Ecological Complexity 7 (2010) 338–348

Contents lists available at ScienceDirect

Ecological Complexity

journal homepage: www.elsevier.com/locate/ecocom

Demonstrating the importance of intangible ecosystem services from peri-urban landscapes

Henrik Vejre *, Frank Søndergaard Jensen, Bo Jellesmark Thorsen

Forest & Landscape, University of Copenhagen, Rolighedsvej 23, 1958 Frederiksberg C, Denmark

ARTICLE INFO

Article history:
Received 5 May 2009
Received in revised form 18 September 2009
Accepted 21 September 2009
Available online 24 October 2009

Keywords:
Landscape values
Cost of provision
Ecosystem services
Landscape functions
Recreation
Aesthetics
Peri-urban landscape

ABSTRACT

Among ecosystem services, the various categories of intangible services linked to human perception, such as aesthetics, recreational values and cultural heritage, must be rated alongside tangible services linked to physical processes, such as wildlife habitats, clean water and air, and filter- and buffer effects. This is a pre-requisite for a sustainable development with a balance between ecological, social and economic values. We analyse ecosystem services in areas of the urban fringe of Copenhagen, where the services provided are mainly related to human perception. We employ relatively simple methods in selected landscapes to qualify or quantify the aesthetics and recreational value, and the scale of the welfare economic value of these ecosystem services. In the first case area, the Danish state acquired 50 villas covering more than 50 ha in order to recreate open vistas and gain access for the public to the seaside. In the second case area, peri-urban open landscapes were protected by conservation orders, to maintain and enhance the benefits of green space for the growing urban population. We assess the value – in a broad sense – of these ecosystem services using three practical methods: a landscape evaluation in terms of services and qualities, an assessment of actual recreational use, and finally an assessment of the costs – in terms of residential development values lost – of securing the provision of aesthetic qualities and recreational opportunities.

Searching the original planning documents we uncovered the original motivation for the land evaluation and decision. The arguments behind the designation and protection of the areas were primarily aesthetic and potentials for recreational use. The two areas receive annually 2–2.5 million and 400.000 visits respectively, proving their strong recreational value. The value of the demolished houses in the first case area exceeds 115 million €, and the value of the lost development opportunities in the second case area exceeds 280 million €.

By combination the three methods, we substantiated that the intangible services may dominate the tangible in cases like these, stressing the need for planners to assess the role and value hereof.

1. Introduction

The complexity of the provision of services from ecosystems, i.e. production, regulation, habitats and information services (see, e.g. de Groot et al., 2002) has been extensively discussed during the past couple of decades. Contemporary problems in the human–environment systems, e.g. climate change, loss of wildlife habitats and water shortages, call for analytical tools which can provide insight into the concrete value of ecosystems. There is a growing consensus that we need to assess the value of non-marketable goods and services from ecosystems to balance the classic values from production-related activities. Environmental valuation (see, e.g. Freeman, 2003 for a theoretical introduction) has emerged as an independent discipline, aiming at valuing and balancing these various goods and services when planning the exploitation of natural resources. A strong challenge for this thinking is its practical applications: qualification and quantification of single and jointly produced ecosystem services as input to management and planning (Turner et al., 2003). Experiences in rating and valuing the values of "hard" ecosystem services such as flood control, CO_2-sequestration, denitrification, filter effects and to some extent recreation have been gained in recent decades. Attempts to aggregate these values even at the highest level have been made (Costanza et al., 1997), but there is still considerable uncertainty about how to practically assess and value the even more intangible or "soft" ecosystem services, such as aesthetics, the mere presence of open space, experience and cultural heritage (e.g. Price, 2008). While valuation methods for non-marketed ecosystem services are of importance, they face at least three key challenges for landscape management and planning to internalise the values of the more intangible ecosystem services.

* *Corresponding author.*
E-mail address: hv@life.ku.dk (H. Vejre).

1476-945X/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.ecocom.2009.09.005

Firstly, undertaking primary environmental valuation studies is time consuming and expensive. Secondly, the stated preference methods in particular are difficult to communicate and potentially flawed by, e.g. hypothetical bias or other methodological uncertainties (e.g. Kahnemann and Knetsch, 1992). This makes it hard to obtain widespread application and in particular acceptance of the approaches. Thirdly, these methods can only capture values, use- or non-use values that people *perceive* as related to the ecosystem in question. Several, even quite "hard" value components may thus escape quantification (Costanza, 2008).

Multiple studies have addressed the challenges of classifying ecosystem services, or the synonymous ecosystem or landscape functions. Classification systems and nomenclatures of ecosystem services (ecosystem functions, landscape functions) vary according to the scientific or strategic point of departure: agriculture (Anon., 2001), landscape planning and management (Brandt and Vejre, 2003a) or conservation of ecosystems (Farber et al., 2002; de Groot et al., 2002). There is a general consensus of distinguishing between marketable goods and other goods or services, the latter being a very heterogeneous group. Distinction between material and non-material services or functions has been proposed by several authors (de Groot et al., 2002; Costanza et al., 1997). Brandt and Vejre (2003b) suggested a further distinction between the intangible or transcending functions, separating perceived functions or services from statutory functions or services, i.e. the articulated visions for the development or status of areas as it is encountered in planning documents. While the many contributions represent some degree of consensus on nomenclature and definitions, severe difficulties persist in classifying and valuing the various services in a consistent and quantitative manner.

Environmental valuation methods may capture parts of the value aspects of the intangible functions or services, but unresolved challenges remain. One challenge is the task of describing the exact spatial extent of the particular service, addressing questions such as "where is the landscape beautiful, and where is it not?", "where are the recreational qualities and where are they not?" i.e. drawing exact boundaries in landscapes where such boundaries are only vaguely defined. Nevertheless, in a world with rapidly developing paradigms for assessing "hard" services, there is also a strong need to develop and highlight the soft values by valuing them with the same priority and rigor as the hard ones.

In the western world, there is a long tradition of valuing landscapes through the instruments of landscape protection by designation (reviewed by Hamin, 2002). A multitude of mostly qualitative methods have been employed in the identification and delineation of landscapes of high cultural and aesthetic quality in most European countries, leading to the declaration of protected landscapes of various kinds. However, there is often limited documentation of methodology and exact criteria for these delineations; rather, they rest on subjective descriptions and qualitative assessments.

The aim of this study is to identify and value a sample of soft landscape services: the landscape aesthetics and the recreational use, and further to assess the monetary value of open landscapes reserved for these two services. We aim at identifying the exact criteria used for the identification and delineation of protected areas where intangible services are the primary outputs, as well as assessing the extent of recreational use of these areas, and establish an economic valuation of the same areas.

2. Methods of assessment

2.1. Case study approach

The point of departure of this paper is a number of landscapes, an approach which bears resemblance to the case study approach known from social sciences (e.g. Yin, 2003). The social science approach aims at characterising the real world, which may be highly complex, and cannot easily be subdued to controlled experiments. By working with cases we attempt to illustrate the complexity of assessing the intangible ecosystem services provided by real-world peri-urban landscapes. As such we employ explorative, descriptive and explanatory approaches in the study.

We choose areas in the peri-urban landscapes north of Copenhagen (Fig. 1) known for their high aesthetic and recreational qualities, representing a long conservation tradition. The areas provide several ecosystem services, including, e.g. production, habitat protection and drinking water supply. However, the areas are not unique in terms of any of these specific functions or services, but they are unique in their provision of intangible landscape values in the Greater Copenhagen area, making them particularly suitable for studies of intangible services.

The advantage of a case study approach is that we leave environmental valuation theory related to ecosystem services and its more abstract and generic applications somewhat behind, and we limit ourselves to the challenge of describing the complexity of the type of ecosystem service to that relevant to the case study areas. This of course limits the generality of observations made, but it enhances their value for communication with decision-makers. Further, the access to data is adequate, and the knowledge of the history of the case areas is comprehensive and detailed.

2.2. Description of case areas

The case areas are located north of Copenhagen, the capital of Denmark (Fig. 1). The landscape consists of an undulating moraine plateau with scattered hills and hillocks, dissected by deeply cut glacial valleys and ravines. Lakes and forests are abundantly scattered in the landscape, making this part of the urban fringe of Copenhagen quite attractive. A summary of data regarding the case areas is given in Table 1.

2.2.1. Springforbi

The Springforbi case area is approximately 50 ha, located at the eastern-faced coast north of Copenhagen (Fig. 1), and generally considered the most fashionable high-life urban area of Denmark. The area possesses high icon value in terms of aesthetics and cultural history. The coastline became scattered with bourgeoisie's villas through the second half of the 19th century, and further developed from 1900 to 1920, with a dense urban structure to a distance of 20 km from Copenhagen, eliminating public access to the coast (Vejre et al., 2007). The same period brought an increasing pressure for recreational opportunities, not least pertaining to the coast. The growing stock of industrial workers in Copenhagen living under poor conditions revealed urgent needs for access to open space. Hence, the1920s brought a clash between private property rights and a rising democratic agenda of gaining access to the coast for recreational and public health purposes. Simultaneously, there was a rising concern as to the consumption of what was considered high value landscapes in terms of aesthetics and cultural history. This concern was probably most pronounced at Springforbi, where there was a particular consciousness of the loss of access to the coast (Struckmann, 1929). The combined forces of the conservative interests in aesthetics and cultural history, and the labour movements' interests in recreational opportunities and public health spawned the 1930s decisions of acquiring more than 50 villas at the most high-rated (in terms of real estate) address of Denmark (Struckmann, 1942). From 1940 all 50 villas, covering approximately 52 ha, were gradually taken over by the State. The procedure was a simple acquisition of the properties whenever they became available on the market. After acquisition the single lots were opened to the

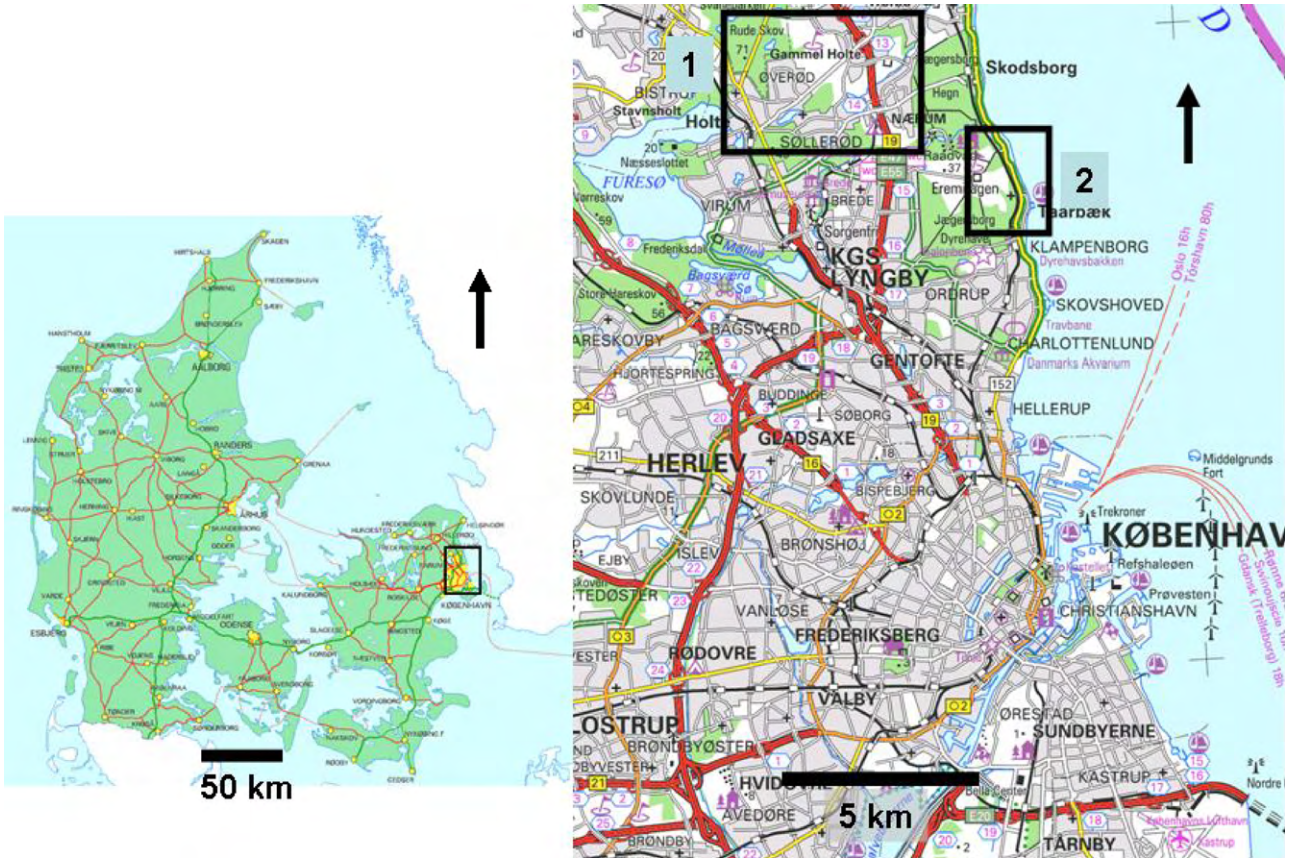

Fig. 1. Map of Denmark, and of Greater Copenhagen showing the location of the study areas: Søllerød (1) and Springforbi (2).

public and since the 1940s (the most recent being from 2006) villas have been demolished too. In 1982, only about 30 villas were left, and today less than ten are still standing (Fig. 2), some of which are now preserved for architectural reasons. The area has gradually been converted into a public park with access to the beach below the cliffs. The outcome may be characterised as a rather unique form of de-urbanisation, opening of the landscape, converting a closed private suburb into a public open space park landscape.

The land cover of the 50 ha comprises grassland with scattered trees, and shrub land at the low coastal cliffs. In terms of ecological qualities the area rates quite low. The grassland is basically the old garden lawns of the demolished villas. There are no qualities related to old extensive grasslands or continuous forest cover, as can be seen in the nearby Natura 2000 designated forest and grassland area.

2.2.2. Søllerød Municipality green space

The second case area comprises the open landscapes in Søllerød Municipality (as of 2007 part of Rudersdal Municipality), north of Copenhagen (Fig. 1). This municipality houses some of the most attractive residential areas of Denmark, due to the high proportion of protected forests, lakes and preserved open land, combined with its proximity to the sea and downtown Copenhagen (15 km). Until 1900, the municipality was in essence a rural area with scattered forest patches (the forests of this region were generally protected in the 1780s), but the opening of the railroads in the last part of the 19th century brought a number of summer residences (Fig. 5). From 1900 to 1930 there was an extensive sprawl of summer houses, gradually developing into full-time residential areas. This settling of Søllerød Municipality took place in the most attractive parts of the landscape: at lakeshores, along forest edges, water-courses and valley slopes (Vejre et al., 2007). The negative effects of the consumption of high quality open land became evident in the 1920s. The sprawl threatened to exclude the general public from access to recreational opportunities. In 1928, the first initiative was taken to contain the urban sprawl, by the establishment of a committee for the elaboration of a general urban plan for greater

Table 1
Summary of information regarding the two case areas.

	Springforbi	Søllerød Nature Park
Area	50 ha	280 ha
Land cover/land use 2009	Public park, lawns, scattered trees and villas	Agricultural fields, pastures, forests, lakes, wetlands, golf course
Major ecosystem services	Recreation, aesthetics	Recreation, aesthetics, wildlife habitats, ground water
Public intervention method	Acquisition and demolition	Nature conservation orders
Ownership 2009	100% State owned	90% State or municipality; 10% private
Period of intervention	1940–1960 (acquisition) 1940–2006 (demolitions)	1930–1960
Landscape evaluation indicators	Potential vista; connection between coast and Deergarden	Wetlands, steep terrain, proximity to forests and lakes
Cost of provision	>800 million DKK (>110 million €)	2125–4250 million DKK (280–570 million €)

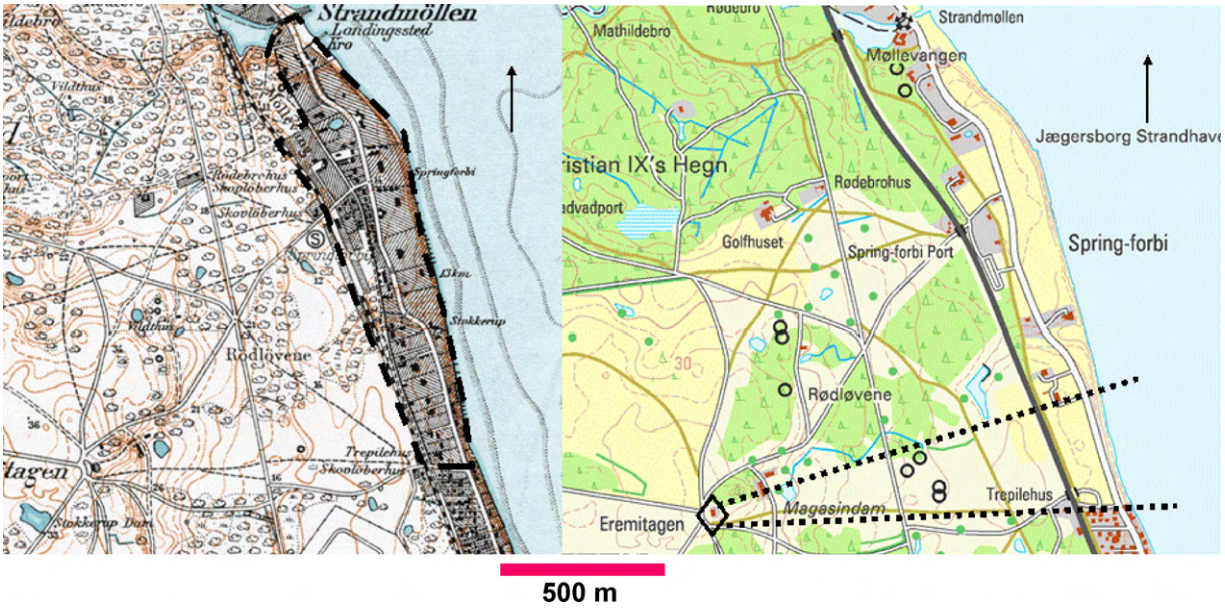

Fig. 2. Map of the Springforbi area in 1930 (left) and in 2004 (right) On the 1930 map the project area is indicated by the hatched line. On the 2004 map the vista from the "Eremitage" castle is indicated. In 1930 the situation prior to the acquisition process is clear: some 50 mansions and other houses blocking the access between the forests and pasture area "Dyrehaven" and the coast. In 2004 the effect of almost 70 years of demolition is visible, less than ten buildings are left, and only one between the road and the coast. The entire area is a public park, some of the remaining buildings are now protected, but still a few are to be demolished.

Copenhagen (Gaardmand, 1993). In 1936, the committee published a plan for the establishment of a recreational network in the landscapes north of Copenhagen (Forchammer, 1936), Fig. 3. The plan suggested the protection of patches of open landscapes, combined with a recreational infrastructure connecting the city centre with the landscapes. The plan was approved in 1938, Fig. 4 (Blixencrone-Møller, 1939), and from 1938 to 1960 the plan was almost realised by imposing nature protection orders in all the designated areas, in the 1940s also supported by the local mayor in Søllerød (Goldschmidt et al., 2006). Alongside this development the remaining areas of Søllerød Municipality was more or less urbanised, so today the entire municipality of approximately 35 km^2 is divided into three distinct classes: (i) protected forests, (ii) open countryside under nature protection orders, and (iii) urban areas. The open land consists of five larger patches (each covering more than 1 km^2) and several smaller patches. The larger areas cover a total of 8.5 km^2.

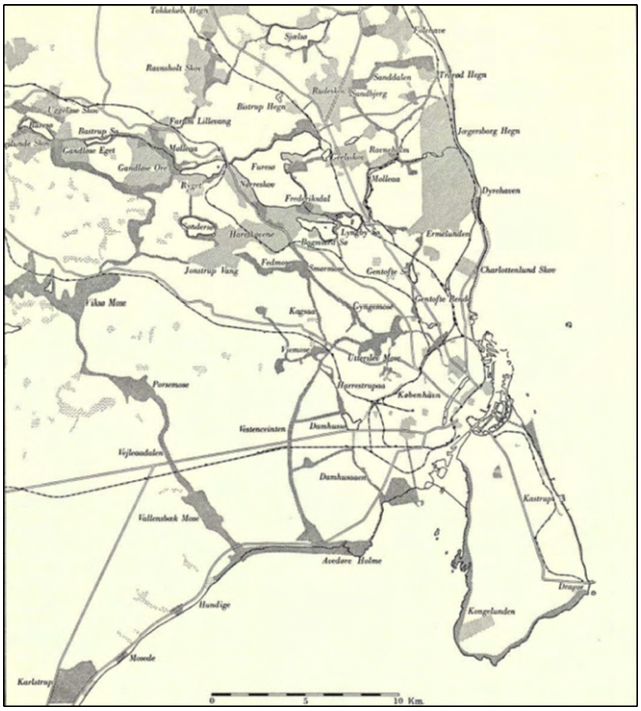

Fig. 3. The original nature conservation for Greater Copenhagen plan of Forchammer (1936) indicating the critical core areas with the highest aesthetic qualities and strongest potentials for recreation. Light grey, existing forests, dark grey, proposed conservation areas.

In this context we concentrate the case study to the so-called Søllerød Nature Park area (Fig. 6). The Nature Park covers an area of 4 km^2. The land cover of the open space comprises agricultural land (120 ha, all under organic management), various wetlands (25 ha), forests (85 ha) and extensive grassland (150 ha), including golf courses. The forests are primarily plantation forests with a relatively low biological quality. Most of the grasslands are less than 50 years old and do not contain large biological qualities. In a few patches old permanent pastures with a high biodiversity are found. The prime nature quality is linked to the numerous small lakes and ponds.

2.3. Landscape and land evaluation methods

In this paper, we attempt to scrutinise the procedure originally employed to delineate the protected areas of the Copenhagen urban fringe. The procedures bear resemblance to both classic land evaluation and more contemporary landscape evaluation.

Land evaluations are generally performed in order to rate qualities of land areas. Evaluation procedures have been developed and refined throughout the 20th century (e.g. Zonneveld, 1995; Rossiter, 1996). These evaluations have largely addressed production-oriented land use purposes, such as suitability for crop production. Also evaluation for intrinsic values has been developed (e.g. Hamin, 2002). In general, land evaluation follows a rather strict procedure of defining the aim (guiding principles), defining land qualities (which properties determine the usefulness of the land to the specific aim?) and finally the indicators (which easily field identifiable variables represent the properties?).

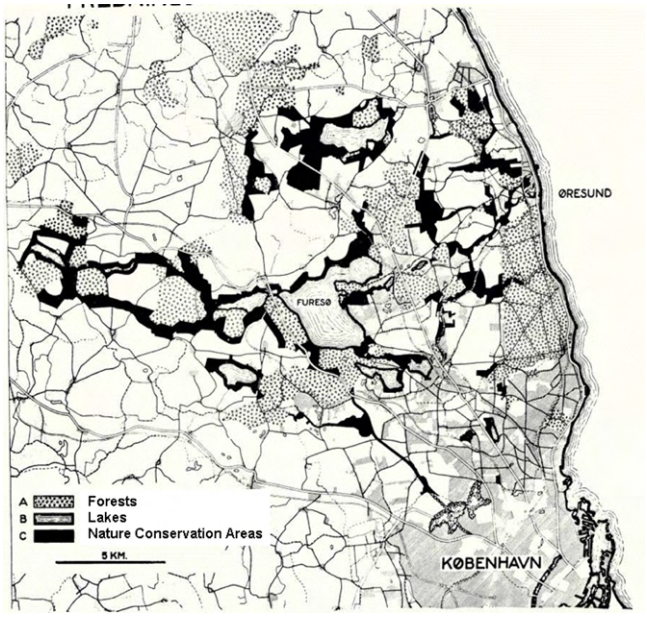

Fig. 4. The approved plan of 1938 for nature protection orders, indicating the final delineation of the future protected landscapes north of Copenhagen. The plan did not deal with the landscapes west and southwest of Copenhagen. Note that some areas were significantly expanded in comparison to the proposal (Fig. 3).

Land evaluation has been performed for two overall purposes: finding the most appropriate site for a given activity, and finding the most appropriate activity for a given site. Examples of classic land evaluation procedures encompass resource mapping for agricultural development or landscape analysis prior to the location of infrastructure. More recently, we have seen procedures of identifying the most appropriate conservation areas, e.g. the Natura 2000 process of the EU (Anon., 1992). In contrast, landscape evaluation is performed to rate more intangible values of landscapes such as visual qualities and place identity.

We employed a retrospective "evaluation of the evaluation" procedure, as we took point of departure in the areas delineated decades ago and scrutinised the relevant documents in order to identify the original articulated aims and guiding principles behind the designations of conservation areas. Further, the identification of properties and the indicators used by the land surveyors in the delineation procedure were attempted. It should be stressed that the evaluation procedure behind these designations somehow follow the classic land evaluation procedures, inasmuch as the designation procedure followed a well-defined aim, and rested on field identifiable indicators, such as wetlands and steep terrain, as representative of a more complicated state of land units fulfilling the defined aim. It should be kept in mind that the evaluation was performed in the 1930s by a skilled engineer and urban planner, decades before landscape architects formulated formal visual analysis procedures.

But the evaluation certainly bears similarities to modern landscape evaluations such as Ian McHarg's approach which employ ecological knowledge in physical planning by overlay methodology where information on soil, vegetation and hydrology are combined and translated into social value (Natuhara, 2006), or Dearden and Sadler's (1989) evaluation techniques of social dependent aesthetic values. It also bears resemblance with Steinitz' six-stage process for landscape planning, of which the landscape evaluation step include aspects such as costs, beauty, user satisfaction, public health, but also nutrient fluxes and habitat quality (Steinitz, 1990, 1995).

2.4. Recreational use assessment

Outdoor recreation demand is basically linked to resources such as land based and man-made services. From a social-psychological point of view, outdoor recreation demand refers to a person's willingness to spend time and other resources on recreation. The outcome of this behaviour is an experience that satisfies personal needs. Demand for recreation opportunities is thus a demand for instruments or courses of action to realise a psychological demand. Another approach, traditionally relating to resource allocation, is to consider demand for recreation activities on specific sites or resources (Clawson and Knetsch, 1978). Outdoor recreation should also be considered within the context of, e.g. social, health, sport, culture, forest and nature policy, and is thereby linked to other social and economic goods and services.

Over the past decades, numerous techniques and methods have been used to monitor visit to natural areas (e.g. Gasvoda, 1999; Hornback and Eagles, 1999; Watson et al., 2000; Cessford and Muhar, 2003; Arnberger et al., 2005; Kajala et al., 2007; Sievänen et al., 2008). This variety of methods is partly a consequence of the broad range of recreation activities and settings. Since recreation involves both a psychological experience and participation in a specific activity in a specific area, studying outdoor recreation usually requires more than simply counting the number of visits. Gathering information about preferences, the perceived outcomes of visits, the prior expectations of visitors, and the journey to and from the area must be included. The choice of method depends on the aim of the study, the type of area, the extent of various activities, the number and types of visitors. Additional considerations comprise the geographical and natural characteristics of the area, and the behaviour patterns of the visitors. Those uses can be concentrated or widely distributed, different activities may involve different movement patterns, and the number of entry points to the area varies. Many on-site studies are based on data gathered from samples of visitors. However, a statistical representative sample may be difficult to achieve, since the size of the total research population is rarely known exactly; in order to count or interview all visitors, the entire boundary of the area must be monitored, which is costly and often not feasible. However, given knowledge of general patterns of visit, and the location of entry points, it is usually possible to select a number of strategic data-gathering locations which together provide an acceptable level of representativity.

The analyses and results we present in this paper estimate the extent of recreational use in two case areas, using a household survey in Søllerød Municipality (Baroudy, 2007) and a national on-site survey wherefrom visit to specific sites in Søllerød Municipality as well as Springforbi is extracted (Jensen, 2003).

2.4.1. Household survey in Søllerød Municipality

A questionnaire was distributed in 2006 among residents living within a distance of 500 m from the nature area Søllerød Nature Park (Fig. 6). The respondents were chosen randomly among the households. A total of 500 questionnaires were distributed, and approximately 50% was returned. The respondents gave basic information such as age and gender, and addressed questions pertaining to their use of and activities in the nature area: purpose and frequency of visits, the satisfaction with facilities, and the attitude towards other visitors. Finally, the respondents were asked to indicate their favourite route on a map of the area. About 200 respondents provided that information.

2.4.2. National on-site survey

From earlier surveys we have extracted and refined data on number of visitors in selected forest and nature areas of Søllerød Municipality (five areas) and the Springforbi area.

The basic data collection in 1996–1997 consisted of instantaneous, manual counts of parked cars and the delivering of 85,673 questionnaires in 592 forest/nature areas, with an area totalling approximately 201,000 ha (Jensen, 2003). The response rate for the questionnaires was 46.7%. During the field work all the places where visitors could park their car (at a given forest/nature area) were surveyed in the course of 1 h (simply by counting the number of parked cars and delivery of questionnaires under their windscreen).

The time for manual counting at specific registration periods had been selected by stratified random sampling. The counting was carried out at 20 randomly stratified moments of maximum 1 h. The stratification took the seasonally, weekly and daily variation into account. The enumerations to annual figures based on the sample were undertaken by sample estimation (weighting).

The advantages of this method include the benefit that it is based on a relatively manageable field work effort; and that information regarding the number of users is obtained simultaneously for a large number of forest/nature areas. Among its weaknesses is that only the recreational use of the car-borne visitors is included in the actual counting. However, based on information from other national surveys (Jensen and Koch, 1997) it is possible to estimate the total number of all types of visitors—independent of means of transport. This is possible based on general knowledge of the relationship between travelling distance and use of car as a means of transportation. In Koch (1980) detailed descriptions of the different methodological aspects are presented.

2.5. Economic assessment

The theory and application of environmental valuation methods is by now far developed (e.g. Freeman, 2003) and builds on the assumption that choices made by individuals (actually revealed or stated hypothetical choices) involving trade-offs between non-marketed and marketed goods and services, reveal to the analyst the (marginal welfare economic) preferences and the value of the non-marketed assets.

Revealed preferences can be obtained from markets, where people trade goods that have an environmental attribute aspect of interest, e.g. hedonic pricing methods can assess the effect on house prices of proximity to, e.g. peri-urban forest and the implied environmental services (Tyrväinen and Miettinen, 2000; Crompton, 2001; Anthon et al., 2005). A strong limitation of the revealed preferences is that they capture only the kind of values that can be appropriated by acting in the related market studied. Stated preference method is – in theory – capable of valuing the more intangible values related to, e.g. cultural heritage and landscapes (Hasler et al., 2008; Tuan and Navrud, 2008). Both of these approaches can only capture use or non-use values, as perceived by people. Some value components may not be evaluated at all (Costanza, 2008) and the information provided by respondents in stated preference valuation studies can have quite dramatic influence on the values estimated, e.g. for biodiversity protection (Jacobsen et al., 2008).

A severe practical drawback of both of these approaches is that they are often too advanced and cumbersome for the typical urban planning unit or consultancy firm to undertake appropriately, and they are also difficult to communicate to decision-makers. Partly for these reasons, a number of other approaches to assess the economic value of environmental services prevail in the literature, and in particular in practice. This includes some cost based methods, e.g. direct abatement costs incurred for avoiding an environmental damage, costs of replacement or restoration of environmental damages, or loss of environmental benefits. Or the cost of provision, which assesses the opportunity cost – in terms of marketed values and goods forgone – of adjusting land uses and production systems to provide increased ecosystem services (Pearce, 1998; Freeman, 2003). As measures of value, these approaches to "pricing" the environment are heavily flawed as they do not address the welfare effect of the environmental goods and services, but only the (budget) cost of providing these services (Freeman, 2003). Thus, observed direct costs incurred by individuals or societies may usually, at best, be an absolute lower bound of the value of the environmental service provided.

The direct cost based approaches do, however, have the advantage – from a practical point of view – of being fairly easy to apply as data are often reasonably easy to find. Furthermore, layman as well as decision-makers can often better relate to, understand and accept these methods. In this study, we will show two examples of how these direct cost of provision approaches can be applied as part of a three-tier approach to assessing the values of peri-urban open spaces and the ecosystem services they provide. More explicitly, real estate agents in the two different case areas were asked about property values for real estates in the following specific settings:

- Real estates prices at Strandvejen, neighbouring the Springforbi area, for houses comparable to the demolished houses (case area 1, Fig. 2).
- Real estate prices for vacant yet undeveloped building lots approved for single-family houses in Søllerød Municipality (case area 2, Fig. 5).
- Price differences between real estates bordering open space in Søllerød Municipality, and comparable real estates with no direct access to the open space. Similarly, the price effect of having a sea view in the Springforbi area was assessed.

Based on these data, we can provide some illustrative measures of the values that society has sacrificed to maintain these open spaces for the sake of recreation and aesthetics.

3. Assessment results

The two case areas were protected or developed for the sake of provision of two primary services: aesthetics and recreation. We first provide an analysis of the original land and landscape evaluation of the two areas, which employs a qualitative analysis to pinpoint the nature of the intangible services, and also pinpointing the reasons behind the exact delineation chosen during the planning process. Subsequently, the recreational use of the areas is documented and discussed also in terms of quality of the recreational experiences pursued by users. Finally, an assessment of the costs of providing these benefits is made, which can be considered a lower bound on the economic value of the ecosystem services provided. For summaries of data consult Tables 1 and 2.

3.1. Land and landscape evaluations

3.1.1. The delineation of the case areas

It is not within the scope of this paper to perform an updated landscape analysis to identify the aesthetic qualities of the areas *per se*. Rather, we analysed the original land and landscape evaluation procedures on which the designations of the 1930s and 1940s rest. This is done by scrutinising the original planning documents, from which the rationale behind the exact delineation of the two case areas was extracted. The delineation of the Springforbi case is found scattered in the archives of the Danish Forest and Nature Agency and in various publications of the 1940s. The delineation of the Søllerød case was published along with the other area delineations of northern Copenhagen in 1936 (Forchammer, 1936; Blixencrone-Møller, 1939). In both cases the exact

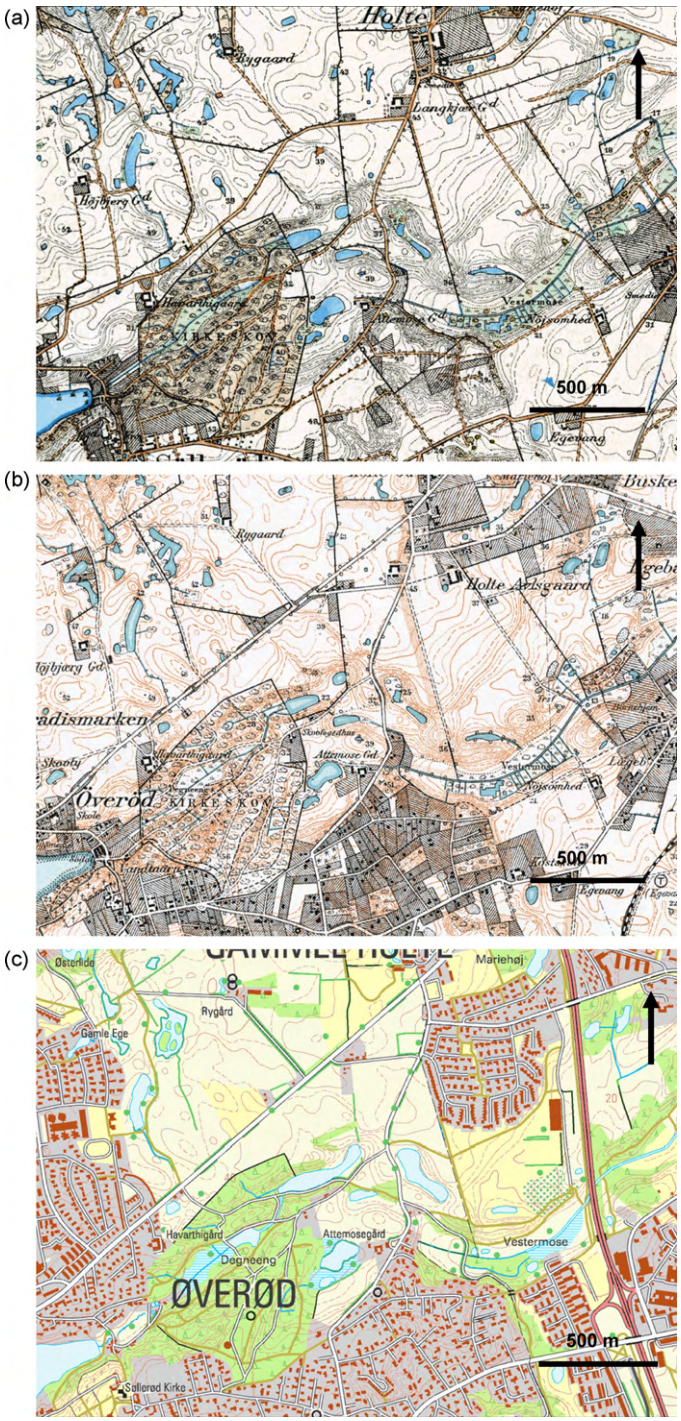

Fig. 5. Maps of the three stages progressive development of the southern part of Søllerød Nature Park. (a) Map from 1890 shows the rural area of Søllerød Municipality, (b) map from 1940 shows the beginning urban sprawl, and the (c) contemporary map shows the three categories of the landscape today: urban areas, protected forests and open landscapes under nature protection orders.

delineation represents decisions made by a very limited number of experts.

3.1.1.1. Springforbi area. The Springforbi area was chosen as the core area for the process of regaining the public access to the coast for several reasons. The surroundings of the area were important—it links the central, open plains of Jægersborg Dyrehave (a deer park) with the sea at a point where cliffs make broad vistas possible.

The aim of the Springforbi demolitions was to clear a strip for the sake of public access to the coast, and for reclaiming the vistas from the iconic vantage point the Eremitage, a royal hunting castle from 1736, placed in the centre of Dyrehaven. Prior to the urbanisation of the coast, visitors could admire the view over the plains, across the sea to the coast of Scania (South Sweden).

Further, the area comprised some of the larger villas, which were not yet parcelled out, making the process of public acquisitions easier. Starting with the villa "Springforbi" (2.5 ha, later to lend name to the entire area, Fig. 2) in 1940, the villas "Beaulieu" and "Konow" (each 1.5 ha) in 1941, a core area was defined for the future establishment of a public park (Struckmann, 1942). The three villas were demolished shortly thereafter. In the following decades the State Forest Service pursued a strategy of buying properties whenever possible to expand the park area, and after a few years decision on the exact delineation of the park area became relevant. To the north the watercourse "Mølleaaen" constituted a natural borderline for the park. In contrast, the southern demarcation line was a very pragmatic choice. The boundary for the park area was decided so the villas to evade demolition are not visible from the Eremitage i.e. an aesthetically motivated demarcation (Fig. 2). Further, the delineation corresponded with one of the major access routes to the forest.

3.1.1.2. Søllerød Municipality green space. The land evaluation, on which the delineation of the conservation areas rests, was literally done entirely by Olaf Forchammer, the Chief Engineer of Copenhagen City, working for the committee for the elaboration of a comprehensive urban plan for Copenhagen. Surveying intensively in the areas north of Copenhagen in the early 1930s he drafted the plan in a comprehensive report (Forchammer, 1936) (Fig. 3) which in a revised form of 1938 was realised almost completely (Fig. 4). The premises for designating the future green space are carefully described in the report. The guiding principle for Forchammer's survey was recreation, both as a physical exercise requiring space and land, and as a mental experience, requiring attractive landscape, peace and views. Nature conservation in terms of habitat and species protection was a subdued issue at that time and only mentioned briefly. Concerns regarding the urban development were raised as many new settlements were not equipped with sewers, leaving lakes and wetlands vulnerable to pollution. As landscape qualities, Forchammer surveyed the landscape for larger open land, for beautiful vistas, for peaceful environments, and for areas located in close connection to protected forests and lakes. The most prominent indicators were steep terrain, proximity to lakes and forests, wetlands and watercourses. Properties determining recreational qualities comprised the presence of lakes and coasts with potentials for bathing, and areas suitable for camping grounds close to water and forests and curiously, far from "tempting" facilities such as inns and restaurants.

After defining what were to be the core areas of the future conservation areas, Forchammer sketched future recreational traffic routes and parkways, connecting the city centre with the conservation areas, and interconnecting them. In essence, the plan of 1936 dealt with the identification of the *critical core areas*. In the plan maps, the areas are hatched (Fig. 3), and they are not exactly delineated. In the further process, a committee under the Prime Minister decided the exact boundaries, basically by following clear features in the landscapes, such as roads and hedgerows, or cadastral boundaries (Fig. 4). The core areas are hence the parts of the landscape that Forchammer in the early 1930s found the most attractive, the boundaries determined by pragmatic decisions.

Table 2
Intensity of recreational use of the case study areas 1996/1997 (Jensen, 2003).

Area	Annual visits (1000)	Annual visits per ha	Annual visitor hours (1000)	Annual visitor hours per ha
The Søllerød Municipality case				
Trørød Hegn	56	997	56	1008
Kohaven	2	60	4	104
Søllerød Kirkeskov and Rygaard[a]	136	655	179	866
Geel Skov	202	1045	247	1279
Ravneholmene	25	260	35	367
The Springforbi case				
Jægersborg Dyrehave and Hegn	7501	4460	15,263	9074

[a] Almost equivalent to Søllerød Nature Park.

3.2. Recreational uses

The intensity of recreational uses is shown in Table 2. Data for Søllerød Municipality consists of five nature areas, which in total receive 421,000 visits a year—equivalent to 720 visits/year/ha or 890 visitor h/year/ha. This level of visit is considered an intensive use (defined as 300–999 visitor h/year/ha) in a Danish context. The area "Søllerød Kirkeskov and Rygaard" in Table 2 is almost equivalent to Søllerød Nature Park (case area 2) with 136,000 visits a year—equivalent to 655 visits/year/ha or 866 visitor h/year/ha. The household survey in Søllerød Municipality gave some additional information on the recreational use of the Søllerød Nature Park—indicating that approximately half of the respondents visit their local nature area at least once a week. The typical activity is a foot trip/stroll, walking the dog, jogging or cycling. About one third of the visitors appreciate wildlife (watching birds) during the visit. About 90% of the visitors are very satisfied with the facilities and opportunities within the area. Certain conflicts among users are mentioned, in particular animosity towards mountain bikers and dogs without a leash. The respondents' map with favourite routes gives a detailed impression of the use of the recreational infrastructure, and the variation in intensity of recreational traffic (Fig. 6).

The visit of the Springforbi case is based on the total use of Jægersborg Dyrehave and Hegn, which is very intensively used with more than 7 million visits a year—equivalent to 4460 visits/year/ha or 9074 visitor h/year/ha. Specific geographical delimitation of the recreational use of the Springforbi part of the total area is relatively complicated, as recreationists obviously are not static in their use of the area. It is possible to make a rough estimation based on the specific use of the five entrance points, which are directly linked to the Springforbi area. For these entry points alone, the yearly number of visits can be estimated at approximately 1.1 million. This is a conservative estimate, as numerous visitors from other entry points to Jægersborg Dyrehave will visit the Springforbi area, especially due to the vista from the Eremitage castle (Fig. 2). A more realistic proxy will probably be the double—around 2–2.5 million visits a year. As for Søllerød, most visitors to Springforbi are satisfied with the facilities, and conflicts with mountain bikers and dogs without leash are mentioned by some visitors.

Whether the 1996/1997 recreation data are valid for 2008 is of course questionable. But as this paper is testing how far we can get in valuating ecosystem services by relatively simple quantifications, we suppose the accuracy to be adequate in this context. For testing of benefits transfer of forest recreation over time, see e.g. Zandersen et al. (2007a,b).

3.3. Assessing cost of provision in the case studies

Based on the simple methods described above, we can provide some illustrative measures of the values that society have sacrificed to maintain these open spaces for the sake of recreation and aesthetics.

3.3.1. The Springforbi area

Real estate prices along the coast road north of Copenhagen, Figs. 1 and 2, are among the highest in Denmark. This is due to the attractiveness of the area in general, being close to the city centre, close to the sea (the Øresund) and also quite close to Jægersborg Dyrehave and Jægersborg State Forest District (Fig. 2). In addition, houses in this area are quite large, by Danish standards, often situated on fairly small land lots. Prices for typical units consisting of a house with 200–500 m^2 of living space, on a land lot of some 500–800 m^2, lie within 10–30 million DKK as of November 2008, corresponding to 1.3–4 million €. Incidentally the estate exactly neighbouring the Springforbi case area was for sale at 32 million

Fig. 6. The recreational intensity as expressed by number of passages in Søllerød Nature Park. Data represents approximately 200 inputs from local residents within a distance of 500 m from the area (Baroudy, 2007).

DKK (>4 million €) at the time of gathering data for this analysis. The huge variation in prices arises not only because of the variation in the size of land lots and notably house sizes, but also because of an important variation in the environmental attributes of different sites. Estate dealers all stressed that in this area there is a significant difference between houses on the seawards side of the North-South travelling coastal road and those on the landwards side (Fig. 2). They assessed that properties with a clear view towards the sea had on average a price premium of about 20–30%. This is well in accordance with several hedonic pricing studies on similar environmental attributes from other places in Denmark, reporting effects of lake view or neighbouring a forest of up to 20% in more wealthy and larger urban areas, and some 10% in the countryside, where supply of such environmental attributes is higher and average income is lower (Anthon et al., 2005; Birr-Pedersen, 2006).

In 1940, about 50 villas of varying sizes but typical for the general area occupied the strip of land between the inland open area and the seaside. All villas were taken over by the state, and about 40 were demolished, several of them facing the sea directly. The number of villas demolished was probably too small to affect the general housing market in the area. Even for the nearby houses, the increase in environmental value is likely to be negligible as nearness to coast and inland forest lands was already present. Based on the above evidence, we assess that the market value of these estates would – in today's currency – have been in the range of 400–1200 million DKK or 50–160 million €. Compared with the surrounding area, relatively many of these houses were facing the sea, implying that the actual costs are likely to be at the upper end of this interval, most likely above 800 million DKK.

This is the present value of the sacrifice that society in the 1940s decided to make in return for the (in principle) eternal ecosystem service provided by the landscape connecting the seaside to the inland open grassland and forest areas, and the views and access to the sea. Of course, society may in principle expand housing in another part of the urban region, to maintain the supply of houses. This may potentially cause a reduction in eco-system services elsewhere, which cannot be assessed here. It seems safe to assume, however, that their value will not rival those estimated here.

3.3.2. *The Søllerød Municipality green space*

While heavily urbanised, Søllerød Municipality is characterised by large tracts of land left undeveloped to preserve the natural beauty of the landscape and the landscape amenities that are important parts of the attractiveness of the area in terms of demand for single-family houses. These areas are all protected against urbanisation and subjected to very strict regulation. When these restrictions were decided, the implication for society was to forgo opportunities for further urbanisation and development of residential areas. A master plan of 1943 for the development of the municipality (i.e., before the conservation planning process was entirely unfolded and generally accepted by the local municipalities) literally suggested the development of the entire area into various urban categories (Goldschmidt et al., 2006). Hence, it is relevant to express the value of the open space at least partly as missed development opportunities. The area, however, is so large that a full development would have direct supply effects on the house market in the region, causing lower prices. It is large enough for some 10–15,000 land lots for single-family houses to be established in the better parts of these tracts. Apart from the negative effect on the house market in the area, the effect of a large scale development would also be to erode a significant part of the value of the existing environmental attributes embedded in the value of existing houses.

Estate agents again assess that houses with direct access and connection to the forests and open lands in the area, have a selling price some 25% higher than houses just a few hundred meters away. This is in accordance with hedonic models of similar cases (Anthon et al., 2005; Birr-Pedersen, 2006). Several hundred houses in the area benefit from this direct access, and with a typical single-family house in the area having a selling price of 5–10 million DKK (0.7–1.4 million €), the aggregate environmental value component of the existing property values is likely to amount to several 100 million DKK. Thus, if we want to consider the opportunity cost of forgone residential development, we would in fact need a model of the house market in the area capable of assessing non-marginal effects of changes in the supply of housing as well as the supply of environmental services.

That the potential value of the environmental services is, nevertheless, massive can be illustrated by making a more cautious partial calculation: If, for instance, only some 10% of the open space of Søllerød Municipality was parcelled out as typical single-family house lots, which in Denmark typically cover 800–1000 m^2, still more than 1000 lots could be sold. As vacant lots in the area are sold for typically 2500–5000 DKK (350–700 €) per m^2, these lots would represent a gross value of 2125–4250 million DKK (280–570 million €). Increasing the built-up area may of course reduce the value of the environmental services experienced by those already living in the area, but nothing near the gain measured here. Thus, in spite of the value of the current ecosystem services likely to be embedded in the current property stock, society is willingly carrying a cost much larger than this to preserve the general ecosystem services arising from these urban open areas and forest patches.

4. Discussion and concluding remarks

The combination of three distinct methods: the land evaluation and identification of qualities, assessment of recreational use, and monetary assessment, gave a unique opportunity of valuing intangible services within the same limited tracts of land. We should, however, discuss the degree of representativity before aiming at any general conclusion.

The case in Søllerød Municipality – Søllerød Nature Park – is representative of green space in the northern suburbs of Copenhagen in terms of landscape, ownership, location and land cover (even though it is larger than the average green area in Søllerød Municipality). But the area rates as some of the most attractive and pricey in terms of real estate, and cannot without reservation be compared with green areas west and southwest of Copenhagen. The Springforbi area is quite unique, the location, neighbourhood and price level is not to be found anywhere else in Denmark.

The delineation of the case areas followed different pathways. In Søllerød, the delineation was based on a decision on the location of critical core areas, followed by a pragmatic decision on the exact boundaries. In Springforbi, the opposite and very costly procedure was followed. The extent of the Springforbi area was not based on existing values, but on potential values, and consequently the decisions were where to create the ecosystem services. The study revealed that the underlying evaluation of the landscape qualities is heterogeneous in nature, elitist in the sense that the task was done by a few individuals, and subjective. The evaluation and decisions were made before participatory planning was an issue, and the planning process must be characterised as functionalistic and centralised.

It should further be noted that the planning documents were not straight-forward. They were very detailed in Søllerød Municipality, but scattered and not published in Springforbi.

Interestingly, the results that the "old experts" came up with three generations ago, reflect more or less what more recent forest and landscape preference studies of the general Danish population have revealed (Koch and Jensen, 1988; Jensen, 1999). At a time where participatory planning is enthroned, a more philosophic

discussion of nature quality and democracy could be enlightening and rewarding, as the case of e.g. Arler (2002), who discusses the pros et cons of the use of "the experienced connoisseur" and "the biological connoisseur" in the process of identification of nature quality.

We estimated aesthetics, open space amenity and recreation pressure, but in a comprehensive study of ecosystem services we should also have valued other services, e.g. habitat value, groundwater extraction, CO_2 sequestration etc. We did not compile these data in any quantitative manner, but some remarks should be made on the other ecosystem services. The Springforbi area's limited extent of 50 ha proves insignificant for services such as filter and CO_2 sequestration, though its capacity per ha may be as high as many other green space areas. There is no significant water extraction, and the area is not known to house any species of special importance, in particular when compared to reference areas of biodiversity hotspots in other locations of greater Copenhagen. Being a part of the larger forest area it certainly provides some habitat services. Truly it is an area serving mainly intangible services or functions. The broad range of services discussed here differs strongly in their "spatial extent". As an extreme, the carbon sequestration is strictly limited to the area itself, whereas the transboundary effect is larger for the habitat service, as organisms may cross boundaries. As another extreme, the aesthetic and transcending, cultural services certainly "radiate" out of the area, not just because the area has impact on vistas from a much larger areas, but also because the service penetrate into the minds of an entire population, as the site is an iconic landmark playing a role for people not even visiting the area.

In contrast the nature areas of Søllerød have important habitats, in particular such pertaining to wetlands and forests. Also, the areas are large enough to play a role as climate mediators, as CO_2-sequestration areas and as water reservoirs. However, these services are not unique for this area, and better substitutes are found in the region. Hence, it is beyond doubt that the recreational and landscape/aesthetic values are the prime ecosystem services provided from these areas. The case neatly demonstrates the power of spatial planning in reducing the costs of acquiring urban green space, with "eternal" provision of recreational and aesthetic services.

The Springforbi case is a very illustrative example of the level of costs that the society is facing, when no or just inadequate planning is unfolded. The coast north of Copenhagen was developed before any regulation on urban sprawl was formulated. The first urban planning regulation was enforced in the 1920s, and prior to that the authorities had almost no power or legal instruments to preserve areas for recreational purposes. With contemporary legislation it would have been rather simple to delineate a recreational zone without compensation to owners, and in general all Danish coasts are protected by strict regulation on development 3 km inland from the coastline. In 2009 values, an estimated average of about 115 million € would be the cost of compensating for the lack of spatial planning instruments in a small area of 50 ha.

In comparison to the Springforbi area, the process of spatial planning, and the implementation of the plan by employment of nature protection orders and payment of compensation to the landowners, proved to work in Søllerød.

The tools becoming available in Denmark in the late 1930s were conservation planning, meaning that local and regional authorities could designate areas of importance for recreation and nature conservation. The mere designation had legal deferment effect on any development, until a central committee had approved the plan. The declaration of nature conservation order was not free of charge, as private landowners could claim a compensation for lost development opportunities. In some cases the authorities had to pay compensation, in other cases the landowners voluntarily let their properties be subjected to nature conservation orders. However, this planning hindered other development opportunities. In 2009 values, the sacrifice made for preserving these 8 km^2 in Søllerød is in the range of 280–570 million €.

From an economic point of view, the role of the more or less centralised spatial planning process, from goal formulation to implementation, is to correct the following important market failure: Without regulation and spatial planning, beautiful peri-urban landscapes will – roughly speaking – be developed until the point where they are no longer beautiful and at least as crowded as any other potential piece of land available for development, *ceteris paribus*. The spatial planning process and laws regulating it are capable of protecting such local public goods from a super-optimal degree of development.

In any case study the question should be raised whether the analysis is universal or confined to a specific geographic area. The results are probably somewhat confined—the vicinity to an urban conglomerate plays a role.

In other cases, demolition of houses on critical sites in Denmark has taken place. The UNESCO World Heritage Site Jelling, which is an ancient Viking monument from the 10th century, was cleared of a number of residential houses surrounding it (Adriansen, 2003). An old industrial complex was cleared near Hamlet's castle Kronborg in connection with its admission onto the UNESCO list. Globally, several examples of demolitions near ancient monuments and near unique nature sites could be mentioned. One is Uluru/Ayers Rock in Australia, where tourist facilities next to the rock were demolished in the 1970s. But we have so far not found other records of the demolition of estates located on a city's most fashionable address – for the sake of a view – anywhere in the world.

On the other hand, the case of safeguarding green areas at the city perimeter is probably valid for urban conglomerates of most developed countries, and certainly of use for developing countries with sprawling cities. In order to safeguard and develop recreational and aesthetic land values in a future dominated by climate change and biodiversity agendas, development of sound planning, evaluation and mapping methods which identify and delineate these values are important (e.g. Caspersen and Olafsson, 2009).

5. Conclusions

Among ecosystem services, the category of intangible, transcending and social functions must be rated alongside tangible services linked to physical processes such as habitats, water, air, buffering etc. if a balanced sustainable development is to be reached.

The cases and the case histories we have described in this paper demonstrate several things:

- that the intangible services may certainly rival the tangible ones in some areas around larger cities
- that there are several ways in which these values can easily be quantified in a way suitable for communication
- that some degree of centralised spatial planning processes can – even if not as participatory and transparent as those of today – protect the common interests and the public goods in peri-urban areas and counteract the market failure implied by these large externalities.

Acknowledgements

The authors wish to thank Chief Forester Klaus Waage Sørensen at the Danish Forest and Nature Agency, Copenhagen for valuable contributions to the description of the Springforbi Case.

References

Adriansen, I., 2003. Nationale symboler i det danske rige 1830–2000. Museum Tusculanum, ISBN: 87-7289-794-5 (in Danish).

Anon., 1992. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Council of Europe. Online at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31992L0043:EN:NOT.

Anon., 2001. Multifunctionality. Towards an Analytical Framework. OECD Publications, 2. Rue Àndré-Pascal, 75775 Paris Cedex 16, France.

Anthon, S., Thorsen, B.J., Helles, F., 2005. Urban-fringe afforestation projects and taxable hedonic values. Urban For. Urban Green. 3, 79–91.

Arler, F.;1;, 2002. Naturkvalitet og demokrati. In: Arler, F. (Ed.), Humanøkologi, Miljø, teknologi og samfund, Aalborg Universitetsforlag, pp. 389–408 (in Danish).

Arnberger, A., Haider, W., Brandenburg, C., 2005. Evaluating visitor monitoring techniques: a comparison of counting and video observation data. Environ. Manage. 36, 317–327.

Baroudy, A.T., 2007. Friluftsliv, Forvaltning og Fremtid i Søllerød Naturpark og Vaserne. Masters Thesis. University of Copenhagen (in Danish, English abstract).

Birr-Pedersen, K., 2006. Measurement and Benefit Transfer of Amenity Values from Afforestation Projects: A Spatial Economic Valuation Approach Using GIS Technology. PhD-dissertation. University of Copenhagen.

Blixencrone-Møller, C., 1939. Københavnsegnens Fredningsplan. In: Struckmann, E. (Ed.), Dansk Naturfredning. Danmarks Naturfredningsforenings Aarsskrift 1938-39, Gyldendalske Boghandel, Nordisk Forlag, København (in Danish).

Brandt, J., Vejre, H. (Eds.), 2003. Multifunctional Landscapes, vols. I and II. WIT Press, Southampton, ISBN: 1-85312-934-8, ISSN: 1369-8273.

Brandt, J., Vejre, H., 2003b. Multifunctional landscapes—motives, concepts and perceptions. In: Brandt, J., Vejre, H. (Eds.), Multifunctional Landscapes, vols. I and II. WIT Press, Southampton, ISBN: 1-85312-934-8, ISSN: 1369-8273.

Caspersen, O.H., Olafsson, A.S., 2009. Recreational mapping and planning for enlargement of the green structure in greater Copenhagen. Urban For. Urban Green., doi:10.1016/j.ufug.2009.06.007.

Cessford, G., Muhar, A., 2003. An overview of monitoring options for visitor numbers in national parks and other protected natural and recreation areas. J. Nat. Conserv. 11, 240–250.

Clawson, M., Knetsch, J.L., 1978. Economics of Outdoor Recreation. Resources for the Future, Inc. by The John Hopkins University Press, Baltimore and London.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M., 1997. The value of the world's ecosystem services and natural capital. Nature 387, 253–387.

Costanza, R., 2008. Ecosystem services: multiple classification systems are needed. Biol. Conserv. 141, 350–352.

Crompton, J.L., 2001. The impact of parks on property values: a review of the empirical evidence. J. Leisure Res. 33, 1–31.

Dearden, P., Sadler, B., 1989. Landscape evaluation: approaches and applications. Westernal Geographical Series, vol. 25. University of Victoria.

de Groot, R.S., Wilson, M.A., Boumnas, R.M.J., 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecol. Econ. 41, 393–408.

Farber, S.C., Costanza, R., Wilson, M.A., 2002. Economic and ecological concepts for valuing ecosystem services. Ecol. Econ. 41, 375–392.

Forchammer, O., 1936. Københavnsegnens Grønne Omraader. Forslag til et System af Omraader for Friluftsliv, Dansk Byplanlaboratorium, Gyldendalske Boghandel, Nordisk Forlag, København (in Danish).

Freeman III, A.M., 2003. The Measurement of Environmental and Resource Values, Theory and Methods, second ed. Resources for the Future, Washington, DC.

Gaardmand, A., 1993. Dansk Byplanlægning 1938-1992, Arkitektens Forlag, ISBN 87-7407-132-7 (in Danish).

Gasvoda, D., 1999. Trail traffic counters: Update, Report 9923-2835-MTDC, USDA Forest Service. Missoula Technology and Development Centre, Missoula, MN.

Goldschmidt, E., Johansen, J., Monies, F., Stilling, N.P., 2006. Vejen til Rudersdal, Søllerød Municipality, ISBN 87-88792-55-2 (in Danish).

Hamin, E.M., 2002. Western European approaches to landscape protection: a review of the literature. J. Planning Lit. 16, 339–358.

Hasler, B., Jacobsen, J.B., Lundhede, T.H., Martinsen, L., Thorsen, B.J., 2008. Værdisætning af natur og kulturgoder. Et metodestudie af betydningen af ændringer i skala og betalingsformat [Valuation of environmental and cultural goods. A methodological study on the role of embedding scale and payment format]. Report no. 695, National Environmental Research Institute, Rosklide, Denmark, 81 pp.

Hornback, K.E., Eagles, P.F.J., 1999. Guidelines for Public Use Measurement and Reporting at Parks and Protected Areas. IUCN, Gland, Switzerland and Cambridge, UK.

Jacobsen, J.B., Boiesen, J.H., Thorsen, B.J., Strange, N., 2008. What's in a name? The use of quantitative measures vs. 'Iconised' species when valuing biodiversity. Environ. Resource Econ. 39, 249–263.

Jensen, F.S., 1999. Forest Recreation in Denmark from the 1970s to the 1990s. The Research Series No. 26-1999, Forskningscentret for Skov & Landskab, Hørsholm, Denmark.

Jensen, F.S., 2003. Friluftsliv i 592 skove og andre naturområder, Skovbrugsserien nr. 32-2003, Skov & Landskab, Hørsholm, Denmark (in Danish).

Jensen, F.S., Koch, N.E., 1997. Friluftsliv i skovene 1976/77-1993/94. The Research Series No. 20-1997, Forskningscentret for Skov & Landskab, Hørsholm, Denmark (in Danish).

Kahnemann, D., Knetsch, J.L., 1992. Valuing public goods: the purchase of moral satisfaction. J. Environ. Econ. Manage. 22, 57–70.

Kajala, L., Almik, A., Dahl, R., Diksaite, L., Erkkonen, J., Fredman, P., Jensen, F.S., Karoles, K. Sievänen, T., Skov-Petersen, H., Vistad, O.I., Wallsten, P., 2007. Visitor monitoring in nature areas—a manual based on experiences from the Nordic and Baltic countries. TemaNord 2007:534, Naturvårdsverket, Bromma, Sweden.

Koch, N.E., 1980. Skovenes friluftsfunktion i Danmark. II. del. Anvendelsen af skovene, regionalt betragtet. (Forest recreation in Denmark. Part II: the use of the forests considered regionally). Forstl. Forsøgsv. Danm. 37, 73–383 (in Danish, English summary).

Koch, N.E., Jensen, F.S., 1988. Skovenes friluftsfunktion i Danmark. IV. del. Befolkningens ønsker til skovenes og det åbne lands udformning. (Forest recreation in Denmark. Part IV: the preferences of the population). Forstl. Forsøgsv. Danm. 41, 243–516 (in Danish, English summary).

Natuhara, Y., 2006. Landscape evaluation for ecosystem planning. Landscape Ecol. Eng. 2, 3–11.

Pearce, David, 1998. Cost-benefit analysis and environmental policy. Oxford Rev. Econ. Pol. 14, 84–100.

Price, C., 2008. Landscape economics at dawn: an eye-witness account. Landsc. Res. 33, 263–280.

Rossiter, D.G., 1996. A theoretical framework for land evaluation. Geoderma 72, 165–190.

Sievänen, T., Arnberger, A., Dehez, J., Grant, N., Jensen, F.S., Skov-Petersen, H. (Eds.), 2008. Forest Recreation Monitoring—a European Perspective. Working Papers of the Finnish Forest Research Institute 79, Helsinki, Finland.

Steinitz, C., 1990. A framework for theory applicable to the education of landscape architects (and other design professionals). Landsc. J. 136–143.

Steinitz, C., 1995. A framework for planning practice and education. In: Bunji, M. (Ed.), Ecological Landscape Planning. Process Architecture, Tokyo, pp. 42–54.

Struckmann, E., 1929. Dansk Naturfredning. Danmarks Naturfredningsforenings Aarsskrift 1928-29, Gyldendalske Boghandel, Nordisk Forlag, København 1939 (in Danish).

Struckmann, E., 1942. Dansk Naturfredning. Danmarks Naturfredningsforenings Aarsskrift 1941-42. Gyldendalske Boghandel, Nordisk Forlag. København (in Danish).

Tyrväinen, L., Miettinen, A., 2000. Property prices and urban forest amenities. J. Environ. Econ. Manage. 39, 203–223.

Tuan, T.H., Navrud, S., 2008. Capturing the benefits of preserving cultural heritage. J. Cult. Heritage 9, 326–337.

Turner, R.K., Paavola, J., Farber, S., Cooper, P., Jessamy, V., Rosendo, S., Georgiou, S., 2003. Valuing nature: lessons learnt and future research directions. Ecol. Econ. 46, 493–510.

Vejre, H., Primdahl, J., Brandt, J., 2007. The Copenhagen finger plan. In: Pedroli, B., van Doorn, A., de Blust, G., Paracchini, M.L., Wascher, D., Bunce, F. (Eds.), Europe's Living Landscapes. Landscape Europe, Wageningen/KNNV Publishing, Zeist, ISBN: 978 90 5011 258 1.

Watson, A.E., Cole, D.N., Turner, D.L., Reynolds, P.S., 2000. Wilderness Recreation Use Estimation: A Handbook of Methods and Systems. General Technical Report RMRS-GTR-56. USDA Forest Service Rocky Mountain Research Station.

Yin, R.K., 2003. Case study research design and methods. Applied Social Research Methods Series, vol. 5. SAGE, ISBN 0761925538, 9780761925538.

Zandersen, M., Termansen, M., Jensen, F.S., 2007a. Testing benefits transfer of forest recreation values over a twenty-year time horizon. Land Econ. 83, 412–440.

Zandersen, M., Termansen, M., Jensen, F.S., 2007b. Evaluating approaches to predict recreation values of new forest sites. J. Forest Econ. 13, 103–128.

Zonneveld, I.S., 1995. Land Ecology. SPB Academic Publishing, Amsterdam, ISBN 90-5103r-r101-7.