

What's happening to our shores?



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Appendix 1a-e:

The geographic distribution and the percentage share of the respective degrees of exploitation within the studied areas for the years 1960, 1986, and 1999.

Appendix 2:

The percentage of shores where the exploitation situation has not changed, increased or decreased during the period of 1960 to 1999.

0 PREFACE

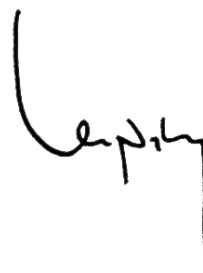
Beaches and shores with their environmental attributes attract us. Many of us find pleasure in visiting and spending time close to shores. Many too want to live close to shorelines, which historically have been important as places for settlement. Also throughout time, water has been important as a means of transportation. In many places, especially those close to densely built-up areas, our desire to live close to shores has placed demands on the natural surroundings leading to environmental changes, physical construction, and privatizing.

Many times it is a matter of small successive changes which are difficult to observe — a kind of “tyranny by little steps”. A small jetty for example often means only a minor impact, but if ones sums up the number of jetties added during a certain period, the collective impact can be considerable. This collective change over a longer time is more difficult to observe with one single spot check.

In order to ensure that enough shores remain for outdoor recreation, and as undisturbed habitats for plants and animals, protective legislation has been introduced successively. An important objective of this legislation (The Swedish Shore Protection Act) is to safeguard the long-term sustainability of shore environments. There have been exemptions, and it is still possible to be granted exemptions for intrusion into areas protected by The Swedish Shore Protection Act, but the requirements for receiving an exemption have become successively more stringent. And even more stringent requirements have been discussed.

This report looks back in time and compares the physical exploitation of shores, based on the number of jetties around the year 2000 with the corresponding situations in the 1960’s and 1980’s. With such a comparison it is possible to see what has been happening to the shores in a longer time perspective. This report provides a good basis for future planning and shows that the shores are being exposed to a high level of exploitation.

More information about BALANCE can be found at <http://www.balance-eu.org>.



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1 SUMMARY

The findings indicate that the amount of undisturbed shoreline in the Stockholm archipelago decreased by almost 20 % from 1960 to 1999. The inventory work was carried out with the help of the so-called *jetty indicator* which, simply put, means a classification system of the shore area (from the shoreline and 100 meters up on land) based on how dense the incidence of jetties is.

The report gives examples of the extent and distribution of physical exploitation in the Stockholm archipelago in 1960, 1986, and 1999. The findings illustrate the need for a holistic and long-term approach, as well as the need for greater knowledge about the history of the management of our shorelines.

Looking at the actual length of the shoreline being studied, we see primarily new exploitation (in places not disturbed earlier) and over time, an exploitation that has crept increasingly further out into the archipelago. However, it is primarily the higher classifications of exploitation that have been on the rise, while the segment of the lower classification of exploitation has kept relatively constant.

On the whole, the general picture is one of successive exploitation where otherwise undisturbed shorelines in the first place have a single jetty built. This is followed by the gradual addition of more jetties being built, in an ongoing process of both the increasing density in and the increasing expansion of already exploited parts of the shoreline. In the process, plants and animals have been increasingly pushed back, and can as a final result, lose their natural habitats completely. Outdoor recreational life as a whole has, in turn, faced a considerable reduction in access to undisturbed shores. At the current rate of exploitation, any present undisturbed shores can be non-existent in 150 years.

It is important to approach each submitted shoreline protection case in the holistic context of the entire provincial landscape, and to be aware of how total exploitation has changed over time.

A combined historic, ecologic, and geographic view can increase the understanding of our shores as a limited resource. It is not until we use a holistic perspective that we can fulfill the intentions of the Swedish Shore Protection Act: To protect the prerequisites for public outdoor recreational life, and to preserve good conditions for life in water and on land for plants and animals.

2 **AIM AND OBJECTIVE**

This study aims, with the use of some examples from a spread of geographic locations, to demonstrate how the physical exploitation of shorelines has developed in the Stockholm archipelago during the second half of the 20th century. The intention is to illustrate the need for a comprehensive view, a long-term approach, and for additional knowledge about the area's developmental history, in the management of our shorelines.

The objective has been to produce a digital map database with the help of aerial photography, which shows the degree of exploitation at three different points in time, so that the change in shoreline exploitation can be followed. The exploitation has been studied with the help of using jetties as indicators.

The study is also submitted as a component to the EU project BALANCE, which has the long-term objective of a sustainable use of the Baltic Sea. The project aims, among other things, to develop strategies and methods for marine physical (town and country) planning (BALANCE, 2006).



Photo 1. A jetty for small private recreation boats. Photo: Christina Fagergren

3 **A STUDY OF CHANGE**

In order to judge the conditions along our shorelines today, an historical, ecological, and geographic frame of reference is needed. It is important to look back to the time when The Swedish Shoreline Protection Act was first enacted, partly to get a picture of the extent and distribution of the physical shoreline exploitation then, and partly to see how the exploitation has changed over time.

If we lack the knowledge of the historical situation, one can only compare with the present situation in today's decision-making processes. Then the total historical picture of change is lost: what changes have occurred, where they have occurred, and at what speed.

It is important to put all shoreline exploitation into a provincial landscape context. It gives us a better understanding, because the shorelines are a limited resource. A structured information basis for planning which factors in the historical development can contribute to better management of our shorelines in the future. An historical, ecological, and geographic analysis also makes possible a future evaluation of The Swedish Shoreline Protection Act.



Photo 2. Untouched stretch of shoreline. Photo: Emil Boström

4 ATTRACTIVE SHORELINES

4.1 Shoreline Protection

There is a great interest in using our shorelines in different ways. We use them for a number of different things: housing (year-round and leisure), different commercial activities (fishing, harbors, tourist industry etc.), military purposes, and last, but not least, shorelines are of great interest for active outdoor recreation. There one can experience the great outdoors and/or just relax.

At the same time, the shore area also contains the habitats of a large number of plant and animal species. Knowledge about the effects of the physical exploitation of shore environments on their biological diversity is limited, but clearly it means everything from encroachment, to the direct loss of habitats.

The increasing pressure on the shorelines has had its influence on the legislation. Shoreline protection has been made increasingly stricter since its enactment in 1950, first in temporary form, and then permanently in 1952 (Naturvårdsverket, 1997). From just applying to certain shorelines to assure access to the shore area for outdoor recreation for the general public, the protection today applies to our shorelines in general with the stated purpose “to protect the necessary conditions for the general public’s outdoor recreational needs, and to maintain good living conditions on land and in water for plant and animal life” (Sveriges Författningssamling, 1998). An important tightening of the regulations was the decision that from July 1, 1975 to allow the shoreline protection regulations to apply generally for land and water areas within 100 meters of the shoreline.

In 2001 Naturvårdsverket was given the task of evaluating the existing shoreline protection, to determine among other things, if the application of the regulations did lead, in fact, to achieving the shoreline protection program’s objectives. That study pointed to a string of weaknesses in the regulations (Naturvårdsverket, 2002). In spite of the general public’s interest, which is a major factor in the legislation, it was found that shoreline protection had not been maintained in certain parts of the country. The cause according to Naturvårdsverket (2002) was, among other things, a complicated set of regulations that implied that there was difficulty in applying said regulations. The consequences are that increasing numbers of shorelines are being exploited when the decisions for exemptions do not follow the intentions of the legislation. At the same time, decision appeals are few, and checks are sporadic. In that way the intentions of shoreline protection are undermined. Miljö- och samhällsbyggnadsdepartementet (2005) also sees the lack of a long-term perspective when it comes to exemption decisions. That is to say that many small encroachments collectively in the long run threaten our unexploited shorelines.

4.2 Physical Exploitation in the Stockholm archipelago

Within the EU-project BALANCE people are trying, among other things, to develop a method to show the degree of shoreline exploitation. The goal is an exploitation index which can be an instrument in environmental monitoring.

One measure of the physical exploitation of shorelines is the inventorying of boat-related exploitation. The occurrence of jetties, quays, and small craft harbors (marinas) can be used as an indicator of the current degree of exploitation (Länsstyrelsen i Stockholms län, 2001 and 2003). This jetty-indicator is one component of the indicator method, which has been developed at Länsstyrelsen i Stockholms län (2001, 2003). In a comprehensive inventory of the Stockholm archipelago, the jetty-indicator shows that an entire 60 % of the inner archipelago was exploited around the year 2000 (Länsstyrelsen i Stockholms län, 2004). The boat-related shoreline exploitation decreases then, the farther out in the archipelago one goes. The corresponding figures for the middle and outer archipelago were 43 % and 23 % respectively. The jetty-indicator showed an even clearer gradient for the category *very strong indication of exploitation* — areas where 36 % of the inner archipelago, 16 % of the middle archipelago, and 4 % of the outer archipelago shorelines are reported. As far as the inner archipelago is concerned, there is a general increase in the degree of exploitation, the closer the shoreline is to the proper city of Stockholm (Länsstyrelsen i Stockholms län, 2004).

The Stockholm archipelago constitutes about 25 % of the Swedish shoreline of the Baltic Sea (Kautsky & Kautsky, 1995). This fact gives Stockholm County a special situation, and a special responsibility with respect to the tenth environmental quality objective *A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos*. This environmental goal is aimed at, among other things, long-term sustainable utilization of the shore area with respect to biodiversity, biogenesis, and the values consistent with outdoor recreation (Miljömålsrådet, 2006).

4.3 Life in the Stockholm Archipelago during the 20th Century

At the end of the 19th century a significant break in the trend occurred when the year-round residents began to leave the archipelago (Hedenstierna, 2000). Between 1945 and 1965 the number of permanent residents in the archipelago was halved from 12,000 to 6,000 when the possibilities grew to live and work in the Stockholm suburbs which were built in the 1950's (Skärgårdsstiftelsen, 2006). With that, the traditional means of livelihood in the archipelago declined significantly.

At the same time as the archipelago was being depopulated of permanent residents, it was being increasingly populated by summer residents, and by a general public pursuing outdoor recreation, “agricultural islands became recreational islands” (Skärgårdsstiftelsen, 2006). Steamboat transportation and road building are factors which contributed to making the archipelago more accessible. For example, highway route 222 from *Nacka* out to *Ormingelandet* and *Värmdölandet* is in effect an extension of the mainland far out into the archipelago. The first *Skurubron* bridge, today along highway route 222, was completed in 1915 (Vägverket, 2006).

In time, summer residence even extended out into the outer archipelago. The first recreational village on the island of *Husarö* for example, began to be built in the middle of the 20th century (Stockholms Läns Museum, 2006).

The depopulation of the archipelago had the result that steps were taken to reverse the trend in the middle of the 20th century. Since then the population has increased to today's 10,000 — or 7,000 if you only count the permanent residents who live on islands

without bridge connections. The year-round permanent archipelago resident is often a Jack-of-all-trades, with a most varied range of work tasks. Among other things, there is work for caretakers, fishermen, farmers, or within the tourist industry at youth hostels and guest harbors (Skärgårdsstiftelsen, 2006). The archipelago is also populated today to a great extent by leisure-time residents, and the share of summer houses converted into year-round residences is increasing. Active outdoor recreation has a great need of shorelines. The municipality of *Värmdö*, for example, has a summertime increase in population from about 35,000 to about 100,000 people, including leisure-time residents and tourists (*Värmdö Kommun*, 2005). In the archipelago there are also larger commercial harbors, and facilities for military operations.

Skärgårdsstiftelsen in Stockholm County has played a leading role in the use of the archipelago shoreline. In connection with the reorganization of the Stockholm Archipelago Foundation, all the publicly owned archipelago land was, in principle, collected under one authority. Skärgårdsstiftelsen today owns 15 % of the land in the archipelago, 75 % is in private ownership, and the other 10 % is owned by corporations (Skärgårdsstiftelsen, 2006). The Foundation's land has a protected status, and the shoreline is kept available for active outdoor recreation.



Photo 3. Water front property. Photo: Christina Fagergren

5 METHODS AND MATERIALS

5.1 A study of change using the indicator method

The work was conducted initially using the indicator method (Mattisson, 2003), a method for surveying the degree of exploitation along the shorelines. It is based on the inventorying of jetties, with the help of aerial photography analysis and/or the occurrence of buildings within the shore area. The information concerning the occurrence of buildings is obtained from the source *Fastighetskartan* in *Geografiska SverigeData (GSD)*; real estate property map.

The jetty indicator concept even includes quays and small boat harbors. The frequency of occurrence of these structures along the shoreline creates then, an indicator of the degree of exploitation in the zone from the shoreline, and 100 meters up on land. The occurrence of jetties at the shore and, with that, the indicated exploitation in the shore zone is presented in 5 classes of exploitation: *no, weak, clear, strong, and very strong exploitation*.

Three distinct points in time are included in this retrospective study. The inventory is comprised of the shorelines which lie outside of today's built-up areas, according to the *GSD Röda kartan/comprehensive map* from 1997. The reason why the shorelines along today's densely built-up areas are excluded is that there are no such earlier maps in digital form with which to compare.

The occurrence of jetties was interpreted in the aerial photographs from 1960/65 and 1986 respectively. The results from the map readings were recorded continually using screen digitalizing, and employing the jetty indicator method (Tullback et al, 2001) using the software program *ArcMap 9.1*. Each jetty and quay was noted as a point feature, and each small boat harbor larger than 0.25 hectares has been noted as a surface feature. As an aid to the screen digitalizing, orthophotos from the year 2000 was used in digital format.

The present-day occurrence of jetties within the studied area was inventoried in 2001 in the most recent infrared aerial photographs from 1999 (Länsstyrelsen i Stockholms län, 2004). The findings from the interpretation of the aerial photographs were checked to see that the method of interpretation was equivalent to that used when working with the aerial photographs from 1980's and the 1960's. The paved surfaces in the 1999 inventory were eliminated, in order to more clearly identify the exploitation related to boating. In addition, a check was made of small boat harbors so that they are noted with the same map symbol, if they were of equivalent size at different points in time. This concerns those harbors whose size was interpreted as close to 0.25 hectares, which is to say the limit between point and surface features. A harbor identified as a surface feature in the 1986 aerial photographs should, if the size is the same, even be noted as a surface feature in the photos from 1999.

Then a frequency of occurrence count was conducted of jetties for each respective point in time in a "vicinity analysis" within a radius of 100 meters (Neighborhood statistics) (Mattisson, 2003). That resulted in an exploitation map for each inventoried point in time, and shows the exploitation indication in 5 classes: *no, weak, clear, strong, and*

very strong exploitation. This means that the “more densely the jetties occur, the higher the exploitation class designation” that is assigned to that shore area (Länsstyrelsen i Stockholms län, 2004).

Both harbors noted as surface features, and densely built-up areas are placed directly in the highest exploitation class. Each harbor area was given a buffer zone of 100 meters so that the frequency of occurrence count of jetties would be correct, and not include any edge effects (Mattisson, 2003). Each densely built-up area was given a buffer zone of 200 meters (Mattisson, 2003). The explanation for this is that the results from the analysis of the aerial photographs in 2001 were being formulated at the same time as the indicator method was under development. Jetties were only officially noted up to 100 meters from the densely built-up area’s borders, and to ensure the correctness of the frequency analysis, the densely built-up areas had to be allotted an additional 100 meters. Even this has been done to eliminate the edge effect.

In the next step, a comparison was made between the exploitation maps from 1960 and 1999. Here the information was analyzed to see if the indicated degree of exploitation had increased, decreased, or remained unchanged during the period. The analysis produced 6 classes of “areas of change”: *unchanged untouched shoreline*, *unchanged exploited shoreline*, *new exploitation on unexploited shoreline*, *increased exploitation on already exploited shoreline*, *exploitation has ceased*, and *reduced exploitation on shorelines with ongoing exploitation*. The comparison was conducted as an overlay-analysis in the “raster environment” using the software program *ArcMap*, with the addition of *Spatial Analyst*.

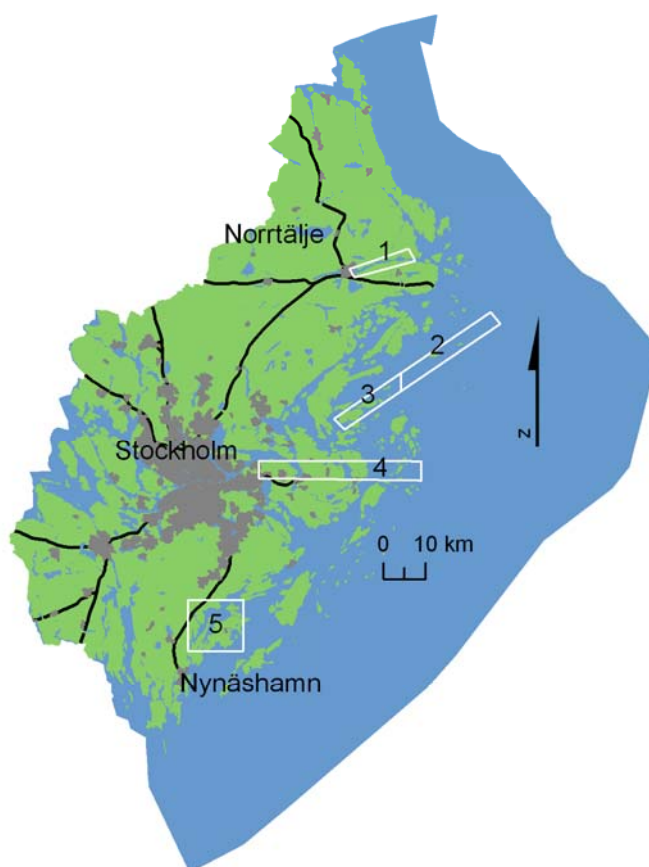
In 3 of the 5 geographical areas of study (Norrtäljeviken, Värmdö- and the Muskö area) are sections of the shorelines that have not been included in the study. The sections that currently lie within the densely built-up areas have been excluded because of a lack of older maps of densely built-up areas in digital format. It has therefore not been possible to follow the development backwards in time, with respect to densely built-up areas, and their changes when spreading. In addition certain areas have been hidden in the oldest aerial photos, for secrecy purposes.

5.2 Geographical Areas of Study

The geographical areas studied are four sections of the Stockholm archipelago (figure 1). The areas were selected to provide examples from the inner-, middle-, and outer- archipelago, or if you will, a gradient from densely built-up areas to sparsely populated areas, or from easily accessible shorelines to more inaccessible ones. The chosen areas also have a geographic north-south spread. The reason why only a selected number of areas have been studied is the limited amount of resources allocated for the work.

The availability of aerial photos for stereo-interpretation has to a certain degree influenced the choice of areas, so the work has primarily been carried out using the County Administrative Board’s existing photographs. There has mostly been a shortage of aerial photos from the 1960’s. This lack of aerial photos mostly concerns the outer sections of the archipelago. Therefore there are, for example, only finalized interpretations from 1986 and 1999 concerning the *Svartlöga-Norripada*-area.

Figure 1. The areas studied and their respective surface areas.
 1 Norrtäljeviken, 41 km²
 2 The Svartlöga-Norrpada area, 97 km²
 3 The Svartsö-Husarö area, 63 km²
 4 The Värmdö area, 169 km²
 5 The Muskö area, 162 km²



6 INCREASED EXPLOITATION OF THE SHORELINES

The percentage of shoreline with an indication of exploitation increased from 22.2 % in 1960 to 37.4 % in 1999 (figure 2). That is an increase of 68 % in the share of exploited shorelines. Shorelines without any indication of exploitation (= untouched shorelines) have, in other words, reduced in spreading by 19.5 % during that period. The pace of exploitation was in principle, the same after 1986 as it was earlier (figure 2). This conclusion holds true for 4 of the 5 geographic areas of study. Concerning *Svartlöga-Norrpada*, there is no conclusion drawn for the period 1960 to 1986, and the reduction in the surface area classed as untouched shoreline in this geographical area is small between 1986 and 1999.

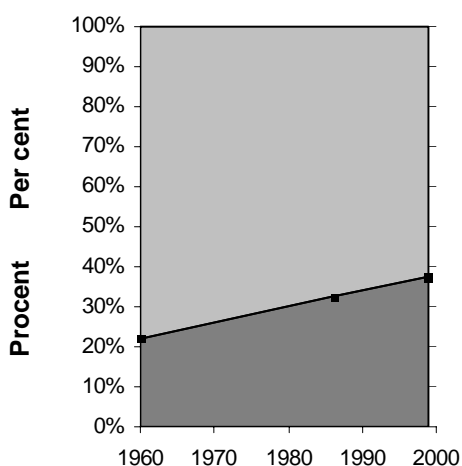


Figure 2. The total percentage of beach zone with indication of exploitation (dark gray) and without indication of exploitation (light gray) respectively, within the geographic areas of study in 1960, 1986, and 1999 (excluding the Svartlöga-Norrpada area). The term beach zone as used in this study includes the area from the shoreline and 100 meters up on land.

The share of untouched shoreline varies between the geographic areas of study (appendix 1 a-e). The *Musköområdet* area has the largest share of untouched shorelines (appendix 1e). They took up 4/5 of the shoreline in 1960 outside the densely built-up areas, and do so even today. For the *Norrtäljeviken* area the situation is the opposite. In 1999 about 45 % of the shoreline lying outside the densely built-up areas was untouched, comparing with 2/3 in 1960 (appendix 1a). The *Värmdö* area has a similar history, but in 1986 the share of untouched shoreline was still larger within the *Värmdö* area, slightly more than 60 % (appendix 1d). The *Svartsö-Husarö* area had, exactly as *Muskö*, about 80 % untouched shoreline in 1960, but up to 1986 they declined significantly more in proportional share than within the *Muskö* area (appendices 1c and 1e). In 1999 the *Svartsö-Husarö* area had just under 2/3 untouched shore zone (appendix 1c).

At the same time as previously untouched shorelines have been exploited, the concentration of jetties along the already exploited shorelines has been widespread. The higher classes of exploitation have, in most cases, greatly increased their share during the period (appendix 1a-e). In 1960 the occurrence of the *very strong exploitation* indicator

was only found in the *Svartsö-Husarö* and *Värmdö* areas (appendices 1c and 1d). The share of this class increased substantially up until 1986, and this class was then also found in the *Norrtäljeviken* and the *Musköområdet* areas (appendices 1a and 1e). In 1999 the concentration of jetties at this level had even reached the *Svartlöga-Norrpada* area (appendix 1b).

The untouched shorelines occur both as longer continuous stretches, and as more splintered fragments between the exploited areas (appendices 1a-e). The increase of exploited areas has occurred partly due to the expansion of already exploited areas, and partly because of the intensified degree of exploitation. Over time many exploited areas have expanded at the expense of the untouched shoreline lying between them. In addition occasional jetties have been built along untouched shorelines.

In a number of cases you can see a zoning within the exploited shoreline areas (appendix 1 a-e). They have a core area where the jetty density is high, which is surrounded by shoreline areas with a lower jetty frequency (for example: southern *Vätö* in *Norrtäljeviken*, *Svartsö*, *Ingemarsö* in *Svartsö-Husaröområdet*, and *Rödlöga* in the *Svartlöga-Norrpada* area). In some cases shorelines with *very strong exploitation indications* adjoin densely built-up areas, which are to be seen as “exploitation-nuclei” (for example on the southwest side of *Muskö* and northern *Värmdölandet*). Additionally in some other cases, the densely built-up areas are surrounded by shorelines without any indication of exploitation.

In a comparison between 1960 and 1999 for degree of exploitation, the *Värmdö* and *Norrtäljeviken* areas had the largest share of expansion areas (appendix 2). Close to 2/5 and slightly more than 1/3 of the shorelines there had been subject to increased exploitation during the 40 years. Next comes the *Svartsö-Husaröområdet* area, with slightly less than 1/4 expansion areas. The *Musköområdet* area has the smallest share of expansion areas. There 1/10 of the shoreline has been subject to increased exploitation.

A larger share of untouched shorelines has been made use of within all these areas, than the previously existing used shorelines there (appendix 2). In the *Norrtäljeviken* and *Värmdö* areas the share is double, and in the *Musköområdet* it is 2.7 times as great. Finally, the *Svartsö-Husaröområdet* area has 3.7 times as large a share of untouched shorelines that have been newly exploited, compared with the previously existing exploited shorelines which have sustained an increased concentration of jetties.

The share of shorelines with reduced exploitation is very low within all of the areas studied (appendix 2). *Värmdö*, which has the largest share, has more than twice the amount (4 %) as *Norrtälje*, which has the smallest share (1.5 %). On most of these shorelines, jetties have been completely removed.

In *Norrtäljeviken*, *Vätö* and the islands to the south of it have a greatly splintered shore zone with very few untouched shoreline areas (appendix 1a). Otherwise *Norrtäljeviken* is very varied. You can see a higher degree of exploitation along the southern shore, but here is also found the longest continuous shore without jetties. The pattern is the same going backwards in time, but the shoreline areas with *weak exploitation indication* were more splintered, and the *very strong exploitation indication* was found not to occur in 1960. Furthermore then it was rather the northern shore in the bay that was more exploited than the southern one.

Within the *Svartlöga-Norrpada* and *Svartsö-Husarö* areas can be seen concentrations of jetties in a few place here and there (appendices 1b and 1c). There the majority of the shoreline exploitation is localized to the larger islands (*Svartsö*, *Ingmarsö*, *Husarö*, *Rödlöga*, and *Svartlöga*) and this has been the case even looking back in time. The farther out you go in the archipelago, the more the jetties lie concentrated together. This accumulation of the higher degrees of exploitation is also more evident looking back in time, but the occasional, more isolated jetties were found more spread out, which is true even today.

At the point in time 1960/65, larger portions of the *Värmdö* area's shorelines were untouched (appendix 1d). The strongest indication of exploitation was found in the area's western portions, and there was only one shore area with the exploitation indication *very strong*. In 1986 twelve areas were found in this category. None of these twelve were then located in the outer parts of the *Värmdö* area, but in 1999 the highest category was found even there. Today in the inner parts of the *Värmdö* area there can be long stretches between untouched shoreline areas. On the islands in the outer area (*Eknö*, *Hasselö*, *Harö*, and *Storö*) the picture is somewhat more splintered, but you can see a concentration of jetties along northern *Harö*'s and southern *Storö*'s shorelines. On these islands are longer continuous stretches of untouched shorelines, but western *Harö*'s and *Eknö*'s untouched shorelines are obviously fragmented.

Larger portions of *Muskö*'s untouched shorelines lie within a military restricted area and the nature reserve area *Hammersta-Häringe* (appendix 1e). They are more or less continuous, in contrast to shorelines lying outside of these areas. There the indicated degree of exploitation is considerably higher with regard to prevalence, so that the untouched shorelines are comprised of only smaller fragments. The highest category of "degree of exploitation", *very strong exploitation*, is however chiefly represented within the military restricted zones. In the 1960's there were a couple of areas with a clear indication of concentrated shoreline exploitation: *Muskö* village, and on the mainland just north of *Häringe*. In 1986 the number of areas had increased to six, and in 1999 one additional area had appeared.

7 DISCUSSION

7.1 *Exploitation within an Historical Perspective*

This study shows that the untouched shorelines of our archipelago have become substantially fewer during the last 40 years. It is evident that the untouched shorelines are fewer and fewer the closer one gets to Stockholm. A considerably less obvious exploitation gradient is the change in exploitation that has occurred over time. The physical shoreline exploitation that can be related to boating has, in general, increased since the 1960's, when the exploitation pressure in the course of time has moved farther and farther out into the archipelago. There is today a year-round permanent population living in the old summer houses from the 1910's, which are found in the inner parts of the archipelago. There are examples from the middle archipelago that today have the same indication degree of exploitation as the inner archipelago had in the 1960's. Today's modern ways of transportation out into the archipelago make the distances feasible, and the great interest in the middle and outer archipelago will hardly decline.

The question is if in the long run, there will be enough shorelines for us all?

The exploitation has developed gradually, both in time and geographic space. In conflict with The Swedish Shore Protection Act's first aim, portions of the shoreline have successively been claimed, and by that means, become inaccessible to the general public's active outdoor recreation. One individual encroachment may seem relatively innocent, but looking at it with a habitat perspective, this study shows a severe trend — that our archipelago shorelines are going to continue diminishing even in the future. Certain types of shorelines can be expected to diminish to a greater extent than others, for example, level shore areas. The development of densely built-up areas between 1960 and 1999 (not studied here) and the fact that this study focuses on the frequency of jetties (how densely the jetties are situated with respect to each other) and not possible additions to and extensions of existing jetties, make the situation even more serious. It can be assumed that the jetties have not only increased in number, but have also grown larger in size during the period. This has also contributed to reducing the amount of untouched shorelines.

We can make the observation that certain shorelines have succeeded better in the face of exploitation than others. Nature reserves and military restricted areas, for example, have in practice preserved shorelines untouched. *Muskö* however, is a good example of how the pressure has increased on the surrounding shorelines, and a picture emerges of hard pressed shorelines which, when they have no protection because of specific owner circumstances, have only fragments of untouched coast remaining.

Which shorelines are there, that remain? The question is important, not just from the perspective of the outdoor recreation enthusiast, but also with thought for the plant and animal life. In aerial photographs it is clear that the shorelines that are "left over" are often inaccessible and without easy access to the water, for example cliffs. The shorelines that have been exploited are the same ones which are of greatest interest to active outdoor recreation enthusiasts: level shorelines where you can relatively easily access the

water, and where it is relatively shallow. These shallow water areas are essential to plant and animal life. Here the variety of species is large, and here also is where we have important nurseries for fish, among other things (Naturvårdsverket, 2005).

The conditions necessary for the general public's outdoor recreation needs can not be seen as safeguarded; neither can it be asserted that good living conditions are being maintained on land and in the water for plant and animal life. To change this development requires the insight that the shorelines are a limited resource, and an awareness of how the exploitation process looks, and what the ecological consequences will be on the habitats in question.

1. That with great likelihood, an isolated jetty on a previously untouched shore will become a future nucleus of exploitation surrounded by somewhat less exploited shorelines.
2. That such exploitation nuclei expand, and only leave fragments of untouched shorelines between themselves.
3. That expansion eventually devours those small fragments between the exploited stretches of shoreline.

Slowly the untouched shorelines are transformed into clearly exploited shorelines, and this is because one has no historic perspective, but only refers to today's, and possibly yesterday's degree of exploitation. With the present pace of exploitation, the untouched shorelines within the geographic areas studied will be gone in about 150 years. It is likely that the situation is just as serious in the other parts of the inner and outer archipelago. Seen from the human perspective, this means that only two additional generations will be able to experience untouched shorelines.

It is important that the responsible authorities take particular responsibility to see to it that the shoreline protection laws are obeyed using the perspective that respects the ecology of the range of habitats. Only then can the work be focused on securing the biodiversity on all three levels: genetic, species, and biotope. At least in the Stockholm archipelago there is an urgent need for a more restrictive approach to granting exemptions. Individual cases involving a "request for exploitation" must be put in a larger context, so that the consequences can be evaluated over time on a county-landscape level. It is important to evaluate: the degree of fragmentation of the untouched shorelines, the distance between the fragments, the size of the fragments, and last but not least, the type of shoreline in question. This all needs to be done so that the proportions can be kept between the different types of shorelines, and also so that sufficiently large portions of the shorelines of specific quality-types can be protected on a long-term basis. It is also important to critically review the degree of exploitation of the already exploited areas, so that a possible additional exploitation can be directed to these shorelines.

In working with the tenth environmental quality objective, *A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos*, one needs to have a collective and integrated approach to our shorelines. How the shorelines are managed and used is an important part for reaching the objective. Miljö- och samhällsbyggnadsdepartementet (2005) emphasizes the importance of improving supervision, training, and information quality in connection with all matters concerning shoreline protection. An historical-

geographical frame of reference would serve that purpose by being a foundation for supervising decision-making, and also for being useful in producing training and other informational materials. In this way the conditions for using the shoreline zone will be sustainable in the long-term, as seen from the aspects of biodiversity, biogenesis, and the values of active outdoor recreation.

7.2 **Methodology Discussion**

In connection with the reading of aerial photographs, a number of errors can arise depending on the method used. There can be reflections on a water surface, making jetties undetectable in the aerial photographs. High heights, very steep slopes, or trees at the water's edge can cause a shadowing of the shoreline so that a certain number of jetties can not be seen. The date of the photographing usually has significance for interpreting the vegetation information in the CIR (color infrared) aerial photographs. It is unclear what effect it has on the identification of jetties, but most likely any possible problems are negligible.

Older photographs can be of such a quality, that it is difficult to see the physical features one wants to see. Furthermore the photos are black and white, which also limits the readability, especially when the vegetation is to be identified. When it comes to identifying jetties, there is some positive compensation by virtue of the fact that the landscape was more open in the 1960's than in the 1980's and 1990's. In other words, the problems concerning the shadowing of the shoreline were fewer.

Using different aerial photograph interpreters within one and the same study can present problems. Doing this requires that the definitions be clear for each type of map feature to be interpreted, and that every interpreter makes equivalent interpretations with respect to the features being studied. To reduce this problem, the reading of the 1999 aerial photographs has been checked so that only the physical exploitation related to boating has been included, and also that equivalent interpretations have been made regarding features, areas, and positioning.

It is important to stress that this is a comparison in time between three density analyses. Many of the changes that are made in connection with jetties are not seen in this study. This concerns those cases where jetties have not increased in number, but (the existing ones) in size. They have been documented as a jetty at each point in time, in spite of the fact that they have become larger, and their impact on the shoreline can be more extensive. In other words, this method does not capture the changes in size, and the results do not have as high a resolution as would be wished in order to be able to include such changes.

Since the shorelines which lie within today's densely built-up areas (see the section *Methods and Materials, A study of change using the indicator method*) have not been included in this study, it means that important areas of change have not been reported here. It is clear however, from reading the aerial photographs, that big changes have occurred: old densely built-up areas have expanded, and new ones have appeared. The changes which one above all is not able to track, are the gradual transitions to class 5, and the untouched areas which are directly transformed into densely built-up areas.

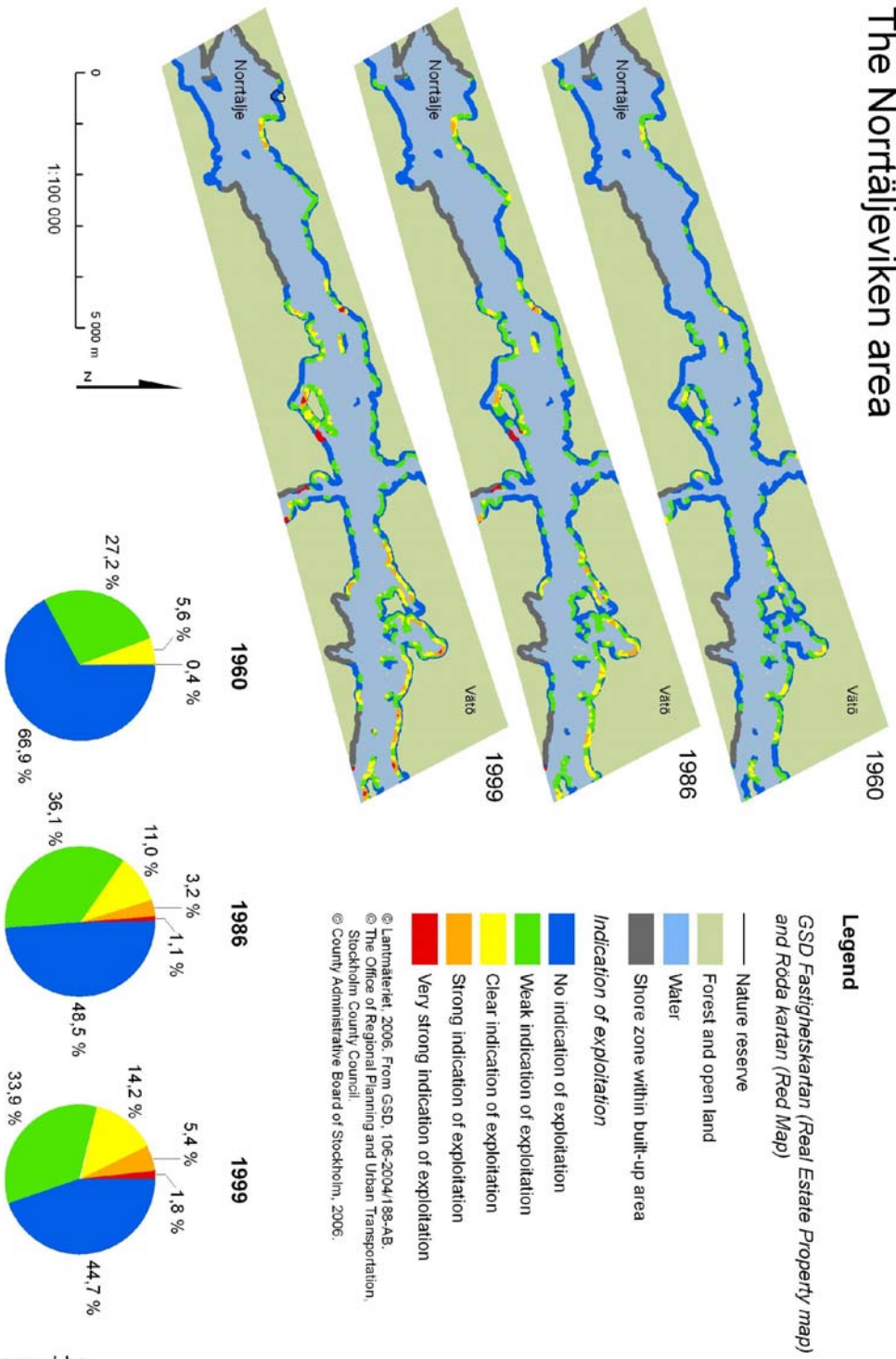
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9 APPENDIX 1A-E

The geographic distribution and the percentage share of the respective degrees of exploitation within the studied areas for the years 1960, 1986, and 1999.

The Norrtäljeviken area

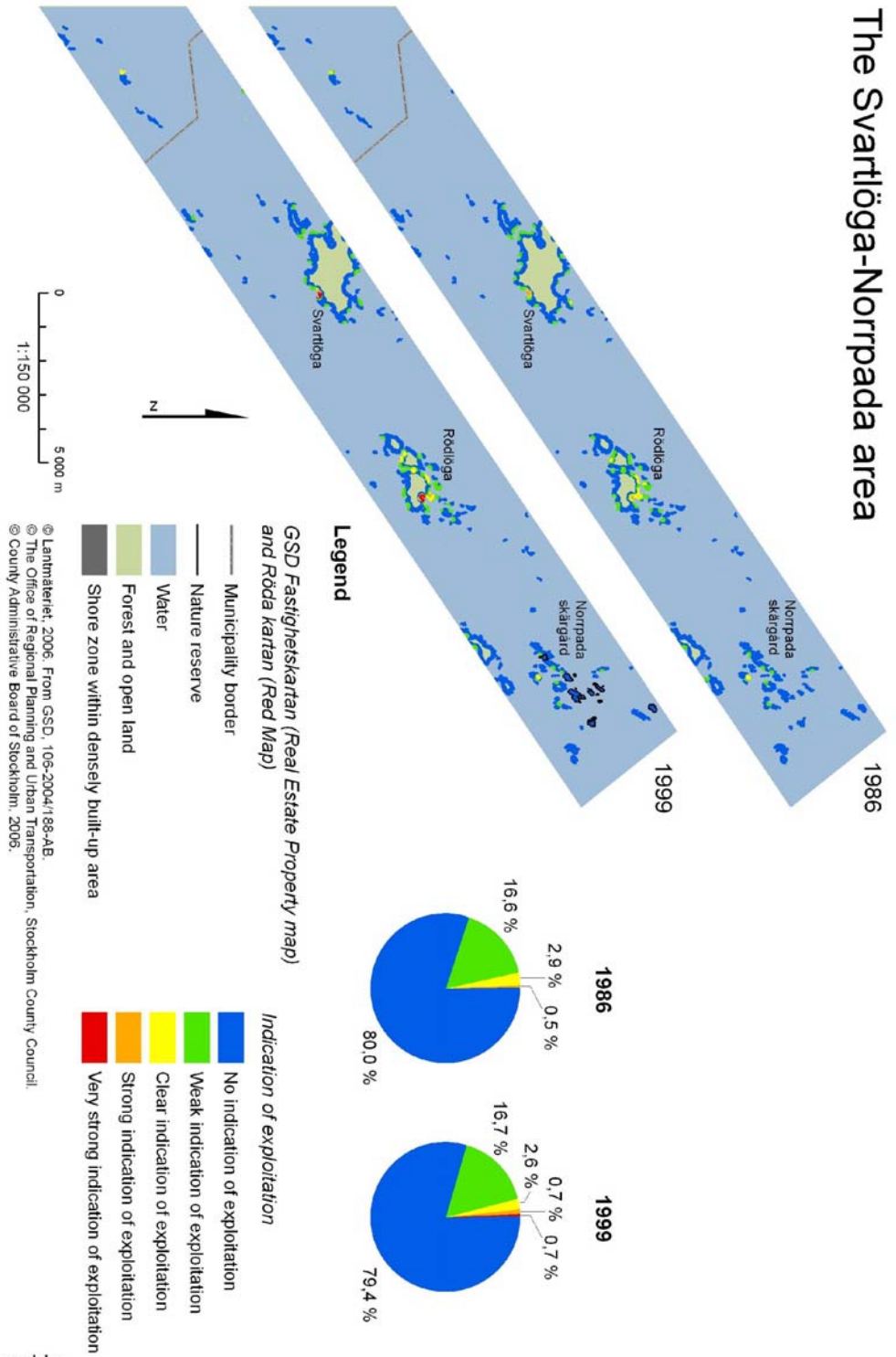


Appendix 1a

Appendix A

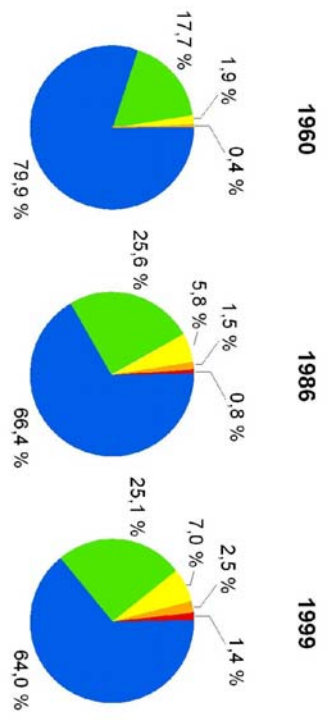
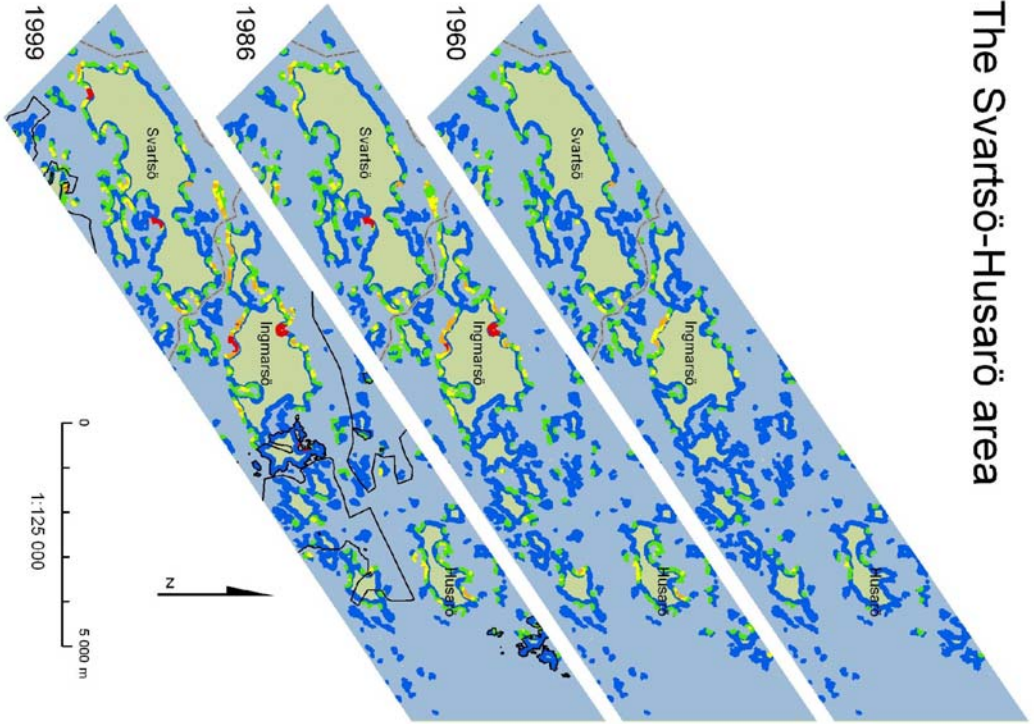
Appendix B

The Svartlöga-Norrpada area



Appendix 1b

The Svartsö-Husarö area



Legend

GSD Fastighetskartan (Real Estate Property map) and Röda kartan (Red Map)

- Municipality border
- Nature reserve
- Water
- Forest and open land
- Shore zone within densely built-up area

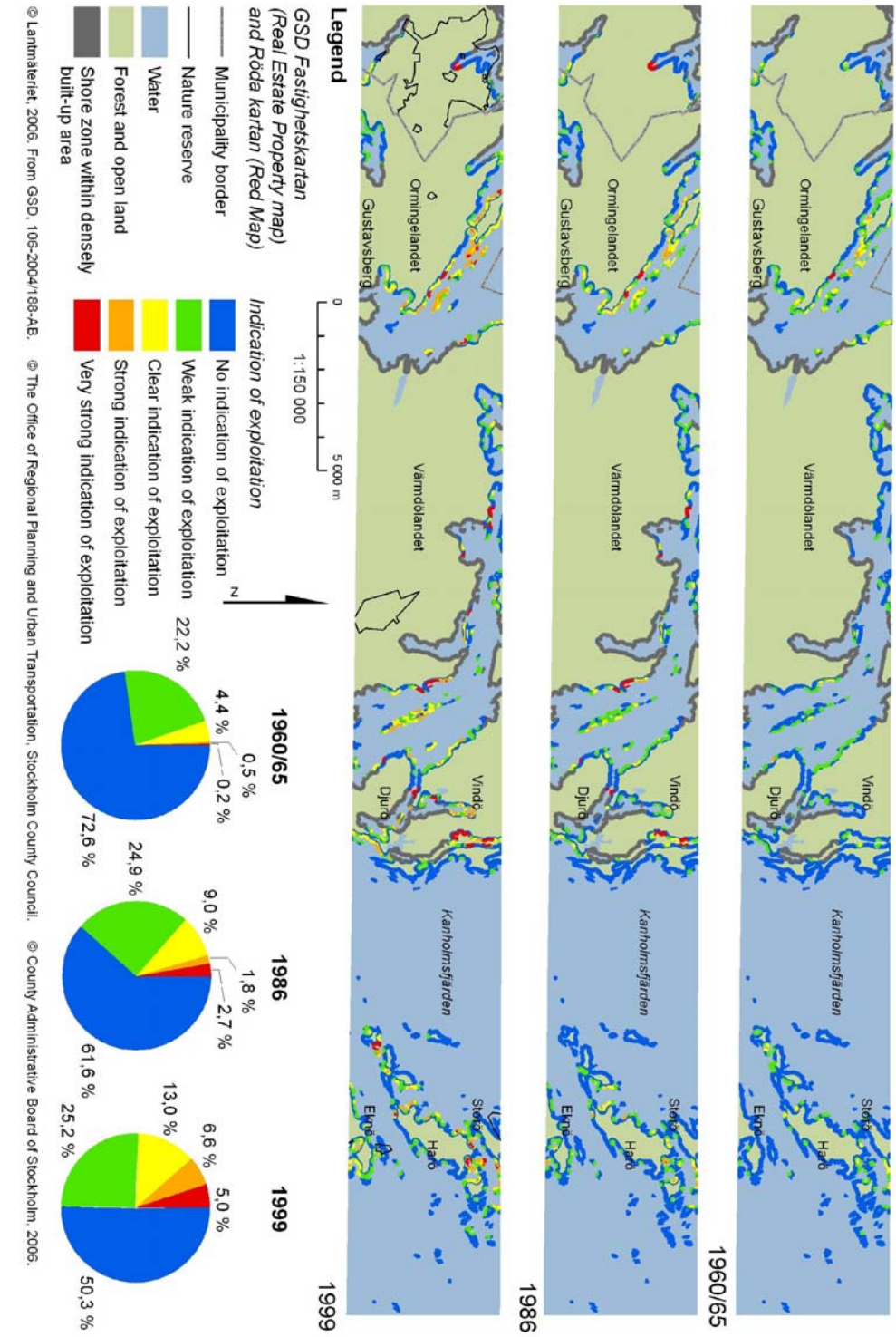
Indication of exploitation

- No indication of exploitation
- Weak indication of exploitation
- Clear indication of exploitation
- Strong indication of exploitation
- Very strong indication of exploitation

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Appendix 1c

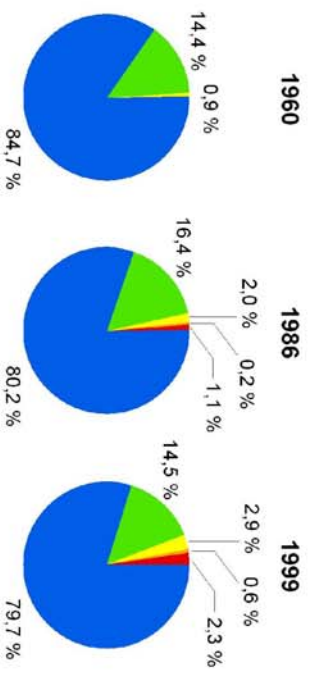
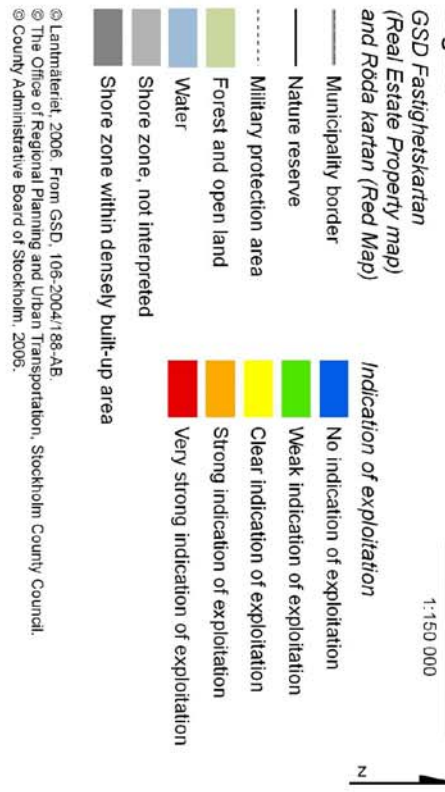
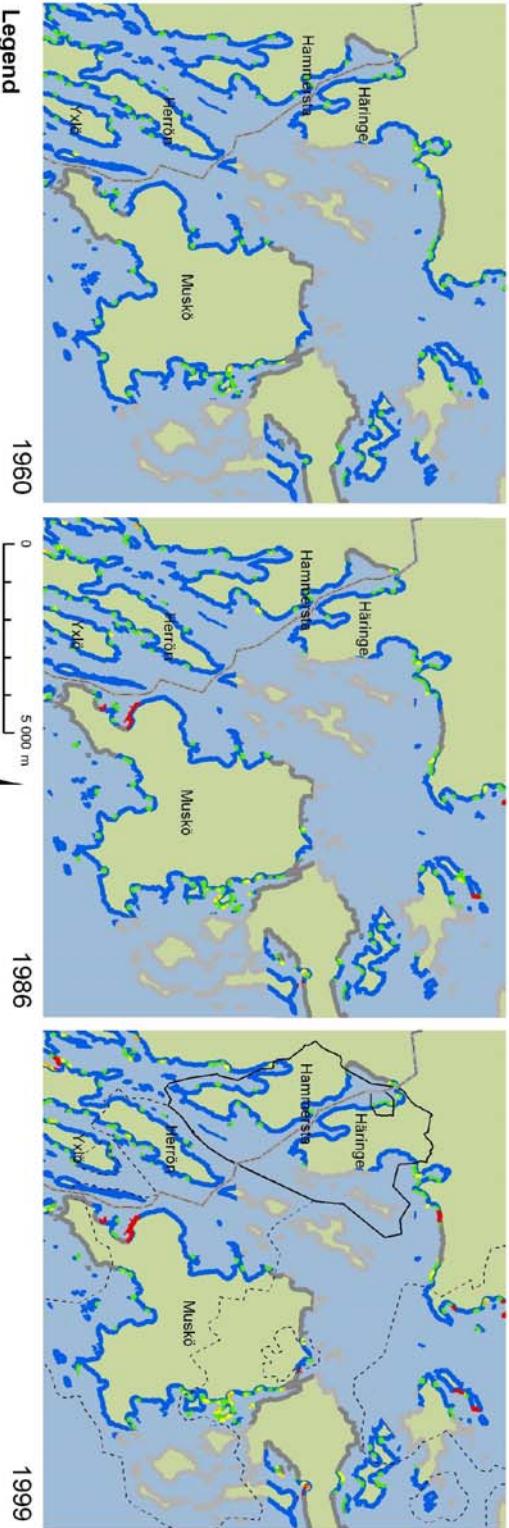
The Värmdö area



Appendix D

Appendix 1d

The Muskö area

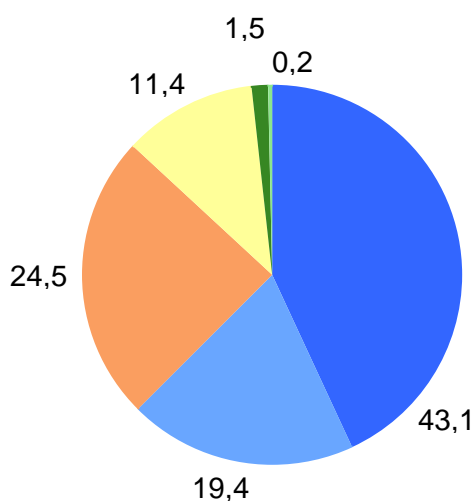


Appendix 1e

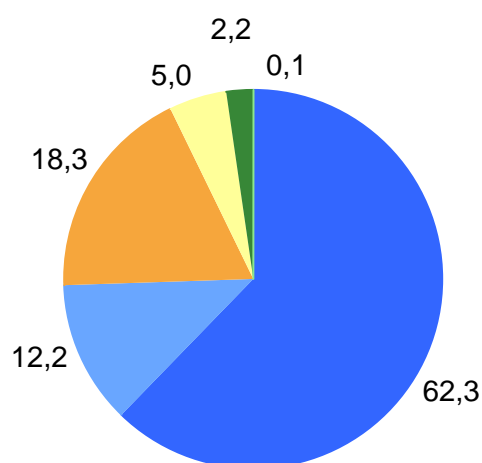
10 APPENDIX 2

The percentage of shores where the exploitation situation has not changed, increased or decreased during the period of 1960 to 1999.

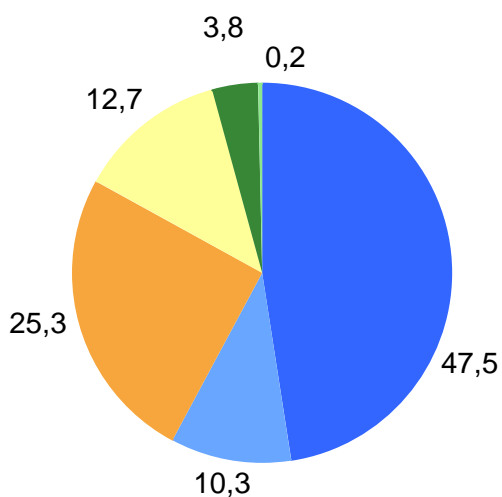
The Norrtäljeviken area



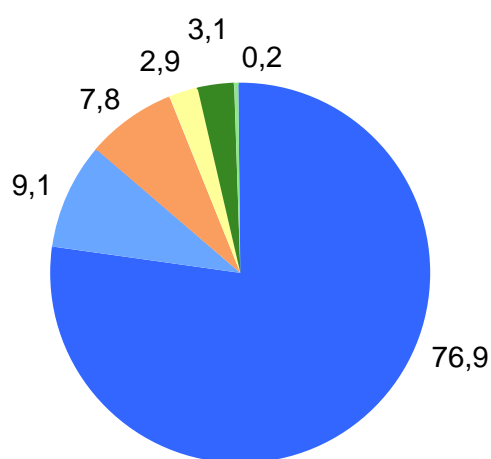
The Svartsö-Husarö area



The Värmdö area



The Muskö area



- Undisturbed shore, unchanged
- Exploited shore, unchanged
- Undisturbed shore with new exploitation
- Exploited shore with increase in exploitation
- Exploitation has ceased allowing natural recovery
- Exploited shore with reduced exploitation

About the BALANCE project:

The BALANCE project aims to provide a transnational marine management template based on zoning, which can assist stakeholders in planning and implementing effective management solutions for sustainable use and protection of our valuable marine landscapes and unique natural heritage. The template will be based on data sharing, mapping of marine landscapes and habitats, development of the blue corridor concept, information on key stakeholder interests and development of a cross-sectoral and transnational Baltic zoning approach. BALANCE thus provides a transnational solution to a transnational problem.

The work is part financed by the European Union through the development fund BSR INTERREG IIIB Neighbourhood Programme and partly by the involved partners. For more information on BALANCE, please see www.balance-eu.org and for the BSR INTERREG Neighbourhood Programme, please see www.bsrinterreg.net

The BALANCE Report Series includes:

- BALANCE Interim Report No. 1** "Delineation of the BALANCE Pilot Areas"
- BALANCE Interim Report No. 2** "Development of a methodology for selection and assessment of a representative MPA network in the Baltic Sea – an interim strategy"
- BALANCE Interim Report No. 3** "Feasibility of hyperspectral remote sensing for mapping benthic macroalgal cover in turbid coastal waters of the Baltic Sea"
- BALANCE Interim Report No. 4** "Literature review of the "Blue Corridors" concept and its applicability to the Baltic Sea"
- BALANCE Interim Report No. 5** "Evaluation of remote sensing methods as a tool to characterise shallow marine habitats I"
- BALANCE Interim Report No. 6** "BALANCE Cruise Report - The Archipelago Sea"
- BALANCE Interim Report No. 7** "BALANCE Cruise Report - The Kattegat"
- BALANCE Interim Report No. 8** "BALANCE Stakeholder Communication Guide"
- BALANCE Interim Report No. 9** "Model simulations of blue corridors in the Baltic Sea"
- BALANCE Interim Report No. 10** "Towards marine landscapes of the Baltic Sea"
- BALANCE Interim Report No. 11** "Fish habitat modelling in a Baltic Sea archipelago region"
- BALANCE Interim Report No. 12** "Evaluation of remote sensing methods as a tool to characterise shallow marine habitats II"
- BALANCE Interim Report No. 13** "Harmonizing marine geological data with the EUNIS habitat classification"
- BALANCE Interim Report No. 14** "Intercalibration of sediment data from the Archipelago Sea"
- BALANCE Interim Report No. 15** "Biodiversity on boulder reefs in the central Kattegat"
- BALANCE Interim Report No. 16** "The stakeholder - nature conservation's best friend or its worst enemy?"
- BALANCE Interim Report No. 17** "Baltic Sea oxygen maps"
- BALANCE Interim Report No. 18** "A practical guide to Blue Corridors"
- BALANCE Interim Report No. 19** "The BALANCE Data Portal"
- BALANCE Interim Report No. 20** "The reproductive volume of Baltic Cod – mapping and application"
- BALANCE Interim Report No. 21** "Mapping of marine habitats in the Kattegat"
- BALANCE Interim Report No. 22** "E-participation as tool in planning processes"
- BALANCE Interim Report No. 23** "The modelling *Furcellaria lumbricalis* habitats along the Latvian coast"
- BALANCE Interim Report No. 24** "Towards a representative MPA network in the Baltic Sea"
- BALANCE Interim Report No. 25** "Towards ecological coherence of the MPA network in the Baltic Sea"
- BALANCE Interim Report No. 26** "What's happening to our shores?"
- BALANCE Interim Report No. 27** "Mapping and modelling of marine habitats in the Baltic Sea"
- BALANCE Interim Report No. 28** "GIS tools for marine planning and management"
- BALANCE Interim Report No. 29** "Essential fish habitats and fish migration patterns in the Northern Baltic Sea"
- BALANCE Interim Report No. 30** "Mapping of Natura 2000 habitats in Baltic Sea archipelago areas"
- BALANCE Interim Report No. 31** "Marine landscapes and benthic habitats in the Archipelago Sea"
- BALANCE Interim Report No. 32** "Guidelines for harmonisation of marine data"
- BALANCE Interim Report No. 33** "The BALANCE Conference"

In addition, the above activities are summarized in four technical summary reports on the following themes 1) Data availability and harmonisation, 2) Marine landscape and habitat mapping, 3) Ecological coherence and principles for MPA selection and design, and 4) Tools and a template for marine spatial planning. The BALANCE Synthesis Report "Towards a Baltic Sea in balance" integrates and demonstrates the key results of BALANCE and provides guidance for future marine spatial planning.