Semi-natural pastures in Scania: grazing and the support system

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Semi-natural pastures are one of the most species-rich habitats found in Sweden and many endangered species are connected to them. Strongly declining in area, semi-natural pastures in Sweden can be eligible for financial support within the EU agri-environmental scheme. The definition of pastures eligible for the scheme was changed in 2008, more specifically the amount of trees and bushes was restricted. This study aimed to investigate if farmers who previously had been part of the agri-environmental scheme, but left it, still kept maintaining pastures with grazing animals. 72 semi-natural pastures were randomly selected using ArcGIS and were visited during the fall of 2015. Grazing as well as tree and bush cover was recorded. Results showed that fewer pastures outside the scheme were grazed than pastures within the scheme. There was also a near significant difference between pastures outside and within the scheme regarding tree cover. The fact that many farmers abandon the management of pastures outside of the agri-environmental scheme is a strong threat to the biodiversity connected to semi-natural pastures. The root of the problem seems to be the unprofitability connected to pastures together with the change of pasture definition. This study suggests that the agri-environmental scheme needs to be evaluated and improved to stop the decline of meadows and pastures in Scania and the rest of Sweden.

Introduction

Semi-natural pastures (henceforth referred to as pastures) are grasslands that are grazed by domestic animals, which are not currently exposed to fertilizers or herbicides and have not been either ploughed or fertilized during recent times (Olsson 2008). Semi-natural pastures are very heterogeneous, often including trees, bushes and open grassland, which together with a long continuity of grazing can lead to very high species richness (Cousins and Eriksson 2001). Semi-natural pastures also act as an important biotope for many insects, mushrooms, birds (Emanuelsson 2008), bats (Länsstyrelsen 2011) and amphibians (Länsstyrelsen 2013). Many of the species connected to pastures are rare and red-listed (Olsson 2008).

The area of pastures in Sweden has drastically declined since the end of the 19th century, less than a percent of the initial area remains today (Bernes 1994). In Scania, the southernmost region in Sweden, the landscape was shaped by meadows and pastures, which accounted for at least half or more of the total area of Scania during the 16th century (Emanuelsson et al. 2002). The need for manure for food production on fields put domestic animals to the centre of food production in the 17th century. Meadows and pastures needed to be abundant to produce enough animal feed for the whole year (Emanuelsson et al. 2002).

According to the Swedish Board of Agriculture (2000), *Jordbruksverket*, the decline of pastures in Sweden has been largely connected with the transition to a more intense agricultural system, based on fewer but larger farms and less dependent on grazing animals. This transition was driven by the development and spread of modern fertilizers in the 1950s, which disrupted the balance and connection between crop farming and animal husbandry (Bernes 2011).

Scania can be roughly divided into three regions; *the plains districts* in which fields and large-scale agriculture dominate. The soil is fertile and the landscape has been shaped for production by straightening roads, rivers and borders for effective land use. Few obstacles remain in terms of non-arable outcrops, ditches and solitary trees. *The central regions* have more meagre

soils, more rocks and are more dominated by pastures. *The forest regions* in northern Scania only have spots of pastures and agriculture and are more dominated by forest. The forest regions together with the central regions contain mostly smallholding farms (Länsstyrelsen i Skåne 2015).

Between 2002 and 2004 a survey of semi-natural pastures and meadows was carried out, which described the natural values related to pastures and meadows in the whole of Sweden (Jordbruksverket 2005a). The results from this survey, *Ängs- och betesmarksinventeringen*, are publicly accessible through the online database TUVA (Jordbruksverket 2005a). The survey will henceforth be referred to through its database TUVA.

Sweden entered the European Union (EU) in 1995 and has since then taken part in its Common Agriculture Policy (CAP). This policy is reflected in the Rural Development Programme of Sweden, *Landsbygdsprogrammet*. The previous programme ran between 2007 and 2013 and has now been exchanged for the new program spanning from 2014 to 2020 (Regeringskansliet 2012a). The database TUVA is often used to follow up and evaluate pastures.

The Government of Sweden has decided on 16 national environmental objectives, among these *a Varied Agricultural Landscape*, which states the importance of meadows and pastures, conservation of natural and cultural environments and the preservation and strengthening of biodiversity. Another environmental objective is *a Rich Diversity of Plant and Animal Life*, which states among other things that the preservation of natural habitats and species needs to be favourable, the status for threatened species improved and that enough genetic diversity has to be maintained inside and between populations (Regeringskansliet 2012b).

Pastures in Sweden can be eligible to take part in the agri-environmental scheme from the EU (henceforth referred to support or support system), which is the main financial instrument for preserving pastures in Sweden. The support differs in terms of both amount and requirements for pastures with common and particular natural values. The pasture must fit the definition for pastures: it is grazed every year, it supplies enough fodder for the animals, it is not fertilized, it is not suitable for ploughing and it is registered as agricultural land (Jordbruksverket 2012a).

The definition of pastures was changed in 2008, introducing a restriction on the amount of trees and bushes that were allowed in the pasture (Jordbruksverket 2010). Sweden had received critique from the European Commission, which claimed that Sweden had been granting support to pastures with too high tree and bush cover. Sweden changing the definition of pastures eligible for support was a direct result of this critique. The new definition restricted the number of trees in a pasture to 50 per hectare (ha), with the exception of trees with high natural, cultural or visual values. Bushy areas larger than 0.01 ha that are inaccessible for livestock were not eligible for support. Pastures with particular values (determined by the County Administrative Board, *Länsstyrelsen*) were excluded from the additional requirements for trees and bushes. The European Commission was not satisfied with the new definition, thus it was changed again in 2009. This new definition allowed a maximum of 60 trees per ha for pastures with common values and 100 trees per ha for pastures with particular values. The changed definition included all trees, even those with high natural or cultural values (Jordbruksverket 2010).

A study of meadows and pastures in Scania showed that 20% of pastures and meadows with high natural values (included in TUVA) were managed outside of the support system (Helgeson 2013). The analysis showed that there was a negative correlation between high levels of tree and bush cover and the probability that the land was supported. Helgeson suggests a connection between her results and the change of pasture definition in 2008. This hypothesis is further supported by the results of the survey conducted within the study, where many farmers shared their opinions about the new definition (Helgeson 2013).

This study set out to investigate the relationship between the maintenance of pastures in Scania County and the Agri-environmental payments. The following questions were investigated: (1) Is there a difference between supported and unsupported pastures regarding the likelihood that they are grazed? (2) Are there differences in grazing between pastures included and excluded from TUVA? (3) Do supported and unsup-

Table 1. Definition of the support periods (in years) used for pasture selection within the study

Categories	Support period
Supported	2002-2004 and 2011, 2012 or 2013
Unsupported	2002-2004 but not 2011, 2012 or 2013

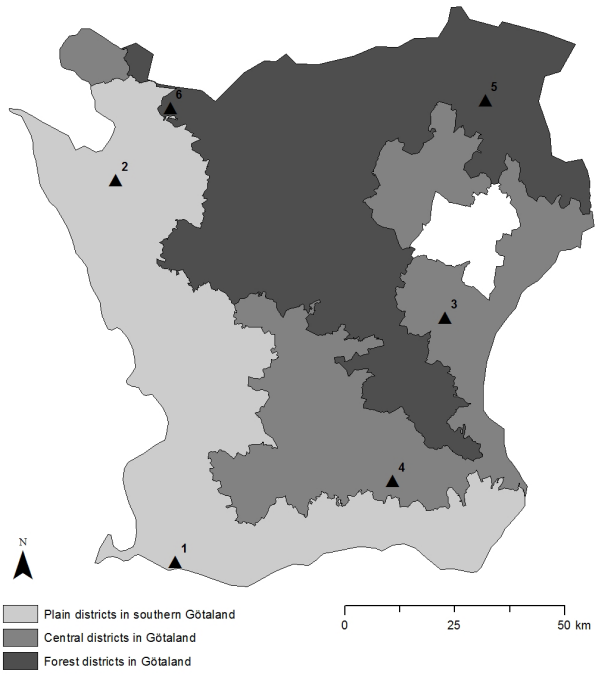

Figure 1. The location of points (1-6) in the three production areas in Scania, Sweden. The white polygon above point no. 3 is the plain of Kristianstad, which was excluded from the study.

ported pastures differ in terms of tree and bush cover? (4) Is there any difference in tree and bush clearance between supported and unsupported pastures? (5) In how many instances have unsupported pastures been planted with trees?

Method

Selection of pastures using background data

GIS shapefiles containing data on supported agricultural land for every year between 2002 and 2013 were acquired from the Swedish Board of Agriculture. Data from 2001 was available but excluded since it was incomplete; data from 2014 was also excluded based on the change of the Rural Development Programme between 2013 and 2014 (Regeringskansliet 2012a). Shapefiles containing data about pastures included in the survey of meadows and semi-natural pastures were collected from the database TUVA, Jordbruksverket. In this study, pastures in TUVA were used as proxies for pastures with high natural values. A shapefile containing agricultural production areas was used and edited to only contain the three areas present in Scania (parts of the production areas extending beyond the border of Scania were removed from the shapefile). The three production areas (Figure 1) and their corresponding numbers are (1) Plain districts in southern Götaland, (2) Central districts in Götaland and (5) Forest districts in Götaland.

Pastures in Scania County were randomly selected based on whether or not they were present in the support system (Table 1). To control for the possible effect of high natural values (such pastures can receive a higher support) roughly half of the selected pastures overlapped with areas included TUVA (41 were included and 31 not included). No differentiation was made between the degrees of natural values described for each pasture in TUVA.

All data above was imported to ArcMap (ESRI ArcGIS 10.2.2) and the tool "Create Random Points" (Data Management, Spatial Analyst extension) was used to generate two points within each of the three production areas (resulting in a total of six points) with the requirement that the two points are at least 25 kilometres from each other. Islands were excluded for

Table 2. Collected variables, their categories and definitions of the different categories

Variable	Category	Definition
Grazing	Grazed	Grazing has taken place this year
	Not Grazed	The area is not grazed, overgrown or abandoned.
Tree cover [1]	None/A few	0-10% canopy cover
	Semi-open	10-70% canopy cover
	Closed	>70% canopy cover
Bush cover [2]	None/A few	0-10% cover
	Semi-open	10-70% cover
	Closed	>70% cover
Tree and bush clearance	Yes	Traces of cut or cleared bushes and/or trees were found
	No	No traces of cut or cleared bushes and/or trees were found
Plantation [3]	Yes	Pasture has been planted with trees
	No	Pasture has not been planted with trees

[1] Including woody plants above three meters tall, usually having only one main trunk.

[2] Woody plants shorter than three meters usually having more than one main trunk. *Juniperus communis* was counted as a bush.

[3] Counted as plantation if more than 50% of the pasture was planted (natural spreading of trees not included).

logistical reasons as well as the plain of Kristianstad, Kristianstadsslätten (Figure 1), which for the most part consists of arable land. Thereafter the closest 12 pastures to each of the six points, sized between 0.3 and 50 ha, were selected: three supported pastures found in TUVA, three supported pastures not found in TUVA, three unsupported pastures found in TUVA and three unsupported pastures not found in TUVA. This resulted in a total of 72 selected pastures for all six points (Figure 1).

Data collection

Inventories of the selected pastures were carried out in the end of the grazing season, between 15th and 19th October 2015. This is an optimal time for grazing studies since grazing pressure can easily be determined. A handheld GPS device in combination with printed maps was used to locate the selected pastures. Terrängkartan, a terrain map produced by Lantmäteriet, was used both on the printed maps and on the GPS device to efficiently identify pasture borders. The coordinate system SWEREF 99 TM was consistently used in the study. The method for evaluation the pastures (Table 2) have been adapted from Jordbruksverket (2005b).

Statistical analysis

The relationship between ”support” and ”grazing” was investigated for the whole sample (using a Chi-Squared test) as well as within each of the three production areas (using Fishers Exact Test). The relationships between “grazing” and “TUVA”, “support” and “tree cover”, “support” and “bush cover”, and “tree cover” and “production area” were investigated using Fishers Exact Test. All statistical tests were performed in IBM SPSS Statistics 22 (64-bit version).

Results

34 out of the 36 (94%) supported pastures were found grazed during the inventory and for unsupported pastures 22 out of 36 (61%) were grazed (Figure 2). Therefore a total of 58 out of 72 (81%) pastures were grazed. A Chi-Squared test showed that there was a significant difference ($\chi^2_1 = 11.571$, n = 72, p = 0.001) in grazing between supported and unsupported pastures. There was a significant difference in grazing between supported and unsupported pastures within production area no. 2 (p=0.014) but not in production areas no. 1 (p=0.069) and no. 5 (p=1.0). There was no difference (p=0.525) in grazing between pastures included and pastures excluded from the TUVA database (Figure 3). There seems to be a difference (p=0.054), although not statistically significant, in tree cover between supported and unsupported pastures (Table 3). Production area no. 5 has a significantly (p=0.009) higher tree cover than production areas no. 1 and no. 2 (Table 4). There were no significant differences in bush cover between pastures with and without support (p=0.752). Out of all 72 pastures only one pasture was found planted with trees and only one pasture had been cleared, both were unsupported pastures.

Discussion

Differences in grazing

The result for grazing between supported (94%) and unsupported pastures (61%) is consistent with the main hypothesis that there is a difference in grazing between supported and unsupported pastures. More specifically, grazing occurs less in unsupported than in supported pastures. This shows that some but far from all farmers continue to maintain their pastures after leaving the support system. These results are consistent with those by Jordbruksverket (2010b). It should be noted however that their study focused only on pastures included in TUVA. This indicates the importance of the support system for proper management of pastures, which in turn is vital for the preservation of biodiversity related to pastures. Unsupported pastures, although grazed so far, should be considered in danger of becoming abandoned and overgrown in the future.

Results showed a significant difference in grazing inside of production area no. 2, but not for no. 1 and no. 5. Production area no. 2 represents central districts, which constitute a transition area between the plains and the forest areas. The central districts have histor-

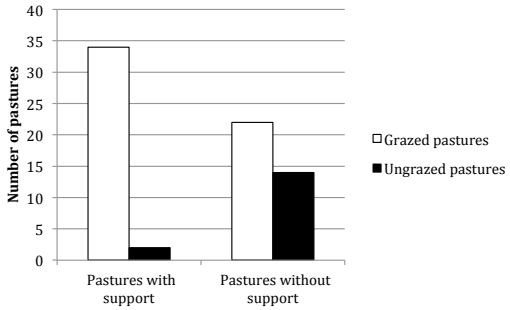

Figure 2. Differences in grazing in supported and unsupported pastures in Scania, Sweden. There proved to be a significant (p=0.001) difference in grazing between pastures with and without support.

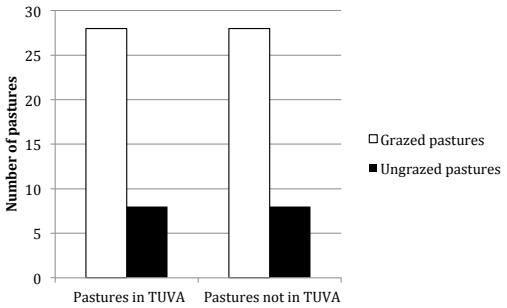

Figure 3. Differences in grazing in pastures included and excluded from the TUVA database in Scania, Sweden. There was no significant (p=0.525) difference in grazing between pastures included in and excluded from the TUVA database.

Table 3. Tree cover in supported and unsupported pastures in Scania, Sweden			
	None/A few	**Semi-open**	**Closed**
Supported pastures	80.6%	19.4%	0.0%
Unsupported pastures	63.9%	22.2%	13.9%

ically been more abundant in meadows and pastures compared to the plains and forest districts and the soils are more meagre there than in the plains district (Emanuelsson et al. 2002). It is possible that pasture owners in the central districts have been more focused on cattle production on pastures and have been struck harder by the changes in pasture definition and the general unprofitability of managing unfertilized pastures with domestic animals.

Pastures included in TUVA

Results show no differences in grazing between pastures included and excluded from the TUVA database. Jordbruksverket (2010b) found a slightly higher average of high natural values in pastures without support. Later it was shown that the higher natural and cultural values a pasture had, the more likely it was that it was in the support system (Jordbruksverket, 2012b). The findings of Helgeson (2013) together with the results of this study suggest that unsupported pastures with high natural values has more or less the same chance of becoming abandoned and overgrown as unsupported pastures with low natural values. The cause of this could be related to increased management of pastures with high natural values. A high number of trees and bushes will require more maintenance but also be more rocky and meagre, which could have a negative effect on the fodder yields, making such pastures less profitable to own and maintain.

Tree and bush cover

The near significant difference in tree cover between supported and unsupported pastures is supported by Helgeson (2013), whose models showed that a high tree cover correlated negatively with the probability that a pasture would still be part of the support system. Both of these results could be explained by the change of pasture definition (CAP tree rules). Pastures with a high level of trees require more attention in terms of maintenance and intermittent tree and bush clearances. Pastures with a low level of maintenance have been correlated with a high likelihood of being part of the support system (Jordbruksverket 2010b and 2012b). Even though there were significantly more trees in production area no. 5, this did not affect the level of grazing in unsupported pastures compared to supported pastures; only production area no. 2 showed differences of its own (see "Differences for each production area").

The lack of difference in bush cover between supported and unsupported pastures could be a result of increased tree and bush clearance in pastures (Jordbruksverket (2010a), regardless of their involvement in the support system. These results refute the hypothesis and earlier research, as by Helgeson (2013) who showed that, similarly to tree cover, high bush cover correlated negatively with the probability that a pasture would still be part of the support system.

Tree and bush clearance

The fact that tree and bush clearance was only observed in one of the selected pastures was a surprising result and refutes the hypothesis that there would be a difference in the number of tree and bush clearances between supported and unsupported pastures. Jordbruksverket (2010a) could through a satellite-based study show significant increases of tree and bush clearance in Southern Sweden between 2007 and 2008, a result they connect to the more strict pasture definition implemented in 2008. It is likely that the method used in this study was not thorough enough to detect cleared areas within pastures.

Plantations

The frequency of planted pastures was counted to investigate how common this procedure was. There was only one instance of a pasture planted with trees, in this case a young spruce plantation. It would have been more useful to record a more general variable as altered land use instead of only plantations. While plantations were only recorded once, there were several previously supported pastures that were found to be fields for wildlife and game, tilled fields and in some instances built environments.

Table 4. Distribution of tree cover in the different production areas in Scania, Sweden			
Production area	**None/A few**	**Semi-open**	**Closed**
(1) Plain districts in southern Götaland	87.5%	12.5%	0.0%
(2) Central districts in Götaland	83.3%	12.5%	4.2%
(5) Forest districts in Götaland	45.8%	37.5%	16.7%

Conclusion

Several studies have previously looked into the subject of pastures related to the support system, especially pastures included in TUVA. This study was the first one to collect data from the field to assess the actual frequencies of grazed pastures outside of the support system. The fact that many farmers stop maintaining their pastures when no longer receiving support for them is troubling for the conservation of the vast biodiversity connected to pastures. There seems to be a connection between unmaintained pastures and a high tree cover. This does add further support to, as previous studies have suggested and shown, the possibility that the change in pasture definition has driven additional farmers away from the support system. There seems to be a lack of a proper "carrot" for the farmers to keep receiving support and to keep maintaining their pastures. To be able to reach the goals set by the Swedish Government, the national environmental objectives of a varied agricultural landscape and a rich diversity of plant and animal life, the support system needs to be evaluated and improved to stop the decline of meadows and pastures in Scania and the rest of Sweden.

Acknowledgements

I would like to thank Ola Olsson for supervising my work and leading me along the way. I also would like to thank my parents for their helpful support and peer review. I also want to thank Olof Åström for introducing me to Adobe InDesign. At last I want to thank Katrin Humal, who was always there to help me with everything from spelling to statistics.

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