high coast
kvarken
archipelago
WORLD HERITAGE

CVI

Application of the Climate Vulnerability Index

for the High Coast/Kvarken Archipelago
World Heritage Property

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CVI

VALUES-BASED | SCIENCE-DRIVEN | COMMUNITY-FOCUSED

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METSÄHALLITUS
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Bergö gaddarna, Kvarken Archipelago
Photo: Malin Henriksson

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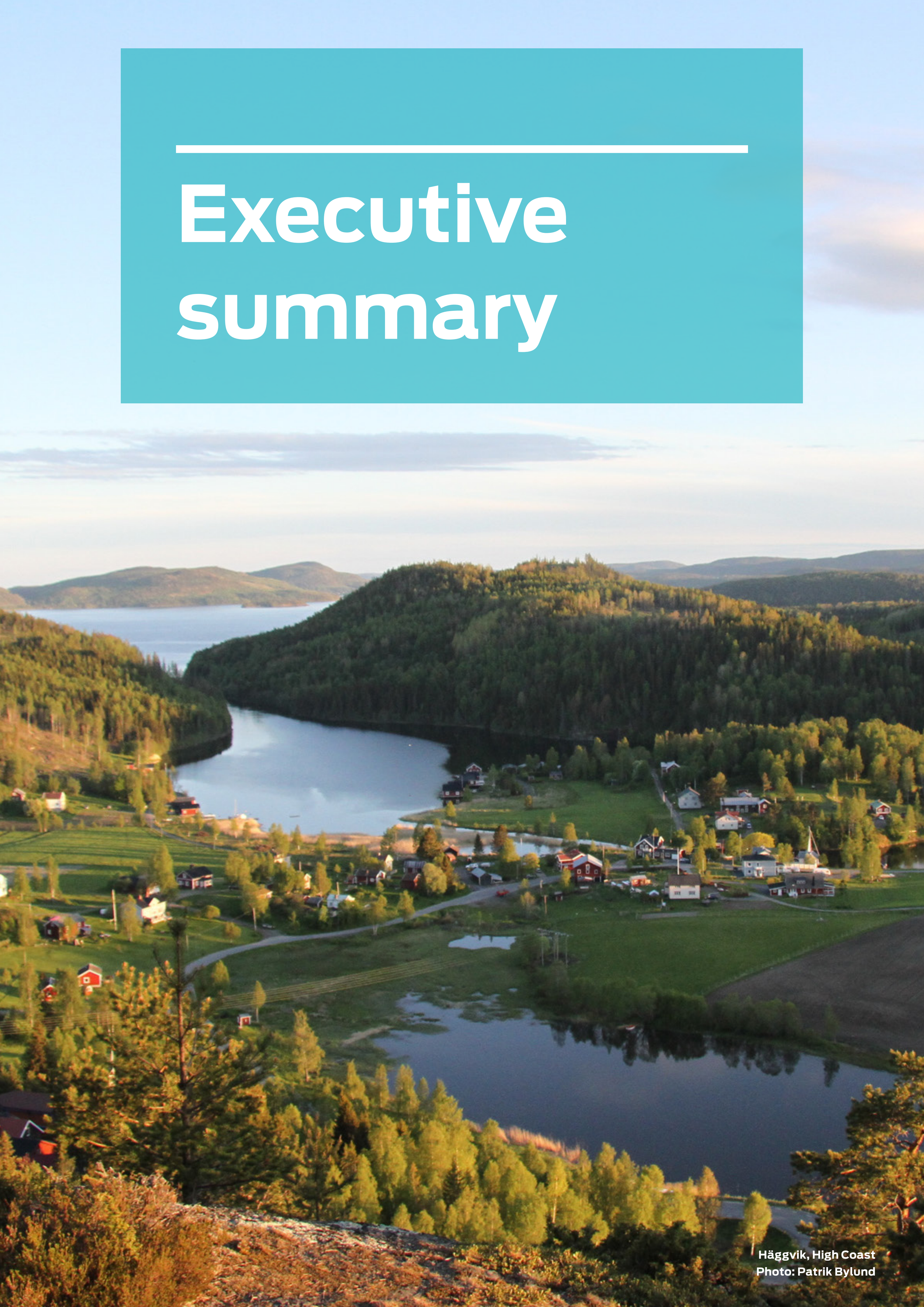


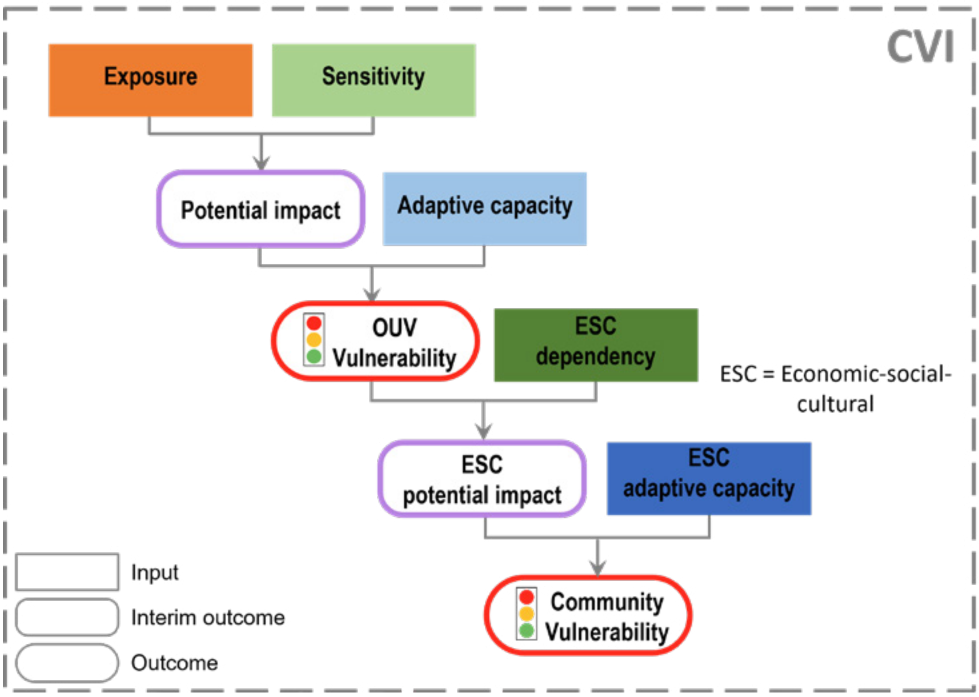
Häggvik, High Coast
Photo: Patrik Bylund

Executive summary

Climate change has been identified as the fastest-growing threat to World Heritage (WH) and many WH properties are already experiencing related effects. This has resulted in significant negative impacts, damage and degradation to the properties, as well as to the communities associated with them. As the climate crisis intensifies, there remains an urgent need to understand the climate vulnerability of the world's natural and cultural heritage.

The High Coast/Kvarken Archipelago WH property reflects a landscape that is already constantly changing – post-glacial land uplift means today there is 1% more land than there was in 2006. However, impacts of climate change are also occurring.

This report describes the outcomes from an application of the Climate Vulnerability Index (CVI) for the High Coast/Kvarken Archipelago. The CVI methodology is a technique to rapidly assess the vulnerability of natural and cultural WH, assessing the realised and potential impacts to (i) the values that collectively comprise the Outstanding Universal Value (OUV) of the property; and (ii) the associated community.



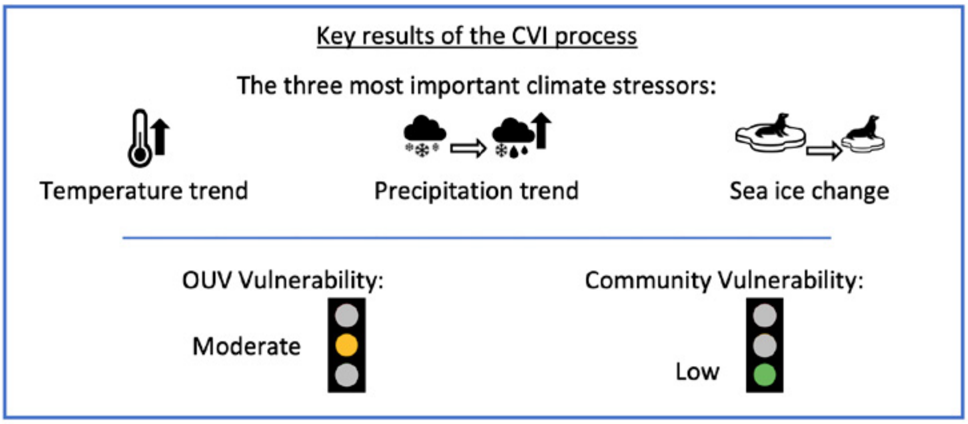
The Climate Vulnerability Index (CVI) framework.

Prior to the workshop, the Statement of OUV was used to determine a list of seven key values, which provided the foundation for the analysis. The CVI workshop was held over six half-days on 15th-17th and 22nd-24th March 2022, involving the managers of the WH property, researchers, and representative from relevant agencies, the community, NGOs, and municipal and regional councils. Whilst the analysis focused on the WH values, participants noted many other significant property values (important at local, regional and international levels) that also likely to be affected by climate change.

Within the CVI process, participants selected ca. 2050 as the future time scale on which to assess vulnerability and chose to consider a high-emissions scenario (RCP8.5/SSP5-8.5), noting that climate projections for mid-century are similar under an intermediate scenario (RCP4.5/SSP2-4.5). Participants identified the three key climate stressors of greatest threat to the WH property as: Temperature trend, Precipitation trend and Sea ice change.

The potential impact on the OUV, derived from the exposure and sensitivity (see framework diagram, previous page), was determined as high (on a four-point scale, low/moderate/high/extreme) for each key climate stressor. Once adaptive capacity was evaluated, considering specific strategies prioritised during the workshop, the combined **OUV Vulnerability** for the property was determined to be **Moderate** (three-point scale, low/moderate/high).

Community Vulnerability was considered by evaluating effects on economic, social and cultural (ESC) connections with the property. The potential impact on the community associated with the property was assessed to be low (three-point scale, low/moderate/high). The future impact on economic activities related to the property resulting from a loss of WH values was assessed to be negative but only at a minimal level (four-point scale, minimal/low/moderate/high). A focus was given to tourism activities during the process. Impacts to social interactions were also deemed to be negative at a minimal level (four-point scale), whilst effects on cultural connections were assessed as positive at a low level (four-point scale). The adaptive capacities were each assessed as moderate (four-point scale) for economic, social and cultural aspects. As a result, the **Community Vulnerability** was determined as **Low** (three-point scale). Country-specific evaluations of Community Vulnerability were assessed as Low for each property component, though the Finnish community was considered to be more vulnerable to a loss of WH values than that associated with the Swedish component.



Climate change is expected to threaten the resilience of some areas more than others in the High Coast/Kvarken Archipelago and to increasingly impact upon some of the values that collectively contribute to the OUV. Biological values were considered more vulnerable to impacts from climate change than geological values. The identified levels of vulnerability emphasise the importance of developing effective strategies for climate change adaptation in the WH property. It also highlights the value of local knowledge and experience not only for the local area, but also nationally and internationally.

Funding support for this project was provided by Interreg Botnia-Atlantica.

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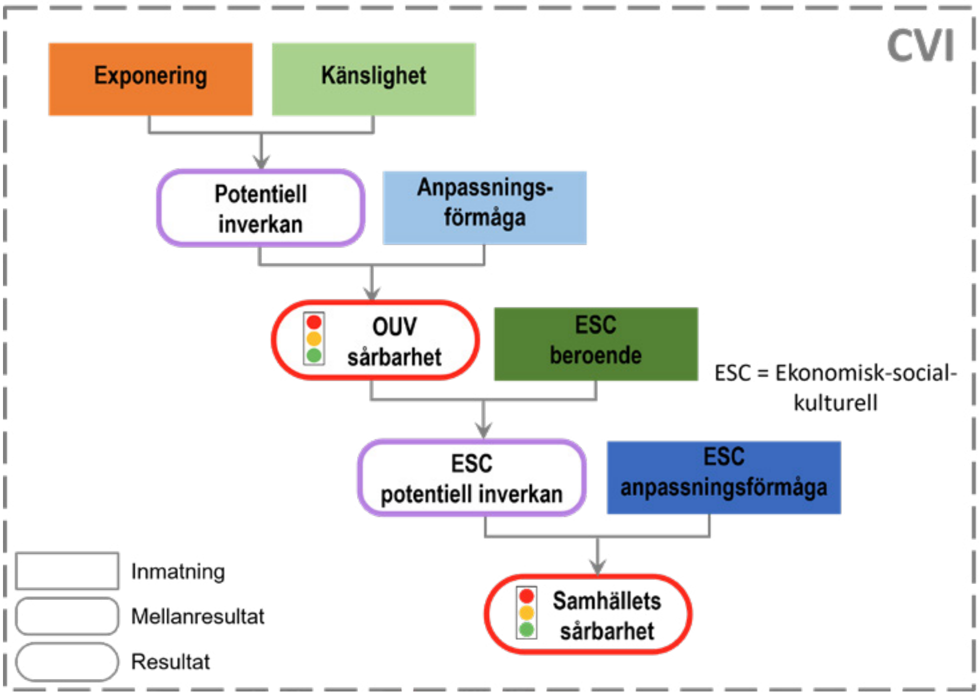
Sammanfattning

Klimatförändringar anses vara de snabbast växande hoten mot världsarven. Flera världsarv och deras lokalsamhällen påverkas redan av de negativa effekter, skador och försämringar som klimatförändring för med sig. I och med att klimatkrisen tilltar är det angeläget att utreda klimatförändringarnas effekter på världsarven.

Världsarvet Höga Kusten/Kvarkens skärgård befinner i ständig naturlig förändring – till följd av postglacial landhöjning är andelen landområden 1 % större nu än år 2006. Området påverkas dock också av klimatförändringarna.

Den här rapporten presenterar klimatsårbarhetsindexet CVI:s utslag för världsarvet Höga Kusten/Kvarkens skärgård. Klimatsårbarhetsindexet är en metod som används för att snabbt bedöma sårbarheten hos ett världsarv. Metoden utvärderar klimatförändringarnas effekter eller potentiella effekter på 1) världsarvets särskilt stora universella värde (OUV, Outstanding Universal Value), och 2) världsarvets lokalsamhällen.



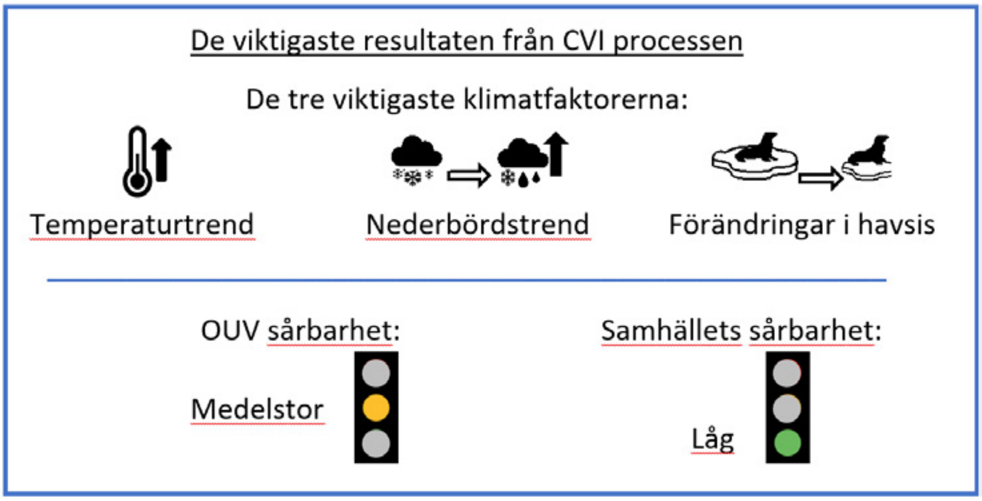
Klimatsårbarhetsindexet CVI:s uppbyggnad.

Analysen grundar sig på sju nyckelvärden som fastställdes utifrån utlåtandet om världsarvets särskilt stora universella värde, innan en workshop kring klimatsårbarhetsindexet ordnades. Workshoppen pågick under sex halva arbetsdagar 15–17.3 och 22–24.3.2022, och engagerade världsarvets förvaltare, forskare, representanter för berörda myndigheter och lokalsamhällena, medborgarorganisationer samt kommunala och regionala organisationer.

Deltagarna använde år 2050 som referenspunkt i CVI-processen när de bedömde klimatsårbarheten, och utgick från ett scenario med stora utsläpp (RCP8.5/SSP5-8.5), medvetna om att det har samma klimatprognos för 2050 som scenariot med medelstora utsläpp (RCP4.5/SSP2-4.5). Deltagarna identifierade följande tre centrala faktorer i klimatet som utgör de största hoten mot världsarvet: temperaturtrenden, nederbördstrenden och förändringar i havsisarna.

Faktorernas enskilda potentiella inverkan på världsarvets särskilt stora universella värde bedömdes utifrån exponering och känslighetsnivå (se bild). Varje faktor bedömdes ha en stor potentiell effekt (fyrstegsskala: liten/medelstor/stor/extrem). Anpassningsförmågan bedömdes utifrån de särskilda strategier som uppmärksammats på workshoppen, och det särskilt stora universella värdets totala sårbarhetsnivå bedömdes vara medelstor (trestegsskala).

Sårbarheten hos lokalsamhället undersöktes genom att utvärdera effekten på ekonomiska, sociala och kulturella (ESC) kopplingar till världsarvet. Den potentiella effekten på lokalsamhället ansågs vara liten (trestegsskala: liten–stor). Sådana världsarvsvärden som gått förlorade bedömdes ha negativ, men mycket liten framtida effekt på ekonomisk aktivitet inom världsarvet (fyrstegsskala: mycket liten–stor). Bedömningen fokuserade på turismen. Effekten på social samverkan ansågs också vara negativ och liten (fyrstegsskala), medan effekten på kulturella kontakter ansågs vara positiv och mycket liten (fyrstegsskala). Anpassningsförmågan ansågs vara medelmåttig ur ett ekonomiskt, socialt och kulturellt perspektiv (fyrstegsskala). Därmed bedömdes samhällets sårbarhetsnivå vara låg (trestegsskala). Samhällets sårbarhetsnivå ansågs vara låg i Höga Kusten och Kvarkens skärgård, även om samhället i den finländska delen av världsarvet ansågs vara mer sårbart för förlorade världsarvsvärden än samhället i den svenska delen.



Klimatförändringarna väntas hota vissa områden mer än andra i Höga Kusten och Kvarkens skärgård i fråga om återhämtningsförmågan, samtidigt som den väntas ha allt större effekt på vissa av de värden som tillsammans bildar världsarvets särskilt stora universella värde. De biologiska värdena konstaterades vara mer känsliga för klimatförändringarnas effekter än de geologiska. De identifierade sårbarhetsnivåerna understryker vikten av att världsarvet utvecklar effektiva strategier för att anpassa sig till klimatförändringarna. Rapportens resultat visar dessutom att lokal kunskap och erfarenhet inte endast har en lokal betydelse, utan även ett nationellt och internationellt värde.

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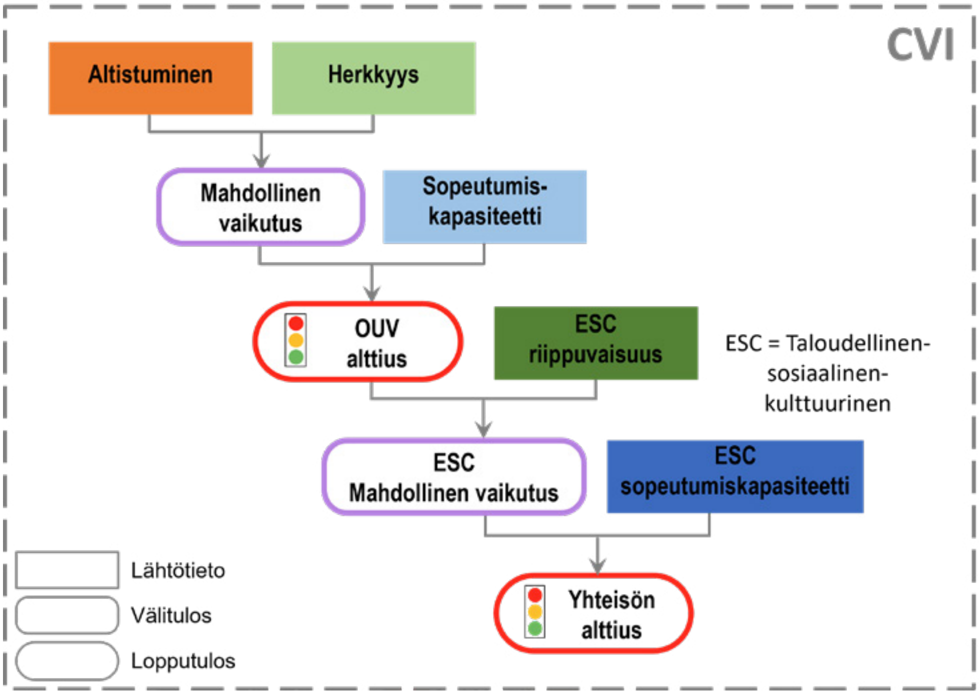
Tiivistelmä

Ilmastonmuutosta pidetään nopeimmin kasvavana uhkana maailmanperinnölle, ja se on jo alkanut vaikuttaa useisiin maailmanperintökohteisiin. Ilmastonmuutos on aiheuttanut merkittäviä haittoja ja vahinkoja sekä rappeutumista useissa maailmanperintökohteissa ja niihin liittyvissä yhteisöissä. Ilmastokriisi pahenee, joten nyt on kiire selvittää, millä tavoilla ilmastonmuutos voi vahingoittaa kulttuuri- ja luonnonperintöä.

Korkearannikon ja Merenkurkun saariston maailmanperintökohteessa jatkuva muutos on luonnollista: postglasiaalisen maankohoamisen vuoksi alueella on nyt prosentin verran enemmän kuivaa maata kuin vuonna 2006. Maailmanperintökohteeseen vaikuttaa myös ilmastonmuutos.

Tässä raportissa esitellään tulokset, jotka saatiin soveltamalla ilmastoalttiusindeksiä (CVI) Korkearannikon ja Merenkurkun saariston maailmanperintökohteeseen. Ilmastoalttiusindeksi on menetelmä, jolla voidaan nopeasti arvioida kulttuuri- ja luonnonperintökohteiden alttiutta ilmastonmuutoksen aiheuttamille muutoksille. Menetelmällä arvioidaan, miten ilmastonmuutos on jo vaikuttanut tai saattaa vaikuttaa 1) arvoihin, jotka muodostavat maailmanperintökohteen erityisen yleismaailmallisen arvon (OUV), sekä 2) maailmanperintökohteeseen liittyvään yhteisöön.



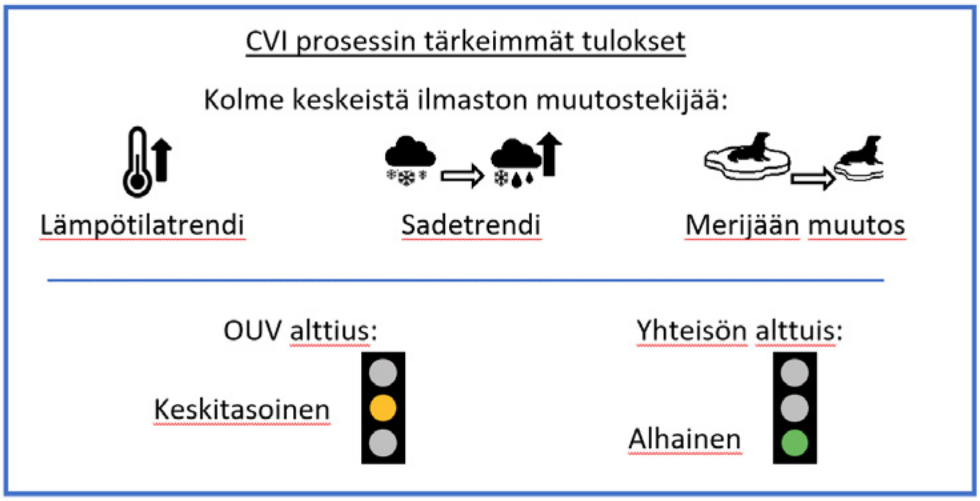
Ilmastoalttiusindeksin (CVI) kaavionäkymä.

Analyysi perustuu seitsemän keskeisen arvon luetteloon, joka koostettiin kohteen erityisen yleismaailmallisen arvon selostuksen perusteella ennen työpajan järjestämistä. CVI-työpaja järjestettiin puolipäiväisenä kuuden päivän aikana 15.–17. ja 22.–24.3.2022. Työpajaan osallistui maailmanperintökohteen hallinnoivat tahot, tutkijoita ja yhteisön edustajia. Mukana oli myös kohteeseen liittyvien virastojen, kansalaisjärjestöjen sekä kunnallisten ja alueellisten organisaatioiden edustajia.

Osallistujat valitsivat CVI-prosessin puitteissa vuoden 2050 ajankohdaksi, jonka perusteella arvioidaan alttiutta ilmastonmuutoksen vaikutuksille. Skenaarioksi valittiin suurten päästöjen skenaario (RCP8.5/SSP5-8.5), sillä sen ja keskisuurten päästöjen skenaarion (RCP4.5/SSP2-4.5) ilmastoennusteet vuosisadan puolivälille ovat samankaltaiset. Osallistujat rajasivat kolme keskeistä ilmaston kuormitustekijää, jotka ovat maailmanperintökohteen suurimmat uhat: lämpötilatrendi, sadetrendi ja merijään muutos.

Kunkin ilmaston kuormitustekijän mahdollinen vaikutus erityiseen yleismaailmalliseen arvoon määritettiin altistumisen ja herkkyyden perusteella (katso kuva). Jokaisen kolmen keskeisen tekijän mahdollinen vaikutus arvioitiin suureksi (asteikolla alhainen/keskitasoinen/suuri/äärimmäinen). Sopeutumiskapasiteetti arvioitiin ottamalla huomioon työpajassa priorisoidut erityisstrategiat, ja kohteen yhdistetyksi **OUV-alttiudeksi** saatiin **keskitasoinen** (kolmiportaisella asteikolla).

Yhteisön alttiutta ilmastonmuutoksen vaikutuksille tutkittiin arvioimalla yhteisön taloudellisia, sosiaalisia ja kulttuurisia (ESC) yhteyksiä maailmanperintökohteeseen. Mahdollinen vaikutus kohteeseen liittyvään yhteisöön arvioitiin alhaiseksi (kolmiportaisella asteikolla alhaisesta suureen). Maailmanperintöarvojen menetyksen tuleva vaikutus kohteeseen liittyvään taloudelliseen toimintaan arvioitiin negatiiviseksi mutta erittäin pieneksi (neliportaisella asteikolla erittäin pienestä suureen). Arvioinnissa keskityttiin matkailutoimintaan. Sosiaaliseen vuorovaikutukseen kohdistuvia vaikutuksia pidettiin myös negatiivisina ja pieninä (neliportaisella asteikolla), kun taas kulttuuriyhteyksiin kohdistuvia vaikutuksia pidettiin myönteisinä ja erittäin pieninä (neliportaisella asteikolla). Sopeutumiskapasiteetit arvioitiin taloudellisten, sosiaalisten ja kulttuurillisten näkökohtien osalta keskitasoisiksi (neliportaisella asteikolla). Tämän seurauksena **yhteisön alttius** arvioitiin **alhaiseksi** (kolmiportaisella asteikolla). Yhteisön alttiuden maakohtaisen arvioinnin tulos oli alhainen kohteen molemmille osille, vaikka Suomessa sijaitsevan osan yhteisön arvioitiin olevan herkempi maailmanperintöarvojen menetykselle kuin Ruotsissa sijaitsevan osan yhteisö.



Ilmastonmuutoksen odotetaan uhkaavan tiettyjen Korkearannikon ja Merenkurkun saariston osien selviytymiskykyä enemmän kuin muiden ja vaikuttavan entistä enemmän joihinkin niistä arvoista, jotka yhdessä muodostavat kohteen erityisen yleismaailmallisen arvon. Biologisten arvojen todettiin olevan alttiimpia ilmastonmuutoksen vaikutuksille kuin geologisten arvojen. Havaitut alttiustasot ilmastomuutoksen vaikutuksille korostavat sitä, että maailmanperintökohteessa on tärkeää kehittää tehokkaita sopeutumisstrategioita ilmastonmuutosta varten. Raportin tulokset korostavat myös sitä, että paikallinen tietämys ja kokemukset eivät ole arvokkaita ainoastaan kohteen lähialueella vaan myös kansallisesti ja kansainvälisesti.

Hanketta rahoitti Interreg Botnia-Atlantica.

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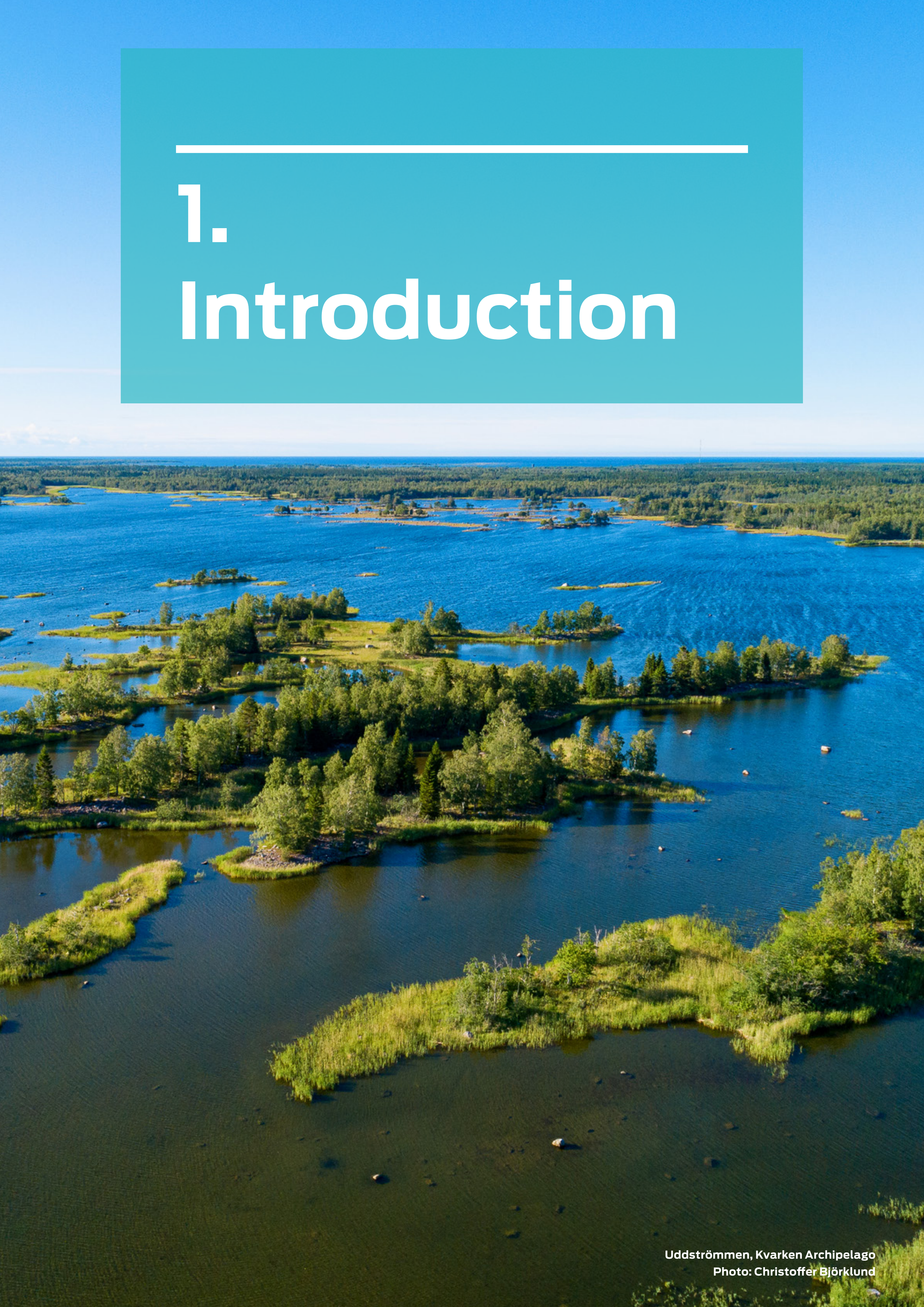
1. Introduction



Uddströmmen, Kvarken Archipelago
Photo: Christoffer Björklund

1.1 Background to this report

This report outlines the results of applying the Climate Vulnerability Index (CVI) to assess the High Coast (Sweden) and the Kvarken Archipelago (Finland), both situated in the Gulf of Bothnia, a northern extension of the Baltic Sea (Figure 2.1).

Together these areas comprise a transboundary UNESCO World Heritage (WH) listed property, with the High Coast originally listed separately in 2000, and the Kvarken Archipelago added in 2006. They represent complementary examples of post-glacial uplifting landscapes and have been described as 'where high meets low': the High Coast's hilly scenery with high islands, steep shores, smooth cliffs, and deep inlets is a stark contrast to the Kvarken Archipelago with its thousands of low-lying islands, shallow bays, moraine ridges and massive boulder fields.

Collectively these values have been internationally recognised as being outstanding examples of the prominent effects of post-glacial rebound following the melting of the continental ice sheet 18,000 to 10,500 years ago. The World Heritage Site continues to rise from the sea in a process of rapid glacio-isostatic uplift, and the land, previously weighed down under the weight of glaciers, is lifting at rates that are among the highest in the world.

Despite the durability of the geological values, climate change is impacting the values that collectively comprise the Outstanding Universal Value (OUV) of the property. This is a worldwide concern, as climate change is a growing global risk to most WH properties, many of which – natural, cultural, and mixed – are already being impacted.

> "...Climate change continues to affect more and more natural World Heritage sites... in 2020, climate change has become the most prevalent current threat, and still remains by far the largest potential threat." (Osipova et al. 2020)

The Intergovernmental Panel on Climate Change (IPCC) has predicted with 'high confidence' that 'global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate' (IPCC 2019).

The urgency for climate action demands an assessment of the climate change impacts upon all the values for which the property was recognised as well as the wider implications of climate change as a driver and/or constraint for sustainable development. This requires identifying, understanding, and assessing interactions between climate and the heritage values, understanding that management and sustainable development can both have positive or negative impacts upon these.

The CVI process, outlined in sections 1.2 and 5.1, is best undertaken through a workshop of diverse stakeholders (including property managers, researchers, community representatives, management agency representatives, and other stakeholders). Due to the Covid pandemic, it was decided to conduct the CVI as an online workshop; this was undertaken over six half-days in March 2022 given the time zone differences between Sweden, Finland and Australia where the workshop facilitators are based. The workshop schedule is provided in Appendix 3.

1.2 Overview of the Climate Vulnerability Index

The CVI is a systematic and rapid assessment tool that is values-based, science-driven and community-focused. It was initially developed to assess the impacts of climate change upon WH properties, considering the Outstanding Universal Value (OUV) and the associated community.

The CVI process works sequentially through the steps outlined in Section 5, enabling a systematic evaluation of the threats of climate change. Unlike many other risk assessment approaches, the CVI comprises two distinct primary outcomes (see Figure 5.1), assessing:

- **OUV Vulnerability**, evaluating potential impacts to the values and attributes for which the property has been internationally recognised; and

- **Community Vulnerability**, assessing the level of economic, social, and cultural dependence that associated communities (local, national, and international) have on the WH property (collectively referred to as "ESC dependencies") and their adaptive capacity to cope with climate change-related loss of WH values.

Both assessments of vulnerability are highly relevant for key stakeholders, including site managers, responsible management agencies, and the local communities that live in and around the property. Through its application, the CVI enables managers and stakeholders to consider what may be appropriate adaptive capacities for the management of their natural, cultural and community assets.

This application of the CVI for High Coast/Kvarken Archipelago provided several important precedents, including:

- the first time the CVI had been applied in either Sweden or Finland;
- the first time that CVI had been applied to a transboundary WH property with separate and distinct components; and
- the first time that CVI breakout groups for the Community Vulnerability were intentionally grouped by country (two Finnish, two Swedish) to focus on local issues for each property component; this also enabled the breakouts to be conducted in the local languages and the feedback from participants was this was beneficial and effective.

1.3 Why was High Coast/Kvarken Archipelago chosen for the CVI?

Climate change is becoming an increasingly significant factor for the managers of all WH properties. Following a presentation of the CVI methodology during an online meeting of WH marine managers in 2020, the managers of the High Coast/Kvarken Archipelago saw the potential of applying the CVI to better understand the impacts of climate change upon this property. It was previously thought that the land uplift would be greater than sea level rise and that the geological traces were fairly robust. New scenarios from the IPCC in 2019 pointed to a possibility that might not be the case by the end of the century. The managers also wanted to examine the impact of climate change on the biological values mentioned in the Statement of Outstanding Universal Value.

As a result, the managers of the property contacted the CVI developers and requested assistance to help assess climate impacts, and to raise awareness in the community about the impacts of climate change. They also jointly sought EU funding through Interreg Botnia-Atlantica for hosting a CVI workshop, highlighting this would help finalize a joint management plan for both the Swedish and Finnish components of the WH property. The management plan scheduled to remain in place until 2030 will be finalized during 2022. By running the CVI process in parallel with the management planning, climate change adaptations and measures were better able to be integrated into the plan.

There was also the potential to increase the awareness of other Nordic WH managers about climate change and further assist in the development of the CVI methodology.

2. The High Coast/Kvarken Archipelago World Heritage property

Högabonden, High Coast
Photo: Fabiola De Graaf

2.1 Location

The High Coast/Kvarken Archipelago WH property is located on opposite sides of the Gulf of Bothnia (Figure 2.1). The combined area of the WH property is 3,464 km^2 of which 71% is sea.

The High Coast component is on the east coast of Sweden and consists of a single area (about 1,520 km^2) within the Swedish municipalities of Kramfors and Örnsköldsvik. The Kvarken Archipelago component, on the west coast of Finland, has two sub-areas, one to the north and the other to the south. These two sub-areas total about 1,940 km^2 (of which 85% is sea and including 5,600 islands) within the Finnish municipalities of Korsholm, Korsnäs, Malax, Vaasa and Vörå.

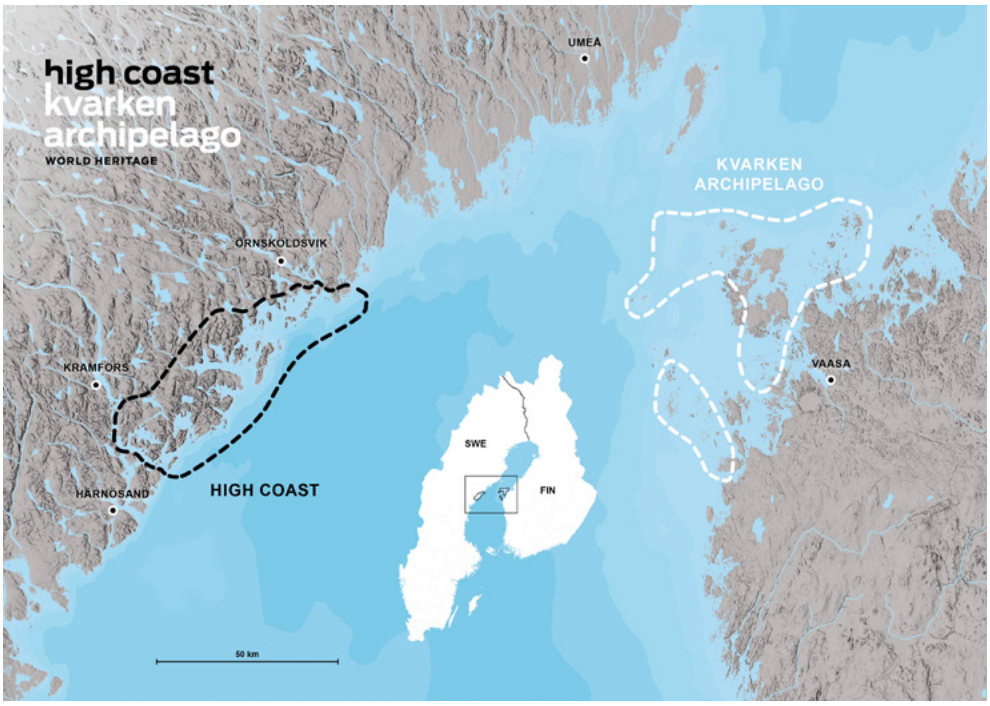


Figure 2.1 - Location of High Coast/Kvarken Archipelago WH property. Map showing the location of the various components in Sweden and Finland of the High Coast/Kvarken Archipelago World Heritage property.

2.2 Geological and geographical aspects

The three components of the High Coast/Kvarken Archipelago WH property afford outstanding opportunities for the understanding of the important processes that formed the glaciated and land uplift areas of the Earth's surface. They include a unique number of visible geological traces of the isostatic rebound from the last Ice Age. During that Ice Age, the entire area was covered by an ice sheet that was up to

3 km thick. The weight of the ice pressed down the crust of the earth. When the ice started to melt some 18,000 years ago, the land started to rise back again.

Since the area became ice free 10,500 years ago, the land has risen 286 meters, which is the largest measured isostatic rebound. This land uplift has left many traces in the landscape, and new traces are still created today. These traces of the land uplift since the last Ice Age, together with the large isostatic rebound, are the basis of the World Heritage listing. The absolute land uplift is 9 mm/year, while the apparent land uplift is now 6 mm/year due to rising sea level.

Today there are some 7,000 people living within the WH property, and this number increases during the summer. Both Kvarken Archipelago and the High Coast are popular places for summer houses, with over 3,000 summer houses in the High Coast and an estimate of at least the same number in Kvarken Archipelago. In Kvarken Archipelago, roughly half of the area is state owned, and half privately owned. The main part of the land is privately owned. In High Coast 10% of the land is state owned and 90% privately owned. 37% of the WH property is formally protected as Natura 2000-areas, National Park or Nature reserves.

2.3 Identifying the Values of the World Heritage Property

2.3.1 The World Heritage values

The High Coast was internationally recognised under criterion (viii) was inscribed on the WH list in 2000 acknowledging it contained:

… outstanding examples representing major stages of Earth's history, including the record of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features

Criterion (viii) https://whc.unesco.org/en/criteria/

The WH property was expanded with the addition of the Kvarken Archipelago in 2006 under the same WH criterion, and together they form a special geological unit, where the phenomenon of land uplift affects the landscapes in a unique way (Figure 2.2).

Upon inscription to the WH List, the globally significant values of a property are summarised in a Statement of Outstanding Universal Value (SOUV), a fixed description of the values of the property referenced to the date of inscription. The SOUV for High Coast/Kvarken Archipelago (Attachment 1) was developed retrospectively in 2012 (https://whc.unesco.org/en/list/1143).

Prior to the CVI workshop, excerpts from the SOUV for High Coast/Kvarken Archipelago were identified and grouped together to form the seven 'key values' listed in Table 2.1, namely:

1. Traces of the Ice Age
2. Contrasting landscapes
3. The discovery of the land uplift phenomenon and research
4. Land uplift and the impact of the sea
5. Ecological processes associated with land uplift
6. Societal interactions (with WH values)
7. Conservation and management

Table 2.1 shows how the excerpts were grouped and how the 'key values' and 'attributes' (tangible or intangible characteristics) were derived. These key values, underpinned by their attributes, then became a foundation for the initial assessments in the CVI workshop.

[1]Attributes are usually at the level at which management is undertaken within the property.

Figure 2.2. Aerial view of moraines at Trutören and Märaskär, Kvarken Archipelago. Photo: Christoffer Björklund

2.3.2 Other Significant Property Values

As well as values that have been internationally recognised and therefore form part of the SOUV, WH properties invariably include other significant values, whether they are heritage values (tangible or intangible) or other values (e.g., social, cultural, economic, spiritual, environmental, scientific).

These other values may be considered 'significant' locally, regionally, or even nationally, and may be recognised under local or regional by-laws, or even national legislation. For example, there are numerous endemic plant species found only in the WH property that are not listed in the SOUV.

Such values are referred to as other Significant Property Values (SPVs) for the CVI, recognising that some of these other values may also be subject to impacts from stressors like climate change. Attachment 2 provides the list of SPVs developed for High Coast/Kvarken Archipelago.

2.4 Managing the World Heritage property

Sweden and Finland both have responsibility to protect and manage their component of the WH property, because each country has signed the World Heritage Convention and they both endorsed the nomination to be listed as World Heritage. In Sweden and Finland, the regional or national authorities have the practical management responsibility for their component of the WH property.

In the High Coast, the County Administrative Board of Västernorrland is responsible and a management council discusses the management of the Swedish aspects of the WH property. The management council includes representatives from the County Administrative Board and politicians and civil servants from Kramfors and Örnsköldvik municipalities. Management plans for the High Coast have been prepared by the County Administrative Board.

Metsähallitus (Parks and Wildlife Finland) is responsible for the Kvarken Archipelago, working through an advisory committee, which includes regional authorities, municipalities and local stakeholders. The advisory committee has prepared a development strategy for the Kvarken Archipelago, based on the 2009 management plan for the Kvarken Archipelago. From this strategy, the committee produces an action plan every second year.

The WH property also has a joint, transnational cooperation group that meets twice per year. This group includes local politicians, civil servants and responsible management authorities from both Sweden and Finland. The cooperation group focuses on the joint management and other issues that affect the entire WH property. The cooperation group has tasked the World Heritage coordinators with the preparation of a joint management plan. Every six or seven years, the property managers, on behalf of the cooperation group, coordinate the preparation of a periodic report which addresses the application of the WH Convention as part of a broad regional assessment by UNESCO. Periodic Reports outline the state of the management, protection, and threats to the property. If necessary, UNESCO can also request a statement of conservation to get a better understanding of potential threats and dangers.

2.5 Evaluation of current condition and recent trend of the key World Heritage values

During the workshop, an assessment of the current condition and recent trend (since the year of inscription, 2000) of the key values was undertaken (Table 2.1). This provides a benchmark for the WH property and helped the workshop participants understand the list of key values and attributes.

Table 2.1 Assessment of current condition and recent trend for the key values derived from SOUV

Legend:

	Rating	Criteria
Current condition (i.e., colour of box around arrows)	Good	The site's value are in good condition and are likely to be maintained for the foreseeable future, provided that current conservation measures are maintained.
	Good with some concerns	While some concerns exist, with minor additional conservation measures the site's values are likely to be essentially maintained over the long-term.
	Significant Concern	The site's values are threatened and/or may be showing signs of deterioration. Significan additional conservation measures are needed to maintain and/or restore values over the medium to long-term.
	Critical	The site's values are severely threatened and/or deteriorating. Immediate large-scale additional conservation measures are needed to maintain and/or restore the site's values over the short to medium-term or the values may be lost.
Recent trend	➞ STABLE ↗ IMPROVED ↘ DETERIORATED ? UNKNOWN	

Table 2.1 continued (see legend on page 28)

<table>
<tr><th>Key values</th><th>Excerpts taken directly from the Statement of OUV</th><th>Attributes (at the level at which management is undertaken) for each key value</th><th>Assessment of current condition and recent trend (since 2006 inscription)</th></tr>
<tr><td rowspan="6">Traces of the Ice Age</td><td>This part of the world has experienced several Ice Ages during the last 2–3 million years and has been under the centre of the continental ice sheet a number of times.</td><td rowspan="6">Tangible attributes
• glacial depositional formations (for example: De Geer moraines and other moraine ridges, boulder terrain)
• rouche moutonnées and striations
• The worn, abraded landscape as a whole
• land uplift
• underwater geological formations

Intangible attributes
• several Ice Ages
• The area has been under the centre of the continental ice sheet</td><td rowspan="3">→</td></tr>
<tr><td>Present land uplift started when the ice began to melt about 18,000 years ago and the earth's crust was gradually released from the weight of the ice.</td></tr>
<tr><td>The landscape of the High Coast/Kvarken Archipelago today is mainly the result of the last Ice Age and the impact of the sea and the succession of vegetation</td></tr>
<tr><td>Kvarken Archipelago ... possesses a distinctive array of glacial depositional formations such as De Geer moraines, which add to the variety of glacial land- and seascape features in the region.</td><td rowspan="3">↗</td></tr>
<tr><td>variety of glacial land- and seascape features</td></tr>
<tr><td>Kvarken includes...the most superlative geological terrestrial formations, , formations lying in the shallow sea, as well as the majority of the moraine feature</td></tr>
<tr><td rowspan="7">Contrasting landscapes</td><td>This vast area of 346,434 ha (of which about 100,700 ha are terrestrial) is where high meets low: the High Coast's hilly scenery with high islands, steep shores, smooth cliffs, and deep inlets is a complete contrast to the Kvarken Archipelago with its thousands of low-lying islands, shallow bays, moraine ridges and massive boulder fields.</td><td rowspan="7">Tangible attributes
• Differences in the landscapes in High Coast and Kvarken Archipelago
• High Coast: high islands, steep shores, smooth cliffs, deep inlets with off-cut bays, deep sea
• Kvarken Archipelago: low-lying islands, shallow bays, moraine ridges and boulder fields, flads and gloes, shallow sea

Intangible attributes
• High Coast contains land uplift traces from the highest coastline 10500 years ago to today´s ongoing geological processes
• complementary examples of land uplift landscapes, high meets low
• Geological development of the bedrock (500 million years ago)</td><td rowspan="7">→</td></tr>
<tr><td>The Kvarken Archipelago, with its 5,600 islands and surrounding sea, possesses a distinctive array of glacial depositional formations</td></tr>
<tr><td>The High Coast and the Kvarken Archipelago represent complementary examples of post-glacial uplifting landscapes.</td></tr>
<tr><td>The boundaries of the High Coast in Sweden encompass the principal area of national conservation interest, extending inland to include the full zonation of uplifted land and some of the highest shoreline, while excluding areas under large-scale forestry management.</td></tr>
<tr><td>Seaward, the boundary incorporates key offshore islands and marine areas that are a logical extension of the topographic continuum of uplifted land surface, thus taking account of ongoing geological processes.</td></tr>
<tr><td>... about 71% of the property is sea</td></tr>
<tr><td>In the High Coast the sea is deep (as much as 293 m), while in the Kvarken Archipelago the sea is very shallow (with mean depth less than 10 m).</td></tr>
<tr><td rowspan="3">The discovery of the land uplift phenomenon and research</td><td>... of exceptional geological value</td><td rowspan="3">Tangible attributes
• key area for understanding deglaciation and land uplift processes
• diverse area for studying moraine formations

Intangible attributes
• important place in the history of science, because of the understanding of land uplift in the 19th century</td><td rowspan="3">→</td></tr>
<tr><td>This phenomenon was first recognized and studied here, making the property a key area for understanding the processes of crustal response to the melting of the continental ice sheet.</td></tr>
<tr><td>It is a global, exceptional and diverse area for studying moraine archipelagos.</td></tr>
</table>

Table 2.1 continued (see legend on page 28)

Key values	Excerpts taken directly from the Statement of OUV	Attributes (at the level at which management is undertaken) for each key value	Assessment of current condition and recent trend (since 2006 inscription)
Land uplift and the impact of the sea	The landscape of the High Coast/Kvarken Archipelago today is mainly the result of the last Ice Age and the impact of the sea and the succession of vegetation	Tangible attributes • land uplift • new islands • succession of vegetation (land uplift forests) • highest coastline and till-capped hills • tunnel caves • cobble fields • off-cut lakes, flads and gloes • beach deposits • beach ridges • ravines in sediment • bare washed rock surfaces Intangible attributes • some of the highest rates of isostatic uplift in the world and 290 m of land uplift recorded • dynamic ongoing geological processes • national conservation interest • effects of land uplift are visible during a generation	→
	After last glaciation, the land has elevated a total of 800 metres, with the highest uplift in the world after the last Ice Age recorded here		
	both areas have some of the highest rates of isostatic uplift in the world, meaning that the land still continues to rise in elevation following the retreat of the last inland ice sheet, with around 290 m of land uplift recorded over the past 10,500 years.		
	The uplift is ongoing and is associated with major changes in the water bodies in post-glacial times.		
	encompass the principal area of national conservation interest, extending inland to include the full zonation of uplifted land and some of the highest shoreline		
	For the past 10,500 years, the land has been rising at around 0.9 m per century a phenomenon that can be observed in a human lifetime and is expected to continue.		↗
	rising sea levels would influence the visible effects of land uplift in the coastal landscape, by reducing the area of new land emerging from the sea each year		
	outstanding example of the continuity of this change with dynamic ongoing geological processes forming the land- and seascape, including interesting interactions with biological processes and ecosystem development		→
	Underwater geological formations have not been widely affected by erosion or processes such as colonization by vegetation or human activity		
	Continual elevation of the land results in the emergence of new islands and distinctive glacial landforms, while inlets become progressively cut off from the sea, transforming them into estuaries and ultimately lakes		↘
Ecological processes associated with land uplift	The Baltic Sea has undergone dramatic changes since the last Ice Age, including a series of transitions from marine water to freshwater and then to brackish water, consequently causing subsequent changes in plant and animal life.	Tangible attributes • plant and animal life adapting to the ongoing changes in the landscape • ongoing geological processes forming many different habitats • Ice Age relicts • flad-gloe lake systems • beach deposits with shell sediment • land uplift forest Intangible attributes • continuity of change	→
	This serial transboundary property serves as an outstanding example of the continuity of this change with dynamic ongoing geological processes forming the land- and seascape, including interesting interactions with biological processes and ecosystem development.		↘
Societal interactions (with WH values)	key activities taking place on the property, such as infrastructural development of communities and industries, tourism, fishery and shipping	Tangible attributes • infrastructural development of communities • tourism, fishery and shipping • small-scale traditional farming and fishing Intangible attributes • recreational values (such as fishing, berry picking and other outdoor activities) • cultural interactions with the landscape • strong place connectivity amongst the population	↗
	While there is a small resident human population in the property (around 4,500 in the High Coast and 2,500 in the Kvarken Archipelago), people are engaged in small-scale traditional farming, forestry and fishing, all of which have negligible impact on geological values.		↘

Table 2.1 continued (see legend on page 28)

<table>
<tr><th>Key values</th><th>Excerpts taken directly from the Statement of OUV</th><th>Attributes (at the level at which management is undertaken) for each key value</th><th>Assessment of current condition and recent trend (since 2006 inscription)</th></tr>
<tr><td rowspan="13">Conservation and management</td><td>The relevant regional authorities and municipalities in Sweden and Finland have established a transnational consultative body, mainly to ensure that all three core areas of this serial transnational site have a joint management strategy for the property as a whole</td><td rowspan="13">Tangible attributes
• transnational consultative body
• joint management strategy for property
• nature reserve, national park, Natura 2000 areas
• regional land use plan (Kvarken Archipelago)
• landscape of national interest (High Coast)
• national legislation
• geological features can be affected by building or infrastructure projects
• biological and cultural values can be affected by increasing visitor pressure or oil/ chemical spill

Intangible attributes
• management in cooperation with other interests in the area</td><td>↗</td></tr>
<tr><td>The boundaries of this serial property comprise the areas with the most outstanding geological and geomorphological attributes of the site</td><td rowspan="4">→</td></tr>
<tr><td>The boundaries of the High Coast in Sweden encompass the principal area of national conservation interest, extending inland to include the full zonation of uplifted land and some of the highest shoreline, while excluding areas under large-scale forestry management.</td></tr>
<tr><td>The High Coast is a landscape of national interest, which gives the recreational and nature conservation values of the property additional legal protection and serves as guidance for societal development.</td></tr>
<tr><td>In the Kvarken Archipelago, a regional land use plan protects its Outstanding Universal Value, as well as recognizes geological values in the zone between the two core areas on the Finnish side</td></tr>
<tr><td>About 37% of the property is either nature reserve or national park, and the site also belongs to the Natura 2000 European network of protected areas.</td><td rowspan="2">↗</td></tr>
<tr><td>effective management of the property needs to further develop an ecosystem approach that integrates the management of the protected areas</td></tr>
<tr><td>All these different kinds of protected areas have regulations restricting land use, which provide a good level of protection to geological formations, as well as to flora and fauna.</td><td>→</td></tr>
<tr><td>The remaining parts, about 63% of the property, do not have the same level of protection, but the national legislation gives possibilities for safeguarding the integrity of the property</td><td>?</td></tr>
<tr><td>For the terrestrial portion ... several large-scale development projects have been noted as issues which could affect the integrity of the property</td><td rowspan="2">↘</td></tr>
<tr><td>Potential threats in the future are major building projects that could destroy some part of outstanding geological features or have a severe impact on the important views of the property</td></tr>
<tr><td>Increasing visitor pressure and an oil/chemical spill ... are potential threats to the biological and cultural values</td><td>↘</td></tr>
<tr><td>All threats are addressed by implementing the national legislation, strategic planning measures and actions that aim to improve knowledge and awareness of the property values among authorities, stakeholders and the local population.</td><td>↗</td></tr>
</table>

3.
Physical and community context

Fällskäret, Kvarken Archipelago
Photo: Christoffer Björklund

3.1 Detection of the land uplift phenomenon

3.1.1 The High Coast

The High Coast is characterized by many hills, valleys, islands, and lakes. The hills usually have softly rounded shapes and the height differences between the highest and lowest parts of the terrain within one and the same slope may exceed 200 m. It is also the only place around the Baltic Sea where hills as high and steep as these go all the way to the sea, hence the name.

On the top of the hills, there are usually a sparse pine forest. In the valleys and ravines there are more lush spruce forests, with deciduous trees interspersed. It is also in the valleys the farmland is found. On the south and east sides of some steep hills, southern species have survived because of the favourable microclimate.

3.1.2 The Kvarken Archipelago

The Kvarken Archipelago is a flat landscape with some 5,600 islands and shallow seas. The islands are also young, the oldest having risen out of the sea only 2,000 years ago. The area of land is increasing by approx. 1 km2 each year due to the land uplift. The area is in a constant succession, in both the forests on land and in the sea.

The unique geomorphic character of the Kvarken Archipelago is provided by the many different types of moraine formations and other geological features, such as bolder fields that show traces of deglaciation and land uplift. In the middle of the northern component of the Archipelago at Svedjehamn in Bjorkoby, the long narrow moraines can be seen as long parallel ridges rising from the water with spaces in between. Travelling by boat in the area has its challenges, as the waters are full of rocks and dangerous shallows. Shallow bays and lagoons are getting landlocked and forming lakes. Birch and other deciduous trees dominate the islands. On the older islands there are also spruce and in some places pine forests.

3.1.3 The Gulf of Bothnia

The Baltic Sea with the Gulf of Bothnia has brackish water with a salinity gradient from more salt water in the southwest to more influence of fresh water in the north and northeast. Within the WH property, the salinity is between 0.4 and 0.6%. The sea in Kvarken Archipelago is very shallow, usually a few meters, with a maximum depth of only 20 meters. In the High Coast, the sea is deeper, with a maximum of 293 meters, and the shorelines are usually steeper. Even in the High Coast, the land uplift has made many waterways and harbours too shallow. Just like in the Kvarken Archipelago, the High Coast charts have been redrawn many times over the centuries.

The Baltic Sea has a low biodiversity with almost no species adapted to the brackish water. Instead, the species composition is a very interesting mix of freshwater species and marine species. During the winter, the Gulf of Bothnia usually gets covered in ice.

3.2 Economic context

About two-thirds of the inhabitants within the WH property live in High Coast, of which a larger part is accessible by car and the main road E4 cuts through the area in north-south direction. Estimates are 5000 people in High Coast, 2200 in Kvarken Archipelago. Only Korsholm of the five municipalities in Kvarken Archipelago has people living year-round inside the area, since most of Kvarken Archipelago is not accessible by car. This economic description is applicable for the villages outside the site but connected to it, but all examples are from the part of Korsholm municipality within the WH property.

The differences in number of inhabitants and accessibility between High Coast and Kvarken Archipelago are reflected in the business with High Coast having overall more work opportunities inside the WH property. Both areas have a strong tradition of self-reliance. The average number of businesses per capita is above national numbers in the High Coast. In Finland, Korsholm municipality is slightly above national numbers in people getting their outcome from running a business, almost 11%, and traditionally the entrepreneurship is strong in the archipelago. The unemployment rate in Kvarken Archipelago is below 6% and there is a total number of about 320 persons working inside the WH property in Finland (statistics from 2019). Of these, about 30 people work within restaurants and accommodation.

In the High Coast destination (Örnsköldsvik, Kramfors, Sollefteå and Härnösand municipalities) there are about 1200 people employed in the tourism industry in 2019, an increase with 7.1% since 2017. The revenue in that industry was 2.77 billion SEK in the destination in 2019, a 15% increase from 2017. In Kramfors, around 3% of the workforce are working in the tourism industry compared to a national average of 2.4%. Tourism remains a fast-growing industry and includes hiking, enjoying the outdoors boating, fishing and skiing.

Typical for business in the WH property is that they have only 1-5 employees. Most of the businesses are service related and tourism industry is on the rise. High Coast has a wider range of restaurants and alternatives for overnight stay than Kvarken Archipelago. Manufacturing industries are not related to tourism nor World Heritage but is a substantial business, especially in High Coast with industries making boats, houses, electrical components, fishing nets and shoes. Some of these industries employs over 50 persons. In Kvarken Archipelago the enterprises are fewer and smaller, but i.e., industries making fishing nets and agriculture and forestry machineries employs 10-30 persons.

Inside the WH property there are both agriculture and forestry. Forestry is the more important business monetary, but agriculture is also important for maintaining an open traditional landscape. There are a small number of commercial fisheries fishing inside the WH property, but these are all on a small, traditional scale. There are estimates of around 400 people working in the forestry-fishing-agriculture industries within High Coast. The agriculture and forestry industry are also characterized by being small-scale operations. Large scale trawling outside of the WH property may well impact the fish stocks inside the property.

The names High Coast and Kvarken Archipelago are both used in marketing and branding, but slightly differently in Sweden and Finland. The use of High Coast conveys a feeling of deep forests, high mountains and campfires, whereas Kvarken Archipelago speaks more about the uniqueness of the landscape and its World Heritage status.

3.3 Societal context

The larger cities in the region are located outside the WH property. The inhabitants of the property are living in rural areas or in small villages with a few hundred people up to almost a thousand people. Historically the villages in the WH property have been self-reliant and have not always appreciated the involvement from the government and municipalities. Traces of this 'do it yourself mentality' can be seen still.

Less reliance on government or the municipality to organize the society has led to volunteer associations and village cooperatives taking responsibility for many aspects, ensuring for example, that the local school or general store survives. These associations and cooperatives are an important part of the societal fabric in both Kvarken Archipelago and the High Coast. Landowner associations that have a joint ownership of village owned lands are especially important in Kvarken Archipelago where they have large influence in the archipelago, since they own the water areas and also the new land that rises out of it because of the land uplift.

There is a long tradition of artists living and acting in the High Coast, especially in the Nordingrå area. For over 100 years, the dramatic and beautiful landscape has attracted painters and photographers. In general, there is a strong place attachment among the locals. In Kvarken Archipelago, several villages outside the site are strongly connected to it because the islands within the border belong to different villages outside of it. The place attachment is not only connected to where people live. Many people living outside the area have a strong place attachment to it because of the large number of summer cottages in both Kvarken Archipelago and High Coast.

The current trend with leading an active outdoor life is strong in the WH property. Both visitors and inhabitants enjoy the very good opportunities for outdoor recreation that exists in the area. Activities such as hiking, kayaking, biking, foraging, Nordic skating, and trail running are popular, but also more traditional activities such as hunting, fishing, skiing, ice fishing and berry picking. Boating culture is very popular in both High Coast and Kvarken Archipelago.

3.4 Cultural context

3.4.1 The land

Most of the land with the WH property is not well suited for cultivation. In the extremely rocky Kvarken Archipelago, people had to move stones to make fields, so there are lots of stone fences in the villages. In the steep High Coast, the hilltops and hillsides are not suitable for cultivation, but the valleys between the mountains comprise very fertile land. After the Ice Age, the valleys were bays that were sheltered by islands and peninsulas, and a lot of beneficial sediment ended up in these bays. As the uplift raised the land, the bays gradually became the valleys that are visible nowadays.

Livestock farming has long been a source of food, marketable goods, and tax funds. The women took care of the farms and livestock when the men were at sea fishing, hunting seals or on trade trips. The seal hunting trips in winter lasted for weeks, and the conditions on the sea ice were cold and dangerous. Children helped their parents but also attended school. The children who lived in the outer archipelago attended school on the mainland or on the larger islands. If the sea ice was not strong enough, the children could not come home for Christmas.

In the High Coast, people kept livestock up in the forested hills where the Sami people also kept their reindeer. In the Kvarken Archipelago, sheep, cows and goats were brought onto the islands for summer grazing, which meant long milking trips for the women. They also harvested hay from the shore meadows for the cattle's winter fodder. The remains of old barns still exist, but nowadays are far from the beach because of the land uplift.

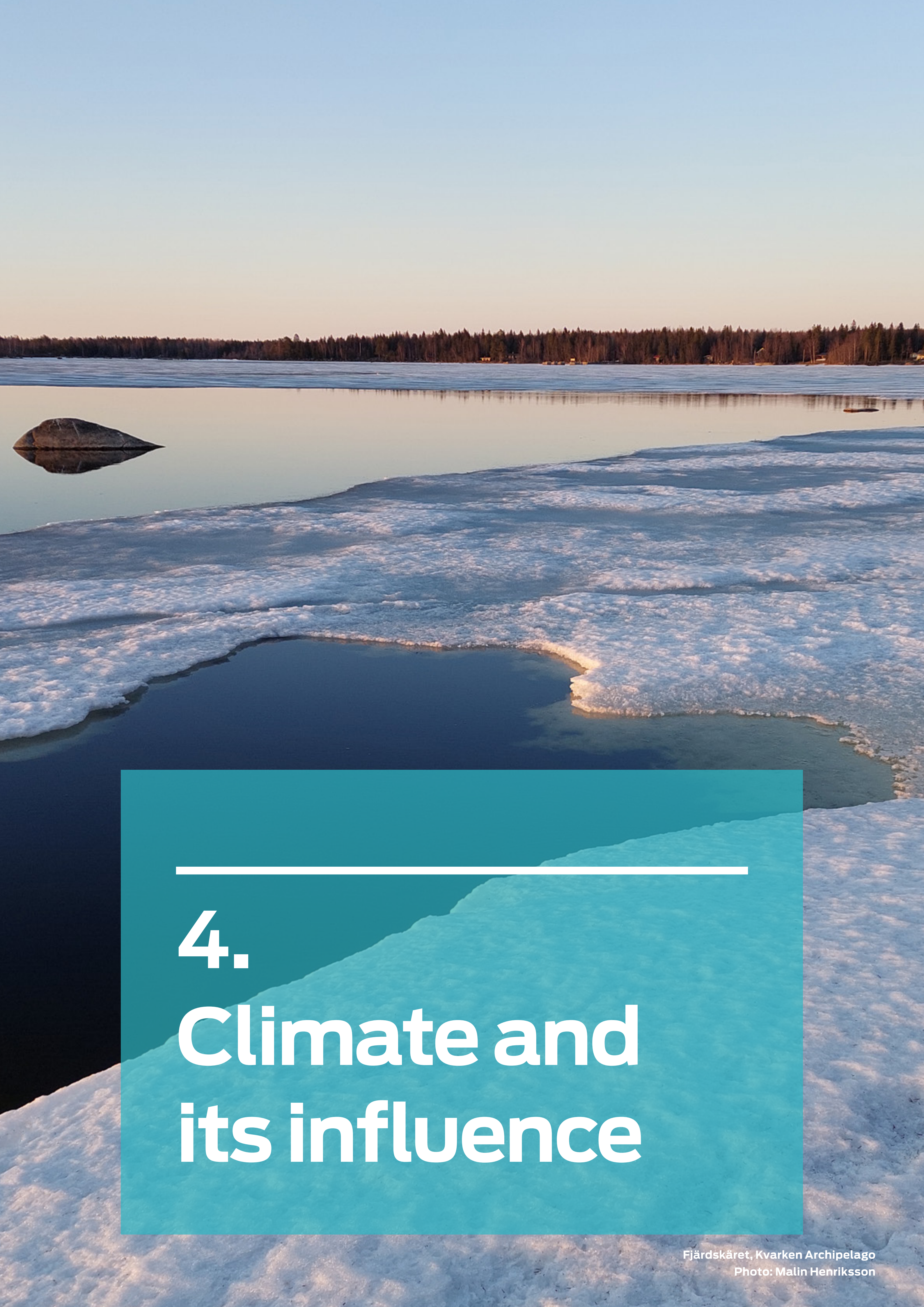
3.4.2 The sea

The sea has always been a way of life in the High Coast and in the Kvarken Archipelago. Stone Age hunters hunted seal at the High Coast when the tops of till-capped hills were just islands about 8,000 years ago. At that time the Kvarken Archipelago was still deep down in the sea. It took another 7,000 years before the seal hunters and Vikings visited the first islands of the Kvarken Archipelago.

Because of the land uplift, people have always had to adapt to the changing nature. People had to move their harbours closer to the sea when the land uplift gradually made the sea bays too shallow or even separated from the sea. In the low-lying and shallow Kvarken Archipelago, the land uplift is occurring surprisingly fast. The land uplift makes the boat passages shallower and lifts boulders above sea level. The Kvarken Archipelago has even been called the archipelago of wrecks because of the many vessels that have gone ashore here. The boat passages are marked, but winter ice can move the boulders from the boat passages. Legend has it, that the Valsörarna Islands and many small islets were formed when a large sack carried by Finn the Giant, split so the stones he was carrying fell out – the giant became angry and threw the stones in all directions.

In just one lifetime, a boathouse may not be accessible by boat anymore. Similarly, prehistoric fishing camps are nowadays in the forest, while new harbours are intentionally built on the outer borders of the archipelago. Sometimes people had to build new settlements or move whole towns, which happened with the old city of Vaasa.

At the High Coast's steep shores, there are the traces of the ancient remains, starting from the Stone Age, into the Bronze Age and continuing to the Iron Age. Humans have always settled near the water. The higher the ancient remains are in the landscape, the older they are. The oldest traces of humans are nowadays 160 meters above sea level, and they are about 8,000 years old. Among the most interesting findings are a trading place from the Stone Age and burial cairns from the Bronze Age.



4. Climate and its influence

Fjärdskäret, Kvarken Archipelago
Photo: Malin Henriksson

4.1 Climate in the High Coast and Kvarken Archipelago (1971-2000)

The regional climate of High Coast/Kvarken Archipelago (including the county of Västernorrland in Sweden and the municipalities of Vörå, Korsholm, Vaasa, Malax and Korsnäs in western Finland) is characterised by the four seasons of the year and the differences between these.

Historically, the winter months (December, January and February) had an average temperature of -8.3°C in High Coast (1971-2000; Table 4.1) (SMHI 20922) and -3.5°C in Kvarken Archipelago (Table 4.2) (FMI 2022a). During the winter season, the ocean was covered with ice. Coverage was typically 100% in the area closest to land, though further out to sea there were years when the ice cover was not complete. There are historical stories of people going by car over the ice between Sweden and Finland.

Spring (March-May) and summer (June-August) have had average temperatures of 1°C and 13°C, respectively, in High Coast and around 2.5°C and 12.5°C, respectively, in Kvarken Archipelago. The vegetation period has started in the beginning of May and ended in the middle of October in both areas.

Table 4.1 Climate indicators for the High Coast area, historical and projected (RCP8.5)

			Projected	
Climate indicator	Unit	Historical 1971–2000	2041-2070	2071-2100
Temperature				
Annual-average	ºC	2.2	5.5	7.4
Winter	ºC	-8.3	-3.7	-1.3
Spring	ºC	1.5	4.4	6.1
Summer	ºC	13.0	15.8	17.7
Autumn	ºC	2.5	5.3	7.0
Summer heatwave (days each year when the daily maximum is above 25ºC).	#days	4.4	14.9	26.9
Length of vegetation period	#days	151	183	204
Start of vegetation period	day of year	127	110	97
Precipitation				
Annual-average	mm/month	55	64	69
Winter (Dec-Feb)	mm/month	43	53	59
Spring (Mar-May)	mm/month	40	49	55
Summer (Jun-Aug)	mm/month	74	82	85
Autumn (Sep-Nov)	mm/month	64	73	77
Number of days with heavy precipitation >10 mm	#days	16.3	20.9	23.6
Number of days with extreme precipitation >25 mm	#days	2.9	4.7	5.8

Table includes data sourced from SMHI (2022); RCP is 'Representative Concentration Pathway'

Table 4.2 Climate indicators for the Kvarken Archipelago area - historical and projected (RCP8.5).

			Projected	
Climate indicator	**Unit**	**Historical 1971–2000**	**2041-2070**	**2071-2100**
Temperature				
Annual-average	ºC	ca 3-5	7-8	9-10
Winter	ºC	ca -3 to -4	-1 to 0	1-2
Spring	ºC	ca 2-3	4-6	6-8
Summer	ºC	ca 12-13	17-18	19-20
Autumn	ºC	ca 5-6	8-9, 9-10	10-11
Summer heatwave (days each year when the daily maximum is above 25ºC).	#days	ca 0-4	2-12	10-28
Length of vegetation period	#days	160-180	200-220	220-260
Start of vegetation period	day of year	ca 130	95-105	74-84
Precipitation				
Annual-average	mm/month	40-50	40-60	50-60
Winter (Dec-Feb)	mm/month	40-50	40-50	40-60
Spring (Mar-May)	mm/month	20-30	30-40	30-40
Summer (Jun-Aug)	mm/month	30-50	50-70	50-70
Autumn (Sep-Nov)	mm/month	40-50	60-70	60-80
Number of days with heavy precipitation >10 mm	#days	8-10	12-14	14-16
Number of days with extreme precipitation >25 mm	#days	0-2	2-4	2-4

Table includes data sourced from SMHI (2022); RCP is 'Representative Concentration Pathway'

The average monthly precipitation during the year has been around 55 mm in High Coast (Table 4.1) and 45 mm in Kvarken Archipelago (Table 4.2). Precipitation is fairly evenly distributed during the seasons, with slightly higher values in summer and autumn. During the winter months precipitation has been in the form of snow. The snow cover, which is typically slightly thinner the closer you get to the coast, typically covered the area for about five months in High Coast and 3-4.5 months in Kvarken Archipelago.

Precipitation affects flows in the watercourses, which have varied through the year. Flows have been low during winter, increasing sharply during the spring months, when the snowmelt contributed to an increase. The flows levelled off during summer (at around 10-20% of the peak flow of spring), increasing slightly with autumn rains.

4.2 Observed climate trends

In the last 20 years, the winters have become warmer, with average winter temperature now around -7°C in High Coast (SMHI 2022) and -3°C in Kvarken Archipelago (FMI2022a). The days with a snow-covered landscape have also decreased in recent years, now about a month shorter in the High Coast and around two weeks shorter in Kvarken Archipelago (FMI 2022a) than historical values. The amount of precipitation is as high, or higher; however, it now rains (instead of snowing) in coastal areas.

In the last 20 years, the vegetation period has increased by about 1-2 weeks (SMHI 2022, FMI 2022b). Numbers of heatwave days (with daily maximum temperature above 25°C) have been 4.4 days, on average, something that has changed only marginally in recent years (SMHI 2022, FMI 2022c).

4.3 Emissions scenarios

Emissions scenarios are used to model future climate. These emissions scenarios are based on predicted future emissions of greenhouse gases, which are based on assumptions of the future development (e.g., population growth, globalisation, world economy, and sustainable technology).

The Intergovernmental Panel on Climate Change (IPCC) has presented four different kinds of emissions scenarios called Representative Concentration Pathways (RCPs). The RCPs are extended in the latest IPCC analyses by incorporating different socioeconomic considerations to define Shared Socioeconomic Pathways (SSPs). In this analysis, two of those scenarios are used:

- RCP4.5/SSP2-4.5: Some efforts to reduce greenhouse gas emissions are in place and global warming would exceed 2°C by the end of the century. This would translate into a warming of ca 3°C in Finland and Sweden.

- RCP8.5/SSP5-8.5: The worst-case among the IPCC climate scenarios, in which emissions increase through the 21st century and global warming would exceed 4°C by the end of the century. This would translate into a warming of ca 5-6°C in Finland and Sweden.

For simplicity, we will refer to these scenarios using the RCP numbering.

4.4 Climate projections for the land area of High Coast and related impacts

Climate projections for temperature and precipitation provide insight to how the area will be affected by a changing climate. A gradual change takes place until the middle of the century after which the temperature and the amount of precipitation increase at an ever-faster rate (Table 4.1). At the end of this century, the annual-average temperature will increase by between 2-5˚C in High Coast, depending on the climate scenario (Figure 4.1, Table 4.1). The largest change in temperature occurs during the winter when the projected increase is up to 7˚C (Table 4.1). Importantly, this means that the increased precipitation in the coastal area during winter will be in the form of rain instead of snow. The number of days with maximum temperature below freezing (0˚C) is projected to decline (Figure 4.1). The increased temperature will also affect the growing season, which will be 1-2 months longer and may start as early as April and last until the end of October (Table 4.1).

The amount of precipitation is predicted to increase through the century with the largest increase during autumn and winter (Table 4.2). This will increase flows in waterways and increase the risk of floods. Extreme weather events, such as heavy rain and heavy snowfall, will occur more often (Table 4.1). Where downpours will occur is difficult to predict from climate modelling, so it is important to analyse where in the landscape there are areas with risks of being affected by intense rainfall, such as buildings located in so-called low points in the landscape.

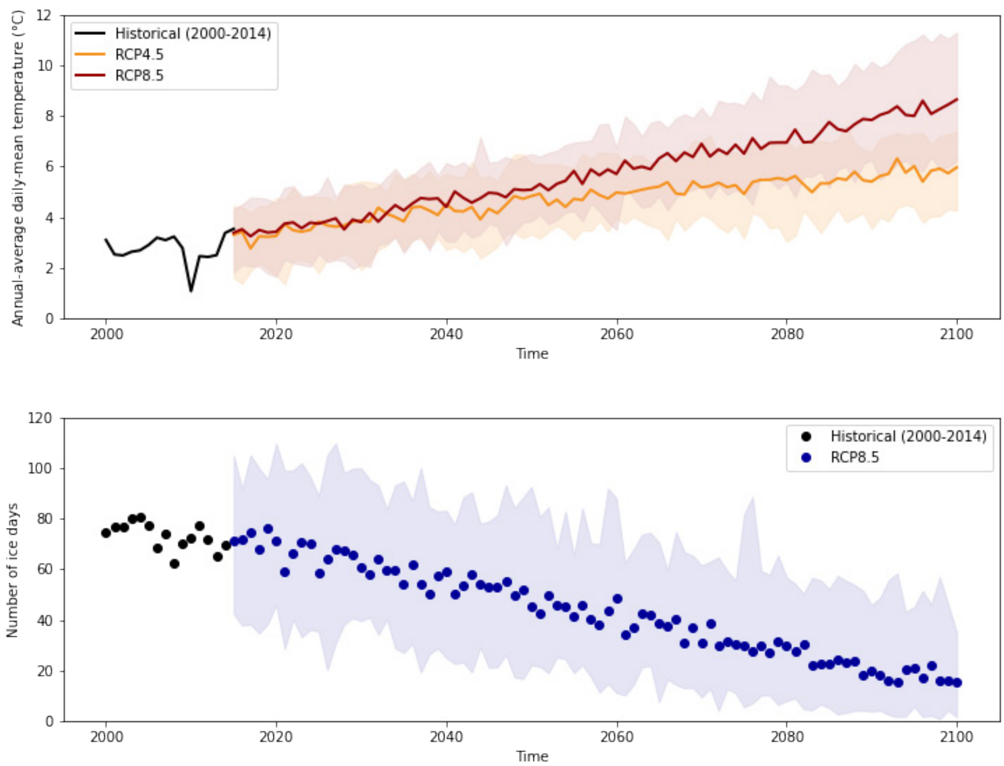


Figure 4.1 (upper) Annual-average temperature for Västernorrland County, historical (2000-2014) and projected (2015-2100) under Representative Concentration Pathway (RCP) 4.5 and 8.5; (lower) Number of days each year for Västernorrland County for which the maximum temperature is projected to be <0°C ('ice days') under RCP8.5.

Effects of climate change in the High Coast area, a part of the County of Västernorrland, are summarised from the report "Översiktlig klimat- och sårbarhetsanalys – naturolyckor" (General Climate and vulnerability analysis – natural disasters; Fallsvik et al. 2010). The following sections describe how different types of natural disasters could increase due to the changing climate.

Climate projections show changes in the seasonal distribution of flows and floods in watercourses. The clear seasonal characteristics we see today with low winter flows and a pronounced spring flood will be replaced by a flow regime with higher flows during autumn and winter, and lower spring floods. Annual average water flow is expected to increase by about 10-20% in general for the larger watercourses. During the period up to 2050, the volume of 'once in 100-year' flows appears to be unchanged. Beyond that time, the extent of flooded areas along the current watercourses depends on the flow volume and the control strategy applied in areas with hydro power plants. Projected annual-average runoff indicates a decrease of the volume of 100-year flows during this century compared with the reference period (1971-2000).

Conditions for erosion along the coast exist within areas of the Kramfors and Örnsköldsvik municipalities (in the World Heritage area). Long-term erosion is normally assessed using mean sea level. However, despite the rapid land uplift in Västernorrland County, climate change can lead to higher sea levels than present conditions in certain air pressure and wind conditions, which means that areas not previously exposed to erosion may be affected. Conditions for erosion exist along sections of each of the county's larger watercourses. The projected increase in annual-average water flow during this century and changes in seasonal flows influence erosion. Expected moderate water flows will have a longer duration, which means that for a large part of the county, erosion along watercourses may increase.

Parts of Västernorrland County are among the areas in Sweden that have the highest frequency of landslides. These rapid movements of unstable soil, for example, on mountains or in river slopes can cause major damage. Instability often prevails along river slopes located further inland, where the soil layers closest to the slope crest consist of firmer sand and silt, while the deeper soil layers consist of loose clay or silty clay. Changing precipitation conditions will affect surface and groundwater levels, pore pressure in the ground as well as water flow and water levels in the watercourses. Rainfall can also lead to slower sludge flows in watercourses.

4.5 Climate projections for the land area of Kvarken Archipelago and related impacts

Climate projections of temperature and precipitation show a similar trend to the High Coast, with varying magnitudes. Depending on the climate scenario, the end-of-century annual average temperature is projected to increase by 2-6°C (Figure 4.2, Table 4.2). As in the High Coast, the largest seasonal temperature change will be in winter, of up to 7°C (Table 4.2). A significant proportion of winter precipitation is anticipated to be as rain instead of snow. Projected warming will also cause the growing season to lengthen by 1-2 months, starting as early as late-March and extend through October (Tables 4.2).

Precipitation is projected to increase in all seasons with the largest increase during autumn and winter (Table 4.2). The number of days heavy (>10 mm) and extreme (>25 mm) precipitation are projected to double by the end-of-century. Effects of erosion may be amplified during such events.

While the projected climate change in the Kvarken Archipelago is similar to that of the High Coast, the effects from this on the values of the property are likely to vary. Erosion will likely also be an issue in the low-lying islands and shallow bays of the Finnish component. However, it may be in the effects upon the marine biota of the estuaries and lakes that the greatest difference from the Swedish region is evident. Temperature changes may lead to range shifts of plant and animal species and changes to precipitation may also affect habitats on a smaller scale.

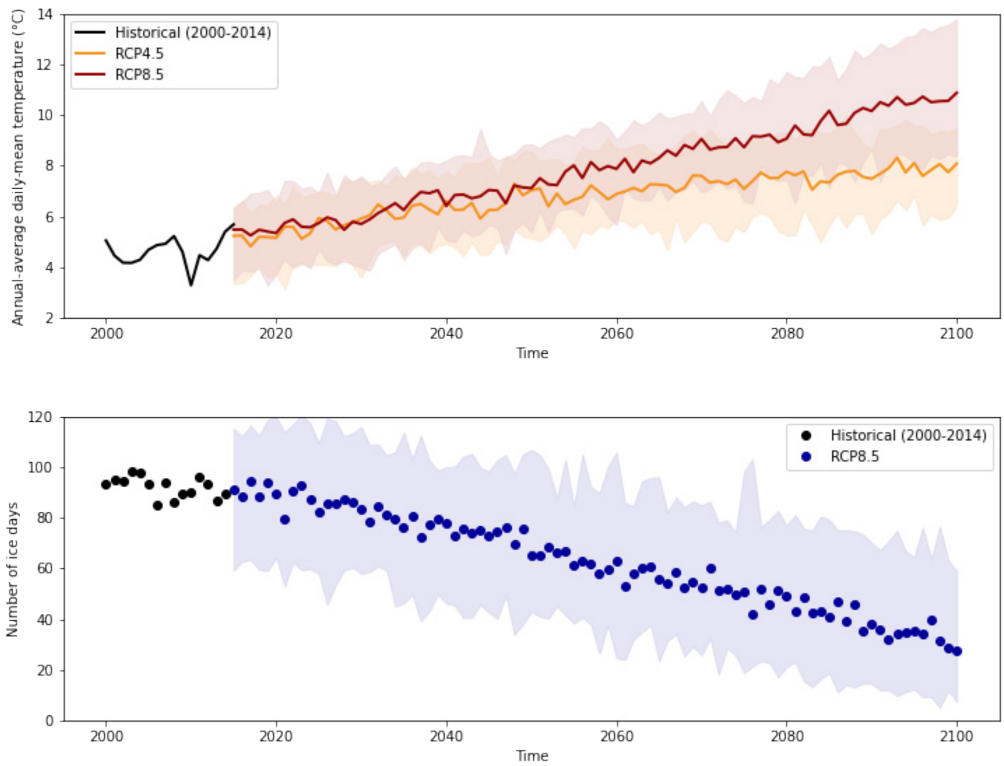


Figure 4.2 (upper) Annual-average temperature for western Finland, historical (2000-2014) and projected (2015-2100) under Representative Concentration Pathway (RCP) 4.5 and 8.5; (lower) Number of days each year for western Finland for which the maximum temperature is projected to be <0ºC ('ice days') under RCP8.5.

4.6 Climate projections for the sea area of High Coast and Kvarken Archipelago

Climate projections for the Gulf of Bothnia were undertaken by the Swedish Meteorological and Hydrological Institute (SMHI) together with the Finnish Meteorological Institute (FMI) within ECOnnect project. Under climate scenario RCP8.5 for the period 2070-2099, average bottom water temperature during summer months will increase by around 3˚C (compared with 1976-2005), while winter ice thickness will decrease by over 80% (Figure 4.3). Moreover, salinity is projected to decrease, on average, by 10%, though this projection has high uncertainty.

The geological outstanding values of the WH property have been formed as land has risen from the sea. The land-uplift today is around 9 mm/year. How much the global sea level rise will be in the coming century is difficult to calculate, as it consists of large uncertainties about how fast the large sea ice will melt. This means that we cannot say with certainty what the development will look like on our coasts in the future. Research within the ECOnnect project (based on Pellikka et al. 2018) predicts that sea-level in the project area could decrease by around 30 cm towards the end of the century (Table 4.3).

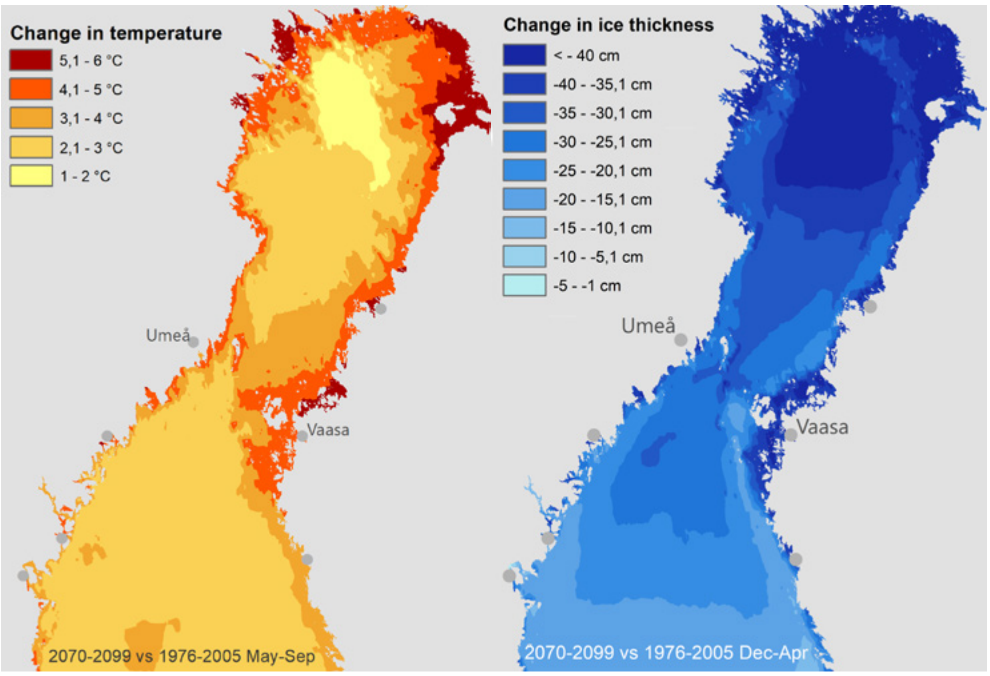
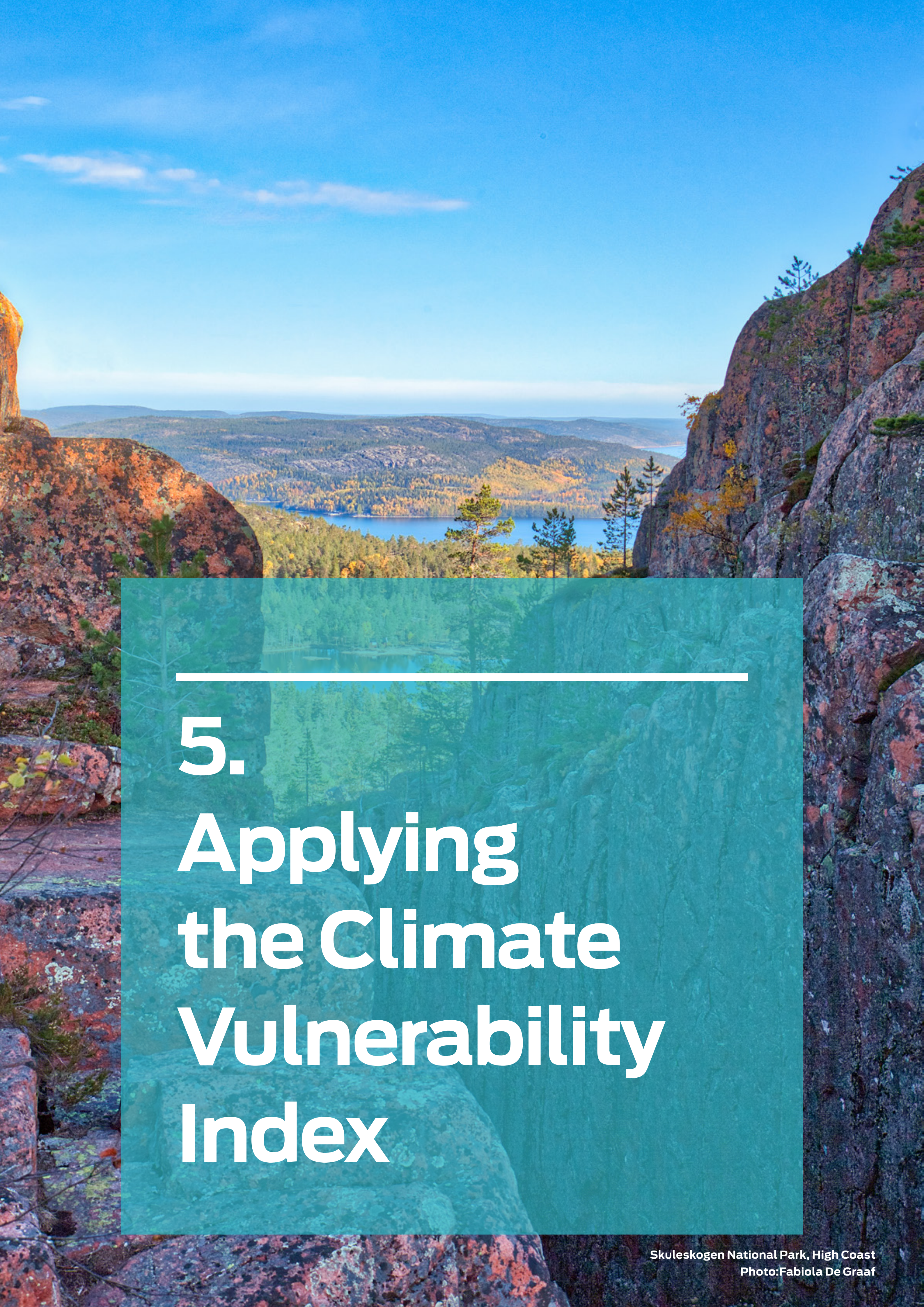


Figure 4.3 (left) change in bottom temperature during May-Sept. (right) change in ice thickness During dec-April. Models created in project ECOnnect.

Table 4.3 Mean sea level change for different locations within and close to the High Coast/ Kvarken Archipelago World Heritage property (Särkkä et al. 2021).

City	Mean sea level change, 2000-2100 (cm)	Scenario:
Vaasa/Vasa	-31	14 different scenarios (including RCP 4.5, RCP 8.5)
Kaskinen/Kaskö	-22	
Härnösand	-31	

Figure 4.4 Winter ice thickness will decrease according to climate scenario RCP8.5.
Photo: Malin Henriksson



5. Applying the Climate Vulnerability Index

Skuleskogen National Park, High Coast
Photo:Fabiola De Graaf

5.1 Background

The Climate Vulnerability Index (CVI) is a systematic and rapid assessment tool that is values-based, science-driven and community-focused. The CVI was initially developed to assess the vulnerability to climate change of all types of WH properties, considering the Outstanding Universal Value (OUV) and the associated 'community' (local, domestic, and international people groups).

The foundation for the CVI process is the Statement of OUV for a property (Appendix 1), from which key WH values are summarised (Table 2.1). The climate stressors most likely to impact the key values (and attributes) are identified for a defined and agreed time scale (e.g., ca 2050) from a list of possible stressors (Table 5.1). With this foundation established, the CVI framework is applied (Figure 5.1; for a more detailed outline of the CVI process, see Day et al. 2020).

The CVI framework builds upon the vulnerability framework approach described in the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007). Vulnerability of OUV is determined by assessing the exposure, sensitivity and adaptive capacity with respect to determined climate stressors (Figure 5.1). The OUV Vulnerability becomes the exposure term to assess the vulnerability of the community associated with the property, combining assessments of economic-social-cultural dependency (sensitivity) and adaptive capacity (Figure 5.1). A customised spreadsheet-based worksheet is used to determine outcomes based on user inputs.

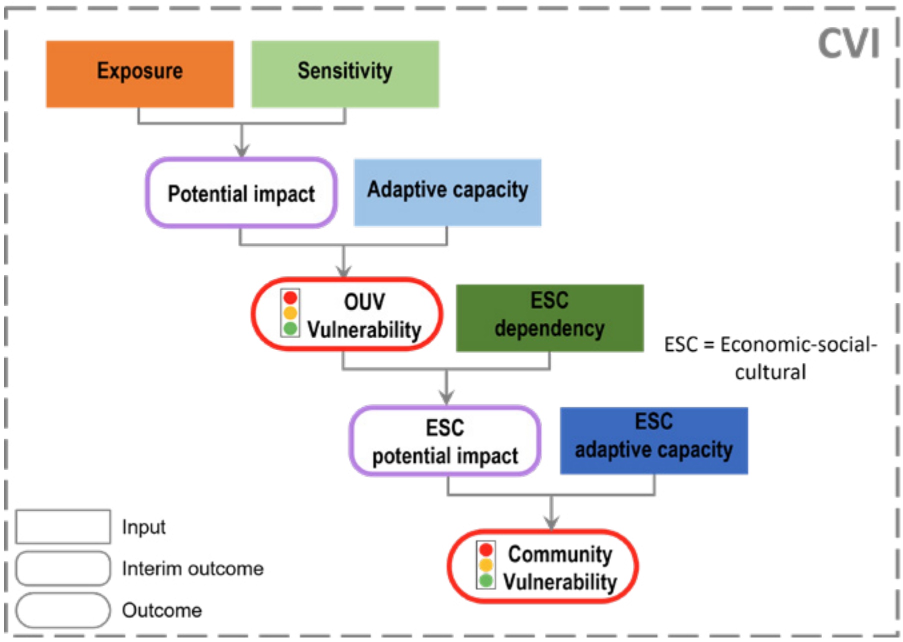


Figure 5.1 The CVI framework used to undertake rapid assessment of climate change vulnerability of World Heritage properties and the associated community.

While the CVI was initially developed in Australia, input and support for the CVI has subsequently come from many experts around the world. This includes the International Council on Monuments and Sites (ICOMOS) and the International Union for Conservation of Nature (IUCN), the two primary advisory bodies to the WH Committee. For the High Coast/Kvarken Archipelago CVI, there was also extensive input and guidance from the Steering Committee established specifically for the CVI application.

At the time of this report, applications of the CVI have occurred in natural WH properties in Australia, Germany/Netherlands/Denmark and Seychelles, and in diverse cultural WH properties across Scotland, Norway and Africa (see CVI website, https://cvi-heritage.org/).

5.2 The CVI process for High Coast/Kvarken Archipelago

5.2.1 Preparatory work

Prior to the CVI workshop, the following preparatory steps were undertaken:

1. The Statement of OUV for High Coast/Kvarken Archipelago (Appendix 1) was analysed and excerpts categorised into key values and their accompanying attributes (Table 2.1)

2. A list of 15 climate stressors typically considered in the CVI process was translated into local languages and provided to participants prior to the workshop (Table 5.1).

3. An overview of the key economic activities linked to the WH values was compiled (Section 3).

4. Background information was prepared outlining key aspects of climate change for the area (Section 4).

5. An initial list of other Significant Property Values (SPVs) was compiled; see Appendix 2.

5.2.2 The online workshop

Due to uncertainty regarding international travel due to the COVID-19 pandemic, the decision was made by the Steering Committee to hold the workshop online (using the Zoom platform). Participants joined the workshop from locations across Sweden and Finland, whilst the facilitators were located in Townsville, Australia.

A total of six four-hour sessions were scheduled for Scandinavian mornings (from 8am in Sweden, 9am in Finland), which corresponded to evenings in eastern Australia (from 5pm). The workshop sessions were conducted through a series of plenary and breakout groups, in which information was presented and assessments were undertaken and discussed. Breakout sessions were held using the breakout rooms feature of the Zoom platform.

In the first week (15-17 March 2022), the OUV Vulnerability was determined by assessing the exposure, sensitivity and adaptive capacity (Figure 5.1) of the key values with respect to three chosen key climate stressors. Four breakout groups were defined for the OUV Vulnerability assessment with participants from both countries in each group. This provided a single outcome for the High Coast/ Kvarken Archipelago property and had the benefit of participants learning more about the values and attributes present in the other property component (and the risks faced).

Figure 5.2 Trysunda in High Coast is an island community shaped by land uplift. Photo: Fabiola de Graaf

Table 5.1 List of climate stressors from which three key climate stressors were chosen by the workshop participants.

	Climate Stressor	Synonyms and associated terms	Timeframe
Temperature	Temperature trend (air and/ or water)	warming; hotter than average weather; longer growing seasons; sea surface temperature (SST); ocean warming; more algal bloom peaks in a year	Gradual/slow/ chronic change
	Extreme temperature events	heatwaves; hot spell; desiccation; marine heatwaves	Sudden/abrupt/ acute events
Water cycle	Precipitation trend	rainfall; rainstorms; showers; drizzle; heavy dew; hailstorms; snow	Gradual/slow/ chronic change
	Intense precipitation events	heavy rainstorms, tropical cyclones, storminess; extreme rainfall; downpour	Sudden/abrupt/ acute events
	Flooding (fluvial, pluvial)	runoff; soil absorption; flash flood; intermittent waterways	Sudden/abrupt/ acute events
	Drought (severity, duration, frequency)	aridity; dehydration; below average rainfall, prolonged water shortage; low soil moisture	Gradual/slow/ chronic change
Wind & Storms	Mean wind trend	gale; wind gusts; change in wind direction	Gradual/slow/ chronic change
	Storm intensity and frequency	tropical cyclone; hurricane; tornado; storminess, extreme rainfall; lightning strikes	Sudden/abrupt/ acute events
Snow & Ice	Sea/lake ice change	ice extent; ice thickness; changes in dates of ice forming and melting	Gradual/slow/ chronic change
	Snow cover or glacier change	snowpack; ice volume; snow/ice thickness or extent; snow compaction; number of days changing between below and above 0ºC	Gradual/slow/ chronic change
Coastal	Sea level rise (trend)	flooding; subsidence; post-glacial rebound; ocean heat content; thermal expansion	Gradual/slow/ chronic change
	Coastal flood	coastal inundation, nuisance flooding; salt water intrusion; extreme low water	Sudden/abrupt/ acute events
	Storm surge	storm floods; significant wave height; wave setup; storm tides; coastal flooding; cyclones; hurricanes	Sudden/abrupt/ acute events
	Coastal erosion	sediment transport; wave action; accretion; deposition.	Gradual/slow/ chronic change
	Changing currents	altered ocean patterns; thermohaline circulation; ocean dynamics; ocean conveyor-belt	Gradual/slow/ chronic change
Context-specific	e.g., Ocean acidification	change in ph; acidity; ocean chemistry; chemical reaction	Gradual/slow/ chronic change
	e.g., Wildfire risk	bushfire; forest fire	Sudden/abrupt / acute events

As shown in Figure 5.1, the OUV Vulnerability was then used as the exposure term for the Community Vulnerability assessment in the second workshop week (22-24 March 2022). For the community associated with the property, assessments of dependency (the sensitivity term) and adaptive capacity were made for economic, social and cultural connections with the property values.

For the Community Vulnerability assessment, the breakout groups were rearranged so that participants in each group were from a single country. This enabled assessment of the vulnerability to each community separately, which were then synthesised to provide an overall Community Vulnerability assessment. All assessed outputs from the groups were reported back to subsequent plenary sessions for synthesis. Outcomes for each component were recorded in a customised spreadsheet to determine final results.

5.3 Key climatic stressors

The list of possible climate stressors (Table 5.1) had been translated and provided to participants prior to the workshop. The CVI process allows for the inclusion of additional 'context-specific' stressors and for High Coast/Kvarken Archipelago, the Steering Committee recommended that Salinity change also be considered; during the workshop, Wildfire risk was also discussed and included. In breakout groups, participants selected those stressors likely to have the most impact on each of the key values of OUV, which were synthesised in plenary (Table 2.1).

The workshop selected the time scale to consider impacts as ca. 2050 and considered future effects under a high-emissions climate scenario (RCP8.5, SSP5-8.5), noting that for mid-century there is little difference between that and an intermediate scenario (RCP4.5, SSP2-4.5). The climate stressors appearing in the top three for each value (including equal-third) were used to rank the stressors (Table 5.2; Figure 5.3). From this, the three climate stressors assessed as likely to have the greatest impact on the OUV for High Coast/Kvarken Archipelago were determined as:

- Temperature trend (air and/or water) – TT;
- Precipitation trend – PT; and
- Sea ice change – IC.

Table 5.2 Climate stressors identified as likely to have the greatest impact for each of seven attributes of OUV. Marked cells indicate that the climate stressor was in the top three responses (including equal-third) for each key value. Stressor impacts were assessed for ca. 2050 and a high-emissions climate scenario.

	Temperature trend (air and/or water)	Extreme temperature events	Precipitation trend	Intense precipitation events	Flooding (fluvial, pluvial)	Drought (severity, duration, frequency)	Mean wind trend	Storm intensity and frequency	Sea/lake ice change	Snow cover change	Sea level rise (trend)	Coastal flood	Storm surge	Coastal erosion	Changing currents	Salinity change	Wildfire risk
Key values of OUV	**Key values of OUV**																
Traces of the Ice Age			X								X			X			
Contrasting landscapes	X								X		X			X			
Land uplift and the impact of the sea			X						X		X						
The discovery of the land uplift phenomenon and research	X		X		X			X	X	X	X						
Ecological processes associated with land uplift	X		X					X	X								
Societal interactions (with WH values)	X		X					X	X								
Conservation and management	X			X				X									
Total	5	0	5	1	1	0	0	4	5	1	4	0	0	2	0	0	0

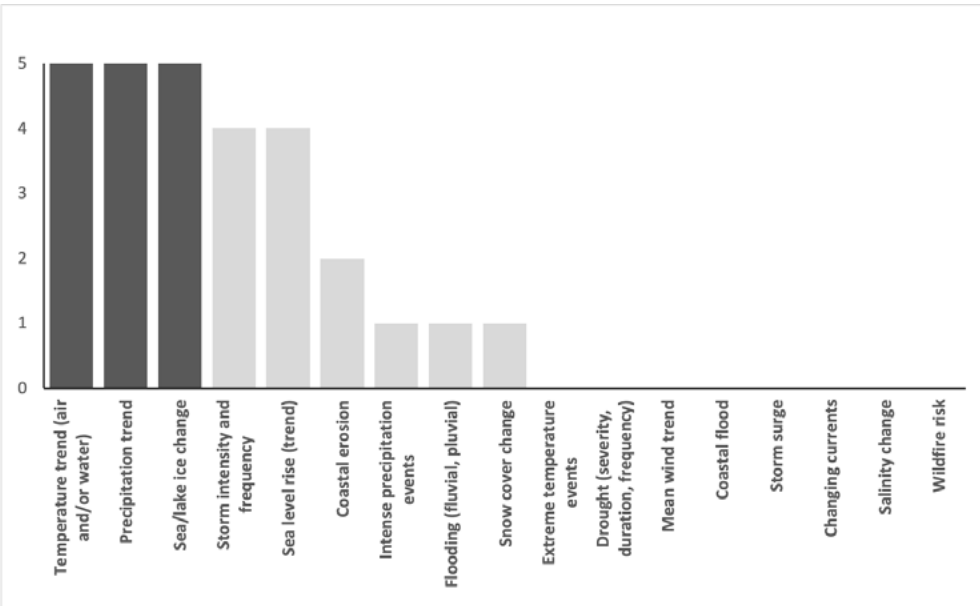


Figure 5.3 Histogram of the number of key values of OUV for High Coast/Kvarken Archipelago for which each of 17 climate stressors were among the top three likely to cause impacts (ca. 2050, high-emissions scenario).

5.4 OUV Vulnerability

Assessments of **exposure** and **sensitivity** of the OUV system to each of the identified three key climate stressors were undertaken using a five-point categorical scale that were adapted from categories used by IPCC and IUCN analyses (see Day et al. 2020 for details). Modifiers were applied to the initial assessments to include effects of temporal scale and trend (for exposure), and spatial scale and compounding factors (for sensitivity).

Compounding factors were discussed to already be occurring with at least one of the three stressors (Temperature trend, TT) already exacerbating impacts on the values. Increased occurrence of invasive species (particularly noting fish species), eutrophication and algal blooms linked to TT were noted as concerning; however, participants reported that many compounding factors are, as yet, unknown and difficult to predict. Precipitation trend (PT) was related by participants to an increase in extreme weather events, noting also that the increase in rainfall (as opposed to snow) is linked to TT; PT, like TT, also increases eutrophication. Sea ice change (SIC) has led to changes in patterns of vegetation, specifically noting that reduced ice results in less scouring of vegetation from marine rocks. In addition, SIC was anticipated to have a great impact on the hospitality industry and society more generally, as well as affecting the seal population that depends on quality ice cover in winter (particularly for birthing in February/March).

Figure 5.4 The key climate stressors can have compounding effects on the flads and gloe-lakes in Kvakren Archipelago. Photo: Christoffer Björklund

Table 5.3 Rapid assessment of OUV Vulnerability to identified three key climate stressors. Assessed values of exposure, sensitivity and adaptive capacity contribute to derived outcomes for potential impact and OUV Vulnerability. Colours used correspond to the elements of the CVI framework (Figure 5.1).

Key Climate Stressors:	Temperature trend (air and/or water)	Precipitation trend	Sea ice change
Exposure	Very likely	Likely	Likely
Temporal scale	On-going	On-going	On-going
Trend	Moderate increase	Moderate increase	Moderate increase
Exposure	**Very likely** ○○○○●	**Likely** ○○○●○	**Very likely** ○○○○●
Sensitivity	Low/Moderate	Low	Moderate
Spatial scale	Extensive	Extensive	Localised/Extensive
Compounding factors	High probability	High probability	Moderate/High probability
Sensitivity	**Moderate** ○○●○○	**Moderate** ○○●○○	**Moderate** ○○●○○
Potential impact	**High** ○○●○	**High** ○○●○	**High** ○○●○
Local management response	Low	Low	Low
Scientific/technical support	Moderate/High	High	Low
Effectiveness	Low/Moderate	Moderate	Very low/Low
Adaptive capacity	**Moderate** ○○●○	**Moderate** ○○●○	**Low** ○●○○
OUV Vulnerability	**Moderate** ○●○	**Moderate** ○●○	Moderate ○●○
Combined OUV Vulnerability	**Moderate** ○●○		

Results from exposure and sensitivity assessments undertaken in breakout groups were synthesised in plenary. After including modifiers, the Exposure was determined as very likely (>90%, highest category; Table 5.3) for Temperature trend (air and/or water) and Sea ice change, whilst for Precipitation trend was in the second highest category, likely (66-90%). Sensitivity of OUV to each of the stressors was determined as moderate (middle category of five), indicating loss or alteration of a few key WH values will occur. Notably, the application of modifiers incremented the assessed Sensitivity with respect to Temperature trend and Precipitation trend (from low/moderate and low, respectively).

The **potential impact**, derived from exposure and sensitivity, was determined as high (second highest on a four-point scale, low/moderate/high/extreme) for all three stressors (Table 5.3).

The **adaptive capacity** of a system to respond to stress can reduce the potential impacts. Adaptive capacity of the OUV system was assessed for each key climate stressor by considering the levels of local management response and scientific/technical support (four-point scale), as well as the effectiveness of these to address impacts from each stressor (four-point scale). Workshop participants brainstormed adaptive capacity options (Table 5.3), from which a subset (shown in bold) was selected to provide focus for the assessments.

The adaptive capacity was determined to be moderate (second highest on a four-point scale, very low/low/moderate/high) with respect to Temperature trend and Precipitation trend and low (second lowest) for Sea ice change. The OUV Vulnerability (three-point scale, low/moderate/high) was determined to be moderate for all three key climate stressors, leading to the combined **OUV Vulnerability** assessment for the High Coast/Kvarken Archipelago as **Moderate** (Table 5.3).

Table 5.4 Strategies for adaptive capacity brainstormed during the workshop, with those prioritised for the assessment shown in bold.

Key climate stressors	Possible adaptive capacities
Temperature trend (TT)	• **Reduce wear of the ground (in High Coast) through improved hiking paths (including wooden pathways) and possibly limiting access/ periodic closure of certain areas; e.g., that are exposed to heavy rainfall to minimise damage; seasonal closures of tourist attraction** (also PT) • Changing albedo – counter this through microclimate intervention (via roads, houses) • Pumping in cold water during hot periods; cooling units powered by solar power • Cooling units in the forests to prevent the European spruce bark beetle to infest the area • Revegetation (suitable trees, mixed species)
Precipitation trend (PT)	• **Ecological water run off systems (stop heavy rain runoff, create wetlands to retain water), more natural streams and rivers** • Preserving open habitats (also SIC)
Sea ice change (SIC)	• **Ice usually scraped away vegetation from shallow areas – mechanical process to replace this natural process?** • Artificial ice around and powered by wind turbines – shading and place for seals to breed • Artificial snow caves for the ringed seal for its pups
General	• **Restore the natural reproduction places for fish** • Joint management plan for fisheries in the area • Make recipes for fish in the High Coast/Kvarken Archipelago (rather than imported fish) • Spread information about how the WH area can be affected, including the output of these workshops to the public

5.5 Community Vulnerability

Assessing the Community Vulnerability is undertaken by considering the economic, social, and cultural (ESC) aspects of the community associated with the property using metrics of **Dependency** and Adaptive capacity. Dependency reflects the extent to which a decline in WH values will affect ESC indicators in the future. These effects can be positive or negative. Separate assessments for economic, social and cultural dependency are combined to give an overall ESC dependency. **Adaptive capacity** reflects the current level of capacity within each component to adapt in the face of a decline in WH values due to key climate stressors, and only has a positive directionality. As for dependency, separate assessments for economic, social and cultural adaptive capacity are combined to give an overall ESC adaptive capacity. Assessments were undertaken in small breakout groups, which again resulted in a spectrum of responses for each that was resolved in plenary.

For the first time in a multi-national CVI application, breakout groups for the Community Vulnerability assessments were aligned with the individual country; i.e., participants in each group were either all from Sweden or all from Finland. This enabled consideration of differential impacts on the communities associated with the property component in each country. The country-specific Community Vulnerability was assessed as Low for both components but was higher for the Kvarken Archipelago than for the High Coast. Participants concurred with this assessment, that the Finnish community was more vulnerable to a loss of WH values than the Swedish community.

A specific scenario was provided to participants to guide assessment of likely climate change impacts on the economic, social and cultural aspects. The selected scenario elements, based on climate projections for ca. 2050 (Section 3), were: (i) Temperature trend: a 2°C increase in air temperature from present conditions, which would lengthen the growing season of vegetation; (ii) Precipitation trend: an increase in precipitation in autumn/winter of 25-40%, with less snow and more rain, and an increased frequency of heavy precipitation; and (iii) Sea ice change: a decrease in ice thickness by 65%.

5.5.1 Economic activities

The economic component considers the economic effects on economic activities/business types that are directly associated with the WH property. In preparation for the workshop, the steering committee developed a list of eight activities:

- Tourism activities (e.g., tours)
- Tourism services (e.g., accommodation, restaurants)
- Agriculture
- Forestry
- Fishing
- Manufacturing (e.g., boats, electrical components, shoes, fishing nets)
- Government (national, regional or municipal); and
- Village interest groups/NGOs.

During the assessment, workshop participants determined that Tourism activities and Tourism services were the most important activities for the economic evaluations and these were given additional consideration in making the final assessments; some participants noted that these were difficult to distinguish from one another. Participants also noted that Manufacturing had little reliance upon the WH values and so was given lesser consideration during the process.

Participants indicated that warmer temperature would increase visitation in summer (e.g., for hiking) but could also lead to water quality issues that would negatively affect tourism and fishing. Increased rain in autumn would reduce tourist experience on hiking trails. In winter, less snow was thought to have a negative effect on tourism and also forestry, which will also face issues related to increased pests (TT), and higher precipitation (PT) and less frost (TT) that increase fire risk and decrease ground stability (leading to tree fall in high wind/storm conditions). For agriculture, the longer growing season could be beneficial; however, the increased unpredictability of weather events may counter any benefit. Regarding government entities, participants indicated that there is likely to be an increase in the demand for maintenance, planning, permitting consideration and adaptive management, all of which would require additional resourcing that may not be available (thus putting pressure on the existing human resource).

Participants noted the importance within the community of village interest groups/non-government organisations, indicating that these may face some of the same pressures noted for government entities but that there is a welcome increase in the commitment to the area from these groups.

The capacity to adapt was considered to be higher for tourism, manufacturing, government and village interest groups than for agriculture, forestry and fishing. Business operations (tourism, manufacturing) and voluntary organisations were considered to already be needing to adapt as part of their practice, whilst for government there was noted a slower capacity due to bureaucratic processes. Production industries (agriculture, forestry and fishing) were recognised as requiring additional economic resources to adapt (e.g., change crop, replant forests, target new species) whilst also having long time requirements for change.

5.5.2 Social interactions

Social indicators used to inform the assessments were considered within four categories: Human capital; Social capital; Natural capital; and Built capital (after Costanza et al. 2007). Locals were determined by the workshop to be the most important group upon which the social assessments should be focused and this was taken into consideration for the final assessments. Participants noted that, for the dependency term, some positive benefits would occur to society, such as increased physical and mental health through societal connections; however, there were also noted negative effects from increased rainfall and algal blooms, particularly on locals. Domestic visitors were considered to have similar impacts to locals but lesser in magnitude, whilst international tourists were thought to experience less impacts again. Locals were considered to have demonstrated capacity to adapt, with modern technology providing further opportunity to do so; domestic visitors had a similar level of adaptive capacity, noting their flexibility whilst travelling. International tourists were considered to be attracted by the World Heritage status and values, and to be more dependent upon services provided. Social dependency was assessed as minimal-negative, whilst the adaptive capacity was moderate (Table 5.4).

5.5.3 Cultural connections

Cultural indicators were also considered within four categories pertaining to: Self; People; Environment; and Pleasure (after Marshall et al. 2019). Cultural connections of locals were also considered by the workshop to be of greatest importance and this was taken into consideration for the final assessment. The potential loss of traditions (e.g., related to fishing) was described as having a negative effect on the cultural connections of locals, though this was in contrast to the enhanced pride in the natural values and the improved awareness, management and protection of these values. Growth in 'digital travelling' resources for domestic and international people was thought to lead to enhanced connection with the High Coast/Kvarken Archipelago. As cultural connections are 'close to the heart' and there is a strong 'attachment to place' for locals, many participants considered there was less capacity to adapt to change than for domestic and international people who have less connection to the High Coast/Kvarken Archipelago. Cultural dependency was assessed as low-positive, whilst the adaptive capacity was moderate (Table 5.4).

5.5.4 Combining the ESC assessments

Combining the three components, the overall ESC dependency was determined as minimal-positive, which, combined with the OUV Vulnerability (as the exposure term), resulted in the ESC potential impact being assessed as low (three-point scale, low to high; Table 5.5). The combined ESC adaptive capacity was assessed as moderate (three-point scale, low/moderate/high). These outcomes determined the **Community Vulnerability** as **Low** (three-point scale, low/moderate/high; Table 5.5).

Table 5.5 Rapid assessment of Community Vulnerability to identified three key climate stressors. Assessed values of economic, social and cultural (ESC) dependency (sensitivity, ranging from negative to positive) and adaptive capacity contribute to derived outcomes for ESC potential impact and Community Vulnerability.

Economic	Minimal-negative
Social	Minimal-negative
Cultural	Low-positive
ESC dependency	**[-] ○○○○ Minimal-positive ●○○○ [+]**
ESC potential impact	**Low** ●○○
Economic	Moderate
Social	Moderate
Cultural	Moderate
ESC adaptive capacity	**Moderate** ○●○
Community Vulnerability	**Low** ●○○

5.6 Summary – application of the CVI

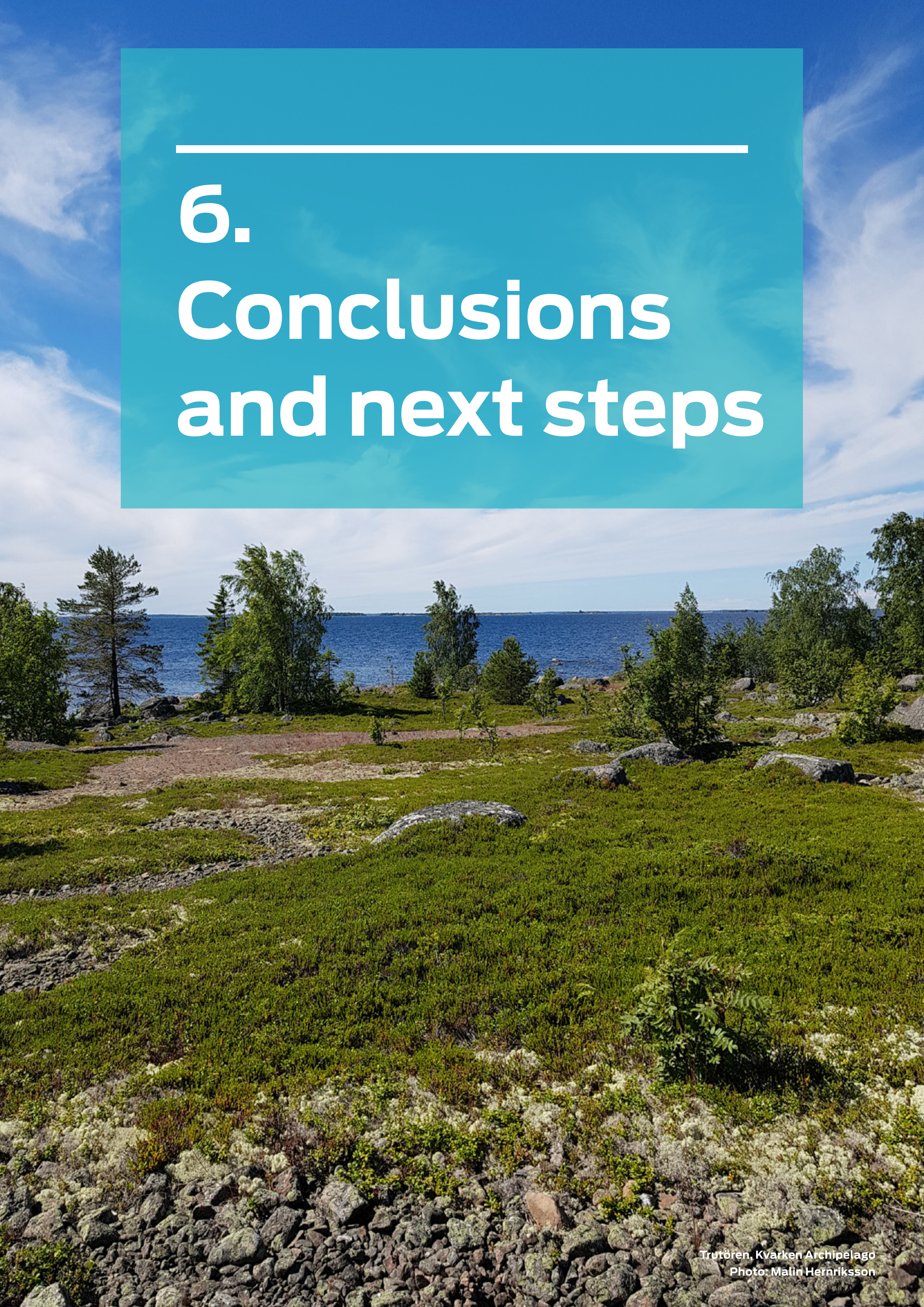
Temperature trend (air and/or water), Precipitation trend and Sea ice change were identified as the three climate stressors likely to most impact the WH values of the High Coast/Kvarken Archipelago. Potential impact from each of these key stressors was scored in the high category, with adaptive capacity to mitigate impacts from each being assessed as moderate or low.

As a result, the OUV Vulnerability was determined to be in the middle category (Moderate). Impacts from the key climate stressors were judged as likely to lead to minimal positive impact on the economic, social and cultural aspects of the High Coast/Kvarken Archipelago community. As the adaptive capacity of the community to the climate stressors was determined to be at a moderate level, the overall Community Vulnerability was assessed to be in the lowest category (Low).

The workshop results indicate the changes that might be expected over the next 30 years (ca. 2050 scenario) are anticipated to have significant effects on the values that comprise the OUV of the property and that this would have minimal impact upon the High Coast/Kvarken Archipelago community in terms of the economy, society or culture potential impact (though likely moreso for Kvarken Archipelago than High Coast).

Figure 5.5 The OUV Vulnerability was determined higher than the Community Vulnerability. Traces of the Ice Age and landuplift are two of the key values of the OUV. Photo: Fabiola de Graaf

6. Conclusions and next steps



Trutören, Kvarken Archipelago
Photo: Malin Henriksson

6.1 Learnings from the CVI in High Coast/ Kvarken Archipelago

Due to the Covid-19 pandemic, the entire CVI workshop needed to be undertaken online and facilitated remotely from Australia. As an online format, there were some benefits but also some downsides. For example, the carbon footprint of all participants was greatly reduced, but there was less time available for discussions or information exchange. What is normally a three-day 'in-person' workshop needed to be undertaken over 6 half-days (i.e., mornings in Sweden and Finland, equating to evenings in Australia given the time difference); for some participants this was considered too great a time commitment. The online format also enabled a few participants to simultaneously undertake other tasks, which meant their contribution to the workshop was probably less than if they had been co-located together.

This workshop did, however, provide invaluable lessons for other transboundary WH properties and the wider application of the CVI in Sweden and Finland. This application was the first time that CVI breakout groups for the Community Vulnerability were intentionally grouped by country (two Finnish, two Swedish) to focus on local issues for each property component; this also enabled the breakouts to be conducted in the local languages, which the participants reported was beneficial.

Some locals were unable to attend the workshop due to existing commitments; however, there was sufficient participation to ensure the community was suitably represented. There was a notable absence of experts representing national organisations; e.g., national heritage boards (Swedish National Heritage Board and Finnish Ministry of the Environment); meteorological institutes (Swedish Meteorological and Hydrological Institute, SMHI; and Finnish Meteorological institute, FMI); and geological survey institutions (Geological Survey of Sweden, SGU; and Geological Survey of Finland, GTK). To ensure proper inclusion of information from these topic areas, it would have benefited the CVI process to have representatives of these organisations participate in the workshop. While some of these organisations were represented for part of the time, or offered to respond offline to specific questions arising, having them engaged in the full process would have helped other participants to better understand the relevant topics. It would have also helped these organisations understand aspects of the WH property relevant to their operations as part of national obligations to the WH Convention. Despite this, knowledge from workshop attendees in these areas meant the CVI process was able to be completed.

Feedback from other CVI applications following both online and in-person workshops indicate the distinct advantages of in-person workshops. This includes enabling participants to get to know each other during the breaks and post-workshop gatherings; in several instances, such interactions have led to improved collaborations between researchers and managers. However, while there are benefits of in-person workshops with all participants in the same location, there is also a need to recognise there are travel issues for participants within a transboundary or serial property which must also be considered.

Despite some minor issues, this online workshop provided useful outcomes and clear benchmarks for future assessments.

6.2 Management implications for High Coast/ Kvarken Archipelago

A new management plan is currently being developed for the WH property; its preparation has been closely linked to the key values determined in the CVI process. Similarly, the Nature Interpretation plan for High Coast and Kvarken Archipelago has many similar aspects, which is reassuring for the property managers. Importantly, these plans are for the collective WH property rather than for individual components. The key values list with the current condition and recent trend evaluations will be used in the management plan, in identifying and prioritising the issues that are most important to address management efforts. Other outcomes from the CVI process (described in Sections 6.3 and 6.4) will also input to the actions and activities that will be outlined in the management plan, especially noting the benefit given the joint-nature of the management plan.

6.3 Gaps and opportunities identified during the CVI process

During the workshop, various items were identified as knowledge gaps, possible research questions or policy needs. The workshop did not have time to discuss these in any detail, but they are listed here as some may be useful to guide future research priorities or improve management effectiveness:

6.3.1 Research gaps relating to the WH property

- Need for further research into uplift and sea-level rise across the property; while there are existing stations, is real-time data stream needed?
- Uncertainty in projected changes in salinity (compared with temperature, sea-level rise, etc.).
- Ice 'normally' scrapes away vegetation; do we need an artificial process to replicate this? - costs to remove may be prohibitive. Will climate change lead to an increase in vegetation overgrowth of WH values (land and water)? Does that create a need for maintenance? e.g., the value of a boulder field is known only if visible; also submerged moraines.

6.3.2 Research gaps relating to climate and WH values

- Require a better understanding of how climate change will lead to compounding factors.
- Need for an overall assessment of climate change effects on the community on local/regional scale in a societal and cultural perspective.
- Interest and activity from museums (about natural and cultural heritage)
- Finnish climate panel has made some assessments (e.g., flooding impacts), including some effects upon cultural heritage.

6.3.3 Policy and guidance gaps relating to improved communication

- The WH property boundaries are not well understood by the community.
- Need for communication about uplift and sea-level rise and existing variation in sea level for both the general public and tourists.
- Greater need for communication as to how climate change is impacting the WH area – need to spread the output of this workshop.

6.3.4 Policy and guidance gaps relating to tourism/visitors

- Need for better monitoring of changes due to increased tourism; Identify Limits of Acceptable Change (LAC).
- Is there a need to develop new places to visit to decrease the pressures on existing locations? A way to prepare for a future with increasing tourism. The municipality has a responsibility for providing opportunities for visitors without creating a conflict with locals.

6.3.5 Policy and guidance gaps relating to management

- Policy gap - very little funding for the WH area at the moment.
- Need for more effective community engagement and a more effective expert advisory group across WH property.
- There was a recognition for improved monitoring program for all World Heritage properties as an essential management tool for increasing the knowledge about effects of climate change and as a basis for possible adaptive measures.

6.4 Lessons for other Nordic WH Properties

The managers for High Coast/Kvarken Archipelago recognised that many of the aspects of the CVI process could be useful for others working in WH management. For example, in addition to the increased understanding of climate impacts, some valuable outcomes include:

- breaking down the SOUV to determine the key values for each WH property;
- identifying the attributes (tangible and intangible) associated with the key values;
- assessing the current condition and recent trend of those key values (see Table 2.1);
- developing and prioritising possible strategies for adaptive capacity (see Table 5.3); and
- determining other Significant Property values for a specific area (see Appendix 2).

The outcomes from this workshop may provide useful information on climate impacts for other Nordic WH properties. In addition to the High Coast/Kvarken Archipelago, inscribed solely for its natural values, Sweden has fourteen other WH properties inscribed on the WH list. Of these, 13 are cultural properties, and one is a mixed site (the Laponian Area, the home of the Saami people in the Arctic region of northern Sweden). Similarly, Finland has six other WH properties, all listed under cultural criteria.

Whilst the identified key climate stressors and assessed vulnerabilities for the High Coast/Kvarken Archipelago natural WH property may not be directly relevant to all other properties, there are useful lessons for those properties from this process. Bringing researchers from different and relevant fields together with people from the local community and managers, at local and regional levels, broadened perspectives in the discussions and was useful during the workshop. Inviting managers from other WH properties to the workshop was intended as an opportunity for learning and exchange of knowledge and experience. Several WH properties in Sweden and Finland have started, or are soon to renew, their management plan and this workshop provided an opportunity to focus on climate change and adaptive capacity. Raising awareness as to how climate change is impacting cultural and natural heritage broadly was one aim of the workshop.

6.5 Revisiting the CVI Process in High Coast/ Kvarken Archipelago

Given the current development of the management plan for the High Coast/Kvarken Archipelago, the CVI outcomes are extremely timely. Reflections on these outcomes need to be converted into new ways of thinking and changes in the management and action plans for the property. The new management plan clearly needs to address climate change and potential adaptation measures.

Given the recent CVI process has provided clear benchmarks against which progress in the WH property can be assessed, consideration should be given to revisiting the process in the future. The CVI process has been shown to be both systematic and relatively rapid, and it may well be that future iterations can build upon the preliminary work done in 2022 rather than start with a totally 'blank sheet'. In the process of developing the next management plan, in 2028-2030, the management will re-evaluate the trends and current conditions of the key values to use in the next management plan cycle. Whether a revisit of the whole CVI process occurs, and whether it is tied to the process for management planning, will be decisions for senior management in the future.

Högklinten, High Coast
Photo: Erik Engelro

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  Patrik Bylund
  Malin Henriksson

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Hummelvik, High Coast
Photo: Erik Engelro

Statement of outstanding universal value

High Coast/Kvarken Archipelago

Brief synthesis

The High Coast in Sweden and the Kvarken Archipelago in Finland are situated on opposite sides of the Gulf of Bothnia, in the northern part of the Baltic Sea. This vast area of 346,434 ha (of which about 100,700 ha are terrestrial) is where high meets low: the High Coast's hilly scenery with high islands, steep shores, smooth cliffs, and deep inlets is a complete contrast to the Kvarken Archipelago with its thousands of low-lying islands, shallow bays, moraine ridges and massive boulder fields. This part of the world has experienced several Ice Ages during the last 2-3 million years and has been under the centre of the continental ice sheet a number of times. Present land uplift started when the ice began to melt about 18,000 years ago and the earth's crust was gradually released from the weight of the ice.

The landscape of the High Coast/Kvarken Archipelago today is mainly the result of the last Ice Age and the impact of the sea and the succession of vegetation. After the last glaciation, the land has elevated a total of 800 metres, with the highest uplift in the world after the last Ice Age recorded here. For the past 10,500 years, the land has been rising at around 0.9 m per century, a phenomenon that can be observed in a human lifetime and is expected to continue. Continual elevation of the land results in the emergence of new islands and distinctive glacial landforms, while inlets become progressively cut off from the sea, transforming them into estuaries and ultimately lakes.

The Baltic Sea has undergone dramatic changes since the last Ice Age, including a series of transitions from marine water to freshwater and then to brackish water, consequently causing subsequent changes in plant and animal life. This serial transboundary property serves as an outstanding example of the continuity of this change with dynamic ongoing geological processes forming the land- and seascape, including interesting interactions with biological processes and ecosystem development.

Criterion (viii): The High Coast/Kvarken Archipelago is of exceptional geological value for two main reasons. First, both areas have some of the highest rates of isostatic uplift in the world, meaning that the land still continues to rise in elevation following the retreat of the last inland ice sheet, with around 290 m of land uplift recorded over the past 10,500 years. The uplift is ongoing and is associated with major changes in the water bodies in post-glacial times. This phenomenon was first recognized and studied here, making the property a key area for understanding the processes of crustal response to the melting of the continental ice sheet. Second, the Kvarken Archipelago, with its 5,600 islands and surrounding sea, possesses a distinctive array of glacial depositional formations, such as De Geer moraines, which add to the variety of glacial land- and seascape features in the region. It is a global, exceptional and diverse area for studying moraine archipelagos. The High Coast and the Kvarken Archipelago represent complementary examples of post-glacial uplifting landscapes.

Integrity

The boundaries of this serial property comprise the areas with the most outstanding geological and geomorphological attributes of the site. The boundaries of the High Coast in Sweden encompass the principal area of national conservation interest, extending inland to include the full zonation of uplifted land and some of the highest shoreline, while excluding areas under large-scale forestry management. Seaward, the boundary incorporates key offshore islands and marine areas that are a logical extension of the topographic continuum of uplifted land surface, thus taking account of ongoing geological processes.

The Kvarken Archipelago in Finland includes two separate areas of land and sea: the most superlative geological terrestrial formations, formations lying in the shallow sea, as well as the majority of the moraine features are included. While the geological boundaries of the property do not coincide with legal or administrative boundaries, the science behind their selection is justified.

Note that about 71% of the property is sea. In the High Coast the sea is deep (as much as 293 m), while in the Kvarken Archipelago the sea is very shallow (with mean depth less than 10 m). Underwater geological formations have not been widely affected by erosion or processes such as colonization by vegetation or human activity. For the terrestrial portion, however, several large-scale development projects have been noted as issues which could affect the integrity of the property. While there is a small resident human population in the property (around 4,500 in the High Coast and 2,500 in the Kvarken Archipelago), people are engaged in small-scale traditional farming, forestry and fishing, all of which have negligible impact on geological values.

Protection and management requirements

In both Sweden and Finland, World Heritage management issues are dealt with at regional level, by established bodies with representatives from authorities, municipalities and local stakeholders. The relevant regional authorities and municipalities in Sweden and Finland have established a transnational consultative body, mainly to ensure that all three core areas of this serial transnational site have a joint management strategy for the property as a whole.

There is no particular legislation that directly protects the Outstanding Universal Value of the High Coast/Kvarken Archipelago, but the general environmental national legislation gives a satisfactory indirect protection of the entire property. About 37% of the property is either nature reserve or national park, and the site also belongs to the Natura 2000 European network of protected areas. All these different kinds of protected areas have regulations restricting land use, which provide a good level of protection to geological formations, as well as to flora and fauna. The remaining parts, about 63% of the property, do not have the same level of protection, but the national legislation gives possibilities for safeguarding the integrity of the property. Furthermore, the High Coast is a landscape of national interest, which gives the recreational and nature conservation values of the property additional legal protection and serves as guidance for societal development. In the Kvarken Archipelago, a regional land use plan protects its Outstanding Universal Value, as well as recognizes geological values in the zone between the two core areas on the Finnish side.

The effective management of the property needs to further develop an ecosystem approach that integrates the management of the protected areas with other key activities taking place on the property, such as infrastructural development of communities and industries, tourism, fishery and shipping.

Potential threats in the future are major building projects that could destroy some part of outstanding geological features or have a severe impact on the important views of the property. Increasing visitor pressure and an oil or chemical spill in the sea are potential threats to the biological and cultural values. Global warming is not a threat to the land uplift phenomenon itself, as it will not affect the geological process. However, rising sea levels would influence the visible effects of land uplift in the coastal landscape, by reducing the area of new land emerging from the sea each year. Natural catastrophes, such as violent earthquakes or volcanic eruptions, are unlikely in Sweden and Finland.

All threats are addressed by implementing the national legislation, strategic planning measures and actions that aim to improve knowledge and awareness of the property values among authorities, stakeholders and the local population.

[Table 2.1 shows how excerpts from this SOUV were grouped together to identify the key values used in the CVI assessment].

Other significant property values (SPVs)

Other values that are locally, regionally, or nationally significant within a World Heritage property

The SOUV is based on the values that are internationally recognised as being outstanding, but WH properties invariably include other values, whether they are heritage values (tangible or intangible) or other values (e.g., economic, social, spiritual, environmental, scientific).

These values may be important locally, regionally, or nationally, and may even be considered 'significant' under local or regional by-laws, or even national legislation. For the CVI, these are referred to as other **Significant Property Values (SPVs)**, recognising that these other values will also be subject to impacts from stressors like climate change.

The SPVs have been listed in broad groupings (e.g., aesthetic, biological diversity, historic/cultural, spiritual, economic, scientific values) as shown below. It may also help to prioritise the SPVs within each group.

Broad groupings of SPVs	Key SPVs (list in a prioritised order based on significance)	Additional justification (Why is the value significant? Locally, regionally or nationally?)
Biological diversity (e.g., other flora, fauna, or habitats of significance not in the SOUV)	Birds	Important nesting and migration area
	Fish	Local populations of whitefish, endangered sea spawning grayling, sea trout, salmon
	Reefs and other structures under water	Adds diversity, important habitat for many species, typical for Kvarken (Natura 2000 habitat)
	Vascular plants and algae	Rich vegetation is typical for water purification and sediment stabilisation, and offers protected habitats and good feeding grounds for many species; e.g. endemic species (such as Fucus radicans, Deschampsia bothnica, and Arabidopsis petraea) and Chara meadows.
	Shallow bays and other shallow marine areas	Shallow marine areas (often soft bottoms) typically have rich vegetation and offer suitable habitat for many species. These areas house many values – fish, vegetation, birds, mammals, water management and purification. They are important spawning areas for many species (such as perch, pike, whitefish and the endangered grayling).
	Hard bottoms	Blue mussel, bladderwrack and narrow wrack inhabit hard bottoms. Algae can live unusually deep in the High Coast because of good water clarity.
	Heterogeneity	There is a small-scale mosaic of many different habitats on land as well as in the sea.
	Grazed birch forests, wooden pastures, and heaths	These habitat types are connected to grazing, mainly by sheep; and are managed with controlled burns to improve grazing and lingon berry foraging. Rich in biodiversity when properly maintained but threatened by overgrowth.
	Bat migrations routes	
	South-facing slopes	Southern plant species (such as hazel, lime and Geranium robertianum) have found a refugium on the hill slopes with a more suitable microclimate.
	Rock surfaces	Old-growth pine forests with rare insects and fungi (such as Chalcophora mariana) connected to old and dead pines in dry, open and nutrient poor conditions on rock surfaces.
	Lush spruce forests in valleys	In the valleys and ravines there are productive forests of spruce, interspersed with deciduous trees such as maple, birch, rowan and aspen. Often nutrient rich and sometimes with high pH from shell gravel, the conditions are suitable for a rich flora of orchids, ferns and herbaceous plants.
Aesthetic values or phenomena (e.g., any special scenic qualities or phenomena that are significant)	Untouched nature	
	Silence	
	Darkness	
	Natural beauty and views	
	Picturesque fishing villages	
	Landmarks	High Coast Bridge, Replotbron, Lighthouses and beacons (e.g., Högbonden, Valsörarna), Skuleberget
Economic values (e.g., provide income or employment opportunities through tourism, fishing, or other commercial activities, etc.)	Tourism	Nature tourism, adventure tourism
	Fishing	Both recreational and commercial fishing. The practice of recreational fishing, including ice fishing, is larger.
	Agriculture	Also important for aesthetic values
	Forestry	
	Manufacturing industry	

Broad groupings of SPVs	Key SPVs (list in a prioritised order based on significance)	Additional justification (Why is the value significant? Locally, regionally or nationally?)
Recreational values (e.g., provide for recreational activities like hiking, camping, wildlife viewing, etc.)	Summer cottages	
	Fishing	
	Collecting berries and mushrooms	
	Hunting	
	Boating	
	Hiking	
	Camping	
	Active Outdoor	Examples include trail running, climbing, Nordic skating and kayaking.
	Bird Watching	
	Swimming, winter bathing	
Historic/ cultural values (e.g., features or locations that represent history or enable traditions or ways of life to continue, etc.)	Wrecks	
	Artistic "hub"	There are many artists active in the High Coast area, which is also a popular place to visit for artists/painters.
	Fishing villages	
	Fermented herring (High Coast)	
	Fisherman chapels	
	Compass roses, stone labyrinths	
	Stone cairns	
	Open grazing lands	
	Smoked fish	
Learning/ Scientific values (e.g., opportunities for scientific research, nature interpretation, etc.)	Natural succession / land uplift environment / bird and bat migration	Valsörarnas biologiska station
	Geology	
	Naturum, World Heritage Gateway	
Spiritual/ Philosophical fulfilment (e.g., areas that are sacred, religious, or spiritually significant, etc.)	Place attachment	
	Beautiful scenery	
	Churches, fisherman chapels	
Health/ therapeutic values (e.g., areas that enable people to feel better physically or mentally, etc.)	Outdoor life	
	Forest baths	
	Summer house relaxing	
	Winter baths	

CVI workshop schedule

Day 1: Tuesday 15th March 2022 (08:00–12:00 SWE = 09:00–13:00 FIN)	
1.	Welcome to the workshop; Overview of workshop aims; explain use of plenary and breakout-group sessions; first time things; basic logistics (breaks – eye, body, etc.); parking lot; SG intro.
2.	Introductions of participants (30 second max/person), specific to High Coast/Kvarken Archipelago; Breakout Group slides; years game; photo
3.	Brief overview of the CVI process
4.	High Coast/Kvarken Archipelago presentation, including the distinctive elements
5.	Ensure all participants are aware of the Statement of OUV for the High Coast/Kvarken Archipelago (presentation augmenting pre-workshop tasks) and how the table of key values was derived from the Statement of OUV
6.	Undertake high-level assessment of current condition of key values and the recent trend in those values (i.e., since the date of inscription)
7.	Discuss other values that are significant at a local scale (i.e., SPVs / attributes) but are not part of OUV
8.	Introduction to climate change issues globally and regionally
9.	Questions about CVI arising from Day 1 & wrap up

Day 2: Wednesday 16th March 2022 (08:00–12:00 SWE = 09:00–13:00 FIN)	
10.	Brief recap of Day 1 and overview of Day 2; photo
11.	Provide overview of climate change (historical and projected) for High Coast/Kvarken Archipelago, differences in projected impacts from projection scenarios including timescales, and geographically specific projections. Agree upon the climate scenario and timeframe for the assessment (e.g., Business-as-usual for 2050)
12.	Show list of climate stressors – check for (i) understanding? (ii) timescales? Demonstrate selection of top three climate stressors impacting each key value (discussed in #4)
13.	Using the list of climate stressors provided, small groups to brainstorm what are the top three climate stressors impacting the key values of OUV
14.	Bring outputs from (#13) back to plenary and ensure all participants agree on which climate change stressors are impacting the attributes of OUV compare with pre-workshop.
15.	Revisit process for exposure, including detail of categories; and review modifiers
16.	Participants in breakout groups assess the exposure term (and modifiers) for each of the three key climate stressors
17.	Bring outputs from #16 back to plenary and discuss any variation in assessments of exposure
18.	Wrap-up discussion, review Day 2, preview Day 3

Day 3 – Thursday 17th March 2022 (08:00–12:00 SWE = 09:00–13:00 FIN)	
19.	Brief recap of Day 2 and overview of Day 3; photo
20.	Introduction to CVI process for sensitivity (including categories; and modifiers) and review the potential impact matrix that combines sensitivity with exposure. Remind of climate scenario for analysis (e.g., BAU 2050)
21.	Participants in breakout groups assess the sensitivity (thus determining potential impact) for the key CC stressors.
22.	Bring outputs from #21 back to plenary and discuss any variation in assessments of sensitivity (interactive session)
23.	Introduction to adaptive capacity and brainstorming task to identify existing strategies used to mitigate climate-related impacts and potential adaptive capacities.
24.	Participants in breakout groups brainstorm existing strategies used to mitigate climate-related impacts and potential adaptive capacities, identify which key climate stressors and key values these respond to.
25.	Bring outputs from #24 back to plenary. Prioritise these in terms of feasibility. Introduce adaptive capacity assessment.
26.	Participants in breakout groups assess the adaptive capacity (thus determining OUV Vulnerability) for the key CC stressors.
27.	Bring outputs from #26 back to plenary and discuss any variation in assessments of adaptive capacity
28.	Plenary discussion of assessments of exposure, sensitivity and adaptive capacity, and any effect on OUV Vulnerability
29.	Scenario; Wrap up discussion, review Day 3, preview Day 4

Day 4 – Tuesday 22nd March 2022 (08:00–12:00 SWE = 09:00–13:00 FIN)	
30.	Brief recap of Days 1-3 and overview of Day 4; new Break-out groups
31.	Revisit process for analysing economic, social and cultural (ESC) dependency. Review the ESC potential impact matrix that combines these. Revisit process for analysing economic, social and cultural adaptative capacity - presentation. Recap scenario.
32.	Economic, social and cultural summary for the High Coast/Kvarken Archipelago
33.	Discussion of business types for analysis and introduction to Economic breakout group.
34.	Participants in breakout groups assess the economic dependency and adaptive capacity for High Coast/Kvarken Archipelago
35.	Bring outputs from #34 back to plenary and discuss any variation in assessments of economic dependency and adaptive capacity.
36.	Wrap up discussion, review Day 4, preview Day 5

Day 5 – Wednesday 23rd March 2022 (08:00–12:00 SWE = 09:00–13:00 FIN)	
37.	Brief recap of Day 4 and overview of Day 5
38.	Introduction to Social dependency breakout group.
39.	Participants in breakout groups assess the social dependency and adaptive capacity for High Coast/ Kvarken Archipelago
40.	Bring outputs from #39 back to plenary and discuss any variation in assessments of social dependencies and corresponding adaptive capacities
41.	Introduction to Cultural dependency breakout group.
42.	Participants in breakout groups assess the cultural dependency (thus determining ESC potential impact) and adaptive capacity (thus determining Community vulnerability) for High Coast/Kvarken Archipelago
43.	Bring outputs from #42 back to plenary and discuss any variation in assessments of cultural dependencies and corresponding adaptive capacities. Examine the effect of these on Community Vulnerability
44.	Wrap up discussion, review Day 5, preview Day 6

Day 6 – Thursday 24th March 2022 (08:00–12:00 SWE = 09:00–13:00 FIN)	
45.	Brief recap of Day 5 and overview of Day 6
46.	Summarise outcomes from workshop, following final analysis worksheet (interactive session).
47.	Recap on those items that had been 'parked' during the workshop.
48.	Discussion of next steps
49.	Receive feedback on CVI framework and workshop process (interactive session).
50.	Complete workshop evaluation forms; receive other feedback from participants.
51.	Thanks and close

List of CVI workshop participants

(Steering Committee members indicated by *)

Participant's name		Country	Participant's organisation
Emma	Andersson	Sweden	The Nature Conservation Association
Emma	Anderssén*	Finland	Metsähallitus (Parks & Wildlife Finland)
Anette	Bäck*	Finland	Metsähallitus (Parks & Wildlife Finland)
Göran	Backman	Finland	Vörå municipality, Kvarken Archipelago Advisory Committee
Anna	Blomqvist	Sweden	National Knowledge Center for Climate Adaptation, SMHI
Anna	Bonde	Finland	Centre for Economic Development, Transport and Environment
Christine	Bonn	Finland	Regional Council of Ostrobothnia
Patrik	Bylund*	Sweden	County Administrative Board of Västernorrland
Geir	Byrkjeland	Finland	Korsholm municipality
Torbjörn	Engberg	Sweden	County Administrative Board of Västernorrland
John	Ericson	Finland	Kvarken Archipelago Advisory Committee
Lise-Lotte	Flemming	Finland	Metsähallitus (Parks & Wildlife Finland)
Mari	Hällerstrand	Sweden	NIFF (Nordingrå interest and business cooperative)
Malin	Henriksson*	Finland	Metsähallitus (Parks & Wildlife Finland)
Sophie	Holmgren	Sweden	Bygdsam Nätradalen
Peter	Källberg	Finland	Vaasa Region Development Company
Joel	Libell	Sweden	High Coast Destination Development
Camilla	Moliis	Finland	Korsnäs municipality
Kenth	Nedergård	Finland	Kvarken World Heritage Association
Markus	Norrback	Finland	Malax municipality
Milla	Öystilä	Finland	Fortress of Suomenlinna (World Heritage)
Susanne	Rantakokko	Sweden	The Nature Conservation Association
Clara	Rosander Sjöberg	Sweden	Kramfors municipality
Viveka	Sjödin*	Sweden	County Administrative Board of Västernorrland
Holger	Steffen	Sweden	Lantmäteriet, Geodetic Infrastructure
Tuija	Warén	Finland	Metsähallitus (Parks & Wildlife Finland)
Sune	Westberg	Sweden	Örnsköldsvik municipality
Participant's name			
Scott	Heron*	Australia	Physics, James Cook University
Jon	Day*	Australia	ARC CoE CRS, James Cook University

Glossary

Adaptive capacity
The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Anthropogenic
Resulting from or produced by human activities.

Climate
The composite or generally prevailing weather conditions of a region, as temperature, air pressure, humidity, precipitation, sunshine, cloudiness, and winds, throughout the year, averaged over a series of years.

Climate change
A change in the pattern of weather, and related changes in oceans and land surfaces, occurring over time scales of decades or longer.

Climate projection
A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. Projections from the Coupled Model Intercomparison Project Phase 6 (CMIP6) are referred to in this report.

Exposure
A measure of the contact between a system (whether physical or social) and a stressor.

Sensitivity
The degree to which a system is affected, either adversely or beneficially, by climate variability or change.

Extreme weather event
A weather event that is rare at a particular place and time of year. Definitions of 'rare' vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed probability.

IPCC (Intergovernmental Panel on Climate Change)
The United Nations body, established in 1988, for assessing the science related to climate change; it was created to provide policymakers with regular scientific assessments on climate change, its implications, and potential future risks, as well as to put forward adaptation and mitigation options. The IPCC is the most authoritative international body on climate science and is an essential component of the world's response to climate change.

Mitigation (of climate change)
A human intervention to reduce emissions or enhance the sinks of greenhouse gases (GHGs). Mitigation measures in climate policy are technologies, processes or practices that contribute to mitigation, for example renewable energy technologies, waste minimisation processes, public transport commuting practices, etc.

Restoration (in an environmental context)
Involves human interventions to assist the recovery of an ecosystem that has been previously degraded, damaged, or destroyed.

Weather
The state of the atmosphere – its temperature, humidity, wind, rainfall and so on – over hours to weeks.


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archipelago
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http://highcoastkvarken.org