Recreational services and carbon dioxide sequestration – two ecosystem services within Stockholm's green land structure

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Summary

The scope of this pilot study has been to coarsely estimate the monetary value of two forest ecosystem services, recreational value and CO_2 sequestration, in a local municipality forest of 450 acres functioning as a part of a green land corridor in to the central part of Stockholm City. Published scientific report has been locally applied [1]. The results show that the annual recreational value of the limited area is at least SEK 9 million, based on an estimated annual visitor frequency of 3000 unique passages of at least 100 meters in to the forest. The annual value of CO_2 sequestration is at least SEK 2,3 million. In order to minimize exaggerations the calculated results are based on lowest stated factors from the published sources.

Delimitation

The geographical delimitation of the studied forest area is shown in Fig. 1. The forest area includes well established hiking and running trails, strolling paths, biking roads and follows boundaries for old time back country forest pasture land [2]. In addition the delimitation follows natural structures of the forest, inside a well functioning entirety for recreation exists. The total area for the pilot forest is GIS determined to 450 hectares. The studied area is a part of the green land structure in to Stockholm city.

Users

The forest in this study has a traditional cultural land use heritage with a background of forestry and farming methods typically used in the region for centuries before the modern era. Approximately equal parts of the forest in this study belongs to regular forestry, low intensity forestry or voluntary saved forests, partly with national top level scores for bio diversity. One part of the forest neighbors a natural reserve established year 1970, another part has been fulfills requirements for a new natural reserve [3]. The recreational activities are typically walking, biking, different kinds of training (summer as well as winter), berry and mushroom picking, horse back riding, excursions and education.

Entrances

Entrances to the studied pilot forest are parking lots with connection to paths with electric light, hiking trails, broad forest paths or prepared gravel roads for walking and biking. The main entrance, where most of the trails start, is next to one of the municipalities schools. From the surrounding community there are seven entries in to the forest area. These different facilities are placed on both public and private land, whose owners traditionally have served the society and its people according to the national land ethic rule.

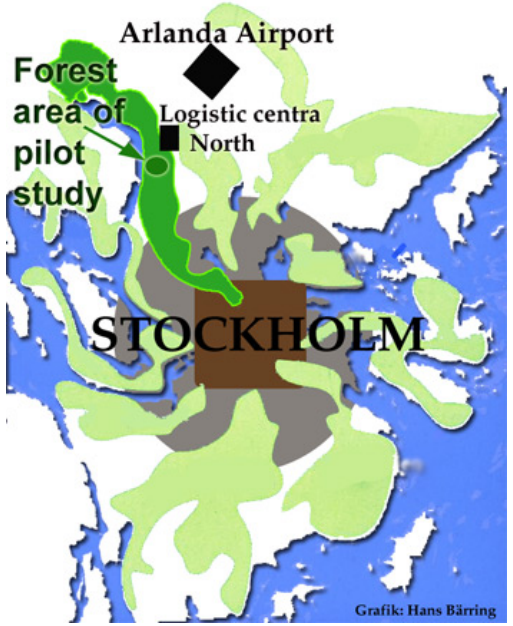

Fig. 1A) Stockholm green land corridors.

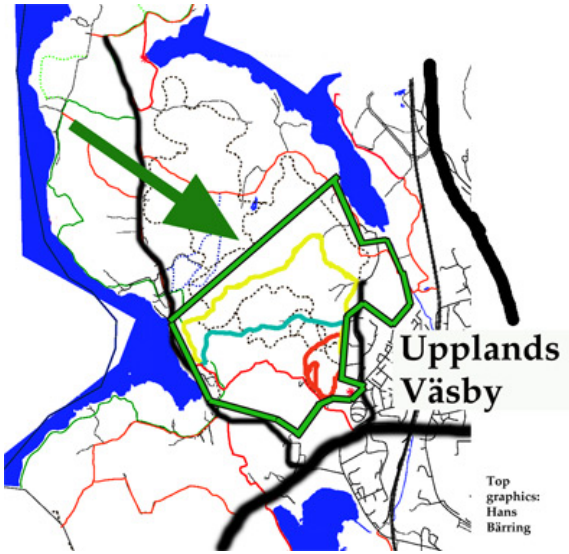

Fig. 1B) Close up of pilot forest in this study.
Roads in black, hiking and biking trails in colors.

Visitor frequency

In order to calculate the monetary value of a recreational area it is important to know the visitor frequency [4]. A green land area with a relatively low number of annual visitors may have a high attraction for recreation and open air lifestyle in general. Therefore it is also important to understand the areas existing functions, attractions and user categories, its uniqueness and fame in the local as well as the regional society. The visitor frequency is also closely related with the settlement and infrastructure close to the green land area and how these entities in its own turn appears in different geographical directions.

Visitors to a forest can be ordered in to three categories: ”Borough users” (living max. 1 km or 15 minutes normal walking away), ”Municipality users” (max. 4 km), ”Tourists” (more than 4 km). The categories ”Municipality users” and ”Tourists” are typically people who visit the forest as a target and often for a specific reason, e.g., running or skiing. Fig. 2 gives an illustration on how different user categories typically tend to contribute to the awareness of and explicit recreational value.

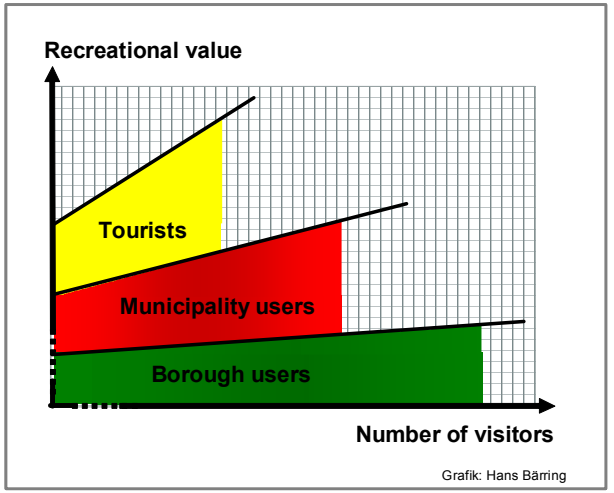

Fig. 2) Recreational value typically increases with different kinds of visitors, especially long distance visitors such as tourists

In lack of actual measurements of the number of visits further into a forest than 100 meters from a public road or official prepared ground there are different methods to estimate the number of visitors. A commonly used measure is to derive the number of citizens living maximum 1 kilometer away from the forest [5,6,7]. In this pilot study the number of visitors are estimated from the number of close living citizens (”borough users”) which according to the definition given above are amply 6000 persons. An assumption is that half of these citizens visit the studied forest and really appreciates the recreational area. This yields 3000 unique recreational visits annually. To further relate to this number the national Internet site www.skidspår.se had 10 201 unique counts the winter season 2010/2011 (November to Mars) providing hourly updated information about the status of the maintained cross-country skiing tracks in the studied pilot forest.

Recreational value – calculation example I

Gren & Isacs [1] states that the average value of forest recreation corresponds to SEK 3000 annually and person (Middle part of Sweden). The recreational value that the forest in this study yearly provides can thus straightforwardly be claimed to be: 3000*3000 = SEK 9 million.

Recreational value – calculation example II

An alternative approach is to estimate the value of forest recreation based upon the most important parts of the forest. Turning to Gren & Isacs [1] for such an approach provides a surface based average value of forest recreation of SEK 800 per hectare, year and person (middle Sweden, from SEK 320 up to maximum SEK 1600). The delimited forest in this pilot study is GIS calculated to 450 hectares (Fig. 1). Firstly, assume that the average value of the studied forest's recreation is SEK 320 per hectares, year and person. Secondly, assume that there are only specific zones, such as corridors and targeted areas within the forest that concentrates and are most important for the recreation. The total length of the prepared paths within the pilot forest is approximately 13,5 kilometers, corresponding to 135 hectares given a green belt width of the corridor of 50 meters on both sides of the paths. It can thus be claimed that 135 hectares (or 30 percent) of the whole pilot forest provides the economical relevant recreation for the official society, i.e., fundamental folk health and education. Thirdly, assume that at the most 50 percent of the number of visits uses all these paths, is of economical significance and of unique interest for the official society. Based on such an area based approach the recreational core value of the most important parts of the pilot forest reaches: 320 * (450 * 0,3) * (3000 *0.5) = SEK 64,8 million annually (!).

This pilot study gives a forest recreational value in between SEK 9 and 65 million (!) annually, depending on calculation method. (Se also Appendix 2)

Forest value for CO_2 sequestration – calculation example

As a consequence of predicted human related climate changes the forests ability to reduce and store CO_2 is an important ecosystem service to derive. A forest has two fundamental and important system functions in these regards: the forest floor, i.e., the ground stores carbon (C-X) and it binds gaseous CO_2. According to Gren & Isacs a typical midst Swedish forest ground has an average biomass growth corresponding to the elimination of 0,17 tons of carbon per hectare, and that the average amount of stored carbon is 85 tones per hectares. The EU markets kilo price for carbon dioxide are reported to vary in between SEK 0,06 och 0,3 per kilogram carbon dioxide (C-). The pilot forest's value for CO2 sequestration can thus be estimated to:
(0,06 * 0,17 10^3 + 0,06 * 85*10^3) * 450 = SEK 2,3 million annually.

Critical views to the results in this pilot study

This report has been produced to give a general account for two of many different ecosystem services that a greater coherent forest next to a town yearly provides the society. Behind the ecosystem services recreation and carbon dioxide sequestration stand important welfare topics such as folk health and sustainable development. Never the less the derivations of the results are based on imprecise assumptions. Data are fetched from not only comprehensive but also a limited selection of sources and research results. This can be seen as unscientific and can be claimed to be directly misleading, especially in a local perspective and for concrete planning. From that point of view it is well agreed upon that this studies result lack some significance. However, the topics are of such importance that this pilot studies approach and results should not be neglected. For instance one third of Europe's forests reveal signs of fading vitality and significant stress from e.g. climate changes [8]. The different values of forests and the human dependence of these are by all established assessors judged to in many ways increase significantly in the future.

This is a non-financed pilot study where important topics for the development of society have tentatively been addressed. It is important to remember that the valuation of ecosystem services is a research area under strong development and that the real monetary value is clearly questionable. The keynote has been to deliberately derive the results.

In prep.

Selection of references

1. Ecological economics, Gren & Isacs, 2009
2. Geographical places and historical names in Upplands Väsby municipality, L-E Jansson 2005 (Book in Swedish)
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4. Measuring the Economic Impact of Park and Recreation Services, J. L. Crompton, National Recreation and Park Association, Research series 2010
5. Visitor Study of the I2-forest in Karlstad, The Importance of Urban Forest for the Society, 2007
6. SLU publication Fakta Skog, Nr 10, 2000
7. Facts of town-close forests, Swedish Natural Conservation Society, 2010
8. EU-projec FutMon, S. Wulf, Dept of Forest Resource Management, SLU, 2011

Graphics and all photos from Runbyskogen taken by Hans Bärring

Appendix 1

Example of an equation for recreation value:

value = Activity * Environmental factor * Social factor * Service factor (eq 1)

Assume a personal desired activity such as running. The value of that activity increases if there is fresh air, nice and beutiful surroundings, doing it with training mates on a designated track and so on. The value for a simple run scores higher due to Social and Service factors provided in for instance a marathon event. Another example is forest hiking. The value increases if the Environmental factor scores high. For instance a hike in a beautiful remote mountain wilderness area. Downhill skiing is a third example. It may be a desired and fun activity, but it scores higher due to adherent factors which are dispelled in the lift ticket prices. And so on.

Assume a willingness to pay (market price) SEK 20 for a single 10 km run (Activity). This can easily be SEK 80 due to adherent factors as in eq. 1. Variation in trails and on average two times a week results in an annual value of 80 * 2 * 52 = SEK 8320. Assume that there are 1000 people enjoying hiking or running in such a way. It ends up to a value of approximately SEK 8 million. In this way it is possible to "play" with numbers to try to understand different factors as well as in the end figure the recreation value of a forest, provided to society. Positive but complicating factors in all this are for instance long term positive health effects.

Appendix 2

Example of forest ecosystem services:

- Sustainable harvest, logging, bio-fuel et c
- Recreation
- Carbon dioxide sequestration
- Climate regulation
- Regulation of water cycle, e.g., groundwater formation and protection
- Soils formation and protection
- Biodiversity and gene pools
- Pollution sequestration
- Noise reduction
- Landscape beauty