

World Heritage Sites

Protected Areas and World Heritage



HIGH COAST / KVARKEN ARCHIPELAGO SWEDEN & FINLAND

The High Coast in the western Gulf of Bothnia has been largely shaped by glaciation and the rebound of the land by 285m following the retreat of the overlying glacier 9,600 years ago. This is the highest such uplift known, and is the type locality for research into isostatic rebound. The Kvarken Archipelago of 6,500 islands across the Gulf of Bothnia is a landscape in continuous change and an outstanding example of post-glacial island uplift in a flat and shallow morainal archipelago. As with the High Coast, which it complements, this is the world's most representative area for studying the process.

COUNTRIES

Sweden and Finland

NAME

High Coast / Kvarken Archipelago

NATURAL WORLD HERITAGE TRANSBOUNDARY SERIAL SITE

2000: The High Coast inscribed on the World Heritage List under Natural Criterion viii.

2006: The Kvarken Archipelago inscribed on the World Heritage List under Natural Criterion viii, as an extension to the High Coast.

STATEMENT OF OUTSTANDING UNIVERSAL VALUE [pending]

INTERNATIONAL DESIGNATIONS (KVARKEN ARCHIPELAGO)

1974: The Valassaaret and Björkögrunden Archipelago designated a Wetland of International Importance under the Ramsar Convention (16,730 ha).

2004: The Quark Archipelago Wetland created from the Valassaaret and Björkögrunden Archipelago site, extended to include the Mikkelinsaaret Islands (to 63,699 ha).

IUCN MANAGEMENT CATEGORIES

The High Coast World Heritage site: V Protected Landscape/Seascape comprising:

Skuleskogen National Park: II National Park

Nordingrå Nature Conservation Area: V Protected Landscape/Seascape

Nature Reserves:

Balesudden	Ia	Strict Nature Reserve	Halsviksgravinen	IV	Habitat/Species Management Area
Högbonden	Ia	Strict Nature Reserve	Rotsidan	IV	Habitat/Species Management Area
Ögeltjärn	Ia	Strict Nature Reserve	Skuleskogen	IV	Habitat/Species Management Area
Omneberget	Ia	Strict Nature Reserve	Storön	IV	Habitat/Species Management Area
Södra Ulvön	Ia	Strict Nature Reserve	Vilmyran	IV	Habitat/Species Management Area
Trysunda	Ia	Strict Nature Reserve	Herrestaberget		Unassigned
Gnäggen	III	Natural Monument	Storholmen		Unassigned
Mjältön	III	Natural Monument	Storsand		Unassigned
Norrfällsviken	III	Natural Monument			
Skuleberget	III	Natural Monument			

The site also includes 11 Landscape Protection Areas and eight Bird Sanctuaries.

The Kvarken Archipelago: Unassigned.

Areas where legally gazetted: V Protected Landscape/Seascape

BIOGEOGRAPHICAL PROVINCE

West Eurasian Taiga (2.3.3)

GEOGRAPHICAL LOCATION

The High Coast and Kvarken (Quark) Archipelago lie either side of the Kvarken Strait between the Gulf and the Bay of Bothnia, the northern extensions of the Baltic Sea between Sweden and Finland. The High Coast in Sweden lies about 150 km southwest of the Kvarken Islands in the province of Västernorrland. Its northern boundary lies about 10 km south of the town of Örnsköldsvik. Inland on the west, the border cuts just south of the town of Köpmanholmen, but includes the villages of Docksta and Ullånger. It turns south along the centre of Ångermanälven fjord. The eastern boundary incorporates all the offshore islands, running about 4 to 10 km beyond most of them. The site's geographical coordinates are: 17°54' to 19°13'E, 62°44' to 63°13'N.

The Kvarken Archipelago lies halfway along the west coast of Finland, 10 km northwest of the town of Vaasa between 62°42'N to 63°28'N by 20°37'E to 21°52'E. It lies at the mouth of the Bay of Bothnia, about 150 km northeast of the High Coast in Sweden.

DATES AND HISTORY OF ESTABLISHMENT

The High Coast:

- 1968: Eight Landscape Protection Areas established in the area;
- 1969: Storsand and Norrfällsviken Nature Reserves and one Landscape Protection Area established;
- 1970: Storön and Gnäggen Nature Reserves established;
- 1971: Södra Ulvön and Herrestaberget Nature Reserves established;
- 1974: Rotsidan, Skuleberget, Halsviksravinen, Mjältön and Vilmyran Nature Reserves and one Landscape Protection Area established;
- 1975: Storholmen Nature Reserve established;
- 1976: Eight Bird Sanctuaries established;
- 1983: Nordingrå Nature Conservation Area and one Landscape Protection Area established;
- 1984: Skuleskogen National Park established;
- 1985: Balesudden Nature Reserve established;
- 1987: Högbonden and Trysunda Nature Reserves established;
- 1990: Skuleskogen Nature Reserve established;
- 1992: Omneberget Nature Reserve established;
- 1994: Ögeltjärn Nature Reserve established;
- 2000: The whole area granted World Heritage status;
- 2003: Natura 2000 habitats designated within Skuleskogen National Park.

Kvarken Archipelago:

- 1974: Two small island groups (Valassaaret and Björkögrunden) designated a Ramsar site;
- 1982-96: Nine nature conservation programs were established in Finland covering shore protection, bird-rich lakes and bays, old-growth forests, an island group and a scenic landscape area; work on these areas is to be completed by 2007;
- 1997: Nature Conservation Act passed, giving the nine nature conservation programs legal support;
- 1998: The Natura 2000 area of the Kvarken Archipelago approved by the Helsinki Commission for inclusion in the Baltic Sea Protected Areas network; work on this is to be completed by 2007;
- 2004: The Valassaaret and Björkögrunden Ramsar site extended to include the Mikkelinsaaret Islands;

2005: The Baltic designated a Particularly Sensitive Sea Area by the International Maritime Organisation permitting coastal states to adopt protective measures against the effects of international shipping.

LAND TENURE

The High Coast: The State owns about 5,000 ha, including the land area of the Skuleskogen National Park and most of the nature reserves and bird sanctuaries. The rest of the land is in private ownership. Kvarken Archipelago: Land area ownership is divided between the state which owns 1,878 ha, village communities, and private owners who own 15,615 ha. Sea areas totalling 70,212 ha are in state ownership. The Ministry of the Environment administers the area through the Forest and Park Service and the West Finland Regional Environmental Centre (*Vastra Finlands Miljöcentral*).

AREAS

The total composite area of the High Coast / Kvarken Archipelago site is 336,900 ha: (UNESCO gives 194,400 ha in 2008)

The High Coast totals 142,500 ha: 62,500 ha (43.9%) of this area is land, 80,000 ha (55.1%) is sea. The total includes the following protected areas:

Skuleskogen National Park: 2,950 ha (including 300 ha of sea)
Nordingrå Nature Conservation Area: 6,000 ha.

Nature Reserves:

Balesudden	934 ha	Skuleskogen	97 ha
Trysunda	932 ha	Ögeltjärn	72 ha
Högbonden	335 ha	Halsviksravinen	63 ha
Storön	302 ha	Omneberget	27 ha
Norrfällsviken	227 ha	Storsand	12 ha
Skuleberget	226 ha	Herrestaberget	9 ha
Södra Ulvön	200 ha	Storholmen	9 ha
Mjältön	147 ha	Vilmyran	5 ha
Rotsidan	112 ha	Gnäggen	2 ha

The Kvarken Archipelago totals 194,400 ha, in two areas, 15.1% being land, 84.9% being shallow sea: Core Area A to the north: 160,000 ha (16.6% land; 83.4% sea). Core Area B to the south: 34,400 ha (7.8% land; 92.2% sea). A buffer area of 137,700 ha was proposed, 7% being land, 93% being marine.

ALTITUDE

The High Coast: Sea level to 333m (Dalsberget). Underwater depths exceed 20m.
Kvarken Archipelago: Sea level to -20m which drops by about 8-8.5mm per year.

PHYSICAL FEATURES

The High Coast of Ångermanland is the only hilly coastline in east Sweden, a region of steep-sided flat-topped forested hills and cliffy coasts with particularly interesting geology and geomorphology. In many areas the bedrock or overlying deposits are exposed, and are therefore relatively easy to study. In the southwest the underlying bedrock is granite and gneiss, in the north and east there are magmatic rocks including reddish rapakivi granite, gabbro and anorthosite. Throughout the area are seams of diabase, which breaks down into fertile soils, with large diabase slabs in some areas overlying ancient sandstone. The sea floor of the Baltic is also of sandstone, overlain by younger rocks, including Ordovician limestones. The most sharply contoured submarine topography in the Baltic exists close offshore, extending nearby to the deepest point in the Gulf, the Ulvö Trench (-293m). Tides are low, winds having more effect on the water level, and the seas ice over in winter.

The Scandinavian Peninsula was affected by three major ice ages: the Elster, Saale and Weichsel. During the most recent of these, the Weichsel, the vast Fennoscandian glacier ice-cap 3 kilometres thick was centred on, and had its greatest volume directly over, the High Coast area. The greatest extent of the ice cap was around 18,000 years ago. Immediately following the retreat of the ice, the land began to lift, with initial rates of elevation of 100-150mm per year. It is estimated that the total uplift since this time has been around 800m, possibly the highest uplift of any area in the world in recent geological history. The final retreat of the ice from the High Coast occurred about 9,600 years ago,

when the land was some 285m lower than its current level. The present rate of uplift is about 8mm per year. The geomorphology of the region is shaped by the combined processes of glaciation, glacial retreat and the continuing emergence of new land that has left a mosaic of shallow, sheltered embayments and islands next to deep, open waters resulting in a wide range of habitats. The only other land that has experienced comparable uplift after the last glaciation is southern Hudson's Bay in Canada, where the total isostatic uplift is 272m.

Glaciation has left a strong mark on the landscape. The glacial flow was from the north-west, and this side of the mountains is the most heavily worn. Valleys are oriented northwest to southeast, the southeast sides of the mountains being generally far steeper. Deep grooves have been worn along vast whalebacks of bare bedrock and striated roches moutonnées. There are numerous steep faults and fissures, many gouged out by freezing and both glacial and fluvial erosion. At the time of the final retreat of the ice only the highest peaks in the area were above sea level. The highest coastline level is an important geological feature since it left only the areas above this line with untransformed glacial moraines which in many places are the best soils for forestry and farmland. In the High Coast this is at the highest level, some 285m above the current sea level and there are only nine till-capped peaks within the nominated site. Below this height many surfaces were washed clean by the sea, and the moraines sorted and deposited by the sea at lower levels in fields of shingle. Fine clays, silts and sands filled the valley bottoms; larger gravels and rocks were deposited in more exposed areas. As the land continued to rise, salt-water bays were cut off, forming many lakes which have gradually become fresh water.

The Kvarken Archipelago off the west coast of Finland extends over some 70 kilometres from east to west and 70 kilometres from north to south, comprising 6,550 low islands. The nominated site contains a major island group, the Björköby Archipelago, with some ten small satellite archipelagoes (Core Area A), and, between 10 to 40 km southwest, five small archipelagoes (Core Area B) (MoE, 2005). It consists of 5,600 islands and islets formed of glacial moraine which are slowly rising from the sea. Its landscape and landforms were created mostly by glacial action over a preCambrian peneplain during the last Ice Age, between 10,000 to 24,000 years ago. They are characterised by extensive moraine deposits, a shallow brackish sea of low 0.4 to 0.5 ‰ salinity, and a shoreline 2,416 kilometres long. The major geomorphologic feature is the unusual ridged fields of De Geer ('washboard') moraines, especially in Core Area A, formed by the melting of the continental ice sheet. Several formations are represented in the site: mainland, island, coasts and open sea including as yet 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. This is well illustrated in the labyrinth of *flad* lagoons and *gløe* lakes along the shallow shores of Core Area B, which is also covered by many glacial erratic boulders. These formations are among the Natura 2000-designated habitats (MoE, 2005)

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 Fennoscandian 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 formation of new islands occurs because the site is in the centre of the uplift area which is continually emerging from the sea as a result of isostatic rebound following its release from the glacier's weight. The site complements the High Coast World Heritage Site in Sweden 150 kilometres to the southwest which is also slowly rising. At their closest, islands of the two sites are only 7 km apart. 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, moderated by a rise in the sea level resulting from global warming. The Archipelago is one of the world's most representative sites of such uplift.

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 very great number of boulders. The spectacular profusion of the De Geer moraines is the most notable feature. They are exceptionally well formed and are excellent representatives of the

form: ridges of bouldery till up to 5m high, 10-50m wide, and in some cases more than 1,000m long, occurring in large fields and compact clusters at 40-300m intervals, mostly in low-lying areas. 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. Compared with the High Coast which is ancient, stable and steeply hilly, the Kvarken Archipelago is of low relief, morainal, recent and dynamic. The two post-glacial coasts, high and low, are thus quite complementary.

CLIMATE

The High Coast climate is cold temperate with an annual mean temperature of about 4°C. For half the year average temperatures are below freezing and the low total precipitation is spread over three-quarters of the year. In winter the Northern Kvarken strait freezes over, allowing passage between Finland and Sweden. The climate of the Kvarken Islands is southern boreal, influenced by the sea. Snow and ice cover lasts between 140-150 days a year, but rainfall is only 400mm. The annual mean temperature is 3-4°C and is above 6°C during the 150-160 day growing season. The sea is brackish, being reinforced by the vigorous fresh water flow from the many rivers entering the Bay of Bothnia to the north. As a result, the Straits freeze over in winter. Tides are very low but winds and air pressure can create sea level changes of 250cm, the lowest levels occurring in spring, the highest in autumn.

VEGETATION

The High Coast vegetation is typical of west Eurasian taiga, dominated by southern boreal forest, but it shows marked altitudinal zonation and spatial variability, with high floristic diversity, due to the complex pattern of soils and substrate on an uplifted surface of high relief. This includes forests dominated by Norway spruce *Picea abies* with Scots pine *Pinus silvestris* on poorer soils, a range of mixed evergreen and deciduous forest types, with mature forests on till-capped plateau tops. The topography and climate together make the area a distinct vegetational boundary zone, blending southern, northern boreal, western oceanic, eastern continental and even alpine plant species, relicts of a colder climate (Dingwall, 2000). It has been affected by the constant exposure of new land and by changing temperatures. Some areas such as the National Park, were also almost deforested between 1860 and 1900. The site is the northern limit for some 40 plants, some which are relicts of earlier slightly warmer conditions, including oak *Quercus robur*, linden *Tilia cordata*, Norway maple *Acer platanoides* and hazel *Corylus avellana*. Such populations are particularly important in some of the lower south-facing slopes where the soil is good, as in the nature reserves of Omneberget and Skuleberget. High on the cliffs, particularly on north-facing slopes, there are a number of alpine plants, including purple saxifrage *Saxifraga oppositifolia*, tufted saxifrage *Saxifraga caespitosa*, the fern *Polystichum lonchitis* and the three-leaved rush *Juncus trifidus*. Another characteristic plant is the mountain rock-cress *Cardaminopsis petraea*, which is abundant in this part of Sweden.

Common shoreline species include green algae *Cladophora* spp., red algae *Ceramium tenuicorne* and *Furcellaria lumbricalis* and brown algae *Pilayella littoralis* as well as Bladder wrack *Fucus vesiculosus*. The presence of vascular plants and stoneworts in addition to species present in the outer archipelago and its shoreline, are the fundamental differences between vegetation communities of the mid-archipelago. The occurrence of species such as perfoliate *Potamogeton perfoliatus*, horned pondweed *Zannichellia palustris* and water milfoils *Myriophyllum* spp. is due to the area's relatively sheltered situation. Stonewort species include bird's nest stonewort *Tolypella nidifica*, a species that thrives in brackish water, and coral stonewort *Chara tomentosa*. Agriculture forms a significant part of the landscape. Other important plant communities occur in lakes, mires and bogs. There is evidence of wheat and barley having been grown in the area some 4,000 years ago when the temperature was some 2-3°C warmer.

The Kvarken Archipelago 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. They are also acted on by waves and ice-drift, seawater salinity, substrate, topography, microclimate, chemical and physical properties and distance to the mainland. The result is that the seashore habitats are very heterogeneous and biodiverse and represent several Natura 2000 coastal habitat types. They are also highly productive due to phosphate-rich water from the north and nitrate-rich water from the south, and combine freshwater and marine species as the salinity decreases from 5-6 ‰ in the south to 3-4 ‰ in the north of the islands. In

addition to these factors, the mild climate has resulted in many southern species finding their northern limit of distribution here.

The two major marine habitats are hard, stony, bouldery bottoms, and shallow vegetated mud bottoms often covered by meadows of weed. Both are important to spawning fish. The brackish water ecosystems grade to freshwater systems when a half-closed bay (*flad*) between the ridges of till becomes a closed lake (*gloe*), each with its adapted plant community from pondweeds such as *Potamogeton* spp. and stoneworts *Chara* spp. to thickets of the reed *Phragmites australis*. The intertidal zone is heavily stressed and eroded by ice in winter, which favors annuals such as the endemic hairgrass *Deschampsia bottnica*, found only in the Gulf of Bothnia and eyebright *Euphrasia bottnica*. The deltas of several local streams and a river are also rich breeding grounds for fish.

The flat landscape provides very good conditions for wetland development. The succession from shallow bays to wetlands occurs by overgrowth to swamps or swamp forests, by the formation of peatland in a herb-rich marsh, or by peat forming directly on the newly exposed shore. Interactions between the many processes create habitat diversity, from young sedge-dominated shore swamps to complex mires and bogs, with nutrient-poor peat mosses of *Sphagnum* sp. as the dominant species. Other typical wetland plants include various sedges, like bottle sedge *Carex rostrata*, white sedge *C. canescens*, common bog-sedge *C. limosa*, tall bog-sedge *C. magellanica*, marsh cinquefoil *Potentilla palustris*, common cotton-grass *Eriophorum angustifolium*, bogbean *Menyanthes trifoliata*, and cranberry *Vaccinium oxycoccus*.

The shoreline vegetation belts characterise each phase of the uplift, graduating from pioneer plant communities close to the water to a climax forest ecosystem inshore, in chronological sequence which, as the archipelago is flat, give uplift-related dating precise to within 10 years. The plants of the Archipelago are typical for the region. On land the succession is from shore meadows through herb-rich scrub with sea buckthorn *Hippophaë rhamnoides* and a continuous belt of grey alder *Alnus incana*, through rowan *Sorbus aucuparia*, aspen *Populus tremula* and birch *Betula* spp. to climax forest dominated by Norway spruce *Picea abies* and other conifers. Sixteen species are isolated glacial relicts endemic to the Baltic.

FAUNA

The High Coast's terrestrial fauna is typical for the region, but the range of marine habitats provides for a mix of marine, brackish and freshwater species. These are low in diversity but high in populations for some of the macrofauna, some of which are relicts of earlier periods, others at the extremes of their latitudinal and environmental distribution (Dingwall, 2000). All are tolerant of the varying salinity of the brackish water, which off the High Coast ranges between 3 and 6 ‰. There is a major sill across the bottom of the Kvarken Straits at about 25m. Species numbers decline abruptly at the Gulf's entrance from the Baltic and continue to decrease northwards - from 41 fish species in the Baltic to 20 species in the Gulf and only 6 in the Bay of Bothnia. The consequence is that the northern part of the site is near the northern limit of several species. Two northeastern Atlantic seal species are present in the waters off the High Coast, the ringed seal *Phoca hispida* and the grey seal *Halichoerus grypus*. The latter occurs in greater numbers, although there are no suitable haul-out areas for the large gatherings of grey seals which are found in the Northern Quark Archipelago and south of the High Coast.

Saltwater and fresh water fish species regularly occur and reproduce along the High Coast within shallow and deep-water areas of the Archipelago. Warm-water species found in shallow waters include perch *Perca fluviatilis* and roach *Rutilus rutilus*. Cold-water species of fresh and salt-water origin are the white fish Baltic herring *Clupea harengus*, salmon *Salmo salar*, four-horned sculpin and eel pout *Zoarces viviparus*. Immigrant species include sprat *Sprattus sprattus*, cod *Gadus morhua* (VU) and European flounder *Platichthys flesus*. Fish are only found in deeper waters in the summer. Shoreline fauna species include the acorn barnacle *Balanus improvisus*, the common mussel *Mytilus edulis*, the coralline *Electra crustukenta* and the freshwater snail *Theodoxus fluviatilis*. Shallow water crustaceans include the amphipods *Gammarus zaddachi*, *G. oceanicus* at its northern limit, *G. salinus*, *Pallasea quadrispinosa*, a relict species primarily found in fresh water and *Corophium volutator*. Several snail species are found in the mid-archipelago zone: *Paludestrina jenkinsi*, *Theodoxus fluviatilis*, *Lymnaea peregra* and *Bithynia tentaculata*. The benthic fauna of the deeper waters is dominated by a small number of species. These include the isopod *Saduria entomon*, the amphipod *Monoporeia affinis*, the Baltic mussel *Macoma bathica*, a few semi-pelagic opossum shrimp species (Mysidae) and the common sea snail *Liparis liparis*.

Terrestrial mammals occurring within the High coast region include Eurasian lynx *Lynx lynx*, brown bear *Ursus arctos*, roe deer *Capreolus capreolus*, elk *Alces alces* and numerous rodents. The terrestrial birdlife is rich, reflecting the diversity of habitats. The coastal birdlife is typical for the region but offshore islands are of some importance to seabirds. A 1987 survey found 6,000 pairs, of 24 species. Gnäggen Island Nature Reserve is particularly important for nesting guillemots *Uria aalge* and razorbills *Alca torda*. Other species include corncrake *Crex crex*, spotted crake *Porzana porzana*, red-breasted flycatcher *Ficedula parva*, nightingale *Luscinia megarhynchos*, Bohemian waxwing, *Bombicilla garrulus*, marsh warbler *Achrocephalus palustris* and Blyth's reed warbler *Acrocephalus dumetorum*. These species are mainly found on the larger islands of the archipelago, such as North and South Ulvön and on the eastern edge of the mainland near the coast. Species found in Skuleskogen National Park within the nominated site include willow grouse *Lagopus lagopus*, Siberian jay *Perisoreus infaustus* and rustic bunting *Emberiza rustica*. All seven of Sweden's woodpecker species are found here.

The Kvarken Archipelago is on an important migratory route and offers excellent breeding habitats for birds: There are important Baltic populations of black guillemot *Cephus grille* (6,000 pairs, a quarter of the Baltic population) and razorbill *Alca torda* (1,000 pairs); also Caspian and Arctic terns *Sterna caspia* and *S. paradisea*, whitetailed eagle *Haliaetus albicilla* (35 pairs), osprey *Pandion haliaetus* and great scaup *Aythya marila*. Thousands of roughlegged buzzards *Buteo lagopus* and cranes migrate through. Animals living in the Archipelago are typical for the region: grey seal *Halichoerus grypus* and ringed seal *Phoca hispida* from the gulf of Bothnia, breed on the ice in spring. As with the plants, the mild climate encourages many southern species of animals which come to their northern limit of distribution here.

CONSERVATION VALUE

The unique value of the High Coast area is in its unusual geological and geomorphological history of extreme coastal uplift; related ongoing changes are recorded in both the vegetation history and the cultural development of the area. The sites lie within a WWF Global 200 Marine Eco-region and contain a Ramsar Wetland. The Kvarken Archipelago and Skuleskogen National Park include EU Natura 2000 habitats. The Kvarken Archipelago is an outstanding example of the continuing geological process of post-glacial uplift. It is the world's most representative area for the geological and biological study of the process in flat and shallow moraine archipelagoes, complementing the High Coast World Heritage site across the Gulf, of which the Kvarken Archipelago is seen as a natural transboundary extension.

CULTURAL HERITAGE

There is a record along the High Coast of human presence in the late Stone Age from dwellings about 4,000 years old. An important Iron Age village, Gene, which lies near the northern boundary of the site has been excavated and restored, and there are once-coastal grave mounds dating from about 3500-2500 years ago. There are also remains of longhouses dating back to around 100-600 AD. More recent remains of fishing camps with log cabins date back to the 16th century, the end of a period when a series of 12 mysterious stone labyrinths or mazes were built. Some areas were used as mountain pasture in the 19th century. The historical succession of settlement followed the changing level of the coastline: the oldest remains now lie some distance up the hillsides. In the present century there was a major growth in population with increased land under cultivation and large numbers of trees cut down for industry.

Settlement on the Kvarken islands is traced back to 1800-1600 BC, mainly by fishermen and seal hunters. Permanent fishing villages grew up in the 14th century although some islands were uninhabited till the 19th century. Farming and summer pasturing on the seashore meadows was less important. But nearby Vaasa was the main trading centre of the Gulf of Bothnia and some islanders made a living from the many wrecks and from small sea-related industries.

LOCAL HUMAN POPULATION

The High Coast site is a mosaic of natural and manmade landscapes inhabited by approximately 4,500 people in several small settlements, including the large villages of Docksta and Ullånger and Mjällom. Human activities are mainly fishing, small-scale agriculture with growing employment in tourism. Despite this, rural depopulation is occurring, and was seen as a problem in the World Heritage nomination: there are few remaining farmers and commercial fishing has virtually ceased.

The Kvarken Islands' present population is about 2,500, a third being farmers and fishermen. Pasture and haymaking in coastal meadows were common until the 1950's and 1,000 ha are still grazed by

sheep. To increase hay production, forests in the upper alder belt were frequently partially cut to make forest meadows, and moors were fired, and are still fired, to improve the grazing. Forest trees were lopped for timber and firewood. A type of slash and burn farming was practised on some islands until the beginning of the 1990s. The main present activity surrounds the 600 summer cottages, many once fishermen's huts left with their harbours far inland by the uplift. The largest village communities in the core area are Björköby, Replot, Norra Vallgrund, Södra Vallgrund, Maxmo and Sundom.

VISITORS AND VISITOR FACILITIES

In the High Coast region there were over 3,000,000 visitors in 1993, largely between June to August, with a short period of winter sports and skiing in March. These figures include the towns of Kramfors and Örnsköldsvik which lie just outside the World Heritage nominated area. There are a number of interpretation centres, including a Nature Centre, and six additional tourist centres open during the summer. In addition there are substantial museums near the site in Härnösand and Örnsköldsvik. There is a large number of hotels, cabins, hostels and camping grounds within the site. Camping is actually permitted in any area for periods of up to 24 hours. There are also many hiking trails, including the 127 km High Coast trail, and biking, climbing, canoeing and fishing are popular.

In the Kvarken summer cottagers and sailors are the main visitors and there are 5,000 registered small boats in the islands. 200,000 tourists visit each year, and their numbers will increase. Plans for tourism and recreation to develop, monitor and guide sustainable tourism have been drawn up and the provision of infrastructure has begun: old coastguard and pilot stations will become bases for guided walks; and canoeing, fishing, hiking, bird-watching and accommodations are available. The Terranova visitors' nature centre is in the nearby town of Vaasa.

SCIENTIFIC RESEARCH AND FACILITIES

As the site and type locality of the highest isostatic uplift known, the High Coast has been the centre for research on the subject for many years; the highest shoreline in the Baltic was mapped as early as 1888. Plant succession in the area is also well documented: between 1996 and 1998 a comprehensive vegetation survey of marine habitats of the High Coast was made. The terrestrial biota has been less studied. Owing to its dynamic nature the Kvarken Archipelago is an important scientific resource for understanding the processes of glaciated land uplift which originated with the theory of isostatic rebound first advanced by the 19th century geologist G. de Geer after whom the moraine ridges are named. It is also valuable for studying island biogeography where, as defined by Wilson & MacArthur in 1967, biodiversity depends on the size and age of the island and on isolation from sources of seed. Due to the continuous uplift, these factors vary in time and space amongst the large number of islands of different sizes and ages, and are easily studied and analysed. Among other subjects are the development of terrestrial, freshwater, and brackish water ecosystems, the primary succession from exposed shorelines to climax forests on moraine shores, the transition from brackish to freshwater ecosystems, the successive stages of peatland ecosystems and the evolution of meta-populations on isolated islands. Biologically, these areas are highly productive and form very special habitats of significant ecological value. Knowledge related to the behaviour of their meta-populations is a key factor in the field of conservation biology. The Valassaaret Biological Station on Ebbskär island monitors bird populations and runs educational programs (MoE, 2005).

MANAGEMENT

The High Coast: Management is a complex issue in this area. There are management plans for all of the Nature Reserves and the National Park, but protected areas constitute only 18% of the area (Dingwall, 2000). The remaining land is largely under private ownership, but further regulations may still apply. The site falls within the jurisdiction of two municipalities: Örnsköldsvik and Kramfors, both of which adopted development plans in 1990. The site falls within the Västernorrland County which develops policies such as for logging. For some time a management plan for the area has been worked on, prescribing policies for its long-term development. It focuses on the management of its special assets: the geological and biological phenomena related to land uplift, the marine environment and the natural beauty of the landscape. A management committee was formed for the High coast area, with representatives from the County Administrative board, the municipalities of Örnsköldsvik and Kramfors, as well as the County Forest Board. Combined with new and more powerful environmental legislation enacted in Sweden in 1999, greater protection for the site should be achievable.

The Kvarken Archipelago: The Regional Council of Ostrobothnia promotes the sustainable development and protection of the islands, and funnels the funds for various EU financed programs, including for special status for a buffer zone within its 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 and plans for the Mikkelinsaaret islands and for the Lappörona, Slåttskäret and Rönnskäret islands in the Björköby Archipelago. Under the Regional Environmental Centre, two working groups are to be established. 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 in the same areas through the Kvarken-Miljö and other projects. Designation as a transboundary extension of the Swedish High Coast World Heritage area where the geologic processes are complementary, is being agreed (MoE, 2005).

The site contains some areas yet to be protected by national legislation. At present, 80% of the nominated area and one third of the Kvarken Archipelago land area is protected in various ways. The most important areas are included in the Natura 2000 network (106,365 ha, of which 91% is sea), Nature Conservation Programs (85,740 ha) and under the Nature Conservation Act (32,890 ha) (MoE, 2005). These representative habitats are governed by the EU Directives on Habitats and Birds. At present, about half the total area of the Archipelago is not included in Nature Conservation Programs or the Natura 2000 network (which is expanding), mainly areas of sea administered by the Government and some lands associated with the villages on Replot and Björköby Islands. The programs, administered by the West Finland Regional Environmental Centre, cover the protection of shores, the Mikkelinsaaret islands, bird-rich lakes and bays, old-growth forests and a scenically remarkable landscape area around Björköby. The process of establishing them takes several years and requires statutory regulation for each conservation area. The authorities negotiate with landowners in implementing conservation. Such areas are either bought by the state, or privately owned with restrictions on the usufruct. Activities that threaten the conservation status such as visiting certain areas during the bird breeding period are prohibited, but fishing, hunting and the collection of berries and mushrooms are generally allowed. Monitoring programs are carried out for uplift, *flad* and *gloe* formation, primary forest formation, bird species and visitors; also for sea water quality, invertebrates, macro-vegetation and fish.

MANAGEMENT CONSTRAINTS

The multiple ownership of the High Coast area and the original lack of a single management agency or policy presented problems for unified management of the area. The need was recognised in the nomination, a management plan was drawn up and a management committee established. Developmental pressures include construction of masts and power-generating windmills and dredging of shallow areas. There is also a considerable number of roads in the site, including a major motorway and one of the world's longest suspension bridges, built in recent years. Other pressures on the site are not considered to be great. The worst impacts of acid precipitation appear to be in decline, as is pollution discharge, so that these may be some of the cleanest seas in the region.

In the Kvarken islands, the recent presence of environmental toxins greatly reduced the populations of grey seal and white-tailed eagle but they have recovered and at present there are no serious problems on land except for invasion by American mink. However, farming and forestry has increased the acid water run-off from drained sulphate-rich soils and have reduced fish populations. Continual dredging of boat channels creates some disturbance and Replot village on the main island which is connected by road to the mainland may become the terminus for a ferry service to Sweden. There is also some eutrophication in sheltered bays and some risk of oil spills and pollution by pulp industrial waste.

COMPARISON WITH SIMILAR SITES

In the Gulf of Bothnia, there are many archipelagos with moraine landforms and glacially sculpted bed rock morphology, but none of these sites has the geological diversity of the Kvarken Archipelago. The High Coast in Sweden, being an uplifted hilly area of the same rebound, is complementary in its display of glacial features, although its steep topography makes its plant communities more stable and less influenced by the timescale of the land uplift. Instead, species specialization and adaptation are favoured, as well as the long-term survival of relict species. Its succession reflects a timescale precision of 10-100 years where the archipelago, being flat, can yield a dating precision of about 10 years though only for the last 2,000-3,000 years. Land uplift, brackish water environments, sea level

fluctuations, and a lack of tide are features that both have in common. Ecosystems and plant communities are also similar, but differences in topography and geomorphology imply different ways of adaptation to the ongoing land uplift in time and space. Within the West Eurasian Taiga, the Laponian area and West Norwegian Fjords do not illustrate isostatic rebound as well as the two sites. As for the uplift of two more closely related non-WH sites: that of the Skargard Archipelago off Stockholm lacks glacial till deposits; and that of the northern and western White Sea shores on the periphery of the Fennoscandian shield is only 1,0-2,5 mm per year. Drumlins, end moraines and De Geer moraines do occur there but do not form archipelagos.

In North America, the uplift of the St Elias coast in Alaska is far greater but is due to tectonic movement. The area around Richmond Gulf, southeastern Hudson Bay, has a similar history of glaciation and uplifted land. Deglaciation occurred about 1,000 years later and the present uplift rate is higher at 11-13mm 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, being 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 tundra, 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.

STAFF

High Coast: No information is available.

Kvarken Archipelago: The Forest and Park Service in Vaasa has 8 employees administering local state-owned protected areas. The West Finland Regional Environmental Centre has 20 employees responsible for privately owned areas. Training of conservationists and administrators is done by several institutes and universities.

BUDGET

High Coast: No figures are available, but the state provides funding for the management of the National Park, Nature Reserves and historical sites.

Kvarken Archipelago: The state subvents agriculture, forestry and fisheries, research and geological surveys and buys land for conservation where it can. The EU funds nature conservation projects, the local Natura 2000 network and interregional cooperation through Interreg Kvarken MittSkandia which funds the Kvarken-Miljö project among others.

LOCAL ADDRESSES

Swedish Environmental Protection Agency, Blekholmsterrassen 36, Blekholmsgatan 5, S-106 48 Stockholm, Sweden.

Länsstyrelsen i Västernorrlands län, Sektionen för naturvård och miljöövervakning, S-871 86 Härnösand, Västernorrland, Sweden.

Geologiska Undersökning, Box 670, S-751 28 Uppsala, Sweden.

Metsähallitus (Forest & Park Service), West Finland Natural Heritage Services, Hovioikeudenpuistikko 16, 65100 Vaasa, Finland.

West Finland Regional Environmental Centre, PB 262, FI-65101, Vaasa, Finland.

Swedish Environmental Protection Agency, Blekholmsterrassen 36, Blekholmsgatan 5, S-106 48 Stockholm, Sweden.

Länsstyrelsen i Västernorrlands län, Sektionen för naturvård och miljöövervakning, S-871 86 Härnösand, Västernorrland, Sweden.

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DATES

High Coast: January 1998. Updated 11-2000, 6-2006, 8-2008, May 2011.
Kvarken Archipelago: 2006-8, 8-2008, May 2011.