

Ode, Åsa

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## Landscape change and its effects on the visual experience of a case study area in the Öresunds region

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## **Landscape change and its effect on the visual experience of a case study area in the Öresunds region**

*Dr Åsa Ode, Department of Landscape Planning Alnarp, Swedish University of Agricultural Sciences. Email: Asa.Ode@lpal.slu.se*

### **1. Abstract**

The study focuses on landscape change, from an historical perspective (year 1915) and as a discussion of future changes (year 2015) for a case study area in southern Sweden. The historical situation is based on map data while the situation of 2015 is a predictive modelling based on spatial planning and policy documents for the case study area. The study identifies changes in land cover and their spatial distribution within the landscape. The result is discussed in relation to perceived change as well as the areas sensitivity to change. The paper further outlines implications of the result for management and planning in the context of the European Landscape Convention.

### **2. Introduction**

The landscape has certain natural characteristics that have been formed by natural processes such as wind, erosion and vegetation. However, today it is to large extent formed by human processes which influence and interact with the appearance of the landscape. These processes are expressions of the functions and values we put on the landscape. These functions include the production of food and material, provision of shelter and houses, recreation and amenity. The importance of these functions within the landscape has changed spatially and temporally as well as in the nature of their expression, following changes in the values of society. These values are today often expressed through policy and planning, changing the settings for production (*e.g.* it is the Common Agricultural Policy (CAP) which today strongly influences the agricultural production within EU). The resulting changes are impacting on the visual impression of the landscape.

However, all areas are not as sensitive to changes and different changes influence the appearance of the landscape in various ways. For instance, the change in grain type from barley to wheat has a low visual impact while the plantation of forest has a greater visual impact. The spatial location of change also influences the visual impression of the landscape.

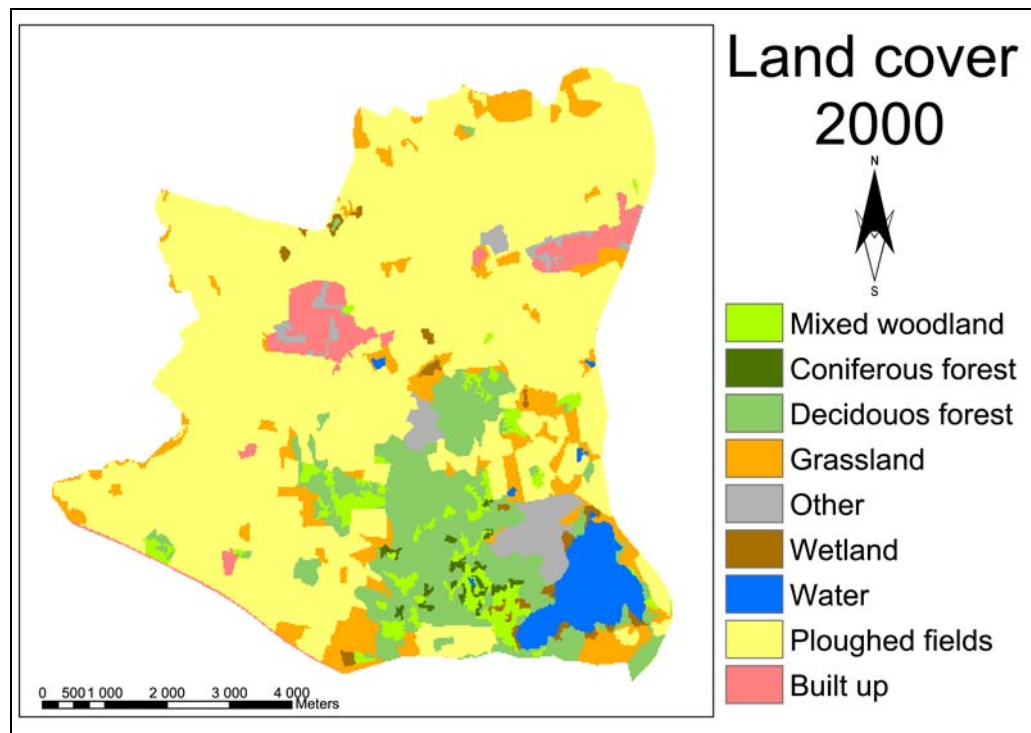
Studies in landscape preference have shown that people show consistency in preferences (e.g. Daniel, 2001) which may be explained by theories in environmental psychology. Though there is a tension between biological and cultural explanations of aesthetic experience, and between viewing behaviour as innate or learned (Bourassa 1991). Many researchers have tended to reduce the two fundamentally different origins of preferences to one. There is evidence of the existence of distinct biological and cultural modes of experience due to specialisation of different parts of the human brain. Norton et al. (1998) and Bell (1999) conclude that preferences are formed in humans on both a genetic and cultural basis. All human beings enter the world with a certain genetic make-up, but the genetically based preferences are, however, challenged and changed by cultural influence, and preferences reflect a combination of the forces of nature and culture. Studies have also shown that preferences are relatively stable over time within the same landscape (Palmer, 1997).

The importance of landscape for the European identity has been stressed in the development of a European Landscape Convention (Council of Europe, 2003). The convention aims at lifting the concept of landscape as a political concept and securing the common landscape heritage of Europe. The Convention establishes the general legal principles which should serve as a basis for adopting national landscape policies. The convention aims to promote European landscape protection, management and planning. The Landscape convention stresses the need to promote the landscape in the legal framework and in active policy and planning. The European Landscape Convention expresses a holistic view of the values of the landscape, where the landscape encompasses multifunctional values that are to be considered simultaneously. The convention further stresses the importance of landscape for providing quality of life. In Sweden there has been a long tradition for landscape issues to be mainly discussed in relation to environmental and ecological policies. This means that the holistic view of landscape is to large extent missing within landscape policies. This lack of holistic in

landscape issues has also lead to a strong polarisation of the values of landscape into natural, cultural and productive and issues such as aesthetics and recreation have received a low priority in landscape management and planning (Sarlöv-Herrlin, 2003).

During the last decades the landscape in southern Sweden has come under increasing pressure for change. This part of Sweden is part of the Öresund region which also contains Zealand in Denmark. It is one of the most fertile parts in Sweden and hence to large extend is dominated by large industrial agriculture. The Öresund region is also a highly populated region with the main cities being Malmö and Lund in Sweden and Copenhagen in Denmark. The Malmö – Lund area is today recognised as one of the most dynamic regions in Sweden with an estimated increase in the population of 20% in the next 20 years (Finansdepartementet, 2004). Studies of the urbanisation process have shown that its affects extend beyond the city boundaries, changing the spatial pattern of the landscape (*e.g.* Antrop & van Eetvelde, 2000).

As test bed for studying change, the area of Torup has been used, see Figure 1. The area is situated in the local municipality of Svedala and c.20 km from Malmö, a city with 250 000 inhabitants, and hence is highly influenced by its urban neighbour. The Öresund Bridge further means that the area is easily reached from Copenhagen. This provides a high urban pressure for the case study area, though in itself still mainly rural. The case study area is situated in area known for its hilly landscape with a strong morphology and small patches of waters and wetlands. The area is mainly open with large agricultural fields. In the southeast of the area the Torup recreation forest is to be found. The area contains several smaller commuting settlements, mainly developed during the 60s and 70s.



**Figure 1.** The case study area that has been used in the study is found in the southwest of Sweden .

The area has been inhabited for a long time with traces still visible dating back to as early as 2000 BC (grave mounds) (Länsstyrelsen i Malmöhus län, 1984). The farming system was for a long time rather stable (11<sup>th</sup> – 19<sup>th</sup> century) though dynamic but with few dramatic changes. The land closest to the farm being a mixture of meadows and fields while on the outskirts the grazed lands were found. The grazed land had in the end of this period been converted to meadows and fields (Emanuelsson *et al.* 2002). From the 19<sup>th</sup> century the landscape has been through some major changes, having a large visual impact. These changes have until the middle of the 20<sup>th</sup> century mainly been related to changes in agricultural production but after this time the urbanisation has come to influence the landscape. The process of urbanization is further estimated to continue, with an increase of the population within Svedala municipality until 2016 to be more than 10 % (KAAB Prognos AB, 2004).

This paper focuses on the changes of the landscape and its visual affects, focusing on questions such as what changes has occurred, where have changes happened, and what future changes are likely to occur. The study shows a time span from before urbanisation affected the case study area (1915), today's landscape, and a future

scenario for the area. This is stressed in relation to policy and planning frameworks and its affect on handling changes in visual quality of landscapes.

### **3. Method**

The method used for this study is mainly a spatial study of changes in land cover for a case study area in southern Sweden. The study is a comparison between economic maps from year 1915, land cover data from year 2000, and land cover data for a future scenario year 2015, based on policies and plans for the case study area.

#### **3.3 Time touchdowns**

For the study of landscape change, three touchdowns in time have been used, year 1915, year 2000, and year 2015. The situation in 1915 is described using the economic map from 1910-15 and is before the mechanization of the agricultural production and the expansion in urbanization. The situation for year 2000 is described using the Swedish land cover data set. The situation for year 2015 is based on planning and policy documents from the local municipalities and county administration and applied to the area as changes to the land cover data set from year 2000. Through the approach of using three frozen moments in time, the changes in between are not taken into account. In this study there has been a deliberate focus on the changes in land cover and not on other features in the landscape. The reasoning for this is based on that land cover is the basis for several monitoring schemes across Europe with regards to landscape change (*e.g.* CORINE (Commission of the European Communities, 1995)).

##### **2.3.1 Year 1915 - Häradsekonomisk karta**

The situation in year 1915 is based on the economic map (Häradsekonomiska kartan) that was one of the first series for Sweden describing land use for most of Sweden. It gives a good overview of land use and vegetation. The focus is on economic values and hence the most productive land is found to be most accurate. For the case study area the following land cover is present: ploughed fields, meadows, garden, built up, wetland, water, reeds and other undistinguished land cover. From other land cover deciduous, mixed and coniferous forest could be distinguished through the use of tree symbols. The

remaining part of the class 'other land' is assumed to be grazed as according to Riksantikvarieämbetet (1995).

The map was retrieved as a raster images without coordinates. The rectifying and digitizing of the historical map is using a method presented by Riksantikvarieämbetet (2002). For this method, common and stable objects are identified in the historical map as well rectified aerial photographs within ArcGIS. Based on the rectified maps screen digitizing was carried out for distinguishable classes.

The area is dominated by ploughed fields with a larger area of deciduous dominated forest around Torup. In the area there is no larger areas of built up land, though smaller settlements are found within the area. Meadows are found along the north and western boundary, mainly following the streams. In the case study area there is areas of water stretching from west to southeast. The study area also has wetlands and meadows spread throughout the area though grassed areas are few.

### **3.3.2 Year 2000 - Svenska marktäckedatabasen (SMD)**

The situation for year 2000 is described using the Swedish land cover database (Svenskan Marktäcke Databasen, SMD). The data shows the land cover based on the classification used for CORINE Land Cover (CLC), where the 35 classes from CLC has been broken down to 57 classes. The data is stored in raster format, with a pixel size of 25 x 25 m, and based on remote sensing data with the classification being made with a mixture of manual, half-automatic and automatic methods (see Lantmäteriet, 2002 for a fuller description of the dataset).

The area is in year 2000 dominated by ploughed fields with a larger area of forest around Torup in the southeast part of the area. In the area two larger settlements could be found, Bara in the center of the case study area and Klågerup in the northeastern part. In the area several grassed areas could be found mainly along the streams in the north and west, but also around Torup.

### **3.2.3 2015 – Scenario development**

The basis for the development of the scenario is land cover, and hence the scenarios will just deal with changes *between* land cover and not socio economic issues or changes *within* land cover classes (for instance changes in arable crops). The base data set to be used is raster data and the changes will be analysed in relation to the situation year 2000 and the land cover data from year 2000.

The scenario developed is based upon proposed changes for the case study area found in policy and planning documents. The main ones are:

- Protection of urban nature for recreation in the Öresund region, Skåne (Länstyrelsen, 2004)
- Comprehensive plan for Svedala municipality (Svedala kommun, 2002)
- Waterframework for Segeå (Segeåvattenvårdsförbund, 2003a, b)

For the comprehensive plan changes in land cover is suggested and marked on a map with regards to land cover and use. This is mainly relating to new housing development. The programme for protection of urban nature identifies areas suitable for developing and enhancing opportunities for recreation. The main area identified is the zone around the river Segeå and its tributaries. The water framework plan identifies locations suitable for the development of wetlands and ponds.

The scenario will hence include the following in order of priority:

1. Housing development will be according to the suggestion in the development plan.
2. Creation of new recreational land
3. Wetland will be created, mainly along Segeå and in low areas for the case study area.
4. Public access for a 100m buffer-zone along Segeå



### **3.3. Analysis of change**

#### **3.3.1 Comparing maps – making datasets comparable**

The analysis of change is done both numerical and spatial, using standard map calculations commands in ArcGIS. In order to compare different datasets (maps) there is a need to make these sets compatible with each other.

The two base datasets (Historical map from 1915 and SMD from 2000) that have been used for the comparisons differ with regards to the motive of their development and hence the technical quality. Issues with regards to comparing maps from different time periods include the need for a common classification, scale and accuracy (Skånes, 1996). In Table 1 the classes found for the two datasets are presented together with a common classification to be used for the comparison. The common classification is mainly based on the classes found in the map from 1915 and consists of 10 categories. Since the SMD has a lower degree of resolution the 1915 map is transformed to achieve the same scale, see Table 2.

**Table 1.** The common classification used in the study in order to cater for comparison.

1915	2000	Common and used classification
Coniferous forest	Coniferous forest 5-15 Coniferous forest >15 m Coniferous forest on bog	Coniferous forest
Mixed woodland	Mixed woodland ej on bog eller berg-i-dagen Mixed woodland on bog	Mixed woodland
Deciduous forest Park	Deciduous forest ej on bog Deciduous forest on bog Non urban park	Deciduous forest
Meadow-land	Pasture	Grassland
	Fruit and berry growing Bushland Sport facilities Golf course Clear cut Gravel and sand pit Road areas	Other
Wetland/reeds	Limnogen Wetlands Wet bog Other bog	Wetland
Water	Lakes and ponds with open surface Lakes and ponds with vegetation covered surface	Water
Ploughed fields	Ploughed fields	Ploughed fields
Built up Garden	Settlements with more than 200 inhabitants and smaller areas of gardens and green spaces Settlements with more than 200 inhabitants and larger areas of gardens and green spaces	Built up

**Table 2.** Qualities of the two base data set dataset.

Year	1915	2000
Scale	1:20 000	25 m
Smallest unit	c. 100 m <sup>2</sup>	1 ha
Classes	11	27

## 4. Result

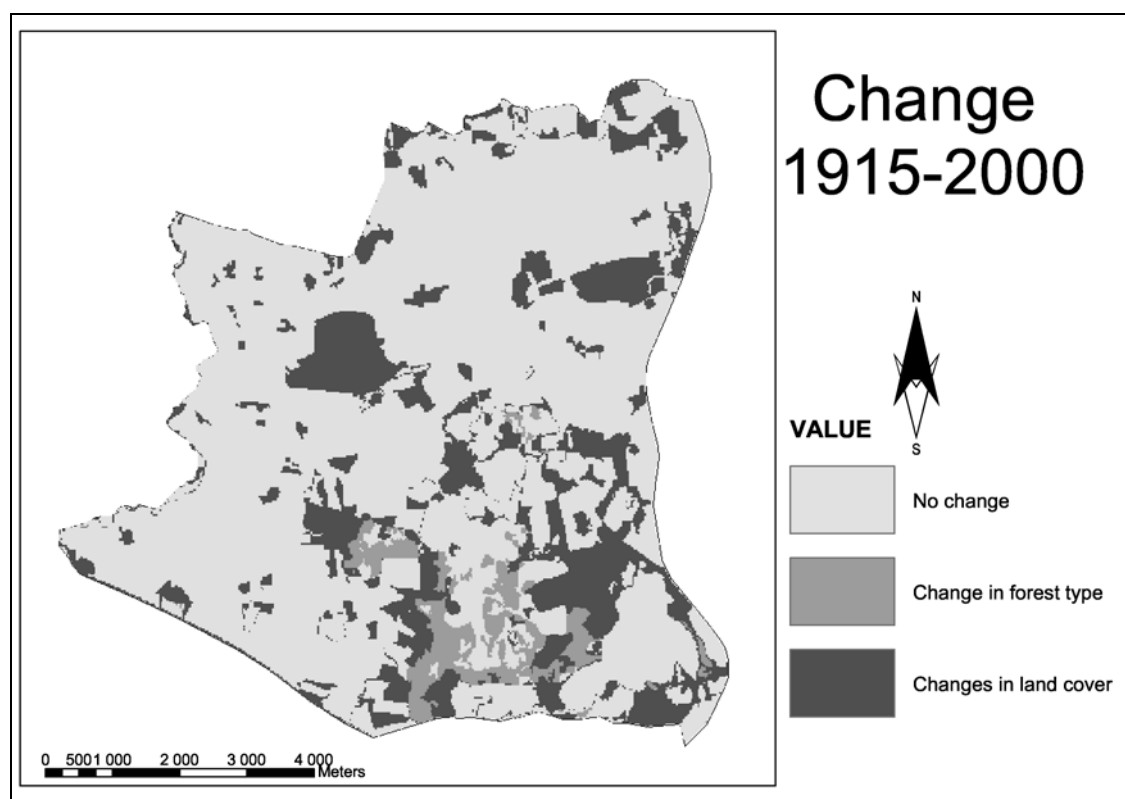
### 4.1 Historical Land cover change 1915-2000

Based on the two datasets for year 1915 and 2000 it is clear that changes have occurred in the case study area, see Table 3 and Figure 2. The most significant change is in the amount of ploughed fields that have decreased by 630 hectares. There is an expansion of built up land by 202 hectares mainly concentrated to previous existing settlements in

Klågerup and Bara. The expansion has mainly been taking part on ploughed fields and meadows. There is also a significant change in the increase of grassland in the case study area.

**Table 3.** Land cover distribution 1915 and 2000 and its changes in hectares.

Land cover	1915	2000	Change
Ploughed fields	4617	3987	-630
Grassland	417	534	+117
Deciduous forest	518	801	+283
Mixed woodland	166	34	-132
Coniferous forest	110	148	+38
Wetland	15	57	+42
Water	277	212	-65
Built up	71	273	+202
Other	42	187	+145



**Figure 2.** Changes in land cover for the period 1915 –2000 divided into changes in forest type and other changes.

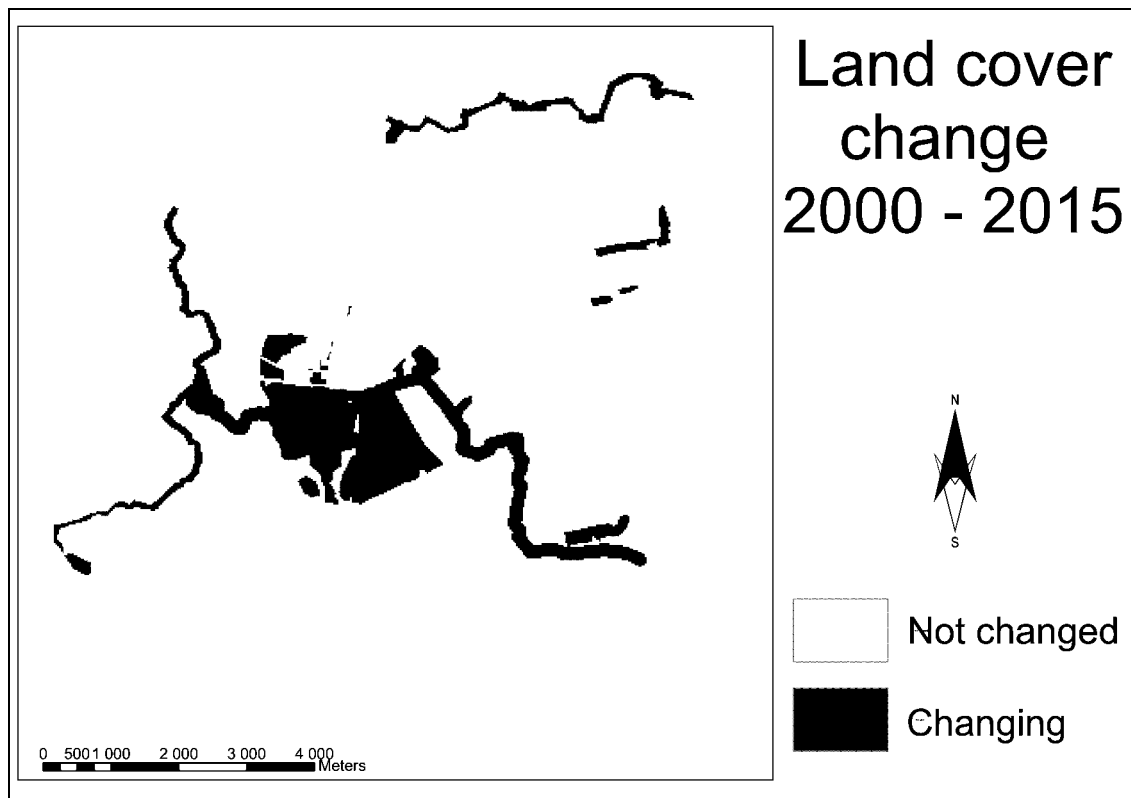
The spatial distribution of changes in land cover, as shown in Figure 2, reveals that changes have occurred across the whole case study area, with both changes occurring for both larger continuous areas and smaller dispersed areas. The whole of the area has hence been affected by changes in land cover. However, certain areas have been under a

higher degree of change. This is the case for the area around Torup recreation forest in the southeast corner, where changes in forest type as well as other land cover changes has occurred. In the northern part of the case study area there is further a high degree of change in relation to the stream.

## **4.2 Future land cover - Scenario 2015**

The scenario developed for the case study area was based on the identified documents and drivers of change as presented in the method section. The documents were mainly focusing on changes in built up land, recreation and wetland and hence these types of land cover have dominated the scenario development. The scenario developed for the case study area shows two large areas of built up land, Bara and Klågerup. The increased recreation facilities are proposed as an increase in grassland as well as expansion of other land uses (in the case south of Bara as an golf course). The creation of wetland has mainly been suggest in relation to Segeå and is hence found here.

The areas of changes are mainly found along the river Segeå and its tributaries and in connection to the existing settlements in the case study area, see Figure 3. Along the streams there is an increase both in wetland as well as grassland. In connection to the settlement Klågerup and Bara, an expansion in the built up is made due to the expected growth of inhabitants in the region. This further puts pressure on land available for recreation which is found both as a new golf course, south of Bara and the transformation of ploughed fields into grassland along the streams, and hence provision of greenways in the landscape.



**Figure 3.** The map shows area that have changed between 2000 and the developed future scenario for 2015.

## 5. Discussion

The results of the study of changes in land cover shows that there have been substantial changes within the area as well as a great amount of proposed changes affecting the landscape pattern.

### 5.1 Changes that are not changes and unrecorded changes

When using maps for the constructing of a time series and a comparison over time for an area certain problems occur. These include differences in:

- quality of the maps,
- system of classification of maps,
- purpose for producing the maps
- technical differences such as transformation

Vourela (2001) suggest a method where the map based information is combined with other information such as descriptions and aerial photographs in order to get the most

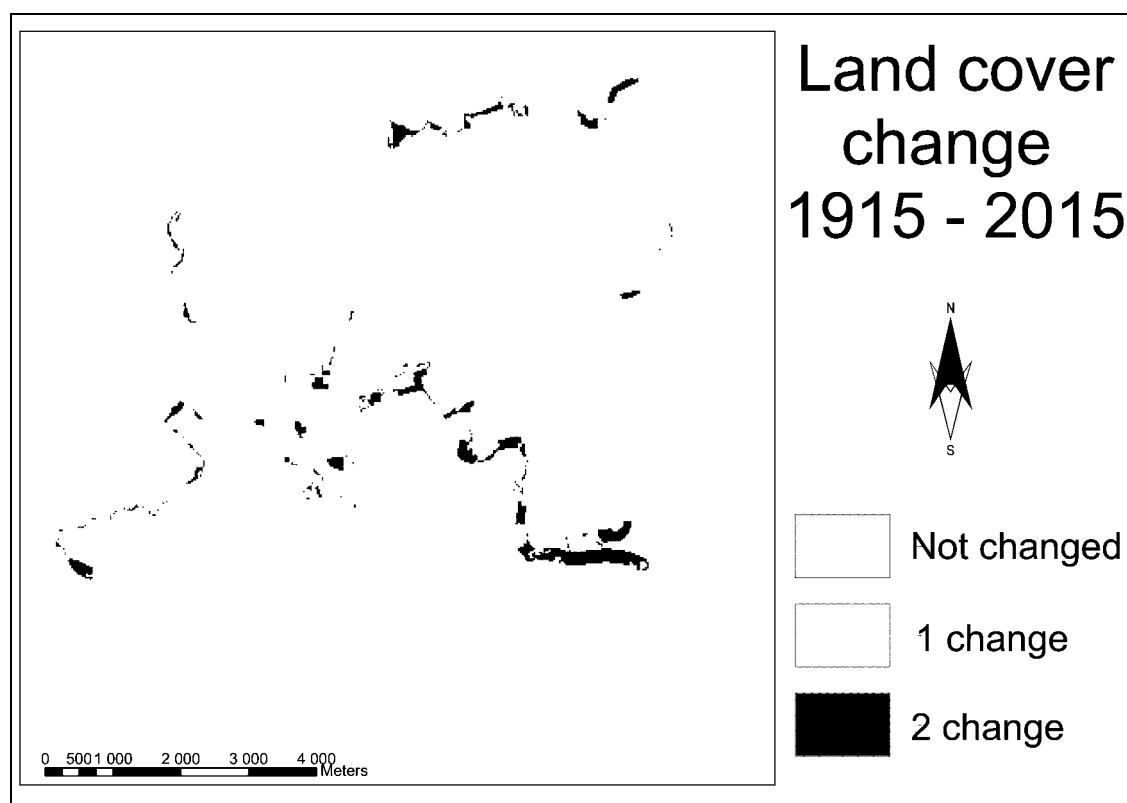
detailed picture of the situation. In the study presented here, this has not been done. However, there is an option of providing more detailed information for instance of the forest through the use of forest records. When working with scenarios these are founded on other than map based information, this information is interpreted spatially.

The largest problem is for the classes where there is little economic value. For instance the forest is very poorly mapped with regards to type in the maps for 1915, leaving space for interpretation when transforming the map based data from 1915 to digital data.

However, there are also changes that are unrecorded with the method used in this paper. The classes used within this study use 9 broad categories in order to allow for comparison. The generalization made means that changes within these categories are unrecorded as change. For instance the class grassland includes meadows and grassland, two land uses with different visual expression for large part of the year. Another category that includes unrecognized changes is the ploughed fields. This category includes a large variation in crops, ranging from grass to energy forest, with distinctive different visual expression. For the period covered within this study there has been a change in the agricultural production for ploughed fields and this is a change that is likely to also be found in the future.

## **5.2 Changes in the landscape – are there areas that are more sensitive to change?**

The result of the changes study shows that there are certain areas that are more sensitive to changes than others. Some of the areas have also changed twice for the time periods used in this study (1915-2000 and 2000-2015) see Figure 4. There is mainly two type of areas that has changed historically and are likely to change in the future; the marginal areas and areas close to settlements.



**Figure 4.** *The map distinguishes between areas with no changes, one change and two changes within the time period studied.*

The marginal areas in the case study area are mainly found around Torup recreational forest and along Segeå and its tributaries. For both these areas, changes have occurred historically and are proposed to change in the future. This might be explained by the fact that these areas are the ones most easily changed, when the urbanisation processes puts demands on the move from a production landscape towards a multifunctional landscape.

The area close to settlement is under a different kind of pressure for change. The settlements of Bara and Klågerup, have both expanded and it is planned to expand them further in the future. This is an expression of an active politic to condense the expansion occurring in the Öresund region as expressed by the guidelines from the County board (Länstyrelsen i Skåne, 2004).

The changes in the urban fringe landscape is something that has been explored by several researchers (Antrop, 2000). This study shows that the urbanisation is not just about urban expansion, but also to a high degree a change of other land covers in order

to facilitate and meet the demands that an urban population has on its surrounding countryside. This includes the increase in recreational land, but also the increase of grassland could be seen as an expression of the “horse belt” found around Malmö.

The changes in the land cover distribution are also likely to affect preferences for areas of the landscape. Studies have shown that certain landscape characters are preferred over others, which would assume that a change in landscape composition for an area will affect the preferred “value” with regards to visual quality. Since preferences has shown to be rather stable over time (Palmer, 1997), as well as to partly being evolutionary based (Bourassa, 1991), the preference rating for areas within the landscape is hence likely to have changed as well as are coming to change. However, further research is needed in order to establish the relationship between landscape cover and preference before the impact of changes could be analysed on a more general level.

### **5.3 Conclusion and practical implications for management and planning**

The result of the study presented shows that a landscape in the urban fringe is under change, a change that affects the experience of the landscape. Some of these changes are planned though several of the changes occurring in the landscape less planned. The changes are mainly driven by two factors, urbanisation and production, each of which has a different expression in the landscape.

Historically, a large part of the changes could be explained by the changes in production conditions. It is hard to predict where they will occur since they are dependent on the farmer’s interpretation and adaptation to agricultural policies and innovations within agricultural production. This is in contrast to changes related to the urbanisation processes, which often is directed by planning and policy decisions. The situation when predicting the future landscape is mainly focusing on these changes due to urbanisation, and hence analysis of other changes spatially is limited.

The landscape convention states that a landscape perspective should be taken with regards to planning, management and policies (Council of Europe, 2003). However, the



study shows that there is a large part of change in the landscape for which it is hard to predict spatial expression, and hence the changes influence on the experience for people.

Economic and environmental policies are sometimes developed with an aim of either providing a change or preserving a present situation (examples could be found in some of the formulations within the CAP). The suggested changes within the CAP as interpreted by the Swedish Agricultural Department (Jordbruksverket, 2004) shows measures to support changes within land cover categories (mainly ploughed fields) rather than measures that will change land cover categories.

Studies have further shown that the impact of these changes on a landscape scale is to large extent depending on the individual landowners decision (*e.g.* is the impact of the EU agricultural policies as described in Larsson, 2004). The study by Larsson (2004) further showed that local initiatives (in his case a local water framework project targeted to increase the amount of wetland) were more likely to have an impact on changes in land cover.

The result from this study shows that landscape is under a constant change with regards to its land cover. While the planning situation of today is capable of dealing with the planned changes, changes in agricultural production and its impact are hard to foresee and predict and hence plan for. The study further showed that there are also changes not always visible as changes in land cover they do still have a visual impact. The result of the study further shows that there is a strong impact of urbanisation for the rural landscape, leading towards changes in land cover that are not only development based, but also related to recreation and a urban-rural lifestyle (*e.g.* of this are the horse farms on the fringe which has a strong urban connection). Both the planned and the production based changes has an affect on the visual landscape, which among others needs to be considered in order to meet recommendations set forward in the European Landscape Convention. Though today there are limited tools available for analysing and discussing the impact of changes in land cover within a Swedish planning context.

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