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## WORLD HERITAGE NOMINATION – IUCN TECHNICAL EVALUATION

### THE KVARKEN ARCHIPELAGO (FINLAND) - ID N° 898 Bis

#### (Proposed extension to The High Coast of Sweden)

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**Background note:** The Kvarken Archipelago is proposed as an extension to the existing World Heritage (WH) property of the High Coast of Sweden, inscribed on the WH List in 2000. The High Coast was inscribed under natural criterion (i) as one of the places in the world that is experiencing isostatic uplift as a result of deglaciation. The Committee was also informed at the time by the delegate of Finland that a nomination (serial transboundary) for the nearby KA area was in preparation.

#### 1. DOCUMENTATION

- i) **Date nomination received by IUCN:** April 2005
- ii) **Additional information requested from and provided by the State Party:** At the conclusion of the IUCN field evaluation in August, 2005, it was decided by the Finnish State Party that a reduction in boundaries of the property was needed to provide a more focused and coherent nomination. Documentation was adjusted and new maps were prepared and sent to the WH Centre and IUCN on 29 September, 2005.
- iii) **IUCN-WCMC Data Sheet :** 7 references
- iv) **Additional Literature Consulted:** Nordic Council of Ministers. 1996. **Nordic World Heritage: Proposals for New Areas for the UNESCO World Heritage List**; Dingwall, P. et al. 2005. **Geological World Heritage: A Global Framework**. Global Theme Study. IUCN; Gilligan, B. et al. 2005. **Management Effectiveness Evaluation of Finland's Protected Areas**. Metsähallitus, Helsinki; Anon. 2003. **The High Coast – A World Heritage Site**. Vasternorrland County; Lammi, S. and Sevola, P. 2004. **New Land**. Vaasa; Geological Survey of Sweden. 1994. National Atlas of Sweden; Ehlers, J. et al. 1995. **Glacial Deposits in NE Europe**. Rotterdam; Flint, R. 1971. **Glacial and Quaternary Geology**. Wiley; Seppala, M. ed. 2005. **The Physical Geography of Fennoscandia**. Oxford University Press; Larsen, C.F. et al. 2005. Rapid viscoelastic uplift in southeast Alaska caused by post-Little Ice Age glacial retreat, in **Earth and Planetary Science Letters** 23, 548-560.
- v) **Consultations:** 9 external reviewers. Officials from Ministry of Environment, West Finland Natural Heritage, Geological Survey of Finland, West Finland Regional Environment Centre, Regional Council of Ostrobothnia, Municipality mayors.
- vi) **Field Visit:** Jim Thorsell, August, 2005
- vii) **Date of IUCN approval of this report:** 11 April 2006

#### 2. SUMMARY OF NATURAL VALUES

The Kvarken Archipelago (KA) in the Gulf of Bothnia off the west coast of Finland extends over some 70 kilometres from east to west and by 60 kilometres from north to south. The total Archipelago consists of 6,550 islands and islets formed of glacial moraines that are slowly rising from the sea. The nomination consists of two core areas within this region with a total area of 194,400 ha of land (15%) and sea (85%). The KA extension, if approved, would more than double the size of the existing High Coast WH property in Sweden (142,500 ha).

Area of proposed KA extension to High Coast WH property

Core site A: 160,000 ha  
Core site B: 34,400 ha  
**Total area: 194,400 ha**

The nominated area includes 5600 islands, the highest of which is 20m asl. Landforms in the KA were created mostly by glacial action over a pre-Cambrian peneplain during the last Ice Age, between 10,000 - 24,000 years ago. They are characterised by extensive moraine deposits, a shallow brackish sea of low salinity, and a shoreline 2416 kilometres long. The major geomorphologic feature is the unusual ridged washboard moraines or "De Geer moraines" formed by the melting of the continental ice sheet. Several

formations are represented in the property: mainland, island, coasts and open sea including relatively unaltered underwater geological features. As a consequence of the advancing shoreline, islands appear and unite, peninsulas expand, lakes evolve from bays and develop into marshes and peat fens, resulting in an unusual variety of environmental gradients, both topographic and hydrographic.

The formation of new islands occurs because the property is in the centre of the Fennoscandian land uplift area, which is continually emerging from the sea as a result of isostatic rebound. This occurs when land previously weighed down under the weight of a glacier slowly lifts after the glacier has disappeared. The property complements the High Coast WH property in Sweden, 150 kilometres to the southwest, which is also rising at a similar rate. The last glacier to cover the whole Scandinavian Peninsula drained on the east and south towards the present White Sea, Gulf of Finland and Baltic Sea with the Earth's crust depressed beneath it. The total initial depression is assumed to have been about 900 - 1,000 meters when the Scandinavian Ice Sheet was 3,400m-3,700 meters thick. The land started to lift 20,000 years ago, as de-glaciation began. During the first thousand years of uplift, the rebound rate was up to 100mm per year. The present uplift rate is 8 to 8.5mm per year, increasing the land area of the archipelago by one square kilometre a year. The sea at the Northern Kvarken strait is only 25m deep at a sill across the mouth of the Bay of Bothnia. At the present rate Finland and Sweden will be connected by a land bridge across the strait within 2,500 years, when the Bay will become the largest freshwater lake in Europe. Isostatic rebound is likely to continue for 10,000 - 12,500 years in the Kvarken area and the uplift will probably be between 100 and 125 metres.

The islands are covered by deposits both glacial and post-glacial: drumlins and flute lines parallel to the flow; hummocky, transverse, terminal and de Geer moraines at right angles to it as well as thick till deposits and a great number of boulder fields. The profusion of the De Geer moraines is the most notable feature. The melting and disintegrating ice front reached the Kvarken area 10,600-10,400 years ago when the area was covered by a 250-270m deep glacial lake. A floating and fracturing ice front with calving icebergs was typical of glacial marine conditions during this stage. Varved clay chronology has shown that the annual withdrawal of the ice margin was fast, up to 200-500m per year, leaving the regular ridges of till which reflect the probable positions of the intermittently retreating margin of ice.

The climate is southern boreal, influenced by the sea. Snow and ice cover lasts between 140-150 days a year and rainfall is 400mm. KA is a dynamic landscape, most obvious in flat and shallow areas where uplift is supplemented by sedimentation. The continually emerging shores are colonized by pioneer species which are gradually replaced by a succession of plant communities as the land rises in various ways due to the large number of environmental gradients. Seashore habitats are very heterogeneous and represent several Natura 2000 coastal habitat types. The Archipelago is on an important migratory route and offers excellent breeding habitats for birds. There are important Baltic populations of black guillemot (6,000 pairs, a quarter of

the Baltic population) and razorbill (1,000 pairs); also Caspian and Arctic terns, whitetailed eagle (35 pairs), osprey and great scaup. Thousands of roughlegged buzzards and cranes also migrate through. Marine mammals living in the KA are typical for the Baltic region such as grey and ringed seals. As with the plants, the mild climate encourages many southern species of animals which come to their northern limit of distribution here.

### 3. COMPARISON WITH OTHER AREAS

This section closely follows the text of the IUCN evaluation on the comparison of the High Coast in Sweden as presented to the Committee in 2000.

#### 3.1 Comparison with other World Heritage properties

There are 200 protected areas in the West Eurasian Taiga Biogeographic Province, including one mixed WH property in Sweden (The Laponian Area) and three natural WH properties (the High Coast of Sweden, the Virgin Komi Forest in Russia and the West Norwegian Fjords). Apart from the High Coast (HC), these existing properties are much larger and also display a wide range of geological features. They do not, however, illustrate the isostatic uplift phenomena that occurs in the KA, except, of course, the HC, to which KA is being proposed as an extension.

Many other areas in the Baltic Sea region and Gulf of Bothnia contain archipelagos with moraine landforms which display raised coastlines including several identified in the 1996 Nordic World Heritage report of proposed natural sites. None of these have the geological diversity of the KA nor have the extent of uplift.

There are 71 properties inscribed on the WH List under geological/earth science criteria, many of which contain glacial landforms and several of which have and are experiencing uplift (e.g. Gros Morne, Los Glaciares and Macquarie Island). The only property, however, inscribed under the theme of "Ice Ages" in the Global Geological Theme Study (IUCN, 2005) is the HC in Sweden. There are also 10 natural WH properties under the coastal systems earth sciences theme (IUCN, 2005), some of which (e.g. St. Elias Parks, Henderson Island, Te Wahipounamu - Southwest New Zealand and the Pitons Management Area) illustrate raised coastline phenomenon. Recent research along the coast of southeast Alaska including parts of the St. Elias Parks WH property indicates uplift rates three times that of those found in Fennoscandia (i.e. as high as 32mm per year). Part of this is due to the tectonic setting of coastal Alaska which is fundamentally different than the continental shield of Fennoscandia, but nevertheless, the rate of uplift in Alaska is the highest yet recorded in the world. The distinctiveness of the KA (along with the HC) is that the isostatic uplift is entirely due to the disappearance of a continental ice sheet, the long period of uplift (up to 20,000 years) and the range of coastal and marine landform features displayed as a result.

### 3.2 Comparison with other areas experiencing isostatic rebound

Another major area with comparable isostatic uplift is found in Richmond Gulf in south-eastern Hudson's Bay (Canada). This area has a similar history of glaciation and uplifted land. Deglaciation occurred about 1,000 years later and the present uplift rate is higher at 11-13 mm per year. It also lies on a Precambrian bedrock peneplain, with deep paleozoic sediments, but unlike the boulder-rich moraine of the archipelago, the moraines of Hudson Bay are boulder-poor, owing to softer rocks. De Geer moraines, drumlin fields, transverse moraines and hummocky moraines occur there but do not form archipelagos. The wide low-lying western coasts of Hudson Bay area are a wetland-dominated landscape, which is lacking in the Northern Kvarken. The east coasts resemble it more, having a more broken topography and thin stunted forests. But the climatic, topographic, and geomorphological differences are considerable and make the area less nutrient-rich and diverse than the archipelago. The sub-arctic macroclimate of Hudson Bay with permafrost, salt water, strong winds, and a deep, long lasting snow cover affect the structure and dynamics of its coastal ecosystems more than land uplift, the effects of which are more obvious in the Kvarken Archipelago.

Isostatic phenomena are also evident in the northern and western shores of the White Sea on the periphery of the Fennoscandian shield. The land uplift rate is only 1,0-2,5 mm per year. Drumlins, end moraines and De Geer moraines (also called "washboard" moraines) do occur there but do not form archipelagos. The Stockholm Skargard in Sweden is a larger archipelago with some 24,000 islands. It has also experienced some uplift, but is mostly lacking in glacial till deposits which characterize other coastal areas in the Bothnian Sea Region.

In conclusion, the KA and the HC are one of several places in the world that are experiencing uplift as a result of deglaciation. Isostatic rebound is well-illustrated in this area and is among the highest known, although recent data from Alaska suggest that uplift rates are much more rapid there (but over a much shorter period of time). Both the HC and the KA have been well-documented scientifically, and are essentially the "type area" for research on isostasy, the phenomenon having been first recognised and studied there (Flint, 1971).

Other natural values of the KA (wildlife and vegetation succession processes) are also important but relatively common and do not stand out as unique at an international level. Useful information is also provided on the aquatic environment in Appendix 3 of the nomination which indicates the regionally important values of the marine area.

Similarly, the scenic values of the KA, consisting of a blend of farmland, coastline and islands, are harmonious, but typical of much of the rural landscape of northern Europe

### 3.3 Relation of the Kvarken Area to the High Coast

Unlike the predominantly erosional HC, the KA is a moraine archipelago. Its flat topography comprises

glacial till deposited by the melting ice sheet and formed into hummocky moraines and drumlins rising 20-30m above sea level. The archipelagos are mostly less than 1,000 years old. Uplift of the shallow seabed rapidly transforms bays into fladas and glo-lakes (two types of lagoons), then into freshwater lakes, even over the lifetime of a single human generation. Plant succession is equally rapid on the newly created land, displaying marked shoreline zonation. Each phase of uplift has its own characteristic vegetation assemblage, with young marshes of sedges at sea level extending through a series of successional stages to mature spruce forest furthest from the shore.

While the HC and the Kvarken have isostatic rebound in common, they are geologically contrasting areas with marked differences in topography. This in turn has important implications for differences in plant and animal life. The HC has a dramatic land surface of bedrock hills, high islands, steep shores and deep bays and straits -features that do not otherwise occur in the Baltic region. The KA is a low-relief area of extensive archipelagos of till and intervening shallow sea and unique depositional features notable the De Greer (or washboard) moraines. The HC is also much older, revealing 10,000 years of geological evolution, as opposed to the corresponding 2,000-year history of the Kvarken.

The HC is, therefore, a relatively stable biological environment, while the KA, whose low-lying landscape is constantly changing due to rising land, is biologically highly dynamic, with plants and animals continuously colonising newly emergent land surfaces and successional habitats. Thus, the HC and KA areas differ considerably in the ways land uplift processes act on the biota. They are, in fact, complementary in terms of their biophysical evolution. They represent, respectively, the high and low topographical extremes of post-glacial uplifted landscapes in the Baltic.

## 4. INTEGRITY

### 4.1 Legal status and ownership

A variety of protective measures cover 80% of the property, including several sites in the Natura 2000 Network (governed by EU Directives on Habitats and Birds and in process of expansion), a RAMSAR site and national measures under the Nature Conservation Act. In the remaining 20% the geological values are also protected under national legislation. As in the HC, there is also a portion of the land area and sea frontage owned privately or by village communities. A much greater extent of land and sea, however, in KA, as compared to the HC, is owned by the State.

### 4.2 Boundaries

Definition of boundaries of the property went through several iterations and much input from the Geological Survey of Finland. Final deliberations resulted in two core areas of land and sea where the major focus of geological features occurs. Only the most superlative terrestrial formations and formations lying in the shallow

sea are included in the two core areas as well as the majority of the moraine features. While the geological boundaries of the property do not coincide with legal or administrative boundaries, the science behind their selection is justified and IUCN considers that the two core areas incorporate the essence of the KA. A *de facto* buffer zone around the property is provided for in the regional plan for Ostrobothnia, and the geological values will be taken into consideration in local and regional planning.

#### 4.3 Management

The Regional Council of Ostrobothnia promotes the sustainable development and protection of the archipelago and funnels the funds for various EU financed programs. It is also including special status for a buffer zone around the nominated area as part of the regional plan. The main responsibility for nature conservation and environmental protection rests with the Metsähallitus (Forest and Park Service) and the West Finland Regional Environmental Centre which controls most land-uses, regulates and permits small-scale farming, fishing and forestry. The municipalities are responsible for planning and land use within their jurisdictions. Detailed management plans for the area include recent local shore master plans for the Archipelago by the municipalities of Malax, Vaasa and Korsnäs. Cooperation is planned with the Swedish HC property where the geologic processes are complementary. For public presentation there are two nature stations and one museum within the area. A visitor centre ("House of the Sea") is also planned near the road entrance to the property.

#### 4.4 Threats

Although there are some threats to the biological values of the property (e.g. environmental toxins, agricultural runoff and dredging), there are no threats to the geological values of the KA. The resident human population of 2500 in the KA (compared to 4500 in the HC) is engaged in small scale traditional farming, forestry and fishing, all of which have negligible impact on geological values. Tourism pressures are not at a high level (200,000 annually) but will certainly increase in future. Some 600 summer cottages are found throughout the KA but these also pose minimal threats. Both of these issues are adequately addressed in tourism and recreation plans for the property. A long term change in the area may come from the effects of global warming (sea level rise) which may moderate the rate of uplift.

#### 4.5 Serial property

When serial properties, such as this one, are evaluated, IUCN poses a standard set of three questions:

- a) What is the justification for the serial approach?**  
The nominated property was selected by a panel of experts who determined that two focus areas contained the full range of glacial features that comprise the international values of the property. Each of the two core areas as well as the contrasting site of the HC has a different morphology and geology and displays a different range of geomorphological

features. The two parts of the nomination are thus complementary and reinforce the rationale for addition to the existing HC WH property.

- b) Are the separate elements of the property functionally linked?** At their closest point, the two core areas are 7 km apart and are separated only by open sea and a few islands. KA is some 150 km from the HC on the east coast of Sweden. The entire area was covered by the Scandinavian continental ice sheet and its features are derived from the after effects of its retreat.
- c) Is there an overall management framework for all the components?** Under the Regional Environmental Centre two working groups are to be established once the property is included as an extension of the Swedish HC. One to coordinate the land-uses, conservation and management of the existing mix of protected and unprotected private, municipal and state lands. The second will promote sustainable tourist and other enterprises. Both eventually will share common guidelines with their Swedish counterparts. The Kvarken Council is a cross-border association to promote cooperation between Finnish and Swedish municipalities. The entire area on the Finnish side is covered under the regional plan prepared by the Regional council of Ostrobothnia.

## 5. ADDITIONAL INFORMATION

**5.1 Name of property:** In a letter from the Swedish Minister for Education, Research and Culture dated 31.01.2005, it was noted that Sweden had "...no objection to the designation of the Kvarken archipelago as a serial nomination to form an international extension of Sweden's High Coast World Heritage site." In a follow-up letter of 19.09.2005, the same office agreed to the name High Coast/Kvarken Archipelago as the collective name for the property.

**5.2 Public support:** A five year process of consultation was involved in the preparation of this nomination. Also, a "Statement of Intent" regarding future sustainable management for the property has been signed by all the local management authorities and municipalities concerned (Appendix 10 in the nomination). The process is thus both "bottom up" and "top down" and ensures long term cooperation for the KA.

## 6. APPLICATION OF CRITERIA / STATEMENT OF SIGNIFICANCE

The Kvarken Archipelago has been nominated as a transboundary serial property under natural criterion (i).

### Criterion (i): Earth's History and Geological Features

The Kvarken Archipelago, with its 5600 islands and surrounding sea, is of exceptional geological value for two main reasons. First, it is an area of rapid glacio-

isostatic uplift with rates that are among the highest in the world. The uplift has been ongoing for thousands of years and is associated with major changes in the water bodies in post glacial times. The Kvarken, along with the existing High Coast, its Swedish equivalent on the west coast of the Gulf of Bothnia, are key areas for the understanding of the processes of crustal response to the melting of the continental ice sheet. Second, the Kvarken area possesses a distinctive array of glacial depositional landforms, such as De Greer moraines, which add to the variety of glacial landscapes features in the region and reinforce the previous validity of the High Coast inscription. IUCN considers that the nominated property meets this criterion

IUCN also notes that this property has other important and complementary natural values but these are secondary to the criterion used in the nomination. They are, however, being considered in the integrated management of KA region.

## 7. RECOMMENDATION

IUCN recommends that the Committee **extend** the High Coast World Heritage property (Sweden) to include the Kvarken Archipelago (Finland) on the basis of natural criterion (i).

The property thus becomes a serial transboundary property of both Finland and Sweden with the new name of *High Coast / Kvarken Archipelago* (Sweden/Finland). The total size of the transboundary serial property will be 336,900 ha as detailed below.

Total area of property:

State Party	Property name	Land (ha)	Sea (ha)	Total (ha)
Sweden	High Coast	62,500	80,000	142,500
Finland	Kvarken Archipelago (Core A)	26,560	133,440	160,000
Finland	Kvarken Archipelago (Core B)	2,683.2	31,716.8	34,400
				<b>336,900</b>

**Map 1: Location of nominated property**



Map 2: Boundaries of nominated property



