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Distinguishing priority sectors for the Lithuanian Baltic Sea coastal management

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Abstract In order to distinguish the priority sectors of the Lithuanian coast (in terms of coastal management), this study analyses the main factors that are responsible for the current state of the coast and that will have an influence on its future development. The mentioned factors include: the current state and geodynamic trends of coastal sectors, character and intensity of coast use, possible anthropogenic factors which may affect coastal stability and influence of climate change. The generalization of the results of this analysis allows distinguishing the coastal sectors that can be regarded as the priority ones in terms of coastal management. The legal basis for the coastal management regulation and HELCOM recommendations were taken into consideration.

Keywords *Baltic Sea, coastal management, geodynamic trend, impacts of climate changes, coast use.*

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INTRODUCTION

The present state of the Lithuanian coastal zone is an object of concern not only for researchers but also for the Government, mass media and public. The recreational space deteriorates and reduces as a result of coastal abrasion. The hydrotechnical constructions and other industrial objects as well as their infrastructure in the coastal zone are in danger.

In the last 30 years (1976–2006), the total length of Lithuanian accumulative coastal sectors has been reducing by about 110 m every year on the average. The total length of eroded coastal sectors has been increasing by 367 m every year on the average. For comparison it should be reminded that during the previous 30 years (1946–1976), the total annual reduction of accumulative coastal sectors was 100 m on the average, and the increase of the length of eroded sectors was only 33 m (Žilinskas & Jarmalavičius 2007a). Thus in the last 30 years, the rates of the Baltic Sea coastal abrasion have increased more than tenfold.

The "Law of the Coastal Zone of the Republic of Lithuania (02 07 2002, No IX – 1016, Article 3) provides for "safeguarding sustainable use of coastal zone for national and public use" and "safeguarding the implementation of protection measures for nature and cultural monuments". The same Law (Article 8) emphasizes the necessity of implementation of coastal management measures "for preservation or regeneration of the prime or typical properties of coasts…".

By Order No 442 of 01 09 2003 of the Minister of Environment the "Programme for Coastal Zone Management" was confirmed. It served as a basis for the development and implementation of coastal management projects for 2004–2007. The project "Regeneration and preservation of the Baltic Sea coastal zone" assumed in 2005 and supported by the EU is scheduled to be finished until the middle of 2008. The coastal management works of the last five years (replenishment of Melnragė–Giruliai nearshore and Palanga beaches with sand, reconstruction of the groyne at the Palanga pier, elementary reinforcement of the dune ridge, development of recreational infrastructure, etc.) have brought positive results and they must be continued. For this purpose a new "Programme of coastal management for 2008–2013" was elaborated and confirmed.

However, the capacities and means for simultaneous management of the whole Lithuanian coastal zone are insufficient. Moreover, as practice has shown, much time is wasted on implementation of legal requirements (coordination of coastal management measures with various institutions, organization of tenders for concrete works, etc.). Bearing this in mind, it is necessary to distinguish the most vulnerable coastal sectors in the Lithuanian coastal zone for the priority management.

MATERIAL

The present research includes the whole Lithuanian marine coast (90.6 km in length) from the border with Latvia till the border with the Russian Federation in the Curonian lagoon (Fig. 1). The paper is a generalization of scientific research material collected while developing Lithuanian coastal management projects and supervising the coastal management works in 1996–2007: (Supervision of ... 1996; Determining coastal ... 1997; Target programme ... 1999; Coastal zone ... 2001; Target programme ... 2003, Geological atlas ... 2004; Modified coastal ... 2005; Nourishment of ... 2007, Lietuvos Baltijos ...2007; and others).

Fig. 1. Location map of study area.

The assessment of the current state of the coast and morphodynamic trends is based on the data on Lithuanian coastal dynamics collected within the monitoring network developed by the coastal research and coastal management team of the Coastal Research Department, Institute of Geology and Geography, in 1993. The annual investigations (repeated levelling) were carried out using an electronic tachometer (TOPCON GTS 229) in 98 specially selected and equipped stationary stations (50 in the Curonian spit and 48 in the mainland coast). One measuring point represented approximately 1 km long coastal sector in the Curonian Spit and about 700 m in the mainland. During field works, supplementary instrumental measurements were made between the stations making sure that the measuring stations really represented the state of the coast in the neighbouring sectors. Supplementary measurements were carried out in the whole coast after extreme storms, especially in the most vulnerable sectors (e.g. Palanga, Kopgalis, etc.) and in the sectors where the nearshore or shore regeneration works had been carried out (Melnragė II–Giruliai and Palanga). The measurements included the time frame from 1993 until 2007. The long-term geodynamic coastal trends were evaluated based on the best geoindicator – the budget of the surface sediments (m^3/m): sum of the spatial and temporal changes of washed out or blown out and accumulated coastal material (calculated until the average long-term sea level).

The assessment of the state of the coast and the influencing factors was also based on the results of the previous investigations: (Kirlys 1990; Žaromskis 1998; Žaromskis & Žilinskas 1996; Žilinskas 1993, 1998, 2005; Žilinskas & Jarmalavičius 1995, 1996, 2007b; Žilinskas *et al*. 1994, 2000, 2001; Jarmalavičius & Žilinskas 1996, 2001, 2002, 2003, 2006; Dubra 2006; and others).

The character of the coast use is evaluated based on the territorial planning documentation (master plans of Neringa, Klaipėda city and district and Palanga city, National Park of Curonian Spit and Regional Coastal Park). The intensity of the flow of holiday-makers and the suitability of the beaches in the recreation zones is evaluated based on the results of the previous investigations (Akevičiūtė *et al.* 2002, 2003, 2004; Jarmalavičius & Žilinskas 2003, 2007).

The impact of climate changes is evaluated on the ground of material collected during the implementation of the international project INTERREG III B (ASTRA) (Žilinskas & Jarmalavičius 2007; Jarmalavičius *et al. 2007*).

The priorities of coastal management were distinguished following the Lithuanian legal basis regulating the management of coastal zone: Principles of Coastal Preservation and Use (Žin., 2000, Nr.19-473), Strategic Principles of Lithuanian Baltic Sea Coast Management (Žin., 2001 Nr.103-3690), and Law of the Coastal Zone of the Republic of Lithuania (Žin., 2002, Nr. 73-3091). The recommendations of HELCOM (Helsinki Com-

mission 1996) and the common practice over the world (Salm & Clark 1984; Van de Graff *et al* 1991;Clark 1992; Tjalle H. 1992; World Bank 1993; OECD 1995; Beatley *et al.* 2002; Worsley *et al.* 2005; Forrest 2006; and others) were also used as sources for this study.

RESULTS

Current geodynamic trends in coastal sectors

The illustrations given below present the generalized long-term (1993–2007 and 2003–2007) geodynamic trends in the Curonian spit and mainland coasts. The data about the changes of coastal sediments (Fig. 2) show that the following coastal sectors are most intensively eroded: Šventoji–Latvian border, Ošupis environs, Rąnžė–Birutės Kalnas, Nemirseta–Olando Kepurė, Melnragė I and technogenic sector of Klaipėda port.

The most intensively eroded coastal sectors of Curonian spit are: Kopgalis, Juodkrantė, Preila, and, in recent years, the northern part of Nida (Fig. 3). Taking into account the current state of the coast and its geodynamic trends, the above mentioned coastal sectors (in the mainland and in the Curonian spit) should be regarded as the priority ones.

Character of coast use

It should be noted that nature preservation is the dominant trend of use of the Lithuanian Baltic Sea coast: the preserved territories in the mainland coast occupy about 15.4 km (about 39 per cent of the total length of mainland coast) whereas the whole Curonian spit has the status of preserved territory (51 km).

In view of the legal status and international requirements (Helsinki Commission 1996), the priorities in the preserved territories are given to preservation and regeneration of the natural environment and natural processes. Therefore, notwithstanding the negative coastal dynamic trends, only those coastal management measures that would neutralize the impacts of anthropogenic activity and would help to regenerate the natural coastal processes should be applied in the mainland Coastal Regional Park. The measures mitigating the impacts of anthropogenic activity in the preserved territories of Curonian spit (except the zones of recreational priority) should be combined with the coastal management measures, which could neutralize the hazards to the existence of Curonian spit as an integral geomorphological form.

For the Lithuanian people and the foreign visitors to be able to have a good rest and restore the mental and physical strength, all recreational areas of intensive use in the Lithuanian coastal zone should be given the

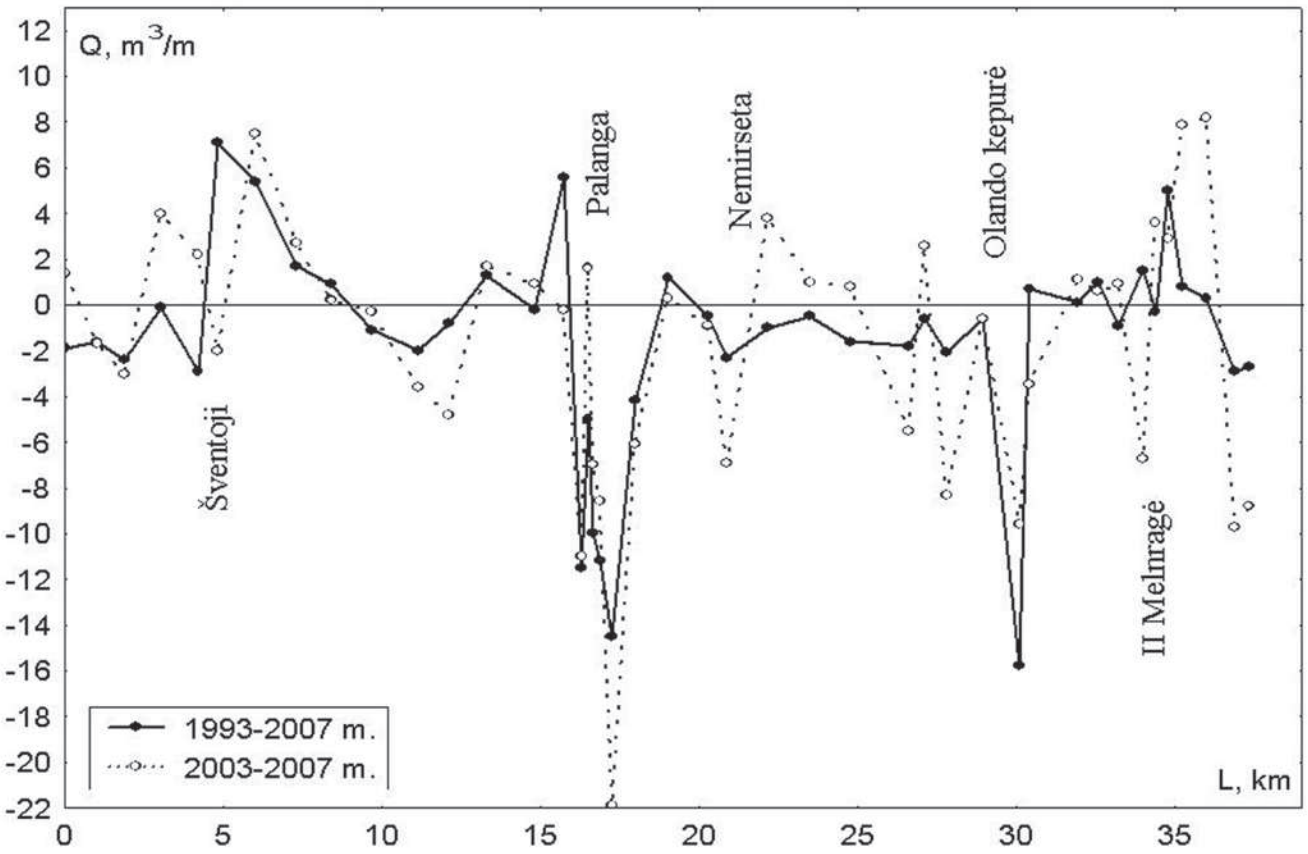

Fig. 2. Average annual changes of coastal sediments (Q, m^3/m) in 1993–2007 and 2003–2007 in the mainland coast. "0" of abscissa axis – state border with Latvia.

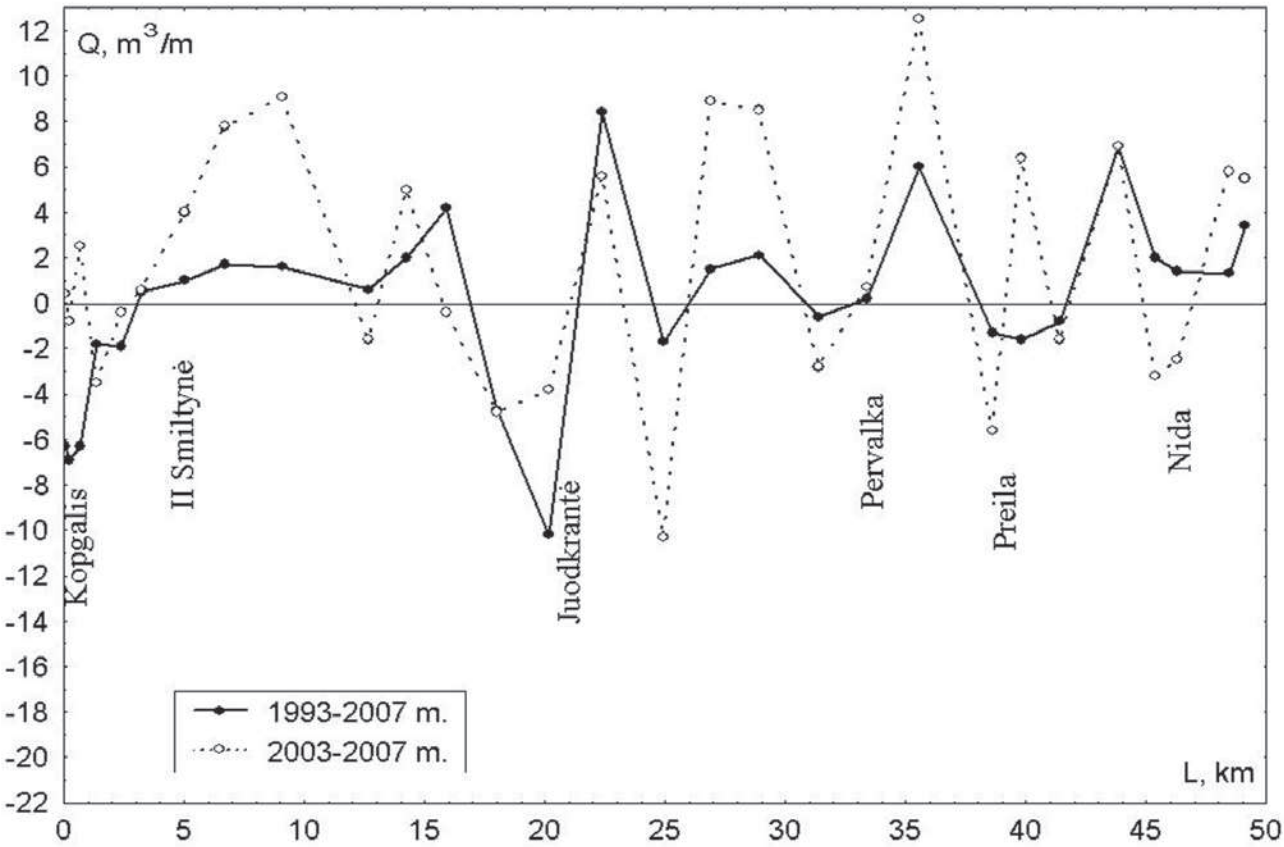

Fig. 3. Average annual changes of coastal sediments (Q, m^3/m) in 1993–2007 and 2003–2007 in the mainland coast. "0" of abscissa axis – Klaipėda port jetty.

status of coastal management priority. Attractiveness of the recreational zones depends on the state of the coast. Moreover, recreation as a branch of economic activity not only provides a source of income to the coastal population but also adds to the national budget.

The coastal sectors intensively used for recreation in the mainland coast are: Šventoji, Palanga, Giruliai and Melnragė I and II. The total length of these sectors is approximately 23.1 km, which is about 61 per cent of the total length of the mainland coast. The coastal sectors intensively used for recreation in the Curonian spit are: Smiltynė I and II, Juodkrantė, Pervalka, Preila and Nida. The total length of recreational zones in the Curonian spit is around 18 km, which is 35.3 per cent of the total length of the Lithuanian part of Curonian spit.

On the negative side, intensive flows of holiday-makers in the recreational zones produce a strong adverse effect on the state of the coast. The harmful impacts of recreation on the coastal state must be diminished in any way. All recreational zones should be also classified as priority zones in terms of coastal management.

Potential anthropogenic factors, which may affect the stability of coasts

Economic development does not bypass the coastal zone. For example, the restoration of the port in Šventoji is scheduled to be done in the nearest future. The possibility to build a deepwater port in Klaipėda is also turning into a practical scheme. Recreation and urbanization in the coastal zone are ever more intensifying. The mentioned factors undoubtedly will produce different, and most probably, negative impacts on the Lithuanian coasts.

The projected port constructions

Šventoji port. Building and exploitation of any larger hydrotechnical construction always affects the state of the adjacent coastal sectors. Due to the unsolved questions of land property, unfinished project works and preparation of technical documentation along with some other circumstances, today the idea about the project Šventoji port is uncertain. For this reason, a more exact assessment of the possible impacts of Šventoji port on the coast is possible only after solution of the above-mentioned questions. It is possible to assume that in case the entrance channel reaches its project depth of 7 m, the deficiency of sediments will occur north of the port. In the course of time, the impact zone of this deficiency may reach the Papė port in Latvia. The surplus of sediments is likely to occur on the southern side of the project port. Its potential impact zone may reach Mancikės. If the coast development follows the previously described classical pattern, observed during the construction of the old Šventoji port, the potential sediment deficiency north of the port could be reduced by passing sediments from the

southern to the northern side of the port. The state of the coast in this region also will be affected by regular dredging of the entrance channel (seeking to maintain a stable depth in the fairway).

Deepwater port of Klaipėda. According to the preliminary assessments, the potential impact zone of the deepwater port may reach the sector south of Alksnynė in the Curonian spit and Olando Kepurė cape in the mainland coast. Yet without a detailed technical project of the port, without determining the impact of the deepwater port on the coastal zone dynamics (which is possible only after detailed morphometric, hydrodynamic and lithodynamic investigations) and without a model of possible hydrolithodynamic situation after the port construction, the character of possible impacts of the port on the coastal zone dynamics cannot be correctly evaluated. Only the fulfilment of the mentioned conditions would provide information about the probability of sediment accumulation or abrasion in the southern part of the port (Kopgalis), either as a result of prolongation of the southern jetty or as a result of marine water flows during storms. There is also a possibility that these two factors will be at equilibrium and the coast will remain stable. The same can be said about the potential impact on the coastal geodynamic situation in the coastal sector north of the port. Without detailed investigations and modelling it is impossible to tell what factors will predetermine the state of the coastal zone at Melnragė I. It could be the lee responsible for coastal stability and provided by the projected deepwater port (resembling a rectangular island in its form) or it could be a powerful water rise causing an intensive coast abrasion, which is likely to occur under the conditions of strong western winds.

Thus while distinguishing the priority sectors of coastal management it is necessary to take into account (as much as possible at this moment) the possible impact of building the projected hydrotechnical constructions.

Increasing recreational intensity and urban development

Recreational loads strongly affect the state of the coast and its dune ridge in particular. Destruction of plant cover by holiday-makers intensifies deflation processes in the summit of the dune ridge and on both of its slopes. Sand pushing down the slopes by holiday-makers (especially with bicycles and baby carriages or carts) contributes to dune ridge degradation even more. The dependence of the level of the dune ridge degradation on the recreational loads is well reflected by the results of previous investigations (Žilinskas *et al.* 2001): for example, in the Palanga foredune ridge enduring high recreational loads, the deflation forms somewhere form even for 82 per cent of the total dune ridge area in the sector. In the Nida dune ridge enduring lower recreational loads, deflation forms account for 17 per cent and in the preserved territories of Curonian spit only for 0.9 per cent.

The rapid urbanization of the coastal cities (Klaipėda, Palanga and Šventoji in particular) encourages an ever increasing number of people to move there for a permanent residence. Naturally, this circumstance is directly responsible for an increasing number of visitors to the sea. Building of residential houses, villas and rest houses in the area behind the dune ridge causes an even more serious hazard for the state of the dune ridge. In the last ten years alone, the number of mentioned objects in the coastal segment between Ošupis and Šventoji has doubled. Construction works in the area behind the dune ridge often inflict great damage to its slopes: compaction by enginery, dozing of the eastern slope, etc. The tracks to the sea across the dune ridge worn by local residents and visitors quickly turn into trenches dissecting the dune ridge till its base. The dissected dune ridge is subject to a rapid degradation.

The increasing recreational load and urbanization will eventually contribute to the dune ridge degradation. Without the dune ridge, the area of land inundated during strong storms would increase three-fold and during extreme storms even five-fold (Target programme … 2003). Approximate calculations show that without the dune ridge and under the conditions of the present rates of the coastal abrasion in the middle of the bay in the coastal sector Palanga pier–Birutė Mount, during strong storms the sea water would reach café "Voveraitė vardu Salvadoras" and the parallel to the shore Meilė Alley.

Thus, distinguishing the priority coastal management sectors it is necessary to take into account the rates of urbanization and intensity of recreation.

Impacts of climate changes

Climate changes also belong to the factors that affect the stability of Lithuanian coasts.

Climate warming contributes to the rise of the level of the World Ocean. The acceleration of the Baltic Sea water rise is also observed in the Lithuanian coasts (Jarmalavičius *et al.* 2007b): in 1898–1975, the average sea level was rising relatively slowly (+0.4 mm per year, i.e. in 77 years it rose only by about 3.1 cm); yet in –2005, the rates of rise were relatively high (+3.9 mm per year, i.e. in 30 years it rose even by 12 cm). Though the current rates of the sea level rise so far do not induce marked land inundations in the Lithuanian coastal zone, their interaction with the wave set-up strengthen the coastal abrasion during storms. For example, in the sector Rąnžė Stream–Birutė Mount (Palanga) with low beaches (small slope angle), the sea water rise by 30 cm results in flooding 17 m of the beaches. Due to this, even during relatively weak storms, waves and swash already reach and erode the foredune ridge, whereas in other sectors they hardly reach even the middle of the beach.

Comparative analysis of seasonal variations of the Baltic Sea water level in 1898–1927 and 1976–2005 showed that the average sea level rises in all seasons. Yet the maximal values occurred in winter (11.3 cm), which accounts for even 45 per cent of the total annual water level rise. The determined seasonal variations of water level showed that their pattern has undergone essential changes. At the beginning of the 20th century, the maximal values of water level occurred in summer, whereas at the end of the 20th century, the maximal values of water rise occurred in winter. The seasonal variations of the maximal values of water rise are also important for the state of the coasts. At the beginning of the 20th century, the Baltic Sea water level at the Lithuanian coasts typically reached its maximal values in summer at the conditions of a relatively calm weather and produced almost no influence on the state of the coasts. In recent years, the maximal values have been occurring in winter, under stormy conditions. The combination of the maximal seasonal water rise with wave set-up increases coastal abrasion (Žilinskas & Jarmalavičius 1996). Due to this, the Lithuanian coasts are strongly eroded almost every winter.

Despite the above mentioned long-term and seasonal changes of the Baltic sea level, the strongest negative effect on the Lithuanian coasts is produced by the increasing recurrence (tending to increase even more) of strong winds, rise of the air and water temperatures in winter and related reduction of the number of days with ice cover in the nearshore and snow cover on the beach.

The changing climate in the mid latitudes entails intensification of cyclonic activity. This pattern of climate change also manifests in Lithuania (Bukantis *et al*. 2001). The intensification of cyclonic activity is responsible for increasing recurrence of strong storms at the Lithuanian coasts and shortening of the spans of calm weather. Formerly, the deep cyclones occurred in the Lithuanian coastal area every 6–8 years. Recently, they have been occurring every 2–3 years: "Anatoly" in 05 12 1999 and a series of deep cyclones in 12 2001–02 02 2002 ("Ervin" in 07–09 01 2005, "Peras" in 13–15 01 2007 and "Cyril" in 19–20 01 2007). Moreover, during the last 30 years, the recurrence and velocities of south-western (set-up) winds have increased and the velocities of south-eastern (lowering of the water level) winds have reduced (Dailidienė 2007). I.e. the number of days with a high sea level (entailing coastal abrasion) has increased and the number of days with a low sea level (entailing coastal accumulation) has decreased. Besides, the recurrence and duration of strong winds (with velocities exceeding 25 m/s) have also increased. Due to this, the coast devastated by storms has no time to restore its equilibrium profile.

In addition, the intensity of the coastal abrasion is intensified by air temperature rise that in our latitudes is predetermined by warming winters (Bukantis *el al*. 2001). The warming winters reduce the number of cold spans (the term cold span is applied to time intervals when air temperature -16° persists for 5 days and more): 20 years passed between the next-to-last (1986) and the last (2006) cold spans in the coastal area. It should be noted that, in comparison with 1961–1990, during the years 1991 to 2005, the water temperature in the Baltic Sea near Klaipėda and in the Curonian lagoon at Nida has become higher by 0.6 °C. The winter temperatures are responsible for the duration of ice cover on the nearshore. Since the year 1961 to 2005, the numbers of days with ice cover on the Baltic Sea nearshore at Nida had decreased by about 58 per cent, that is, from the average of 60 days in 1961–1975 to 26 days in 1991–2005 (Dailidienė 2007). The effect of these circumstances on the state of coasts can be easily forecasted. The ice in the nearshore acts as a natural breakwater protecting the coast from storm action in winter. Besides, the frozen beach and foredune sands are more resistant to wave abrasion and eliminate deflation effects.

The similar conclusions can be drawn about the decreasing number of days with the snow cover because this cover also functions as a protective element against the foredune defilation.

Last but no least, it should be noted that climate changes mainly affect the coastal sectors with the poorest current geodynamic state.

DISCUSSION

The priority sectors of coastal management were distinguished based on the above presented analysis of the factors affecting the development of the Lithuanian sea coast. The following priority sectors were distinguished in the mainland coast: Palanga recreational zone (between Kunigiškės and Birutė Mount and between the "Auska" villa and Coastal Regional park), Klaipėda recreational zone (between Giruliai and the technogenic zone of Klaipėda port), and coastal sector between the Šventoji port and Latvian border (Fig. 4).

Palanga recreational zone. Palanga is the most frequently visited Lithuanian health resort. The recreational load and expansion of the urban areas in the Palanga coasts is increasing every year. The beaches and the foredune ridge in the southern part of Palanga (most highly appreciated by holiday-makers) are strongly degrading. Due to sediment deficiency in the nearshore and on the shore, this coastal sector is vulnerable to climate changes. In view of this, the described coastal sector should be distinguished as a priority one. It should be pointed out that the current state of the coast in the northern part of Palanga between the rescue station and Kunigiškės is fairly good. Yet bearing in mind the deteriorating state of the southern part of the sector and seeking to preserve the unchanged total recreational space of Palanga, it is necessary to preserve the northern part of the sector in the best possible state, i.e. the reduction of recreational space in the southern part of the sector should be compensated by

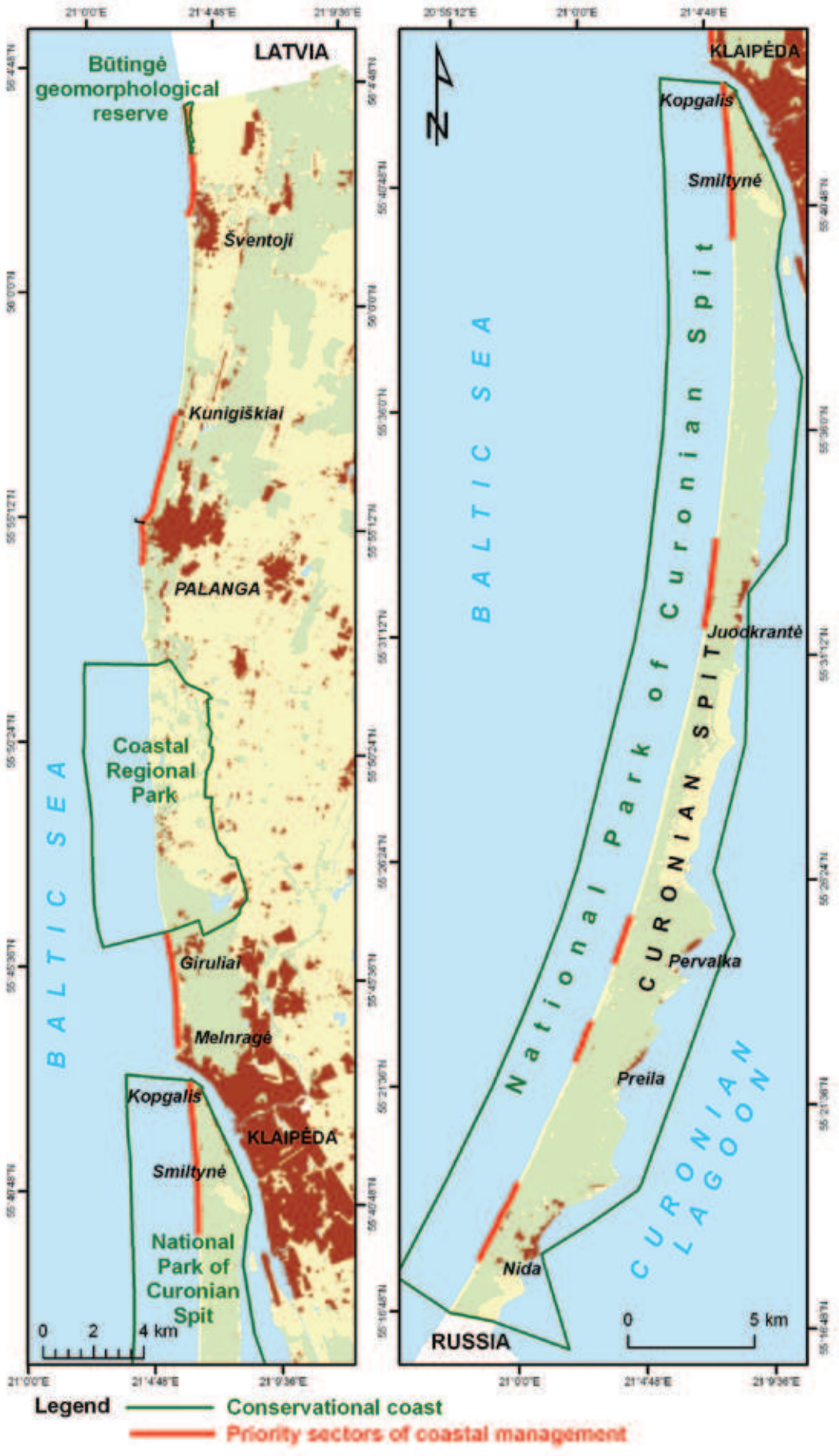

Fig. 4. Priority sectors of coastal management of Lithuania.

its expansion in the northern part. The coastal sector between the "Auska" villa and Coastal Regional Park is also classified as a priority one because the foredune ridge is dissected by multiple ravines (some of them reach the base of the ridge) through which the sand is blown behind the ridge. The blown sand is eliminated from the eolodynamic circulation along the shore what produces a negative effect on the northward sectors.

Klaipėda recreational zone. In warm summer days, the number of visitors to the Klaipėda recreational zone reaches over fifty thousand. Under the conditions of expanding urbanization, the number of visitors to the coastal area is constantly increasing. Yet the expansion of the Klaipėda recreational zone is impossible because in the northern part it borders the Olando Kepurė landscape reserve where sunbathing and bathing conditions are poor (narrow stony beaches, the shore inconvenient for bathing, absence of the dune ridge, etc.). Besides, an intensive recreational load in the preserved coastal area cannot be tolerated. The project construction of a deepwater port will not only reduce the attractiveness of the Klaipėda recreational zone but also will deteriorate its state. Moreover, the state of the sector Melnragė II–Giruliai is strongly affected by the consequences of climate changes, which are likely to increase in the future. For the mentioned reasons, the Klaipėda recreational zone should be classified as a priority sector.

Šventoji port–Latvian border sector. Increasing recreational load and urbanization are observed in the southern part of this sector. Yet the geodynamic trends are unsatisfactory throughout the whole sector. The reconstructed Šventoji port will produce an adverse effect on this sector. Besides, the state of this coastal sector is affected by the consequences of climate changes, which are likely to increase in the future. On the other hand, the jetties of the old port are permeable to sediments. This is a favourable circumstance at least for a temporary stabilization of this coastal sector. To speak in images, the measures of coastal management should help to "catch" as much sand transported by waves and currents from the southern part of Šventoji port as possible. For this reason, the sector Šventoji port–Latvian border should be given the status of a priority sector.

The following coastal management priority sectors were distinguished in the Curonian Spit coast: *all recreational zones* except Alksnynė (Fig. 4). The number of holiday-makers in the Curonian spit is rapidly increasing. The number of visitors in the beginning of the 1960 was 5 thousand people whereas at the beginning of the 21st century it reached more than a million (Akevičiūtė *et al*. 2002). The number of holiday-makers will increase in the future. After the inclusion of Curonian spit into the UNESCO list of preserved objects, the number of foreign visitors was and will be increasing. Due to deteriorating recreational conditions in the mainland coast, many Lithuanian people prefer the vacation in the spit. Though at present the coastal state in all recreational zones of the spit is relatively good, it requires regular coastal management. If coastal management works were to stop in these zones at least for a few years, the liquidation of the hotbeds of conflicts of coastal management would require ten-fold investments. The effect of climate changes should be classified among the most hazardous factors for the priority coastal management coastal sectors of Curonian Spit.

The *Alksnynė* (so far reserved) recreational zone is not classified as a priority coastal zone because its geodynamic state is very good, recreational load is small and its rapid increase in the nearest future is not expected.

The *Kopgalis* sector should be discussed separately. Though its recreational load is small (visited only by the visitors of the Sea Museum) the poor current geodynamic state and the possible increase of abrasion after considerable deepening of the port jetties are great hazards for this coastal sector. The hazard is aggravated even more by an increasing frequency of recurring and strengthening south-western winds whose set-up contributes to the intensive coast abrasion. The worst of it is that intensive abrasion processes taking place in this sector also affect the state of the adjacent intensive recreation zone Smiltynė I. The for a long time prevailing tendency of accumulation in Smiltynė I has been replaced by the coastal abrasion. For this reason, the Kopgalis coast also should be given a coastal management priority status.

It should be noted that currently, in the priority coastal zones of Smiltynė, Juodkrantė, Pervalka, Preila and Nida (the Curonian Spit), and the coastal sector between the villa "Auska" and the Coastal Regional Park, it is sufficient to apply the basic means (meaning, the protection and the supervision of the foredune) of the coastal management. Meanwhile, in the coastal zones of Kopgalys (the Curonian Spit), the recreational zones of Klaipėda, the coastal area between Kunigiškės and Birutė Mount, and the coastal sector between the Šventoji port and the Latvian border, it is necessary to employ a complex totality of the coastal management means. This should include not only the management of the foredune, but also the replenishment of the coastal zone deposits.

CONCLUSIONS

Distinguishing of priority sectors in the Lithuanian coastal area should be based not only on the character of coastal use, its current state and geodynamic trends, but also on the factors, which will potentially influence its future development. These factors include development of anthropogenic activity (building of ports and hydrotechnical constructions and intensification of recreation and urbanization) and the climate changes. Generalization of the influence of these factors on the Lithuanian coasts allows distinguishing the coastal sectors, which should be given the priority status in the coastal management.

The following priority sectors were distinguished in the mainland coast: Palanga recreational zone (between Kunigiškės and Birutė Mount and between the "Auska" villa and Coastal Regional park), Klaipėda recreational zone (between Giruliai and the technogenic zone of Klaipėda port), and coastal sector between the Šventoji port and the Latvian border. The following recreational zones of the Curonian Spit coast were classified as the priority ones: Smiltynė, Juodkrantė, Pervalka, Preila, Nida, and the coastal zone of Kopgalis.

The overall length of the recommended priority zones would be 32,5 km, which would constitute 35,9 % of the total length of the Lithuanian sea coast: 17,2 km of the mainland coast and 15,3 of the Curonian Spit coast.

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