ENVIRONMENTAL ACCOUNTS

MIR 2015:3

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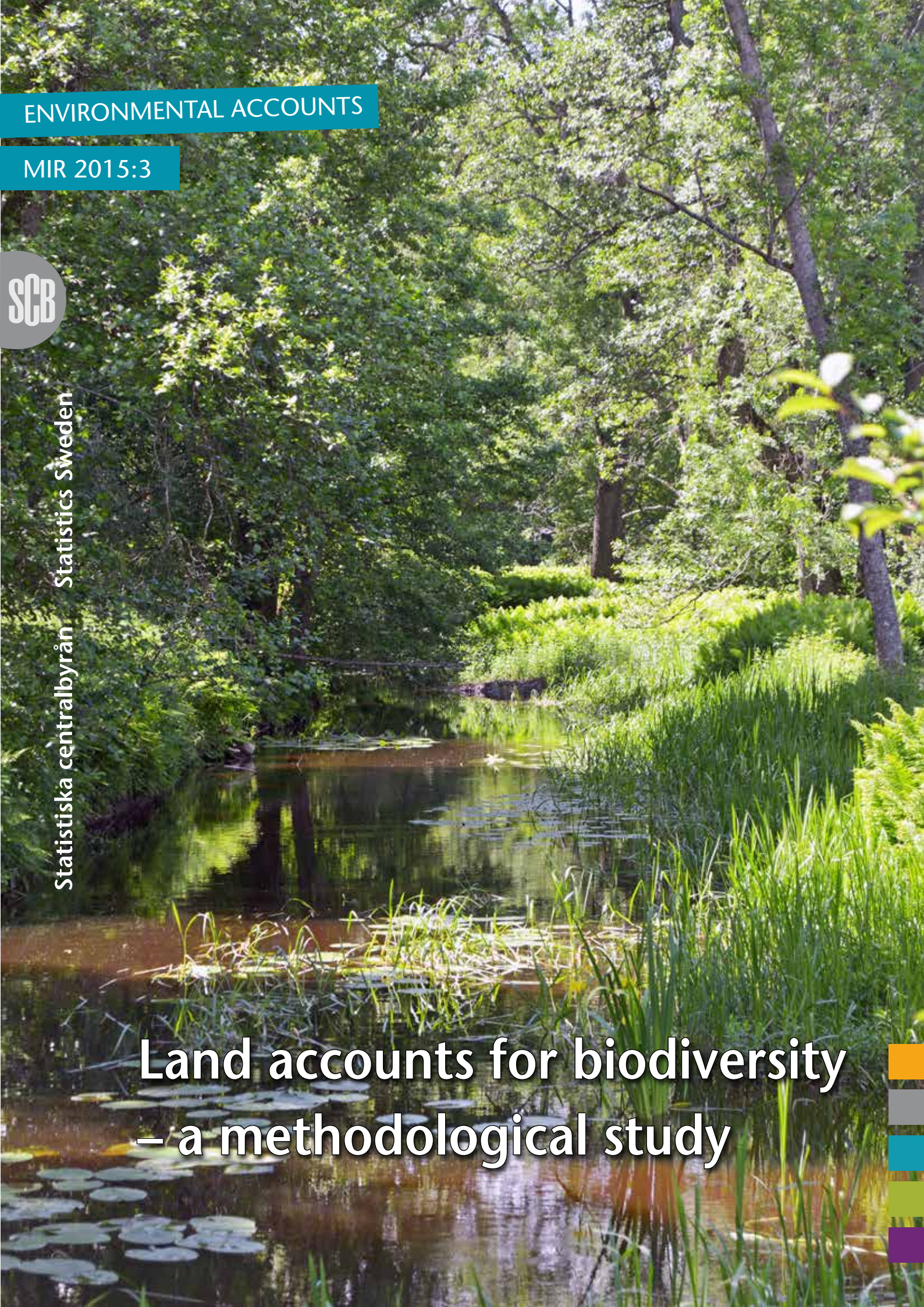

Land accounts for biodiversity – a methodological study

ENVIRONMENTAL ACCOUNTS 2015:3

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Producer Statistics Sweden, Unit of Environmental Accounts and Natural Resources
Box 24300, SE-104 51 Stockholm
+46 8 506 940 00

Enquiries Nancy Steinbach +46 8 506 940 97
nancy.steinbach@scb.se
Viveka Palm +46 8 506 942 19
viveka.palm@scb.se

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Foreword

This report was commissioned by the Swedish Ministry of the Environment. Its aim is to describe experimental statistics within the framework of the environmental accounts connected to ecosystems and land ownership.

The environmental accounts are a statistical system that describes the links between the environment and the economy. This is done by measuring the contribution from the environment to the economy (e.g. the use of raw material, water, energy and land) and the impact on the environment made by the economy (emissions to air and water, and waste). The environmental accounts system also highlights the environment-related transactions in the national accounts system.

The hope is that it will be possible in the future to combine statistics about ecosystem services in a way that fits into the environmental accounting system so that it can provide a more complete picture of how the economy affects the environment and vice versa.

A statistical standard for environmental accounting called the System of Environmental-Economic Accounting Central Framework (SEEA CF) has been established within the UN.

According to the UN, an environmental accounting system should cover:

- material flows in the economy
- economic variables of environmental interest
- nature resources and stocks

The UN has also published a report on how to produce ecosystem statistics in theory. Countries are recommended to test how this might be possible in practice.

This report has been produced by the Unit for Environmental Economics and Natural Resources at Statistics Sweden (Sebastian Constantino, Jerker Moström, Viveka Palm, Nancy Steinbach and Elin Törnqvist) in cooperation with the Swedish University of Agricultural Sciences (SLU) (Lena Tranvik and Håkan Berglund).

Statistics Sweden, January 2015

Marie Haldorson

Kaisa Ben Daher

Statistics Sweden would like to thank
All our data providers – private persons, enterprises, authorities and organisations – who make it possible for Statistics Sweden to produce reliable and up-to-date statistics that satisfy society's need for information.

Contents

Summary

This report is a pilot study aimed at developing a method for producing statistics on owners (industries) of land that is important for biodiversity. The method aims to link land use to the environmental accounting system and thereby be able to analyse which economic players control valuable habitats. It is possible that this type of information can provide a general picture of how the responsibility for Sweden's land is distributed, who owns the land and how its structure looks in the Swedish economy.

The project has used data sources for habitats that have been identified as important for the preservation of biodiversity. Data sources for owners of the land in question have also been used. Development of the method has involved linking land use data with data on who owns the land broken down into the following groups: central government, municipalities and county councils, the business sector (industries), e.g. agriculture and forestry, and private ownership. Eight different registers have been used to achieve this. The link to form of ownership creates a "key" that allows the material to be used in the environmental accounting system, which is an internationally harmonised statistical system linking the economy and the environment.

The habitats examined are Western taiga and grasslands[1] in accordance with the definitions in the EU Habitats Directive, wetlands in accordance with the definition in the Swedish National Wetlands Inventory and key forest biotopes according to the Swedish Forest Agency.

Aquatic habitats have not been covered in the project. No monetary valuation of ecosystem services has been made in the project.

The starting-point has been the habitats reported under Article 17 of the Habitats Directive. This starting-point has been used in order to obtain a classification that can be used in international contexts. A crucial aspect is to cover areas both inside and outside protected areas. Habitats within appointed Natura2000 sites are protected, but the responsibility for achieving favourable conservation status covers the entire landscape, which means that it is also interesting to include other areas containing these habitats, something which has been done in this study.

In other words, the project looks at how we can report a subset of these habitats in Sweden. The habitats studied in detail in this report are Western taiga (EU code 9010, approximately 17 percent of Swedish forest land), habitat-classified grasslands in the meadows and grazing land inventory (8 percent of the total grasslands and grazing lands in Sweden) and wetlands in accordance with the National Wetlands Inventory (about 84 percent of the total wetlands in Sweden). Key forest biotopes were also studied in detail.

[1] Siliceous grasslands, Nordic alvar and Humid meadows

Table S.1
Habitat areas covered in this report, area in hectares

	Wetlands	Western taiga	Key forest biotopes	Meadows and grazing land - habitats	Total meadows and grazing land
Total studied in this report	4 324 509	4 430 474	463 940	177 716	288 542
Total area in Sweden	5 155 800*	25 768 000**	463 940	3 682 008 ***	3 682 008
Percentage studied in this report	84%	17%	100%	5%	8%

*Source: Land use in Sweden: 2010.
** Source: kNN database Estimated as the total surface area of all pixels in the kNN database that contain spruce and/or pine forest
*** Source: Land use in Sweden: 2010. Includes both naturally grass-covered land and grass-covered land associated with the arable landscape.

Who owns the land?

The aim is to describe and define actors whose actions have an impact on the conditions for biodiversity. These actors can be private landowners, businesses and public institutions. The Swedish Standard for Industry Classification (SNI) is used in this report. It categorises a business according to its main activity and regardless of its ownership structure. This means, for example, that the activity dictates the classification, not the ownership. For example, state-owned real estate companies are also classified in the real estate sector. The results show that this is perfectly possible to do using a combination of statistics and registers that are co-processed.

The classifications of habitats differ slightly in the various registers. The Habitats Directive reports listed habitats that the EU Member States have agreed to preserve. To be able to provide a good description of how economic actors use ecosystems, it is desirable to also include habitats with less stringent conservation requirements or lower natural values. This is something that needs to be examined further.

The project also found that there is a larger number of properties owned by enterprises that are not classified according to any industrial code. A case in point is the fact that 16 percent of all Western taiga owners in Sweden could not identified as either private or business sector owners. In order to be able to produce continuous high-quality statistics in this field, it is desirable to further analyse the part that is unclassified so that it can also be allocated to the right economic actor.

Habitat terminology

The project has identified a need to further improve the terminology so that we can differentiate between the concept of "Habitats listed in the Habitats Directive" and "Habitats in general". In the report, we define habitats as "habitats in general".

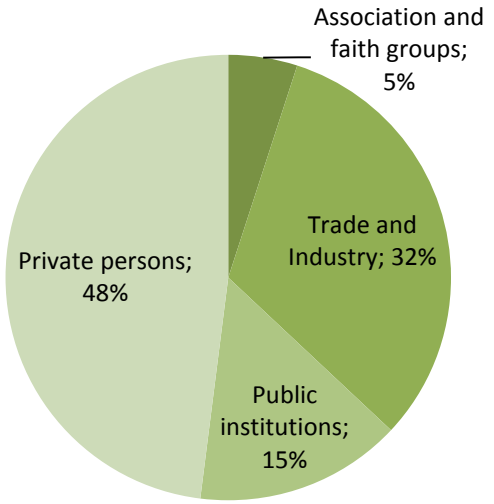
A more detailed discussion is also needed on how we should report parts of habitats that fall outside the strict assessment for land that is reported to the Habitats Directive. This report presents data that is in line with the strict assessment in the Habitats Directive and that falls outside it. For example, the wetlands inventory used cannot separate the categories reported to the Habitats Directive while the delimitations for Western taiga are considered to be well in line with the habitats according to the directive.

To create value added in the habitat statistics, it would also be desirable to have national land accounts that included all the land in Sweden. This would provide the conditions needed for a comparison between land that has high natural values and is important for other reasons as well.

Private persons own the majority of Swedish land

Over half the land in Sweden is owned by private persons. Just over 30 percent of the land is owned by the business sector in the form of enterprises that mainly operate in the agriculture and forestry sector. The Swedish public sector owns 15 percent of the land, this includes municipalities, county councils, count administrative boards and central agencies and authorities. Just under 5 percent of Sweden's land is owned by associations and faith groups.

Figure S.1
Breakdown of Sweden's total land area in 2010 by owner category



Total: 38 million hectares

Source: 2011 Register of Real Estate Assessment (FTR), Statistics Sweden
Comments on the figure: Ownership data has been retrieved from the Register of Real Estate Assessment (FTR). A part of the state-owned land is missing from the register, this leads to a certain underestimation of the amount of publicly owned land. This refers mostly to publicly owned land in the Swedish mountains.

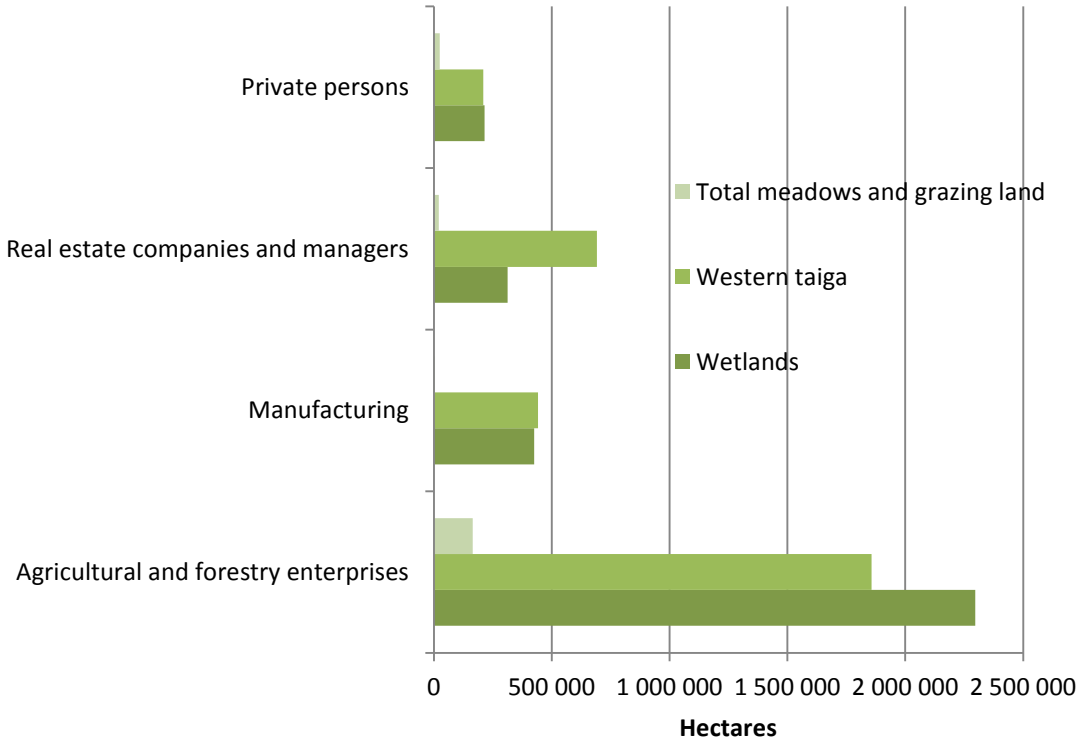
Which industries own habitats with high natural values?

Who owns the land that is important in achieving favourable conservation status for species and habitats in Sweden? In comparison with the total land area, the majority of which is privately owned, the opposite is true for land containing listed habitats.

Experimental results show that for the Western taiga habitat in accordance with the Habitats Directive (mixed coniferous forest), the business sector owns just under 80 percent of the land. Western taiga is roughly defined as mixed coniferous forest of a certain age and quality (high natural values). Within the business sector, it is agricultural and forest enterprises that own the vast majority of Sweden's Western taiga. Agricultural and forest companies also own most of the wetlands and grasslands and grazing land. The manufacturing industry is the second-largest landowner of the three categories with the exception of Western taiga, where more land is owned by real estate companies and real estate managers.

Private persons only own 5 percent of Western taiga land and wetlands and 8 percent of all meadows and grazing land.

Figure S.2
The four largest owner groups of Total meadows and grazing land, Western taiga and Wetlands, hectares, Industry SNI 2007



Comments on the figure: please note that it is no possible to add the habitats together as they can overlap. Primarily with reference to Total meadows and grazing land and Wetlands

1 Introduction

In 2013, the Nordic Council of Ministers appointed an ad hoc group to investigate the scope for supplementing GDP with other indicators over a two-year period. The work plan included following on from the recommendations drawn up by the Nordic TEEB (The Economics of Ecosystems and Biodiversity) (TemaNord 2012).

Measuring sustainable development and welfare is a central area as regards promoting the green economy, both nationally and internationally. Sweden has international commitments in this area, e.g. as part of the strategic plan to strengthen and preserve biodiversity as adopted at the Tenth Meeting of the Conference of the Parties to the Convention on Biodiversity in Nagoya in 2010. One of the targets involves the integration of the value of biodiversity into development plans, economic decisions and national accounting. This target has been incorporated into Sweden's environmental objectives system as a milestone target, although without any explicit reference to national accounting.

The Swedish milestone target states that *no later than 2018 will the significance of biodiversity and the value of ecosystem services be common knowledge and integrated into economic arguments, political considerations and other societal decisions where relevant and appropriate.*

As a result of the government enquiry Räkna med miljön (Count on the environment) from 1991 (Official Government Reports 1991:37-38), Statistics Sweden, the Swedish Environmental Protection Agency and the Swedish National Institute of Economic Research were assigned the task of developing a Swedish environmental accounting system. Much of the system has been developed since the enquiry, including air emission accounting, environmental taxes, environmental protection expenditure, and an international statistical standard has been developed (System of Environmental-Economics Accounting), to which Sweden contributed.

Regarding certain issues, however, methods to highlight how the environment and the economy interact have yet to be developed. An intensive global debate is currently ongoing regarding ecosystem services and how to take them into account by using statistics that can be linked to economic considerations. The EU has stressed that it intends to examine whether this goal can be achieved within the environmental accounting system. The OECD has also discussed the issue[2].

The results are also being used by the Nordic Council of Minister's ad-hoc group for supplementary welfare indicators as Swedish input on how to develop ecosystem accounts.

[2] Currently ongoing is an expert group working on this isse: Task Force on the implementation of the SEEA Central Framework

1.1 Purpose

The following project has as its aim to start developing a new statistical module for the environmental accounting system. It involves linking together data on land that is valuable for biodiversity with other statistics that can highlight the connection to the economy, such as conditions of ownership, employment and turnover. By examining how statistics from different data sources can be co-processed and whether the degree of detail is sufficient to analyse the conditions of ownership, prerequisites for a future follow-up of Swedish land are created, both as regards land that is of particular importance for biodiversity as well as total land use in Sweden.

The project has been limited to certain habitats that are reported in accordance with Article 17 of the Habitats Directive and key biotopes. The landscapes studied in detail in this report are Western taiga (EU code 9010, approximately 17 percent of Swedish forest land), habitat-classified grasslands in the inventory of meadows and grazing land (8 percent of the total grasslands and grazing land in Sweden) and wetlands in accordance with the wetlands inventory (about 84 percent of the total wetlands in Sweden). Key forest biotopes were also studied in detail.

Table 1.1
Area of habitats covered in this report, area in hectares

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The Habitats Directive states which species and habitats are to be protected in the EU. These have been jointly determined by the various Member States. The Directive covers 1 000 species, 164 of which can be found in Sweden. Of the 231 habitats covered, Sweden has 88. The Directive was introduced in 1992 but only came into force in Sweden when the country joined the EU in 1995 (Sohlman, 2008).

The categories used in the reporting for Natura 2000 are of particular interest. The reporting to the Habitats Directive is not limited to Natura 2000 sites but takes place for each species and habitat in the whole country[3].

[3] Sohlman A. (ed) 2008. *Species and habitats in the Habitat Directive - status in Sweden: 2007.* Species Information Centre, SLU, Uppsala.

In 2007, EU Member States reported the conservation status during 2001-2006 of the habitats and species that are protected under Article 17 of the Habitat Directive. The analysis included about 1 180 species and 216 habitats, with nine species groups and nine habitat types distributed among eleven biogeographical regions. A new, similar reporting system has been developed in 2013 which, in Sweden, covers about 90 habitats and 160 species in three terrestrial and two marine biogeographical regions.

Important data sources in this cooperation project between Statistics Sweden and SLU are: the information from the Habitats Directive, habitat data, the Register of Real Estate Assessment (FTR), the cadastral map, the business register and land use statistics. The fact that the focus is on reporting habitats to the EU enables international comparisons if more countries were to develop similar statistics. The proposal for this project was developed in SCB MIR 2013:2[4] which was drawn up in parallel with the Swedish enquiry on ecosystem services[5].

No monetary valuation will be made within the framework of this project. The link to the economy is instead made via the ownership and structure of the industries that own the land. Further limits apply to water and fossil cycles, and nitrogen and phosphorous balances that are not described in the report.

1.2 The added value of classifying the statistics by industry

The framework for the project is a statistical system called environmental accounting. The statistics compiled within this concept make it possible to link environmental impact to economic actors and product groups.

The statistics can be used for benchmarking different industries and to analyse e.g. the environmental impact of consumption. Similarly, it is possible to study the impact of economic instruments on the environment.

Since the system is international[6] and has been developed as a satellite system to the national accounts, there is plenty of scope for following the indicators on an international basis.

Statistics within the framework of ecosystems and biodiversity provide the prerequisites for the environmental accounts to contribute standardised information, broken down by industry but also by sector. It can for example be information about areas such as land use, water use, fishing statistics and agricultural statistics.

Ownership can be broken down in the model developed in this project in slightly different ways, using an industry-oriented and a sector-oriented approach. The industry-oriented approach involves prioritising information on who, in terms of which industry, owns the land. This means that public institutions are mainly described in terms of the activities they

[4] http://www.scb.se/statistik/_publikationer/MI1301_2013I02_BR_MI71BR1302.pdf

[5] http://www.regeringen.se/content/1/c6/22/61/92/97321dd6.pdf

[6] The environmental accounts became a statistical standard in accordance with the UN 2012 model.

do. If the information is instead broken down based on a sector-oriented approach, the owner's institutional affiliation is given priority in the reporting. The information is therefore broken down into a number of rougher categories, i.e. the business sector, public administration and private persons. Both approaches have their advantages and disadvantages. In this project, we have elected to concentrate more on the industry-orientated approach as this is important in order to be able to use data in the environmental accounting system. Chapter 3 provides examples of how sector-classified statistics on Sweden's total land area can be described while Chapter 4 shows how industry-classified statistics on habitats are handled.

In future projects, such information can provide a picture of which valuable natural areas are not covered by environmental protection laws and provisions. It is furthermore possible to formulate a picture of the structure in the industries in terms of the distribution between small and large enterprises, turnover, number of employees and how many workplaces they have at their disposal in comparison with the industry as a whole that does not own any of the surveyed land types.

A limitation in the analysis in this report concerns how the industry classification is designed. The method predicates that it is the owner's industry category that is captured. This differs from other environmental accounts statistics in that it is normally the industry category of the operator of a certain business activity that is captured. The difference lies in the fact that the owner (who is shown in this study) does not always perform the activity on site. An example is a property manager being the major owner of land that is important to biodiversity. It is not, however, always the property manager who utilises the properties on the land in question; it may have been let to another organisation. Regarding industrial activities, the difference is not as obvious. Paper and paper product enterprises have been shown to own land where the specific activity in question is also performed.

Something that can also been seen as a limitation is the fact that state-owned enterprises are allocated to the industry category of their activity and it is not possible to see what the ownership forms for the enterprise look like. Such cases require classification by sector instead.

1.3 International development of methods

In the world of statistics, methods are being developed to create the concepts and quantities needed in order to incorporate these more nature-oriented components into the environmental accounts. A manual *System of Environmental-Economic Accounting 2012 Experimental Ecosystem Accounting* has been published by the UN[7].

Since ecosystem accounting is still being developed, there are as yet only a few statistics offices that have had the opportunity to be involved. Australia is however one country that has started work and the UK has allocated high priority to it for a long time.

[7] http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf

Different ways of approaching the issue of biodiversity via the environmental accounts have been described in Lenzen et al 2012 and Mattila 2013. By linking data from red lists with information on which industries constitute a threat as regards trade between different regions in the world using an input-output model, they have calculated which countries' consumption is driving development.

An example of a country that has developed similar statistics to those we have compiled in this report is Australia. In Australia, it has been calculated that, in the state of Victoria, over 60 percent of the land and water resources are owned by the business sector; conditions that are similar to those in Sweden.

Table 1.1.
Land-ecosystem asset account - Victorian land classified by Major Vegetation Groups (NVIS), aggregated by land use (VLUIS, 2005)

Major vegetation groups	Primary production	Residental	Industrial	Commercial	Extractive industry	Infrastructure/ utilities	Community services	Sport, recreation and culture	National parks, conservation areas, forest reserves and natural water reserves	Non-active assessments and header records	Unclassified	total
Acacia forests and woodlands	1 519	138	33	1	5	152	35	16	16 938		8	18 845
Acacia open woodlands	100								156			256
Acacia shrublands	1 367	296		3		222	77	60	8 088			10 113
Callitris forests and woodlands	1 161	284	1	3	1	90		72	332		2	1 946
Casuarina forests and woodlands	50 888	563	128	61	270	11 915	513	8	125 989		114	190 449
Chenopod shrublands, Samphire shrublands and forblands	34 426	162	7	16	2 791	3 104	49	4 027	72 995	17	5	117 599
Eucalypt open forest	782 813	157 594	1 156	3 491	4 061	88 425	12 743	3 018	3 921 191		963	4 975 455
Eucalypt open woodlands	94 267	11 762	296	499	370	11 296	2 522		126 641		6	247 659
Eucalypt tall open forests	16					364			53 196			53 576
Eucalypt woodlands	1 127 834	117 490	1 967	4 583	6 173	108 635	8 970	3 059	1 079 878	2	978	2 459 569
Heathlands	11 311	466	84	58	12	1 977	60	370	230 109		14	244 461
Low closed forests and tall closed shrublands	15 035	2 971	80	24	18	1 395	61	54	15 602		1	35 241
Mallee open woodlands and sparse mallee shrublands	12 104	88	2			1 286	27	1	29 871		1	43 380
Mallee woodlands and shrublands	180 416	4 563	140	40	5 432	35 874	765	201	1 350 187		36	1 577 654
Mangroves	1 019	180	18	2	1	84		25	3 664		13	5 006
Melaleuca forests and woodlands	10	5				3			47			65
Naturally bare - sand, rock, claypan, mudflat	83	17	22			35	7	3	4 267		25	4 459
Other forests and woodlands	2 937	642	5	108	36	875	89	129	50 920		15	55 756
Other grasslands, herblands, sedgelands and rushlands	34 346	1 344	53	29	23	4 602	59	85	56 942		64	97 547
Other open woodlands									77			77
Other shrublands	37 030	1 878	70	135	98	3 056	1 235	788	114 833		128	159 251
Rainforests and vine thickets	3 975	190		8		170	4	24	35 793			40 164
Tussock grassland	107 805	8 305	822	168	1 190	5 855	404	198	15 238		4	139 989
Unclassified native vegetation	2 067	224	20		2	306	272	150	5 001		32	8 074
Total native vegetation	2 502 529	309 162	4 904	9 229	20 483	279 721	27 892	12 288	7 317 955	19	2 409	10 486 591

Source: Victorian Government Department of Sustainability and Environment, 2013

2 Land and habitats

In the same way as information on ownership can be grouped in different ways, land data can also be presented differently depending on the purpose, data material and issue at hand. The main focus of this project is on habitats but the model developed in the project also enables owners to be classified by land use category. In this section, we explain the difference between land use categories and habitats, the general meaning of the concept of habitats and the specific significance of habitats in relation to the Habitats Directive.

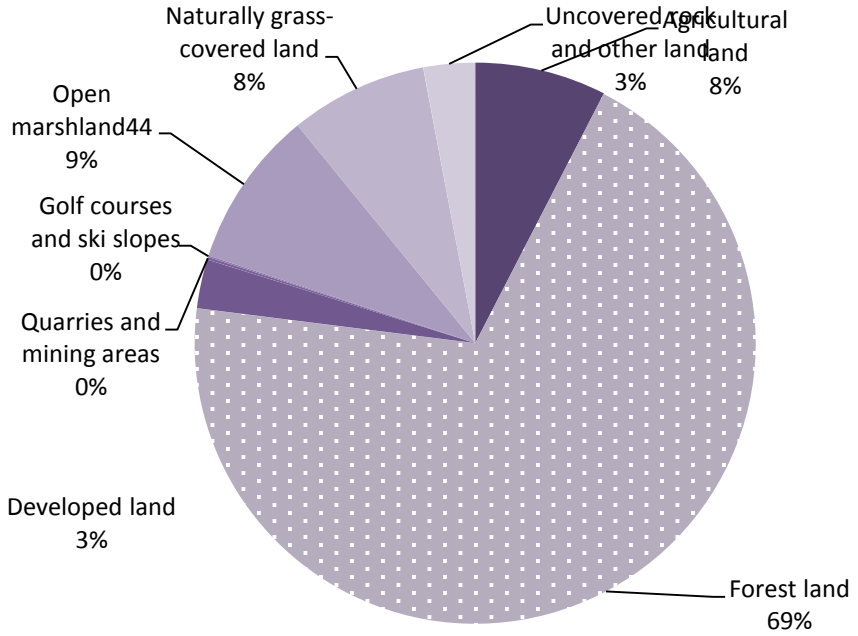
2.1 Land use categories

The official statistics divide land use into rough categories that correspond to what the land is mainly used for. Several of the categories correspond to economic sectors such as agriculture and forestry, while others have no such connection, for example developed land.

Sweden's land area amounts to around 41 million hectares. Added to this is 4 million hectares of lakes and about 8 million hectares of sea.

In 2010 there were 28 million hectares of forest land, which is approximately two thirds of the total area, or about 70 percent. Agricultural land is responsible for 8 percent of Sweden's land use while only 3 percent consists of developed land.

Figure 2.1
Land use per land use category, 2010



Total: 41 million hectares
Source: Statistics Sweden 2013

2.2 Habitats

The different land use categories reported above can be subdivided into habitats. Habitat means in general a landscape area of quite uniform character and structure that has a specific flora and/or fauna. A habitat can be a large area, e.g. a moor, heath, spruce forest or lake, but may also be a small area, e.g. a specific type of small water body or section of shoreline. Plants and animals require different habitats to be able to survive and reproduce. One and the same habitat can include many such habitats for flora and fauna (Sohlman, 2008). How many habitat there are in Sweden depends on the level of detail selected.

2.3 Habitats in accordance with the Habitats Directive

The concept of habitat is also used in relation to the Habitats Directive. Here the concept has a slightly more specific and narrower meaning and in addition to an area of uniform structure and character also refers to a certain quality requirement in order to satisfy the various definitions.

An example is *taiga,* which normally refers to the coniferous forest belt in the northern hemisphere, from Norway, through Sweden and Finland to Siberia in Russia. Following this general meaning, therefore, large parts of the Swedish forest is to be regarded as taiga. To be classified as the habitat referred to in the Habitats Directive as Western taiga (EU code 9010), it has to be possible, in the relatively near future, for the forest to become natural forest or to resemble natural forest as regards its properties and structures. It may have been affected by e.g. selective cutting, grazing or natural disturbance. The forest must be in a late or relatively late stage of succession. It must contain old trees and dead wood as well as have a continuity for the types of tree in question. If natural disturbance processes or management methods, mainly fire or conservation burning, with the aim of simulating such processes, have affected the area, areas in earlier stages of succession can also be included if they add significant value. Properties and structures that are typical for natural forests are also normally to be found in earlier stages of succession. The forest's hydrology should not be too affected by drainage and the occurrence of nutrient-demanding herbs is the exception (Swedish EPA 2011).

Sweden has undertaken to conserve 89 habitats and about 164 species in accordance with the Habitats Directive. These habitats and species are important parts of Sweden's biodiversity. The habitats cover a great deal that is of interest from a nature conservation point of view, while the selection of species in the Habitat Directive represents only a minor share of the species worthy of protection that occur in the country. In the long term, the reporting in accordance with Article 17 is to include information on management and other conservation measures.

In the chapter that follows, the expression "habitat" is used not just to describe areas that fulfil the habitat criteria in accordance with the directive but has a wider definition. This wider definition includes mostly wetlands and grasslands.

3 Sector breakdown of land

This section aims to provide a general picture of land ownership in Sweden that can serve as a framework for the analysis of habitat breakdown among owners and sectors.

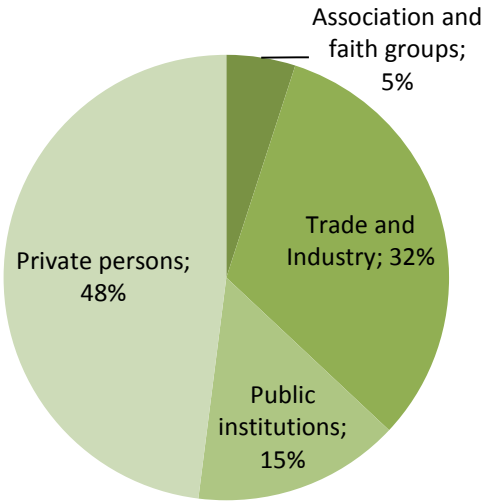
Ownership has a considerable impact on how the land is utilised for different purposes and hence on the conditions for the preservation of biodiversity. Who owns the land affects control over it and in the long run how instruments are designed to safeguard its conservation. If the state owns the land, certain conditions prevail, whereas entirely different conditions apply if the land is owned by a private individual or enterprise.

The scale of ownership is also significant; how much land is owned by a specific landowner category and how the land is allocated, i.e. its geographical distribution. The conditions for using the land are different between a large and a small agricultural enterprise. A forest company with large adjacent land areas can conduct its forestry operations in a different to one whose land is more widely dispersed.

So who owns the land in Sweden and what are the different ownership conditions? Where in Sweden, and in which industries, are those who own the private land? Which industries in the business sector own the most land and what about public ownership?

In Sweden, as in most of the western world, the majority of the land is owned by private persons, a fact clearly illustrated in Figure 3.1 below. Just over half the land in Sweden is owned by private persons. Just over 32 percent of the land is owned by the business sector in the form of enterprises that mainly operate in the agriculture and forestry sectors. The Swedish public sector owns 15 percent of the land, this includes municipalities, county councils, count administrative boards and central agencies and authorities but also state-owned enterprises. Just under 5 percent of Sweden's land is owned by associations and faith groups.

Figure 3.1. Distribution of Sweden's total land area in 2010 by owner category



Total ownership category: 38 million hectares
Source: 2011 Register of Real Estate Assessment (FTR), Statistics Sweden
Comments on the figure: Ownership data has been retrieved from the Register of Real Estate Assessment (fastighetstaxeringsregistret - FTR). A part of the state-owned land is missing from the register, which gives a certain underestimation of the amount of publicly owned land. This refers mostly to state-owned land in the mountains.

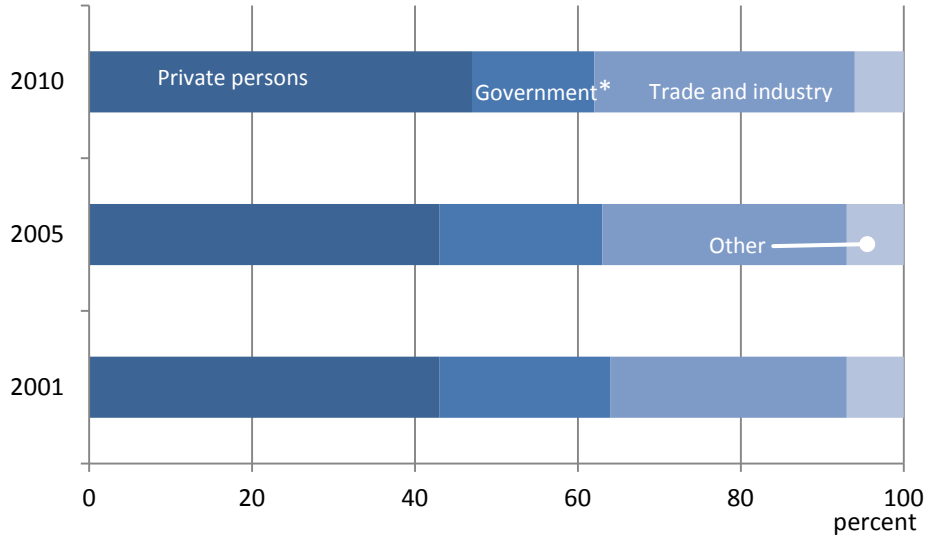
The privately owned land (owned by private persons) is mostly made up of developed land, agricultural land and forest land, while most of the state-owned land is unproductive land in the form of mountains, marshland, etc. The remaining state-owned land is mostly forest. Most of the land owned by the business sector is also forest.

3.1 Changes in land ownership

The distribution of land ownership has shifted over time. The biggest change between 2001 and 2010 was that private ownership (by private persons) went up from 43 to 48 percent. The proportion of land owned by the business sector was also higher in 2010 compared to 2001, with an increase of 3 percent during the period, from 29 to 32 percent. Public ownership on the other hand decreased from 21 to 15 percent[8].

[8]Public ownership also includes state-owned enterprises, i.e. market producers.

Figure 3.2.
Share of total land ownership in 2001, 2005 and 2010, by ownership category



Source: 2011 Register of Real Estate Assessment (FTR), Statistics Sweden
Comments on the figure: Ownership data has been retrieved from the Register of Real Estate Assessment (FTR). A part of the state-owned land is missing from the register, which gives a certain underestimation of the amount of publicly owned land. This refers mostly to state-owned land in the mountains. *Government also includes municipality ownership

3.2 Land ownership of private persons

There are over 2 million landowners in Sweden obliged to declare their land holdings on their annual tax return. The largest number of owners is to be found in the three largest counties: Stockholm (16 percent of private landowner ownership), Skåne (12 percent) and Västra Götaland County (16 percent). As regards landownership distribution between men and women, it is most even in Stockholm County where 40 percent of landowners are women. Jönköping County has the most uneven distribution between the sexes with only 27 percent women.

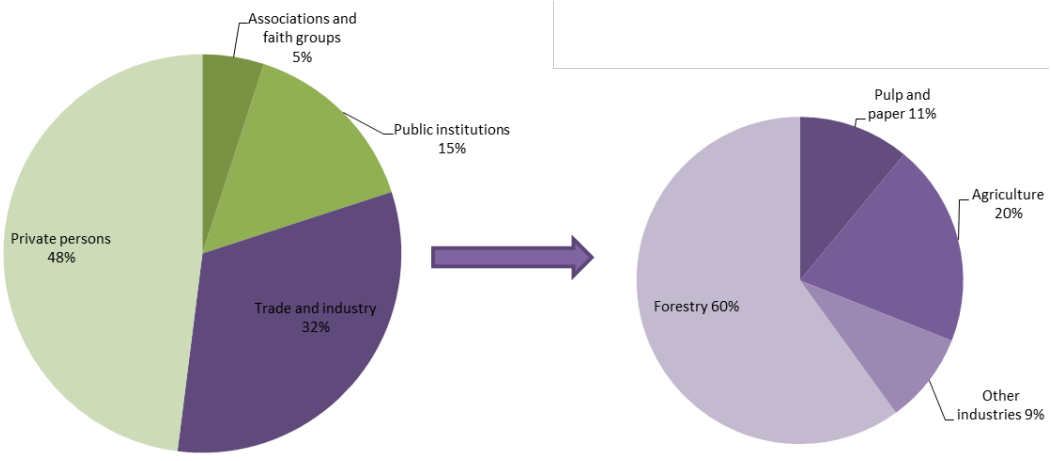
In terms of direct ownership, women own 11 percent of Sweden's land and men own 36 percent if we simultaneously consider that 47 percent of the country's land is owned by private persons. Indirect ownership, i.e. private persons owning land by virtue of them owning a company that in turn owns the land directly, is not included here.

Many private landowners are employed and can be linked to an industry. Just under a tenth of all owners of privately owned land work in Education. That is more than in Agriculture and Forestry, where 4 percent of private landowners work (2 percent in each industry respectively). Eighteen percent of private landowners work in one of these three industries; Specialised construction activities, Human health activities and Public administration.

3.3. Land ownership of the business sector

The business sector is also a large landowner in Sweden, mostly of forest land. The diagram below shows the main industries that are registered as owners of the land area owned by the business sector as a whole. Sixty percent of the land has a connection to the forest industry. Agricultural enterprises own 20 percent of the total area owned by the business sector and 11 percent is owned by the paper and paper products manufacturing industry.

Figure 3.3.
Business sector's land ownership in 2010 broken down into the three largest owner industries

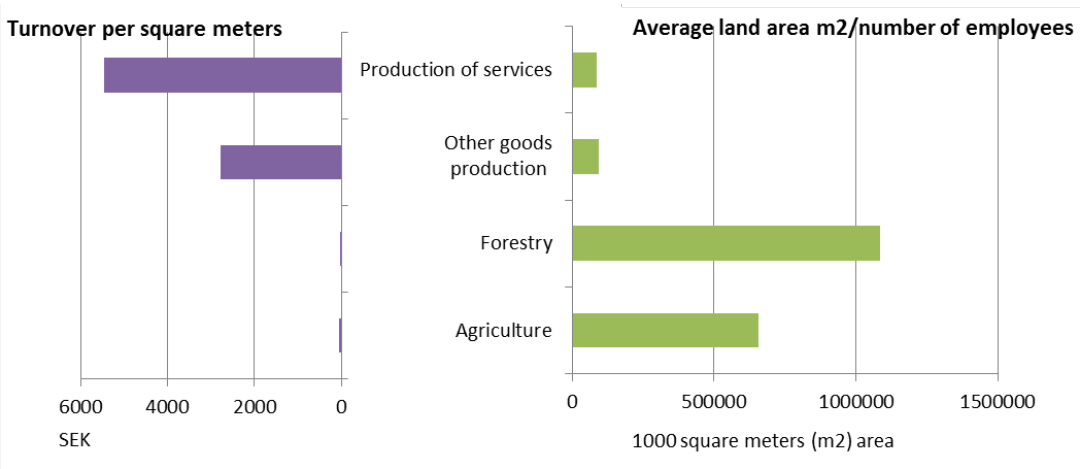


Total area owned by the Trade and industry sector: 12.5 million hectares
Source: 2011 Register of Real Estate Assessment (FTR), Statistics Sweden
Sole proprietors are included in the total for the business sector, regardless of whether their land is private or belongs to their company.

By linking economic statistics, e.g. turnover and employment, with information about the business sector's land ownership, it is possible to illustrate land use in new ways. The diagram below shows the two traditional industries of forestry and agricultural together with the rest of the business sector categorised into service and goods production.

The turnover per square metre of owned land is significantly higher for the rest of the business sector; service production being the highest with a turnover of more than SEK 5 000 per square metre. Forestry and agriculture are both under SEK 100 per square metre. The opposite occurs if we instead look at the average area of owned land in relation to the number of gainfully employed persons. The highest values are then attributed to forestry with over 1 000 000 square metres per gainfully employed person and to agriculture with over 600 000 square metres per gainfully employed person.

Figure 3.4.
Average area per gainfully employed person and turnover per square metre in 2010 for selected industries

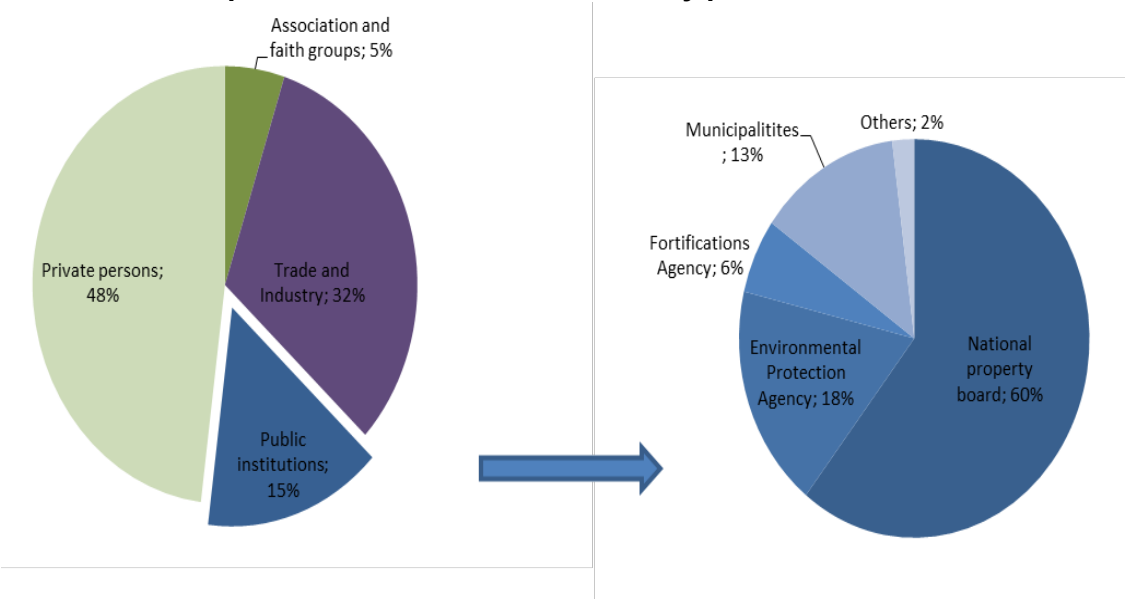


Source: 2011 Register of Real Estate Assessment (FTR), 2010 Structural Business Statistics, 2010 Register-based Labour Market Statistics (RAMS), Statistics Sweden

3.4 Public land ownership

Public sector Sweden, i.e. central government, municipalities, county councils and state-owned enterprises, owns 15 percent of the land area in Sweden. Of this share, the National Property Board owns 60 percent and the Swedish Environmental Protection Agency 18 percent. The third largest owner is the Swedish Fortifications Agency with 6 percent. The municipalities taken as a whole own just under 15 percent of the publicly owned land. Their land ownership is mainly in or close to urban areas.

Figure 3.5.
Public ownership of land in 2010, broken down by public sector actor



Total land area in public ownership: 8.5 million hectares
Source: 2011 Register of Real Estate Assessment (FTR), Statistics Sweden and information from the Swedish Fortifications Agency, the National Property Board and the Swedish Environmental Protection Agency.

4 Industry classification of habitats

This chapter describes how the statistics can be interpreted when they are broken down into the owner's industry classification. In contrast to Chapter 3, all enterprises have been classified into a specific industry regardless of who actually owns the enterprise itself. This means that state-owned enterprises and institutions are classified in the industry according to their activity.

Some economic data is also described here. It provides information on the turnover, number of employees and number of workplaces of the industries that own a certain habitat. This information indicates what the ownership structure looks like. It may be in the form of a certain habitat being mostly owned by a certain industry that has a considerable environmental impact. Or that the statistics have captured many large enterprises that are responsible for a large share of their industry's total turnover.

As regards the properties on the land that has been surveyed, between 90 and 96 percent are farming units depending on the habitat. Ninety-six percent of the forest that constitutes key biotopes is owned by farming units while 90 percent of grasslands are linked to them. A small number of properties that are one- or two-dwelling houses or rental tenure units are linked to Western taiga and wetlands.

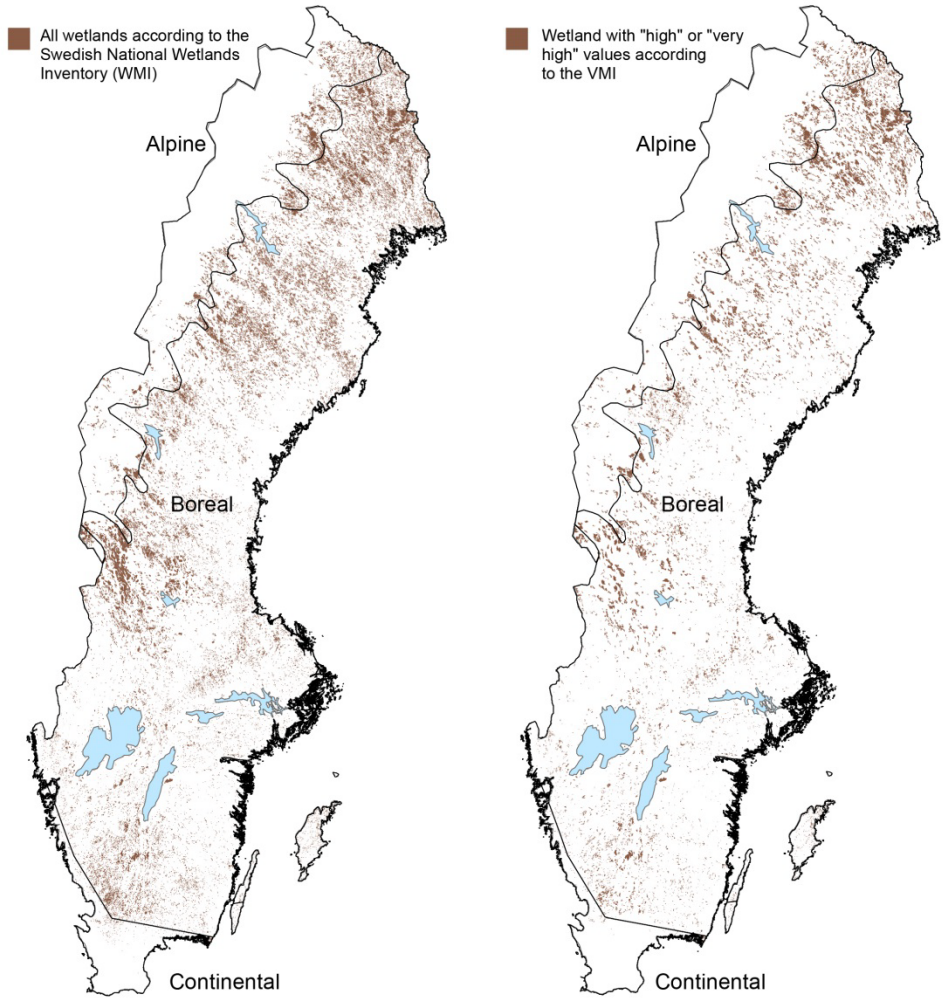
4.1 Wetlands

Sweden is one of the world's ten most wetland-rich countries. Together with the other Nordic countries, we have the most varied composition of wetland types in Europe. Many threatened species are linked to wetlands, especially to alkaline fens and farmed wetlands. Only in northern Sweden however can you still find extensive marshlands unaffected by human impact (SLU, Species Information Centre)

The Swedish National Wetlands Inventory has surveyed an area of 4.3 million hectares, which is about ten percent of the country's total area of 44 million hectares. This survey forms the basis of the results in this chapter as a proxy for wetland-related habitats since a direct translation of the habitats in the Habitats Directive is not possible (more information about the Wetlands Inventory can be found in Chapter 5.1.3).

A large proportion of Sweden's wetlands is covered by the 10 wetland habitats, the status of which Sweden reports in accordance with the Habitats Directive (see Appendix 1 for a list of the relevant habitats). This chapter presents ownership categories for the total area of wetlands.

Map 4.1
Total distribution of wetlands in Sweden, 2010



The map on the left shows the total distribution of wetlands in Sweden in relation to biogeographical regions and the map on the right shows wetlands with a natural value classification of "high" or "very high" in accordance with the 1980-2010 Wetlands Inventory (WMI).
Source: Statistics Sweden's specially adapted version of WMI, Swedish Environmental Protection Agency

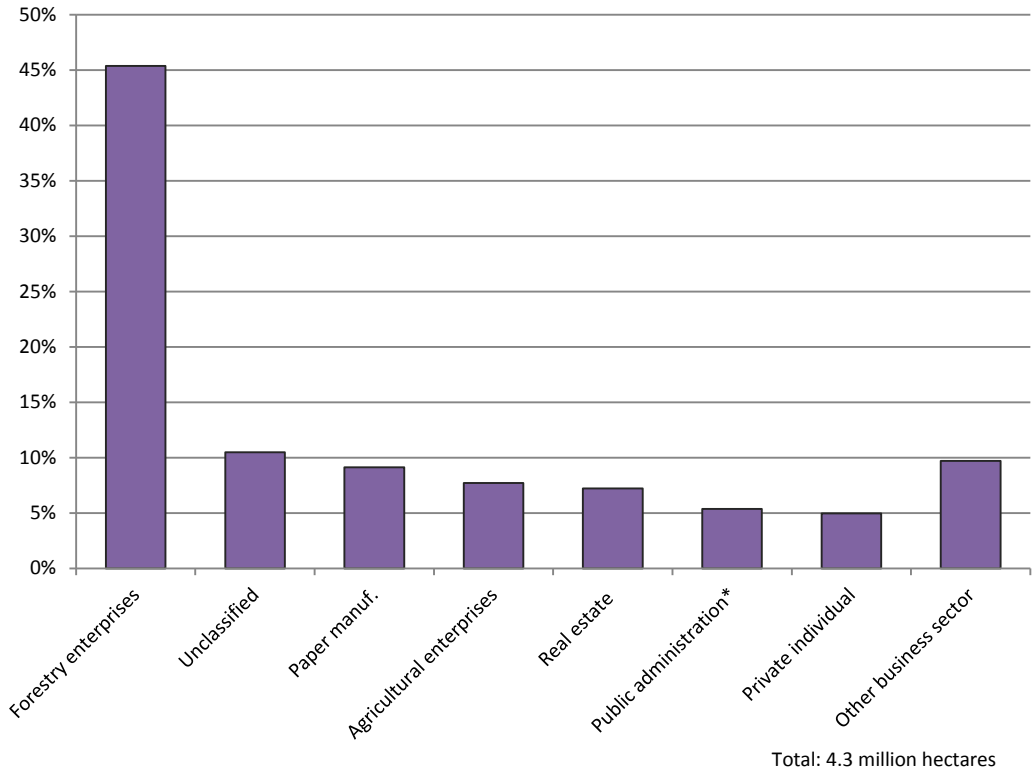
The Wetlands Inventory showed that about 20 percent of the registered wetlands were completed undisturbed. Measures such as ditching, clear-cutting and road drainage had been registered for the remaining 80 percent (Swedish EPA, 2009).

Figure 4.1 shows that it is the business sector and primarily forestry that owns the largest share of wetlands (45 percent of all the wetland area according to VMI). Agriculture, which in practice means single-use agricultural enterprises and not so many mixed-use enterprises (both agriculture and forestry), owns just eight percent of all wetlands. Agencies that own wetlands are relatively limited; just five percent of the wetland area being owned by public administration and defence.

It is interesting to note that the manufacturing industry, in the form of paper and paper products manufacturing, owns nine percent of the

wetlands in Sweden, which is a greater share than for example that owned by the agricultural industry.

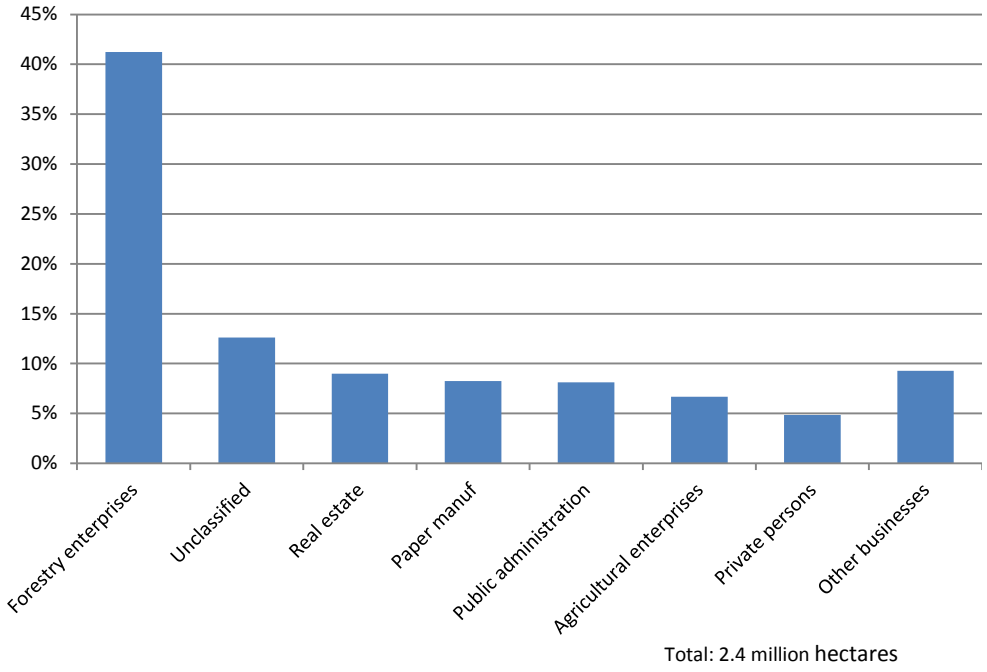
Figure 4.1
Total amount of wetlands broken down by industry owner, 2010, percent, SNI 2007



Source: Statistics Sweden, specially adapted from VMI, FTR, FDB
Note on the figure: *Public administration includes: central government, municipalities, county councils and the Armed Forces.

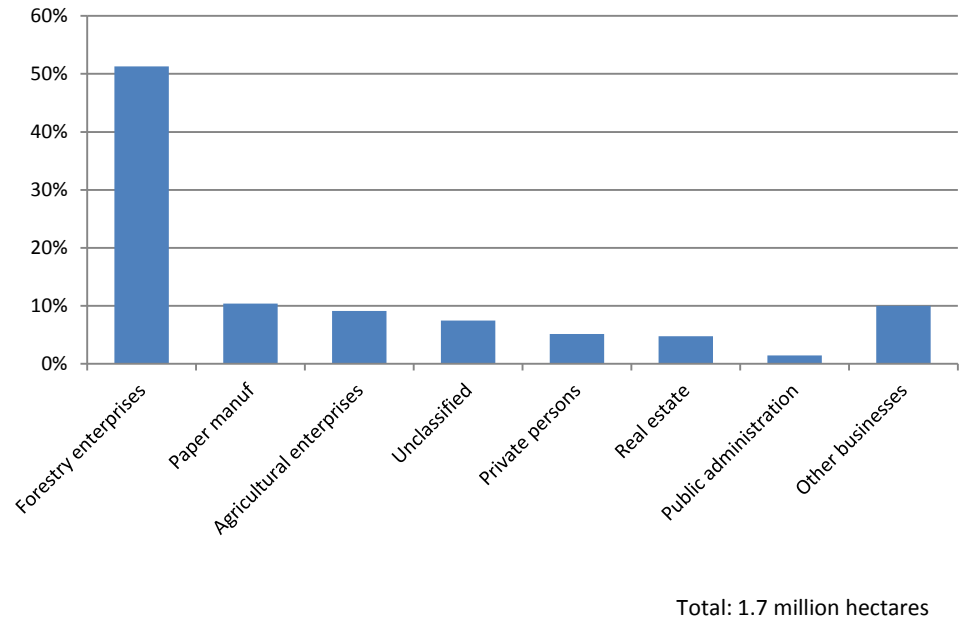
The ownership picture differs slightly as regards the distribution of wetlands by natural value classification. The share of wetlands with high and very high natural values and owned by the forestry industry is slightly lower than for the total as is the total for the rest of the business sector and agriculture. The share of land owned by public administration and defence is higher, eight percent compared to five percent for the total area of wetlands. A general profile of the ownership structure within the forestry industry, e.g. whether the owners are large or small forestry enterprises, and whether there area any special characteristics for the group, is given below.

Figure 4.2
Ownership distribution of wetlands with "high" or "very high" natural values, industry (SNI 2007)



Source: Statistics Sweden, specially adapted from VMI, FTR, FDB

Figure 4.3
Ownership distribution of wetlands with "some" or "low" natural values, by industry (SNI 2007)

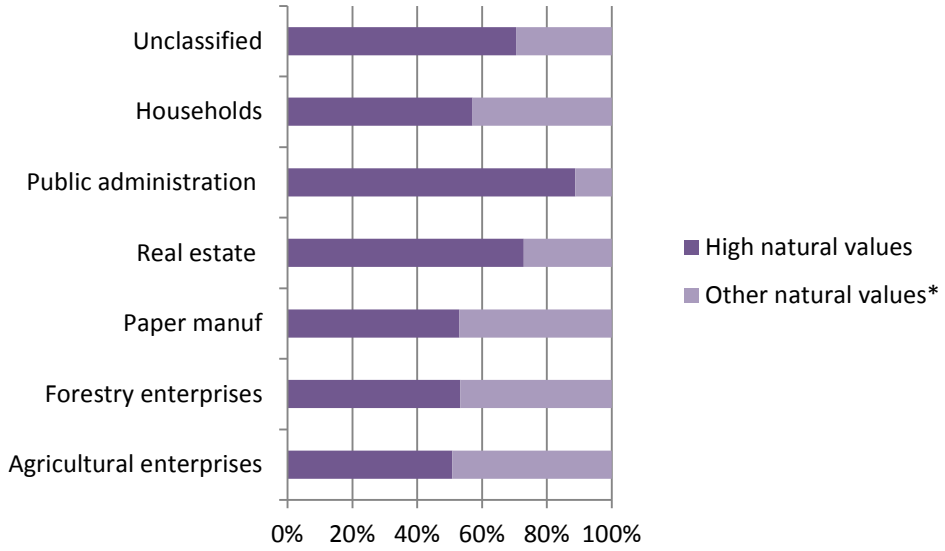


Source: Statistics Sweden, specially adapted from VMI, FTR, FDB

The opposite is true for the natural value classifications "some" or "low". Public administration and defence own a very small share of these wetlands, only two percent, while forestry owns over 50 percent of them.

If we look at how wetland ownership per owner category is distributed between high and low natural values, it is clear that public ownership, in the form of public administration and defence, stands out. Almost 90 percent of their wetlands are classified as having high natural values. The agricultural industry's share of ownership shows that it owns equal amounts of wetlands of both high and low natural value. The National Property Board is for example classified in the Real Estate activities industry.

Figure 4.4
Distribution of wetlands by natural value classification and industry owner (industry SNI 2007)



Source: Statistics Sweden, specially adapted from VMI, FTR, FDB

A feasible explanation for the large share of public ownership of wetlands with a higher natural value classification is that the Wetlands Inventory (VMI) has provided part of the background material on which decisions to establish national parks and nature reserves are based. Wetlands with a higher natural value classification may therefore have been given priority in this work and more of them have hence been transferred to public management. Another contributory factor may be the fact that large wetlands with high natural value classifications are situated in the mountainous regions of northern Sweden, where much of the land is traditionally owned by central government. It must be stressed, however, that the public administration and defence category does not include all public sector owners, only central government, municipalities, county councils and the Armed Forces.

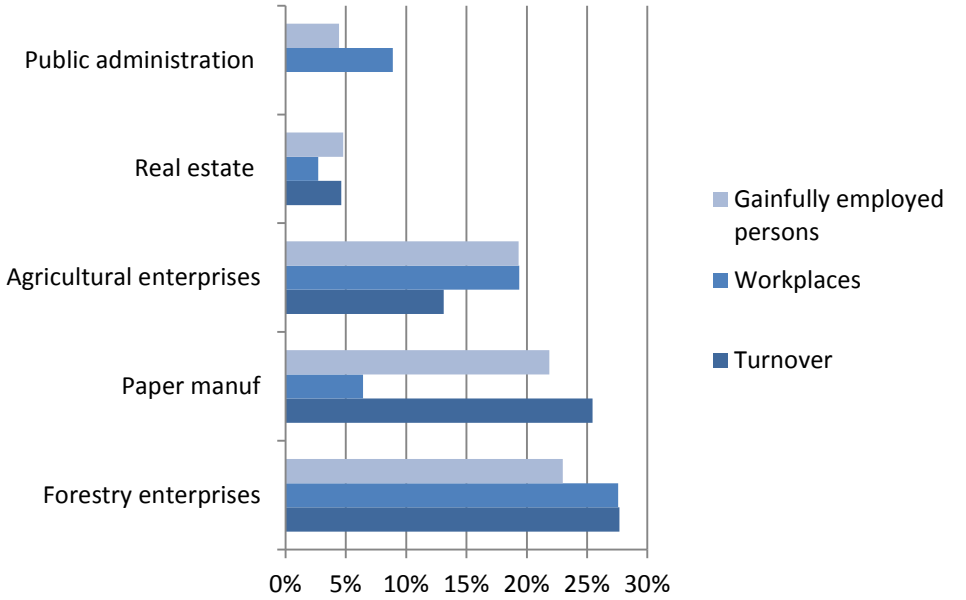
Structure profiles

A picture of the ownership structure is provided based on the wetland ownership statistics. It is also possible to see what the ownership structure

looks like in economic terms. Using this information, a picture is provided showing how large the owners are in comparison with the industry as a whole. It is possible to give an idea of the potential for setting aside resources in order to preserve the habitat in question or whether the habitat is a part of regular production and therefore more important to preserve for a good economic return.

Another picture of whether large or small enterprises own the land can be given via structure profiles. Regarding the manufacture of paper and paper products, it has been shown that 25 percent of the industry's total turnover emanates from enterprises that own wetlands. Together with the fact that the share of workplaces is lower (six percent) and that the share of gainfully employed persons is considerable, we can deduce that the wetlands are owned by large enterprises.

Figure 4.5
Structure profile for owners of wetlands, number of gainfully employed persons, workplaces and turnover, percent of the total industry, 2010



Source: Statistics Sweden, specially adapted from VMI, FTR, FDB and RAMS

Note on the figure: Public administration and defence have no turnover since they are not market producers.

4.2 Forest land

Sweden's forest land makes up about 70 percent of the total land area and amounts to about 28 million hectares. Just over 22 million of these is productive forest land. By virtue of Sweden having a considerable share of Europe's forest area, the country also has a major responsibility for the various forest habitats and their associated species. The Species Information Centre (2014) has adjudged the conservation status for the majority of forest habitats to be poor. The area of the habitats is too small, is decreasing or is growing at far too slow a rate, despite nature conservation

measures to develop and protect the country's forest land. Among the species listed in the European Habitats Directive, the situation is particularly serious for forest-dwelling invertebrates (e.g. fire insects) and mosses. The explanation is believed to be above all a shortage of dead wood and old trees as well as the absence of fire and flooding.

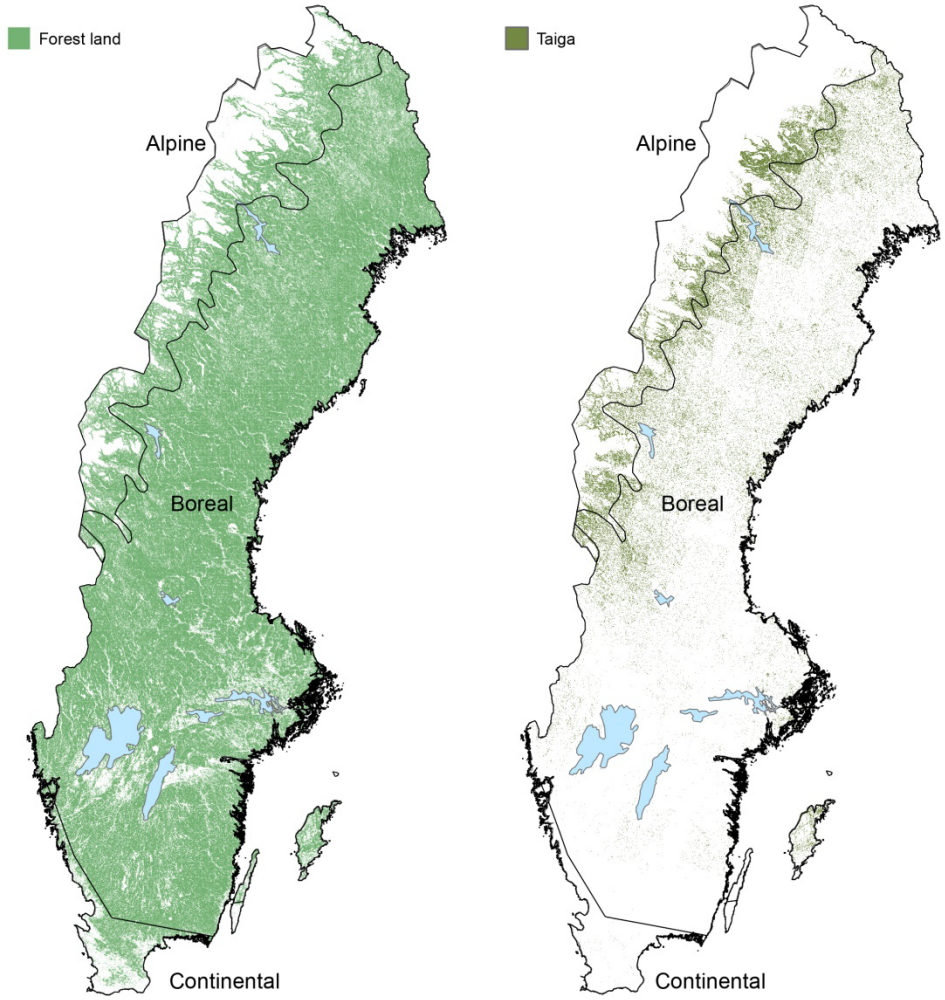
Sweden reports the status of 17 different forest habitats. The most common terrestrial habitat is Western taiga (EU code: 9010). Its area distribution is about 478 500 km^2 and an area of occurrence of 20 714 km^2 (data from the National Forest Tax Assessment and the National Swedish Landscape Inventory; Species Information Centre, 2014).

The analyses in this project are restricted to Western taiga since it has the largest geographical distribution and area of occurrence among terrestrial forest habitats. Furthermore, the data conditions were considered to be the best for this habitat. By using data from the kNN database (Please see the section Data sources for a detailed description), the project did a GIS analysis of the taiga area. The kNN quantifies the area of forest land criteria that fulfils the criteria for Western taiga. The area of Western taiga was identified by combining data on tree types and stand age.

The results from the analysis produced a major overestimation compared to the reported area estimates in the alpine and boreal region (Species Information Centre 2014). The area was, on the other hand, underestimated in the continental region. Despite the overestimation of the relative area of Western taiga, the project still believes it functions well enough in this context as representation for the habitat so that it is meaningful to analyse.

As a supplement to the Western taiga habitat, the Swedish Forest Agency's data on key biotopes has also been analysed. The starting-point will be different here since the key biotopes do not represent a specific habitat but rather a collection of forest-associated habitats that have been identified as being of importance for biodiversity.

Map 4.2
Total distribution of forest lands and distribution of Western taiga, 2010

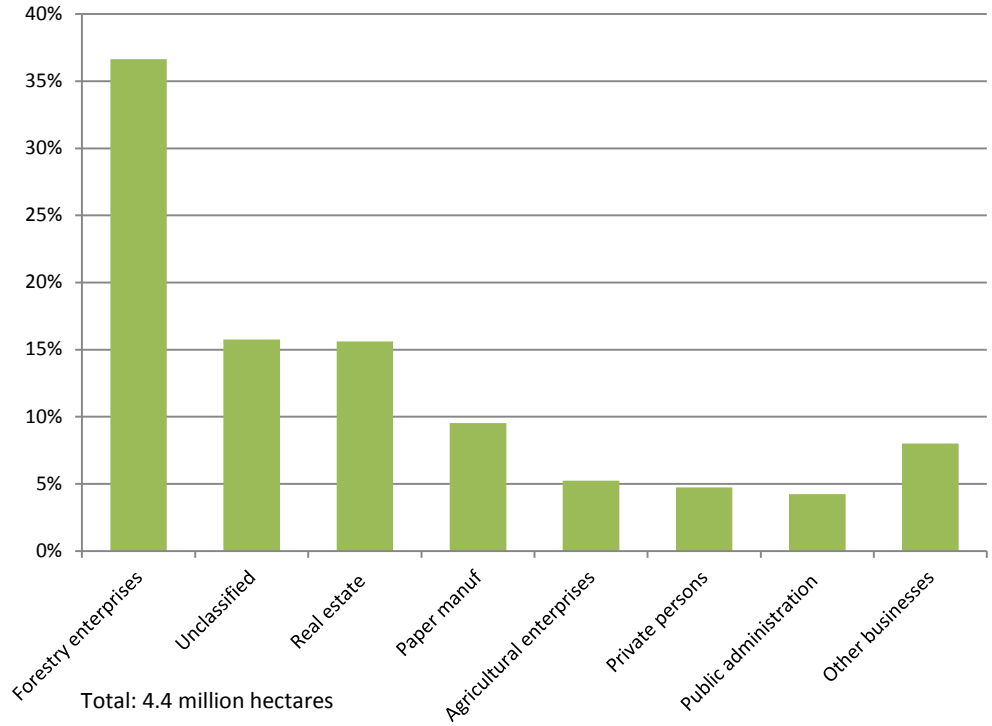


The map on the left shows the total distribution of forest land in Sweden in relation to biogeographical regions and the map on the right shows Western taiga (according to analyses in this project).
Source: Cadastral map and road map, Lantmateriet and adaptation of the kNN database, SLU

Who then owns the Western taiga? The total ownership picture is generally very similarly to the picture for wetlands ownership. As is the case for wetlands, forestry is the largest owner category - 37 percent. Its share of Western taiga ownership is slightly smaller than its share of wetlands ownership, however. The biggest difference compared to the distribution of wetlands is the major share owned by real estate companies and managers, of which state-owned real estate companies have a major proportion, and the large share whose owners have not been classified. Both have a 16 percent share. Part of the explanation for this is that Western taiga as a habitat (according to the adaptation of the kNN database) is more spread out geographically than wetlands in VMI and occurs in smaller stands in or close to urban areas on land that is owned by different industries and households. It may be a question of stands on industrial sites or on large properties connected to residential houses and holiday homes. This is

particularly true in the Stockholm archipelago and on Gotland. These areas of Western taiga are particularly interesting as they are not covered by the instruments for protection and environmental concern that are normally linked to the forest sector.

Figure 4.6
Share of Western taiga ownership by industry, 2010, share of total area of Western taiga, per industry (SNI 2007)



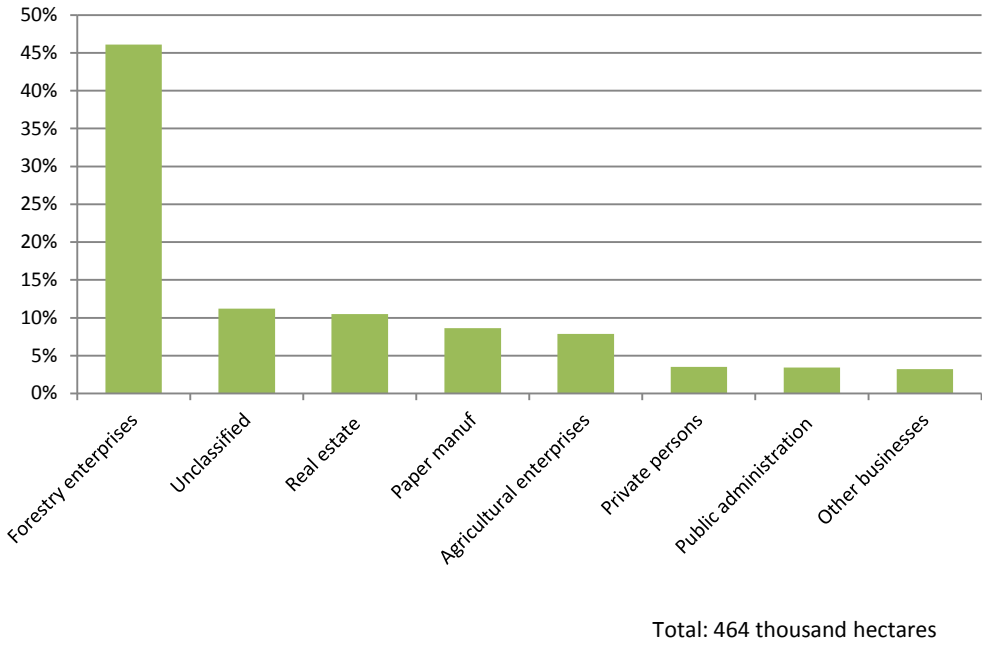
Source: Statistics Sweden after special adaptation of kNN, FTR, and FDB

4.2.1 Areas of key forest biotopes in Sweden

An analysis of the area of key biotopes gives a partially different picture than the one for Western taiga. Here, the share of ownership linked to forestry is considerably larger and the items for unclassified business sector and unclassified households are significantly smaller. As Western taiga represents a habitat whereas key biotopes on the other hand represent a sample of biologically important forest, regardless of the forest habitat, the two quantities are not comparable. Another difference between the different data sources is that key biotopes are identified in the field and more stringently defined in contrast to Western taiga, which in our case consists of a satellite image interpretation combined with estimated parameters.

It is quite clear that the highest values in terms of key biotopes are to be found on land owned by the forestry sector. This is natural based on the fact that forestry also utilises a relatively large share of the total forest land.

Figure 4.7
Share of ownership of key biotopes by industry, share of total area of key biotopes, per industry (SNI 2007)



Source: Statistics Sweden after special adaptation of Swedish Forest Agency, FTR, and FDB

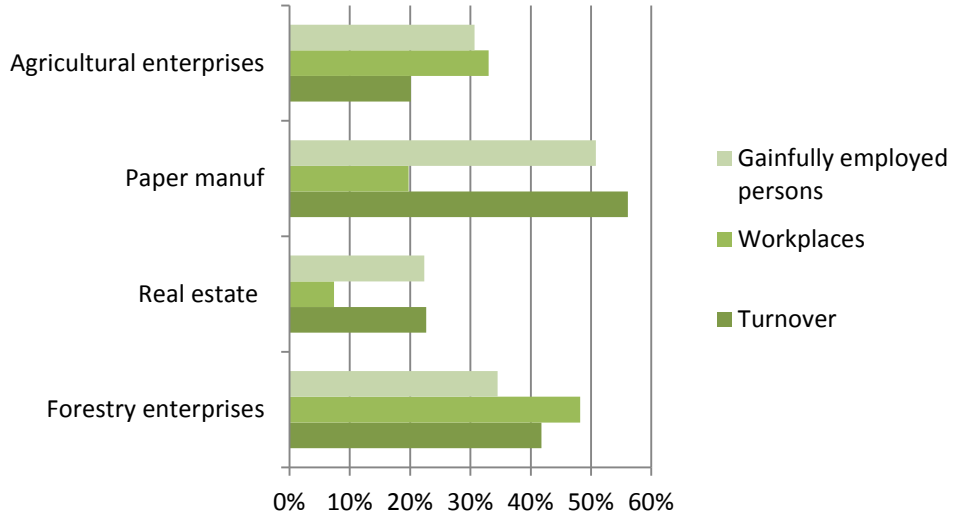
Structure profiles

As for wetlands, it is possible to identify the owners of both Western taiga and key biotopes. This example focuses on a structure profile of Western taiga owners

Figure 4.8 makes it clear that forestry enterprises that own land with Western taiga are responsible for 42 percent of the turnover, compared to the entire forestry industry. It is however in the paper and paper products manufacturing industry that the largest share of enterprises own land with Western taiga - 56 percent. A reasonable explanation may be that paper and paper product manufacturing facilities are located in close proximity to forest land, i.e. close to the main product. It is also clear from the figure that large enterprises are those who own the land as there are few workplaces compared to the number of gainfully employed persons.

Despite forestry owning the majority of the land with Western taiga, those who own the land are not so large compared to the industry itself. The structure indicates that it is mostly small enterprises that own Western taiga as the distribution of workplaces is higher than both the number of gainfully employed persons and the turnover.

Figure 4.8
Workplaces, gainfully employed persons and turnover Western taiga owners, share of Sweden, by industry (SNI 2007)

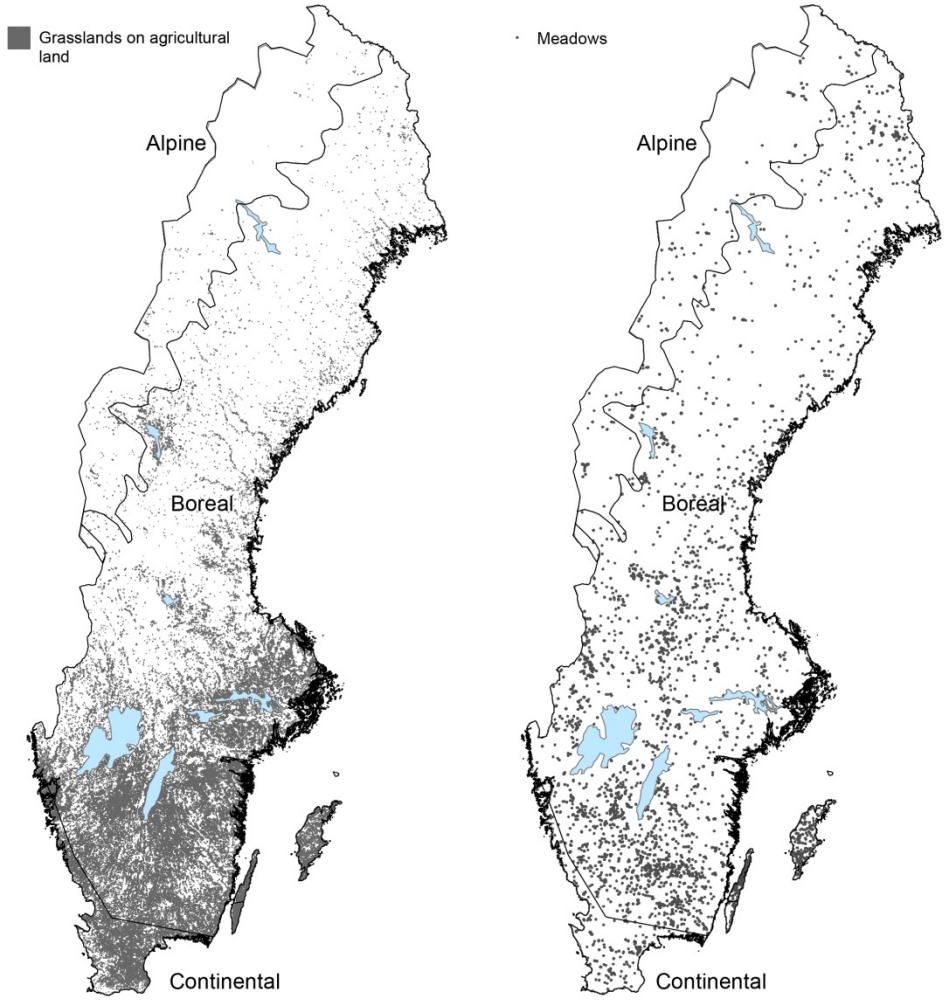


Source: Statistics Sweden after special adaptation of kNN, FTR, FDB and RAMS

4.3 Meadows and grazing land

Most meadows and grazing land habitats are linked to the arable landscape even though there are relatively large areas of naturally occurring grass-covered land in other landscapes. Natural heathland, grassy heaths and herb meadows can in particular be found in the mountains with the strongest concentration in Norrbotten County. The natural grass-covered land amounts to roughly 3.2 million hectares and meadows and grazing-land linked to the arable landscape amount to almost half a million hectares. A small percentage of the grasslands in the arable landscape are of high biological value. In the Swedish Board of Agriculture's meadows and grazing-land inventory, around 288 000 hectares are adjudged to be of such high value that they require higher levels of compensation. About 64 percent of the total area of grasslands is linked to the arable landscape.

Map 4.3
Total distribution of grasslands on agricultural land and distribution of meadows, 2010



The map on the left shows the occurrence of all grasslands linked to the arable landscape in relation to biogeographical regions and the map on the right shows the occurrence of meadows. The surfaces have been converted into points so that the meadows can be seen on the current map scale.
Source: Blockdatabasen and the Meadows and Grazing Land Inventory (TUVA), Swedish Board of Agriculture.

Most grassland-associated habitats have decreased considerably and been fragmented as the small-scale and very varied cultivation methods of the old farming community have been gradually replaced by modern agriculture and forestry, with large units and well-defined boundaries between different types of land (Sohlman, 2008).

The status of most grassland-associated habitats is therefore considered to be poor, as is the status of many of the species associated with them. The main reason is that these habitats now occur very rarely and very fragmented, in addition to them being of low quality due to the land no longer being farmed, problems with nitrogen deposition and poorly

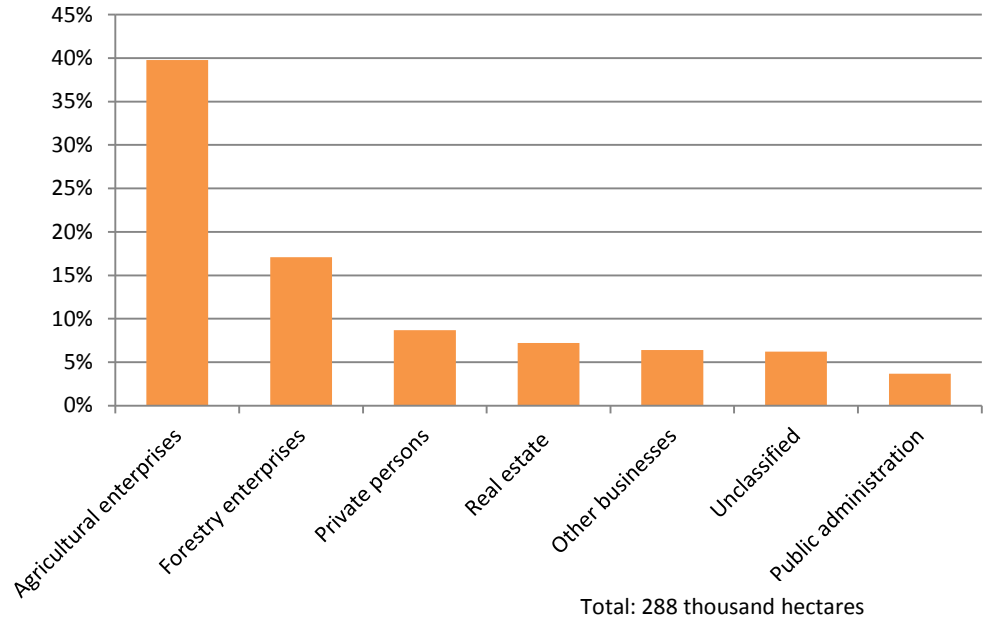
adapted management. The situation is similar in all biogeographical regions, even if there are certain differences. The problem of discontinued farming is greatest in the alpine and boreal regions while eutrophying nitrogen deposition from air pollution causes most problems in continental regions (Sohlman, 2008).

Sweden reports the status of 14 different grassland habitats, of which lowland siliceous grasslands (EU code 6270) have the widest area of distribution and occurrence according to the Species Information Centre. Humid meadows (EU code 6410) also have a wide area of distribution and occurrence. We have therefore chosen to analyse these two habitats in the project. Since hayfields and meadows are among the most threatened categories of grassland-associated landscapes, we have chosen to analyse them as well. Due to small areas of distribution and occurrence, we have decided to look at all kinds of meadows together (i.e. according to TUVA) and not divide them up in accordance with the Habitat Directive.

In the same way as we can expect much of the Western taiga to be linked to forestry, it is also reasonable to expect much of the total area of meadows and grazing land to be linked to agriculture.

Figure 4.9 clearly indicates that this is the case. About 40 percent of all meadows and grazing land reported in the TUVA database can be linked to agriculture. A relatively large share, 17 percent, can also be linked to forestry. In this case, it is very likely that forestry is represented by combined agriculture and forestry.

Figure 4.9
Share of all meadows and grazing land ownership by industry, 2010, (SNI 2007)



Source: Statistics Sweden after special adaptation of TUVA, FTR, and FDB

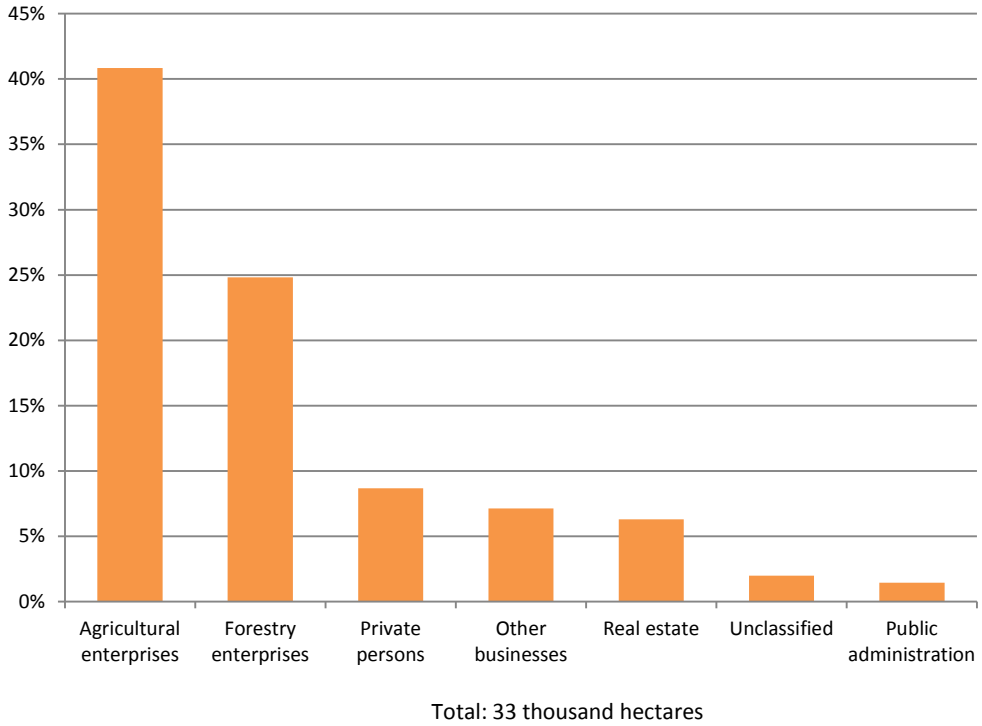
If we look on the habitat level, the picture is slightly different. Figure 4.10 shows the distribution of siliceous grasslands. They have the same share connected to agriculture as grasslands in general but a markedly larger

share connected to forestry, 25 percent compared to 17 percent for the total area of meadows and grazing land. If we look at meadows, this pattern is even more accentuated. Figure 4.11 shows the distribution of all meadows according to the TUVA database. As is the case for siliceous grasslands, the percentage of forestry is similar but agriculture only owns 26 percent.

We can assume that the higher share of forestry for both siliceous grasslands and meadows is partly due to the fact that this type of grasslands occurs more commonly on smaller farming enterprises whose activities are more focused on a combination of agriculture and forestry. The link between meadows and small-scale agriculture, not least in border areas, has been established before although it cannot be discerned from the statistics compiled in our project.

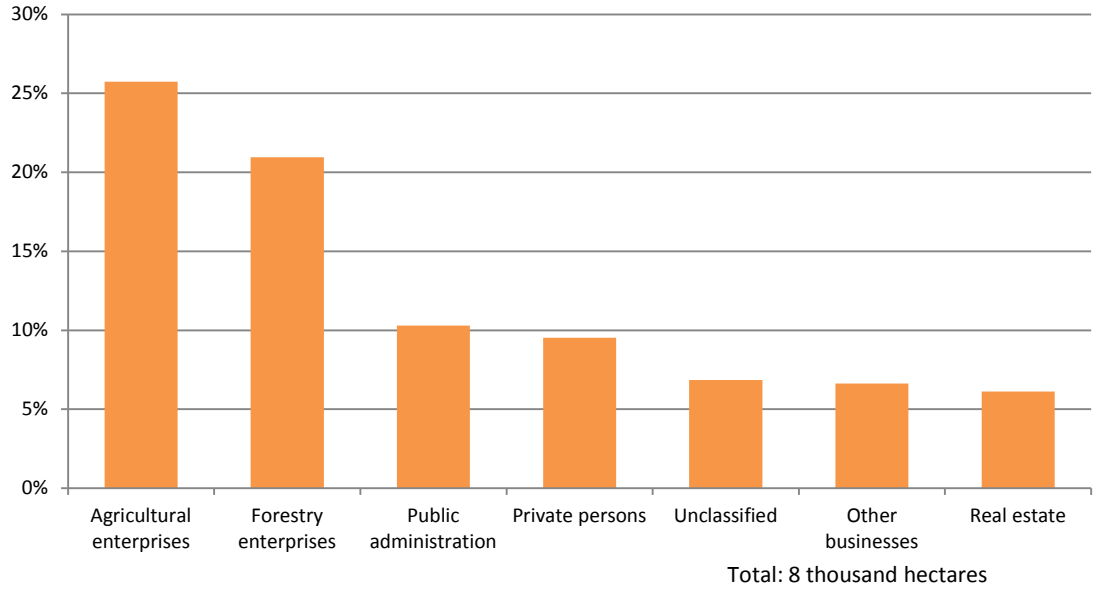
Matching with further data from the Register of Real Estate Assessment (FTR) might shed light on the link between the occurrence of meadows and the size of farming units to which the meadows are linked. There has not been any scope for this within our project, however.

Figure 4.10
Share of siliceous grassland (EU code 6270) ownership by industry, 2010, share of total area of siliceous grasslands, per industry (SNI 2007)



Source: Statistics Sweden after special adaptation of TUVA, FTR, and FDB

Figure 4.11
Share of meadow ownership by industry, share of total area of meadows, per industry (SNI 2007)



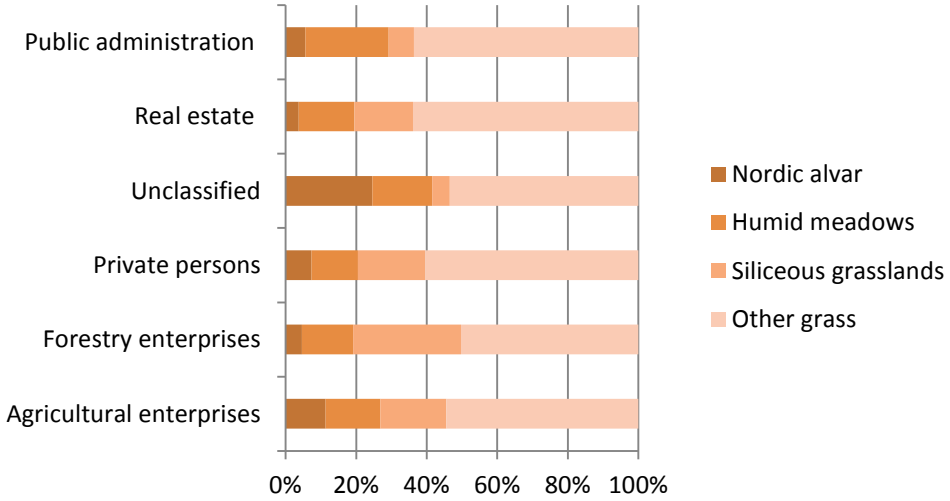
Source: Statistics Sweden after special adaptation of TUVA, FTR, and FDB

There is reason to consider what the distribution of the selected grassland types looks like within each industry respectively, as this provides information on what the industry-wise distribution of the grassland types looks like.

Figure 4.12 shows that, in e.g. agriculture, holdings of grasslands are dominated by the Other grasslands category, i.e. those that are not Nordic alvar, siliceous grasslands or humid meadows. The industry that owns the largest share of siliceous grasslands is forestry, followed by businesses that have not been possible to categorise, households and then agriculture.

The group that has not been possible to categorise owns the biggest share of Nordic alvar.

Figure 4.12
Ownership structure of grasslands in accordance with the Habitat Directive, share of total grasslands and meadows, 2010, by industry (SNI 2007)



Source: Statistics Sweden (FTR, FDB) and Swedish Board of Agriculture (TUVA),

Much of the Species Information Centre reporting is based on data from the Meadows and Grazing Land Inventory (Swedish Board of Agriculture's TUVA database), which in terms of scale and design is well suited to matching with properties. It has, however, not been possible in the project to completely reconstruct the area measurements reported to the Habitats Directive since the Species Information Centre has added data from other sources that could not be used.

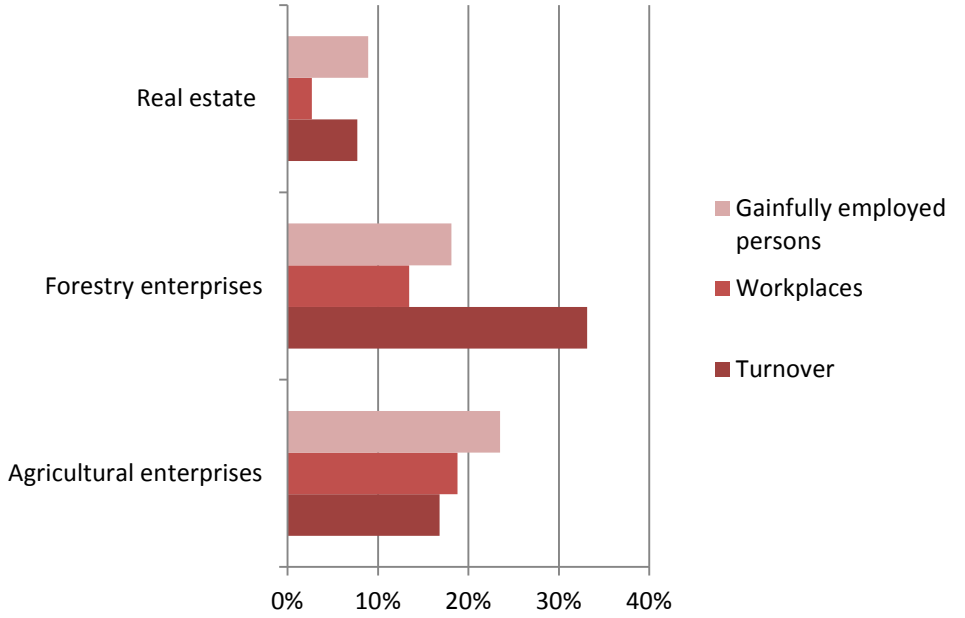
Structure profiles

As for wetlands and Western taiga, it is possible to identify the owners of grasslands. This example focuses on a structure profile of owners of all grasslands according to TUVA.

Figure 4.13 makes it clear that forestry enterprises that own meadows and grazing land are responsible for 33 percent of the turnover, compared to the entire forestry industry. The statistics show that large enterprises are captured with a high employee-to-workplace ratio.

A relatively large proportion of those working in agriculture in Sweden own meadows and grazing land. Despite this, they are only responsible for a small share of the turnover and workplaces, which indicates that the ownership structure includes many small enterprises.

Figure 4.13
Structure profile for total meadows and grazing land 2010, distribution of gainfully employed persons, workplaces and turnover in the industry in total, (SNI 2007)



Source: Statistics Sweden's special adaptations of TUVA, FDB, RAMS and FTR

5 Method and data sources

The project aims to examine the scope for producing new statistics on land use and habitats that are particularly relevant for the conservation of biodiversity and to adapt this to the industrial classification (SNI 2007) in the environmental accounts. There are currently several different ways of classifying land.

This project primarily examines how categories of land could be linked to economic actors or to threatened species.

The work follows two parallel tracks:

One of these attempts to identify the actors whose actions affect the conditions for biodiversity. Actors can in this case be landowners subdivided into categories such as enterprises, public institutions or private persons. The project also examines the extent to which and the precision with which the actors can be linked to land ownership both economically and geographically. An analysis has also been performed based on which industry these actors belong to, i.e. what business activity is conducted by those who own the important land.

The other track examines physical reality in the form of land use structures and habitats. In a similar way to the first one, this track examines the extent to which biodiversity can be described qualitatively and geographically. The issues discussed include whether there is data on relevant land use categories, species and habitats with an adequate level of detail or whether it is necessary to use other types of data (proxy data).

The next step is for these two tracks to converge, i.e. it should be possible to link data on the type of land use and the occurrence of a particular habitat to data on the various actors in order to produce statistics in the environmental accounting system. For certain habitats , this linkage can be fully achieved. For others, the data is not sufficiently complete. Some counties have performed more complete surveys that can show where there is potential to link the data in those parts of the country where there is currently a lack of usable data.

5.1 Data sources

As is described above, the aim has been to use data on some of the habitats included in the Habitats Directive and whose status is reported by Sweden to the EU. This required eight different databases that were matched using the method described in more detail below and which consists of map data, registers, inventories and sample surveys.

Table 5.1
Overview of data sources for habitats used in the project

	Forest land	**Meadows and grazing land**	**Wetlands**
Data	kNN database Inventory of key biotopes (both the Swedish Forest Agency's own inventory and those done by individual forest companies) The Business Register The Register of Real Estate Assessment (FTR) RAMS	Tuva 1 - Complete Meadows and Grazing Land Inventory Tuva 2 - All habitat-classed sites in the Meadows and Grazing Land Inventory The Business Register The Register of Real Estate Assessment (FTR) RAMS	The Wetlands Inventory (VMI) The Business Register The Register of Real Estate Assessment (FTR) RAMS
Coverage	National	National	National
Equivalent habitat according to the Habitats Directive	Western taiga	Siliceous grasslands Humid meadows Nordic alvar Meadows have also been examined altogether. Though without being linked to habitat in accordance with the directive	No, not a habitat
Producers	SLU Swedish Forest Agency Statistics Sweden	Swedish Board of Agriculture Statistics Sweden	Swedish Environmental Protection Agency Statistics Sweden
Comments	Average age of stand in combination with tree type data. Simplified assumptions have resulted in an overestimation of the area.	Habitat codes in the Meadows and Grazing Land Inventory have been used for the sample of habitats.	No translation to habitats according to the Habitats Directive possible using VMI as a basis. The entire VMI has formed the basis of the area breakdown and natural values classification.

5.1.1 KNN-Sweden 2010 (forest)

kNN-Sweden 2010 is a nationwide database containing data on Sweden's forests, the aim of which is to provide forest information free of charge. The database is maintained by the Department of Forest Resource Management at SLU. The basic format is raster-based digital maps with a high degree of detail that cover the majority of Sweden's forest land.

The estimated variables are growing stock per hectare, average age of stand, average height and biomass (above and below ground added together). Regarding growing stock, there are raster layers with estimates of tree types as well as of the total growing stock.

The kNN Sweden database has been developed by combining field data from the National Forest Assessment (RT), random sample inventories and comprehensive data from satellite images. A method called kNN (k nearest neighbour) is used to estimate the values of the satellite image pixels, hence the name of the database. The estimates have only been made for forest land in accordance with the delimitation in the Lantmateriet (National Land Survey) road map. For a more detailed description of the kNN databases, please visit: http://www.slu.se/sv/centrumbildningar-och-projekt/riksskogstaxeringen/tjanster-och-produkter/interaktiva-tjanster/slu-skogskarta.

With the help of variables in kNN-Sweden, it is possible to calculate some of the habitats listed in the Habitats Directive. The project has used kNN-Sweden in an attempt to recreate the habitat *Western taiga* by combining data on tree type and average age of stand.

As part of the MOTH project (Demonstration of an integrated North-European system for monitoring terrestrial habitats), which is a system for assessing habitats and which has assisted in the reporting to the Habitats Directive, an instruction manual for habitat assessment has been produced. According to the manual, one of the natural criteria for forest-clad habitats is at least 40 years older than the "lowest recommended final felling age". This age varies from region to region and depends on the tree type. In the project, we have simplified the delimitation and let pixels with the occurrence of spruce or pine in combination with an average age of stand of 100 years represent *Western taiga* according to the Habitats Directive definition. Compared to the area data reported to the EU, our delimitation leads to a substantial overestimation of the area of *Western taiga.*

Even though the basic data can be found in raster grids equivalent to 25 x 25 m, kNN-Sweden is primarily supposed to be used in slightly larger forest areas as part of the method is based on estimates from the National Forest Inventory's sample areas. If the area is less than a few hundred hectares, the data should be used with caution. Being aware of the limitations of the database, we have nevertheless elected to match the data with property areas. This is due to the fact that there is no alternative to kNN.

5.1.2 Key biotopes (forest)

Key biotopes are forest areas with very high natural values. They play a key role in the preservation of threatened forest flora and fauna. A key biotope is an area with a special habitat that is of considerable importance to forest flora and fauna and has the right conditions to give protection to threatened and red-listed species. A forest area can be a key biotope because it has a special history or because of rare ecological conditions. Some key biotopes only occur in certain types of terrain such as shoreline forests, ravines and screes.

The Key Biotope Inventory has been performed across the country using a common method. Just over 50 different types of key biotopes have been defined. When performing the inventory, all areas have been assessed, defined and described in the field by specialist personnel. Fieldwork is preceded by extensive preparations, the aim of which is to narrow down

the number of feasible key biotopes in several different ways. One step in the preparations is to interpret aerial photographs and satellite images. Studies of geological and historical maps can also provide important information, as can reviews of old ecological inventories.

After the fieldwork is completed, the collected data is registered in a database at the Swedish Forest Agency. The surveyed areas are represented in the database in the form of polygons with accompanying descriptions. The polygons are relatively accurately defined which enables them to be matched with properties.

The habitats in the Key Biotope Inventory do not correspond directly to the definitions of habitats in the Habitats Directive even though it is possible to make selections from the database that tally to a certain extent. All key biotopes have been included in the analysis, i.e. without considering which forest habitat they represent.

There are two different types of source data for the key biotopes; one for the inventory performed by the Swedish Forest Agency and one for the inventories done by the large forest companies themselves on their own land. Both data sources have been used in the calculations.

5.1.3 The Wetlands Inventory (VMI)

The National Wetlands Inventory (VMI) has taken stock of Sweden's lowland wetland assets for 25 years. In total, VMI has examined 35 000 units with a total area of 4.3 million hectares, which is 10 percent of Sweden's total surface area. The aim of the inventory has been to create a knowledge bank of the country's wetlands that can be used for environmental monitoring and nature resource planning. The idea was also to use the inventory data as background information as a basis for authorities to make decisions on drainage and clear-cutting matters.

The VMI defines wetlands as: "Areas of land where water is present directly under, on or directly over the surface for most of the year, and vegetation-clad water areas. At least 50 percent of the vegetation should be hydrophilic, i.e. have a special affinity to water, for an area to be defined as a wetland. An exception are intermittently drained lake, sea and watercourse bottoms that are counted as wetlands even though they lack vegetation. For practical reasons, only large lowland wetlands have been examined; all wetlands in northern Sweden over 50 hectares and mainly wetlands in southern Sweden over 10 hectares. All wetlands included in the inventory (sites) have been examined from aerial photographs and classified in terms of their natural values. In total, 12 percent of the wetlands have been visited in the field to provide additional information about their natural values. From the aerial photographs, all the wetlands were classified into one of the 47 different wetland types.

The wetland classification in VMI does not correspond exactly to the habitat definitions in the Habitats Directive and it therefore not possible to use VMI as a basis for classifying the habitats in the Directive by owner and industry. Another problem is that the sample of sites in VMI is weighted towards larger wetlands (at least 10 hectares). We have therefore decided to

use VMI as general proxy data for wetland-related habitats that are important for biodiversity.

The wetlands in VMI are classified into "conservation classes". In this report, the conservation classes "High natural values" and "Other natural values" have been used. Appendix 2 provides a general description of the natural values classification.

1. High natural values ('Very high natural values', 'High natural values')
2. Other ('Some natural values', 'Low natural values' and 'Unknown natural values')

5.1.4 Meadows and Grazing Land Inventory (TUVA)

The Swedish Board of Agriculture performed an inventory of Sweden's meadows and grazing land in 2002-2004. The inventory continued on a smaller scale between 2007 and 2013. In this later inventory, new land areas were examined and a selection of land areas were revisited. The inventory covered all land areas that were entitled to the higher level of compensation in the environmental compensation scheme for the preservation of grazing land and hay meadows. Furthermore, all land areas given a high classification in the meadows and pastures inventory of the 1990s were visited. In addition, other land areas were included that Sweden's county boards had identified as having high natural and cultural values. The results have been combined in the TUVA database. TUVA contains data on the natural and cultural values of 229 000 hectares of grazing land, 6 700 hectares of meadows and 35 000 hectares of land for restoration. For a more detailed description of the TUVA database, please visit:
http://www.jordbruksverket.se/etjanster/etjanster/tuva.4.2b43ae8f11f6479737780001120.html.

There are two different versions of the TUVA database. One version that contains all the land areas visited as part of the inventory up to the end of 2013. The database includes land areas that have been fully examined, areas that are restorable and areas that are no longer relevant. The attribute tables contain field ID, inventory date, area, soil type, cultivation class, tree cover, number of valuable trees, number of indicator species, cultivation status and links to individual site reports. Only fully examined land areas are included in the *Meadows and Grazing Land Inventory - Habitats.* In this version, the examined land areas are broken down so that each habitat, in accordance with the Habitats Directive, has its own surface area. We have used both versions of the TUVA database in the project.

Even if the TUVA database in the form of the *Meadows and Grazing Land Inventory - Habitats* contains habitat data that adheres to the definitions in the Habitats Directive, TUVA does not provide a complete picture of the occurrence of habitats since habitats that are located outside the agricultural landscape are not included. In other words, the figure obtained by adding up the areas per habitat in the TUVA database is not the same as the figure reported to the EU. The Species Information Centre uses the TUVA database as background material but then supplements and adapts it accordingly.

5.1.5 The Register of Real Estate Assessment (FTR)

In accordance with the Real Estate Assessment Ordinance (1993:1199), Statistics Sweden has the task of establishing and publicly declaring the results of general, simplified and special real estate assessments. A register of real estate assessment is maintained at Statistics Sweden for this purpose. The Register of Real Estate Assessment (FTR) is a base register for statistics production and as such shall be used to provide a description of the country's real estate stock. According to provisions in the Real Estate Assessment Ordinance, the Swedish Tax Agency must, no later than 31 October in the year of assessment, send the data required to compile the results of general, simplified and special real estate assessments. The primary data is retrieved from the decisions made by the local tax authorities. The National Tax Office extracts the data from the databases in the real estate assessment system. Changes made due to reassessments done after the data has been extracted are not included in the statistics.

Data on legal form and ownership category is retrieved from the Statistics Sweden Business Register (FDB). The data is processed by Statistics Sweden and stored in a database,

the Register of Real Estate Assessment at Statistics Sweden, containing data on all the country's assessment and valuation units. The data covers, among other things, the type of assessment unit (e.g. one- or two-dwelling building, multi-dwelling building, industrial unit, agricultural unit, etc.) as well as area, type of ownership and ownership structure. The FTR was transferred to digital format in the 1980s. The first "structured" versions of the FTR date back to the mid-1990s, which gives us a good opportunity to study changes in urban land-use and development over time. Using codes, the data can be linked to properties and then to a geographical link to the property layers in the GSD Property Map (see below for more details). The FTR has also been used in the broader processing of data for the various habitats.

5.1.6 GSD Property Map layers

The GSD Property Map is based on Lantmäteriet's fundamental geographical databases, in which data of varying quality has been collected on location accuracy, content and topicality. The Property Map is the most detailed map available in Sweden on the national level. It contains, among other things, data on buildings, types of land and property classification. It is regularly updated. For more detailed information on the GSD Property Map, please visit: http://www.lantmateriet.se/Kartor-och-geografisk-information/Kartor/Fastighetskartan/GSD-Fastighetskartan-vektor-.

The map layers with property classification do not in themselves contain any data on type of ownership, owner or assessment. Using unique codes, however, data from the Real Estate Assessment Register (FTR) can be linked to the property classification. The layers of the Property Map, supplemented with data from FTR, form the basis for processing all the habitats in the project.

5.1.7 SCB Business Register (FDB)

The SCB Business Register (FDB) is a register of all the enterprises, authorities, organisations and their workplaces. FDB plays a central role as a sample framework and coordination instrument for statistical production at Statistics Sweden. This is particularly true regarding economic statistics. In accordance with parliamentary decisions, Statistics Sweden has had the task of maintaining a register of enterprises and their workplaces since 1963.

FDB 2010 has been used for this study. The database contains information on approximately 1.4 million workplaces, distributed among nearly 1.3 million corporate ID numbers. Apart from location (address), there is also information on each company's industrial classification and workplaces in accordance with the Swedish Standard for Industry Classification (SNI 2007). The industry classification is crucial in order to be able to classify land ownership by industry. Information on land owners in the Register of Real Estate Assessment (FTR) is matched with FDB in order to be able to add an industry code in cases where the real estate owner is an enterprise, an authority or an organisation. In this way, the business sector's ownership of different habitats can be analysed. Economic variables, such as turnover, are also retrieved from the FDB.

5.1.8 Register-based Labour Market Statistics (RAMS)

The register-based labour market statistics provide information every year on employment among the Swedish population both nationally and on the regional level. Employment is described in terms of gainful employment, industrial classification and commuting. The statistics also provide information on the workforce structure in enterprises and at workplaces and they can shed light on labour market events and flows.

The basic data in the survey is information on the individual's gainful employment or business activities as well as any associated details. The most important source for this information is tax authority registers. Information on employment can be found on the earnings statements that every employer is obliged to submit to the Tax Agency for anyone who has been paid a gross salary or other form of compensation during the year.

In contrast to many other business variables, such as turnover and value added, employment via RAMS can be directly linked to a specific workplace instead of just to an enterprise as a whole, which makes it easier to produce regional statistics.

There are several employment variables in RAMS. This study uses two of them: gainfully employed persons and number of jobs. Gainfully employed persons are people aged between 16 and 74 registered on the population register with a main job while number of jobs is all jobs that have led to a salary or income from business activities regardless of the extent of the work and the age of the person involved. Gainfully employed persons is the variable normally used in statistical contexts while the number of jobs variable is broader in its definition and therefore includes more, which can be useful when estimating the number of persons who e.g. own small businesses but don't have it as their main job.

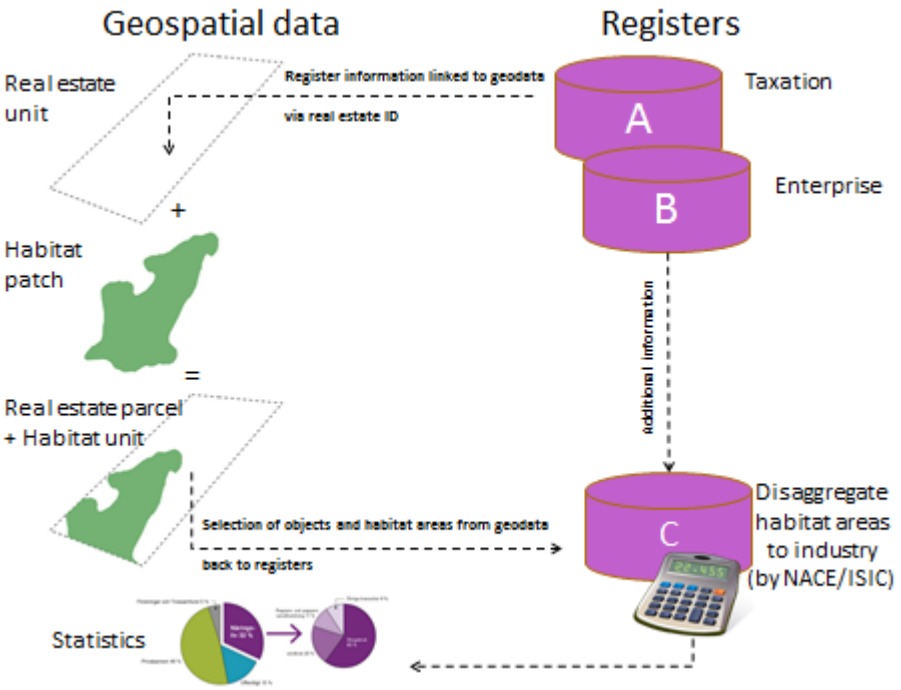
5.2 The method

The basis of the method is the matching of data on habitats with register data on ownership, industries and enterprises. This matching is done with the help of geographical analysis on a low geographical level. The conditions needed to be able to match a certain habitat with data on ownership and industry are as follows:

- The habitat must be well defined as a geographical site
- The data on ownership, sector and industry classification can be presented on a detailed geographical level
- There must be a geographical "linkage level" between habitat and ownership information and it must be possible to transfer the register information to the habitat.

In our case, the linkage level is properties that are defined as geographical surfaces in the GSD Property Map. Data on assessment and ownership can be matched to the geographical delimitation of the property via codes in the Property Register and Real Estate Assessment Register respectively. Data from the Business Register can also be linked to the property, i.e. if there are set coordinates and an industry code (SNI 2007) for the workplace. By using the property as a "cake tin" around the habitat, the register data associated with the property can be transferred to the habitat.

Figure 5.1
Diagram of the information flow in the method



The method is generic in that it can be used to match all types of land and/or habitats with ownership and industries, as long as the above conditions have been met. The explicit aim of the project has been to study land that is especially relevant for the *preservation of biodiversity* and to

adapt this to the classifications in the environmental accounts. What exactly constitutes such land can be classified in many different ways.

In order to find a workable delimitation, the project chose to use as a basis the definitions of habitats that are reported in accordance with Article 17 of the EU Habitats Directive and that are consistently reported by the Member States. There are several reasons for this delimitation: firstly, the definitions were harmonised among the Member States in order to facilitate comparison if several countries were to choose to implement a similar accounting model; and secondly, the definitions, at least in theory, are unambiguous with clear boundaries, which is an advantage from a statistical perspective. In reality, however, few of the habitats under the EU Habitats Directive are clearly defined geographically with the resolution and quality needed to divide up the areas with property as a linkage level. The background data used for reporting to the EU and which, in Sweden's case, is compiled by the Species Information Centre is based partly on high-resolution geodata and partly on estimates of habitat occurrence in the biogeographical level. It has not been possible to use this kind of data in the project. The aim has instead been to use proxy data that as far as possible should correspond to the habitats defined in the Habitats Directive. In addition to this, other data that represents land that is particularly relevant for the preservation of biodiversity has been used.

5.2.1 Breakdown of habitats into owners

Linking habitats, owners and industries can be done in different ways. Three different ways have been identified in this project, each of them with a varying degree of reliability and relevance for further analysis.

Breakdown into sectors based on ownership (First delimitation)

In the first delimitation, the habitat is linked to an owner category and "sector" via the type code in the Register of Real Estate Assessment. This is the simplest level that requires the least number of assumptions and generates the most complete results in that the largest share of the total habitat area can be allocated. In this way, a certain habitat can be broken down by owner category of the sector (central government, municipality and county council, private individual, etc.) and by type of property (farming property, multi-dwelling building, one- or two-dwelling building, etc.). In this type of analysis, the focus is on which institutional sectors own the land. The owner can choose whether to utilise the land or not. This approach does not shed light on the owner's business activity. It is not possible to link the land to industries in terms of other environmental impacts or economic instruments.

On this level, only tables with the various habitats and the Register of Real Estate Assessment have been used to produce statistics on the owner and type code of each habitat respectively. The results of the first delimitation are presented below in Chapter 5.4, Tables 5.5 and 5.6.

Breakdown into industry based on ownership (Second delimitation)

In the second delimitation, data on ownership down to the enterprise/individual level is used, which provides a good opportunity to see which industries own the habitat in question. This more detailed

breakdown makes it possible to bypass the cruder "sector breakdown" in the first level. The industry breakdown of the habitats is, however, based on ownership and not on data describing how the land is actually utilised. Level two requires more assumptions than level one, in order to e.g. identify a main owner of a property with several co-owners, although in principle the entire habitat area can be broken down.

The results of the second delimitation are presented below in Chapter 5.4.

Coding to the Swedish Standard for Industry Classification (SNI)

The Swedish Standard for Industry Classification, SNI, is a statistical standard for the classification of production units (enterprises, workplaces, etc.) into industries. SNI is based on the European NACE classification system (Nomenclature statistique des Activités économiques dans la Communauté Européenne (SCB MIS 2007:2)

The main variable used in the SNI coding is Ngs1 (Ngs = Statistical industry). Using mainly this variable achieves greater concordance with the economic statistics. In cases where Ngs1 is missing, the Ng1 (Ng = Industry) variable has been used). In cases when both these variables are missing, the SNI coding from FTR is used. Fourthly, for organisations that still have no SNI code, or have the SNI code 00 (No main group), legal form (primarily from FDB and then from FTR) is used for the SNI coding as follows:

Table 5.2
Linkage of legal form to SNI

Legal form	Legal form, text	SNI
51	Economic associations excl. housing cooperatives	94
53	Housing cooperatives	68
54	Tenant housing cooperatives	68
61	Nonprofit associations	94
62	Cooperative associations, road associations, road-owners' associations	68
63	Registered faith groups	94
71	Family foundations	65
72	Other foundations and trusts, including pension funds and employee foundations	65
81	Central government units	84
82	Municipalities	84
87	Public corporations and institutions	84
10	Sole-proprietorship	XX (Unclassified business sector)
21	Partnerships	XX (Unclassified business sector)
31	Trading partnerships, limited partnerships	XX (Unclassified business sector)
49	Other limited companies	XX (Unclassified business sector)
91	Estates of deceased persons	XX (Unclassified business sector)
96	Foreign legal entities	XX (Unclassified business sector)
98	Other Swedish legal entities formed in accordance with special legislation	XX (Unclassified business sector)
2	Unknown organisations or owners without Swedish personal ID number	YY (Unknown organisations or owners without Swedish personal ID number)
99	Legal form unidentified	YY (Unknown organisations or owners without Swedish personal ID number)
0	Natural person	FYS (Natural persons)

In those cases where SNI coding is still missing (i.e. no match has been found in FDB either), a further matching is attempted; to the Owner from the land map (which corresponds to legal form). The following SNI coding has been performed based on owner:

Table 5.3
Linkage of legal form group to SNI

Owner (Legal form group)	Owner, text	SNI
1	Central government	84
2	Municipality	84
3	Swedish Church	94
5	Estates of deceased persons	XX (Unclassified business sector)
6	Swedish limited companies	XX (Unclassified business sector)
7	Housing cooperatives	68
8	Municipal housing companies	68
9	Other	YY (Unknown organisations or owners without Swedish personal ID number)
0	Unknown owner	YY (Unknown organisations or owners without Swedish personal ID number)
4	Natural persons	FYS (Natural persons)

A final matching as regards SNI coding is performed via the feature type variable from the land map.

Table 5.4
Linkage of feature type to SNI

Feature type	Explanation	SNI
SAMF	Cooperatively owned area	68
SAMFO	Cooperatively owned area, with no identity	68
FASTO	Property area, with no identity	YY (Unknown organisations or owners without Swedish personal ID number)
PROPERTY	Property area	YY (Unknown organisations or owners without Swedish personal ID number)
OSPEC	Unspecified	YY (Unknown organisations or owners without Swedish personal ID number)

Result tables

Results of all processing described above are entered in result tables in Excel format in which all habitats are described.

- SNI in two levels (sub- and main group level, e.g. A, then A01, A02) are classification/summation levels. There are six reporting variables for all these:

- Habitat area
- Turnover
- Number of workplaces

- Number of jobs (according to RAMS)
- Number of employees (according to RAMS)
- Share of habitat area

It has been possible to break down some of the habitats even further. In such cases, the above result tables have also been compiled for this level, e.g. concerning grasslands that are described in Chapter 4 above.

- **Wetlands** have been divided into two groups using the NV (natural values) class.
    1. High natural values ('Very high natural values', 'High natural values')
    2. Other ('Some natural values', 'Low natural values' and 'Unknown natural values')

- **Meadows and grazing land - habitats** have been divided into four groups using the habitat variable.

1. 6270 (Siliceous grasslands)
2. 6280 (Nordic alvar)
3. 6410 (Humid meadows)
4. Other (excluding the habitats 'OTHER HABITAT', 'CULTIVATED GRAZING LAND' 'UNDEFINED')

- **Total meadows and grazing land** have been divided into two groups using the land class variable.

1. Meadow
2. Other

Breakdown into industry based on workplaces (Third delimitation)

In the third delimitation, the industry classification of the habitat area has been done by using geo-coded workplaces from the Business Register. The aim of using workplaces as a basis for the breakdown of habitat areas is to obtain a stronger link between habitat and land use since ownership does not necessarily provide a clear idea of what the land is used for. Workplace, on the other hand, provides the information needed to know what takes place on the land in question in terms of the direct effect of the business activity.

The starting-point is that using workplaces as a basis for the industry classification can help to better illustrate who has control of the land. Another aim is to enable better linkage between land use and economic variables such as employment and turnover. This delimitation has the best information value but at the same time requires the largest number of assumptions and provides the least coverage of areas in total as few properties have one or more workplaces. Only a small part of the habitat area can therefore be classified by industry.

The results of the third delimitation are presented in Chapter 5.4, Table 5.7 below.

5.3 Special cases in the Register of Real Estate Assessment

The Register of Real Estate Assessment (FTR) contains information on land ownership in Sweden collected from real estate assessments. There are several different units in the register, the two most important for this study being the property and the assessment unit. The property unit has geographical information that is necessary for linkage with data on habitats with set coordinates, e.g. the wetlands inventory. The other unit, the assessment unit, contains information on the landowner which enables us to see whether it is e.g. a private individual or an enterprise that owns the land. This ownership data can then be linked to other registers to find out in which industry the enterprise primarily operates, how many employees it has, etc.

Normally, there is concordance between the property unit and the assessment unit, i.e. a 1:1 ratio. The landowner data is then valid for the specified property without the need for additional processing. The situation is different when there are several assessment units for a single property. It is then possible to link several owners to the same property and hence the same geographical information. In this situation, a representative landowner has been chosen based on the amount of land owned. The landowner who owns the largest area is chosen to enable matching with other registers and the geographical information. This simplified assumption applies to 24 percent of all the area in FTR.

Figure 5.2
Schematic diagram of properties and assessment units

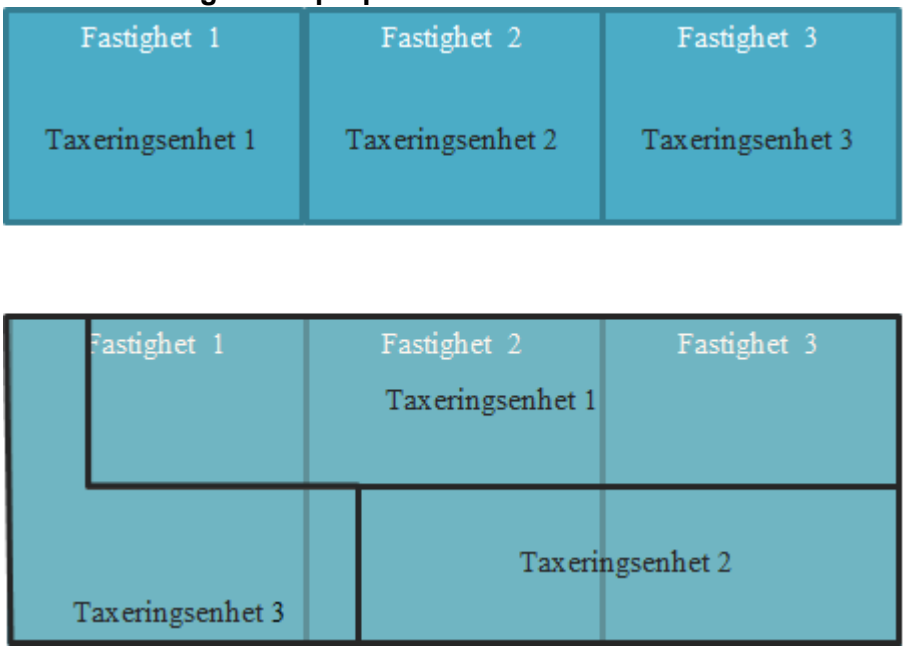


Figure 5.2 indicates a 1:1 ratio between the property and the assessment unit in the upper classification. In the lower classification, the assessment units overlap the properties and then the largest landowner is selected (assessment unit 1) to represent all three properties.

5.4 Results of the method analyses

The three delimitations identified produce three different results.

The sector breakdown gives us information on the major groups of actors via their respective institutional sectors such as public, private and business sector ownership. This method has been tried and tested before (SCB 2013) while the industry classification is entirely new.

Sector breakdown - First delimitation

The habitats are presented below broken down into owner and type code respectively according to the above method description.

Legal form according to the Register of Real Estate Assessment

This first delimitation focusing on legal form and type of property shows that it is primarily natural persons who own land linked to Wetlands and Grass and grazing land. Farming units are prominent as the property unit. The second-largest landowner is Swedish AB (Swedish limited companies), although industrial units do not constitute a major share of the property units. We can deduce, however, that most limited companies own some type of farming unit.

Table 5.5
Habitats broken down by owner, area in hectares.

Owner	Wetlands	Western taiga	Key forest biotopes	Meadows and grazing land - habitats	Total meadows and grazing land
Unknown owner, missing owner	152 415	106 941	12 482	11 075	14 789
Central government	683 906	1 282 657	83 913	11 779	18 226
Municipality	37 666	37 070	10 334	4 863	8 888
Swedish Church	2 162	3 029	406	173	407
Natural persons	1 629 813	1 278 749	127 260	131 025	215 403
Estates of deceased persons	38 373	28 961	2 594	1 619	2 768
Swedish AB	1 461 329	1 370 229	205 947	8 896	14 448
Housing cooperatives	34	215	33	3	10
Municipal housing companies	267	661	61	3	25
Other	318 544	321 962	20 910	8 280	13 578
Total	4 324 509	4 430 474	463 940	177 716	288 542

For Wetlands and Western taiga, the second-largest property consists of Special sites and Not established/unknown assessment units (Table 5.6). The project has not been able to establish what this indicates but there is some form of activity there.

Table 5.6
Habitats broken down by type code, grouped, area in hectares.

Type code, grouped	Wetlands	Western taiga	Key forest biotopes	Meadows and grazing land - habitats	Total meadows and grazing land
Farming unit	4 093 687	4 213 431	446 378	160 408	263 351
One- or two-dwelling unit	5 790	23 074	1 074	1 572	2 841
Multi-dwelling unit and Owner-occupied dwelling unit	728	1 013	158	156	290
Industrial unit	8 937	12 876	2 885	2 583	4 225
Industrial unit, quarry land	2 484	439	33	21	33
Electricity generation unit	360	1 845	133	85	102
Special unit	61 324	71 215	1 640	2 163	3 605
Not established/unknown assessment unit, missing type code	151 200	106 580	11 639	10 727	14 095
Total	4 324 510	4 430 473	463 940	177 715	288 542

Second delimitation: Industry classification

Every property in the Register of Real Estate Assessment has been allocated an owner in accordance with the description above in Chapter 5.2.1.

To obtain a more accurate picture of employees within each SNI respectively, we have used RAMS, and the Number of jobs variable, including those who work in their own firms without employees. These would otherwise have been zero if we had used FDB data for the number of employees. This may however result in our reported number of employees differing from other reported results.

When testing this method on the habitats that we were able to classify on an even more detailed level (soil class, conservation class, etc.), we could ascertain that it is only plausible on this level to look at the area data for the sub-classes of each habitat respectively. This is because the same owner can own land in several of the sub-classes and a summation of the economic variables would then not be possible. If this were to be done, it would then be necessary to look at each sub-class individually, without adding them together.

Table 5.7 presents the experimental results that have been calculated and described above in Chapter 4.

Table 5.7
Habitats broken down by industry, SNI 2007, area in hectares

	Industry, SNI 2007	Wetlands	Western taiga	Key biotope	Meadows and grazing land - habitats	Total meadows and grazing land
A	Agricultural, forestry and fishing enterprises	2 296 461	1 856 751	250 549	100 092	164 349
B	Mining and quarrying industry	2 669	4 501	499	106	175
C	Manufacturing industry	425 736	442 566	42 020	3 018	4 162
D	Electricity, gas and heat plants	3 987	5 527	622	397	609
E	Water supply, sewerage, waste management facilities	1 016	974	359	44	81
F	Construction industry	25 560	21 833	2 019	2 328	3 628
G	Trade; motor vehicle and motorcycle garages	18 775	12 199	1 221	1 205	1 918
H	Transportation and storage enterprises	7 567	6 223	491	474	796
I	Hotels and restaurants	9 447	7 725	676	419	758
J	Information and communication enterprises	2 427	2 327	255	158	330
K	Financial and insurance companies	4 095	3 654	674	287	495
L	Real estate companies and managers	312 727	691 689	48 627	12 661	20 840
M	Legal, accounting, scientific and technical enterprises	28 819	16 583	3 013	1 732	3 202
N	Renting and leasing, property service, travel service and other support service enterprises	8 562	7 575	713	823	1 274
O	Public administration and defence	232 471	187 546	15 998	6 682	10 566
P	Education	6 956	14 229	4 005	1 804	3 165
Q	Health and medical care, social service units	36 062	28 309	6 405	3 348	6 297
R	Arts, entertainment and recreation units	4 957	7 691	774	1 074	1 731
S	Other service enterprises	24 066	21 294	1 701	1 807	2 735
U	International organisations, foreign embassies, etc.	0	0	0	0	0
	Private persons	214 958	209 496	16 340	15 178	25 064
	Unknown business sector	204 096	183 574	14 885	10 897	18 429
	Unknown others	453 096	698 206	52 094	13 181	17 938
	Total	4 324 510	4 430 473	463 940	177 716	288 542

Third delimitation: Geographical location of workplaces, classified by industry

When testing the method on the third delimitation, i.e. looking at whether there were workplaces on the various land types we examined, the following emerged:

Table 5.7
Workplaces that are located on habitats:

Land type	Percentage of land where workplaces are located
Wetlands	18%
Key biotopes - forest	19%
Western taiga	23%
Meadows and grazing land - habitats	47%
Total meadows and grazing land	48%

It has proven difficult in practice to apply the third delimitation in the analysis due to its low level of accuracy. There are quite simply only a few workplaces located on properties that contain the selected habitats. There nothing particularly strange about this since most of the areas studied are a long way from built-up and urban areas. We nevertheless think that the third delimitation is interesting as an analytical starting-point and can probably be used to link business activities and habitats in certain areas, e.g. habitats in or close to urban areas.

6 Discussion and further development

Most of the work in the project has been about finding a platform for linking data on ownership and users, industries and economic variables to land and habitats. Above all, the project has made it possible to demonstrate the potential of the approach, partly as a result of the use of proxy data. It is both possible and meaningful to link economic and ownership data with individual habitats in order to create better understanding of the conditions for habitat management, potential threats and a better basis for being able to understand how changes in economic structures can be reflected in land areas and habitats. The results from the project must nevertheless be considered experimental and plenty of work still needs to be done to generate "clear-cut" data.

This section highlights a few proposals for further development in order to realise the idea of a breakdown of the habitats in the Habitats Directive as well as the ideas as regards the potential of the method for use outside this field on the national level.

6.1 More high-resolution habitat data or better proxy data

The greatest challenge in the project has been the availability of high-resolution and well-defined data on habitats that correspond to the Habitats Directive and the areas reported to the EU. The Species Information Centre, which, as commissioned by the Swedish Environmental Protection Agency and HaV, is responsible for the compilation and EU reporting of Swedish habitat statistics, has used statistical estimates on a higher geographical level in the absence of such data.

It has not been possible to use the information on estimated habitats in the method upon which this project is based. Consequently, neither has it been possible to break down by sector and industry the habitat areas reported directly to the EU. Access to more detailed surveys and geographical delimitations of the habitats in the Habitats Directive is a prerequisite for being able to include the statistics in the environmental accounting system on the national level.

Another option is to find better proxy data that can replace habitat data as defined in the Habitats Directive. This requires closer dialogue with the Species Information Centre since Statistics Sweden cannot make such an assessment itself. This was unfortunately outside the scope of the project.

From a European perspective, the advantage with the habitats in the Habitats Directive is that they are well defined and the data collection is harmonised. The methods and design of data collection systems for environmental monitoring have not been harmonised internationally, however. Despite this, however, the conditions are in place to be able to

integrate environmental accounting data on a European level. Since the project found that it was not possible to make direct use of the data material reported to the Habitats Directive, the existence of other data for European-wide statistics that could be used instead should be examined. Implementation of the INSPIRE Directive[9] provides certain prerequisites both for the harmonisation of geographical data and for making it available.

6.2 Land accounting

In order for the statistics on the industrial classification of individual habitats to be the subject of more in-depth analysis and interpretation, more background material is required. The data presented in Chapter 2 of this report, and that is based on the statistics produced on land use in Sweden, is seen as constituting such background material.

This data is however to be considered more as an embryo for more full-scale land accounting. An owner and industry classification of all land (per land use category) to the same degree of detail as is presented for the habitats in this report would make it easier to interpret what the breakdown of the individual habitats actually means. Does, for example, the breakdown of a certain grassland-related habitat deviate sharply from how all grasslands in the country are divided among different owners and industries? Or, where do we find the major forest companies compared to the small-scale forestry operators?

From there, we can also start to look for links between how various types of land use contribute to or counteract the conditions for biodiversity. Using the total area for different land type categories provides a better basis for analysing variables such as turnover and employment in relation to the land.

One could, for example, produce "industry profiles", i.e. what the composition of the total land use looks like for a specific industry. One could also produce "land use profiles" which, in a similar way, show what the industry composition looks like for a specific land use category. The aim would be to be able to draw conclusions about the sensitivity of the land users to economic change, taxation and other instruments.

Statistics Sweden has previously performed individual pilot projects to examine what scope there is for compiling land accounts although the agency does not currently produce such statistics on a regular basis.

6.3 Analysis for ecosystem services and green infrastructure

As we can see, the method has considerable potential for application outside the habitats listed in the Habitats Directive. One of its strength is its ability to describe the management conditions for land and habitats based on a control perspective, i.e. who owns and who uses the land. This is key

[9] Infrastructure for Spatial Information in the European Community: http://inspire.ec.europa.eu/

knowledge from an economic instrument perspective. By adopting an industry perspective, it is also possible to turn the question around and draw conclusions with regard to what land can be expected to be affected in the event of a change in the economic conditions of a particular industry.

In recent years, ecosystem services have increasingly come into focus, implying a broader view of the land and the ability of different habitats to generate different types of benefits. In such a context, it is not just those habitats that are most valuable for biodiversity which are important but in fact all types of land use since it produces different types of services. It is instead more interesting to shed light on the land use management, i.e. the forms of land use, such as utilisation methods, large- versus small-scale and the conditions for sustainable, long-term land use management. We believe that the method can be an important contribution to be able to perform better analyses of the potential and prerequisites for different types of ecosystem services.

An area that is particularly interesting to analyse with respect to who has control of the land and how it is linked to the economy is urban ecosystem services. Since the city is not synonymous with an economic sector in the same way as forest land or the agricultural landscape, it is less clear which actors exercise control over the land and how they utilised it. Furthermore, land use in urban areas is characterised by considerable heterogeneity and a diversity of business activities. In and around urban areas, business activity data can be generated more naturally since the link between land and workplace is clearer here than in rural areas. As a result, there is better scope for producing accounts in accordance with the delimitation for workplaces described in Chapter 5.

In order to safeguard biodiversity in the longer term, structures and functions are needed in the landscape, i.e. green infrastructure, which makes it possible for species to spread and move around in the landscape. It may be a question of different habitats and structures existing in the landscape and being distributed in a way that guarantees the long-term survival of habitats and species and safeguards the ability of ecosystems to deliver services (SOU 2014:15). To guarantee the need for green infrastructure, measures will have to be implemented in the landscape that are far beyond the safeguards created as a result of the establishment of protected areas. By using a certain type of infrastructure, e.g. broad-leaved deciduous forest as a starting-point, and breaking it down by owner and industry, we can create a better basis for describing who is responsible for conservation. It also provides better prerequisites for costs associated with safeguarding the green infrastructure.

Appendix 1: Habitat classes

Grass lands			
6110	*	Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi	Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi
6120	*	Xeric sand calcareous grasslands	Xeric sand calcareous grasslands
6150		Siliceous alpine and boreal grasslands	Siliceous alpine grasslands
6170		Alpine and subalpine calcareous grasslands	Alpine calcareous grasslands
6210		Semi-natural dry grasslands and scrubland facies on calcareous substrates (* important orchid sites)	semi-natural dry grasslands
6230	*	species-rich Nardus grasslands, on siliceous substrates in mountain areas	Nardus grasslands
6270	*	Fennoscandian lowland species-rich dry to mesic grasslands	dry to mesic grasslands
6280	*	Nordic alvar and precambrian calcareous flatrocks	Nordic alvar
6410		Molinia meadows on calcareous, peaty or clayey-silt-laden soils	Molinia meadows
6430		Hydrophilous tall herb fringe communities	Hydrophilous tall herb meadows
6450		Northern boreal alluvial meadows	Northern boreal alluvial meadows
6510		Lowland hay meadows	Lowland hay meadows
6520		mountain hay meadows	mountain hay meadows
6530	*	Fennoscandian wooded meadows	Fennoscandian wooded meadows
Wetlands			
7110	*	Active raised bogs	Active raised bogs
7120		degraded raised bogs	damaged raised bogs
7130		Blanket bogs (*if active bog)	blanket bogs
7140		Transition mires and quaking bogs	open mires and bogs
7160		Fennoscandian mineral-rich springs and springfens	springs and springfens
7210	*	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	fens with Cladium mariscus
7220	*	Petrifying springs with tufa formation	Tufa springs
7230		Alkaline fens	Alkaline fens
7240	*	Alpine pioneer formations of the *Caricion bicoloris-atrofuscae*	Alpine flushes
7310	*	Aapa mires	Aapa mires
7320	*	Palsa mires	Palsa mires
Mountains and caves			
8110		Siliceous screes	Siliceous screes
8120		Calcareous screes	Calcareous screes
8210		Calcareous rocky slopes with chasmophytic vegetation	Calcareous rocky slopes
8220		Siliceous rocky slopes with chasmophytic vegetation	Siliceous rocky slopes
8230		Siliceous rock with pioneer vegetation	Dry rocky meadows
8240	*	Limestone pavements	Limestone pavements

	8310	caves not open to the public	caves
	8340	Permanent glaciers	glaciers
Forests			
	9010 *	Western Taïga	Taïga
	9020 *	Fennoscandian hemiboreal natural old broad-leaved deciduous forest	northern broad-leaved deciduous forest
	9030 *	Natural forests of primary succession stages of landupheaval coast	landupheaval forests
	9040	Nordic subalpine/subarctic forests with *Betula pubescens* ssp *czerepanovii*	Montane birch forests
	9050	Fennoscandian herb-rich forests with *Picea abies*	herb-rich pine forest
	9060	Coniferous forests on, or connected to, glaciofluvial eskers	Coniferous forests on or connected to eskers
	9070	Fennoscandian wooded pastures	Wooded pastures
	9080 *	Fennoscandian deciduous swamp woods	Deciduous swamp woods
	9110	*Luzulo-Fagetum* beech forests	nutrient-poor beech forests
	9130	*Asperulo-Fagetum* beech forests	nutrient-rich beech forests
	9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*	nutrient-rich oak forests
	9170	Galio-Carpinetum oak-hornbeam forests	Dry oak forests
	9180 *	*Tilio-Acerion* forests on slopes, screes and ravines	Broad-leaved deciduous forests on slopes, screes and ravines
	9190	Old acidiphilous oak woods with *Quercus robur* on sandy plains	nutrient-poor oak woods
91D0	*	Bog woodland	Bog woodland
91E0	*	Alluvial forests with *Almus glutinosa* and *Fraxinus excelsior*	Alluvial deciduous forests
91F0		Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Lumus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers	Riparian mixed forests

There are also habitats under the headings:
Lakes and watercourses
Sand dunes
Coastal areas and seas

Appendix 2: Classification of natural values, VMI

Natural values are classified in the Wetlands Inventory on a four-point scale, where:

• **Class 1** sites with very high natural values for the region and of international or national conservation value. The vast majority of them are undisturbed and need to be preserved for the future. No measures that can disturb or further affect the hydrology of the site should be permitted.

• **Class 2** sites that are generally undisturbed by measures, have high natural values and are of national or regional conservation value. Measures that affect the hydrology of the site should be avoided.

• **Class 3** sites that consist of everything from undisturbed wetlands with relatively high natural values to more disturbed wetlands with some preserved natural values and are of local conservation value. This class can contain sites that are disturbed to a certain extent and otherwise intact. Measures may be permitted if the affect on natural and cultural values is limited.

• **Class 4** sites that are substantially disturbed and lack natural values according to the results of the VMI inventory. Some sites may however have certain natural and cultural values. A few undisturbed wetlands may exist. When developing land, it is these sites that should be made use of first of all since they have already been substantially disturbed.

A detailed description can be found here:

Swedish Environmental Protection Agency 2009: Report 5925 The National Wetlands Inventory - results from 25 years of inventories. (in Swedish only)

http://www.naturvardsverket.se/Documents/publikationer/978-91-620-5925-5.pdf?pid=3525

References

Eide W. (red) 2014. *Arter & naturtyper i habitatdirektivet – bevarandestatus i Sverige 2013*. ArtDatabanken SLU, Uppsala

Gardfjell, H & Hagner, Å. 2013. *Instruktion för Habitatinventering i NILS och MOTH, 2013.* Version 2013-04-16. Skoglig Resurshushållning, SLU

FN: *System of Environmental-Economic Accounting 2012 Experimental Ecosystem Accounting*, FN 2013

M. Lenzen, D. Moran, K. Kanemoto, B. Foran, L. Lobefaro & A. Geschke. *International trade drives biodiversity threats in developing nations.* Nature 486, 109-112 (07 June 2012).

Tuomas J Mattila. *Input-output analysis of the networks of productivity, consumption and environmental destruction in Finland*. Aalto University, Doctoral Dissertations 124/2013

Naturvårdsverket, 2009. *Våtmarksinventeringen – resultat från 25 års inventeringar. Nationell slutrapport för våtmarksinventeringen (VMI) i Sverige.* Rapport 5925. Naturvårdsverket.

Naturvårdsverket 2011. *Svenska tolkningar Natura 2000 naturtyper.*

Naturvårdsverket: *Naturtypsvisa vägledningar och en kortlista finns*

Naturtyper beskrivna

http://www.naturvardsverket.se/Stod-i-miljoarbetet/Vagledning-amnesvis/Natura-2000/

SCB MIR 2013:2 *Kartläggning av datakällor för kvantifiering av ekosystemtjänster.* SCB 2013.

SCB 2013. *Markanvändningen i Sverige 2010.*

SCB MIS 2007:2 *SNI 2007. Standard för svensk näringsgrensindelning 2007*. Korrigerad version 2009-02-12

Sohlman A. (red.) 2008. *Arter och naturtyper i habitatdirektivet – tillståndet i Sverige 2007.* ArtDatabanken SLU, Uppsala

SOU 2014:50. *Med miljömålen i fokus – hållbar användning av mark och vatten.*

Sveriges Lantbruksuniversitet: *kNN-Sverige - Aktuella kartdata över skogsmarken, årgång 2005 och 2010. Skoglig resurshusållning*, SLU

TemaNord 2012:559. *Socio-economic importance of ecosystem services in the Nordic countries. Synthesis in the context of The Economics of Ecosystems and Biodiversity (TEEB).* Kettunen, M, Vihervaara, P, Kinnunen, S, D'Amato, D, Badura, T, Argimon, M and Ten Brink, P. Nordic Council of Ministers, 2012.

Victorian Government Department of Sustainability and Environment. *Environmental-economic accounting Victorian experimental ecosystem accounts*, 27 March 2013

The Environmental Accounts is an information system developed to systematically describe the connections between environment and economy. Statistics on environment and economy provide a foundation for calculations on costs of environmental measures and damages, analysis of environmental and economic policy as well as indicators on environmental status and sustainable development.

Report 2015:3 Land accounts for biodiversity – a methodological study

This report was commissioned by the Swedish Ministry of the Environment. Its aim is to describe experimental statistics within the framework of the environmental accounts connected to ecosystems and land ownership. This study tested three approaches to achieve this. Several registers and inventories were connected in order to provide a picture of who in Sweden owns land important for biodiversity and biological diversity.

Since 1998, the Environmental accounts report series has been published at Statistics Sweden. They are available on: www.scb.se/MI1301.

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