

Human impact on the landscape of small islands in the West-Estonian archipelago

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Abstract. Research on the development of the interrelationships between society and environment is crucial for the understanding of contemporary landscapes. The West-Estonian archipelago provides an opportunity for such investigations because of its small size, landscape diversity, and well-defined economic activities.

The contemporary landscapes of the islands reflect environmental changes resulting from centuries of human activity. This paper describes both natural and human factors in the change in landscape of small Estonian islands during the last centuries.

During the period 1850-1940, human activity diversified the landscape structure. During World War II, with the establishment of Soviet rule, the islets were depopulated; their landscape became more uniform and lost their economic and ecological vitality. The re-establishment of private ownership of land and a market economy is predicted to result in positive changes in the landscape of the islets.

Keywords: Agriculture; Estonia; Historical geography; Islet ecology; Nature conservation.

Introduction

Estonia is situated at the northeastern shore of the Baltic Sea. Biogeographically it forms part of the Boreonemoral zone. Ca. 9 % of the Estonian territory consists of islands. They number ca. 1500 and most of them are located in the West-Estonian Archipelago (Fig. 1). The largest islands, Saaremaa, Hiiumaa, Muhumaa, and Vormsi, are surrounded by numerous islets, most of which do not exceed 10 km² in area. However, it is precisely these islets which make the landscape of the West-Estonian Archipelago unique.

The islands emerged from the sea at different times, thus facilitating the comparative study of soil formation, vegetation history, and human impacts on the environment. Most islets emerged above the present sea level only during the last millennium and some are still rising today. Human settlement has greatly changed the islets and it is difficult to find a location where natural conditions have remained entirely unaffected by human activ-

ity. The traditional economic activities on the islets have been agriculture and fishing. Valuable information on land use can be extracted from maps dating from the 17th century.

Historical background

The knowledge of human impact on the islets in prehistoric time is limited. Archeological finds on the islets are scarce, there is hardly any cultural layer, and even paleobotanical research is limited, as peat sequences are missing. Old archive material (maps, population census data, etc.), oral information, and old literature sources are essential to the study of the process of land utilization on the islets during the past centuries. The best indicator of human impact on the natural environment is the distribution of arable land, where changes reveal the process of bringing land under cultivation and mirror the pattern of human activity at different times.

Several large-scale maps of the islets from different centuries are available; they enable the identification of changes in land use and in the extension of intensively used land. These maps provide also important information on the configuration of the islands and the location of specific objects, such as stone fences and ditches. Based on distribution maps of land parcels (fields, grassland, woodland, etc.) land values can be estimated and the means of production can be classified (Ellermaa 1980; Troska 1987). In the old system of private ownership, land was classified based on its potential maximum rental income. During the Soviet period when land property was nationalized, land classification was based on maximum production potential.

The first large-scale maps of the islets were used as a basis for taxation; they date from the Swedish period at the end of the 17th century (archives of Tartu and Stockholm). The topographical maps of the Russian army from the beginning of the 19th century (kept in the Central State Military Historical Archive in Moscow) also reveal valuable information. The next series of relatively precise maps date from the middle of the 19th century. 'Verst maps' (Russian topographic maps at a

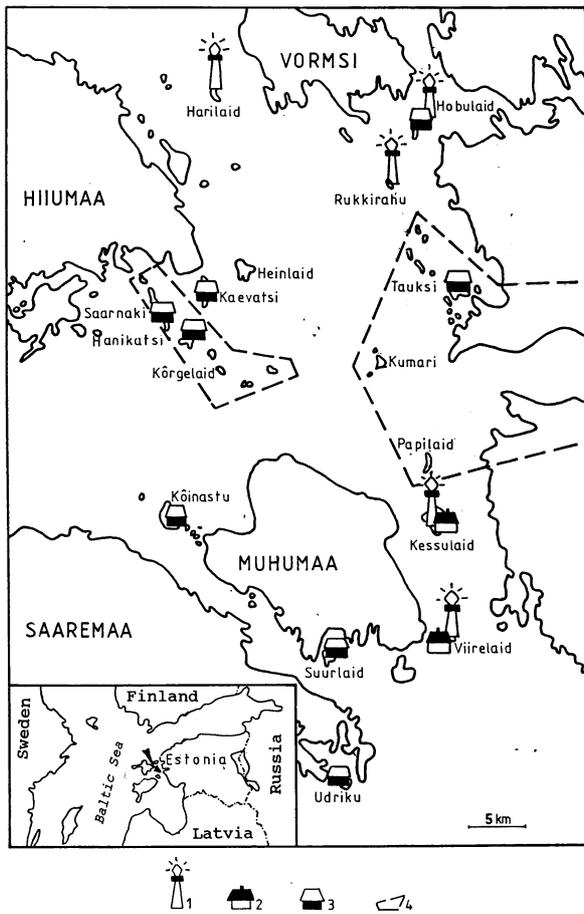


Fig. 1. West-Estonian archipelago and the study area today. 1= Lighthouse; 2 = Farm; 3 = Cottage; 4 = Nature protection area.

scale 1 : 42 000; a verst is Russian unit of measurement, one verst being 1067 m) also exist from the turn of the 19th century. From 1934 to 1940 schematic Ordnance Survey maps - scale 1 : 10 000 - were produced, which only show Ordnance Survey identification and boundaries. Most of these maps were used for land assessment. More precise maps of the islands (scale 1 : 10 000) based on aerial surveys were made for the first time in 1956.

Large-scale maps were generally not available during the Soviet period, but the work of Varep (1962, 1992) sustained interest in old maps and historical geography in Estonia.

Shapes and areas of islands have changed during the course of the last centuries. This is due to coastal uplift in the region, as well as improved precision of mapping. In the present study different maps were standardized to the same scale and unified using certain fixed points which can be recognised on all the maps.

Geographical conditions

The islets discussed in this paper are located in Väinameri, the West-Estonian 'inland sea' situated at 58° - 59° N; 22°30' - 23°30' E. They vary in size from 0.16 to 3.9 km². The distance between the inhabited islets and the largest islands or the mainland ranges from ca. 300 m to 10 km. The human settlements on the islets are connected to the mainland by boat in the ice-free period, and over the ice in winter, while in the periods of ice formation and break up, the settlements are isolated.

The climate on the islets is more maritime than on the mainland, with higher air temperatures in autumn and winter. The mean annual air temperature in the region of the islets is 5.5 °C. February is the coldest month, with a mean temperature from -4.5 to -5.5 °C. July is the warmest month, with a mean temperature from 16.5 - 17.5 °C. The mean annual precipitation is 500 - 550 mm.

Geologically, the islets consist of a crystalline basement which is covered by a Paleozoic sedimentary cover, with Ordovician and Silurian carbonate rock outcrops. In many places rendzina leptosols have developed on limestone, on which substrate specific alvar communities have developed (Ratas et al. 1988).

In the Pleistocene period the area was covered several times by continental ice, and today lime till is the predominant soil-forming sediment. In the Post-Glacial period the development of the islands was closely connected with the evolution of the Baltic Sea and with the isostatic land uplift. The majority of the islets emerged during the Limnaea Stage of the Baltic Sea in the Sub-Boreal and Sub-Atlantic periods, 4000 yr ago; land uplift still continues. The oldest islet is Kessulaid, which probably emerged ca. 5000 yr ago at the end of the Littorina period (Luha 1940). More recent data on ancient shorelines of the Estonian coast support this dating (Kessel & Raukas 1979). Its highest point is 15 m a.s.l.

Today, the islets differ considerably from each other with respect to natural conditions, particularly soil and vegetation cover. Widespread soil types are saline littoral soils, rendzina leptosols and gleysols on till and coastal deposits with different calcareous composition. (Ratas et al. 1988). The plant communities vary in their developmental phase and structure. Vegetation units occurring include coastal, dry, and wet meadows, wooded meadows, juniper scrub, and forests. The flora of the islets is exceptionally rich in species, including rare ones (Rebassoo 1975, 1987). The islets are also breeding places and annual migration stopovers for birds (Leito & Leito 1995).

Ca. 30 different geocomplexes (landscape units) have been distinguished by Ratas et al. (1988). Each geocomplex can be considered as a long-term stage in

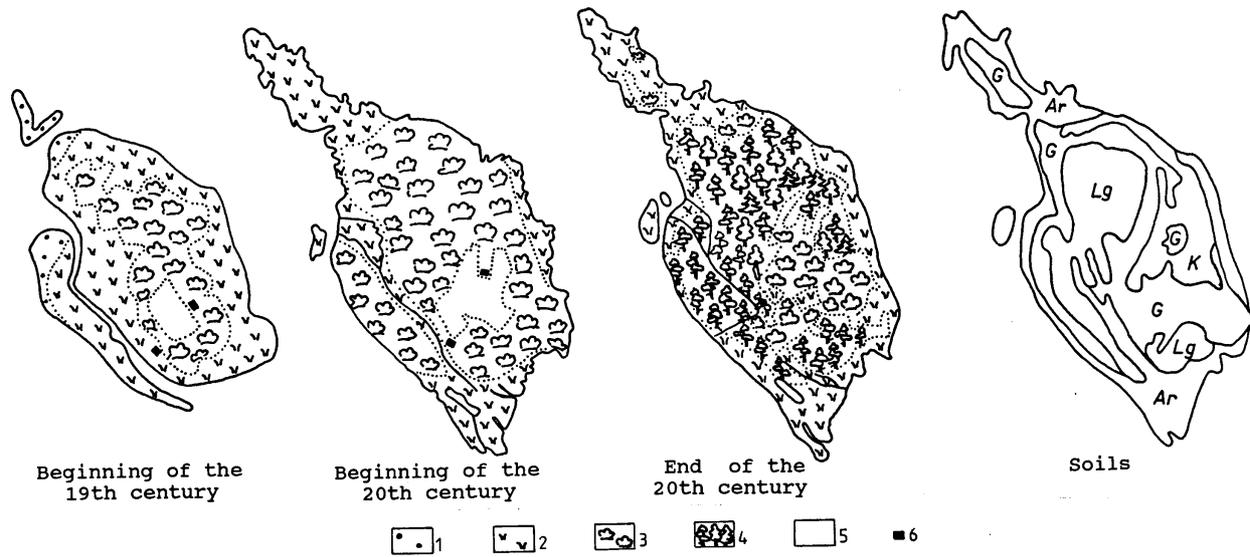


Fig. 2. Changes in landscape configuration and pattern on the Vohilaid islet (area 3.9 km² at present). 1 = Barren area; 2 = Meadow; 3 = Shrubland; 4 = Forest; 5 = Cultivated fields; 6 = House. Soils: Ar = Saline littoral soils; G = Gleysols; K = Rendzic leptosols; Lg = Gleyic podzols.

Table 1. The periods of land utilization on Estonian islets.

Time scale	General land use characteristics	Landscape changes
ca. 5000 yr ago		The oldest parts of the islets emerged due to the post-glacial isostatic land upheaval. Development of terrestrial landscapes.
Up to the 16th Century	I. Seasonal use Islets used as resting places by fishermen and for trapping and hunting. Bigger islands used as hay meadow or pasture.	Land use reduced the abundance of birds and plants only slightly. It changed the plant cover to some degree, but not the landscape as a whole.
16th and 17th Century	II. Permanent settlement Some islets became permanently inhabited.	First fields appeared.
From 1850 to 1940	Period of intensive exploitation. Islets were used as hay meadows, pastures and cultivated fields. Forest was almost absent; In the winter people travelled over the ice from the islands to the mainland, staying overnight in inns. Lighthouses and landmarks near shipping lines were built.	The landscape was seriously altered by human impact. Fields were interspersed with woods, wooded meadows, shrubberies and meadows. Farms, windmills and stone fences added to the diversity of the landscape. Its structure became more varied.
During and after World War II	III. Abandonment of many settlements Settlements were largely destroyed; gradually the fields were left fallow, hay-making declined and the islets were only used as pastures.	The landscape structure impoverished. Cultural landscapes (fields) and semi-natural landscapes (wooded meadows) disappeared. A few islets were inhabited and/or used for recreation.
From 1957 to 1989	A large number of islets were brought under nature protection following a new Law on Nature Protection.	Development of woods.
Since 1990	Return of private land ownership.	? Landscape diversification expected.

the process of landscape development (Kokovkin & Ratas 1992).

Human impact

The history of land utilization on the Estonian islets can be divided into three main periods (Table 1). In the 16th and 17th centuries, many of the islets became permanently inhabited. Published data on Saarnaki shows that it was inhabited by two families in 1564 (Tiik 1970). Kõinastu and Kessulaid had one farm each in the 16th century (Saaremaa 1934). It is likely that the settlements on the islets were maintained by the owners of large estates on the mainland who wanted to protect their hayfields on the islets, and secure a supply of fresh

fish (Tiik 1970), and even to create farmland. The 17th century famines in Estonia may also have contributed to the utilization of the islets. On some islets the proximity to sailing and transportation routes may have led to settlements (Ratas & Puurmann 1994). On most of the islets, there were one to three farms, while on a few, such as Kessulaid and Kõinastu, there even was a small village. The total number of inhabitants on the islets has varied over time. The largest population was found on Kõinastu, which had 81 inhabitants in 1850 (Anon. 1934). Altogether, ca. 20 of the West-Estonian islets have been inhabited at one time or another.

The capability of the islets to sustain human settlements depended on their landscape diversity and size. The location of the islets has not been a major constraint to settlement because the majority are relatively close to

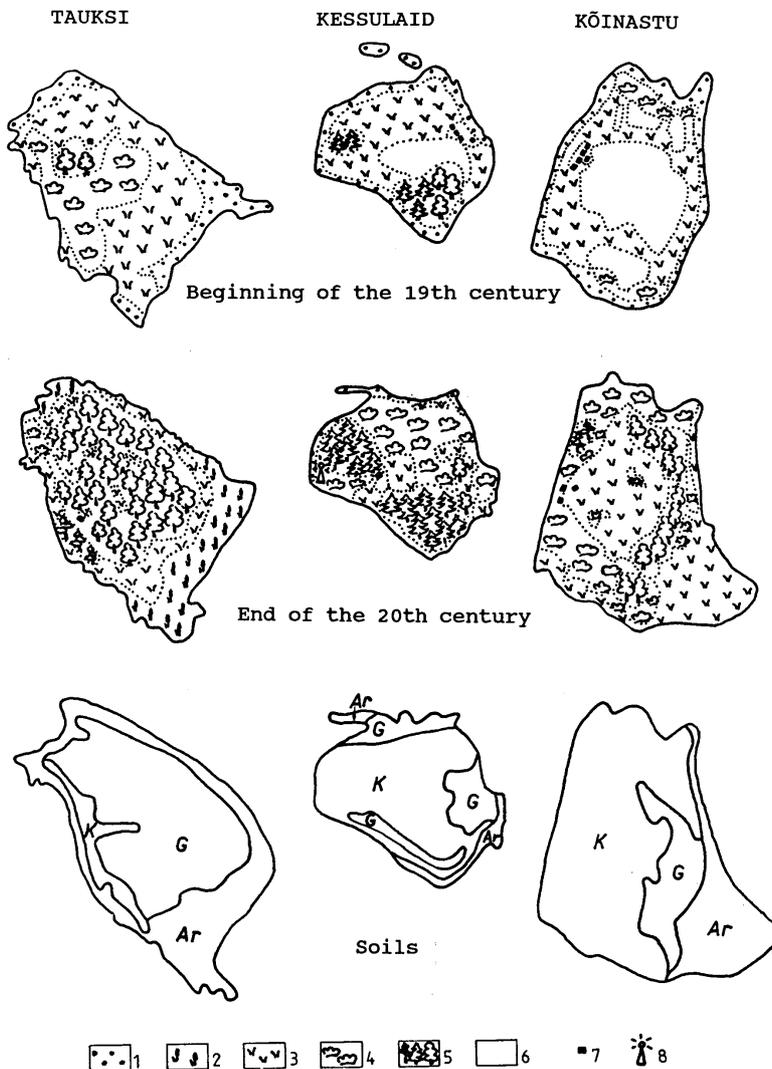


Fig. 3. Land use on the islets. 1 = Barren area; 2 = Reeds; 3 = Meadow; 4 = Shrubland; 5 = Forest; 6 = Cultivated field; 7 = House; 8 = Lighthouse. Soils: Ar = Saline littoral soils; G = Gleysols; K = Rendzic leptosols. Actual areas: Tauksi - 2.5 km²; Kessulaid - 1.7 km²; Kõinastu - 2.6 km².

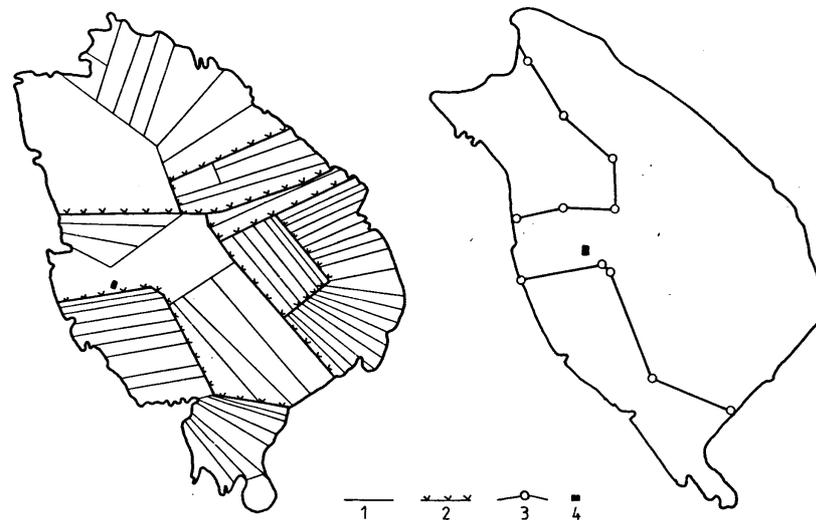


Fig. 4. Land division on Tauksi islet in the 1930s and the 1960s (area 2.5 km²). 1= Boundary between farmlands; 2 = Boundary between estates; 3 = Boundary between the lands of collective farms; 4 = Farm.

the mainland or to other, larger islands.

The cultivation of the islets began on the higher elevations. The lower parts were used for haymaking and grazing. As the islets increased in area through the isostatic uplift and as their landscape changed, the types of land changed too (Fig. 2). On several islets certain farms had land, e.g. hay meadows or even cultivated fields.

Of course, land use pattern depends also on topographic and edaphic factors. Fig. 3 shows the land use of three islets, each of which is about 2 km² in area. On Kessulaid and Kõinastu, where drought-sensitive and moderately moist calcareous soils predominate, arable land accounted for about 10 - 30 % of the area at the beginning of the 19th century. The grasslands of these two islets were used primarily for grazing. Much of the land used for haymaking was found on neighbouring islets. On Tauksi, where moist gleysols predominate, fields accounted for less than 1 % of the area. This islet was used primarily for haymaking; practically the whole islet was mown, with the land divided for this purpose between mainland farms (Fig. 4).

For centuries, cultivated fields have been located on higher elevations where rendzina leptosols on limestone bedrock or till dominate today. The soils here are relatively fertile (like those developed on till) and have adequate moisture conditions. The largest cultivated fields (up to 10 ha) were found on Kõinastu. Social and economic pressure has also influenced land use on the islets, such as the conversion of meadows into arable

land. For example, the Vohilaid and Heinlaid islets were cultivated during the famine in the 1790s.

Mostly a two-field or three-field, occasionally also a four-field system of crop rotation was used. A two-course rotation left major parts of arable land fallow, while a three-course rotation utilized the main part of the arable land for annual cultivation. The crops grown included wheat, rye, potatoes and vegetables.

Manure and seaweed were used to fertilize the soils and to replenish depleted plant nutrients. On some islets, the main purpose of keeping animals was to secure a source of fertilizer (Kõinastu). In a number of places, the seashore was divided between farms to assure equal opportunity for collecting seaweed. Seaweed was either spread on the fields directly, or it was used first as floor covering in stables and later put on the fields. The use of seaweed as fertilizer also enhanced the moisture content of the soil. Since the 1930s mineral fertilizers have also been applied.

The keeping of animals played an important role in the economy of the islet farms. Animals were raised for household consumption as well as for sale. The number of animals kept was dependent on the fertility of the land. Ploughing agriculture was only possible in association with herding, which supplied both draught animals and manure. Keeping herds was also important for providing food, leather and wool.

Herding depended on the availability of fodder from hay meadows and pastures. Pastures were found in the coastal meadows and higher elevations on leptosols

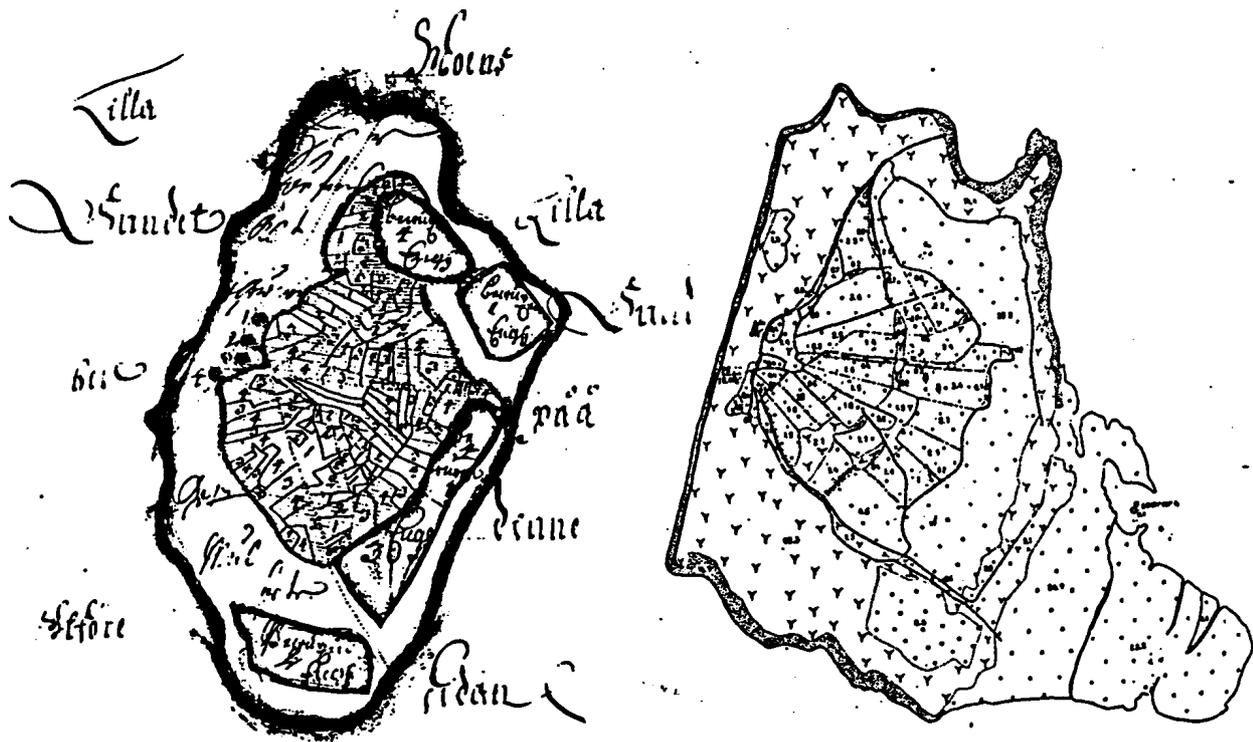


Fig. 5. Land division on the islet Kõinastu in 1687/1688 (map from the Swedish period, available in the Stockholm Archive) and in the 1980s (land use map from the Soviet period). The area of Kõinastu is at present 2.6 km².

with sparse vegetation. As a consequence of the long, and constant intensive use, particularly sheep grazing, a characteristic alvar plant community developed. Grazing prevented the meadows from becoming overgrown with shrubs, and regulated the growth of reeds at the shore. In addition to sheep, horses and cattle were used for grazing.

Hay meadows were located on lower ground with gleysols. As a consequence of mowing, species-rich plant communities of meadows and wooded meadows developed and persisted. Obtaining enough winter fodder for the animals was a great problem. In order to help solving this problem, many of the uninhabited islets were used as hay meadows, and additional grassland areas were obtained by digging ditches and draining wetlands.

Maps from different periods show the distribution of arable land, which depended greatly on natural conditions on the islets, as well as on agricultural practices. The map of Kõinastu from 1687/1688 indicates that an irregular system of strip-farming was used (Fig. 5). The cultivated fields were divided into predominantly four-sided parcels of different sizes and shapes. The fields were divided into four parts, with each part allocated to

a different household. This partition of the cultivated fields, which belonged to a village, reflected the democratic traditions of the village community. As the fertility of the land was not uniform but varying in relation to soil moisture and stoniness, the village allocated a portion of each soil type to each farm household. Every farm household was supposed to have equal rights to use the land.

The strip-farming system on the islet of Kõinastu lasted until the beginning of this century. After parcels were separated, a settlement pattern resulted in which each farm's cropland was located immediately behind the farm buildings. A regular system of land division was applied, with the parcels delineated by straight stone fences. The resulting pattern of straight lines and geometrical forms dominated in the cultural landscape, whereas such patterns were rare or entirely lacking in natural landscapes (Kant 1932). Wood lots and pastures were also divided, but used in common. Natural conditions on the islands were taken into account in the division of farmlands.

By the end of the 1930s, the landscape of the West-Estonian islets had been greatly affected by human

activity. Human settlements had a varied impact on the environment of the islets; although the vegetation cover had been substantially altered, soil composition (soil thickness, decline of humus content, etc.) had changed relatively little due to agriculture, and land drainage had not had an adverse effect. The settlement pattern and land use had been, on the whole, environmentally sound. As a result of the traditional settlement pattern and land use, the landscape structure had become more varied. The managed vegetation types, stone walls, paths, ditches and buildings constituted a dynamic, ecologically diverse, and resilient landscape. However, the landscape and ecology of the islets changed drastically after Estonia became part of the Soviet Union.

After World War II large-scale collective farms were established in Estonia, the first one in 1947 on the island of Saaremaa. In the early years of farm collectivization, fields were still planted on some of the islets, and haymaking and grazing continued. But later the typical landscape elements, such as meadows and cultivated fields, rapidly disappeared after individual farms had been abandoned. Some islets were used by collective farms as grazing land for large herds of young animals, thereby often exceeding the environmental carrying capacity (cf. Fig. 4). Another, environmentally more positive aspect of the postwar situation was that the archipelago was an area of military strategic importance.

Since 1957, when a new Law on Nature Protection was adopted in Estonia, a large number of the West-Estonian islets have been included in nature protection zones. Although this law saved them at least from overgrazing, it did not restore or preserve the traditional forms of human settlement and their influence on the landscape. The challenge now is how to re-establish and protect the rich and varied natural and semi-natural plant communities, the relics of earlier land use patterns, which previously characterized the islets. Landscapes are dynamic and respond to land-use changes. Thus, conservation of the typical islet landscape involves not only nature conservation as such, but also preservation and restoration of traditional land use practices, traditional settlement patterns, and traditional ways of life.

In 1990 the West-Estonian Archipelago Biosphere Reserve was formed. One of the main objectives of the biosphere reserve is to create effective links between conservation and development, where the needs of society are in concordance with environmental conditions. However, the social and economical conditions are not the same today as they were when traditional practices were followed.

Since 1991, Estonia is in the process of privatization of state enterprises, 'decollectivization' of agriculture, and introducing a land reform to establish a land market with private ownership. This all will very likely, and in

the near future, change the landscape of the islets and the allocation and utilization of arable land. Changes in land ownership will demand new types of protection of the islets. It is doubtful whether the traditional settlement pattern and economic activities will ever be re-established on the islets. Moreover, new forms of land use are under development, i.e. tourism and recreation, particularly the building of holiday homes.

Conclusions

The West-Estonian islets are young and rapidly evolving. The comparison of maps from different periods reveals the changes in the relationship between human use of the land and the natural environment. The cultural landscape on the islets has been very dynamic during the last centuries.

Landscape development due to human settlements on the islets is manifested foremost in changes in the vegetation cover, a component of the landscape which can easily be altered. Agricultural activities have prevented the afforestation of the islets for many centuries. As a consequence, only small patches of woodland have established, whereas the potential natural vegetation would be forest for most of the area. Today the landscape is characterized by a decrease in diversity of plant communities and by the disappearance of agricultural land. Fields have become fallow, and meadows and wooded meadows have become overgrown with shrubs. The previous cultural landscape types have been replaced by new, more natural communities.

Because the cultural landscape changes rapidly after land use alters, conservation of the typical islet landscape involves the preservation and restoration of the traditional way of life based on agriculture and fishing. The course of political developments, and the form of ownership they produce, determine the course of development of the landscape on islets.

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