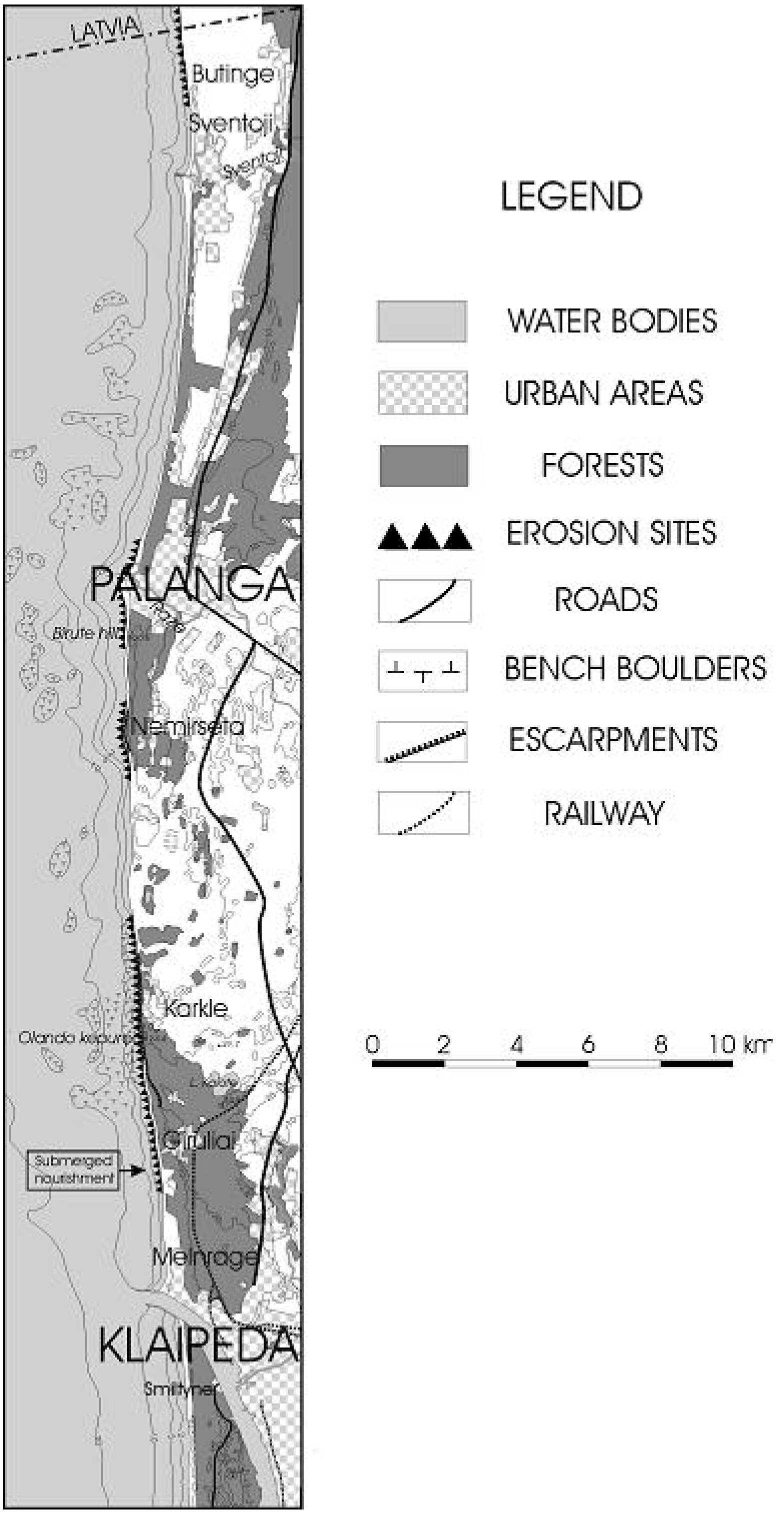

Fig. 2: Map of Klaipeda – Palanga case study area.

The reworking of glacial deposits by waves and longshore currents had sorted out the moraine till into sand, gravel, pebbles and boulders. The prevailing sediment type in the foreshore, beach and dunes of the accumulative part of the case study area is fine and medium-sized Quartz sand (M_d=0.2 – 0.5 mm). The composition of sediments at the eroded soft rock cliffs is more diverse. Quarternary loam or till deposits of different size, including clay, sand, gravel, pebble and boulders form soft cliffs (bluffs). Medium-sized sand covers the beach, but also sorted gravel, pebble and boulders left from the eroded bluffs are found there. Boulders and pebble also prevail on the surface of the foreshore bench forming a characteristic "hard bottom" habitat.

1.1.3 Morphology

The morphological structure of the Lithuanian coast is rather simple (see Figure 1). The southern half is formed by the Curonian Spit, a narrow concave peninsula separating the Curonian Lagoon from the Baltic Sea. The Curonian spit is a sandy stretch of land extending 98 kilometres, half of which belongs to Lithuania, the other half to Russia. The width of the peninsula varies from 400 metres to 3.8 kilometres.

The Curonian spit is separated from the mainland coast by a narrow Klaipeda strait (Figure 2). The strait serves as an outlet for the Nemunas river discharge to the sea, and as a Klaipeda seaport gate as well. The mainland coast of Lithuania stretches to the north of the Klaipeda strait. It changes into erosive - accumulative coastline, where cliff and dune coasts occur alternately. It has a shape of three concave arcs, which are separated by rather indistinct heads. Such shape of the shoreline reflects the morphological structure of the mainland, where the eroded heads – ledges of the winding longshore ridges of Pleistocene moraines and/or Holocene dunes provide sediments filling the adjacent low-lying accretion coast.

Till bluffs formed at the eroded heads are up to 20 m high. At the promontories the beach is only 10 – 15 m wide. Beach of the accretion coast is 30 – 50 m wide and relatively steep (i = 0.07). The onshore part of the sedimentary coast is nearly everywhere framed by the artificially created 8 – 15 m high foredune behind the beach. Behind the modern foredune there are 20 – 25 m high ancient formations left by the Littorina sea transgression: the ancient marine scarp and/or parabolic dune ridges.

The foreshore bottom relief mirrors the onshore one. Several (2–3) shore-parallel underwater sand ramparts feature the flat foreshore of the sedimentary coastal area, while the hard bottom bench in front of the eroded soft bluffs has a more fragmented relief.

Three different morphodynamic coastal strips could be distinguished in the case study area, from south to north:

- **South:** the coastal strip between Smiltyne and Melnrage is characterized by a relatively strong accretion. The beach is wide (50-70 m), covered by a well-sorted medium-sized sand. It is framed by a 12 – 14 m high artificial foredune. The foreshore is very shallow, it has three ramparts and sandy bottoms down to the 20-30 m depth.

- **Middle:** coastal scarps and bluffs of glacial drift deposits prevail between Giruliai and Nemirseta. They are overtopped by the Aeolian sand of the Holocene period. A terrace from Littorina sea transgression with steep scarps forms another important coastal landscape feature with numerous coastal wetlands, rivulets and dense mixed old forest plantations. It gradually descends down northwards and southwards from the glacial bluff of Olando kepure, where it reaches 25 m height. A relative height of the Littorina sea terrace slope varies from 8 to 11 m.

- **North:** north of Nemirseta the grading of the coast during the series of the Baltic Sea transgressions all through the Holocene created favourable conditions for sand accretion. The shoreline is relatively stable (except the places adjacent to the Palanga pier and near Latvian border). The beach is relatively wide (50 – 90 m), covered by a well-sorted medium-sized sand. It is framed by a 3 – 6 m high artificial foredune. There is a coastal accumulative plain covered by the Aeolian sand of the Holocene period behind the foredune. The Littorina terrace is much lower and much wider there compared to the area south of Nemirseta. It is covered by numerous coastal wetlands, rivulets, pine-forest plantations. The major landmark of this area is Birute hill – a 20 m high parabolic dune. The foreshore is relatively shallow. It has three ramparts and sandy bottoms. Glacial drift deposits come to the bottom surface at the depth of 4 – 6 m, where bottom topography becomes fragmented.

1.1.4 Physical processes

Waves and storm surge, longshore currents

Wave activity and the wind-induced surge during storm events are the principal physical erosion agents in the case study area. The coast of the case study area is exposed to the strongest and the most frequent storms of the longest western (SW, W and NW) fetches. The mean wave height during westerly storms reaches 4 m in the deep offshore at Klaipeda, when the wind velocity is 20 m/s. Therefore during every storm event the beach is overrun by waves and the storm surge erodes foredunes or soft rock bluffs. Annually there are about 73 stormy days with the wind velocity above 15 m/s on the Lithuanian Baltic coast.

A succession of severe storms of the kind seen in the southeast Baltic in recent decades resulted in a more permanent shoreline recession in the case study area. In the last fifty years Lithuanian coastline has been subjected to at least ten extremely strong storms (1954, 1967, 1969, 1971, 1975, 1983, 1986, 1990, 1992 and 1999) of the kind that, according to statistics, should occur only once in a hundred years. The increasing coastal erosion is largely due to the increasing storm frequency. Series of subsequent storms enhance the erosion process. The graded open coast of the case study area is favourable for the development of longshore currents, which serve as the main agent of sediment distribution along the coast.

Decline of sediments

Since the 1830's the construction of Klaipeda seaport breakwaters (jetties), as well as regular dredging of bottom sediments at the Seagate corrupted the resulting secular northbound longshore sediment drift, which for centuries had supplied the Lithuanian mainland coast with sand brought from the eroded Sambian promontory. Furthermore 500 thousand cub. m of polluted sand was taken away from the beaches of the case study area after the disastrous crude oil spill out of a wrecked tanker at Klaipeda in November 1981.

Such human intervention caused the deficit of sediments at the mainland foreshore and beaches, and significantly reduced the resistance of the mainland coast against erosion. This situation makes the coast of the case study area particularly vulnerable facing the increased storm frequency in the second half of the 20th century.

Ice

Only in extremely cold winters an ice fringe develops on the Lithuanian Baltic coast. A fast ice protects the coast from strong winter storms. However during the last two decades the winters used to be extraordinarily warm, and fast ice has formed only in 1979, 1987, 1995 and 2002. Therefore its long-term protective or erosive impact was negligible in the case study area.

Eustasy vs. Isostasy

The annual eustatic sea level rise in the case study area is app. 1 – 2 mm. However there is no clear evidence about the impact of such increase upon the resulting secular shoreline development.

Tide

Regular tide ranges in the adjacent Baltic Sea foreshore are less than 0.25 m; therefore tidal action plays virtually no role in coastal development.

Weathering and underwashing

Both processes play an important role in decreasing the resistance and stability of the exposed seaward slopes of the eroded soft rock bluffs thus making them more susceptible to wave action. However the exact assessment of the erosion role from weathering and underwashing is difficult as this impact is closely linked to wave action and no special investigations into the problem have been taken so far.

1.1.5 Erosion

The resulting direction of the secular sediment drift along the Lithuanian Baltic coast is northbound – from the eroded bluffs of the Sambian promontory towards the Gulf of Riga. Various researchers give different estimated net sediment transport rates within the range of 100 – 500 thou. cub. m annually.

Structural erosion

In a secular time span the graded coastal stretch of Klaipeda and Palanga is close to the dynamic equilibrium conditions. The accretion prevails in Smiltyne, Melnrage and Palanga – Sventoji (app. 0,5 – 1 m annually) and the resulting secular retreat of coastline is at Olando kepure and Nemirseta bluffs (app. 0.3 – 0.5 m annually).

Acute erosion

The last few decades witnessed a certain change of dynamic equilibrium conditions in coastal development of the case study area. The activation of coastal processes has been observed along the entire coastline. As it has been already mentioned above, an increase in coastal erosion is triggered by the increased frequency of the extremely strong and disastrous storms of the westerly fetches. Also, direct human impact should be considered as well, e.g., the corruption of the longshore sediment drift due to the upgrading of seaport facilities in Klaipeda.

Certain secular erosion cycles could be recognized in the case study area based on the comparative cartometric survey. The accretion prevailed along the entire length of the Lithuanian coast (except the Olando kepure and Nemirseta bluffs) in the first halves of 19th and 20th centuries, whereas the erosion zones had expanded in the second halves of 19th and 20th centuries. Such shoreline development cycles could be caused by possible secular cycles of storm frequency, and/or by a more active human intervention into the coastal zone of the case study area in second halves of 19th and 20th centuries as well.

The coming decades might witness a further expansion of erosion zones due to global climate change, which could enhance the activation of storms in the Baltic Sea region, and due to ever more active human intervention into the coastal zone (mainly, related to a further expansion of the Klaipeda seaport).

1.2 Socio-economic aspects

1.2.1 Population rate

The total number of inhabitants living in Klaipeda – Palanga case study area (within the 2 km coastal zone) and population density is given in Table 1.

Table 1: Population of the Klaipeda – Palanga case study area (within the 2 km coastal zone).

Locality	Population	Density
Klaipeda	2000	70
Karkle	1000	40
Palanga	18000	600
Šventoji	4000	130
TOTAL	25000	270

1.2.2 Major functions of the coastal zone

- **Industry, transport and energy**: There are two international seaports in the case study area: Klaipeda State Seaport is located in the south, whereas the floating Butinge Oil terminal is located next to the Latvian border in the north. Klaipeda State Seaport is one of the largest seaports in the eastern Baltic region with the annual cargo turnover of 19.7 Mio. metric tons in 2002. The quays located at the Seagate belong to the "Klaipedos nafta" oil terminal. The annual turnover of that enterprise was 6,7 Mio. metric tons of oil in 2002. Meanwhile the annual turnover of Butinge oil terminal was 6.2 Mio. metric tons of oil products in 2002. Palanga municipal wastewater treatment plant is located in Butinge (ca. 5,1 Mio cub. m of wastewater treated annually).

- **Tourism and recreation**: The entire study area is the most favourite destination for summer vacations in Lithuania. Palanga is one of the biggest seaside resorts in the east Baltic region. Data about tourism capacity of the case study area are summarized in Table 2.

Table 2: Tourism in Klaipeda – Palanga area (in 2002).

Locality	Tourism facilities (beds)	Annual tourist visits (in millions)	Daily tourist visits of the peak season	Annual overnights (in thousand)
Smiltyne	100	2	45'000	8
Melnrage-Giruliai	1'100	4	75'000	90
Karkle	500	1	25'000	30
Palanga	80'000	6.5	200'000	4'000
Sventoji	20'000	1.5	50'000	700
TOTAL	101'700	15	395'000	4'828

The major international tourist attractions are the Water World in Smiltyne (app. 800 thousand visitors annually) and the Amber Museum in Palanga (app. 100 thousand visitors annually).

- **Urbanisation (safety of people and investments):** The distribution of population within the case study area is given above in Table 1. The least safe concentration of inhabitants is in the central part of Palanga town and in Sventoji settlement, where residential areas for app. 14 thousand inhabitants are located on the low-lying accumulative lowland behind the foredune. These areas could face an eventual flooding threat if an extremely violent storm surge breaks the foredune. Also, leisure facilities could face similar danger: the Water World in Smiltyne, the Amber Museum in Palanga, app. 30 hotels, hostels and camping sites (total number of beds – 5 thousand), app. 30 km of coastal streets and roads.

- **Fisheries:** Small scale fishing provides income for app. 200 fishermen in the case study area. Baltic herring, sprat, cod, salmon and smelt prevail in the commercial catches. The distribution of fishing boats and catches is given in Table 3.

Table 3: Fishing boats and commercial fish catches in Klaipeda – Palanga area in 2002.

Locality	Number of boats	Annual catches (in tons)
Smiltyne	6	5
Melnrage-Giruliai	10	8
Karkle	8	7
Palanga	8	6.5
Sventoji	12	9.5
TOTAL	44	36

- **Nature conservation:** The case study area is very important for conservation of cultural and natural heritage as well. The Curonian spit is included into the World Heritage List as a cultural landscape of international importance. It has the status of national park. Also, Pajuris (Seaside) regional park and two nature reserves are located in the case study area (Table 4). The foreshore in front of Palanga is protected as an internationally important bird area.

Table 4: Protected nature areas in the coastal zone of Klaipeda – Palanga.

Name	Protection status	Size (ha)	Main biotopes
Kursiu nerija	National park	780*	Vegetated dunes, foredune, embryo dunes, sandy shallows
Pajuris	Regional park	2700	Vegetated dunes, foredune, embryo dunes, sandy shallows, hard bottoms, dune slacks, sandy meadows
Butinge	Geomorphological reserve	113	Vegetated dunes, foredune, embryo dunes, sandy shallows, dune slacks
Sventoji	Ornithological reserve	236	Dune slacks and marshes

* within the administrative borders of Klaipeda city

- **Agriculture and forestry:** No agriculture and forestry of an industrial scale is in this predominantly recreational area. Agricultural activities are of small-scale, whereas forests mainly serve for recreational and conservation purposes.

Fig. 3: Melnrage rescue station and leisure facilities with the exposed concrete revetment on the retreating beach. Photo: E. Paplauskis, May 2001.

1.2.3 Land use

In Figure 2, the land use at the case area is shown. Land use mainly comprises forestry, urban areas and industry. The forests are present along most of the coastal stretch and mainly serve for recreational and conservation purposes. Forestry covers about fifty % of the coastal strip. The urban areas are concentrated at Klaipeda, Palanga and Sventoji. With industry mainly the seaport areas are meant.

1.2.4 Assessment of capital at risk

Within the case study area increasing erosion currently threatens the foredune and leisure facilities of the Giruliai and Palanga beaches (Melnrage rescue station, Palanga promenade pier, etc. see Figure 3). As these are the most visited seaside beaches in Lithuania, the total capital at risk could be valued ca. 4 – 6 Mio EUR. The costs of damage inflicted by the

December 1999 hurricane ('Anatole') to the coastal zone of the case study area are given in Table 5.

Table 5: Damage inflicted upon the Klaipeda – Palanga coast by the December 4, 1999 storm.

Locality	Amount of damage	Description of damage
Smiltyne	120'000 EUR	Eroded seaward slope of the foredune on 5 km strip (200 thou. cub. m of sand washed away), destroyed stair and paths leading to the beach
Melnrage-Giruliai	100'000 EUR	Eroded seaward slope of the foredune on 4 km strip (150 thou. cub. m of sand washed away), destroyed stair and paths leading to the beach
Karkle	130'000 EUR	Eroded seaward slope of the foredune on 3 km strip (1 km of the foredune completely erased)), 50 thou. cub. m of sand and 15 thou. cub. m of till washed away, destroyed stair and paths leading to the beach
Palanga	430'000 EUR	Eroded seaward slope of the foredune on 10 km strip (1 km of the foredune completely erased)), 500 thou. cub. m of sand washed away, damaged promenade pier, destroyed stair and paths leading to the beach
Sventoji	170'000 EUR	Eroded seaward slope of the foredune on 14 km strip (350 thou. cub. m of sand washed away), destroyed stair and paths leading to the beach
TOTAL	950'000 EUR	Eroded seaward slope of the foredune on 36 km strip (2 km of the foredune completely erased), 1250 thou. cub. m of sand and 15 thou. cub. m of till washed away, damaged Palanga promenade pier, destroyed stair and paths leading to the beach

2. PROBLEM DESCRIPTION

2.1 Eroding sites

The eroding sites at the case area are described from south to north:

- **Giruliai- Karkle**

Both, structural and acute erosion are present in this coastal strip. A secular annual retreat of the eroded coastal bluff at Olando kepure is app. 0.2 m. The height of the bluff varies from 24.4 m at Karkle to 4.4 m near Giruliai. The bluff is active, not covered by vegetation, with numerous traces of landslides, landslips, fallen trees and sliding bushes (Figure 4). The beach between Giruliai and Karkle is relatively narrow, 10 – 15 m wide, covered by mixed sediments, where gravel prevails with admixture of medium-sized sand, pebble and boulders. The foreshore is relatively steep, formed by a bench of boulders, pebble and gravel.

In the second half of the 20th century the erosion zone has expanded app. 2 – 3 km south and north from the Olando kepure bluff. The annual retreat rate of the hitherto stable coast was 0.5 – 1.0 m in the period of 1950 – 2000. The scale of the coastal retreat is witnessed by the exposure of a coastal fortification from the World War II, which was originally built in the foredune (Figure 5).

Fig. 4: Till debris at the foot of the eroded Olando kepure bluff. Photo: A. Stubra, May 1999.

Fig. 5: World War II bunker in Giruliai, which became exposed on the beach as the foredune retreated. Photo: E. Paplauskis, May 2001.

- **Nemirseta**

Like in the case of the above-described Giruliai-Karkle coastal strip, both, structural and acute erosion are present there. A secular annual retreat of the eroded coastal bluff at Nemirseta is app. 0.4 m. The height of the bluff is only 4.6 m there. The bluff is active, not covered by vegetation, but without traces of landslides and landslips. The beach at Nemirseta is 15 – 25 m wide, covered by mixed sediments, where medium-sized sand prevails with admixture of gravel, pebble and boulders. The foreshore is relatively steep, formed by a bench of boulders, pebble and gravel. In the last decades of the 20th century the erosion zone has expanded app. 1 – 2 km south and north from the Nemirseta bluff. The annual retreat rate of the hitherto stable coast was 1 – 1.5 m in the period of 1950 – 2000.

- **Central Palanga**

This structurally stable open and graded coast is characterized by conditions of very dynamic equilibrium, which suffers from unreasonable human impact. The construction of the promenade pier in late 1880s and its numerous reconstructions during the 20th century caused dramatic shifts of the coastline in the central part of Palanga seaside resort, which was the most valuable for recreation. The resulting retreat of the shoreline was 0.7 – 1.2 m annually in the period of 1950 – 2000.

- **Butinge**

This is another strip of structurally stable accretion coast, which suffered from the acute erosion in the last decades. The annual retreat of the coastline was app. 1 – 1.5 m in the period of 1950 – 2000. Such dramatic shift in the trend of coastal dynamics most probably is caused by the impact of the Sventoji pier, as Butinge is on the leeward side of the pier regarding the northbound sediment drift.

2.2 Impacts

The impacts of erosion at the different coastal strips at the case area are described from south to north:

- **Giruliai- Karkle**

The beach became narrow (only 20 – 25 m wide), covered by mixed sediments with admixture of gravel and pebble, the seaward slope of the foredune became eroded during every stronger storm event and restored only by human efforts. Some leisure facilities (Melnrage rescue station, two camping sites in Giruliai and Karkle) and a heritage graveyard in Karkle became threatened by coastal retreat.

- **Nemirseta**

The beach became less wide (30 – 40 m wide) and covered by medium-sized sand with admixture of gravel and pebble. The seaward slope of the foredune became eroded during every stronger storm event and restored only by human efforts.

- **Central Palanga**

The wide sandy accretion beach and the foredune, which boasted the most intensive recreational use in the east Baltic region throughout the second half of the last century are washed away during every bigger storm event. It takes a lot of efforts to restore coastal leisure amenities (foredune, stairs, paths, etc.) before every summer season.

- **Butinge**

Waves have completely erased the seaward part of the coastal village at Butinge (app. 10 ancient wooden cottages). Also, the discharge pipeline of the Palanga wastewater facilities is exposed to wave action due to coastal erosion.

3. SOLUTIONS / MEASURES

3.1 Policy options

Policy options adopted

The most opted coastal protection policy in Lithuania in general and in the case study area in particular is limited intervention through coastal foredune and forest management, as well as through the submerged nourishment aimed to stabilize the coastal zone, particularly the recreational beaches.

Policy options considered

A national shoreline management strategy for Lithuania is currently being considered, which might include more active shoreline management policy measures aimed to hold the shoreline at Karkle and Butinge. However this strategy is only in the initial discussion phase yet.

3.2 Strategy

3.2.1 Approach related to the problem

To fight coastal erosion, all forests and foredune ridges of the coastal zone in the case study area have been classified as protected and preserved. Coastal forests and dunes being the integral part of the coastal belt enjoy protection within the general nature conservation framework. They are, according to the Law on Forests, specifically regarded as a protected category. The use of forests is limited, clear cutting of trees is not allowed in a zone of 1 km. The foredune is regularly maintained and restored after every season of autumn and winter storms. Any new constructions in the coastal zone are allowed only behind the foredune. Maintenance of the foredune and coastal forests is a joint responsibility of local municipalities and administrations of Kursiu nerija national park and Pajuris regional park.

3.2.2 Issues concerning threat to life and property

There exist detailed evacuation plans for a flooding (storm surge) period in the case study area. Lithuanian Fire Defence and Rescue Service is responsible for the emergency mitigation of erosion and/or flooding disaster effects and for evacuation of people.

Most of expensive houses in the coastal area of Klaipeda and Palanga are insured against damage. In the case of a very big eventual flooding or erosion disaster the municipalities are supposed to provide a temporary dwelling and a limited subsidy for those who would suffer the most. For the bigger aid or for a compensation of damage caused by erosion, like in the case of the December 1999 disaster, municipalities apply to the national Government.

3.3 Technical measures

3.3.1 Type

Foredune and forestry maintenance

As it was already mentioned, maintenance of coastal foredune and forest plantations (restoration, fastening and revegetation of the foredune with marram grass and hybrid marram grass) is the principal technical coastal stabilization measure within the study area (Figure 6).

Submerged nourishment

Sand dredged from the Klaipeda Seaport gate was applied for the submerged nourishment of the coastal zone in the foreshore at Giruliai in 2001 (Figure 7).

Fig. 6: Eroded foredune fastened with fences and fascines in Pajuris regional park. Photo: E. Paplauskis, June 2001.

Fig. 7: Submerged foreshore nourishment at Giruliai. Photo: V. Kaunas, April, 2001.

3.3.2 Technical details

Foredune and forestry maintenance

The foredune is maintained behind the beaches at 80% of the case study area. Coastal pine plantations cover 50% of the coast length behind the foredune ridge and other coastal locations. The total area of managed foredune ridge and coastal pine forest plantations within the case study area is 42 sq. km.

Submerged nourishment

The total volume of sand applied for the submerged foreshore nourishment at Giruliai in February – July 2001 was 537 thousand cub. m of sand, dumped at the depth of 4 – 6 m.

3.3.3 Costs

Foredune and forestry maintenance

Annual maintenance cost for coastal pine forests is 3,0 thousand EUR per hectare. Annual maintenance costs for coastal foredune (in average year) is 1.5 thousand EUR per hectare. The revegetation of the foredune by marram grass costs another 2.0 thousand EUR per hectare, but it is not applied every year.

Submerged nourishment

The total cost of Klaipeda Seagate dredging and submerged foreshore nourishment at Giruliai in 2001 was 1.26 M. EUR.

4. EFFECTS AND LESSONS LEARNT

4.1 Effects related to erosion

Preliminary investigations into the effects of the experimental submerged foreshore nourishment at Giruliai have raised certain hopes that application of this ‘soft’ measure might effectively mitigate the negative impact caused by the corruption of the longshore sediment drift. The only problem is that such measure is a rather costly one.

Forest and foredune maintenance and restoration is effective in mitigation the damage due to storms. This measure is cost-effective because the labour costs in Lithuania are relatively low.

4.2 Effects related to socio-economic aspects

The ongoing efforts of limited intervention by restoring and maintaining the foredune and by keeping new constructions away from the coast are successful in limiting the damage, which is inflicted by storm activity upon the socio-economic functions of the coastal zone. As it is evident from Table 5, even in the case of the most severe hurricanes the damage is limited to such leisure amenities as beaches, seaward slopes of foredunes and small-scale leisure facilities like wooden paths, stairs, etc. The only exception is the promenade pier in Palanga.

4.3 Effects in neighbouring regions

The expensive and unsuccessful reconstruction of the promenade pier in Palanga in late 1990s has proved that any human intervention into the highly dynamic environment of the open Baltic coast might cause unpredictable effects regarding coastline development in neighbouring regions. The reconstruction of the pier has triggered erosion of the adjacent beaches and foredunes. This negative trend was enhanced by the increased storm wave action in late 1900s. As it was already mentioned above, the corruption of the longshore sediment drift at the mouth of the Klaipeda strait has enhanced coastal erosion on the entire Lithuanian (and even Latvian) mainland Baltic coast.

4.4 Relation with a ICZM

According to Lithuanian legislation, all coastal management issues, including coastal defense, development and/or coastal conservation are integrated into the general physical planning and management framework. Requirements exist to prepare territorial planning documents for coastal zone management and assess environmental impact of the planned solutions. The Lithuanian Law on Territorial Planning of 1995 establishes a planning system on four levels: national planning, county planning, local comprehensive planning and detailed planning. The Klaïpeda county master plan was adopted in 2002. It is compulsory according to the Law on Territorial Planning, and some issues of ICZM might be regarded as state policy as Klaïpeda County covers the whole coastal area of Lithuania. It aims to provide clear guidelines for sustainable and integrated development priorities of the Klaïpeda county until the year 2020. It is to become a key part of the state spatial planning system and a guide for other plans. It is anticipated that the proposed national shoreline management strategy will be integrated into the Klaipeda county master plan.

The municipalities prepare comprehensive and detailed plans, secure their implementation and participate in county plan production. A comprehensive plan is prepared for the territory of a rural municipality or a town. Comprehensive planning establishes more specific land use requirements and obligations and defines the primary purpose of certain areas within a local community, town, or particular property. It also determines parts of rural areas where detailed planning is mandatory. There is a comprehensive plan approved for Klaïpeda urban municipality and in 2003 similar comprehensive plans will be developed for Palanga urban municipality and Klaipeda rural municipalities as well. All three plans will cover issues on ICZM.

An international ICZM project for the Baltic States and Poland (1998 – 2000) also covered the case study area. This satellite-image and GIS (Geographic Information System) based project was aimed to give Estonia, Latvia, Lithuania and Poland the opportunity to better manage their coastal resources in an environmental and sustainable way.

4.5 Conclusions

Effectiveness

There are at least two aspects of effectiveness to be considered: a) process efficiency and b) cost – benefit efficiency. Regarding process efficiency we should consider how effectively a chosen strategy mitigates the corrupted natural conditions of coastal dynamic equilibrium, or how effectively a chosen strategy is able to reduce negative impacts of the global climate change. In this respect the submerged nourishment of the mainland foreshore using dredged deposits might appear to be the only truly effective in a long-term coastline management strategy. On the other hand, it is a rather costly strategy, unless the foreshore nourishment costs are internalised either into the Klaipeda seaport operational costs or into the costs of coastal leisure services.

Comparing the costs of the above described traditional limited intervention policy against the damage of coastal leisure amenities we see that foredune restoration and revegetation efforts are still effective as long as they succeed to mitigate the damage done to the coast by storm activity, and as long as these costs are reasonable due to low manual labour costs in Lithuania.

Possible undesirable effects

The process of sediment dumping and the turbulence of the bottom at the submerged nourishment sites have inflicted losses to a dozen of local small-scale fishermen, which used the Baltic foreshore at Giruliai as their fishing ground.

Gaps in information

Many issues related to the current development of the Lithuanian Baltic coast are still unclear. Firstly, what is the main source of sediments feeding the mainland coast; secondly, what is the scale of the impact from human intervention upon the coastal zone (particularly from the expansion of Klaipeda seaport facilities); thirdly, what is a long–term effect from the submerged nourishment of the foreshore, and which are the best sites for application of that strategy. Finally, what will be the long-term trends of the main physical processes causing coastal erosion in the case study area in the 21st century. Apparently, only a comprehensive long-term coastal monitoring could give answers to these crucial questions.

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