

## Increasing human impact on coastal areas of Estonia in recent decades

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### ABSTRACT

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The coastal zone is a crucial environment that is experiencing pressure from a wide variety of different agents and interests. One key problem in recent decades has been a rapid increase in the number of holiday houses built as close as possible to the seashore. As in the Nordic countries, the historical roots of land use on the Estonian coast go back to ancient society. The original coastal settlements were usually concentrated around naturally suitable harbours. People used the pastures and fishing huts during the summer season. This was an essential part of making an adequate living and was not associated with recreation. The first expansion of villa settlements close to towns took place in the 19<sup>th</sup> century at Estonia's famous summer resort, Pärnu. Unlike in the Nordic countries where major coastal settlement expansion took place after WWII, almost the entire coast of Estonia was proclaimed the Soviet border zone where people were not allowed to live. Nearly 3,800 km of shoreline, except the coastal cities and a few summer resorts were under the control of Soviet military forces. Revival of coastal land use and a rapid increase of coastal settlements have occurred over the last 10-15 years. This paper focusses on population changes on the coast of Saaremaa Island associated with increasing pressure and conflicts of interests. We also examine the advantages and disadvantages of existing legislation regulating land use within the Estonian coastal zone. The work is based on GIS techniques.

**ADDITIONAL INDEX WORDS:** *Baltic Sea, Saaremaa Island, climate change, coastal settlements, coastal zone management*

### INTRODUCTION

Estonia is a small seaside country in the Baltic Sea region situated along the periphery of Northern Europe. Its total area is 45,227 km<sup>2</sup>. Its population is 1,344,684 inhabitants (January, 2006 estimate).

The shoreline of Estonia is relatively long – nearly 3,800 km. Estonia's long shoreline, relative to its area, is attributable to the many sharply-indented peninsulas and bays that characterise the mainland's coastal zone and to its approximately 1,500 islands the coastal perimeters of which make up two-thirds of Estonia's total shoreline. Most of the islands are concentrated on the western coast and form the west Estonian archipelago (Figure 1a).

The development of the coast has been strongly influenced by the properties of the bedrock and the geological activity of the Pleistocene glaciers. The territory was finally freed from the last glaciers about 11,000 years ago. After deglaciation, the low-lying coastal areas were flooded. These territories have been emerging from the sea during the entire Holocene epoch, while the velocity of the land uplift has been gradually decreasing. The ancient coastal landforms associated with different stages of the Baltic Sea have varying elevations. The ancient shorelines from some of these stages have been detected by as much as 150 km from the present location of the shore.

The time of arrival of our ancestry to the area of present-day Estonia is still a hot topic of discussion. According to the archaeological findings, the oldest settlements date back at least 9,500 years. Changes in farming techniques fuelled an increase in population, which in turn led to the establishment of the first

fortified settlements by the end of the Bronze Age, about 1,900 years ago. In 98 A.D., the Roman politician Tacitus noted Estonia, described the people, *Aestiorum gentes* and their habits, attire and strange language.

According to historical documents many of the coastal areas of Estonia have been permanently inhabited since at least the 13<sup>th</sup> century. The principal traditional economic activities that have supported human life on the coast have been fishing, seal hunting, agriculture, and, less frequently, forestry. The most intensive exploitation of the coast occurred from the middle of the 19<sup>th</sup> century and continued until 1940.

World War II and the socialist order altered the way of life over the following 50 years. Most of Estonia's coast was proclaimed a border zone of the Soviet Union. Therefore, the traditional activities of local inhabitants were either curtailed or prohibited altogether. Coastal settlement, together with its traditional rural landscape such as wooded meadows and coastal pastures started to disappear. The landscape began to revert back to its original state.

The Estonian Republic regained its independence in 1991 and since that time, growing coastal land use activity and a rapid increase of coastal settlements over the last 10-15 years have increased the pressures and conflicts of interest in Estonia's coastal areas.

The current paper focusses on the main trends of both natural development and population changes in the coastal zone in recent decades. We also discuss the management and development of the coastal zone in relation to the specific problems facing them.

Finally, we examine the advantages and disadvantages of existing legislation regulating land use along the Estonian coast.

## STUDY AREA

The principal results of the current paper are based on our investigation and analysis of data obtained primarily from Saaremaa Island. Saaremaa can be considered a small model of Estonia, where the shore types, development of coastal settlements and the history of human impact on the seashores are quite similar to the rest of the country.

Saaremaa is an island located in the western Estonian archipelago. It is 2,673 km<sup>2</sup> in area; has a population of 35,076 (as of January, 2006); and has a population density of 13.1 inhabitants per km<sup>2</sup>. It is the fourth largest island in the Baltic Sea after Sjaelland, Gotland and Fyn.

Saaremaa's geography is highly variable with different geomorphic types of coast differently exposed to the open sea. The main geomorphic features of the coastal zone here reflect the preglacial relief, the last glacial phase and postglacial isostatic uplift which is still going on with the mean velocity of 2 mm per year. The northern coast of the island is characterised by its Siluran glint and by its limestone cliffs, which tower over the tops of the island's many peninsulas. Many spits and beach ridges consisting of gravel and pebble have been formed beside the cliffs as a result of permanent strong erosion of the cliffs (Figure 1b). Rocky shores made up of limestone alternating with accumulative sandy, gravel and pebble shores are predominant on the western coast of Saaremaa. Extensive sandy beaches are concentrated on the southern coast, west of Kuressaare - the main urban centre of the island. The central and eastern part of the southern coast mainly consists of eroded till shores and silty shores covered with vegetation.

About 40% of the population of Saaremaa lives in Kuressaare, the capital of the district. The rural settlements are small and the permanent population in coastal villages is sparse. The number of temporary residents in coastal villages has increased dramatically over the last few decades as more people have begun to build summer cottages there.

## DATA AND METHODS

The current study is based on the results obtained during the fieldwork in the study sites in different parts of Saaremaa as well as on an analysis of existing maps and datasets. The main trends in natural development of different shore types with differing exposure to the open sea described in the current paper are based on the results of specific coastal studies carried out in recent years in Saaremaa (ORVIKU *et al.*, 2003; PUURMANN and RATAS, 1998).

Landscape analysis and historical-geographical interpretations were the main research methodologies used in assessing the changes in land cover pattern and their relationships with changed human impact. In order to analyse important geographical, cultural and socio-economic factors contributing to the development of coastal landscapes and to estimate the pace and character of such changes, we applied the following methods. First, we analysed landscape changes by comparing maps from different periods that show land cover. Maps identifying land cover are available back to the beginning of the 20<sup>th</sup> century and in some cases even earlier. The land cover units are based on the Corine system (MEINER, 1999). Second, we analysed the data obtained from the landscape transects compiled within the frameworks of the Estonian coastal zone monitoring program.

The problems of increasing human impact and recent developments in coastal zone utilisation are examined not only on the basis of the above-mentioned scientific research results but

also on the basis of a number of large-scale maps from different times. In that regard, we used the Russian 1 verst (1,067 km) maps from 1895-1917 in 1: 42,000 scale and the Soviet General Staff topographic maps from 1935-1939 in 1: 50,000 scale among the older ones. We also used the Estonian Basic Map (1: 10,000 scale) in Lambert-EST projection and the Estonian Base Map (1: 50,000 scale) in TM BALTIC projection from the Estonian Land Board, which are the main sources for the present-day digital datasets used in this article. Finally, we obtained some additional data from the Land Cadastre.

The analytical work with the datasets is still in progress within the framework of the Interreg IIIB project "Developing Policies and Adaptation Strategies for Global Climate Change in the Baltic Sea Region" (ASTRA), funded by the European Regional Development Foundation (ERDF) for the purpose of creating a detailed coastal zone management plan for Saaremaa Island. *MapInfo* software is used in the data processing. The results are

Table 1: Distribution of data layers.

Directory	Subdirectory	Explanation
Administrative division		Boundaries of communes, villages
Maps	Map sheets	Carts (1: 10,000; 1: 50,000)
	Cadastre map	
	Basic Map	
	Topography	Data on elevations
	Background map	Basic map data as a background for thematic maps
Settlements		Data on settlements
Corine		Land cover units
Geology		Geological data, mineral resources
Cadastre		Cadastre units and boundaries
Nature conservation	Natura 2000	Nature conservation areas and objects. Pre-selected areas
Land use		Land use data
Landscape		Theme planning data Milieu valuable areas for housing
Forest		State forests, forests on the Basic Map
Protection of national heritage		National heritage sites and objects
Local authorities		Community plans
Subdivision plat	Wind zones	Pan-district plans
Arable land		Data on soil productivity
Shore		Shore data
Service media	Aerodromes	Sources of pollution Data on electricity, gas, water supply, drainage and sewerage systems
Roads	Basic map	Data on roads, tracks, hiking paths
Water bodies	Basic map	Rivers, brooks, lakes, ponds, springs etc.

presented using GIS technique. An overview of data layers is given in Table 1.

## RESULTS AND DISCUSSION

### Trends of Climate Change

Extraordinary climatic changes have occurred during the last few decades in Estonia and in the whole Baltic Sea region for which the driving force appears to be a change in atmospheric circulation. The intensity of zonal circulation has significantly increased, and the number of cyclones crossing the Baltic Sea in winter has also increased (SEPP *et al.*, 2005). This has induced warmer winters and springs with a mean air temperature increase of over 1°C per half century. This trend is particularly evident during periods between January and May. During those periods, there is a decreasing tendency in sea-level pressure and an increase in precipitation, which are concurrent. As a consequence, the snow cover duration and the extent of sea ice have significantly decreased (JAAGUS, 2006). Stronger and more frequent storms in winter that coincide with the described climatic changes (ALEXANDERSSON *et al.*, 2000; ORVIKU *et al.*, 2003) are one of the key factors shaping the coast of Saaremaa today.

### Evolution of Geologically Active Shores

The Estonian coasts are considered regressive at present and even the effect of the average ocean-level rise (1.5 – 2.0 mm/year; CHURCH, 2001; etc.) is insignificant on their evolution. The rate of the annual land uplift ranges from 1 to 3 mm (1.5 to 2.5 mm in Saaremaa) with a maximum uplift occurring on the NW coast (VALLNER *et al.*, 1988).

Two important factors influencing the formation and development of seashores in Estonia are: (1) the Baltic Sea is a more or less isolated basin with brackish-water (mean salinity 6–7‰) due to a narrow connection with the Atlantic Ocean through the Danish Straits; and, (2) sea-level fluctuations caused by tides (1–2 cm) are negligible compared to those caused by surges arising from westerly storms, the most recent example of which was the high storm surge (up to +2.75 m in Pärnu Bay) caused by an exceptionally powerful storm in January, 2005 (SUURSAAR *et al.*, 2006).

Some parts of the accumulative coast in Saaremaa are well exposed to the waves and westerly prevailing winds. These are geologically active and the most rapidly changing coasts. The most significant processes shaping the shores there today are erosion and the accumulation of sediments caused by wave activity. Rapid coastal change expressed in both shoreline displacement and in the structure of coastal formations usually results from very powerful storms or from stormy periods of a long duration accompanied by high sea level conditions (ORVIKU *et al.*, 2003).

Activation of shore processes, which are presumed to be associated with warmer winters, has been observed in Saaremaa in the last 20–30 years. In many places the shores have been severely damaged by frequent storm surges. Sandy shores, which are preferred as recreational areas, are particularly vulnerable to such kind of damage. Strong erosion by storm waves combined with a deficit of sediment has often resulted in shoreline retreat and the destruction of sandy beaches in spite of the land uplift.

### Changes in Coastal Zone Land Cover Pattern

The land cover pattern on the coast is the most dynamic feature, showing a certain stage in the development of coastal landscape at a given moment of time

Coastal wetland vegetation, including seashore meadows, in Saaremaa is mostly located in shallow, regressive coastal areas with wide and flat shore where wave activity is negligible even during strong storms. The characteristic feature of these areas is that they become temporarily flooded with seawater from time to time. The soil–vegetation complexes of seashore meadows have undergone a series of stages in their development from hydrolittoral to epilittoral as a result of land uplift. A constant replacement of one plant community by another in a certain site over a certain time interval supports this general process.

On sandy plains of marine origin, the meadows have been traditionally used as pastures. The period of most intensive exploitation of coastal meadows lasted from the middle of the 1850's up to the beginning of the 1940's. At that time the coastal landscapes were strongly influenced by human activity. Fields were interspersed with woods, wooded meadows, shrubberies and meadows. Farms, windmills and stone fences added to the diversity. Insular landscape structures became more varied.

A comparative analysis of land cover maps of agricultural coastal areas from different time periods suggests that the area of land used for agriculture has steadily decreased over the last 60 years. Reed beds, shrubberies or woodlands and overgrowth replace the former grasslands (Figure 2). The expansion of reed beds is caused by a cessation of grazing and mowing. The main trends of changes in coastal land cover pattern are as follows: natural seashore grasslands become shrubberies or reed beds; wooded meadows and small fields become forests; natural forests become managed forests; and natural land cover generally becomes areas for summer cottages and dwellings.

### Historical Background of Coastal Population and Land Use

Centuries-old human land use has played an important role in the formation of the present-day coastal landscape of Saaremaa. The ensuing suitability of land for exploitation is of crucial importance in determining the use of different coastal areas.

According to archaeological findings, the territory of Saaremaa has been inhabited at least five thousand years. Since 1227 through November, 1918, Saaremaa, like the rest of Estonia, was under the rule of different countries and powers (i.e., the Germans, Danes, Swedes and Russians).

The coastal areas have been in common use by local communities over the entire history of Estonia. These areas were generally too brackish for land cultivation and thus were not used by the villages and small farmsteads as crop fields. Instead, they were used in accordance with the laws of the local community. Even inland villages had opportunities to use the coastal areas (JOHANSEN, 1964). Permanent settlements and cattle grazing were not generally permitted along the shoreline. However, fishermen were allowed to set up temporary campsites near the shoreline and could build small sheds for nets and boats.

The harbours too were in common use by the local communities. Due to the scarcity of suitable land for cultivation, the fields were divided into parcels of different sizes and shapes. The village allocated a portion of each soil type to each household. The diverse land cover pattern consisting of numerous small parcels reflects the communal traditions of the village communities (Figure 3). Such land use practices remained in effect in Saaremaa until the 18<sup>th</sup> century, much longer than anywhere else in Estonia. After that, various land reforms were enacted that allowed the land to be divided into separately owned plots and to be sold. Nonetheless, common use of the seashore grasslands and the forests remained in effect until WWI.

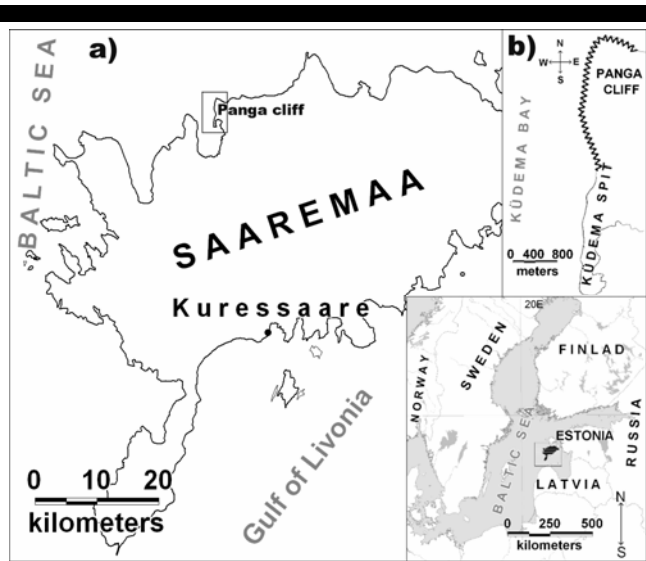


Figure 1. a) Saaremaa in west Estonian archipelago, b) Panga limestone cliff and Küdema Spit consisting of gravel and pebble.



Figure 2. Land cover changes on Vilsandi Island in 1700-1990.

At the end of 1919, after gaining independence, the manors were expropriated by law and the land was allocated to the local peasants. Although the private farmsteads became the dominant form of land ownership, the coastal areas still remained in common use for mowing, grazing and fishing facilities. As fisheries had been a collective activity since ancient times, the traditions were kept alive in Saaremaa until WWII. The sheds for nets were erected one beside another (often under the same roof) in the sites most suitable for boats to come ashore.

Favourable climatic conditions and geographical isolation helped the island become one of the most densely populated areas

in Estonia until the Soviet occupation and the beginning of WW II. It was a typical agrarian region with about 10,000 farms. Due to the unavailability of new land naturally suitable for cultivation, the majority of the fields have been in the same place for centuries. Following the old traditions, seafaring, fishing and seal hunting were also important sources of income on the coast.

The events in summer 1940 interrupted everything that had been achieved. The Soviet occupation and the first deportations of local residents to Siberia were followed the next year by Estonia's involvement in WWII. After the end of the war in 1945, the Soviet occupation continued for nearly half a century.

Its location along the lengthy western border of the Soviet Union meant that all of Saaremaa was proclaimed a restricted zone with strict limitations on sea-borne navigation and even movement on land. Multiple rows of barbed wire fencing made most of the western part of the shoreline inaccessible and any boats were destroyed. The private property was abolished by the Soviets and the small farms were collectivised.

After liberation from the Soviet occupation in 1991, new land reforms were initiated to return the land back to the former landowners and their successors. For the first time in the island's history the seashores of Saaremaa, as well as the rest of Estonia, were privatised. Since that time, relatively low land prices have been attractive to foreign buyers and particularly for Finns, who have acquired large tracts of coastal land. As a result, the towpath on the seashore has been closed for public access in many places.

### Some Aspects of Coastal Zone Management

Integrated Coastal Zone Management (ICZM) as a systematic activity is missing today in Estonia. Some projects more or less encompassing the spatial planning of the coastal zone have been and are being developed. Certain progress has been achieved only on Hiiumaa Island, where, within the frameworks of the Estonian Pilot Project "The Hiiumaa Island", the functioning of the ICZM model at the county and municipal level was tested. As a result of this project, the ICZM information centre was established in Kärdla, the main urban centre of Hiiumaa.

A few local authorities in Saaremaa have managed to create a comprehensive land use plan for the municipalities and to establish regulations governing construction along the coast. Unfortunately, these measures have been undertaken more as a way to legally sanction existing activities than to regulate future coastal development. In some cases, spatial planning procedures are impeded by interest groups who argue that the coastal development regulations under consideration might adversely affect their businesses.

Estonia's current patchwork of laws and regulations regulating its coastal zone – while still evolving – remains incomplete and subject to numerous loopholes and other abuses. Many local authorities cannot even keep up with the rapid economic progress occurring today in Estonia. A good example of that is the local authorities' reaction to the powerful storm (and subsequent flood) that struck Estonia in January, 2005. The people whose properties suffered the most from the storm accused the local authorities of doing nothing to prevent or mitigate the disaster and protect their property.

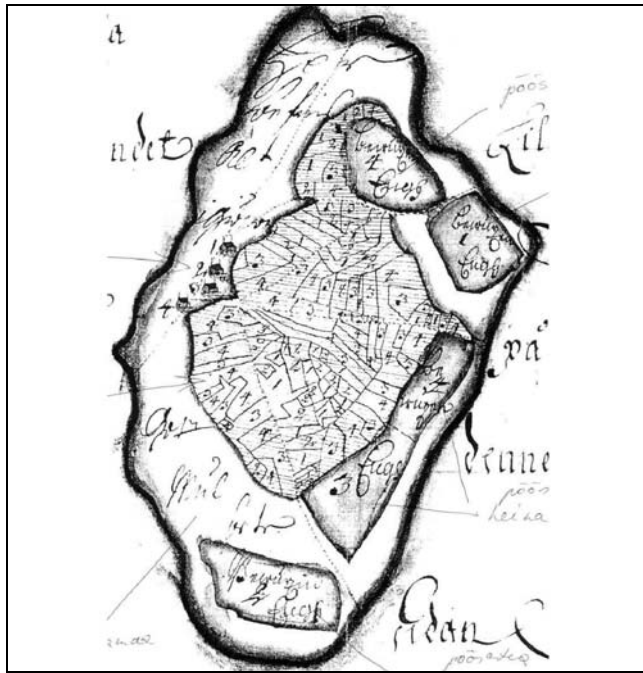


Figure 3. Fields divided into parcels on Kõinastu Island in 1687/1688.

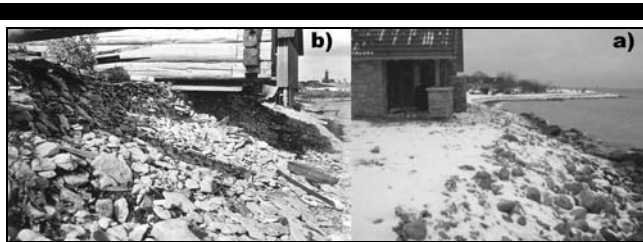


Figure 4. A new summer cottage (a) is erected on the fundament of a former boatshed (b); (photos: K.Orviku).

Existing laws governing Estonia's natural areas prohibits construction within a 100 m zone from the mean shoreline on mainland Estonia and in 200 m zone in Saaremaa. However, the act gives the right for the Minister of the Environment to make exceptions and to reduce the size of the protected zone (Figure 4). Unfortunately, flaws in the statutory scheme have at times been exploited by landowners and developers and the statute has not been adequate to protect the country's environmental interests.

Certain conflicts between the existing regulatory scheme and current land use needs and practices are evident. Regulations based solely on a uniform set of parameters (such as, regulations protecting forests or prohibiting construction or activities within 100 or 200 m of the mean shoreline, etc.) have caused misunderstandings and are usually sufficiently tailored to suit either the natural conditions or existing customs and practices. Indeed, strict adherence to such rules may occasionally give undesirable results. In many places, the old traditional settlements are located in zones currently restricted to any building and conversely, forests and cultivated fields, commonly used for many centuries but abandoned today, lie in the middle of a construction area.

The attitude of local authorities, landowners and developers towards the sea has not changed during Estonia's 15 years of independence. The sea remains, in the minds of many Estonians, dangerous and off-limits. Nearly two generations of people have been living with the knowledge that going to the sea is forbidden and can be punished. This is one of the most enduring proscriptions left behind by the Soviet occupation. Mismanagement of Estonia's coastal zone is evident and a common sense of responsibility in handling this precious resource is still missing. In short, Estonia needs a comprehensive long-term coastal zone development and management strategy both for today and for tomorrow.

## CONCLUSION

An expected mean global sea-level rise, combined with more frequent cyclonic activity and increasing storminess, could significantly affect the Estonian coast over the next 100 years. Estonia is facing a serious challenge today: how to use the coast in a sustainable manner and to preserve it for the next generation in a rapidly changing world. One option is to follow the practice of the Nordic countries, i.e. to rest Estonia's coastal zone management scheme on the principles of private ownership, the net effect of which will be to make the coast inaccessible to the vast majority of the population. Another possibility is to keep alive Estonia's old traditions and to keep the shores open to public access and common use. A comprehensive coastal zone management scheme will allow the public to consider fully these approaches and others in order to determine the best way for Estonia to manage this important resource and to protect the coastal zone against the negative effects of both global climate change and increasing encroachment by development.

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