Improving Swedish nature reserve visitor maps with focus on relevance and visual communication

Att förbättra besökskartor för svenska naturreservat med fokus på relevans och visuell kommunikation

By Aron Hejdström
Thesis for a Bachelor of Arts in Graphic Design
Design and Visual Communication
K3, Malmö högskola, 2012-2013
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Abstract

At first glance, the image of a map looks familiar to a graphic designer. It comprises colours, shapes and typography. But beyond the graphical surface it hides a complex system of techniques and rules, like the clockwork behind a dial. This thesis tries to approach and improve map production from a starting point in graphic design. By addressing visitor maps for nature reserves it aims to make nature more accessible and appealing to a larger group of people.

The main purpose of the thesis is to examine how Swedish nature reserve visitor maps can be improved with focus on relevance for their aims and use and how this is communicated through the visual presentation. A secondary purpose is to examine how to produce such maps in a rational way, using digital geographic information systems (GIS) and adopted working processes.

The research was conducted using a combination of traditional methods and techniques combined with research through design activity. Methods and techniques were gathered from ethnography, action-research and usability-research and include literature studies, interviews, questionnaire surveys, participatory observation, action-research protocols, beta-testing and collection of samples.

The design activity resulted in both free-standing sketches and map-sketches for the Gotlandic nature reserves Langhammars and Stora Karlsö. Two processes and one descriptive structure were developed and described: a process to adopt visual representations of map-information to its contextual relevance, a process to produce nature reserve visitor maps, and a structure to present practical design work in a scientific context. Results also comprised collected answers, discussions and samples from questionnaire surveys, participatory observation, interviews and general research.

The thesis concludes that it is fruitful to consider the visitor map as “a product made for use” and apply a usability-approach as it is rather an example of visual information than visual communication. Close research of both sender and users is also important to be able to select, adapt and fine-tune the information in the map in relation to its aims and use.

The digital possibilities that enables GIS to provide easy accessible and accurate data can produce efficient workflows in map design if combined with the graphic designers experience to develop and streamline design processes. The combination of modern technology, practical design work and research is profitable in both an analogue and digital context and makes visitor maps a contemporary and interesting area for both researchers and practitioners.

Keywords

Graphic Design, Cartography, Nature reserves, GIS, Design process.
Foreword and acknowledgement

The process leading to this thesis has indeed been a long and winding road.

I started to think about interesting subjects and applications for my exam as soon as I started my education program, four years ago. At least a year before the thesis work started I calculated on doing something on information design and maps. Maybe the long planning was a problem, maybe the fact that both my girlfriend, her sister and her sisters husband worked on their Phds in plant evolution, bio technology and neuropsychology made me aim a little bit too high. It is possible but not probable, I have always complicated my life by doing things a little too big or complex. Visions and ideas coming to life is the engine of my existence.

With a personality like that, it’s good not to be alone. Throughout this project, I have met and been in contact with lots of people whom have given me their time and patient, their knowledge and support. Without them, this work couldn’t have been done. I am very thankful for this and hope I can return such favours one day.

Thanks to my families and my dear Anneli for supporting me again and again and for making my time in Skåne so pleasant. Thanks to Tina-Marie Whitman and Karin Larsson who supported me and helped me in the most essential parts of my work and thaks to all who inspired, commented and helped from near and on distance, Rune Pettersson, Åsa Harvard Maare, Lena Pettersson, Fredrik Collijn, Jana Holsanova, Sofie Lindblom, Martin Farran-Lee, Carina Andersson, Roger Johansson and all the helpful people at Humanities Lab at Lund University, GIS-Centre at Lund University, Stockholm Reciliation Centre at Stockholm University and Lantmäteriet and Länsstyrelsen.

Thank you so much!

To anyone reading this thesis I would like to invite you to contact me if you have comments or ideas that you want to share with me, it would be appriciated! I would also be glad for a contact or message if you use any ideas or text in the thesis for reference in your own thesis or elsewhere. Contact me at +46 736 30 83 92 or aronhejdstrom@yahoo.se
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3 - Introduction

As a graphic designer, I’d like to see myself as someone with great possibility to influence people. With straightforward and clear communication I could focus peoples ideas on subjects or issues that I find important and persuade them to react. This puts me in a position of huge responsibility as I have to consider and value the effect of my work, but it also gives me a tool to changes the society to the better.

One area in which the society definitely has to change is in its relation to nature. The list of negative effects the human race has had on the planet is already long, but its getting longer for every day. I sometimes wonder how this can be. The nature gives us fresh air and water and resources to countless purposes. Still people refuse to change their way of living.

This might not sound like a task for a graphic designer, but I disagree. It is quite relevant. My quality as graphic designer is to solve communicational problems, not to draw arty posters. And the communication needed to change peoples minds and get them to understand why care for nature matters, has obviously not been presented – yet.

On a personal level, the nature gives us possibilities to take care of our bodies and souls in outdoor activities. To step into ones boots and go for a walk, maybe bring a picnic, to a near by natural environment is a good start to create interest for nature and environmental issues. In Sweden we have outstanding possibilities to do this thanks to “allemansrätten”, the right of public access. Lots of people benefit from this privilege, but there could be many more.

The subject of my thesis addresses this issue: How can I make nature more accessible and appealing to a larger group of people? One way could be to produce and provide adequate and inspiring visitor maps to the first-rate nature in our Swedish nature reserves. A good combination of information and usability in such products would probably facilitates both visits and positive experiences. In this way, a good map can be the graphic designers contribution to improving the society.

But what is a good map, and how is it produced? The overwhelming amounts of maps popping up on digital devices and internet sites today raises that question. Some of these impress with features such as 3D-views or photographic “live-tours” in cities, others lack proper legends or look worse than maps produced in the 16th century! It seems clear that the communicative aspect of contemporary maps doesn’t kept pace with the on-going technological progress. Still, I believe that the new possibilities advanced geographical information systems (GIS) implies, will have huge effects on many aspects of map quality and map production.

To join this movement of development and progress is exciting. How can my theoretical and practical knowledge as graphic designer and visual communicator add qualities to contemporary map production? What do I have to learn to be able to participate? I believe the answers to both these question are the same: a lot! When first scanning the area I had big problems to find any graphic designer knowing modern cartographic technology or any GIS-expert knowing visual communication. There was one, but he was too busy to stop and say hello! Obviously, there is need and interest for people engaging in this area. In this thesis I will give it a try.

Aims and research questions for thesis

The main aim with this thesis is to study how Swedish nature reserve visitor maps can be improved by selection and visual presentation of relevant information. A secondary aim is to study how geographic information systems (GIS) and adopted working processes can be used to produce such maps in a rational way.

The underlying purpose is to find the best way to produce high quality nature reserve visitor maps that promote outdoor-recreation and care for nature and environment by making nature reserves more accessible and interesting as leisure destination.

The following three research questions were used to approach the thesis aims:

1) - How can a user centred approach help to improve static nature reserve visitor maps?
2) - How can Geographic Information Systems (GIS) and contemporary information presentation patterns be used to improve static nature reserve visitor maps?

3) - What professional practice and knowledge can a graphic designer use to produce good visitor maps for nature reserves?

**Research area distinctions**

To limit my research area and hopefully produce results with higher quality and relevance I have made the following distinctions:

1) - The context is Swedish, which sets some quite general but important basics regarding the societal context and the senders and users.

2) - The target user group is the “common Swedish nature reserve visitors”. These are defined as people between 25-50 years of age, having a medium or big interest in, and experience of, Swedish outdoor life and Swedish nature reserves. They belonging to middle or upper middle class. Both sexes are included. They speak Swedish and represent common Swedish cultural values.

3) - The focus for the thesis is on the process and the scientific report and not on taking a design object into production. The final design-suggestion will therefor not be final in the aspect of “ready for production” but an example of a work in progress.

4) - Only two areas/nature reserves are included, Langhammars and Stora Karlsö nature reserves, both found on Gotland. The cartographic solutions and map objects are therefor not presented as a holistic nomenclature valid and sufficient to apply on any given nature reserve.

5) - The thesis will focus on static maps. Dynamic or interactive maps are the counterpart to static maps and only shortly discussed.

6) - Images of maps are sometimes used in, or as inspiration to art. In this thesis I will not deal with this aspect of maps at all.

**Disposition of thesis**

This thesis consists of two parallel tracks presented together. Its format and disposition firstly correspond to the structure of a scientific report. This is also reflected in how most of the content is presented. Naturally, this is the way as it claims to be a bachelor thesis. Secondly, it also host a practical design project including other types of workflows and other types of material and results. This double approach affect the structure of chapter 6, as I have chosen to present the material and results correspondingly to a general design process structure (explained on p. 20 in chapter 5). Most of the design sketches and maps are presented in chapter 6 (with extensions into the appendix section).

Chapter 4, *Thesis framework*, is a fairly extensive chapter. I present much of the information, examples, theories and sometime conclusions I have drawn from my initial research. This does not only include research for the thesis but for the design project as well.

**Literature and sources**

The literature for the thesis is chosen from a larger selection of titles found in the initial research. It represents to a large extent recommendations from experts in the area together with reference literature from scientific dissertations, papers and articles.

I believe that these sources provide a good representation of general research and theories from treated areas. It is thou important to recognize the limitations of the material since the research has in no sense collected an overall view of existing literature due to the limitations of the bachelor’s exam context.

Regarding expert-informants used as sources in interviews and discussions, I have had the opportunity to work with a wide range of very competent professionals and experts on different subjects. As they are individuals, their opinions are personal and has probably shaped my own ideas and the work to some degree as well.

I will some times refer to different general or basic graphic design knowledge and praxis in my discussions or as own experience. As this thesis is addressed to graphic design students and practitioners I have some times chosen not to refer these to existing literature, even thou other groups of readers would might find this interesting.
4 - Thesis framework

In this chapter I will describe theories and knowledge gained from my literature research. Using my research questions and aims as a starting point, I wander through different disciplines and subject areas that often seems to be linked together in a natural way, one path evolving from another.

To understand the nature of my chosen area and my subsequent decisions and work I begin by defining the map from a historical context. This gives me a starting point from which I continue by analysing maps and cartography through a graphic design perspective. As maps are products made for use I bring a usability approach to the discussion and finally end up by looking at contemporary cartography and digital features such as Geographical Information Systems (GIS).

Defining the map

There is no uniform definition of maps in the literature. One of few attributes that seems to bind maps together is that they consists of a surface where graphical (or three-dimensional) objects or shapes are placed with special emphasis to their relative spatial positioning. Another attribute might be that they all have a purpose to convey or provide some information for a viewer or user.

This very vague definition is not often reflected in our modern understanding of maps. We assume that maps show true pictures of the earth as seen from above, be it simplified. We seldom question the information presented or the information left out. We seldom question the reliability or source of the information or the aims for which the map was created.

In his book on map communication, Lars Brodersen (2002, p. 16) vigorously condemn the map as a truth-bearing document and compare it with the art of a magician:

"A magician present his information in such a way that the audience interprets it in a certain way. Likewise, the map-maker wants the reader to interpret the map in a certain way. It is important to be aware of the fact that the information may not be correct or that it is out-dated, misleading, manipulative, inaccurate, incomplete or... But the presentation of the information makes the reader interprets and use the information in a certain way."

(Translated from Swedish original)

Brodersen puts a strong focus on the sometimes unknown aims of the map producer. There are many historical examples of maps whose main aims are far from facilitating their users with geographical, spatial or altitude information. The extremely expensive Klencke Atlas (fig. 4:1) from 1660 with lavishly gold-plated illustrations and a format of 175 by 190 cm (when open) was made as a gift from the Dutch sugar merchant Johannes Klencke to King Charles II of England with the ultimate purpose to buy royal favour (The Beauty of Maps, 2010a).

Another example is the serio-comic satire map of Europe drawn by Fred Rose in 1877 (fig. 4:2). It depicts the geo-political situation in Europe at the time with Russia as a giant octopus stretching its tentacles and strangling countries on the continent (The Beauty of Maps, 2010b).
These examples show a reversed understanding of maps as informative documents. As Ronald E. Grim, former curator at the Geography and Map Division at the Library of Congress, puts it: Maps should not only be understood...

“...as a record of a specific place at a particular time but also as documents that have a story to tell, both about how and why the maps were created and about what the map have to say regarding the culture in which they were created.”


In other words, maps might tell more about its origin than the world it depicts. Before focusing on the subject of this thesis, it is important to understand the diversity of maps. Maps can be produced for political reasons and they can be produced for functional-, environmental-, democratic-, religious- or artistic reasons. Further on, maps are used for several different purposes: as working tools, for education or leisure activities.

### Graphic design and maps

Maps are intimately connected to graphic design. Not only because they are built up by shapes, colours, typography and images, but especially because they combine this with defined aims and objectives. These characteristics firmly puts maps inside the borders of the discipline. Still, they form an own family that has to be treated and shaped with special care.

When I look at graphic design I recognize and consider the different design choices and features together forming a product. This includes combinations of colours, sizes and cuts of typography and placement of contextual information. These choices gives me information on how the designer has planned the communication, which historical references he/she uses and probably something about the intended user. This is interesting because the same information or underlying aim can often be communicated and reached in ways so different that they have no visual similarities at all. However, my initial research for this thesis has shown that this

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*Fig. 4:2. Serio-comic satire map of Europe drawn by Fred Rose in 1877.*
“visual freedom” does not apply in the same way to maps and cartography.

To a much higher degree than most graphic design, maps has to relate and adapt to scientific, legal and ethical regulations, as well as pure communicative ones. In particular, these include geographic representation and information distribution. A Swedish map can, for instance, be held responsible for accidents occurring due to incorrect information in the map (Hedgren, 2012). As maps are often (wrongly!) seen as objective and truthful documents (Brodersen, 2002), it is also important not to abuse the ethical responsibility this entails. Graphic design in general could be described as a communication- and information-carrier between senders and receivers. Maps, on the other hand, could be described as an interface between the user and the aims and objectives of the sender, filtered through a complex operating system.

As a graphic designer without prior knowledge of map-making, I had to obtain an understanding of this cartographic system and learn how design choices should be adapted to its context. To manage this I made a two-way approach. Besides researching cartographic literature and practice I made complementary studies of research and theory in my own practice, graphic design. The new knowledge and insights I got helped me to avoid severe mistakes and opened up for creative improvements in my subsequent work.

Cartographic process and design process

The practical approach applied in professional design work is often possible to structure into series of different actions. How these actions are conducted differs from one practitioner to another and between projects, but usually they corresponds to some general steps. Initial research, sketches and evaluation are such steps often preceding a final design and together forming a design process. Structuring design work on pre-decided design processes is desirable as it makes the work more efficient.

There are general design processes (GDPs) and specific ones. The advantage of the general process is that it offers a basic structure that is sufficient for most kind of design work. For complex areas or repetitive production, specific design processes are preferable. Map design is a complex area that needs a specific design process, a cartographic design process.

My own experience of design work is that different actions and steps are almost always processed simultaneously or parallel. During the initial research I usually start to plan different concepts and make and evaluate sketches to see if the work at all. For me, design processes does not consists of strictly ordered and isolated steps but sets of actions or activities overlapping each other. These help me to produce a better product if I apply them to my project. Never the less, to specify and isolate important actions makes it possible to evaluate, compare and improve the process which will result in better use of time and possibly better products.

What then differ the cartographic design process from the general design process (GDP)? Lets take a look on the GDP as it is described by the Swedish Industrial Design Foundation, SVID (SVID, 2012) (Fig. 4:5.). The explanatory comments are freely formulated but based on SVIDs (2012) description of the process.

1) **Brief**
   - Defining starting points and usually aims and objectives.

2) **User-studies and analyses/research**
   - Collecting information on users, their needs and about the topic in general.

3) **Concept and visualization**
   - Form, visualize and test one or several concepts based in item 1 and 2.

4) **Evaluation and selection of concept**
   - Comparison and evaluation of test results.

5) **Correction and implementation**
   - Including new test-rounds and corrections.

6) **Production**
   - Industrial or full scale production.

7) **Follow-up and evaluation**
   - of entire process and if the aims and objectives were met.

This is one example of a GDP, not the GDP. As to my knowledge, there is no universally agreed GDP, but SVIDs example above would probably be quite close to one. In this thesis, I will refer to SVIDs model when discussing GDPs further on.

In order to understand a cartographic process and how it differs from the GDP, we must first have a basic understanding of what cartography is. According to the International Cartographic Association (ICA, 2012), cartography is “the discipline dealing with art, science and technology of making and using maps”. ICA does not provide a definition of the cartographer, but
in this thesis I will define a cartographer as a person possessing the knowledge and experience needed to produce and discuss all aspects of maps included by the cartographic definition above. As contemporary cartography becomes more and more sophisticated, map production of today usually includes experts from different areas (Elg & Granath, 2006, p. 21). My conception of a cartographer is that he/she doesn’t have to be an expert in every cartographic area (it is surely not possible), but possessing enough knowledge to produce an efficient map with help of others. The main competence the cartographer thus must have, is how to gather correct data and transform it into information in a 2- or 3-D map design.

Returning to ICAs definition, cartography clearly encompasses a wide range of aspects and working areas: geography, geodesy (measurement and representation of the earth), computer science, visual communication and aesthetics - to name a few. A cartographic process helps us to consider and put these parts into action in order to produce a map.

The following cartographic design process (CDP) is presented by Wolter Arnberg and Bengt Rystedt (Harrie, ed. 2008, p. 261-262) (Fig. 4:6). Explanatory comments are formulated by me and based on discussions and examples about cartographic processes in Brodersen (2002), Elg & Granath (2006, p. 21-36), Harrie (ed. 2008, p. 257-268) and Maps of World (2012) homepage.

3) Design problem

The design problem is solved by an iterative pre-production process traditionally consisting of the following steps:

3a - Selection

The cartographer decides what data is needed to form a product that meet the requirements of the sender and users. The selection also depends on the size and scale of the final map product - a big size and large scale map can hold more detailed information than a small sized map. The process of selecting data is usually done parallel to classification and generalization.

Data is collected from different sources. Geographical data is e.g. collected from state or municipal institutions (or own field measurements/observations) while tourist information can be gathered from local tourist information offices or internet sites. Before gathering or processing geographical data the cartographer must decide on which map projection* and map reference system** to use.

3b - Classification

Classification (also referred to as content generalization) means dividing data into groups requested and defined by the selection process, i.e. highways, roads, buildings, protected areas, crop lands etc. If the user requirements define a need of separating road from forest road, two groups/classes has to be established, otherwise one group/class including both these sub-groups might be sufficient. Data put together in the same group/class will later on be treated as equal and represented in the same way on the map.

To indicate how data should be graphically represented (symbolized) to form information, classification should include defining data as

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* A map projection is a model of how the spherical surface of the earth can be represented on a flat surface, like a printed map. There are several different map projection models with different qualities (Harrie ed., 2008).

** As the earth is not an exact sphere or ellipsoid, it is not possible to define the exact location of geographic places by a mathematical calculation. Instead we define positions in relation to agreed reference points. Different reference points are ordered in different reference systems, e.g. SWEREF 99, which is the contemporary Swedish map reference system. By linking a map to a specific reference system and defining map projection the cartographer relates his/her map to an official system which makes it possible for someone else to recreate it or compare or connect it to other maps (Harrie ed., 2008).
either object, area or line as well as being qualitative, ranked or quantitative (see below for illustration) and if possible the degree of importance to meet sender and user requirements.

3c - Generalization
Generalization (or graphic generalization) is a process where the cartographer adjusts the graphical spreading, position and representation of the input data in a map image so it corresponds to the sender and user requirements and the size and scale of the map. The purpose is to create a map image where unnecessary data/information (for the specific map) is removed and important data/information is emphasized.

The cartographer uses several different techniques in the graphic generalization process. Fig 4:3 exemplify these as presented by Arnberg and Rystedt (in Harrie, ed. 2008, p. 266).

3d - Symbolization
Symbolization is the “graphic design”-part of cartography. This is where the cartographer decides on the actual “look” of the map by defining aesthetic approach and exact visual representation (in colours, texture etc.) for each data represented in the map. It includes e.g. saturation and lightness of used colours and defining a library of figurative symbols (examples from Harrie, ed. 2008 in fig. 4:4) used in the map.

3e - Testing different alternatives
After going through step 3a-3d, the cartographer produce one or several drafts for the final map design.

4) Final layout
The pre-production process ends when the cartographer is happy with a draft of a final layout and design.

5) Manuscript
The manuscript originates from the pre-production process and is a document describing which data to use and how to process it to form information in a suggested map design. If the manuscript meets the requirements of senders and users it is used as a “manual” when producing the map.

6) Does the proposed layout and manuscript meet the requirements of user and sender?
If yes: go to production. If no: go back to the pre-production process and produce new drafts and a new manuscript.

7) Production
All needed data is collected (if not already done) and a final map image is produced based on layout draft and manuscript.
8) Completed map

The production ends with a final map published as print or digital copy and distributed to users.

The design of maps can vary a lot due to map type and purpose for which the map is made. In this sense, the map is a language of communication rather than a type of visualized information. The process above can be used as a basic structure to produce most kinds of maps, maby all.

When comparing the general design process (GDP) (Fig. 4:5) and the cartographic design process (CDP) (Fig. 4:6) as presented above, we can see that the overall structure is quite alike. We have a starting point where we try to define the aims and objectives for the product. This is followed by a introductory research with a focus on the user or reader (which is equivalent with the receiver in a traditional communications model, see p. 17). The core part of the process differ in detail but both consist of iterative processes before a draft is developed to a final original and product.

If we go into detail of the processes it is clear that the CDP contains lots and lots of regulations on how the content should be gathered and processed before even drawing a single line on the map sheet. It seems that the cartographer has to be both scientist, visual communicator and preferably artist in order to create a good map. No wonder that several experts are often included in the process. If we consider the diversity of map design, it is clear that the cartographer actually has a lot of freedom, but this freedom must occur inside strict defined frames. This rigid set of “rules” is what mainly distinguishes the CDP from the GDP, they affect and shapes both the product and the process a lot.

But why make it so difficult? I believe the idea of the “perfect” model giving the human a holistic view and new perspectives is what enforces the complicated CDP and the development of geographical models and systems such as map projections and map reference systems. The idea of a “true” and reliable representation differentiate maps from other graphic design products. These products also deals with describing relations between objects or subjects but including the geographical perspective obviously take this task to a completely new level.

The core question of cartography seems to be: How do we represent a model of the geographical world in a way someone else can understand and use? For me, this leads to the reverse question: How do humans understand and interpret two-dimensional images as representations of the real world? Luckily, I found some guidance in this by studying basic graphic design theory, namely cognition and perception which I will present below. I also found some examples of how theory is transformed to practise in a way I couldn’t tell from my prior knowledge in graphic design. To a graphic designer, this is essential knowledge when trying to understand map design.
Cognition and perception in cartography

“One cornerstone of cartographic design is knowledge of human perception and cognition. These are the means by which we register and interpret maps and needed to be thoroughly understood in order to design useful maps.”

– Hanna Stigmar (2010, p. 18)

Cognition can be defined as “ability to process information” (Araï, 1999, p. 9) and as a scientific area it addresses several aspects such as human sight, hearing, memory and thinking. Cognition is mainly discussed in terms of cognitive processes and these can be divided into four subgroups: perception, attention, memory and imagination (Araï, 1999, p. 10).

Perception (fig. 4:7) is the part of cognition dealing with the individual interpretation and understanding of sensorial information input from sight, touch, taste, smell and hearing. (Araï, 1999, p. 33 and 10). Naturally, when discussing cartography we deal only with visual perception.

In cartography, as well as in other visualized information, there is a very strong and important connection between how the information is visualized and how it is read and understood. This connection can be described in form of design principles, a designer’s equation built by knowledge of cognition and perception mixed with technical and artistic/aesthetic capacity (Abugessaisa et al, 2006; Agrawala et al, 2011; Zakia, 2007). Design principles can be seen as rule-of-thumbs describing how to convey limited information in a larger context and thereby creating a message. Design principles are central parts of design strategies or processes, they are building blocks of visual communication and graphic design.

Both general and specific design principles come into use in cartography. General design principles are described by many authors. These includes e.g. figure-ground, Gestalt-principles, size, colour, shape and salience (Stigmar, 2010; Zakia, 2007). To understand the relevance of design principles for this thesis, I will present some general principles and how they apply to cartography.

Colours

Colour is a very useful tool in cartography since it easily can be combined with other signs and layers of information without ruin the clarity of the map (fig. 4:8 a-d), especially if it is used with a high lightness (Brodersen, 2002). Shared hues are perceived as a stronger and clearer incentive of grouping of objects than shape or texture (fig. 4:8 a-b) (Brodersen, 2002). Fast recognition and ability to connect one map object to a group or a special quality is important for the quality of the cartography.

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Both general and specific design principles come into use in cartography. General design principles are described by many authors. These includes e.g. figure-ground, Gestalt-principles, size, colour, shape and salience (Stigmar, 2010; Zakia, 2007). To understand the relevance of design principles for this thesis, I will present some general principles and how they apply to cartography.

Colours

Colour is a very useful tool in cartography since it easily can be combined with other signs and layers of information without ruin the clarity of the map (fig. 4:8 a-d), especially if it is used with a high lightness (Brodersen, 2002). Shared hues are perceived as a stronger and clearer incentive of grouping of objects than shape or texture (fig. 4:8 a-b) (Brodersen, 2002). Fast recognition and ability to connect one map object to a group or a special quality is important for the quality of the cartography.

Colour is effective, but since up to 7 % of the male population has some kind of colour blindness (medocular.se, 2012), colours have to be treated carefully when used as medium to convey important information to a wide audience. Actual implementation of colour schemes adapted for colour-deficient viewers are often overlooked even thou they exist (Light & Bartlein, 2004).
Qualitative, ranked and quantitative information

An important set of design principles in cartography relates to classification of information as qualitative, ranked or quantitative. Qualitative information is descriptive in a self-explanatory way, ranked information is the result of a comparison in some aspect and quantitative information always includes numbers (Brodersen, 2002). A green apple is an example of qualitative information. Three different sized bananas can be ordered relatively to size where the smallest and the biggest are placed on either side of the middle, describing ranking. The number of coins in my wallet can be described as quantitative information.

In common maps most information is qualitative, showing a house, a forest or a field of crops. In maps used for e.g. statistics and calculation there are several uses of ranked and quantitative information. In common maps we usually have at least one representation of ranked or quantitative information: altitude. Altitude is often presented as altitude curves and/or numbers of height over sea level. Altitude curves are understood in relation to each others, where a smaller curve inside a bigger/wider indicate a change to higher altitude. This is an example of how ranked information can be presented. If height over sea level is presented as numbers, that is an example of quantitative information presentation. These are often combined.

A common mistake is to visualize quantitative or ranked information as if it was qualitative, or vice versa (fig. 4:9.). To avoid this we must understand how the user interprets the visual information. Brodersen (2002) states that qualitative information should be described with different hues of colour (e.g. green and blue) as compared to ranked or quantitative information which should be described with different levels of lightness (e.g. light green, green and dark green) or saturation (black and white, faint green, green and intense green) of the same colour hue. When visualizing e.g. temperatures, altitude, rainfall or population density with different colour hues on a map this is confusing and tedious for the user. To avoid confusion it is also important not to combine different hues with different lightness or saturation (Brodersen, 2002, p. 99-100).

How information should be classified is no constant, it depends on the purpose it will serve (Brodersen, 2002, p. 67). A map where the users are happy with the information that certain areas represent forest can use a qualitative classification and visualization of forest. If the users want to know the percentage or density of broad leaf trees compared to conifer trees in the forest, this information has to be classified and visualized as quantitative or ranked information (fig. 4:10) (Harrie, 1997).
Fig. 4:10. Alternative visualization of different trees species in a forest. From Harrie, 1997.

Grouping by prototypes

Harrie (1997) presents a cognitive theory suggesting that people group objects in relation to prototypes (ideal/representative member of a group) rather than to their characteristics. This theory indicates that a principle for grouping visual representations in cartography could be that it is essential to find and depict specific attributes describing a group that can not be found in other closely related groups. If we, for instance, want to describe old windmills in a map, we must find attributes that separates these from other buildings and modern wind turbines. A solution could be to depict the wings, separating the windmills from buildings, and widen these the further they come from the centre (fig. 4:11). A wind turbine could be differentiated by blades with a more constant thickness.

Fig. 4:11. Map objects created from prototype-grouping theory by Harrie.

Semiotics and intuitive understanding

Both Brodersen (2002) and Stigmar (2010, p. 16) note that the usability of a map is improved by visualizing the important information in an intuitive way.

Applying cognitive terminology on Brodersens (2002) ideas, intuitive understanding of a visual message could be defined as a result of a mental process where the map-user/reader (receiver) with the help of general knowledge and experience can recognize the senders intention with the visual representation. To create visual messages that are intuitively understood by as many as possible, the required knowledge and experience should thus be as general as possible. To look closer to this issue we can go to semiotics, the “science of signs”.

Semiotics is described by Zakia (2007, p. 302) as “the study and application of signs, signs being anything and everything that conveys meaning.” Todays semiotic field has evolved from two different traditions, the North American C. S. Pierce’s “semiotic”, with roots in natural science, and the Swiss Ferdinand de Saussure’s “semiology”, deriving from linguistics and social psychology (MacEachren, 2004, p. 217). As the two traditions partly uses diverse terminology and models, I will only refer to the Piercean tradition in this thesis.

One result of Pierce intention to understand and describe the “logic of science” is his classification of signs by their relation to what they represent, their referent (MacEachren, 2004, p. 217-243). In this typology, Pierce described iconic-, indexical- and symbolic signs (MacEachren, 2004, p. 217-243). These must be interpreted in different ways to provide meaning to a reader (receiver), and as I understand this interpretation process it corresponds to degrees of intuitiveness.

The iconic sign looks like, or have direct similarities with its referent (Zakia, 2007, p. 303; MacEachren, 2004, p. 223). This feature makes it possible to understand an iconic sign (or representation) intuitively.

The indexical sign is close connected to the referent but not picturing it as the iconic sign does (MacEachren, 2004, p. 223). Pierce describes the index as a sign that relate to its referent “by virtue of really being affected” by it (MacEachren, 2004, p. 223) The index is thus directly connected to, and affected by, its referent. Kjörup (2004, p. 49) describe the sudden disappearance of light in a room as an indexical sign for a broken light bulb. Zakia (2007, p. 303) describe the footprints on a sandy beach as an indexical sign (for a walking person). Common to these examples is that they put the indexical sign in a causal relationship with its referent. The indexical sign is a sign of something, not a sign for something (Kjörup, 2004, p. 49-50). I would personally describe it as a trace of its referent. As I understand it, indexical sign always “arises” after or as a result of the referent, never parallel or before. In that case puddles on the street is a index of rain, but dark clouds are not. MacEachren (2004, p. 223) states that the most clearly indexical signs (or map objects) in maps are “the graticule lines or tick marks used to “indicate” latitude and longitude.” To be able to connect the indexical sign to its referent, the reader (receiver) must possess relevant experience or knowledge and some power of deduction.

Finally, a symbolic sign is exclusively built on a cultural convention, something that is agreed on in a specific context (Zakia, 2007, p. 304; MacEachren, 2004, p. 224). One example is the spelled out word “water”,

Barsskog

Lövskog

Barsskog

Lövskog
a symbolic sign built on the cultural convention of an alphabet and a language. As the symbolic representations demand specific prior knowledge of a cultural convention, it is not possible to understand intuitively.

As I will present in chapter six, I used the relationship between intuitive understanding and sign typology to adopt the representation of information in my maps to the interests of its stakeholders. As I was interested in the degree of intuitive understanding tied to different visual representations and the possibility to apply this to the map context, the definition of the indexical sign was to narrow and limiting for practical use. Still I wanted to have an intermediate step between the iconic and the symbolic sign.

The quality I found interesting in the indexical sign was the possibility to use the readers (receivers) power of deduction instead of demanding knowledge of cultural conventions to be able to provide information. What I did was to construct an alternative to the indexical sign, the “connotative sign”. The quality of the connotative sign is that it has a connotative relation to its referent, meaning that any visual representation that could be connected to the referent could qualify. This is of course a very loose connection to the referent, but in a real design situation the connection is strengthened when the designer adapts the visual representation to the target readers (receivers) possibility to connect it to the referent. In this aspect, the connotative sign can be closely related to its referent, like an umbrella to rain (fig. 4:12) or a tractor to agricultural land. The closely related connotative sign makes it easier for a large group of map-users (receivers) to make the connection to the referent and is therefor probably the only interesting type in a visitor map context. A connotative sign that is only related to its referent through a specific feature makes the interpretation possible for only an exclusive group of readers (receivers).

**Increasing map quality by applying user-centered design and usability theories**

As the map concept includes a huge variety of visual design possibilities, it is not possible to define quality in terms of preferred or specified colour schemes, typography, aesthetic approach etc. To be able to discuss quality, we must instead look at attributes that all maps share. Starting from this position, I believe we can search for definitions of quality in two directions. The first is input data. In this aspect, high reliability and accuracy (along with good legibility) should indicate high quality. The second is how well the map serves the interests of its stakeholders. Whether taking a sender or user (reader/receiver) perspective, the quality is determined by how the user respond to the map.

A traditional communication model that is often referred to and used in graphic design is the sender-receiver model. This model aims to describe how to convey information, presenting the sender as the active part and the receiver as passive (Pettersson, 2002, p. 22-23). This means that the sender selects the information, medium and format she thinks appropriate for conveying a certain message and sends it off to the receiver. The receiver is expected to receive the message and understand it in accordance to the senders intention.

In a user-centered and usability approach, this consistent understanding is not at all taken for granted. The focus is put on how the user understands and reacts on certain “messages” and the understanding of this dictates how the sender should design and her message (Dumas and Redish, 1999). In a user-centered approach, the information is rather provided by an information-provider than conveyed by a sender.

Pettersson (2002, p. 26 and 28) suggest that the information receiver in a graphic design context could be called “reader” while the receiver in a information design context could be called “doer”. These concepts indicates the difference between the two areas. While the information has mental effect on the “reader” (creating or changing ideas, opinions, understanding, emotions), it affects decisions about physical actions that the “doer” performs (does) to solve specific tasks (Pettersson, 2002, 26 and 28).

The doer in Petterssons description correspond well with a user in a usability definition, the main difference is that the doer uses information and the user uses a product to solve a task (Dumas and Redish, 1999, p. 4-5). If the doer needs to interact with a product to get the information to solve the task (e.g. map, guide-book, smartphone application etc.), it should be possible to
Improving Swedish nature reserve visitor maps with focus on relevance and visual communication

Bachelor’s thesis by Aron Hejdström

Applying a usability approach on map production is suggested by Brodersen et al. (2001, p. 9) and Stigmar (2010, p. 145). Leaning to usability theories, they define a good map as one providing the user with quick and certain answers to relevant questions. Brodersen et al (2001, p. 9) and Stigmar (2010, p. 145) propose that three types of measures could be used to quantify how “good” the map is:

1) **Time** used to solve the task (quick-slow)
2) **Behaviour** while solving the task (certain-uncertain)
3) Percentage of **correct** answers (right or wrong answers)

This approach to define and quantify quality closely corresponds to a definition of usability presented by usability experts Dumas and Redish (1999, p. 5):

“People consider a product "easy to learn and use" in terms of the time it takes to do what they want, the number of steps they go through, and the success they have in predicting the right action to take.”

The map often include several advanced functions based on presented information. Despite this, it doesn’t naturally mean it is easy to use – functionality and usability is not the same. Functionality refer to what a product can do while usability refer to how it is done (Dumas and Redish, 1999, p. 4). A good map must thus be a combination of functional and usability qualities.

Stigmar (2010, p. 145-146) concludes that the result of the three measures above depend on several cognitive and perceptive factors and lists some examples:

- The presented information
- How the information is presented
- Hierarchies between different object layers
- The amount of information presented
- The media and interface used for presentation
- The application and aim of the presentation

Knowing these parameters of quality and how they can be reached enables me as a designer to plan and evaluate my product and thereby produce a map with higher quality.

Besides the usability approach to defining map quality, it is possible to define quality in terms of how well the map serves the senders or producers aims and objectives - the percentage of actions or decisions that follow the intended. This approach is characterized by the user (reader/receiver) playing a more passive role by using the map for so-called “encyclopaedia search” (when the user starts “reading” the map without a clear purpose) (Brodersen et al, 2001, p. 9) and ingest (consciously or not) the map in ways comparable to commercials or propaganda.

Finally, both approaches could be used together in any combination selected to suit a specific study or research question.

**GIS and interactivity in map production**

A map can be seen as a combination of two parts: the data and the visualization (Brodersen, 2002). If the visualization of the data is well done, it gives it meaning in the eyes of the user and transforms it into information (Brodersen, 2002, p. 22). It is an ever on-going process for cartographers, land-surveyors and geographers how to merge data and visualization into a product with easily accessed information and good usability.

In recent years, the technical developments and digital publications possibilities has reached much further than the development, or at least the implementation, of the visual interface of maps (Schobesberger, 2009), (Stigmar, 2010, p. 6). Mostly, I believe, this is the result of a faster medial flow, technical improvements and a belief that digital systems and tools can substitute for the competence and working experience of cartographers. This is not something specific to map production, there are similar trends in many parts of digitalized publication or production. The possibility to produce something doesn’t mean that the product will automatically become good. An example is the introduction of word processing software in personal computers which initially led to huge amounts of typographically catastrophic productions because people had the possibility but not the skills to use them (Hellmark, 2006, p. 9-11).

Many maps today are made by skilled geographers but they often have limited or no education in visual communication (Stigmar, 2010, p. 7). In order to bring back the graphic design competence to the area of map-making, I believe the best way is to introduce basic geographic knowledge and contemporary technology to designers and let them play with maps for a while. In an early stage of my research, I understood that accessing digital map originals and geo-tagged data could
save me a lot of time as well as providing the possibility to create more geographically accurate maps. This is true even when creating small maps with very limited information content. One of my informants described his working process in which he digitalized geographic data and information by mechanical scanning printed maps and manually tracing them in Adobe Illustrator to receive vector curves. These curves could later be used as a starting point when he designed new maps. This work was not only tedious and time consuming, combination of data from different maps was often problematic due to various map projections, geographic source and scale etc. Clearly, there is much to win in applying a more rational way to map design than this. This conclusion led me to explore and learn the concept and possibilities with GIS.

GIS stands for Geographical Information System. A GIS is a computer based system containing functions for gathering, storing, processing, analysing and visualizing geographical data. Geographic information is referred to in a broad way as any information that, in any way, is tied to a geographical location - geo-tagged. In other words, anything and everything can be a part of a GIS if someone includes it and gives it a geographical reference. Aerial or satellite pictures and statistics are, for instance, often part of a GIS (Harrie ed. 2008, p. 14-24, entire paragraph).

GIS-systems are produced and used for their high potential in structuring, planning and administrate both large and small projects, systems or operations. They can be used to conduct environmental impact assessments on a national level or monitoring the European railway network as well as helping people to find the nearest gas station or the shortest way to the local store. People are not only users of a GIS but also main suppliers and developers. No GIS will work on its own. Often GIS-systems are commonly accessible to a larger group of people, although not all may have the same access to all functions. Some may mainly work as data-suppliers while other conduct analyses and others yet produce visualizations and public information (Harrie ed. 2008, entire paragraph).

GIS-systems are administrated through databases and computer software. A commonly used GIS-tool for digital cartography and geographic information processing is the software ArcGIS from ESRI. There are others, like MapInfo from MapInfo Corporation, but as I understand, ArcGIS is dominant on the market.

To give an example to anyone not familiar with the concept I would name Google Earth as a public and “light” version of a GIS. The functions are very limited compared to a professional GIS, but the main characteristics are there. You can import your own data, connect it to a geographic position and process it in some ways.

During my thesis I worked a lot together with representatives for Länsstyrelsen (the County Administrative Board) as they are one of the main actors of Swedish nature reserve map production. They use GIS very much and in many different situations. Their system consists of GIS software on personal computers/working stations. Through this software the employees can access different sets of data from internal and external databases. Länsstyrelsen produces their own internal databases but also buy or subscribes to several different sets of data from external providers such as Naturvårdsverket (the Swedish Environmental Protection Agency), Sjöfartsverket (the Swedish Maritime Administration) and Lantmäteriet (the Swedish mapping, cadastral and land registration authority).
5 - Research methods and material

Techniques and methodological structure

My work with this thesis can not be depicted as a straight line but rather a winding path. Sometimes crossing or connecting tracks has caught my interest and changed my direction. This is the nature of explorative work, in my case due to a new subject (maps and cartography) and a new format (the scientific structure). Explorative work in a design context means handling even more parallel activities than in usual design work. This has been exciting yet tiring at the same time. When deciding how to present my work and material, the complex process required some careful consideration.

In the preceding chapter (p. 10-13) I present design processes as a way to divide and analyse design work. These processes provide a structure of steps that the designer usually go through in between brief and completed project. After some thought I decided to use the structure of a general design process (GDP) (fig. 4:5) to frame the presentation and discussion of my work. There were several reasons for this decision:

– First of all, the GDP is a mirror of the actual work and include every step of it. This quality ensures that I (as author) don’t forget or diminishes any part during presentation or discussion. As it is not always easy to tell why a specific design choice was made, giving a more holistic view might help readers to assess and understand my process. This is an essential quality to any research presentation.

– Secondly, as the GDP puts a natural focus on the process instead of the final result, it indicates an interest in improving the process, in benefit to similar future production. This has close resemblance with protocols in action research and position my research not only as research through design but also for design. Further on, this fits well with the intention of this thesis: to explore the possibilities to improve the usability of design.

– Thirdly, most kinds of design work, from architecture and product design to graphic design, can fit inside the general design process. This means that the general design process provides a methodical and analytical structure which makes it possible to compare individual practice, methods, techniques and material as well as the final result. Comparison between different research projects is probably much easier than with e. g. case studies, as case studies are more adaptable and lack a rigid structure. This quality could perhaps be of importance to design research as an evolving discipline.

The methodological structure of my work and material presentation might differ from traditional research practice, but inside that structure I have used several well known methods and techniques. These are mainly gathered from action research and ethnographic research, areas that correspond well to interaction design (the design area covering maps). These techniques include interviews, questionnaire surveys, participatory observation, protocol writing etc. Of course I also conducted literature research and research through design - making and evaluating drafts. Ejvegård (2009, p. 33-34) suggests that combining different techniques and methods is a convenient approach in areas where it can be hard to present “undisputable proofs”, (i.e. by applying to tradition ally validated methods) e.g. in art science. To rely on material gathered through only one method or technique can result in wrong assumptions and results if the chosen method is not the exactly right (Ejvegård, 2009). If results from two or more methods points in the same direction, this strengthen the conclusions and the value of the research (Ejvegård, 2009 and Pickering, 2008. p. 4). Pickering (2008, p. 5) bring Ejvegård’s discussion one step further by stating that “methods are only guidelines for practice” and suggesting that “researchers should feel free to adopt them to suit their purposes”. With this support I decided to try to use the GDP as a methodological structure even thou it is unconventional. In the concluding discussion I will come back to the pros and cons of this choice.
**Action-research**

Action research is an extended method (or maybe rather a way of doing research) that focuses on a combination of scientific and practical knowledge. The practitioner is put in the centre with a mission to improve or find hidden problems (later to be corrected) in the solving of a task, simply by doing it - taking action. When the task is solved the practitioner steps back and evaluate and reflect on what happened together with other practitioners and scientists. Scientists contributes with structures for accurate evaluation and protocols. After reflections the process continues in cyclical rounds of new actions and reflections. What is learnt in one round is brought as new knowledge into the next. The idea is that this will help the practician to go from a perhaps undefined problem to an improved process and be able to present gained knowledge to other practitioners by the help of the protocols (Dick, 2002, entire paragraph).

An important part of action research is the collaboration between practitioners and scientists in the evaluative and reflective stages. This is not always a part in the design process as designers often work alone (at least graphic designers). On the other hand, the cyclical approach of action and evaluation correspond well with the design process. The execution of accurate protocols along the process is probably not done often in the design process, but if this is included it would take the design process one step closer to a valid scientific method.

In my work, I have considered the two design processes, the GDP and CDP, as protocols that I have inherited from other designers. These are descriptions of how to proceed to solve design problems. Specific design processes are, like action design protocols, “living documents” that has to change and be updated depending on the specific practitioner and situation and due to changes in techniques etc. In my work I have completed one cyclical round by studying two protocols (GDP and CDP), analyse them and let them guide my actions in practice. My gained experience from putting these protocols into action was a new protocol in form of a new cartographic design process for visitors maps - my own suggestion to an improved process.

My use of the action-research methodology differ on two points compared to how it is presented above. The partition between practitioner and scientist is not present in my thesis as I have worked alone, I represent both of these roles. The iterative structure of going through the entire process over and over again has not been done in the thesis because of the complexity of the process. I will discuss this further in preceding chapters.

**Ethnographic research**

As with action research, ethnographic research tries to analyse objects, processes or events through the eyes of the user or producer, thus using the human impression and experience as starting-point to create knowledge (O’Reilly, 2004). An important difference is that action research has a strong focus on creating knowledge on how to improve a specific process or product (Dick, 2002) while ethnographic studies aim to create knowledge in terms of understanding how and why things are or happens (O’Reilly, 2004). The ethnographic conclusions can later be used to change or improve things, but that is not the intention of the study.

The core of ethnography consists of the researcher involving with “human agents” (informants) in the context of their life and cultures and producing a richly written account on his or her experience and impressions (O’Reilly, 2004). Their main methods are participant observation and interviews, often complemented with other ways to gather data, such as collection of artefacts, taking photos etc. (O’Reilly, 2004).

In this thesis I have used interviews, questionnaires, participant observations and collected pictures and design samples to gather information about my research area and design product. I have analysed this material and put my new-gained knowledge into action in the production of a new product (my map). This last step does not belong to a traditional ethnographic process, as it would probably end in an analyse of what the results from the used techniques say about the subject or its context.
6 - Presentation of material and results

1) Brief

In a research or thesis context we do not speak of a brief. Instead we have aims, objectives and research questions that serves a similar purpose. When using the GDP as a methodological structure I have thus replace the brief with my aims, objectives and research questions (see p. 6 and 7)

The brief is usually the “kick off” of an assignment and the first step in the GDP. That corresponds to the aims and objectives of a research effort. The brief should be the most stripped down way in which the client specify his or her reasons, ideas and target audience for the product to the designer. The purpose is to make the designer understand as exact as possible what the client need and want in order to develop a fitting product. Even thou the client ultimately should be able to write the brief alone, my experience is that the designer often has to help writing or complement the brief with own questions to clarify and turn the clients needs, wants and ideas into aims and objectives.

In the research context, the client is often not as obvious as in the GDP – if you don’t collaborate with, or work for, e.g. a company. Still, the client do exists! For the researcher there is always an underlying client to relate to in form of the research community or society as a whole. The choice of research area and aims and questions should be relevant to contemporary issues and aim to contribute to societal knowledge.

When doing research in the area of design the designer has become a researcher. In the same way she tried to understand the clients ideas and improve the brief in the GDP, she must now try to understand contemporary needs, wants and ideas in the society and meet these with a product (knowledge) formulated in research aims and objectives. In the design context the client produce the brief with help from the designer. In the research context the researcher produce research aims, objectives and research questions with help from potential clients, other researchers or area experts. In this thesis I have formulated the aims, objectives and research questions based on input from representatives from Länsstyrelsen (the County Administrative Board on Gotland), design researchers and experts in the field of maps and cartography.

The brief plays two important roles as I reckon. Firstly it is a way of transforming initial information from the client to the designer, secondly it serves as a document of reference throughout the entire process. When I work as a designer I usually return to the brief now and then to evaluate how well my ideas and design answer to the clients initial needs and wants.

As a researcher I use my defined aims and objectives in a similar way, but even more I use my research questions: as a reference document to keep my work relevant to the aims and objectives. The research questions also helps me to present my research in a clear way by structuring my thesis – the product of the research.

In contrast to the aims and objectives, which are set in an early stage, the research questions are usually (and in my case) loosely formulated in the beginning and not laid down before the later part of the work. By this they are both a result of the work and material on which preceding work and discussions are based.

2) User studies and analyses/research

To gain contextual understanding and find references and inspiration, an initial research is conducted in design practice as well as scientific research. For the initial research in this thesis I used techniques such as interviews, participant observations, literature research, design analyse, picture and design sample collection and a questionnaire survey.

Working as a researcher prior to a designer meant that I had to find an aim and distinct research questions that was contemporary and relevant for the design research community. This was an interesting challenge and required extensive research in which I came into contact with lots of people in different positions. I also had to think about how my role and competence as a visual communicator could be used to link the senders aims and objectives with the users needs and wants.

My initial research can be divided into four subject areas: maps and cartography in a wider sense, contemporary cartographic technology, and analyses of
senders (the map originators) and users (the nature reserve visitors and intended map users).

The general research on maps and cartography gave me a basic knowledge on communicative issues and praxis in map design. Much of this is presented in the fourth chapter – Thesis framework. Material and knowledge from this research were directly put into practice and worked as a frame to the preceding creative process. That material was gathered using literature studies, interviews and participatory observation. The participant observation being a “light-version” limited to only a few hours a time.

To understand the senders aims and objectives, I analysed several Swedish nature reserves visitor maps and made interviews, visits and held recurrent discussions with local representatives for Länsstyrelsen on Gotland and in Västergötland. My contact persons were in direct contact with nature reserve visitor maps as one of their areas of work.

To understand the users needs and wants, I set up a web-based questionnaire including questions on visit experiences to nature reserves and expectations and use of nature reserves visitor maps. The gathered material was complemented and analysed together with my own live experiences of visitors needs and wants from many years of working in a Swedish nature reserve.

Material from both user and sender studies and analyses will be presented ahead.

In the initial research I learnt that it was important that the maps I was going to produce was accurate to official geographic references. This meant they had to be developed from maps provided by Lantmäteriet (the Swedish mapping, cadastral and land registration authority). To do this in an efficient way I had to use digital software designed to process geographical information systems - GIS. Before this thesis project I didn’t know any such software or even the concept of GIS at all. This meant I had to pull an considerable amount of time and effort in learning this and figure out how to use these tools to facilitate my work. This was done by attending an introductory GIS-course at Lund University. The material gathered from this preparatory training mainly consists of acquired personal experience and knowledge together with literature. Some of it is presented in chapter 4, p 18-19.

**Analysing senders aims and objectives**

By studying and analysing large numbers of nature reserve visitor maps I got an overview of commonly used - and expected - visual styles for my subject. This resulted in long lists containing visual examples with associated classifications and own comments (fig. 6:1). These lists constituted a “pictorial library” for inspiration and reference in my preceding graphical work.

The map study was conducted in paralell to in-

<table>
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<th>Subject</th>
<th>Quantitative</th>
<th>Ranked</th>
<th>Qualitative</th>
<th>Icon</th>
<th>Connotative</th>
<th>Symbol</th>
<th>Point</th>
<th>Line</th>
<th>Polygon</th>
<th>Raster / photo</th>
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<tr>
<td>Lighthouse/beacon</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deph of sea</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Different kind of borders</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fig. 6:1. A part of the “library” of analysed design solutions and map-objects from nature reserve visitor maps. The library consists of approximately 130 posts.
Interviews with Lena Pettersson (warden of Gotlandic nature reserves) and Sofie Lindblom (superintendent at Hornborgarsjöns Naturum). Both Lena and Sofie work at Länsstyrelsen and thereby represent the authority that usually produces (or order) nature reserve visitor maps in Sweden. These interviews resulted in the following list of primary and secondary sender aims and objectives for Swedish nature reserve visitor maps:

**Primary sender aims and objectives:**
- Clearly describe the extents of the nature reserve, i.e. the protected area.
- Guide visitors to the main attraction sites.
- Give the visitors the possibility to experience the general and special qualities in the reserve without disturbing the animals or damage the plants or environment.
- Protecting the visitors from actual dangers such as strong currents, steep and slippery slopes or avalanche risk areas.
- See to that visitors enter and exits the area on preferred paths or roads and don’t violate the restricted area with driving motor vehicles etc. Driving and parking outside the road is a major problem in e.g. Langhammars.
- Clearly describe regulations of specific reserve so that people don’t break rules and disturb or damage nature and wildlife.

**Secondary sender aims and objectives:**
- Inform about specific rules or avoid specific problems tied to the area. In Langhammars: Small stone-towers etc. Inform that dogs must be leashed. Keep horse-riding away from walking-trail. Throw garbage in bins, not in nature. Use camp-fire places, don’t make fires anywhere. Etc.
- Keep visitors away from extra sensitive areas or private property.
- Reflect the quality of the authorities work being done in the area.
- To get visitors to appreciate nature conservative and protective work and take a personal response in this work.

**Analysing users needs and wants**

The web questionnaire I constructed (appendix 1:1-1:2) consisted of four open questions and one image containing five map examples. It was sent to 52 persons (28 women and 24 men) via facebook and e-mail messages. 24 of these (13 women and 11 men) responded to the questionnaire within three days, which was the given limit. 21 of the respondents were in age between 20 and 35, three were over 50.

The respondents were picked from people I know and whom I expected to be interested in visiting nature reserves more or less often. The social-economic belonging among the respondents was not homogeneous but no respondents from extremely rich or poor background were included, the respondents are thus likely to represent Swedish middle class.

The answers from the questionnaire was gathered in an original document and later analysed together with my own experiences, compiled to the following lists. Whether user needs and wants was classified as primary or secondary depended on how many of the respondents that raised the issue.

**Primary user needs and wants:**
- Understand where the nature reserve is situated in relation to known sites, such as bigger cities etc.
- Find the easiest way to reach the nature reserve.
- Understand the location of the information site, if the map is positioned in field.
- Find the location of main attractions in the area, such as beautiful viewpoints (to take photos to show friends etc.), giant trees, high waterfalls or that specific plant or bird etc.
- If and where there is a kiosk or manned information centres.
- If and where there are public toilets.
- Find the easiest way to reach... main attractions, information centres , understand how this has to be done (walking, driving, by ropeway etc) and the distance or time it will take.
- Identify clear/bigger landmarks such as streams or buildings etc. and understand if on the right way to the destination.
- Understand how to walk to get a “nice weekend trek”, not to short but not to long either (users have to be able to understand the distance of one or more round-tours, starting and finishing in the same place.

**Secondary user needs and wants:**
- Find other possible entrances or exits to the area and ways to reach these.
- Find out special areas that could be interesting for a cross-country trekking, climbing or putting up a tent (including calculations of vegetation type and altitude).
- Calculate the approximate distance between two points not included by the main attractions.
- Be able to tell if there are any divergent or unexpected areas in surrounding (such as a car road, public beach, old quarry etc.) worth a visit or a detour.
- Find some possible natural viewpoints according to altitude and vegetation type.
- Be able to find the best places to spot a specific plant
or animal by identifying favoured biotopes and natural conditions.
- Be able to tell the main natural characteristics of the nature reserve (e.g. “mostly forest and savannah, some small ponds” or “probably old grassing lands, cultivated land and settlements near the reserve border”).
- Understand rules, which activities are allowed and which are not.
- Estimate the possibilities for disabled persons to move in the area.
- Be able to find out about other interesting natural places (reserves etc.) in the surrounding and understand how to get there.

3) Concept and visualization

In the general design process, this is the stage when a theoretical concept is developed and the first visual sketches are produced to meet this concept. Much time is usually spent on thinking and testing different ideas both theoretically and practically. The concept is the conclusion and the suggested answer to the brief or the research questions.

My work in the context of this thesis correspond quite well with the presentation above. I brought together input from the initial research with my research focus and experimented with different design solutions through sketches (fig. 6:2 a and b, next page) alongside with the development of a theoretical concept.

Concept outlines

After the initial research I had a good overview of traditional and contemporary cartography as well as special sender aims and objectives and user needs and wants for Swedish nature reserve visitor maps. To improve these types of maps I looked at definitions of “good” maps (see chapter 4, p. 17-18) and tried to understand how the information needed to facilitate the specific interests of my case could be presented in a way meeting these definitions.

A traditional approach would be to adapt a cartographic generalization process to the specific aims and objectives and needs and wants for the case (Brodersen, 2002). Clearly expressed this means that you decide what should be included or left out in the map depending on the originator, the target audience and the situation the map is designed for (the user situation). I did this, but through studies of the relation of cognition and perception and visual representations I found a way to customize the maps even more. I could thereby try to take the usability one step further.

As described in chapter 4, the semiotic classification of signs suggests that iconic representations can be intuitively understood while connotative and (especially) symbolic representations acquire imagination, deductive reasoning and prior cultural knowledge.

My concept lies in the conclusion that what is considered important (primary) information, due to sender and user interests in a specific case, should be visually presented with iconic representations while less important (secondary) information should be presented with connotative or symbolic representations. Figure 6:3 shows a way to merge sender and user interests to decide how to represent the information.

### Fig. 6.3. Table to decide semiotic type of information representation.

<table>
<thead>
<tr>
<th>Sender rating</th>
<th>User rating</th>
<th>Iconic if possible</th>
<th>Symbolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>Iconic</td>
<td>Iconic if possible</td>
<td>Symbolic</td>
</tr>
<tr>
<td>Secondary</td>
<td>Iconic</td>
<td>Iconic if possible</td>
<td>Symbolic</td>
</tr>
</tbody>
</table>

At first thought it is tempting to present all information with iconic representation, but knowledge about information visualization (see chapter 4) and basic rules of graphic design show that such an attempt will simply not work or become a catastrophe in a usability perspective. What I did was trying to produce map objects, i.e. graphical representations of information in the map, that was more iconic (like pictograms) for the primarily needed information and more symbolic for secondary information.

While I hopefully improved my maps by implementing the concept above I still faced problems as my sketches of map objects couldn’t express all things I wanted. I was worried that the requested functions of my maps could not be met in a sufficient way. To solve this I took a broader view and gathered inspiration from visualized information on the internet and in contemporary literature.

Holsanova (2010) uses eye-tracking methodology to show reading patterns and connect information visualization and layout with degree and speed of understanding. Her conclusion is that information presented in a combination of different ways such as text, graphics and pictures, is more efficient than if only one of
Fig 6:2 a. Early sketches of map objects.
Fig 6:2 b. Early sketches of map objects.
these ways are used (Holsanova, 2010). Also Pettersson (2002, p. 37) argues that a combination of text and images (including graphics) is preferable when conveying complex information.

As a primary objective for visitors in Swedish nature reserves is to find “main attractions” (due to my user studies) I decided to complement my cartography with photographic pictures and text describing some of these attractions in the mapped areas. As these attractions are always unique, iconic cartographic representation was not enough; they often become to general or looking “childish”. This choice of photographic representation is supported by Pettersson (2002, p. 107) who claims that images “provide a much better overview and understanding of a subject than words”.

To decide which specific main attractions I should include as photographs in my map I analysed the chosen areas, asked and discussed with locals knowing the areas well and used the selection of private pictures uploaded and geo-tagged on Google Earth. The latter technique proved very useful (at least as a starter) as the main tourist attractions in an area would be represented with many pictures from many different contributors while less interesting visit spots collected few or no pictures (fig. 6:4).

4) Evaluation and selection of concept

As the cyclical workflow of action research is continuously present in stage 3, 4 and 5, it is not totally clear where to put the transition between the stages. For this thesis I have chosen to place the theoretical part of the concept together with most of the freestanding design sketches and design solutions in stage 3. I calculate the beginning of stage 4 to when I have merged the concept and single sketches into a map sketch. This is not a final map, but something that looks like a map and can be evaluated as a map. In fact, I merged my concept and sketches into not one map but two different to try the potential of my concept to different conditions. The mapped areas are two different nature reserves on the island of Gotland.

In the following chapter, I will not present, evaluate and select between different theoretical concepts. Instead I will show some different visual solutions to the style of my concept and discuss why I choose the way I did. I will present my workflow and finally describe a field test I conducted with one of my maps together with some results and insights from that test.
Maps of Langhammars

The first area I choose to map for my thesis was Langhammars nature reserve. I choose it because of its relative complex surroundings (among Gotlandic nature reserves) with many different types of map objects present. I didn't know the area, even thou I think I have visited it once or twice.

Before I could start to change or try to improve the map image I had to get the right geographical data in the right format and in the right computer software. This was something I had to do to my second mapped area as well. Clearly speaking, this meant to...

1) obtain geographic data files covering the relevant areas (I used “Terrängkartan” from Lantmäteriet as source),

2) open the files in a special cartographic software (ESRI ArcGIS/ArcMap), choose which parts/layers of the geographical data I wanted to use and convert it to a vectorized file format that I could later...

3) open and work with in software that I knew and that was suitable for visual design activity (Adobe Illustrator).

To figure out how to manage this process and arrive to the “starting-point” for my design activity took a very long time and much headache. Later on it took even longer to understand and get things right to produce the hill-shade modelling for the altitude of the areas (see below for clarification), but with some stubbornness and help from different people I finally made it. The reason I didn't stop half way and designed my maps in ArcMap, which is possible, was that I didn't know the program so well that I could expect to create the map I wanted. I also knew that the program was insufficient to support my need of artistic freedom and experimentation in a way compared to a dedicated graphic design software such as Adobe Illustrator.

One of the most important choices I faced in the design work was how I wanted the overall artistic approach to look like. This was tested by preparing different map “backgrounds”, i.e. the map image that mainly give basic information on land use (such as forest, cultivated land or urban areas). This choice was important but not essential for the function of the map, still it was very important because it affected the artistic style complementary information should be produced to match. The complementary information overlays the map image in form of text, linear map object (such as roads, altitude curves and power lines) and punctual map objects (such as houses, information signs and ancient monuments). Before producing these I thus had to know the artistic style to use.

To choose an approach I prepared four different examples (see below). All these approaches had pros and cons in terms of production and usability. While analysing the different maps I tried to evaluate them in relation to the aims and objectives of the sender, the needs and wants of the users and to the signals I believed they would send to the user. In this evaluation I had good help of the discussion of different map types in Naturvårdsverkets (the Swedish Environmental Protection Agency’s) handbook “Att skylta skyddad natur” (Lundin, 2003) about information distribution in protected natural areas.

The first example (fig. 6:5) was more or less the original or starting point to the others. This is what I got after putting some colours to the cobweb-like image of thin lines that I extracted from the original geographical data sets (fig. 6:10). The image contains one layer in 100% opacity (less than 100% opacity means that a layer is transparent).

The second, hand-drawn, example (fig. 6:6) is a quite common approach which appears in some dif-
different shapes for visitor maps for nature reserves. The hand drawn map is produced to correspond to the same lines and areas as the computer made map so that the geographic accuracy is still correct. I produced this map example by projecting the lines from the original map through a video projector onto a paper where I traced the lines and later added colours (fig. 6:7). The painted map was photographed and returned back to Adobe Illustrator. As it was drawn on a paper with high grain, the surface structure of the paper produced a slight paper-texture in digital map.

In the third example (fig. 6:8) I tried another approach that appears now and then in nature reserves visitor maps: a combination of an aerial photograph and a computer generated map. To my example I extracted aerial photographs from Google Earth, eniro.se and hitta.se. As I understand, all of these originates from Lantmäteriets databases. Several smaller pieces was put together to create a bigger map with fairly good resolution. This merged map was transformed into a grey-scale image, imported to Adobe Illustrator and over-layered with a quite transparent (approximately 30-40% opacity) image of the original map image (fig. 6:5). This was made to make it easier to read and understand the aerial photograph as a map, whith a more distinct separation of different areas (such as forest, cultivated land etc.)
The forth example (fig. 6:9) was an approach I had seen in only few nature reserve visitor maps: a combination of a computer generated map and an image that use shadows (or shades) to give a 3D-impression of the landscape. In my example, I placed a transparent (approximately 40-60% opacity) and modified copy of my original map image (fig. 6:5) upon a computer modelled image using shades to show the altitude of the area (in ESRI ArcMap and henceforth this is called “hill shade”-image). I also tried to give the map a more tactile and humanistic look by digitally simulating a paper-texture and add it to the hill shade-image. I will describe this in detail below.

When I evaluated the examples and choose the style for my map I considered both how the style affected the map function and thereby its usability and which signals its aesthetic appearance would send to the user. I also considered how time consuming and complex it was to produce each special map. Creating an efficient production line is almost always preferable in assignment production and since I wanted to produce relevant and interesting discussions and information for other designers, this was interesting.

The first map have a plain and clearer look. It was quite easy to produce but it contains less information than both map three and four. I didn’t yet know if this would prove to be too little information or if it was sufficient for its purpose. This first map is quite static and flat to me, which is not the case with the second. The second hand-drawn map is much more dynamic, humanistic and vivid in comparison. I like to think that the hand-drawn and humanistic approach better suit the main focus of the user group (to visit nature reserves for leisure, recreation and fun) rather than a clinically exact map (that would better suite a user that had to make exact calculations or measurements in a professional working situation). Another negative aspect of the second map was that it took quite some time to produce. The hand-drawn approach also didn’t give the same exactness and, important to note - the same credibility, to presented reliable geographic data as the computer generated maps.

The third approach including the aerial photographs was also time-consuming to produce but that was mainly because I had to produce a high resolution photograph out of lots of small patches instead of receiving a original high resolution photo from Lantmäteriet at the start. An important difference from map number two is that the details which created “messy-ness” in map three is geographic information that maybe could be interesting for the usability of the map. I am not sure where the third map would position itself in the credibility-aspect, but my guess is somewhere in between but closer to the hand-drawn map than the computer generated. As I already had the original map (fig 6:5) the procedure of over-layering a transparent copy to the photographic image was quite easy.

The fourth approach was more time consuming than all of the others because of technical challenges. I persevered because I thought that this approach could be the best due to its clarity and usability. By modelling a three-dimensional landscape with the help of shadows the user would at first glance have a rough understanding of the altitude variations in the area. This would probably help the user to make a direct and intuitive connection between the map and the reality and create a good starting point for using the map to navigate. The alternative I saw to present altitude information was altitude curves. These might give more exact information than hill-shading but also demands a more skilled user.

The cleanness of map one and four make them suitable to expand with lots of additional data. In comparison, map two and three have a quite messy background which put some limitations to how much or in which way additional data can be placed and still be legible. As I saw the analogue and hand-drawn aesthetic as a preferred quality from the second map I tried to transfer it to the computer-look of map one and four by adding an extra layer of texture on the map image.
After comparing the different qualities of the maps I decided to continue with the development of the fourth map image approach as I thought it to be the best to meet the requirements of my map and target user-group.

**Production of the hill-shade map background image**

The production of the hill-shade map image (fig. 6:9) was time consuming mainly because I didn’t know the techniques and had big difficulties to find someone who knew. Even though the procedure takes some time it is not very complicated if you know it and it can be summarily described in four steps:

1) **The starting point was a shape-file/shp-file**, a vector map file-format for ESRI ArcMap. This file contains many layers of different geographical information that is present in the treated area (such as roads, areas, objects etc.). All this information is presented piece by piece in two ways, partly as lines, dots or polygons (areas) in a two-dimensional “map-window” and partly as detailed meta-information (e.g. classification of size, height, rainfall, density, etc.) in an associative database. After choosing all layers I wanted to use in my map I prepared and exported these to another vector format that could be read in Adobe Illustrator. The first view in Illustrator looked like a cobweb of thin black threads (fig. 6:10). After straightening out the Illustrator file I first produce an basic map showing the land-use/surface information of the area (fig. 6:5).

2) To produce the hill-shade image I had to go back to ESRI ArcMap and isolate the altitude curves from the other layers (fig. 6:11). I also had to configure the meta-data dictionary connected to the curves to be able to process the altitude information through the “hill-shade tool” in ESRI ArcMap and produce the basic hill-shade image.

3) The basic hill-shade image was exported from ESRI ArcMap to Adobe Photoshop and refined to get the right resolution, contrast and lightness (fig. 6:12). A slight paper-like texture was also added in Photoshop.

4) The final hill-shade image was imported to Adobe Illustrator and merged together with a transparent version of the original map image to produce the final “hill-shade map image” (fig. 6:9).
Completing and analysing the Map-sketch of Langhammars

Having decided on the overall artistic approach I could start to take some of my map object sketches towards a final design. My work here mainly consisted of designing, placing in context, evaluating, and redesigning until I had something I was happy with. I also collected expert comments from my contacts and used the knowledge I had gained in the research. For example I decided to use standard map pictograms as long as possible to create recognition and fast understanding among the users. I also used these pictograms as starting-point and redesigned them or tried to follow their style and look when designing new ones. As I have mention earlier, the intention was not to create a final product including all desirable information but rather to explore and try out approaches and systems to deal with information presentation. The results from this work contain both sketches in different stages and a map sketch of Langhammars nature reserve (fig. 6:13). In this map sketch I pulled together most of the map objects with the map background image.

As I will discuss ahead, I didn’t put the Langhammars map sketch to a user test in field. Instead I drew experience from it by design activity and by showing and discussing it with Petter W Rimfors, one of the few locals living in the middle of the nature reserve.

Rimfors main input was to describe how the area actually looked like and point out where the map was wrong. Things like “this path don’t exist any more but we use this old forest road to go from here to here...” and “this area is occupied by a colony of terns all summer so you could never suggest a trekking-route here” gave me some new views on desktop publishing. Without local experts or visits and researches on the actual spot I could not hope to produce a good map. Petter also pointed out several “unknown” objects such as a ruin of an 19th century lime kiln and an old sheeps house. These were not present in the “Terrängkartan”-map but would definitely be interesting to include in a visitors map.

Beta-test/field-test at Stora Karlsö

After adding some main map objects (and thereby information) to the map background image I got something that started to look and work like a map. I decided that this map sketch-state was suitable for going through a user test. I assessed that a test would be able to give important information about pros and cons in details as well as in an holistic aspect.

During my work with designing and adapting
Fig: 6.13. The map-sketch of the Langhammars-map.
nature reserve visitor maps I gradually understood the importance of applying a usability approach to the process. This insight came slowly and was therefore not adopted from the start and neither fully in the later part of the work. Still it affected many of my choices, e.g. that I wanted to evaluate the map in a field-test.

The field-test was thus of great interest, but it proved hard to realize. My existing thesis project time didn’t allow me to travel all the way from Malmö to the remote nature reserve at northern Gotland and set up the test. I sought for alternatives and finally decided to produce a new map for a location where I would spend the coming summer and where it would be easier to set up the test. This meant that I had to set aside the original thesis project dead-line but at the same time it also gave me the opportunity to try my concept and new-gained practical experience on a new area. The latter had seemed like an important aspect to me for some time and that affected my decision to go through with this approach.

Fig. 6.14 a. Front-side of SRC-map no 1. Marked routes and visit-points over a quite simple geographic representation. All maps were printed on both sides of a A4 paper-sheet.

Fig. 6.14 b. Backside of SRC-map no 1. All backsides presented routes and visit-points in pictures and text. All three maps are found in appendix 3:1-3:6.
My second test area was decided to be Stora Karlsö nature reserve, a small island on the west coast of Gotland. I personally know the island very well since I have been working there for several years. My local knowledge and summer employment on the island enabled possibilities to compare the area with the map original from Lantmäteriet as well as conducting visitor studies and a field-test.

The field-test at Stora Karlsö was designed and conducted under special circumstances and in cooperation with members from Stockholm Resilience Centre (SRC). SRC is a multidisciplinary research and communication centre at Stockholm University working with issues connected to environment, nature and society.

Together with two members of SRC I created three maps (fig. 6:14 a-b and appendix 3:1-3:6), each with three different thematic routes presented. These were created to encourage visiting members from SRC to take longer walks around Stora Karlsö and to visit other than the most common tourist-sites. The maps for this test was produced in a similar way as the Langhammars map and used many of its features but the special purpose for SRC also made them different. This meant that I couldn't test all features in the Langhammars map, but instead I had other important insights. The Stora Karlsö map had significantly fewer map objects and only attractions along special routes were included. At the same time the mission to highlight places of special interest and helping people to plan their walking-routes closely resembled my prior map concept.

To gather user-experience from the field-test, I created a small questionnaire that was handed out together with the maps. This questionnaire consisted of the following four questions:

1) - Are you familiar with navigating with a map when tracking by foot? (no, some, much)

2) - Did you choose to take any of the suggested tracks (which) or visit any of the suggested spots (which) or did you make a route on your own? How did the map influence your decision? How did it help you?

3) - The map (including both sides of the paper) is quite simple, but was it too simple? Did it serve its purpose?

4) - Did you miss any important information in the map? What kind of information? What would you have used it for?

In total 26 respondents was included in this survey. The estimated age of the respondents was between 30 and 55. A big majority of the respondents was researchers or PhD-students and the general knowledge level has to be considered very high. Many of the respondents was guest-researchers or exchange-students from countries outside Sweden. The maps and questionnaires were handed out to a bigger group (about 40) but not all wanted to participate. (It is important to notice that their main interest was to socialize by walking together on the island, the map and the suggested routes was a tool to facilitate this.)

After going through and transcribe the returned questionnaires I analysed and compiled the comments. These follow below.

- Most of the respondents stated that they had much experience of maps (15 of 26) and of the remaining eleven, only one said he/she was fairly new to maps. Despite this, it was interesting to see that the users had very different ideas on the quality of the map. Some said it was perfectly clear and with the appropriate level of details (e.g. “Made several D-tours, used map to get back on track.”) while others found it far too simple or unclear in important aspects (e.g. “We did get lost, because of the simplicity of the map.”).

- Several respondents commented on the fact that the suggested routes marked on the maps didn’t follow real paths or trails in field. The result in some cases was that the respondents lost their orientation and way and was confused. One respondent suggested cartographic information on the quality (such as visibility, size, texture/material etc.) of paths and roads as improvement.

The intention with the map was to take the visitors on new routes to new places, but the information that these routes was “off trail” was never presented to the test-group and that is an important notification: The context to which the user is presented to a map is important to what he or she will expect of it.

- Several respondents declared that they lacked information about where the sheep-fences (and fence-openings) and cliff edges were situated in order to plan their routes. One respondent described these as obstacles, a generalization that effectively can be brought back to design-practice: Clearly show/describe features that can or will influence on the activity of the user.

- Some respondents asked for more cartographic details to navigate by, reference points on the map that correspond with easily found landmarks in the field.

“As a walking map for inexperienced map read-
ers some “vertical” elements [...] that one easily see in the landscape, cliffs, antenna, etc. could perhaps be used to support guiding [navigation]..."

“I think putting some illustrations of iconic artefacts/features could be helpful, e.g. a big tree, a fence, a cliff. These iconic representations could give more immediate orientation power. In a sense it would be like merging different scales [...] the high scale with whole island and the small scale of artefacts.”

- One respondent, a trained geographer, wanted to have more information about the diversity of biotopes (such as vegetation patterns and geological shapes) to improve navigation. He/she also asked for a reference between Stora Karlsö and Lilla Karlsö and cartography on fences and crossings - if they are permanent.

- One or two respondent said that the altitude curves was helpful, another that altitude information would be interesting. (I read this as figures complementing the curves.)

- Two or three respondents lacked a legend and one lacked a north arrow.

- Two respondents commented that he/she didn’t understand what the green polygons was (they represented forest/trees).

- The idea of using the backside to highlighted “points of interest” with picture and text seems to have had a positive influence on some respondents.

“The backside with the pictures was nice and informative.”

“Nice pamphlet with both sides in one package - good info.”

“ The text was really helpful and straight to the point. Obviously, once you are in a route you feel like knowing more about the spots.”

“We made slight changes to the route because we were pulled by interesting sites, but always tried to reach the key spots in our route...”

One respondent directly asked for more points of interest marked on the map.

5) Correction and implementation

The field test at Stora Karlsö gave new understanding and insights about selection and presentation of information as well as a reminder of how important it is to pay attention to the user needs and wants in the specific situation. The evaluative expert discussions with Rimfors as well as others about the Langhammars map put light on the complex task to find the right information to present in the map and the need of cooperation with local expertise or extensive research to be able to produce good and relevant nature reserve visitor maps.

In the stage of correction and implementation response and insights such as these are the core input that I, as a designer, use to improve and finalize my
product. In action research the repetitive process works in the same way and as a researcher in this thesis I brought back the Stora Karlsö map to the desktop to try to improve it. The reason I choose the Stora Karlsö map and not the map of Langhammars was the need of local expertise. As I am myself a local expert on Stora Karlsö I would probably reach further in my attempt to improve the Stora Karlsö map than the map of Langhammars. What I did on the Stora Karlsö map should not be seen as a final product but as a suggestion or a start on what could be done.

The two most important insights from the evaluation of the map sketches was the lack of detailed and exact geographic information to navigate by and the quality of complementing pictures and text to describe and highlight sites of special interest. After much thought I decided to try change the artistic approach of the map background image to address the navigation problem. The reason was that the different approaches (fig. 6:5, 6:6, 6:8 and 6:9) also affected the function and usability of the map. In the new version I tried a combination of a aerial photograph and some remains of the hill-shade approach (fig. 6:9). The challenge was to simplify the photograph to get a clean background to apply complementary information on and at the same time keep as much geographic information from the photograph accessible as possible.

In the updated version (fig. 6:15 a and b) I placed the “basic” map on a front of the imagined map-sheet and a secondary map with suggested routs and photographs on the back. The changes I made to produce the new Stora Karlsö map sketch (fig. 6:15) was extensive and could maybe be described as a new concept rather than a correction of a old one.

6) Production

In an ordinary design process the production is an important step as it puts the desktop work into products for the market. This is usually the main goal for the designer and the client as it marks the end of the design-work and the start of the phase where working hours can be repaid by profit from product-sales.

In contrast to this, the production is often of little or no importance in a design-research project. That is, if research focus not lies on a implemented project together with a real client and assignment. I believe that a well-done prototype or blueprint is often sufficient for presenting visual results or doing tests and evaluations. As my work is of experimentally kind, there is no need to make a final product for this thesis. The prototypes are fully usable for answering my research questions.

7) Follow-up and evaluation

In an ordinary design project situation, the follow up and evaluation-phase would be the time to investigate if you product fulfilled the aims and objectives of the sender and the needs and wants of the user. It would also be the time to take a step back and examine the work, the internal communication and the pros and cons of the entire process. By doing this the designer develop her skills and knowledge of a rational and well working professional process, much in the same way as the rounds and protocols in action research. Good ideas and structures should be taken care of and mistakes should be remembered so that they are not repeated in the future.

As with the production-phase, this phase is only partly interesting in a research context which doesn’t carries out the entire process of production. Even thou the most of the mentioned parts above are more or less pointless to try to evaluate, the pros and cons of the process is still of major interest for this thesis. Most of the discussion about the process is done in the next chapter, but the result of my reflections, a suggested process or my “protocol” as compared with the GDP and the CDP, will be presented here. I consider it a result or product of the process rather than an analyse of it.

The process presented below is not how I did, it is a suggestion to myself (or other designers) of what I think could be a good way to produce visitor maps, build on my experiences from this project.

Design schedule for map

Parallel to the development of the theoretical concept I started to organize its practical counterpart as steps in a design schedule. This schedule is inspired by working schedules for map production presented by Brodersen (2002) and aim to support future map production for similar conditions. The steps in this schedule were continuously evaluated and changed to improved the process. The schedule should not be seen as an exact description on what I did but rather as an equivalent to the latest process-report in the cycle of action research.

The aim with this schedule is to produce a user-friendly visitors map.

1) Define area, sender and target user group.

2) Get a digital map over the area. This is your geographical reference original. As the geographic accuracy is important you should get a map from
Lantmäteriet. The “Terrängkartan” map is probably the best one for nature reserve visitor maps due to scale and level of generalization. It is a huge advantage if you can get the map in vector-format via GIS-software.

3) Research the area and context to find out about specific conditions, needs, objects, events etc. This includes interviews and surveys with representatives for senders and target user groups as well as general research and preferably field-visits. Answer the following important questions:

- Which are the primary and secondary reasons for target users to visit this type of area (nature reserve, city, museum, country etc.)?
- Based on visit reasons, which are the primary and secondary tasks the user should be able to solve using a map?
- Which are the primary and secondary aims and objectives the sender wants to achieve with the map?
- Based on target user tasks and sender aims and objectives, which main attractions or features in the area should be highlighted?

The initial research should also generate knowledge about what target users expect of the map by looking at similar cases.

4) List all map objects (i.e. polygons/areas, points and lines) needed to facilitate user tasks and sender aims/objectives. Make a parallel list of related map objects to get an overall nomenclature. (In order to produce adapted visualizations you have to know how many varieties there can be of e.g. roads/paths.)

5) Divide map objects into two groups: one with important/primary objects facilitating primary user tasks or sender aims/objectives and one with less important/secondary objects facilitating secondary user tasks or sender aims/objectives. User tasks and sender aims/objectives will not always give the same importance to map objects. With the help of the following chart you decide if the object should be considered primary or secondary in your special case. If one part consider an object primary you should try to keep it primary.

6) Produce visual representations according to the list: primary map objectives should be presented as iconic representations and secondary objects should be connotative or symbolic representation. It is good to make sketches of all map objects in iconic, connotative and symbolic visuals to understand how they should be presented in the clearest possible way. Sometimes iconic and connotative or connotative and symbolic representations are very similar. To produce sketches of all forms high-lights this and help to clarify the visualizations.

7) Put all map objects together in a uniform map. Use the geographically correct digital original as a reference to get it all right. If you have an original vector map it is probably easier to transform lines and polygons/areas than to import new ones. Add map text such as names, altitude numbers etc. Change decisions about parts if needed to create a clean and user-friendly map.

8) Include pictures and texts of attractions or features that should be highlighted. Make a layout that is adapted to the format of final product but without violating the legibility of the map.

9) Make final corrections and prepare usability testing.

10) Test, evaluate and correct/improve in cycles until user tasks and sender aims/objectives are met in a satisfying way. Go to production.

Fig. 6.3. Table to decide semiotic type of information representation.
7 - Result analysis and discussion

In the first three parts of this chapter, I will analyse and discuss my results using my research questions as starting points. This approach gives me a possibility to return to my initial aim and investigate if the process as a whole was successful. In the fourth part I will examine the use of the design process as a research method. Each part is introduced by a short summary of the following analyse and discussion. In the last part of the chapter, I will make some concluding remarks about the entire work and its relevance for the area of graphic design.

A user-centered approach

- How can a user-centered approach help to improve static nature reserve visitor maps?

A user-centered approach can help to improve the quality of nature reserve visitor maps in several ways.

- Usability theories give a definition to product quality and provides tools to measure it, which makes it possible to create a rational and successful design process.

- Initial research of target users increases the chances that information put into the map is relevant for the needs and wants of the users.

- Analyses of results from initial user- and sender research makes it possible to define the degree of importance in specific map information. Information of primary importance can be separated from secondary information and high-lightened in the map design, thus adopting the map to its users and improving its quality.

- By testing map sketches on users in real situations it is possible to evaluate the quality of product- and design choices. The result of these tests can be used to correct and improve the product.

My initial literature research showed that the map is a diverse concept that won’t lend itself to a general quality classification in terms of preferred or specified colour schemes, typography, aesthetic approach etc. Common to all maps is that they are produced with certain aims and objectives and can be defined as “products made for use”. By applying this definition, usability theory can be used to define product quality and improvement. According to this, a product that permits the user to solve his or her own tasks with few or no failures, in few steps and fast, is “good” (Dumas and Redish, 1999, p. 4-6). The possibility to evaluate map sketches with these tools and determine if certain design choices has improved their quality or not makes it possible to judge the process and the product and make changes if needed.

This possibility is theoretical and might not be as easy to conduct in practice. In an interview (Holsanova, 2012), Jana Holsanova says that the big problem in measuring improvement in visual design is to be able to isolate and examine one specific design choice as even small changes in a map image etc. often include several changed parameters (colour tone, lightness, saturation, size, position etc.).

Like in most product categories, there are already nature reserve visitor maps on the market, and a general map could easily be produced by including the information that is commonly used in these maps. By conducting my own user research I could find the specific needs of my target user group and better understand how to choose or illustrate specific features or information in the map.

One interesting example was how I used geotagged pictures from Google Earth. These pictures form a crowd-sourced information-set produced by the public. Without much effort I could use the pictures to get a basic understanding of what was commonly seen as main tourist attractions in the area. The amount of pictures taken and geo-tagged to a specific attraction indicated the general visitors interest to that attraction. The pictures didn’t give a complete overview but served as a good start to the research. Google Earth is still quite new and the pos-
sibility to upload and geo-tag pictures is probably only in its initial phase. I believe this source of information, which include pictures as well as location and probably upload-date etc., could be of great interest for ethnographic research in the future.

The information gained from my two conducted questionnaires was important to my work. Especially the first played a central role for following design decisions. The result of the questionnaires hopefully mirrors the respondents ideas and manners, but in some way, it probably also reflects the way I designed them, presented them and finally interpreted them. In ethnography, where this is a returning discussion, it is often suggested that a reflexive analyse is a good way to deal with it (O’Reilly, 2012). Such reflexive analyse in this thesis would mainly apply to the “open” questions that I used in both of my questionnaires. The variety of answers sometimes made them hard to group, likewise understanding the exact meaning the respondents did put into specific words. To analyse and interpret the answers I used my own experience from working with nature tourism for several years. My intention was to interpret the answers in an as credible way as possible. The results might still be a minor source of errors but I don't think this will affect the final results significantly.

The initial research of sender aims and objectives and user needs and wants was very important for the possibilities to “fine tune” the map image to meet the specific requirements of this project. To choose the right information to present in the map is naturally the first step, but the process of dividing this information in primary and secondary classes really took me to a higher level. My perspective and understanding when designing the map and the map objects always emerged from this and hopefully it also resulted in a map with better usability. Unfortunately, I had no way of testing this during the process. I think this aspect would be very interesting to research further as the quality of the usability in visual design has become more and more important due to a growing demand for interactivity on the internet.

After producing map sketches of Langhammars (fig. 6.13) and Stora Karlsö (fig. 6.14) I conducted a field-test or “beta-test” with the Stora Karlsö map. A beta-test is defined by sending a nearly finished product to real users in real environments and user-situations to generate input for later changes and improvements (Dumas and Redish, 1999, p. 24). In my test I gave the map together with a questionnaire to a number of small test-groups before they went trekking in the reserve. After returning I collected their comments through the questionnaire. If this approach is combined with a reflexive discussion it fits well in the action-research concept but maybe not in the ethnographic or usability concept. Dumas and Redish (1999, p. 24 and 34) state that a beta-test seldom give much information about the usability of a product due to unsystematic and unmonitored testing which leads to confusing answers that are hard to interpret and use. This was also what I learned from my test. Different respondents had very different experiences and opinions, or at least answers, to the same aspect of the map, more than I would think reasonable. It was also hard to know if I understood the answers correctly. The open-type questions gave even more open answer.

A better way to check the usability of my map would probably have been to adopt the test to the core ethnographic approach of monitoring the interaction between user and product. This could be combined with giving distinct tasks and discuss product details to understand the function or result of certain features or design choices in the map. Dumas and Redish (1999, p. 24 and 34-35) state that unmonitored users may report what they remember, or choose to report, instead of what really happened. This corresponds very much to the impression I got from analysing my results from the beta test.

Even though I would have made many changes to a new field test on Stora Karlsö, I would not have had it undone. The test connected my map to a real user-group and user-situation and gave indications on strong and weak features and design choices. This was of much help in understanding the field of nature reserve visitor maps and how I could make a better product. Among else, the beta-test made me broaden my view and rediscover the value of perceiving the map as a concept where the map-image is surrounded by a context. This context contains its layout together with text and pictures in a print as well as how it is presented or brought to its users.

There is, of course, other methods to analyse the usability of maps. One example which I examined closely in the beginning of my work was the use of eye-tracking methodology. By recording the movements of a test persons eyes (with help of e.g. laser) and connecting the movement patterns to the image or view the person is looking at, it is possible to trace “reading” patterns and habits. Eye-tracking is still a quite young and developing technique, but it has great potential in the field of visual research, including maps (Holsanova, 2012). Answers that might be given when examining maps with eye-tracking could be the time spent watching certain areas or objects compared to others (indicating their importance to solve a specific task) or the number of leaps from objects in the map-image to the legend and back again (indicating the degree
of intuitive understanding of map-objects etc.) (Hol-
sanova, 2012, Johansson, 2012) (fig. 7:1). These kinds
of measurements and test-methods are very interest-
ing for visual research in graphic design and maps. I
believe this is an area well worth exploring in the future
as much is yet to be done. The main drawbacks in eye-
tracking research are its relative high costs and need
of technique and competent lab-personnel for setting
up tests and analysing results. As mentioned above, it
is also hard to isolate and study the effect of specific
design choices in a complex design, such as a map
(Holsanova, 2012). The isolation problem and the time
consuming and complex task to analyse the results was
the main reason why I didn’t use eye-tracking method-
ology in this study.

All in all, my experiences from the study indicate that
a user centered approach and usability theories is very
suitable when trying to improve the quality of visitor
maps for nature reserves. I would suggest this approach
to anyone having similar aims and research field as I
have in this thesis. The reason why I didn’t use a strict
usability approach to this thesis was because I didn’t
have enough initial knowledge or the time to change
my study to suit this approach.

GIS and contemporary communication
in a map-design context

- **How can Geographic Information Systems**
  (GIS) and contemporary information presenta-
tion patterns be used to improve static nature
reserve visitor maps?

The use of GIS and cartographic solutions from con-
temporary information patterns can improve static
nature reserve visitor maps in several ways:

- **GIS makes it possible to rationalize the work-
  flow a lot, giving more time to creating a qual-
  itative map and still making the production less
time-consuming than before.**

- **By using GIS it is easy to get the most correct**
  (or agreed) geographic information available
  and use it as starting point for producing geo-
  graphically correct maps.

- **Digital tools can easily create cartographic**
  effects such as altitude modelling (hill-shade)
  which can be used to improve the usability
  and aesthetics of maps.
From my initial research and introductory classes in GIS I learned that modern digital systems and facilities has had a major effect on map production the last decades. The possibility of creating digital data-bases including 2- and 3-D geographic information has improved the accessibility and efficiency for a much larger group of people. Most people creating maps today does not spend time roaming the countryside and measuring it, they place themselves in front of computers. It is no longer needed to approach map-making as one of my informants did: by manually tracing maps from different books to get original outlines for new ones. Most map suppliers today deliver maps in GIS-format, which means that they are mainly vector based and can be easily adopted and changed to fit different purposes. In many ways, the digital revolution has started a new golden age for maps. But, in order to access all these privileges, the map producer must first know the digital software and in order to create a reliable and professional map, she must also have basic knowledge of cartography. Much of my thesis project time have been spent on understanding, practicing and learning this. My conclusion is without any doubt: you cannot be a professional map, she must also have basic knowledge of cartography without learning the cartographic theory behind the craft. Yes, you can produce maps, but the reliability of these are unsure and their usage is limited.

My work has showed that much time has to be spent in preparations before you can use modern digital facilities to create maps. Issues such as the effects of different map projections and changing scales are important to understand to be able to create efficient workflows and correct maps. In my thesis I had problems with scale because I didn’t decide on the final size an scale for the map from the beginning. This led to additional work in the later part of the process. There are great possibilities of rationalizing map production by using GIS but there are also many pitfalls to avoid and initially much time has to be spent to learn how to use it.

By using GIS, it is possible to access maps created by authorities such as Lantmäteriet (Swedish mapping, cadastral and land registration authority), Länsstyrelsen (County Administrative Board), Naturvårdsverket (Swedish Environmental Protection Agency) and Sjöfartsverket (the Swedish Maritime Administration) etc. As these are authorities, they take responsibility for the content of their maps. If you produce maps for governmental (etc.) use, (including nature reserve visitor maps for Länsstyrelsen) there are legal requirements of reliability put on those maps (Hedgren, 2012). By using maps from authorities as originals, you can guarantee this reliability and produce maps with officially correct (or agreed) geographic information. However, my work has shown that this “officially correct” information (in this case from “Terrängkartan”, by Lantmäteriet) is not entirely reliable, at least not for my purpose.

In evaluative discussions about the Langhammars map-sketch with a person living in the reserve, I learnt that several things were inaccurate or not corresponding to the current situation in the area (Rimfors, 2012). The impression of inadequate information given by “Terrängkartan” was likewise strengthen when I produced the map on Stora Karlö. As I know this place very well I could immediately see that several important objects were missing. A majority of the many ancient monuments as well as many caves and houses were missing and the vegetation information was very old. This experience led me to the conclusion that even official reference maps obtained from Swedish authorities has to be questioned when used as starting point for producing new maps. Rimfors (2012) also pointed out some information of very local character (breeding colonies for birds and current state of smaller roads) that was interesting for my map. All in all, my work shows the difficulties of making isolated desktop map-productions. It indicates the need of field-visits and field-tests and the use of local “area-experts” to be able to ensure the regularity of the map. This should be especially important when making a map adopted to a specific user-group with specific needs and interests. It might actually be a good idea to bring an own GPS to a field-visit to get the correct positions of objects and areas of special interest or importance for the target user group. This is of course very time-consuming but increases the chances of producing a relevant and high quality product. Many of the problems with insufficient information given by “Terrängkartan” could probably be solved by using another map as starting point. If it is possible to access a recent update of a large scale (1:10 000 or larger) map for orienteering, preferably in vector format, this would probably be a good alternative.

Modern GIS-software are complex programs with many different possibilities to use input-data to make calculations or create visualizations. Some, like “hill-shading” (creating a shade-model of the topography of a landscape by using altitude information) or metering distances or areas, can be very useful in map-production.
In min designarbete har jag försökt använda hill-shading för att ge
map-besökare ett snabbt och lätt förståelse för terrängen för att stödja
förråda navigation. Trafiktydigt, och olyckligt, inte har jag utfört någon
evaluerande aktivitet som skulle kunna svara på om detta hade påverkat
kvaliteten av produkt. Jag menade att detta skulle påverka kvaliteten på
ett positivt sätt för navigation och estetisk impression. Den sidan
nästan befallde den hill-shade kunde kanske skapa en
människa- och dynamisk bild för besökare.

Vad jag lärt mig från min arbet med hill-shading
var att den effekten inte är så komplicerat att producera om
du iklippar det, och förbereda tid och resurationer du inte
få att någon som faktiskt
är det för mig, och även denna jag
slogs samman med ett bra resultat, men det var inte så
bra som jag hade hoppats. Den konstnärliga/bäddningsbeschränningen
i ESRI ArcMap förvånade mig. Kvaliteten av det
originella hill-shade bilden var så dålig att jag hade att
processa det i Adobe Photoshop innan jag kunde använda det
i kartan. Jag vet inte om en professionell GIS-expert
kunde producera en ämnesäkvärd bild i ESRI ArcMap bara,
det är dock sannolikt att det är bekvämt för matematiska beräkningar
istället för att producera en ämnesäkvärd bild. Genom detta
måste det vara möjligt att skapa en ämnesäkvärd bild i ESRI ArcMap
medan jag inte har så starka erfarenheter av ESRI ArcMap
och inte har används för matematiska beräkningar
i ESRI ArcMap. Det var detta för mig, och även denna jag
hade så starka erfarenheter av ESRI ArcMap
och inte har används för matematiska beräkningar
för besökare.

Recents forskning om läsbehör och presentation
av information anger att vi läser snabbt text
i en artikel i ett annat språk än information på en
internet web-site (Holsanova, 2010). Holsanova (2010, 
p. 19) yttrar sig om "expanded" reading (det vidgade
begreppet) som ett nytt sätt att assimilera information
et, ett sätt som motsvarar web-site strukturer
where long running texts are replaced with many short
entrances" leading to texts (or sound or video) of
limited length. This theory suggests that people better
understand and remember information if it is pre-
presented in smaller parts and using the type of media
(text, image, sound, film) that best suits its content
(Holsanova, 2010). Holsanovas conclusions are sup-
ported by conventional knowledge about information
presentation in different medial formats. The concept
of multi-medial information presentation and "ex-
panded" reading was something I used more and more
in my design work as the project proceeded. Both my
design practice and results from the beta-test on the
Stora Karlö-map indicated that this was a very suitable
way to convey information and improve the product.
The accessibility of the information and thereby the
usability of the product increased when I combined the
map-image with photographs and shorter passages of
running text.

I believe that this approach can still be explored and
used much more and I believe it is very suitable for the
visitor map medium. It seems like a perfect way
to adopt the product to the needs and wants of the
user as well as the aims and objectives of the sender. I
would argue that the concept of a visitors map should
always be treated including final contextual form and
communication. The map-image in itself should not
stand alone, my design work has indicated that all
needed information cannot be presented inside the
map image and still preserving its usability. The image
will be overwhelmed with information. This is true to
static maps but not interactive and dynamic maps. In
these you have the possibility to place meta-links lead-
ing to text, pictures or film etc. that temporarily can be
permitted to overlay or override important basic in-
formation. There are of course interesting possibilities
to design and develop a product that combine printed
maps with digital applications for e.g. smartphones.
By doing this it would probably be possible to create a
product with good usability and very high user-value
as well as credibility and profit to the sender. In a static
map, "exits" for deepened information or interest could
be presented by e.g. including QR-codes leading to
relevant internet sites or recommendations to visit
certain spots or look for certain things when trekking
the nature reserve.

The role of the researcher and the graphic designer

- What professional practice and knowledge can
a graphic designer use to produce good visitor
maps for nature reserves?

Graphic designers can produce good visitor maps
for nature reserves by...

- collecting the aims and goals of the sender as
well as the needs and wants of target users and
contextual information and carefully merge this
into the product by experience and knowledge in
visual communication.

- approach the task in a rational and structured
way by using existing strategies or develop new
ones suitable for the specific case.

From my experience as a graphic designer I have
learnt that an important part of my role is to step into
communicative tasks as a somewhat neutral or inde-
pendent part. I must listen and adapt to the clients
ideas and opinions, but the best result doesn’t come by
merely following, I must use my own competence and
strategies. I must research the users perspectives and the context in which the product is created and acts. My role is to understand and include communicative aspects that the client doesn’t see. By doing this I can improve the product for the client as well as for the user and eventually for the society as a whole.

The experience I have gained from this thesis work indicates that the importance and need of acting as a free-standing link between sender, user and context is even more needed in contemporary map design than in most other graphic design situations. I believe this is because of the complexity of cartography and the changes that has occurred in the area over the last decades. Cartographers in the past had a primary function of exploring and understanding the landscape and visualize it in maps. Creating general geographic maps was a much more important part of the profession than it is today.

Over the years this has changed, and especially the digitalization of cartography and geographic science has created a totally new situation. GIS and the accuracy of modern land measurement techniques has made it possible to connect not only the “basic” geographical features such as spatial positions, areas and distances to the map, but also an endless amount of other information from all kind of sciences. In fact, I don’t believe there are many things in the world today that couldn’t be presented in a map. This possibility is seen as a blessing in the planning, building and controlling of the modern society. Inevitably this means that the knowledge of maps and GIS are highly coveted and that most professionals working with maps spend much more time on building, maintaining and processing data in GIS than producing maps for a wider audience. The societal position that used to be hold by cartographers is today often filled with engineers and technicians.

My experience from meeting these people in universities, authorities and cartographic fairs is that they often know and interest in every aspect of maps aside of the visual communication.

At the same time, very few professionals in visual communication, such as graphic designers, seems to have the technical and theoretical knowledge to produce geographically correct maps, and doesn’t dare to approach it. The reason probably lies in the most obvious insight my thesis work has given, the considerable amount of time and effort needed to obtain this knowledge.

It is clear that there is a gap between the advanced geographic technology with its masters and the communication experts that supplies the society with information. I believe this is an area where graphic designers can contribute to societal development by learning basic cartography and cartographic techniques or by teaching basic visual communication approaches to map producers.

One example of such an approach is to try to satisfy both senders and users by merging their different interest in the product. In this thesis I have tried to divide information in classes of relative importance as a rational way to calculate which map-objects to give emphasis and which to place in the background. My experience from other graphic design work is that visual dynamics is one of the most important tools for creating successful visual communication. Even though I don’t know exactly how the classification work affected all my design choices, it affected my basic approach on how to visualize the information in the map. Every decision about information- or data representation was carefully considered and defined in respect to the importance of the intended feature. Hopefully this resulted in an increased user-value for the product.

Another important approach graphic designers could teach map producers is to be critical and question the input-data and the clients proposed map-design and map content. My initial research on maps showed that maps are much less objective products than people usually thinks (Brodersen, 2002). It is therefor important for the map producer to question and reflect on the content and design from e.g. political and gender perspectives. Even thou people usually doesn’t reflect on it, maps are very effective tools to promote subjective opinions. Where to draw a borderline or in which language or dialect to present names of locations does reflect subjective societal conventions and not truth (Eriksson, 2007). Societal and environmental effects of design choices generate important discourses in the design community. Many, thou not all, professional designers relate to this in their work and that is an important perspective to forward to anyone dealing with communication, not only maps.

My experience of successful graphic designers is that they are good at being rational and finish-off projects. A way to achieve this is to use adapted working processes similar to the general design process (GDP) that is presented by the Swedish Industrial Design Foundation (SVID, 2012) (fig. 4:5). By using such processes it is possible to reach a desired product quality as fast as possible and thereby create a profitable situation.

From this thesis work I have learnt that the cartographic process is very complex. The more complex task, I believe, the more to win by using a well adopted working process. Because of this, I initially tried to find good process structures for my thesis design work. Parallel to the work I tried to evaluate my own process and create a new design process corresponding to my findings and specially adopted to nature reserve visitor
map. The intention was to create a design process that would benefit a rational and profitable workflow for similar future productions.

This graphic design practise is very similar to the action-research process of working with protocols in iterative cycles. My suggestion to a design process should also be treated like an action-research protocol - as a working document that still can and should be improved. The intention of both is to find the best way to solve a problem. In my thesis work I created maps for two different nature reserves, Langhammars and Stora Karlsö. In the production of the second map (Stora Karlsö), the working process was very much faster and easier because much of the procedures were already known and described in a process document. These experiences indicates that the action-research practice with protocols and iterative cycles and its graphic design counterpart are very effective ways to approach and rationalize map-design and other complex design tasks.

Research method discussion
In previous sub-chapters I have already discussed some parts of my methods and techniques. I will now take a wider approach, first looking at the methods, then at the use of a general design process as a descriptive structure. This can be summarized in two main conclusions:

- I have used approaches and techniques from many areas to examine and answer my research questions. This has partially led to unclear structure and results. At the same time I have gained a wider knowledge of pros and cons of different approaches to research in graphic design and in my specific area.

- To use a general design process as a descriptive structure for material and results has qualities that could be interesting for future design research, but this approach has to be tested and developed more before it could be a true alternative.

One of the basic conditions for this thesis was that it should contain practical graphic design work. This didn't force me to use design practice as a research method, but as it felt natural to do this and it seemed fruitful for my subject, this was where I started. As the material and results from this method is mainly of subjective character and lies in design artefacts and self-perceived experience, I wanted to complement it with recognized methods and techniques from related scientific areas. This was how I found ethnographic-, action-research- and usability methodology. I have tried to pick tidbits from all of them to merge into my own blend to match my needs. I would probably have had better structure and clearer results if I had chosen only one or two approaches, but since I didn't have the needed knowledge, experience or support, this was not an option. After all, this is an explorative work at bachelor’s level. As such, I will shortly reflect on the pros and cons of the different approaches in relation to my work and experience.

The knowledge and use of an ethnographic approach has been central in my work. Perhaps this has been the most important influence as I have tried to get a holistic picture of the area and at the same time examine and understand different parts in detail. The ethnographic idea to apply an holistic approach to understand the details correspond well with the general structure and approach of graphic design work. Interviews, questionnaires and participant observations has been important techniques to collect material and the ethnographic praxis to assess informants and reflexivity (evaluative review of one self) as sources of valid results has enforced me to use my own experiences in discussions and conclusions. It would of course be interesting to try to validate these experiences by using other scientific methods. There are many experience-based conclusions in this thesis that could form the base for interesting research questions in future work.

The iterative structure and the use of protocols in action-research was something I also found relevant for my work when I started. It was not far off to compare the iterative structure of the design practice (sketching, evaluating, improving and sketch again) with the iterative research approach. The use of protocols was also similar to the production of structured design processes.

Looking back at the actual work and processes I can now recognize mismatches in some important points. The core idea of the action-research approach is to combine the action with evaluative and improvement discussions leading to protocols and new rounds. The close connection between these steps were missing in my work. The design work included many smaller tasks where I used an iterative strategy, but in these situations I didn't write protocols and I only partially discussed evaluation and improvements with external experts. Most of the time I represented both the “actor” and the “improvement specialist” and evaluated and improved the result on my own and according to my own experience. The cooperation between a researcher with relevant competence and the “actors” in the
action-research process was not present in my work.

Instead of producing a protocol of the work I actually repeated, I made one for the entire design process of the nature reserve visitor map. This protocol was in the shape of a step-by-step list. For me, this became an important result of my experiences from going through the process. As I see it, it could be a counterpart of the action-research protocol as could the general design process (fig. 4:5) and the cartographic design process (fig. 4:6) I used as its models. Even thou I didn’t have the opportunity to evaluate my protocol (or design process), with an expert and go through the entire process again to improve it more, I reviewed and improved parts of it as I updated the map of Stora Karlsö after the field-test. I hope that my protocol can be used as starting point in future research or practice. As this thesis has shown that the area of user-adopted maps needs scientists as well as practitioners maybe this will come about. A fruitful possibility could be to examine my protocol in as limited tasks as possible to be able to use the repetitive part of the action research to improve it.

During the progression of my work I found more and more reasons to include some sort of usability approach to my research. To measure the quality of my product I could use theoretical tools from usability and the focus slowly turned from producing a visitors map to a "product made for use", that happened to be a map. Unfortunately I didn’t have the knowledge to include a usability approach from the very start, but I used influences and references from it in the latter part of my work. My experiences is that an usability approach is very suitable for a research area like mine, an area where the idea is to create a product that will attract use from people on their leisure time. In a working situation, an employee have strong incentives, such as wages, new assignments or even duty, pushing her to learn and use a product whether it is user-friendly or not. For a leisure activity she is probably much less interested in putting time and effort in solving a problem by using a complicated product. (This does not, however, imply that professional products could be left without usability adoption. Even small improvements in products that are much used by many professionals means much gain in profit.)

The usability approach is very focused on developing the best product for the target user in a specific situation. To me, this makes it ideal to use as the basic tool for product development, but not the only one. This thesis shows very clear that the aims and objectives of the sender of a product differs much from the needs and wants of the user. If the final user is also the client ordering the product, the usability approach could probably stand alone, but when trying to meet the interests of the sender as well as the user, the usability might have to stand back a bit to give space for the interests of the sender. In a map context like mine, this could mean that some map-objects serving the user, e.g. a sign of an ice-cream bar, would be changed for a map-object serving the interests of the sender, e.g. a sign for a restricted area.

My suggestion to anyone conduction a similar thesis work like this would be to use usability research and -theory as a starting point. To me it has been unclear how to produce and present results from the design-practice approach, I believe a usability approach with available defined tools would make it easier. This might also give more time and freedom to work with the design and reach further than I did.

An approach I applied to structure the presentation of my results was to present it in steps following a general design process (GDP). This was nothing I had seen before, which was a reason not to use it, but I found several reasons for doing it anyway. The overall experience of this approach was that it worked well for me in my situation. It was comfortable for me as a graphic designer to use a known structure to present my work in. My doubts of what to include and what to exclude in the scientific context of the thesis was diminished as the approach encouraged me to present as much (relevant work) as possible. As I have already mentioned, the drawback of this is of course the length and focus of the thesis.

The two most positive effects of the approach, that I still insist on after using it, is that it is tailored to the design practice and present a holistic picture of the work, and by that, it enables comparison and thereby validity and reliability to the work. This is what I believe, as I am a novice in the research context and haven’t written other theses it is hard for me to compare or judge. To evaluate the general possibilities of using the GDP as a descriptive structure it would of course be important to see more examples of its use.

Even thou I believe in the qualities and possibilities of using a GDP as descriptive structure, there might be other examples of such structures that would suit this purpose better. One thing in SVIDs GDP (fig. 4:5) that didn’t match my work was the production of several concepts instead of a single one. This occurs in stage three and four, "Concept and visualization" and "Evaluation and selection of concept". In the ordinary design context, the idea is that the designer produces some different concepts that in different ways solves the task. The evaluative process that decides which of these to use could include aspects such as usability, legibility or even aesthetics that could be interesting in
a scientific context, but it could also include the clients liking and profit. In the scientific context, such parameters is often of no interest. Rather, it is interesting to develop a concept that answer to the research aims and -questions and examine and evaluate it properly. Testing another concept could be done in another thesis.

If a structure like the GDP should be used as structure to present material and results in future thesis work in design, I would suggest the following, using the GDP (fig. 4:5) as a starting point:

1) **Research intention**
   Describe research aims, objectives and research questions.

2) **Initial research and studies**
   Describe material and results from initial research of the research area in general and detail (if relevant and if not presented in a previous chapter like I did in this thesis). Include scientific literature references from relevant sources/disciplines. Describe senders (with aims and objectives), users (and their needs and wants) and the context in which the design product will act.

3) **Concept and visualization**
   Describe the development and visualization of a concept based on item 1 and 2.

4) **Evaluation of concept and visualization**
   Describe how the design was evaluated and the result of it.

5) **Correction of concept and/or visualization**
   Describe how the results and experience from the evaluations in item 4 were used to improve the product and the result of this.

6) **Evaluation of working process or experiences**
   Describe complementary results from evaluations or experiences of the working process.

This structure should be used to present material and results in research projects using design practice as technique. The presentation should be followed by a chapter of analyse and discussion of the material and results.

Even though reflexivity and the researchers own impressions and subjective experiences are used as source for results in ethnography, the tradition put greater focus on people that are studied by the ethnographer. The same goes for action-research where the focus lies on the persons taking action in a certain task. My impression and experience of research through design practice is that the focus lies on the self-experienced and self-produced. This is the material from which results are produced. Instead of using other people as instruments for creating knowledge, you use yourself.

Critic is often aimed at social sciences and humanities (to which design belongs) for using abstract and subjective methods and paying too little attention to quantitative methods and techniques (Pickering, 2008. p. 89/David Deacon). The process in design research suggested above would probably attract quite an amount of such critic. To counter this I believe the best way is to be as open as possible with results as well as how these were generated. Presenting a transparent, accurate and holistic report opens up for discussion which opens up for possibilities to examine, compare and validate the work. The openness and accuracy also gives reliability to the results and the researcher.

As reliable and valid results are priority to my work, I have tried to present and describe all relevant parts and aspects of my work as clear as possible. Initially obtained information gathered from areas around the specific research question is often excluded in order to “clean up” the scientific report. I have included much of this information because it often has major impact on later decisions in a design situation. My production of an accurate protocol and especially the use of the GDP as a descriptive structure for the material and results are also direct results of my intention to be as open as possible. This approach might produce a longer and more complex report but I believe that could be a reasonable prize to pay if the result is a clear description that enable other people to understand how and why things happened.
Concluding remarks

This thesis work has generated much experience and many interesting and important conclusions and results. This does not only apply to the design research community, but also practicing graphic designers, map producers and societal development in a wider sense.

The area and research aim of the thesis is contemporary and relevant. We are witnessing a golden era for maps with increasing use in many sectors. Private and leisure use through smart-phone applications has literary exploded and large geographical information systems are used to steer and monitor global trade and transports as well as other important functions in the society. The increased use call for improved efficiency through products that are better adopted to their use and users. This thesis shows that knowledge and experience from the field of graphic design is an important key to achieve this.

From a starting point in graphic design, the thesis approaches the area of cartography. The initial research show that maps are not as closely related to general visual communication and graphic design as it might seems. Beyond its graphical surface, the map hides a complex system of techniques and rules, like the clock-work behind a dial. The thesis conclude that this is one of the main problems causing the gap between modern geographical systems and the communicational quality of its visual interface, the map. To bridge this gap and supply the society with good maps, the thesis suggests that graphic designers and map technicians (GIS engineers etc.) join their expertise by sharing knowledge or working together.

Emerging from a viewpoint considering maps as visual interfaces for mediating information from a sender to a receiver, the thesis find advantages in applying usability theory and defining maps as “products made for use”. This changes the definition of a passive receiver into an active user or reader. The thesis suggests that this is especially suitable for nature reserve visitor maps as they are mainly used by non-experts in leisure situations, indicating a low or limited interest to learn and use complex products. Usability theory provide tools to measure the quality of products from the users point of view, giving a possibility for rational improvement. Tests conducted in the thesis work shows that including presumptive users for evaluation of map-sketches give important information that is hard to achieve in isolated “desktop productions”. These tests also indicates that careful planning, monitoring and follow-up is essential to obtain material that is easy to interpret and use for further product improvements. But this thesis also show that a mere focus on the user is not enough to create a good map. The special competence and position of the graphic designer and her possibility to use different perspectives is crucial. It gives her the ability to conduct own research and collect essential information about the specific sender and the product context as well as the target user. Detailed and case-specific knowledge about this trinity creates a base for good map production. The thesis suggests a processes to fine-tune the adoption of visitor maps to the interests of both senders and users. This is done by dividing map information in classes of relative importance and represent the more important information by map-objects that are more likely to be intuitively understood. The suggested process is a result of research in semiotics and cartography and experience from practical design work.

Interest in improving both research and practice in the area of design is reflected in the thesis. Through combining techniques from different research disciplines with practical design work, it puts map-production in a research context and generates experience that can guide future work. Important results from the thesis includes the suggested descriptive structures of using a general design process (GDP) to present material and results in a scientific report, and the concept of action-research protocols to describe and improve practical workflows and production processes. By taking a holistic approach on map production and research through design practice, the thesis shorten the distance between research and practice and invite these to a closer cooperation for the gain of both.

The research of this thesis has focused on improving static maps. Still, much of the gained experience and results could also be of interest for dynamic and interactive digital products, or combined digital and printed products. This alignment is clearly interesting for todays society and the possibility to further explore and improve these areas will probably attract both researchers and practitioners in the future.
8 - References

Books and dissertation


Articles and conference papers


Internet, TV and interviews


- Hedgren, Stellan (2012). Interview with Stellan Hedgren, former nature reserve map producer at the County Administrative Board on Gotland, 11 June 2012.

- Holsanova, Jana (2012). Intervju with Jana Holsanova at Lund University, 01-03-2012.


Questionnaire number one:

Tänk dig att du precis har kommit fram till ett naturreservat som du inte tidigare besökt.

1) - Skriv en (vanlig) anledning till att du skulle besöka ett naturreservat. (T.ex. söndagsutflykt, tälta på ett fint ställe, kolla på fåglar etc.)

Du står vid en parkeringsplats eller ingång till reservatet där det finns en informationsskylt med en karta.

2) - Brukar du titta på kartan på skylten? (Om inte, skriv nej eller sällan, men svara gärna på de andra frågorna åndå.)

3) - Varför tittar du på kartan? Vilka frågor vill du få svar på? (Skriv först de viktigaste anledningarna i tre till fem punkter. Skriv sedan, under "Fördjupning", om du kommer på fler saker som du brukar / kan tänkas använda kartan till.)

4) - Samma fråga som nr 3: Vad använder du naturreservatskarten till? (Till din hjälp kan du nu titta på de olika kartorna i den bifogade bildfilen "Bild till fråga 4.jpg" och kanske komma på fler frågor som just Du skulle lösa med hjälp av en liknande karta. Fyll inte på listorna under Fråga 3) utan skriv härunder. Var gärna konkret och precis.)

Plats för tankar eller kommentarer om frågorna eller kartor eller dylikt.
Appendix 2:2
Appendix 2:5
Appendix 3:1
Improving Swedish nature reserve visitor maps with focus on relevance and visual communication

Bachelor's thesis by Aron Hejdström

Appendix 3.2

Social-ecological systems

Route A - 3.8 km

Historical knowledge generators
Throughout history, Stora Karlsö has been an important stop over for researchers and other knowledge generators in their quest for new and exiting insights. Not only people from Stockholm Resilience Centre, but also more old-school scientists such as Carl von Linneus (1741). Visit the tree where he figured important things out (site A2), explore the cave where archeologist Hjalmar Stolpe (1890s) uncovered important historical artifacts (site A1), and visit the place where famous Radio journalist Nils Linnmann (1960s) cursed the spinning rope as he was abseiling down to observe the breeding birds (site A3). What was a social-ecological system understanding in those days, and how has it changed?

Route B - 3.2 km

State shifters
Stora Karlsö has gone through major changes during the last centuries. In the 19th century Gotland farmers used the island as a base for fishing and a grazing area for their sheep. Hunting birds and collecting eggs were common activities both to provide food and for pleasure. In the 1880’s the guillemot population had diminished to less than a hundred birds. Willy Wöhler, an aristocrat from Klintehamn, often visited Karlsö and wanted to save the guillemots. Using hunting hares as an attraction, he was able to mobilize resources from a network of friends to buy grazing rights from the farmers in order to transform Stora Karlsö to a paradise. His idea was a flourishing green island with new exotic trees (e.g. Thuja, site B1), no sheep and a lot of birds, in accordance with the nature conservation trends at the time.

Soon the guillemot populations started to recover and became a tourist attraction already in the 1920’s. Juniper bushes flourished in the absence of grazing and succession towards a bush-dominated landscape took off. In the 1970’s discussions about reintroducing grazing started, but it was not until 1990’s that sheep were again brought to the island. A restoration program removing junipers was established pushing the island ecosystem in the direction of the previous state.

In the end of the 20th century cormorants started breeding on Stora Karlsö. The bushes provided good breeding sites and the colony grow to more than a thousand pairs. The cormorant guano has now killed the bushes in some areas in the south and east sides (site B2).

Route C - 3.6 km

Natural history tracks
The geological history of Stora Karlsö dates back to the Silur age, 400 million years ago. At this time, Gotland and Stora Karlsö were located around the equator, and the bedrock is largely made up of former coral reefs. Interesting geological spots include the “rauks” (reef lime stone piles) in Svarthällar (site C3) and the rauk portal “Hässelby Läde” (site C1). After the last ice age (around 12000 years ago), the sea has formed Stora Karlsö in different ways. There are around twenty caves, some of which have been inhabited by our ancestors. One cool cave is just south of site C1. The Littorina Sea was pre-state to the Baltic Sea about 8000-1000 years ago, consisting of a mix of melting water from Scandinavian glaciers and saline Atlantic water. The sea line from the Littorina Sea, when the land was suppressed and the sea level thus higher is visible in northern Norderslätt (site C2). Those are changes that happened over a time scale of millions - thousands of years. How can future climate change affect the Stora Karlsö environment?
Route A - 3.8 km

A changing human history

Stora Karlsö has long been an important harbor in foul weather – a way to adapt to rapidly changing conditions. Although the harbor in the south is terrible, it is still much appreciated in northerly winds (site A1). During the intense period of church construction in the 12th century, limestone was mined in Stora Karlsö and transported to mainland Gotland (site A2).

This is an exposed island in the middle of the sea and the lighthouse has guided ships, helping them to adapt to maladapted courses and misread charts, many years before the use of handheld GPS-devices and smart phones. Stora Karlsö has also been a frontier, and thereby also a natural point for military interests, during times when the global security puzzle looked different than it does today (military bunker site A3). Imagine arriving at this island in the storm, watching out from the lighthouse (site A4) for ships in need of assistance, or peering at the horizon for imagined enemies during the cold war.

Route B - 3.5 km

Ecosystem services at Stora Karlsö

Grazing sheep has historically been a mainstay at Stora Karlsö, converting grass to appreciated steaks, shrublands to grasslands and a walking petting zoo for visiting children (feeding station site B1).

Tourism is the main source of revenue today, with >10,000 visitors annually, many just visiting for the day, but some staying over night as well. In the early summer, many visit for the flowers, in midsummer perhaps to participate in the intense bird ringing activities and in the fall, to watch for migrating birds. The most popular look out for the guillemot colonies is site B2. Prior to tourism, people at Stora Karlsö could find their mainstay through hunting (hunting cottage, site B3) and fishing (fishing hut, site B4).

Route C - 2.5 km

Knowledge generation about seabirds

Presently, Stora Karlsö is the field site for research in seabird ecology and the relationship between humans and seabirds. Starting in 1997, the Baltic Seabird project has used seabirds as a tool to understand interactions between fisheries, fish stocks and top predators dependent on these stocks. During the guillemot chick ringing each summer, island visitors can take part in catching the chicks and learn about the research. Hundreds of chicks jumping from the cliffs each night is a special experience that gives the participants an unique opportunity to relate to the challenges of the Baltic Sea environment (on the beach, site C1). In 2008, an artificial breeding ledge was built for detailed studies of guillemots with minimal disturbance and 13 pairs bred there in 2012 (site C2, possible to go inside).
Appendix 3:6

Cross-scale interactions

Route A - 2.8 km

What is in the micro?

Arriving at Stora Karlsö, it is easy to become impressed by the open skies, the blue sea and the vertical cliffs. However, as you remember, air molecules are microscopic. Local structures, like pebbles, can easily be seen and boulders combined. Take a closer look at the small scale and reflect on the role of these structures in constructing the whole. Take a closer look at the rock formations and find that they are in fact made up of fossilized coral. Remnants from another time and latitude, Stora Karlsö used to be a coral reef. Throughout this walk, you will find many small structures that together make up a history of the past that has resulted in Karlsö today.

Route B - 4.1 km

Finding debris

In the city you find it in the park on islands, primarily along the shores, junk. Non-biodegradable stuff thrown, fallen or blown overboard or dropped on a beach somewhere, eventually reaches the shorelines of even the most remote islands. Plastic debris thrown in the water can cross any scale and travel the world. The type of junk found can tell a lot of things – what is the origin of the things you find and what does it tell you about the way humans interact with ecosystems and vice versa? What do you expect to see in a decade, or a hundred years?

Route C - 3.4 km

Crossing the scales

Stora Karlsö has some permanent resident birds, some temporary residents and many migrants. The islands is hosting the largest populations in the Baltic Sea of some species (common guillemot, razorbill) and other started breeding here for the first time Sweden (Eurasian roseinch, site C1). The oldest known bird of Sweden is a common guillemot ringed in Stora Karlsö in 1965 and recovered alive in the same place in 2008, almost 43 years later. For the birds, the island serve different purposes. It is a place to build a nest (e.g. in the lighthouse garden, site C2), to raice chicks, or a place to temporary visit on the way south in the fall or heading north in the spring. Many water birds rest at Åtvärdshagen, site C5. What is making Stora Karlsö an interesting place for birds, who is visiting and can you see any traces of them?
Appendix 4:2

Routes and attractions on Stora Karlsö