Ecosystem Services in Spatial Planning
- Towards Sustainable Development in the Swedish Physical Planning Process

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Abstract

This thesis aims at defining the connection between the increasingly popular ecosystem services theory and its practical implications for sustainable development in Swedish physical spatial planning. A literature study was made to summarize the ecosystem services and resilience thinking concepts (with an emphasis on ecosystem services), their definitions and potential uses in physical spatial planning. This overview was then applied in choosing a concept framework to be tested in a case-study: the possible changes in ecosystem services and their values in a land-use trade off situation. To gather insight into the benefits of the ecosystem services concept, compared to environmental integration into physical spatial planning on a municipal level today, the literature study was extended to encompass a short overview of environmental management in the Swedish planning system. Finally, the case study was introduced to municipal employees with strong ties to the planning process, in order to gauge their opinions on the ecosystem services concept and its usefulness in planning for sustainability and increased human wellbeing. The results of these interviews showed a generally positive attitude towards the concept as a way to gather and communicate ecological and socio-cultural information to decision makers. The economic valuation was deemed less important as the method is fraught with such difficulties. Overall, the ecosystem services and resilience thinking concepts have great potential to gather the discontinuous environmental management methods toward sustainable (ecologic) development, but in order for this to happen, the municipalities need to be given the right resources, and incentives, for implementation.

Key words: ecosystem services, resilience thinking, physical spatial planning, sustainable development.
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1. Introduction

In *Natures service’s – Societal dependence on natural ecosystems* (1997) Peterson Myers and Reichert claims that the declining environment is a grave problem that human society has to deal with as its prosperity is fundamentally dependant on the ecosystems and their biodiversity. Rockström et al. (2009) describes in turn nine planetary boundaries for humanity to live within in order to insure a sustainable future. Three of these boundaries have already been crossed: the rates of climate change, biodiversity loss and nitrogen removed from the atmosphere today are too large for the earth’s system to keep functioning in the same way as human society is used to. There are great risks of, if and when the boundaries are crossed, the earth tipping over into a new steady state with conditions that are far less suitable for human existence.

In 2005 the *Millennium Ecosystem Assessment* (MEA) was published, an extensive research effort to assess the consequences of environmental decline through ecosystem change for human well-being. It also tried to establish a scientific basis for what actions society needs to take in order to enhance the conservation and sustainable use of the ecosystems. In this study the four main findings showed that: during the last fifty years humans have changed ecosystems faster and more extensively than ever before, which has lead to a substantial and irreversible loss of the worlds biodiversity. These changes have contributed to the great increase in human economic wealth but at the cost of ecosystem services degradation, the possibilities of non linear change of ecosystems and the ability for future generations to gain the same benefits from nature as have been had before. There are considerable risks that the ecosystem services degradation will be even greater as the needs of a growing population is trying to be met and, finally, the challenges of reversing such a degradation are great but not impossible.

In order to deal with these challenges, Folke et al. (2011) call for the new perspectives and world views that are needed, that human development must be reconnected to the capacity of the biosphere in order to sustain the important ecosystem services. One such perspective is resilience thinking, discussed and promoted by Folke et al. (2011) and Wilkinson et al. (2010). Folke et al. (2009) describe this as a framework that complements the broad sustainability agenda and enables management of a changing world system.

In The Economics of Ecosystems and Biodiversity (TEEB) initiative’s manual for cities (TEEB, 2011) it is concluded that the world of today is becoming increasingly urban with more than half of the human population living in cities. Radford and James (2013) visualize the growing changes in the geographic distribution of populations by stating that around 4% of the earth’s total land area is classed as urban landscapes. The growing urbanization escalates the problem of ecosystem degradation according to Jansson (2013), since the city inhabitants are highly dependent on ecosystems outside the city limits and with little regard to the two systems being interlinked.
Cities can be viewed as socio-ecological systems where planning and ecology meet. The tool to manage these systems in a sustainable manner is, according to Wilkinson (2012), resilience thinking with its interconnected concept of ecosystem services valuation and management.

‘Ecosystem services’ is described by, among others, Bastian et al. (2012), Ernstson & Sörlin (2013) and Kontagianni et al. (2010) as a relatively new, but increasingly popular, concept within the research literature concerning ecology and economics. It is also evident, according to Gómes-Baggethun & Barton (2013) that, within the research field, a predominant focus has been given to an economic valuation of single services while intangible ecosystem services, such as the cultural services of recreation and aesthetic experiences, has been given less attention. This is also true for ecosystem services provided by cities.

Physical spatial planning in Sweden can, up until the 1990s, first and foremost be described as a way for society to maximize the profit gained from the use of land and water resources, according to Nyström & Tonell (2012). They also state that the conservation of resources and the ecological systems were largely sidelined in favor of shortsighted economic gains.

With the introduction of the environmental objectives in 1999, a first step was taken to introduce a tool for the integration of sustainable (ecological) development into the Swedish physical planning process (Naturvårdsverket, 2013).

Although, as stated by de Groot et al. (2010) and Ernstson & Sörlin (2013), the ecosystem services concept is still more widely used in theory than in practice, and the actual framework for the concept is still under development, it is now being integrated into the Swedish government work on environmental management and sustainable development.

Within the Swedish environmental objectives system, two sub-goals regarding ecosystem services and/or resilience thinking were set during 2012:

The sub-goal nr 3.5.1. entails the identification and understanding of important services and the factors that sustain them before this year (2013). Sub-goal nr 3.5.2. is about the importance of biodiversity and the value of ecosystem services and it aims at making the importance of these common knowledge and to integrate them into economic and political decisions (and everywhere else relevant and appropriate) in Sweden by the year 2018. By doing this, the government believes society will be better equipped to use the ecosystems in a more sustainable way and to even enhance their capacity in the long run. (Miljödepartementet, 2012)

2. Purpose and Objectives

The purpose of this thesis is to evaluate how environmental management is integrated into physical spatial planning in Sweden today, how the concepts of resilience thinking and ecosystem services are defined and how they can be used for environmental management in the Swedish planning process. Finally, how the use of these concepts would benefit physical spatial planning in the municipalities will be assessed.

The objectives of this thesis is to conduct a literature study where the resilience thinking and ecosystem services (valuation) concepts are defined, to visualize the possible use of the concepts in physical spatial planning through a case study and, lastly, to present the case study
to a small number of municipal physical and/or environmental planners who will give their opinions on the study and the uses of the concepts, in order to answer the following research-questions:

- How is environmental management incorporated into Swedish (physical) spatial planning on a municipal level today?
- How are the resilience thinking and ecosystem services concepts defined and how can they benefit environmental management in local Swedish (physical) spatial planning?
- How can the evaluation of ecosystem services benefit environmental management in a local land use trade-off situation?

3. Method

3.1. Purpose of research

The purpose of this research paper is to get an overview of the ecosystem services concept in theory as well as a picture of how it could work in practice in Swedish local (physical) spatial planning. In order to answer the research questions the approach is to conduct a literature study of the resilience thinking concept but, mainly, the ecosystems services concept, and finally to conduct an explorative study of the ecosystems services concept in Swedish municipal physical planning. The explorative study will consist of a case study where the ecosystems services concept, as defined in the literature review, will be applied to an area of land where different planning objectives are probable. A set of interviews with local spatial planners (and) or environmental managers will then be carried out in order to gage their opinions and views on the concept together with its uses in the municipal physical planning strategies.

3.2. Approach and strategy

This research paper thus combines a theoretical study and an empirical test in order to investigate how well the real world fits with the theory. The empirical section (the case study and the interviews) has an inductive approach in forming a theory based on a specific case, as described by Patel & Davidsson (2011), which then will be discussed and related to previous research on practical uses of ecosystem services in spatial planning. The inductive empirical test can according to Thurén (2007) only produce broad, generalized conclusions that are more or less probable and never true facts. Thus, to verify the results, Thurén (2007) requires the methodological procedures to be extensively described (in detail) in order for someone else to be able to copy the test. The test result should, in as much as possible, be objective and not affected by the researchers’ own opinions as described both by Patel & Davidsson (2011) and Thurén (2007).

Thurén (2007) describes the positivist method as deeply connected to the natural sciences where one, and only one, truth is the answer to every question. The method states that there are only two possible ways to knowledge: empirical (what you can experience with your own senses) and logical (what you can work out with logic) methods. When, instead, using the Hermeneutic method, knowledge is gathered through interpretation: recognition and empathy. The thoughts, feelings and experiences of others are understood through your own feelings.
and experiences. Thurén (2007) means that hermeneutic knowledge is subjective: colored by the interpreters values understanding and the context of the situation.

Since this study is both qualitative and quantitative, the knowledge gathering will be made with a combination of positivistic and hermeneutic methods, which will affect both the reliability and validity of the results. To replicate the study will, in the case of the interviews, be difficult, according to Patel & Davidsson (2011), as the knowledge is contextual and the interviewees can change their opinions regarding the questions.

3.2.1. Literature search and study
The literature study was comprised of books, research papers and also reports from different state agencies and organizations relevant to the research.

The literature search was made both on the internet (Google) and at Karlstad university library (library catalogue, one search and in the databases Science Direct, SciVerse and Scopus). The search words used were: Ecosystem Services, Ecosystem services in spatial planning, Spatial Planning, Sustainable spatial planning, Spatial planning in Sweden, Valuing Ecosystem Services, Urban Planning, Urban Ecosystem Services, Resilience and ecosystem services, resilient cities (also the Swedish equivalents). A limitation was made for research articles published after 2008. The articles was then chosen randomly with but according to relevance, spread of methods, publication sources and the nationality of the authors, all to get as wide a possible overview of the field. Some papers published before 2008 was later chosen because of their many (cross) references in the more recent papers, in order to get a better foundation for the concepts.

Web pages relevant to the research were visited to get information and find relevant publications: the Swedish government, the state agencies Naturvårdsverket and Boverket (also for the law-text links). Here general information has been gathered together with ideas for further information as in links to other pages and authors.

The information has then been concluded as a summary with a perspective on introducing and defining the concepts, practical uses in physical spatial planning, trends in the research and critique. The study is not claiming to be extensive.

3.2.2. The case study
An area in Värmland that fit the description of having high natural values, being located close to an urban area and finally having a development pressure that would present interesting trade-off situations regarding land-use management, needed to be identified. The county administration of Värmland was contacted and their physical spatial planner Malin Iwarsson suggested the Klarälven River delta within Karlstad and Hammarö municipalities. This area fits well into the description above and is also favorable since it is under way to become a nature reserve, and thus has a lot of data and other information available for assessment.

Klarälven River delta was then chosen for the case study. It has many similarities to the studied area in the research paper by Vejre et al. (2010) as it is known for its high aesthetic and recreational qualities and also represents a long tradition of conservation. The areas in the case study by Vejre et al. (2010) provided several ecosystem services, including production,
habitat protection and supply of drinking water. However, the areas were not unique in terms of any of these specific functions or services, but instead are under conservation due to their provisioning of intangible landscape values, making them particularly suitable for studies of intangible services. The same is true for the Klarälven River delta.

The tiered approach described in the TEEB (2010b) Synthesis report for analyzing and structuring the valuation of ecosystem services consist of three steps: 1 – Recognizing Value, 2 – Demonstrating Value and 3 – Capturing Value. In step one, valuable features in the landscape, in ecosystems or connected to biodiversity is identified without attaching a specific price to the value. This step is sometimes enough, especially if the cultural values are high, to protect or use sustainably, a certain area and its biodiversity. In these cases, monetary valuation of biodiversity and ecosystem services may be unnecessary or even detrimental if this second valuation steps fails to reflect the complexity and collection of values. In step two the value is demonstrated in economic terms. This is often useful for policymakers and decision makers e.g. in municipalities or businesses, as it gives them the chance to make decisions that consider the full costs and benefits of a proposed use of an ecosystem, rather than just those costs or values that enter markets in the form of private goods. Step three involves the introduction of mechanisms that incorporate the values of ecosystems into decision making, through incentives and price signals.

For the case study, step one should be enough, as described above, to convey information of value to decision makers. Also, the time restrictions and limited economic knowledge of the author condenses the case study to the first step of the TEEB approach.

Because of this, the case study is not a full valuation study, it only aims at identifying ways in which nature is valuable to society (via ecosystem services) and visualizing how these values might be affected when land-use management changes.

The method used to identify and visualize values of ecosystem services, and how they are affected by land use change, is based on research papers from the literature review.

Palomo et al. (in press) use the concept of service providing hotspots (SPH:s) in communication with decision makers and stakeholders in order to map ecosystem services flows through protected areas. This qualitative method is a simple way of providing information on which specific areas that are particularly important within the delta. In this case-study Anita Andersson, responsible for the formation of Klarälven River delta nature reserve (at the Värmland county administration) was used as an expert in SPH identification.

The stakeholder review is made based on the method by Butler et al. (in press).

The procedure for identification and visualization of ecosystem and biodiversity values in the Klarälven River delta is as follows:

1. Identification of ecosystem services provided by the area
2. Identification of stakeholders connected to service benefits
3. Identification of the most valuable service(s) provided by the area
4. Linking of the most valuable service(s) to specific areas within the delta area, so called service providing hotspots (SPH:s)
5. Four examples of trade-off situations between different land-use alternatives within the delta (connected to the SPH:s) are identified and used to illustrate how ecosystem services provision can change with alternative land-use management.

3.2.3. Interviews
The interviewees were selected through a process where all municipal planning and environmental managers in Värmland County were contacted with an inquiry towards participating in an interview regarding ecosystem services and spatial planning. Four of them replied with a positive answer and, since this number (25%) was deemed enough to get a sampling of opinions, the others were not contacted further.

One week before the interview took place, a copy of the case study was emailed to the interviewee(s), together with information on the topics to be discussed. The aim was to encourage the interviewees to think about the concept and formulate any questions they might have, with the chance to also read up on the topic if interested, in order to receive more well-considered answers during the actual interviews.

A larger number of interviews would have strengthened the results of the thesis, but were not necessary as a qualitative sampling of opinions were the aim (an inductive approach). The size of the municipalities with regards to population density is relatively varied (at least in the Värmland context) but on the small side when seen from a national point of view. This makes the results of the interview study less of a generalization and more of a contextualized example of what reality could look like according to Patel & Davidsson (2011).

The interviews themselves were done in the style of semi-structured qualitative research interviews, with an interview guide (see appendix 1) that provided the topics and a general set of questions that the interviewer (the author) could lean on when necessary. The choice of an interview guide over a list of organized questions was due to the study being of an explorative nature, which according to Kvale & Brinkmann (2009) produces better results if more flexible techniques are used. The interviewer then has the opportunity to follow up on interesting statements or clarify meanings of the interviewee. But flexible methods also demand that the interviewer has a solid knowledge of the topic(s) and it is beneficial to have experience in conducting interviews.

3.3. Validity and Reliability
When conducting quantitative, inductive research studies (such as the case study and the interviews), it is important to observe the validity and the reliability of the research. (Thurén, 2007)

The reliability of the study accounts for the method being thorough and carried out in a correct fashion. The validity accounts for the method being chosen to measure what it is intended to measure. (Patel & Davidsson, 2011)

The literature search was carried out with a clear method in mind but for the final selection of scientific papers studied. Mostly, cross references together with relevance in the title and abstract determined if the paper was studied further, but all possible results were not examined, as this would have taken too long. With regards to reliability and validity it could
be argued that this procedure could be improved if more papers had been read (reliability) and if (Swedish) physical planning theory had been included to a greater extent (validity).

The case study aimed to visualize the ecosystem services concept in a practical example, which makes this information highly contextualized. The approach was well considered and based on a number of research articles while the data collected were ample and site specific, which implies both high reliability and validity.

The interview guide is provided in appendix 1 and the selection of interviewees is clearly described in the method above. The questions asked were as objective and direct as possible, the method chosen was flexible, but the interviewer did not have extensive experience in that role. Thus, both reliability and validity of the results could have been higher, but are sufficient in the context of this research.

4. Thesis Theory

4.1. Swedish physical spatial planning

Nyström & Tonell (2012) describes spatial planning as the tool for deciding what the resources of water and land should be used for in order satisfy human needs. This is not only about exploitation and building of houses, roads and schools, infrastructure for energy provision, waste handling and water treatment, but also very much the conservation of ecological systems and the guarantee that they are maintained and functional through protection of valuable land and water areas. But the resources that nature provides are unevenly distributed around the world and areas with high resource concentration will be more attractive for settlement and exploitation which will then lead to land-use conflicts. The Swedish authority for planning and living, the state agency Boverket (2007), declares physical spatial planning as the intention to weigh different claims for the same land and thus enable the land and its resources to be used for the purpose it is most suited for.

In Planeringens Grunder (The fundaments of planning) by Nyström & Tonell (2012) they discuss physical spatial planning in Sweden. The actual physical plans generated through spatial planning originate from overarching goals that are decided by the Swedish parliament and government and they are thus the expressions of current political agenda. Some of these overarching goals give the municipalities’ free interpretation of how to reach the goals, within a set framework. Long-term sustainable development and citizen participation is two overarching goals that are important, but not binding, for such physical spatial planning, while consideration of national interests on the other hand are.

In Sweden, the 290 municipalities (Statistiska Centralbyrån – SCB, 2013) have a so called planning monopoly: they have the single right to produce physical spatial plans. This is done mainly through comprehensive plans (CP) and detailed plans (DP). The CP is mandatory for all municipalities and this is where the intentions of the use of land and water in the municipality are described. Within a CP you should find integrated goals for social, environmental, economic, city, communications, regional development and national security planning. It should have a long-term perspective and a holistic view of society and nature, and work towards local influencing and dialogue between citizens. The CP is not binding, which means that the intentions stated can be abandoned in other plans by the municipality. DP on
the other hand is binding and the most important tool to implement the intentions (if possible) given in the CP on a detailed level.

The county administration is the government representative in the planning process as they have the task of supervising the municipalities and make sure that they meet the overarching goals. To aid them, they have different texts of law that concerns planning in different ways. The law helps to insure that the municipalities make planning decisions that are beneficial for society in general. The most important texts of law regarding spatial planning are the Plan and Building law (PBL) stating how physical planning should be carried out, and the Environmental Code (EC) is concerning the environmental aspects and considerations in physical planning. (Nyström & Tonell, 2012)

The law concerning spatial planning has three functions: to give details of how the planning process is to be carried out (what plans are mandatory etc.), to provide guidelines for the assessment of public interests and to make sure that the environment and health aspects etc. are considered. Lastly, it provides information on what happens if the law is not followed, and also an incentive to follow it. (Nyström & Tonell, 2012)

4.2. Environmental management in Swedish spatial planning

Physical spatial planning in Sweden today is supposed to be an integrated part in environmental policy, which means there should be a focus on environmental issues in the planning process. (Nyström & Tonell, 2012)

The Swedish physical planning system and its environmental implications are also discussed by Michanek & Zetterberg (2012). They stress the lack of actual protection and management of important environmental values through the planning process. Since the intentions of conserving specific areas, species etc. in a CP is not legally binding, and the environmental management in DP is only directly connected to built up areas, the planning process is unable to legally protect valuable land and resources in undeveloped areas.

The EC regulates the environmental consideration that has to be taken throughout the planning process. The initial paragraph in EC states that the law has the intention to promote sustainable development and that such development has its foundation in the understanding that nature has its own intrinsic value and the right for humans and society to use the natural resources for our gain also comes with the responsibility to manage it well. The environmental code shall be applied so that:

“1. Human health and the environment is protected from damage and adverse effects regardless if these are caused by pollution or other impacts,
2. Valuable natural and cultural environments are protected and managed,
3. That biodiversity should be protected and maintained,
4. Land, water and the additional physical environment should be used in such a way that ecological, social, cultural and socio-economic values are integrated in a long-term sustainable administration are safeguarded, and
5. Reuse and recycling and other economic use of materials, natural resources and energy is promoted in a way that cycling is achieved.” (MB 1 chapter, 1 §)
Chapter two of EC contains the general rules of consideration that are applied for all types of societal activities, which also includes planning. These rules include the precautionary principle, the polluter pays principle, best available technology principle, resource management principle and location principle etc. (MB). The location principle, that “the choice of land for an activity should be appropriate with the consideration that the purpose will be fulfilled with the least possible intrusion and inconvenience”, is particularly appropriate for the planning process. Other chapters in EC important with regards to the planning process are five and six where environmental quality norms and indicators, EIA regulation etc. are situated. An EIA is mandatory for all CP and some DP, regulated in EC. Also chapter three and four, concerning resource management, are incorporated into the planning process. (Nyström & Tonell, 2012)

PBL supports EC as it states the aim to work for sustainable spatial planning, that general rules of consideration towards private and public interests apply, that land should be suitable for what it is intended to be used for (with respect to, first and foremost, public interests), and that the rules of management of land- and water resources, according to chapter three and four in EC, should be considered (PBL). National interests, a stronger form of public interests, are regulated in the two latter chapters and these have a strong position in the planning process and where different interests are conflicting. The Swedish parliament decides what is to be classed as a national interest, and it has many different topics and variations. Most geographical areas that become national interests have some sort of connection to coasts or shores of lakes and rivers, together with areas in the Scandinavian Mountains (the Scandes). (Nyström & Tonell, 2012)

With the introduction of the environmental code in 1999, the parliament also decided upon fifteen environmental objectives that should be aimed at in the work towards sustainable development, and so also in spatial planning. These overarching goals are not binding but were introduced in order to make the environmental dimension in the sustainable development concept more understandable. Since then, another objective has been added and in 2010, a new goal-structure was introduced where an overarching generational goal sums up the sixteen environmental objectives and their many sub goals. This generational goal is the orientation goal for Swedish environmental policy. (Naturvårdsverket, 2013)

The generational goal: “to hand over to the next generation a society in which the major environmental problems in Sweden have been solved, without increasing environmental and health problems outside Sweden’s borders”. (Naturvårdsverket, 2013)

The Swedish environmental objectives most relevant for municipal planning could be (depending on geographical location): A Good Built Environment, Reduced Climate Impact, A Rich Diversity of Plant and Animal Life, Clean Air etc. (See all environmental objectives at naturvårdsverket, 2013)

According to chapter six of the EC, every EIA made for a CP should state how the environmental objectives relevant to the plan-interests are observed. The following up by Boverket of the municipal work on the integration of the environmental goals has shown that this is often not done in a satisfying way. Mostly, the goals are stated, but without any
practical integration in the plans as to how it helps in reaching the goals. (Boverket, 2007)

This is a problem since the CP is the tool that is supposed to integrate sustainable
development in spatial planning and the environmental objectives are the definition (from the
parliament) of the ecological aspects of sustainable development. Without the proper use of
the environmental objectives in the CP, the ecological aspects, and thus also the holistic view,
of sustainable physical development will be overlooked and sustainable spatial planning in
Sweden will not be reached. (Boverket, 2013)

The reason for this lack of practical integration of the objectives in municipal plans could be
many, but Nyström & Tonell (2012) believes that when plans are tried and processed in the
municipalities, the people that do so are planners with varying backgrounds in education:
natural sciences or social sciences, engineers, ecologists, architects etc. For sustainable land-
use decisions to be made in the planning process, it is paramount that different interests in the
municipality work together. This is often a problem within municipalities, that not enough
work is done across sectors, and sometimes the environmental management issues are seen as
separate from planning and other municipal work. There can also be a lack of knowledge
regarding the details of environmental issues, with the people taking the important decisions,
such as politicians. This is an important obstacle for sustainable development and
environmental integration: the traditional, narrow professions and management cultures
within municipalities. Such an argument has also been recognized by Boverket (2013) and
though this is generally the case, sometimes more recent plans have been more considerate
towards environmental integration and sometimes even the objectives.

The two most important environmental goals in Sweden today is, according to the
government (Regeringen, 2013), the climate issue and the preservation of biodiversity. To
preserve biodiversity the use of and other adverse effects on the ecosystems has to be
addressed. Biodiversity conservation is also a necessity in order to reach all the other
environmental objectives.

This is also strongly connected to the recognition of the services that are fundamental to
human wellbeing and that society receives, for free, from the ecosystems (MEA, 2005).

During 2012, the Swedish parliament published a clarification of the environmental objectives
and also a new set of sub-goals for some of the sixteen goals. Two of these sub-goals, under
the objective “A Rich Diversity of Plant and Animal Life” are directly related to ecosystem
services and resilience in planning and development. (Miljödepartementet, 2012)

"The sub-goal on ecosystem services and resilience entails the definition and systematization
of important ecosystem services and factors that affect these, at the latest in 2013.”

"The sub-goal on the importance of biodiversity and the value of ecosystem services entails
that, before 2018, the importance of biodiversity and the value of ecosystem services be
publicly known and integrated into economical standpoints, political considerations and
other decisions in society where this is relevant and reasonable.” (Miljödepartementet, 2012)
With these two sub-goals, the government intends to increase the consciousness of how ecosystem services and biodiversity contribute to human welfare, to create incitements to integrate ecosystem services and their values in all kinds of decisions making processes in society, and in that way work towards a sustainable management of the ecosystems. Values useful to, and necessary for, society cannot be lost because of lack of knowledge that promotes non optimal spatial planning and environmental management. The government also hopes to, in this way, work towards a more cost effective management of the environment. To practice resilience-thinking in environmental management and spatial planning is also very important to be able to handle a changing climate. (Miljödepartementet, 2012)

To reach these sub-goals, the government declares that the consciousness of ecosystem services must grow in society, especially at the local level. "The work with valuing ecosystem services made by companies and municipalities needs to be encouraged and supported further" (p. 163, Miljödepartementet, 2012). Boverket feel that methods for valuation and integration of ecosystem services have to be developed in a way that makes them fit into a local perspective but also a larger, more holistic perspective in order to be useful in municipal spatial planning. The government wants to aim for a national and international cooperation for standardization of valuing methods which enables comparison between regions. (Miljödepartementet, 2012)

4.3. Sustainable planning and resilience thinking

According to Wilkinson (2012) there is little attention being paid to ecological considerations in spatial planning theory. This is problematic, since there is a big need of ecological integration in spatial planning practice in order to address the growing environmental decline and to work towards sustainable development.

Sustainable development is the guide for the world’s preferred progress regarding society, economy and the environment. Many definitions of sustainability demands that the world is viewed as a system according to the International Institute for Sustainable Development (2012). To look at sustainability from a system point of view gives the spectator a better understanding of how the three main aspects are all interconnected parts of a whole, both in the present and the future. Walker & Salt (2006) claim that those systems where humans and nature interact, so called social-ecological systems are especially important to analyze since it is them in particular that need to be managed in a sustainable direction to insure future human wellbeing. Wilkinson (2012) agrees with Walker & Salt (2006) and argues that one such way to manage socio-ecological systems is through adaptive spatial planning: resilience thinking.

System thinking is a way of viewing the world where everything in it, that is all its actors and components, is connected to each other. These connections, or relationships, can be direct or indirect, present through many of the systems different layers and their results can be displayed as emergent, unpredictable behavior and are seldom linear or predictive. Such systems also evolve and change over time. This makes a system (be it a geographical region, a business or an ecosystem) complex, adaptable, hard to analyze and even more difficult to manage in a desired (sustainable) direction. System thinking in sustainable development
therefore gives the spectator more specific means of analyzing the chosen system and to implement the concept of sustainability in its management. (Walker & Salt, 2006)

Resilience thinking is system thinking with a sustainability approach. In the book Resilience thinking by Walker & Salt (2006), resilience thinking is described as: “an approach to managing natural resources that embraces human and natural systems as complex systems continually adapting through cycles of change”. (p 10)

Folke (2006) has compiled an extensive overview of resilience in socio-ecological systems: concept history, its connection to complex adaptive systems and possibility for sustainable development applications. He ends with current research. In his paper, resilience is defined as “the capacity of a system to absorb disturbance and re-organize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks”. (p. 259)

According to Walker & Salt (2006), sustainability management today mostly consists of command-and-control efforts where society is trying to control the social-ecological system that is humans and nature, in order to keep it in a preferred steady state. In this management view, humans set themselves aside from the surrounding environment and are trying to operate in a state where some system functions are the most efficient, the most optimized. For example; a farmer is trying to control the land on and around his farm in order to get as high a yield of crops as possible. He diverts water to prevent flooding, rearranges other water flows for irrigation, removes all intruding plants that compete with his crops, sprays his fields with pesticides to prevent bugs from eating them and fertilizes the soil to make the crops grow even taller. This will initially be a great way for the farmer to receive large crop yields, but will not work over a longer time period.

Efficiency and optimization of a system like this is not bad per se, but it will fail because of the path it leads the system on to, it assumes a linearly changing system and ignores the systems inherent complexity.

Walker & Salt (2006) describe the resilience of a system is its ability to absorb disturbances and still retain its basic functions and structure. The fact that all systems change over time is at the very heart of resilience. To resist these changes is to increase system vulnerability. Resilience thinking answers what important qualities of a system that needs to be maintained or reinforced for a system to be sustainable. “The key to sustainability lies in enhancing the resilience of socio-ecological systems, not in optimizing isolated components of the system”. (p. 9)

Resilience allows for management of complex adaptive systems, such as cities or ecosystems, as it is providing a model of the world built on the system dynamics of cycles and thresholds.

A social-ecological system (or any system) exists in a steady state (which in itself is not permanent), where components and functions are in constant interaction with each other. These interactions change the system and move its steady state (regime) around a point of equilibrium. Thresholds are points that, if the changes in the system are so severe (or persistent over time) that they cannot be counteracted, the system can pass and enter a new regime, or steady state, where the functions of the system are different. The changes and
interactions that push the system over a threshold is often slow moving variables; secondary feedback resulting from actions in the past and that are hard to connect to its original source. These variables are key variables that control the ultimate fate of the system and its relation to existing thresholds.

Managing resilience is to understand social-ecological systems and the key variables that cause it to cross thresholds between regimes, it is adaptability; the possibility to change interactions in the system in order to move threshold or move the current state of the system away from the threshold. It is much easier to cross a threshold, unknowingly, if the managers of the system are unaware of it. (Walker & Salt, 2006)

Systems change through repeated, adaptive cycles. These cycles can be said to consist of a fore-loop and a back-loop. Fore-loops consist of phases where the system is growing; available resources and opportunities are exploited, energy and materials are stored in the system and materials are accumulated. Connections between actors and components increase, opportunists are turned into specialists that are conservative and more efficient, the system becomes more rigid and less resilient. As Walker & Salt (2006) puts it; “The cost of efficiency is a loss in flexibility” (p. 77)

There are dangers with the late fore-loop phase; the system has become locked in its own rigid structure, redundancies (different actors producing the same function) have been removed in favor of the one most efficient producer, there are very high levels of connectedness across scales and parts of the system, feedback loops are slow, subsidies are given for the system not to change (as it is at its most efficient and short term gains are high) and there are many sunk costs in the system such as infrastructure. The chance of system collapse is high since the slightest change has the possibility to tip the system over one or more thresholds that the system has been moving towards.

The back-loop starts, usually by the system passing a threshold, with a release phase where resilience breaks and the system comes undone; all stored resources are released. The back-loop starts out with chaos and uncertainty but ends in a reorganization phase where renewal and reorganization takes place, invention and experimentation are the prominent features; the future is unknown and the system finds new opportunities for resource use.

The fore-loop stretches over long periods in time and the small incremental changes make this seem like a steady state in the system. Back-loops are short and chaotic. All management and policy development for social-ecological systems has been done in and created for systems in a fore-loop, but back-loops are both important and beneficial for the system as a whole. (Walker & Salt, 2006)

To manage a complex adaptive system in change should be done by identifying where in the cycle the system is, and where the manager would like to be headed. Then the system should be managed in that direction, allowing for occasional regenerative phases of the back-loop and the release of resources, although not through a complete collapse of the system as when passing a threshold. Slow, key variables and thresholds need to be identified and the adaptability of the system need to be prioritized (the capacity of actors in a system to manage the system’s resilience). (Walker & Salt, 2006)
For sustainable management of a social-ecological system adaptability through resilience is the key. Walker & Salt (2006) gives nine parameters that a resilient system should value; Diversity – social, economic and biological, Redundancy – where there is an overlap in governance and one function can be produced by several of the actors in the system, Ecological variability – ecosystems are allowed to run their course and collapse and regenerate and reorganize themselves, Modularity – the connections between parts of the system and the system layers are spread out and more or less rigid (if one part of the system collapses, other parts are still functional since they were only loosely connected), Acknowledging slow variables – (these are the controlling variables that control the system and are associated with thresholds) policy should be focused on these, Tight feedback loops – strong and short feedback loops that clearly show the results of actions in the system, Social Capital – the capability of people in the system to respond to changes efficiently and quickly (by maintaining networks, trust and good leadership in the system), Innovation – learning from failures and adapt to local conditions, Ecosystem Services – to incorporate and enable all non priced ecosystem services in development plans.

4.4. The ecosystem services concept
4.4.1. The ecosystem services concept: background and early works.
The concept of ecosystem services emerged, according to Jansson (2013) during the 1970’s and was properly introduced by Ehrlich & Ehrlich (1981) in their Extinction: The causes and consequences of the disappearance of species. Here they declare preservation of the, often not mentioned and likewise often not well understood, ecosystem services, that are essential (and free of cost) for the survival of human society, as the main reasons to keep species from going extinct. This is due to the indirect uses that society derives from the ecosystems. Ehrlich & Ehrlich separates the direct economic benefits that society derives from nature and the ecosystems (medicinal, food, biological control) from the indirect benefits derived through life-support systems: maintenance of the quality and composition of the atmosphere, control and improvement of the climate, regulation of freshwater storage/magazines, formation and maintenance of soil, waste treatment and nutrient cycling, control of pests and diseases, pollination and maintenance of genetic archive. They also conclude that the extinction of species effect all ecosystem services negatively, in one way or another and to different degrees.

Other early works on ecosystem services were made by Gretchen Daily (1997) and Robert Costanza (1997). In Daily’s Nature’s services – societal dependence on natural ecosystems, she, together with the other authors, discuss the rapid degradation of the earth’s ecosystems and unprecedented species extinction, which inevitably will lead towards our own destruction. Peterson Myers & Reichert (1997) here stress that we now know that ecosystem services are essential to human life, that it would be impossibly expensive for technology to replace the ecosystems for service provision, that the scientific and economic understanding of the true complexity and value of these services is terribly low and the combination of ignorance and the fact that they are so important to human well-fare, dictates caution in dealing with them. This knowledge, according to Goulder & Kennedy (1997), and the problem of nature constantly being under-valued in situations of conflicting land-use interests, necessitates a
framework for assessing nature’s true values and incorporation into decision making. Daily further states that, in order to properly manage nature the “primary needs for society with respect to ecosystem services are their identification, characterization, valuation, monitoring and safeguarding.” (p. 369, Daily1997a).

Robert Costanza and the co-authors of *The value of the world’s ecosystem services and natural capital* (1997) tried to estimate what the planet earth is actually giving humanity in terms of welfare and what this is worth in monetary terms, in order to find incentive for sustainable environmental management. They explained that ecosystem services are critical to the functioning of the Earth’s life-support system and, equally so, to human wellbeing, which is why they represent important parts of the total economic value of the planet. The valuation that they undertook was very complicated and they encountered many problems and uncertainties along the way. With this in mind, the estimated value of the entire biosphere (most of which is outside the market) was calculated to be in the range of US$16–54 trillion per year, with an average of US$33 trillion per year. The uncertainties in the method indicate that this is only a minimum value, and that the biosphere is actually even more valuable. The uncertainty of the result has been used to criticize the valuation effort altogether, but as Costanza puts it: “Although ecosystem valuation is certainly difficult and fraught with uncertainties, one choice we do not have is whether or not to do it. Rather, the decisions we make as a society about ecosystems imply valuations (although not necessarily expressed in monetary terms). We can choose to make these valuations explicit or not; we can do them with an explicit acknowledgement of the huge uncertainties involved or not; but as long as we are forced to make choices, we are going through the process of valuation.” (p. 255)

In 2005 the Millennium Ecosystem Assessment (MEA) was published: a global research effort to determine how the changing environment affects the well-being of humans and society. At the same time, an effort to gather a scientific basis for management action and sustainable use of the ecosystems were made. MEA stated, just as Daily had in 1997, that the human species is fundamentally dependent on the flow of ecosystem services, the support system of nature, and therefore the state of the ecosystems and their ability to provide services is crucial. The capacity of ecosystems to provide services derives directly from the operation of natural biogeochemical cycles that, in some cases, have been significantly modified.

The MEA has identified several important changes to the ecosystems that are both connected to human impact and the welfare of the human race: ecosystem structure has changed rapidly, that is the composition of species, the underlying complexity of the ecosystems (such as what habitats or species are present in a particular location). Essentially all of Earth’s ecosystems have been significantly transformed through human actions and the most significant change in ecosystem structure has been that of natural systems to cultivated systems. Approximately one quarter of Earth’s terrestrial surface has been affected in this way. Ecosystem processes has also undergone substantial change which include water, nitrogen, carbon, and phosphorus cycling, soil formation, biomass production etc. These processes changed more rapidly in the second half of the twentieth century than during any other time in human history. With these changes, also ecosystem function has changed, that is the combined result of structure and processes. Another important aspect of ecosystems, and
the functions that they have, is the combination and abundance of its species. The changes to *species* in the ecosystems (due to other effects on the ecosystem) also affect the ecosystem processes. The distribution of species on Earth is becoming more homogenous, that is the differences between the set of species at one location on the planet and the set at another location are, on average, diminishing. This genetic diversity decline is especially significant among cultivated species.

Another important find made by the MEA is that human use of all ecosystem services is growing rapidly. Approximately 60% (fifteen out of twenty four) of the ecosystem services evaluated in the assessment (including 70% of regulating and cultural services) were being degraded or used in an unsustainable way.

The work done by the global initiative The Economics of Ecosystems and Biodiversity (TEEB) builds on the MEA and attempts to translate nature’s values and biodiversity into economic terms via ecosystem services valuation. TEEB published a substantial *Foundations* report in 2010(a) regarding the connection between ecology and economics. This is the most comprehensive overview on the subject of economic valuation of nature to this date.

The report had three goals: “to provide the conceptual foundation to link economics and ecology, to highlight the relationship between biodiversity and ecosystem services and to show their importance for human well-being” (teebweb.org). The report also aimed at putting a price on inaction: what it would cost society if we do not manage the ecosystem services sustainably and also to examine the macroeconomic dimension of ecosystem services loss. (teebweb.org)

TEEB also published a synthesis report (TEEB, 2010b) to complement the foundations in describing the framework produced by the foundations report. It highlights and illustrates the TEEB approach to show how economic concepts and tools can help equip society with the means to incorporate the values of nature into decision making at all levels.

The TEEB valuation approach is as follows: 1 – Recognizing Value, 2 – Demonstrating Value and 3 – Capturing Value. In step one valuable features in the landscape, in ecosystems or connected to biodiversity is identified without attaching a specific price to the value. The full range of ecosystem services and how they are affected is assessed together with the implications for different groups in society. Here it is important to involve all stakeholders both influencing and/or benefiting from the ecosystem services (and biodiversity) being affected. This step is sometimes enough, especially if the cultural values are high, in order to protect or sustainably use a certain area and its biodiversity. In these cases, monetary valuation of biodiversity and ecosystem services may be unnecessary or even detrimental if this second valuation steps fails to reflect the complexity and aggregate of values.

In step two the value is estimated and demonstrated in economic terms. It is also important to consider different temporal and spatial scales in this step, analyzing linkages between when and where costs and benefits of particular uses of biodiversity and ecosystems are realized. This is often useful for policymakers and decision makers e.g. in municipalities or businesses, as it gives them the chance to make decisions that consider the full costs and benefits of a proposed use of an ecosystem, rather than just those costs or values that enter markets in the form of private goods.

Step three involves the introduction of mechanisms that incorporate the values of
ecosystems into decision making, through incentives and price signals: concrete solutions are sought to overcome the undervaluation of nature. The tools for such solutions might include subsidies, payment for ecosystem services, voluntary eco-labeling and certification etc.

The framework is supposed to help provide information, create a common language, reveal opportunities to work with nature, emphasizing the urgency of action and generating information about value. (TEEB, 2010b)

4.4.2. Defining the concept and laying down the framework

Daily (1997b) defined ecosystem services as “the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life” (p. 3). Costanza et al. (1997) defined them as “the benefits human populations derive, directly or indirectly, from ecosystem functions” (p. 253). The third of the most cited definitions, according to Fisher et al. (2009) are the one phrased by the Millennium Ecosystem Assessment (2005) “the benefits people obtain from ecosystems” (p. V).

Because of the ecosystem services concept being such a young research discipline, and the publications so numerous and increasing according to Fisher et al. (2009), there is still no commonly agreed upon definition for the concept. In papers by Ernstson & Sörlin (2013) and de Groot et al. (2010) this is a cause of concern, as well as the fact that there is also no unified framework of quantifying and valuing methods for ecosystem services, which has lead to contradictions and uncertainties within the research field. The same also goes for the classification of ecosystem functions and services as the knowledge of how they interact and integrate is still inadequate. The most common, widely used classifications are the ones in the two largest, most recent research efforts regarding ecosystem services: MEA (2005) and TEEB (2010b).

The MEA (2005) identified four classes of ecosystem services, including provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling. The last class of services differs from the others as they affect human well-being indirectly and over very long time periods (see table 1). The ecosystem services are provided by ecosystem functions that, in their turn, are derived from the ecosystem biophysical and biochemical structures and processes. The ecosystem services, in turn, provide socio-cultural benefits that contribute to human wellbeing. These benefits have a value to society, a value that (sometimes) can be viewed as an economic value (see table 2 and figure 1). This classification system has been used, and extended, in the most significant papers on ecosystem services, such as Costanza et al. (1997), de Groot et al. (2010) and TEEB (2010a,b).

The TEEB (2010a) foundations report built their classification on the MEA (2005) report, but revised the classification somewhat with influences from Costanza et al. (1997), among others. They argued that the supporting services are not benefits directly used by society for human well-being but they are prerequisites for all other services and therefore also part of the other ecosystem services. Instead, they reasoned that habitat and biodiversity are more
meaningful, concrete contributors to the capacity of ecosystems to provide services (as they make up a big part of the ecosystem stricture and affect its processes) and should therefore also be measured as a service and, consequently, valued (see table 1).

Table 1. The classification of ecosystem services and some examples, from TEEB (2010a) chapter 1.

<table>
<thead>
<tr>
<th>Main service types</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provisioning services</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Food (e.g. fish, game and fruit)</td>
</tr>
<tr>
<td>2</td>
<td>Water (e.g. for drinking, irrigation and cooling)</td>
</tr>
<tr>
<td>3</td>
<td>Rawmaterials (e.g. fiber, timber, fuel wood, fodder and fertilizer)</td>
</tr>
<tr>
<td>4</td>
<td>Genetic resources (e.g. for crop-improvement and medicinal purposes)</td>
</tr>
<tr>
<td>5</td>
<td>Medicinal resources (e.g. biochemical products, models &amp; test-organisms)</td>
</tr>
<tr>
<td>6</td>
<td>Ornamental resources (e.g. artisan work, decorative plants, pet animals, fashion)</td>
</tr>
<tr>
<td><strong>Regulating services</strong></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Air quality regulation (e.g. capturing (fine)dust, chemicals, etc)</td>
</tr>
<tr>
<td>8</td>
<td>Climate regulation (incl. C-sequestration, influence of vegetation on rainfall, etc.)</td>
</tr>
<tr>
<td>9</td>
<td>Moderation of extreme events (e.g. storm protection and flood prevention)</td>
</tr>
<tr>
<td>10</td>
<td>Regulation of water flows (e.g. natural drainage, irrigation and drought prevention)</td>
</tr>
<tr>
<td>11</td>
<td>Waste treatment (especially water purification)</td>
</tr>
<tr>
<td>12</td>
<td>Erosion prevention</td>
</tr>
<tr>
<td>13</td>
<td>Maintenance of soil fertility (including soil formation)</td>
</tr>
<tr>
<td>14</td>
<td>Pollination</td>
</tr>
<tr>
<td>15</td>
<td>Biological control (e.g. seed dispersal, pest and disease control)</td>
</tr>
<tr>
<td><strong>Habitat services</strong></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Maintenance of life cycles of migratory species (incl. nursery service)</td>
</tr>
<tr>
<td>17</td>
<td>Maintenance of genetic diversity (especially in gene pool protection)</td>
</tr>
<tr>
<td><strong>Cultural &amp; Amenity services</strong></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Aesthetic information</td>
</tr>
<tr>
<td>19</td>
<td>Opportunities for recreation and tourism</td>
</tr>
<tr>
<td>20</td>
<td>Inspiration for culture, art and design</td>
</tr>
<tr>
<td>21</td>
<td>Spiritual experience</td>
</tr>
<tr>
<td>22</td>
<td>Information for cognitive development (such as education)</td>
</tr>
</tbody>
</table>

Bastian et al. (2012), de Groot (2006), and Fisher et al. (2009) describes the confusions regarding ecosystem functions in the literature. The term “ecosystem function” in the ecosystem services literature has sometimes been used with different meaning, which has contributed to some uncertainties. Function has been used both to describe the internal functioning of the ecosystem (e.g. maintenance of energy fluxes, nutrient (re)ycling, food-web interactions), and sometimes it relates to the benefits derived by humans from the properties and processes of ecosystems (e.g. food production and waste treatment). Functions can also be seen as purely ecological phenomenon or as prerequisite for human satisfaction (that is, the ecosystems have “functions” only if humans can reap the benefits) (see table 3).
Table 2, The benefits that society receives from ecosystem services, from MEA (2005).

<table>
<thead>
<tr>
<th>Services</th>
<th>Benefits received by society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>Products obtained from the ecosystems such as food, fibre, fuel and biochemicals etc.</td>
</tr>
<tr>
<td>Regulating</td>
<td>The benefits obtained through the regulating of processes within ecosystems such as air quality</td>
</tr>
<tr>
<td>services</td>
<td>regulation, climate regulation, water purification, erosion regulation and pollination etc.</td>
</tr>
<tr>
<td>Supporting</td>
<td>The processes that support all other services provided by ecosystems such as water- and nutrient cycling,</td>
</tr>
<tr>
<td>services</td>
<td>production of biomass and soil formation.</td>
</tr>
<tr>
<td>Cultural services</td>
<td>Non-material benefits obtained from the ecosystems through recreation, tourism, aesthetic experiences etc.</td>
</tr>
</tbody>
</table>

Table 3, The ecosystem functions that contribute to and provide ecosystem services, from de Groot (2006).

<table>
<thead>
<tr>
<th>Functions</th>
<th>What they entail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation functions</td>
<td>Functions that maintain the balance of the biosphere and keep ecosystems “healthy”; prevention of erosion, air and water purification, storage and recycling of nutrients, regulation of the chemical composition of the atmosphere etc.</td>
</tr>
<tr>
<td>Habitat functions</td>
<td>Provides space (land) for species to live and reproduce and thus keeps maintaining biological and genetic diversity and the evolutionary process.</td>
</tr>
<tr>
<td>Production functions</td>
<td>Provides resources and products through photosynthesis and biomass production, food, water, medicine and energy.</td>
</tr>
<tr>
<td>Information functions</td>
<td>Provides the possibility for recreation, education and spiritual, aesthetic and cultural enrichment.</td>
</tr>
<tr>
<td>(Carrier functions)</td>
<td>When dealing with semi-natural, in some way altered ecosystems, their provisioning of cultivation, habitation and transportation through the support of related infrastructure.</td>
</tr>
</tbody>
</table>

In de Groot et al. (2010) and TEEB (2010a) the function is defined as “the potential that ecosystems have to deliver a service which in turn depends on ecological structure and processes”. (p. 11 chapter 1) (see figure 1). In figure 1, the chain of causality from ecosystem structure and processes to socio-cultural benefits and values is described, as by de Groot et al. (2010). An illustrative example of links in the chain: biophysical structure and process – vegetation cover (the abundance, what kind of different plants, the slope gradient of the ground etc.) that contribute to catching rain-water and using it for primary production (process of photosynthesis). Function – letting water slowly pass through the ground producing biomass. Service – protection from floods and the provisioning of e.g. timber or hay. Benefit – safety from flood damage, fodder for cattle. Value in no flood damages to
property or restoration costs, hay can be sold or no need to buy fodder from somewhere else. Although the overall structure of this “cascade” is generally accepted, the distinction between “function”, “service” and “benefit” is still debated.

Figure 1. The framework describing the chain of causality from ecosystem structures and processes to socio-cultural benefits and (sometimes) economic value. From de Groot et al. (2010).

Another way of looking at functions, structure and processes of ecosystem services is provided by Bastian et al. (2012) and called the EPPS framework. Instead of ecosystem (or landscape) processes and structure, there are ecosystem properties: spatial and temporal variability e.g. soil properties, biotic material production, nutrient cycles, and biological diversity. The ecosystem function is substituted with ecosystem potential: that is the capacity of an ecosystem or landscape to provide society with services. This approach also considers risk, the carrying capacity and the capacity to capture and balance stresses (the resilience) which limit or may even exclude certain intended uses of services. It applies a sustainable use perspective that further increase the usefulness in environmental management and decision making.

Fisher et al. (2008) contributes with an extensive discussion on the definition, classification and evaluation of ecosystem services. They argue that a definition of ecosystem services should be based on ecology and be made very clear in order to allow meaningful comparisons across time and space. A uniform classification system is less important, or even unhelpful, as ecosystems are inherently complex, they are used very differently across the globe and they
are also perceived very different to beneficiaries in different living-situations around the world.

4.4.3. Valuing ecosystem services
An important contributing factor to the rapid decline in ecosystems and their services is the notion that they are free and abundant (or even seen as infinite). Chee (2004) argues that the ecosystem services are categorized as open access and pure public services, which means that no one “owns” or has the “rights” to these services. Neither can others be excluded from using them (nor benefiting from them) and thus little incentive exists for these beneficiaries to manage the ecosystem services in a sustainable way. They are over consumed by society (TEEB, 2010a). This phenomenon is often referred to as “the tragedy of the commons” (Hardin, 1968).

Economics is the study of how to allocate limited resources and it relies on valuation to gather information about the scarcity of these resources. The value of ecosystem services and biodiversity is a reflection of what society is willing to trade off in order to conserve these natural resources. Economic valuation of ecosystem services and biodiversity can, therefore, explain, to decision makers and society by large, that biodiversity and ecosystem services are scarce and that their decline (in both quality and quantity) will incur costs on society. These costs have to be internalized into policy and decision making to prevent misallocation of natural resources. (TEEB, 2010a)

Both MEA (2005) and TEEB (2010a) express the aim of attaching an (economic) value to ecosystem services: to create better protection and more sustainable maintenance of natural resources (the ecosystems). As few ecosystem services have explicit prices or are traded in open markets, they often end up without consideration in decisions for planning and policy. The ecosystem services that do have “a price” are most likely to be the provisioning services that also are consumptive; they have a direct-use value to society. Some non-consumptive use values (such as recreational values) or non-use values (which may include the spiritual or cultural importance of a landscape or a species) have despite their lack of “price” been influential in decision making on local levels and because of a specific context, such as historical or religious importance.

The economic invisibility of most of the ecosystem services lead to, for example, clear-cutting of forests or unsustainable water extraction from aquifers, because of the existing market signals (influenced by subsidies, taxation etc.) that make it a logical and profitable thing to do. The costs of this environmental degradation (in the form of deforestation) are generally not borne by the companies clearing the land for agriculture or by companies logging and selling the timber. The cost is instead borne by society (and future generations) as the ecosystem services decline, and their loss affects human-well being negatively. The failure to account for the full economic values of ecosystems and biodiversity in decision making and economic assessments has been a significant factor in their continuing loss and degradation.

The TEEB (2010b) report states that for decision makers to be able to account for the ecosystem services provided (and to manage their continued existence) they need information about what kind of services are provided, how this service provision would change with a
different land use management, who is affected by this change and to what degree. Valuation in these circumstances enables policy makers to address trade-offs in a rational manner and not favor private wealth and physical capital above public wealth and natural capital.

When undertaking the task of valuing, and also visualizing, ecosystem services for the benefits of decision makers, de Groot et al. (2010) suggest the following steps in order to make the most appropriate connection between ecosystems, (economic) values and trade-off analysis: quantifying the capacity of ecosystems and landscapes (the total area) to provide goods and services, valuing ecosystem services, linking ecosystem management states to the total bundle of ecosystem services (provided by the area), assessing the trade-offs involved in land cover and land-use change on ecosystem services and finally to use the information in integrated landscape planning. The second to last step, to assess the trade-offs, is particularly important according to Kontagianni et al. (2010) since this is the step where the (scientific) information has to be communicated to the decision makers in a way that they understand and can have use of. Visualizing the ecosystem services and how they will be affected is best made through maps and models where issues of scale (both time and space) can be addressed.

TEEB (2010a) and de Groot et al. (2010) claim that ecosystem services have three different kinds of values: an ecological, a socio-cultural and an economic value. How the value of ecosystem services is presented to a decision maker is of great importance for the trade-off situation and the resulting decision (see also philosophical implications below).

An ecological value, according to de Groot et al. (2010), is a type of indicator value that describes the “health” of the ecosystem, e.g. through quantifying biological diversity. TEEB (2010a) give other indicator values that can be used to convey important (ecological) information about the ecosystem and its ability to provide services are genetic diversity, population sizes, net primary productivity, ecosystem fragmentation, land cover change, production of timber, fisheries production, carbon sequestration, waste assimilation, tourism numbers or income etc. An ecological value (and its meaning for human welfare) can, as stated by Dobbs et al. (2011), be problematic when it comes to visualization and communication to decision makers.

De Groot et al. (2010) describe a socio-cultural value is subjective in its description of the importance that an individual or the society attach to an ecosystem service (especially the cultural services). Cultural differences are fundamental in the way people conceive and relate to the environment and this will also affect the economic values that are derived through subjective methods, an important factor for valuing ecosystem services according to Ernstson & Sörlin (2013).

Economic values are not objective facts nor do they reflect universal truths; instead they reflect the culturally constructed realities, worldviews, mind sets and belief systems of particular societies and sectors of society (TEEB, 2010). Costanza (1997) means that many methods for translating intrinsic ecosystem services values into economic values are based, directly or indirectly, on the ‘willingness to pay’ which, according to TEEB (2010a) and Ernstson & Sörlin (2013) can vary drastically over space and time. These values depend on history, norms, philosophical and ethical views on the human nature relationship of whole societies. It relates to feelings and preferences of individuals, the connection to their mental
Subjective opinions thus influence virtually all monetary valuation according to Ernstson & Sörlin (2013).

Giving ecosystems (and their services) a total monetary value (TEV) is fraught with many obstacles and has also been criticized in several research papers, for example Ernstson & Sörlin (2013).

Ecosystems are very complex, adaptable systems. How they work and interact with each other, what feedback loops that exists, the importance of biodiversity for the functioning of ecosystem processes and services are not well understood. If spatial and temporal scales are added to the mix, even more uncertainties will be present in any attempt of valuation as mentioned by de Groot (2006) and Ernstson & Sörlin (2013). The physical data (ecological indicators and their connection to wellbeing) used in evaluation attempts are therefore reliable only to a certain extent. The methods used for transforming the biophysical structures and processes into monetary terms are often subjective and generalizing, which contributes to the uncertainties of the results, something that is agreed upon by Costanza et al. (1997), Ernstson & Sörlin (2013) and Jansson (2013).

As mentioned above, the first step in the TEEB (2010b) valuation approach was to recognize the ecosystem services and that, sometimes, this step is enough in communicating nature’s values to decision makers. Some ecosystem services values, such as the complex, intangible habitat and cultural services values are inherently subjective and dependent on local conditions which make it more or less impossible to give them an effective (usable) monetary valuation. Resilience, and biodiversity, is also very complex values that are too problematic to capture in monetary valuation and should be presented alongside other values. A resilience value can often be seen as insurance value, which is, in itself, very meaningful for sustainable planning.

Another argument that speaks against putting an (economic) value on nature is that it should be protected for its intrinsic values: for moral reasons. But morals could also argue that no one should go hungry and more natural habitat should be transformed into cultivated land (Costanza et al., 1997). Costanza et al. (1997) argues that, even though the act of transforming ecosystem complexity into a monetary value is tremendously difficult, we still do it every day, weather we realize it or not. In all kinds of alternative choices and trade-off situations, an active evaluation of nature’s resources are made and, should be made, as it gives society a much better chance to manage the finite natural resources in a sustainable way.

The need for valuation, and alternative methods to do it, has been discussed at length in the research literature: from the philosophical and ethical foundations of valuing nature to the definition of the term ‘value’ and concepts of estimating the price of a land area.

In *Nature’s services* (1997) the authors discuss philosophical orientation and its importance in valuing ecosystems and their services. The most prominent philosophy in society, regarding nature and its potential values, will be the base for what value (and with what method) is trying to be captured: the empirical methods used in valuation attempts are based on the philosophical orientation of society. An anthropocentric viewpoint (philosophy) acknowledges that nature is valuable only when it is of service to humans and enhances well-
being. Within the philosophical orientation of anthropocentrism, you find utilitarianism which states that natural things are only valuable if they confer satisfaction to humans. This is the most common philosophy in economics and thus also in cost-benefit analysis (CBA) that aims to provide the largest gain for the most people (strong utilitarianism). According to TEEB (2010a) CBA is the most basic and frequently used tool for valuing different land-use management options and their potential outcomes in physical spatial planning.

As reported by Costanza et al. (1997) and Goulder & Kennedy (1997), species, or services, with neither direct nor indirect use-value to humans can have intrinsic rights to exist. The intrinsic value approach has its roots in the bio-centric philosophy (which is opposed to anthropocentrism).

The “choice” of philosophical base when attempting to recognize environmental value for ethical collective decisions about the preservation of nature will help in determining the outcome. It is therefore important to be aware of the underlying philosophy and how it will affect the results.

Another important obstacle in valuing ecosystem services, as discussed by Costanza et al. (1997), Goulder & Kennedy (1997) and TEEB (2010a) is the attempts to make a total valuation of a single ecosystem or a landscape. Goulder & Kennedy (1997) declare this type of valuation as very difficult and the result does not say much in comparison to the marginal value of the ecosystems: the changes in value or the marginal loss of certain ecosystem services in a trade-off situation. According to de Groot (2006), Fischer et al. (2009), MEA (2005) and TEEB (2010b), valuation of ecosystem services, especially monetary valuation, is best applied when assessing the consequences of changes resulting from alternative management options, rather than for attempting to estimate the total value of ecosystems. In such valuing attempts, it is still important to cover as many services as possible in order to get a relevant value, which is a flaw in many valuation studies as they do not assess the full range of ecosystem services but focus on only a few.

An economic valuation of ecosystem services is first and foremost an aim to give them a total monetary value (ecological plus socio-cultural plus monetary values), which is much simpler to communicate to stakeholders and decision makers, as stated by Ernstson & Sörlin (2013) than the other two values. According to de Groot et al. (2010) a TEV value of an ecosystem service can never, in itself, represent a true, objective and fact-based value of nature, as it has been built upon, more or less, the ecological and socio-cultural values.

In the book Selling Forest Environmental Services (2002), Bishop & Landell-Mills claims that one of most widely used classification systems regarding benefits provided by (forest) ecosystems distinguishes between different benefits in terms of whether they contribute directly or indirectly to human welfare, and whether they entail the consumptive or non-consumptive use of natural resources. This system typically includes four categories of values: direct use, indirect use, option and non-use values. Watershed protection and carbon sequestration are services classified as having indirect use-values (they support and protect economic activities and properties), biodiversity is sometimes considered to have option value due to potential, but as of yet uncertain, future role as source of genetic information for the biochemical industry. Biodiversity can also have a non-use value as far as people value the
knowledge of certain species and ecosystems existing. This type of benefit (or value) classification also separates local and global values: benefits enjoyed at different geographical locations.

Chee (2004) writes extensively on economic valuation of ecosystem services, how it is made, where the problems lie and how to tackle these problems, all from a neoclassical economic theory point of view. Neoclassical economy is built on the notion that trading in markets is the best way to allocate natural resources, but as ecosystems and their services seldom are, this is a fundamental problem of traditional economic theory. Another substantial problem for valuing ecosystem services by letting consumers make choices in markets is that they are assumed to be rational: an individual express the value of the goods through a preference that: is fixed (stable) and ordered in a ranking list, based on complete information and perfect structural knowledge about a choice and that the person acts to maximize satisfaction. This is problematic as preferences change under the influence of education, advertising, variations in abundance and scarcity, changing cultural assumptions and specific social and environmental contexts. In table 4, Chee (2004) describes different kinds of values that ecosystem services can be assigned.

Table 4, Value aspects and what they entail, from Chee (2004).

<table>
<thead>
<tr>
<th>Words describing different value aspects</th>
<th>What they entail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market value</td>
<td>the exchange value, or price, of a commodity or service in the open market</td>
</tr>
<tr>
<td>Intrinsic value</td>
<td>the value of entities that may have little or no market value, but have use value</td>
</tr>
<tr>
<td>Intrinsic, non-use</td>
<td>the value attached to the environment and life forms for their own sake</td>
</tr>
<tr>
<td>Existence value</td>
<td>the value attached to the knowledge that species, natural environments and other ecosystem services exist, even if the individual does not contemplate ever making active use of them</td>
</tr>
<tr>
<td>Bequest/vicarious values</td>
<td>a willingness to pay to preserve the environment for the benefit of other people (intra- and intergenerational aspects)</td>
</tr>
<tr>
<td>Present value</td>
<td>the value today of a future asset (discounted to the present)</td>
</tr>
<tr>
<td>Option value</td>
<td>a willingness to pay a certain sum today for the future use of an asset</td>
</tr>
<tr>
<td>Quasi-option value</td>
<td>the value of preserving options for future use assuming an expectation of increasing knowledge about the functioning of the natural environment</td>
</tr>
</tbody>
</table>

4.4.4. Critique and problems
Dobbs et al. (2011), Ernstson & Sörlin (2013) and TEEB (2010a) all declare that one of the most fundamental problems with the ecosystem services concept and its integration in physical spatial planning is the lack of a unified framework for its implementation. Together with the disagreements on defining important aspects of the concept, such as “function”, and the alternative classifications of the services, this creates a hesitant attitude towards the concept as decisionmakers feel they have to wait for a framework that the scientists have agreed upon.

Another important problem mentioned above, and further by Ernstson & Sörlin (2013) and MEA (2005), is the knowledge gaps regarding the functioning of ecosystem services, their
components, structures and feedback loops and the role of biodiversity in the system’s ability to provide services. With this also comes the time-frames of change, the inertia of ecosystems and the possibility of tipping-points with regards to resilience.

Ernstson & Sörlin (2013) also discuss other prominent difficulties with the ecosystem services concept. They are critical to the use of a final economic valuation of the ecosystem services and the use of such values in decisionmaking and spatial planning.

The ecosystem services concept has become very popular as it promises to be a simple and effective method for the integration of nature into all kinds of decision making processes in society, which is today very attractive, and necessary. It is said to build upon objective assessments of biophysical processes that then are transformed into objective monetary values. The problem is that economical values never can be objective: they also incorporate the ecological and socio-cultural values of the ecosystem services (sometimes to a very large degree). These are, despite the different translating methods, very hard to capture as relevant (true) monetary values but, without this problematic ”translation”, there can be no total economic value of ecosystem services.

To emphasize the difficulties of translating socio-cultural values into their monetary equivalents, both Ernstsson & Sörlin (2013) and Goulder & Kennedy (1997) point out that socio-cultural values are extremely dependant on their location: the history of an area, the social conditions (income, population density, age, religion etc.) of the society or the people asked to relay there sense of value regarding the land-area (or services). This place-based value differs all over the world, even within the same area, and also over time. When translating these values into monetary terms, the cultural and historical context is lost and thus also important information about the value. It is the same with ecological valuation: monetary translation covers up the complex workings of the ecosystem structures and processes, and the information on how the value comes to be is lost.

Other types of critique that has been given regarding the ecosystem services concept is that it does not discuss equity. The benefits of ecosystem services provision is unfairly distributed across the globe, which Ernstson & Sörlin (2013) argue is an important flaw. Another flaw is the apparent bias towards positive services provided by the ecosystems. Disservices, as discussed by Bolund & Hunhammar (1999) and Gómes-Baggethun & Barton (2013), such as parks being home to pests or wetlands breeding mosquitoes that carry diseases, are seldom mentioned in the research literature according to Dobbs et al. (2011) and Ernstson & Sörlin (2013).

de Groot et al. (2010) and Ernstson & Sörlin (2013) agree on two more problems regarding economic valuation of ecosystem services. The monetary valuation can, in some aspects, have the opposite effect of its initial purpose: if an ecosystem service is given a low monetary value, or if a land area is not providing a great amount of services, this can contribute to environmental degradation in the competition with high exploitation values.

Finally it is worth mentioning the inherent problems with measuring (valuing) and comparison of the different kinds of services. Supporting services are prerequisites for all other services and should, technically, be valued much higher than the rest.
4.5. Resilience and ecosystem services in cities
Wilkinson (2012) describe cities as places where planning and ecology meet with the mutual aim of creating resilient sustainable socio-ecological systems.

According to Jansson (2013), the future sustainable cities require a reconnection of society to the biosphere: to live within the limits of what natural systems can provide. To incorporate resilience, through ecosystem services provision, in city planning is not only vital, but offers great potential in reaching sustainable development. It is important to understand that cities not only affect the local ecosystems in its direct vicinity, but is completely dependent on ecosystems far away for its total service provisions, which is not consistent with building resilient cities. To use more (local) ecosystem within the cities for the provisioning of services necessary for the well-being of the inhabitants is important for society in reconnecting to the environment and building resilience in society and cope with a changing world.

Bolund & Hunhammar (1999) wrote a seminal paper on the ecosystem services provided by and important to city landscapes. Cities are dependent on the ecosystems beyond the city limits, but also benefit from internal urban ecosystems. Many environmental problems in urban areas are generated locally and will often most effectively be dealt with through local solutions. The ecosystems within the cities provide the local inhabitants with several ecosystem services that contribute to their wellbeing, and thus also solve some of the local environmental problems, see table 5.

The ecosystem services provided are based on an example from Stockholm, Sweden and should not be generalized as service provision (and importance to inhabitants) differs depending on the conditions of the site.

Table 5. The ecosystems in cities and the services they provide, from Bolund and Hunhammar (1999).

<table>
<thead>
<tr>
<th>Ecosystem in cities</th>
<th>Street trees</th>
<th>Lawns/Parks</th>
<th>Urban Forest</th>
<th>Cultivated Land</th>
<th>Wetland</th>
<th>Stream</th>
<th>Lake/Sea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Filtering</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Micro climate regulation</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Noise reduction</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainwater drainage</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewage treatment</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Recreation/Cultural values</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Other ecosystem services provided by, or important to, cities are food supply, moderation of extreme events, climate regulation, pollination and seed dispersal, as mentioned by Gómes-Bagge, Gómes-Baggethun & Barton (2013).
Fischer et al. (2009) discuss the importance of, when seizing the opportunities that ecosystem services provide for building resilience in cities, the involvement of stakeholders.

Hubacek & Kronenberg (2013) provides a more comprehensive synthesis of the urban ecosystem services literature.

5. The Klarälven River delta – a case study

In order to test the usefulness and applicability of the ecosystem services concept theory presented in the literature review, a land area with several conflicts of interests regarding nature preservation and exploitation was chosen as a suitable study area. This case study thus aims at contributing to the answer of the 2nd and the 3rd research question of this thesis.

5.1. A description of the Klarälven River delta

Heijkenskjöld (1981) writes about the geological history of the Klarälven River. The Klarälven River delta has formed as Klarälven River meets the standing waters of Lake Vänern and, as the water slows down, deposits of its sediment around a number of small islands (an archipelago) made out of solid bedrock. These islands have helped determine the distinctive and unusual shape of the delta. Klarälven river delta is Sweden’s largest freshwater delta below the Scandinavian Mountains (the Scandes) and covers a total area of 3000 ha. The delta has been developing since 1700 BC and the still continuous land rise and ongoing sedimentation keeps the delta under formation, which means that it is still an active delta today.

Kling (1992) describes this particular river delta as having many characteristic properties connected to deltas and delta formation, for example midstream bars, natural levees, oxbow lakes, point bars, delta islands and crevasses, etc., still intact. The delta is in many parts relatively untouched and is therefore, as a whole, greatly representative of delta formation and thus has a very unique value. It is also unusual since, in some parts, it has expanded in the opposite direction to the initial spread of the delta. This uniqueness makes the delta area particularly interesting for research and educational purposes regarding deltas in general but also the development of the natural landscape in northern Vänern.

The Klarälven River delta area relevant to the case study consists of partly the western river-vein, The Dingelsundet vein, The Skoghall vein and the Suttersälven River with land areas in both Karlstad and Hammarö municipalities, see figure 2. The area is 1100 ha with roughly half land and half water, as described by the Värmland County administration (2008). According to Heijkenskjöld (1981) most of the land area was formed during the last 500 years and has since around the year 1800 been subjected to, sometimes extensive, human interference. As the city of Karlstad has expanded, the demand for land area initiated dredging of the river arms and depositing of the dredge-material to fill out bays and shallow areas to create new land.
Kling (1992) characterizes the different part of the delta as follows: Tuvan/Sorgforsådran/Suttersälven is one of the youngest areas of the delta as this is where it “ends” and the largest part of the river meets Lake Vänern. Tuvan has formed after the year 1810 (according to historical map studies) and the area is still under continuous formation. Unfortunately, this is also where most of the human interference has been taking place, and still is, since the sediment transport and deposition cut off important water routes. Substantial dredging of the Suttersälven mouth (north side) and deposition of the river sediments on Tuvan has then taken place. The south side of Tuvan, by Sorgforsådran, is untouched and has very specific delta features that has been protected from wave action from Vänern. The major transport link between Karlstad and Skoghall, Hammaröleden, has been built on the west side of Tuvan and during the construction Tuvan was used as a tip for filling materials. Today there is a snow tip for Karlstad municipality located to the same area.

Knappstaviken, below Björkås, is an interesting area since it is preserved from much human interference. It has many features specific to deltas and delta formation that show the different successive stages of delta formation such as like delta islands, delta lakes, cut-off river veins, natural levees and point bars. For the benefit of the river delta as a whole, it should be left untouched, apart from some reed-clearing in central parts in order to keep open water for the local bird population. (Kling, 1992)

Because of the unusual geological and natural properties of the delta it has been classed as a national interest for conservation by the Swedish authorities. The most active parts of the
delta is situated within the case study area and are at some risk of exploitation interests as Karlstad expands towards Lake Vänern. The areas within the delta with the most pronounced (untouched) value is Knappstaviken and Sorgforsådran (the river mouth by Tuvan). Tuvan, despite human interference, is also of high value since this is where the delta is still under formation today and should therefore be protected to preserve the complete picture of an active delta. Dredging by Tuvan/sorgforsådran and filling of the area (for exploitation) goes against the national interest and can cause damaging erosion at the water’s edge. (Kling, 1992)

Biological and ecological values of the Klarälven River delta are also very high and they stem from the many different nature and vegetation types that it contains, which are hosts to several unusual and endangered species, mostly birds, insects but also some plants. It is a large, continuous area which, together with vegetation variation and its advantageous location for migratory birds, gives rise to substantial local biodiversity. Some of the species in the delta should be protected according to the species- and habitat directive, the bird directive and in relation to being Natura 2000 areas.

Areas of reed (mosaics and cohesive areas), beach meadows, natural deciduous forests with marsh-like elements, wetlands and rock face forests are some of the more unusual nature types. For a list of protected species see county administration (2008) for further information.

The cultural and historic sites in the Klarälven River delta are, for the most part, not particularly old. This is due to the majority of the land being relatively young but there are the exceptions of the bedrock islands where, in one occasion, there are the remains of a Stone Age burial ground and a circle of judging stones. There are also signs of the very old use of managed beach meadows in the same area, and in several other places too. Other values for the cultural landscape are the signs left of old roads, the ferry man cottage and a saw mill. (Värmland County administration, 2008)

Recreational interests in the Klarälven River delta today are very high due to its natural landscape, biodiversity and since it is located in between two densely populated areas within walking and biking distance. There are many roads (with bridges) and walking paths running through the area as well as unmarked paths. The managed beach meadows are grazed by cattle in the summers, several bird watching towers and jetties for fishing are available and there is a central information and educational centre called Naturum on the northern border of the area. The closeness to the water also brings potential for water based recreation and activities, like swimming, ice skating and boating. It is a popular area for both locals and tourists and schools use it for educational purposes for all ages. (Värmland County administration, 2008)

5.2. Results
1. The ecosystem services in the Klarälven River delta are shown in table 6.
Table 6. Typology/characterization from TEEB (2010a) and identified by Anita Anderson at the county administration.

<table>
<thead>
<tr>
<th>Main service types</th>
<th>Provisioning services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Food – fish, game, mushrooms and berries</td>
</tr>
<tr>
<td>2</td>
<td>Water – for irrigation</td>
</tr>
<tr>
<td>3</td>
<td>Rawmaterials – firewood, hay/fodder from grazing</td>
</tr>
<tr>
<td>4</td>
<td>Genetic resources – valuable/rare species</td>
</tr>
<tr>
<td>5</td>
<td>Medicinal resources –</td>
</tr>
<tr>
<td>6</td>
<td>Ornamental resources –</td>
</tr>
<tr>
<td>Regulating services</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Air quality regulation – particles and gases</td>
</tr>
<tr>
<td>8</td>
<td>Climate regulation – micro- and macroclimate</td>
</tr>
<tr>
<td>9</td>
<td>Moderation of extreme events – flood prevention, lessening of heat-waves</td>
</tr>
<tr>
<td>10</td>
<td>Regulation of water flows – natural drainage and drought prevention</td>
</tr>
<tr>
<td>11</td>
<td>Waste treatment – water treatment and noise reduction</td>
</tr>
<tr>
<td>12</td>
<td>Erosion prevention – rich plant life</td>
</tr>
<tr>
<td>13</td>
<td>Maintenance of soil fertility (including soil formation) – sedimentation and microbe activities</td>
</tr>
<tr>
<td>14</td>
<td>Pollination – insects</td>
</tr>
<tr>
<td>15</td>
<td>Biological control – seed dispersal and pest control</td>
</tr>
<tr>
<td>Habitat services</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Maintenance of life cycles of migratory species – nursery for fish and resting place for migratory species and nesting for birds</td>
</tr>
<tr>
<td>17</td>
<td>Maintenance of genetic diversity – range of species</td>
</tr>
<tr>
<td>Cultural &amp; Amenity services</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Aesthetic information – landscape structure</td>
</tr>
<tr>
<td>19</td>
<td>Opportunities for recreation and tourism – walking, boating, fishing, bathing, ice skating, bird watching, historical sites</td>
</tr>
<tr>
<td>20</td>
<td>Inspiration for culture, art and design – landscape structure, present day and historical uses of the landscape</td>
</tr>
<tr>
<td>21</td>
<td>Spiritual experience – religious and historical sites, the landscape itself</td>
</tr>
<tr>
<td>22</td>
<td>Information for cognitive development – education and maintenance of cultural heritage</td>
</tr>
</tbody>
</table>

The Klarälven River delta provides a wide range of ecosystem services. From the area description and the table of identified services, it is evident that most of these services are strongly interconnected. According to de Groot et al. (2010) it is therefore important to consider the landscape, or area, as a whole when attempting to value the services provided. With this landscape perspective, the human interference with the landscape services also need to be considered. This is called management regimes of the natural environment by de Groot et al. (2010). One example of this type of management regimes is the dredging of the river veins of the delta, as these transport a large quantity of sediment, that partly accumulate along the bottom. The dredging maintains the water flow in the river, which contributes positively towards the provision of flood control by the delta.

2. Identifying stakeholders connected to the ecosystem services provided are important for decision makers, as stated by TEEB (2010b), as they can contribute with information and local knowledge needed for further valuation of the services. It also gives the decision makers an overview of who is actually affected by a land-use change, and in what way, which enables
more informed and well grounded decisions to be made in spatial planning.

The stakeholders connected to ecosystem services benefits are based on Butler et al. (in press) and shown in Table 7. The stakeholders identified for the Klarälven River delta was: residents of the delta area, visitors to the delta area (tourists, bird-watchers and hikers etc.), farmers, fishermen, hunters, the local community, the local council, local service providers, consumers, NGO’s, the county administration, industries and the public (society in general and at a larger geographical scale).

Table 7. The typology/characterization of stakeholders in Klarälven River delta, from Butler et al. (in press).

<table>
<thead>
<tr>
<th>Ecosystem Services in Klarälven River delta</th>
<th>Stakeholders</th>
<th>Local on-site</th>
<th>Local off-site</th>
<th>Regional and national</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food</td>
<td>Residents, Visitors, Fishermen, Hunters</td>
<td>Consumers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Water</td>
<td>Residents</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Rawmaterials</td>
<td>Residents, Farmers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Genetic resources</td>
<td>Residents</td>
<td>Community, NGO’s</td>
<td>Industry, County admin., Public</td>
<td>Public</td>
<td></td>
</tr>
<tr>
<td>7 Air quality regulation</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>County admin., Public NGO’s</td>
<td>Public</td>
<td></td>
</tr>
<tr>
<td>8 Climate regulation</td>
<td>Residents, Visitors</td>
<td>Community, Council</td>
<td>County admin.</td>
<td>Public</td>
<td></td>
</tr>
<tr>
<td>9 Moderation of extreme events</td>
<td>Residents, Visitors</td>
<td>Community, Council</td>
<td>County admin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Regulation of water flows</td>
<td>Residents, Visitors</td>
<td>Community, Council</td>
<td>County admin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Waste treatment</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>County admin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Erosion prevention</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>County admin.</td>
<td>NGO’s, Public</td>
<td></td>
</tr>
<tr>
<td>13 Maintenance of soil fertility</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>County admin.</td>
<td>NGO’s, Public</td>
<td></td>
</tr>
<tr>
<td>14 Pollination</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>County admin.</td>
<td>NGO’s, Public</td>
<td></td>
</tr>
<tr>
<td>15 Biological control</td>
<td>Residents, Visitors</td>
<td>Council, Community</td>
<td>County admin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Maintenance of life cycles of migratory species</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>County admin.</td>
<td>NGO’s, Public</td>
<td></td>
</tr>
<tr>
<td>17 Maintenance of genetic diversity</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>Industries, County admin. NGO’s, Public</td>
<td>Public</td>
<td></td>
</tr>
<tr>
<td>18 Aesthetic information</td>
<td>Residents, Visitors</td>
<td>Community, Council, NGO’s</td>
<td>County admin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19 Opportunities for recreation and tourism</td>
<td>Residents, Visitors, Service providers</td>
<td>Community, Council, Service providers</td>
<td>Public</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 Inspiration for culture, art and design</td>
<td>Residents, Visitors</td>
<td>Community, Council</td>
<td>County admin.</td>
<td>NGO’s, Public</td>
<td></td>
</tr>
<tr>
<td>21 Spiritual experience</td>
<td>Residents, Visitors</td>
<td>Community</td>
<td>County admin.</td>
<td>NGO’s, Public</td>
<td></td>
</tr>
<tr>
<td>22 Information for cognitive development</td>
<td>Residents, Visitors</td>
<td>Community, Council</td>
<td>County admin.</td>
<td>NGO’s, Public</td>
<td></td>
</tr>
</tbody>
</table>
As is evident in table 7, there are stakeholders within several different spatial scales: the availability of game is a service that can be used by a person carrying a hunting permit during hunting season, while the macro climate regulation service (sequestration of CO₂ plants) can be beneficial for all of society, even globally. There are also temporal scales related to ecosystem services and their stakeholders: game can be consumed only once, here and now, while the sequestration of carbon dioxide is a service that will benefit society for generations.

3. When analyzing the delta area with regard to identifying the most important service(s), consideration towards its unique geological and biological properties, the cultural heritage of the area and its extensive use as a recreational area for the inhabitants of Skoghall and Karlstad has to be taken into account. These properties, combined with the quality and quantity of the services provided, compared to other similar areas that are located close by, will decide which services are more valued than others. The Klarälven River delta provides a large quantity of services but most of them are “common” services that are also produced by other wooded, natural areas of forest or freshwater/wetland ecosystems in the vicinity, as described by Bishop & Landell-Mills (2002) and Myers (1997). These services include production of fuel wood, climate regulation, regulation of water-flow, maintenance of water and air quality, control of soil erosion and sedimentation, biological control and provision of habitats. Watershed services include, as stated by Carpenter & Postel (1997), water (for irrigation), fish and waste treatment etc.

The delta area is made up of approximately half land and half water. In relation to other, similar, natural areas around Karlstad and Skoghall the delta, and its vegetation cover, is not crucial in the maintenance of air quality or management of micro climate etc., which are services beneficial to urban landscapes as described by Bolund & Hunhammar (1999), Gómes-Baggethun & Barton (2013) and Jansson (2013). The contribution of flood regulation is an important service provided by the area, especially for Karlstad town, but this service is enhanced considerably by human activities in the form of dredging the river veins. From a pure flood regulation perspective, it might be beneficial for Karlstad municipality to increase the dredging and start drainage operations in the area, which would increase the quantity of this service even more. Such activities would implicate large detrimental effects on other ecosystem services provided by the area. With this in mind, one might suspect that, the flood control service of the delta area, in its pure natural form, is not the most important service to consider.

The Klarälven River delta is sandwiched between two densely populated areas (Karlstad and Skoghall) and can therefore be classified as an urban area, which, in turn, affects the ecosystem services that it provides and the benefit people derive from them. It is, despite being largely unaffected by human exploitation, still influenced by human actions from the built up areas around it. According to de Groot et al. (2010) it might thus not provide ecosystem services to the same quality, or quantity, as completely natural areas close by. Plieninger et al. (2013) argue that urban areas become less and less dependent on provisioning and regulating services the more economically developed they get, but also more and more dependent on cultural services when it comes to human wellbeing. With regards to the location of the Klarälven River delta, this would be an applicable assumption.

The Klarälven River delta is however unique in Sweden when it comes to the delta
formation with its accompanying nature types and varied biodiversity (Personal communication, Malin Iwarsson, 7th May). The area has a tradition of nature preservation (recognition of high values both for species protection and recreation) and is used by many for several recreational purposes according to the Värmland County administration (2008). Vejre et al. (2010) has undertaken a similar investigation where the study area provides a wide variety of services in an urban area, but only the intangible values provided by cultural services are unique in comparison to surrounding areas.

When also taking into account the stakeholder view (see table 7), the regulating services display a large number of stakeholders, as do the cultural services, which imply that they are important services with many beneficiaries. In this case, the beneficiaries of the regulating services at the non local scale, derive their benefits from contributions of these services towards the preservation of the delta landscape, and thus, indirectly, from the unique cultural and habitat services.

This concludes that the cultural and habitat services provided by the river delta are the most important.

4. The cultural services provided by the delta are most strongly related to areas with access for the people that use them, and also a close proximity to the users, such as in connection to housing. Places with cultural and historic contexts, such as previously inhabited or cultivated areas, are also important for these services. The habitat services, on the other hand, are often connected more untouched natural areas within the delta, such as the inaccessible deciduous marsh forests and the reed mosaics that are homes to many of the endangered species mentioned (in the management plan and the inventory).

In the Klarälven River delta area, the managed beach meadows could be identified as important Service Providing Hotspots (SPH:s) as they provide historic information and keep a tradition alive that is relevant to the sense of place. A partly managed, culturally relevant landscape is often valued higher than densely wooded areas according to Plieninger et al. (2013). The beach meadows are accessible to users and also, when managed, increase the (visual) accessibility to the water front. Naturvårdsverket (2009) describe managed beach meadows as strongly connected to the habitat services as they host many insect populations and provide both space and nutrition for migratory bird species.

Some important SPH:s in the Klarälven River delta are the managed beach meadows by Mariebergsskogen and Dingelsundet, the Stone Age burial area with its adjacent footpath at Hammarsudde, the footpaths and bird-watching towers around Mariebergsviken and Dingelsundet, the wooded areas just south of Björkås and to the west of Vidöåsen as these are heavily used for recreational hiking in connection to the residential areas, Tuvan where the delta formation processes are still ongoing and finally, the deciduous marsh forests along most of the river veins that are repeatedly exposed to flooding and contains many endangered species.

5. With the high demand of exploitation in this highly valued area, there are many conflicts of interests regarding possible land uses. Some of the SPH:s are involved in these land-use conflicts and therefore it is interesting to see how the provision of ecosystem services would
change with a different land use management. The areas of conflict are presented below in figure 3. At Hammarsudde previously managed beach meadows are considered for restoration and yet again to be grazed by cattle during the summers. Plans to expand the residential area of Björkås to the south would mean the loss of important recreational area and also an infringement on the river banks where many services are provided. Vidöäsen is also a wooded recreational area that is owned by Stora Enzo paper mill in Skoghall and they plan on, in the future, expand their industrial site to also include this area. Finally, Tuvan, with its precious delta formations (and where there is currently a snow-tip) are being considered for the construction of a small marina.

Table 8, the areas of land-use conflict with the effect on ecosystem services following a land-use change.

<table>
<thead>
<tr>
<th>Area</th>
<th>Services that benefit from land-use change</th>
<th>Services that are hindered by land-use change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tuvan</td>
<td>(19)</td>
<td>12, 16, 22</td>
</tr>
<tr>
<td>2. Hammarsudde</td>
<td>3, 4, 16, 17, 18, 19, 20, 21 och 22</td>
<td>7, 8, 9, 10, 13</td>
</tr>
<tr>
<td>3. Vidöäsen</td>
<td>-</td>
<td>1, 3, 7, 8, 10, 12, 13, 14, 18, 19, 20, 21, 22</td>
</tr>
<tr>
<td>4. Björkås</td>
<td>-</td>
<td>1, 3, 7, 8, 10, 12, 13, 14, 18, 19, 20, 21, 22</td>
</tr>
</tbody>
</table>

Regarding Tuvan, the reason for service nr 19 being in brackets (in table 8) are the possibility that a new small scale marina will increase the accessibility of the area for recreation, but that the marina in itself does not enhance this service.

In situations of conflicting development or land-use interests, an assessment of effects on ecosystem services gives qualitative, but not quantitative, information on how the ecosystems and with them, human well-being, will change, see table 8. This is sometimes enough of a valuation to conserve important ecosystems and their services, especially when the values are relying on cultural values, as stated by TEEB (2010b). Since the cultural and habitat services are of particular importance in the Klarälven River delta, these should be considered more carefully in trade-off situations and efforts to protect them should be cost effective and more sustainable in a long-term perspective.
6. Interviews

In order to get better perspectives on the environmental management in Swedish spatial planning, a set of interviews were carried out. The interviewees where either planning and/or environmental managers within the municipality or responsible for covering the environmental perspective in the planning process. The two topics discussed during the interviews were those of environmental integration into the municipal planning process and ecosystem services as a concept for better environmental integration into the plans. The interviews aimed at giving answers to all three research questions.

6.1. The municipalities and the interviewees

Arvika municipality has a population density of 16 inhabitants/km², 26 000 inhabitants in total, and is the second largest municipality, with regards to land area, in Värmland (SCB, 2013).

The interviewee for Arvika municipality is the development manager. Her role in the municipality enables a broad overview of the work on local spatial planning in the municipality. She is also involved with city planning and other development projects in and around Arvika.

Karlstad municipality hosts the “capital” of county Värmland and the population density is 72 inhabitants/km² and a total of 87 000 inhabitants (SCB, 2013).
The two interviewees at Karlstad municipality were the head of the environmental department (environmental inspection) with a focus on supervision in environmental activities and an employee at the technical- and property management administration office – the department of nature and park. She is responsible for the monitoring of municipal interests in nature conservation and outdoor activities in different kinds of plans, also spatial plans, and exploitation projects in general.

Årjäng municipality is another large, rural municipality with a population density of 7 inhabitants/km² and a total population of 10 000 (SCB, 2013).

The interviewee at Årjäng is the environmental and planning manager which gives her a good insight in both planning procedure and environmental integration in the planning process.

Forshaga municipality is, by far, the smallest of the four and has a population density of 33 inhabitants/km² and a total number of inhabitants at 11 000 (SCB, 2013). The interviewee is the environment and planning manager and his position gives him a good overview of the environmental management work done in the municipality and also the integration into spatial plans.

6.2. Results
The results from the interviews can be seen in table 9. The interview guide is provided in appendix 1.

Table 9, the interview results based on personal communication with Leila Ekman, 22\textsuperscript{nd} April (Arvika), Catharina Knutsson, 6\textsuperscript{th} May (Karlstad), Britt-Marie Öjestrand, 29\textsuperscript{th} April (Årjäng) and Urban Ledin, 3\textsuperscript{rd} May (Forshaga).

<table>
<thead>
<tr>
<th>Municipalities</th>
<th>Arvika</th>
<th>Karlstad</th>
<th>Årjäng</th>
<th>Forshaga</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Integration of environmental management in municipal spatial planning</strong></td>
<td>An environmental coordinator studies plans before plan is decided, EIA for plans are made which will affect its environmental contents</td>
<td>The department is involved in the planning process from an early stage to make sure environmental considerations are integrated</td>
<td>Is very important and has become more and more prominent in recent years. The consideration of the environment is always present as a foundation for the planning process through the national and regional goals.</td>
<td>An overall consideration to the environment should be fundamental for all decisions made in spatial planning. This could be easier in a small municipality with shorter decision paths.</td>
</tr>
<tr>
<td><strong>What decides the environmental management parameters in OP and DP</strong></td>
<td>Other steering documents (such as municipal vision, waste- and energy plans etc.),</td>
<td>Important natural values are identified through information from other existing plans (forestry management- and</td>
<td>The environment is integrated into the planning process through checklists and EIA for plans. Also other types</td>
<td>National and regional environmental goals with a local anchoring. A Computer system that</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental issues or parameters important for the municipality spatial planning</td>
<td>The sustainability perspective, conservation of natural and cultural environment, problems and risks of flooding makes climate adaptation important</td>
<td>Flood control and prevention is a big issue in the municipal plans, this is mostly dealt with on a detailed level in DP, distances to the river etc. Local environmental quality goals.</td>
<td>There are both specific and overarching parameters for consideration, like radon, flood risk, sewers and drainage, contaminated areas and nature values and species that need protecting. Bigger questions like climate adaptation is also important, but is addressed through more specific actions, like landslide risks and flooding prevention.</td>
<td>Large problems with mosquito infestations, trying to plan for them to cause as little problems as possible, otherwise general issues such as sustainability and, climate and the national end regional environmental goals.</td>
</tr>
<tr>
<td>A good overview and holistic way to conduct spatial planning and environmental integration</td>
<td>Yes, via EIA. But the environmental perspective does not always have the last say</td>
<td>Yes, since able to influence plans on an early stage, and all types of plans work together.</td>
<td>Yes, as long as the important questions, for the municipality, is always asked in the planning process. It is hard to work efficiently with big questions, therefore use broken down and more detailed local questions.</td>
<td>Yes, through the constant connection to the environmental goals. But there are always possibilities for a better way to work.</td>
</tr>
<tr>
<td>Environmental solutions to</td>
<td>No, not really. Sometimes</td>
<td>Yes, sometimes. Such as natural</td>
<td>Yes, sometimes, when the specific</td>
<td>Not really, but the possibilities</td>
</tr>
<tr>
<td>Problems in planning</td>
<td>possibly in DP areas buffering and lessening flooding.</td>
<td>location allows it, like for storm water drainage and treatment, but often with technical aid.</td>
<td>are there and work towards this is going on.</td>
<td></td>
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</tr>
<tr>
<td>How local knowledge is integrated for environmental conservation</td>
<td>Very useful, valuable, information hard to find anywhere else. In consultation process and parallel talks when information from e.g. county admin. needs complementing</td>
<td>If not enough information exists for a specific area, an inventory is made to capture important values, mostly biological information sought, not much use of local knowledge apart from local organizations. Otherwise caught in consultation.</td>
<td>Local knowledge is important; it is collected through consultation and for small DP, people or organizations with specific knowledge are asked to contribute. Also the local politicians and the comprehensive nature conservation plans are informative.</td>
<td></td>
</tr>
<tr>
<td>Knowledge on ecosystem services</td>
<td>None, no information from government</td>
<td>No (head of dep.) Yes, but nothing they work with in any organized way.</td>
<td>No, but the municipality works with some of them under different names.</td>
<td></td>
</tr>
<tr>
<td>Use of concept (based on case study)</td>
<td>Information produced very detailed and instrumental. Not much use in this type of municipality, political will and exploitation is more important for the most part</td>
<td>Yes, interesting way to look at the environment (head of dep.) very useful, gives detailed information what types of values are promoted or opposed in a trade-off situation, which is an important part in spatial planning</td>
<td>Looks very promising, an excellent way to give straightforward values of an area, when this organized, easier to use. It gives a new respect for what nature actually contributes with to society.</td>
<td></td>
</tr>
<tr>
<td>Information on value: biophysical information or economic</td>
<td>More use of the biophysical information, but still too much detail, useful</td>
<td>The biophysical information is useful in itself as it can make decisions more</td>
<td>The information in itself is very useful, creates respect and reveals/visualizes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The information in itself is very useful, creates respect and reveals/visualizes</td>
<td>The economic information is particularly interesting since this is something</td>
<td></td>
</tr>
<tr>
<td><strong>information</strong></td>
<td>when a specific area needs protection</td>
<td>well-grounded. Uncertain about an economic value, or rather the validity of the method to do so.</td>
<td>the values of nature. Maybe economic values would create even more respect, but questioning if they can really be worked out in a satisfying and useful way.</td>
<td>the politicians listen to. It is hard to get resources for conservation and management, this could be way to show the benefits of such an economic decision.</td>
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1. Arvika
During the interview some issues was emphasized. In a small (when looking at inhabitants) municipality in Värmland, with large areas of untouched nature, there are different priorities when it comes to nature conservation and exploitation, than in a municipality with more people and less land. Political decisions often set the demands for the spatial planning: exploitation and development, in order to get more jobs etc., are what is prioritized. Naturally, the law has to be followed, but since spatial planning is a municipal issue, politicians have a large say in the matter. The localization principle in EIA for example, unless there is extreme circumstances (e.g. nature reserve or breach of environmental quality limits) the exploiter gets to put the external trade wherever he wants, as long as it is in the municipality. It does not happen as the county administration or Boverket hopes it does. That is, realistically, how it looks.

The government goals for the ecosystem services concept is very ambitious and how they are going to be able to implement them as they, at the same time, need to provide resources (time, money, information) to the municipalities for it to happen, is hard to understand. The national environmental objectives are a good example, they are not necessary to follow, thus less implementation is carried out as it demands a lot of work from the municipality (e.g. to make local goals) and money and time. Other issues must be prioritized.

The ecosystem services concept gives too instrumental and detailed information to be useful to others than the ones protesting against a plan suggestion. Political decisions are very influential in spatial planning and this type of information will be hard to communicate to them. Same with the locals, they have a subjective sense of community which affects what they prioritize in planning and nature conservation. They, the ecosystem services, are not interesting enough compared to other interests. (Personal communication, Leila Ekman, 22\textsuperscript{nd} April)

2. Karlstad
The interviewee has heard of the ecosystem services concept within the last three to four years and is aware of how it could work. This is not actively used in the spatial planning process, but the values of ecosystem services is still incorporated into the plans, just from a different perspective and under different names, for example consideration to and protection of biodiversity and all sorts of water regulating services (quality and quantity). They are first and
foremost incorporated into planning as arguments for nature conservation or the suggested physical structure of the plan, e.g. so that nature itself can take care of water and help regulate flows (prevent flooding).

The concept is useful in a way that it makes the values of nature obvious, and this type of information could be used in the planning process, especially in trade-off situations for different land-uses and management. The ecosystem services information could be the in-data to a more comprehensive pros and cons list for assessing land-use alternatives. It could also be a tool and an aid in the checklist preceding an EIA decision for DP. It would make such an assessment much more detailed and extensive. (Personal communication, Catharina Knutsson, 6th May)

3. Årjäng

The municipality is working hard on updating the OP and other plans, the environment as a foundation for OP is especially important, not the least because the environment is fundamental for the municipality and the livelihood of many inhabitants.

The way the municipality is integrating environmental conservation and management today is good, but there is always room for improvement. The national and regional environmental goals need to be anchored locally, through local goals, otherwise it is hard to work with them as they are difficult to relate to, a bit fuzzy, in their broad definitions. It is important to work with details in environmental management, as they add up to something big in the end.

In the planning process, different parameters are the focus of different plans. In a nature preservation plan, parameters such as protecting biodiversity are the most important and in energy- plans and DP other parameters are more important. But when many plans are put together to see what is most important, the answer is always site specific. Values that cannot be moved elsewhere get higher priorities. Therefore it is good to have plans so as not to forget important values and to be able to make the right choices in trade-off situations. Values in a sparsely populated municipality can be very different from a big city municipality. The creation of work is very important for the politicians and has a high priority, but if the knowledge of natural values is provided, then it is well considered, therefore the ecosystem services concept as an information tool is beneficial. Location of trade is also of high priority; a high value for politicians, and one might think it can be located anywhere in a municipality like this, but we cannot be sure unless the area is investigated, with ecosystem services tool for example. The concept is obvious and clear, a good way to present information in a list to politicians; make it available and they will use it. Catch their interest. They wouldn’t believe the natural resources where infinite if they had the knowledge.

Economic value looses respect, because you cannot see the underlying natural structure that creates the value. (Personal communication, Britt-Marie Öjestrand, 29th April)

4. Forshaga

The environment is an important asset in small, rural municipalities such as this one, environmental conservation and management could be turned into businesses and makes people interested in coming here for natural beauty etc., but it is hard to get such information through to politicians.
One big problem in the municipality is the mosquito-problem caused by flooding of natural islands in the river. The mosquitoes invade the homes and gardens of inhabitants and are a real nuisance. To tackle this, we get 1 million SEK a year. It would be much better if we could get funding to deal with the background of the problem and find other solutions as the killing of the mosquitoes and the costs are too big, unsustainable. Instead, since the area and islands have high natural values, especially as habitats for insects and birds, it could be preserved in ways that lessen the problem. Most people in and around the area just wish to pave it over with concrete and be done with it. This is a major conflict of interests that is very hard to solve.

It is hard to make politicians see the actual value of nature, which is why this concept could be very useful. Often, they see the management (often restoration) of the environment as a big, unwanted expense, and wish to put the money elsewhere. With a monetary value of ecosystem services, they could have an incentive to actually invest in the environment instead of seeing it as an expense. An exploitation alternative could be declined if the politicians saw that this would only lead to short term benefits that are actually smaller than the cost to restore or make up for the environmental damage elsewhere. Money is the language that politicians speak. And without money and resources the environment can’t be properly managed.

(Personal communication, Urban Ledin, 3rd May)

7. Discussion

Sustainable development through physical spatial planning, and planning for adequate environmental integration in general, is not realized in Sweden today. As shown in the interviews, and also stated by Boverket (2000) & (2007), the work towards realizing the environmental objectives in municipal planning is not yet what the parliament intended. The objectives represent the attempts of meeting the ecological pillar of sustainable development, preferably through physical CP. This is, according to Michanek & Zetterberg (2012) and Carlman (2003) & (2005), only possible if the objectives are legally operationalized. Carlman (2003) describes a hierarchical system of policy instruments that can be used in order to make people act in a way the government desires; first, soft instruments are used, such as information, in order to change people’s behavior. If this does not work, economic instruments, such as taxes and fees, can force a change of action. If this is still not enough to reach, for example, an environmental objective, the law has to state what a person can and cannot do, in order to ensure the desired effect. Carlman (2005) explain that the role of law is critical in order to fulfill the Swedish environmental objectives.

As described earlier in the theory section, and by Michanek & Zetterberg (2012), the physical spatial planning procedure in Sweden further obstruct the realization of the objectives as the CP, where intentions towards environmental protection and management are stated, are not legally binding. The DP, which in turn is legally binding, only states what a person (company etc.) cannot do and not what they have to do, in a very limited are. Therefore DP is not a suitable tool for enforcing neither the overarching environmental objectives, nor any broad environmental incentives in CP.
The interviewees confirm the discussion by Michanek & Zetterberg (2012) and Carlman (2003) and (2005). Swedish municipalities plan for the environment in order to follow the law, e.g. environmental quality norms etc., but does not really try to do better then what is demanded of them since there is not enough time or resources, something that was put forward by all interviewees. They ask that the government should be more forceful in their actions and requests stricter guidelines for environmental integration (and the environmental objectives) on a municipal level. They also request that the government provide monetary resources needed by the municipalities in order to carry out the work intended.

With the current decentralized planning structure in Sweden there is a lack of holistic integration of environmental management across societal sectors e.g. between natural scientists, engineers, social scientists etc. This is agreed upon by Nyström & Tonell (2012), Wilkinson et al. (2010) and Malin Iwarsson at the Värmland county council (personal communication, 7th May). She claims that this is also evident in the law, but mostly regarding goals and objectives articulated by the government regarding different societal interests. There is not enough cooperation between these goals, or even the law, which sometimes lead to great misunderstandings and unconstructive decisions within municipalities and county administrations, as is also discussed by Carlman (2003). Malin Iwarsson calls the problem “drainpipes”: the view of a problem or an activity is so narrow that it is not considered in a context but as a single entity that should be dealt with in the quickest and easiest way possible. She asks for less decentralized planning operations, if not a better, more elaborate and holistic tool for planning coordination is provided by the government. This notion is reinforced by Wilkinson and Wagenaar (in revision) as they propagate for regional planning and governing system as local scales are too narrow for integrating resilience in a meaningful way. Carlman (2003) & (2005) agrees with the need to have a top-down hierarchy when it comes to planning for the environment, as this leads to a more conclusive management of the environment where concrete environmental goals are set in order to work towards overarching environmental objectives.

Time is an important factor in both the planning process and when dealing with the intra generational implications of sustainability. The planning process of today is too slow to cope with a changing world, according to Wilkinson (2011), and that is also the case in Sweden, expressed by Carlman (2003) and Malin Iwarsson. New scientific information and changes in the physical environment demands constant updates or renewals of local plans in order to keep steering towards a sustainability goal, which is what the concept of adaptive planning is all about, see further in Wilkinson (2011) and Carlman (2003) & (2005). Ahern (2011) and Folke (2006) claim that another important aspect of sustainable physical spatial planning is the integration of resilience thinking.

Historically, our world has been viewed by planners as a steady state system where the future looks more or less like the present, as stated by Nyström & Tonell (2012) and Wilkinson et al. (2010). Ahern (2011) claims that this view has caused planners to act as if societal changes are temporary and manageable and therefore also unnecessary to incorporate into the actual plans themselves. Resilience thinking dictates that all complex adaptive systems, as described by Folke (2006) and Walker & Salt (2006), change, which is also true
for socio-ecological systems. To avoid inevitable changes to turn into catastrophes Wilkinson (2012) stress the need for planners to embrace change and incorporate the capacity of a system to do so and still “survive”. This is, by Wilkinson (2011) described as strategic navigation towards sustainable development through adaptive planning. See also Carlman (2003) & (2005).

The traditional, narrow professions and management cultures within municipalities are a problem when it comes to constructing more modernized, sustainable spatial plans. This culture works against the cooperation across municipal sectors and therefore the necessary holistic planning perspective that weighs different interests on equal terms is lost.

Physical spatial planning is the result of subjective choices, based on values and political influences, according to Wilkinson et al. (in revision) and expressed by several interviewees. The planners’ actual knowledge and experiences also influence the planning results as stated by Ernststson & Sörlin (2013) and Nyström & Tonell (2012). The different (educational) backgrounds and professional positions of the interviewees most likely contributed to their views on the ecosystem services concept. The three interviewees in a managing position were all very positive towards the concept and its possible uses in planning, even though they had not heard about it before. The interviewee with the least focus on the environment in her work-role also had the least faith in the benefits of the concept.

The problem of spatial planning not leading to a sustainable society is not unique for Sweden, but a common truth all over the world. Planning theory is, with today’s methods, not capable of dealing with environmental issues in a changing world (such as climate change), as described by Wilkinson (2011). Strategic spatial planning for adaptability (or adaptive planning) integrates socio-ecological resilience in society that, very plainly, works towards ecological sustainable development. So far, Wilkinson et al. (2012) describe this as an uncharted research field with very few publications, which implies that it is a new way of thinking with unfamiliar concepts and tools for planners in general. This agreed upon by all interviewees, except Catharina Knutsson (personal communication, 6th May) at Karlstad municipality, whose work with environmental integration was on a more detailed level, and she was familiar with the ecosystem services concept, although not in practice.

Nyström & Tonell (2012) state that the philosophical and ethical view of the relationship between society and nature determines the environmental considerations made in municipal physical spatial plans. This is agreed upon by Daily (1997b) who also believes that the view decides what value “nature” represents in decisions regarding conflicting land-use interests. Wilkinson et al. (2012) claim that the use of socio-ecologic resilience, and thus also the use of the ecosystem services concept, gives planners a new way of relating to the environment, which is more geared towards the bio-centric philosophy according to Goulder & Kennedy (1997). TEEB (2010a) describes this as due to the ecosystems being given a more pronounced intrinsic value that has to be accounted for. This increases the importance of ecological consideration and integration in planning as reported by Wilkinson et al. (2010).

Ecosystems and their contribution to human well-being is a well known fact described by Daily (1997b) and MEA (2005), at least for scientists. The decline of the ecosystem services
being the fault of humanity and its activities is also seen as common knowledge. This knowledge has to be communicated to, and understood by, a broad cross-section of society in order to stop degradation of the ecosystems and work towards sustainable development. When this does not happen, something called “the endpoint problem”, as described by Cork et al. (2001), occurs. By introducing resilience thinking and the ecosystem services concept into planning and management structures in society, the knowledge gaps and communication difficulties could be overcome and the problem eliminated. It presents a way to discuss nature’s value to humans and an encouragement to invest in the ecosystems. Resilience can also be said to express a new sort of value language, as suggested by Cork et al. (2001) and TEEB (2010b), that improves the knowledge of ecosystem dynamics and the human-nature relationship. In this way, Wilkinson et al. (2012) means that the resilience concept explains the basis of all ecosystems (services) values.

Several interviewees agreed that one problem regarding nature conservation in planning was the struggle to get proper funding from politicians since they only saw the environmental conservation issues as unwanted expenses. With resilience thinking and valuing ecosystem services, hands on information is provided regarding what good will come of such an activity and instead, environmental conservation and management can be seen as an investment for the future. Valuing ecosystem services is also a possibility to make conservation practices more cost effective according to Miljödepartementet (2012) and some of the interviewees.

The interviewees recognized that, when using the ecosystem services concept to define the value of an area as done in the case study, the information presented is highly relevant in communication with politicians and other decision makers, which is also suggested by TEEB (2010b) and Wilkinson (2012). The complex ecological information can thus be relayed in a short and concise manner that is easy to understand according to Wilkinson & Wagenaar (in revision). Another beneficial implication of presenting ecological information as ecosystem services that was mentioned during the interviews, especially by Britt-Marie Öjestrand (personal communication, 29th April), is the respect that you feel for the physical natural environment which makes it a lot easier to understand its values.

Forshaga municipality is dealing with a very special case of conflicting interests in a land-use situation. Here, it is nature itself that presents the conflict: high natural values (very similar to the Klarälven River delta) but also a very large mosquito population due to alternated flooding of the area, and much distress caused to inhabitants in the surroundings (personal communication, Urban Ledin, 3rd May). Ecosystem disservices, such as the mosquito-problem, are seldom incorporated into the concept discussion nor are how they should be “valued”, as discussed by Ernston & Sörlin (2013). In this case, the concept could be used to weigh the conflicting services against each other and create a solid argument for an efficient, cost effective solution. Today, the municipality is given a “mosquito million” in SEK every year to deal with the problem. Urban Ledin means that this is not sustainable and there must be better ways to solve the problem instead of just remedying it.

As described in the theory section, the valuation of ecosystem services is a necessary but very difficult task in order to help decision makers, such as planners, to make the most sustainable choices in situations of conflicting interests. The view on monetary and non-monetary
valuation is dividing the scientific researchers and more emphasis on non-monetary valuation is evident in the most recent years as discussed by Ernstson & Sörlin (2013). In the municipalities, the opinions were very positive for both ways of presenting ecosystem values, but not by the same interviewees. If they believed in one, they did not see the same use of the other. A majority of the interviewees found non-monetary valuation to be the most appealing value language.

8. Conclusion
The research questions posed in the introduction of this thesis will be answered as follows:

- **How is environmental management incorporated into Swedish (physical) spatial planning on a municipal level today?**
  
  The incorporation of environmental management into the Swedish planning process is mostly based on optional adherence to the environmental objectives (CP) and through very localized regulations of the actions affecting the environment that are *not* allowed (DP). The integration of the environmental objectives is not done to a satisfying degree, as they are not legally operationalized, and therefore does not contribute to sustainable (ecological) development.

- **How are the resilience thinking and the ecosystem services concepts defined and how can they benefit environmental management in local Swedish spatial planning?**
  
  There is no single definition of an ecosystem service but, simply put; it can be seen as the benefits people obtain from ecosystems (MEA, 2005). Resilience in planning contributes to society adapting with a changing world, something that is being urged by Carlman (2005) and Wilkinson (2011).
  
  The concepts will benefit via the introduction of a new way to communicate sustainability: ecosystem services gives decision makers vital information on how the ecosystems should be managed in order to sustain human wellbeing. Resilience thinking in spatial planning represents a new tool for gathering an otherwise sprawling environmental management practice into one cohesive concept that will keep management of changing socio-ecological systems on the course towards a sustainable society.

- **How can the evaluation of ecosystem services benefit environmental management in a local land use trade-off situation?**
  
  By giving ecosystem services a palpable value, their importance to human well-being can be communicated to decision makers and they, in turn, can make decisions that are seen as investments for sustainability and the future. It provides planners with a wider, more holistic perspective that would benefit society and contribute to a more sustainable planning practice.
The Swedish government is very ambitious in their formulation of the sub-goals on ecosystem services. In this study, the literature review revealed a set of problems regarding the concept that could make it less useful for generalizing and comparison, one of the aims that the government has set according to Miljödepartementet (2012). It is better suited for use in trade-off situations where conflicts of interest are present, as discussed by TEEB (2010b) and its beneficial uses in municipal physical spatial planning has been shown in the literature study as well as in the case study and the interviews. For the sub-goal to be reached, the government has to provide the resources needed by the municipalities, in order for them to carry out the job. The case study is a crude example of how the concept could be implemented for (non-monetary) information provisioning in the planning process. The TEEB approach used could be taken further with the inclusion of the 2nd and 3rd step in order to get a better picture of the concept and its uses for planners and decision makers.

9. Acknowledgements

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10. References

Written sources:


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Electronic sources:


11. Appendices

Appendix 1. Interview guide.

What are your duties (primarily related to spatial planning and/or environmental management)?

Environmental consideration in spatial planning.

A. How does the municipality work for integration of environmental management in spatial planning? – EIA for plans, OP vs. DP (e.g. climate issues, natural resources, biodiversity etc)

B. Do you find that your way of working with these questions gives the opportunity for a holistic view and management of the environment in spatial plans?

C. Do you wish to change any aspects of the way that you work today?

D. What kind of parameters is weighed against each other in a land use trade-off situation? What kind of environmental parameters? How (if) does the parameters considered differ between a OP and a DP (on spatial scales)?

E. How are valuable natural areas worthy of protection identified in the planning process? What kind of criteria’s is sued?

F. Is the environment itself ever used as a solution to an “environmental problem” (e.g. polluted water, water flow regulation etc.)? If so, when and how?

G. How is local knowledge looked after within the municipal planning process? Is it sufficient?

Ecosystem services

H. What do you know about ecosystem services? Were you familiar with the concept before I contacted you? If so, where had you gathered this knowledge? Do you know about the sub-goals on ecosystem services presented by the government?

I. What do you think about the concept? What about its uses in municipal spatial planning and (or) environmental management? Would the use of this concept change your way of working with environmental management and conservation and in that case, how?
- Change from a holistic perspective?
- Change for working towards resilience and sustainable development?
- Change the conditions for looking after local knowledge?

J. In what way would the ecosystem services concept be most useful in a trade-off situation?
- Communicating non-economic or economic information?