UPPLANDS STIFTELSEN
NATURVÅRD & FRILUFTSLIV

WWF

REPORT 2013/13

BUTTERFLIES

as indicators for grassland management and biodiversity

- Status and trends 1997–2012
in the Uppland costal region

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BACKGROUND

The species-rich habitats in the agricultural landscape consists of biotopes (e.g. grassland, forest pasture, coppice woodland) and landscape elements (e.g. old trees, stone walls, ponds) of which a majority are formed by a long history of traditional land use. These habitats provide favourable conditions for large numbers of specialised species and for species-rich organism communities. Some particularly important habitats are grazed or mown unfertilised grassland (in particular on sand, base-rich soil, and in wetland), semi-open grazed forest, coppice woodland, and shrubs and old-growth sun-exposed trees. Since such habitats are created by man but have been colonised by wild species, they are often referred to as semi-natural.

In the present agricultural landscape much of the species-rich traditional habitats have vanished due to production intensification in some areas and habitats and abandonment in others. Intensification consists of both transformation of semi-natural habitats (for example of meadows into arable land and of pastures into production forest), and intensification in terms of increased fertilisation, use of biocides, and homogenisation of arable land. With few exceptions, the new habitats are species poor and are mainly colonised by generalist species. Abandoned semi-natural habitats, on the other hand, can for some period of time remain rich in management-dependent species due to slow succession and delayed population responses to changed environmental conditions.

Negative trends can be observed for species/populations and habitats, of which the latter include trends of both abundance (e.g. area of biotope) and habitat quality. Conservation efforts concerning grassland therefore need to focus not only on grassland area, but also on ecological grassland quality, which largely equals management quality.

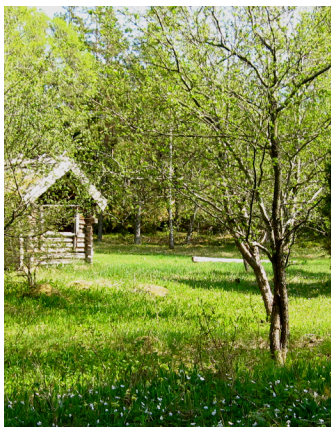


Photo 1–2. Traditional used landscape in eastern Uppland. (Anett Wass)

GRASSLAND AREA, RESTORATION, AND CONTINUED MANAGEMENT

Regarding grassland area, it is essential to maintain the last fragments still in use, as well as to restore abandoned areas which still have rich biodiversity.

Restoration is necessary both to improve the ecological quality of small fragments and of whole landscapes, and to halt the loss of biodiversity due to succession in abandoned grasslands. Without resumed management all management-depending species in an abandoned semi-natural habitat patch can be assumed to eventually become extinct. Extinction in already abandoned habitats is probably the major cause of current biodiversity decline in the agricultural landscape. The loss of biodiversity is often denoted extinction debt and indicates an ongoing and extensive loss of the agricultural landscape's biodiversity independently of conservation measures in the managed areas.

A pilot study in the province of Uppland showed that 20-80 per cent (varying between landscape types) of the populations of management depending vascular plants occur in abandoned grassland (CBM unpublished). Coastal areas and other topographically heterogeneous and dry regions have the highest proportions of abandoned, but still biodiversity-rich, habitats. Such areas thus have the largest needs and potentials for grassland restoration.

Resumed management of species-rich abandoned semi-natural habitats is considered a priority conservation measure. However, judging from the national financial support to resumed management during 2001-2006, the rate of grassland increase by restoration (most likely less than 0.5%/year) is very far from the need of 20-80 per cent in total. This implies that (1) the current rate of management resumption will rescue only a fraction of

the species-rich abandoned habitats before they are lost due to succession; (2) there will continue to be a strong biodiversity decline in agricultural ecosystems; (3) the abundance of management depending species will decrease by almost 20-80 per cent and eventually stabilise at a thus considerably lower level.

Since ceased management of traditional semi-natural habitats is historically a major cause of biodiversity decline in the agricultural landscape, conservation effort has largely focused on preventing further cessation. In general, abandonment of managed habitat has been very low after 1990 compared to earlier decades, most likely due to compensation programs for management, first within the NOLA system, later within the CAP. National area records do not allow analysis of the rate of the still ongoing cessation. However, some studies indicate that at least c. 1 per cent of the managed semi-natural grassland was abandoned per year during c. 1990-2004 (Jordbruksverket 2005, Hiron 2006). The loss of managed grassland may be at least twice as high as the gain due to restoration and resumed management.

GRASSLAND QUALITY

In the semi-natural habitats subject to continuous or resumed management, biodiversity rely on sufficient habitat quality in combination with necessary landscape services such as pollination and dispersal. A growing body of observations and studies indicates, however, that management not always provide habitat quality sufficient for more demanding species. Some examples of such indications are:

- Several management depending species decline in spite of management, in particular pollen- and nectar eaters (Linkowski et al. 2004, Larsson 2006) and phytophagous insects, e.g. butterflies (Kruess and Tscharntke 2002, Björklund 2007).
- Abandoned grassland habitat patches are often richer in phytophagous insects connected to management depending plants, than grazed grassland patches (Björklund 2007).
- Recovery plans for threatened species recommend timing and intensity of management, and habitat structure that are not consistent with directives for management according to CAP (Lennartsson 2010).

Usually the reason is that management is too different from the traditional land use that created the habitats (Gustavsson et al. 2011; Dahlström et al. 2013). This may in turn be caused by too large a focus on vascular plants, lack of knowledge about the links between biodiversity and historical management regimes, e.g. timing of grazing (Dahlström et al. 2008), or application of too intense grazing as an attempt to decrease shrub cover (Pihlgren & Lennartsson 2008; Overud & Lennartsson 2004). Directives for management that are poorly ecologically justified occur both within the Swedish application of CAP regulations and within the Nature 2000 framework. The main criticism, especially concerning CAP, has been that uniform management regimes (in terms of grazing intensity, scrub clearing etc.) are applied without sufficiently considering different management needs among different habitat types (Overud & Lennartsson 2004; Lidén 2006).

Insufficient habitat quality has attracted little attention compared to habitat loss, and few quantitative estimates of its impact are available. Quantitative data are provided mainly by long-term scientific field surveys. For example, around 30 per cent of the populations of the grassland herb field gentian (Gentianella campestris) have gone extinct during 1990-2004 and another 40 per cent have shown negative trends. Around 80 per cent of the

overall decline can be attributed to suboptimal grazing, mainly too intense or too early in the season (Pettersson 2004).

Suboptimal management is likely to be the cause of a considerable ongoing decline of certain species groups, in particular insects, and in certain habitats, in particular dry grasslands and habitats that traditionally were subject to late-season disturbance, e.g. former hay-meadows. Given the slow response of biodiversity to abandonment in many habitats, suboptimal management may in a shorter time perspective sometimes cause faster rate of decline than succession.

MANAGEMENT ASPECTS ON BUTTERFLIES AND THEIR HOST PLANTS

Along the Uppland coast, large proportions of both butterflies and their host plants occur in abandoned, but not yet overgrown, former semi-natural pastures and hay meadows. This calls for considerably increased restoration and resumption of management. This need was one major motive for launching the project Roslagshagar at Upplandsstiftelsen, which aimed at increasing the area of managed biodiversity-rich grassland, and the sustainability of grassland use at the Uppland coast (Roslagen).

In this region, as well as elsewhere in Sweden, many species of butterflies and plants vanished in spite of management, indicating that the current management practices are insufficient for preserving grassland biodiversity. As a result, butterflies are more often found in (temporarily) viable populations in abandoned grasslands than in managed ones, and there are several examples of restoration projects having negative impact on butterfly populations. This calls for developing and implementing ecologically better methods for grassland management as well as for grassland restoration. These needs were a second major motive for the Roslagshagar project.

The purpose of this study is to evaluate the Roslagshagar efforts during the last decade, as well as the grassland management for biodiversity in general. Specifically, we ask:

1. How has restoration of abandoned grasslands, initiated by Upplandsstiftelsen, affected the habitat prerequisites for butterflies?
2. How have the butterfly habitats developed in abandoned grasslands not subject to specific conservation initiatives – to what extent has such areas become resto red by land-owners, how fast is the succession in absence of restoration?
3. How have the butterfly habitats developed in managed grasslands, with or without specific conservation design of the management?

THIS PROJECT

From 1996 a number of semi-natural grasslands in Eastern Uppland have been surveyed by Upplandsstiftelsen, primarily with respect to butterflies and their host-plants, but also in terms of management status and general grassland structure. The grasslands are situated in the limestone-rich archipelago and coastal area of Northern Roslagen, known for its rich flora. The butterfly fauna was investigated through active search on host-plants and in other suitable habitats, and through manual light-trapping.

Several species-rich grasslands were discovered, and the work showed a much richer butterfly fauna in the region than earlier known. A second survey, mainly 2002-04, discovered several other grasslands, of which some are included in this study.

For some of the identified grasslands, restoration and improved management was applied, e.g. through advice to land-owners, financial support to active measures, facilitation

of contacts between land-owners and external owners of cattle etc. All grasslands subject to such measures became eligible for agri-environment payment, which has been the main economic incentive for restoration and continuation of grassland use during the period.

Other grasslands were left without particular initiatives from Upplandsstiftelsen after the first survey. Some of those were in use at the first survey, others were abandoned.

Since the sampling effort regarding species of butterflies and plants varied between sites, the data from the initial survey cannot be used quantitatively. On the other hand, the data provide qualitative information about relationships between butterfly occurrence, host-plant occurrence, and management. The qualitative data on grassland status and biodiversity, together with information about subsequent conservation measures can be used to evaluate how species-rich grasslands of conservation concern have developed during 10-15 years in Sweden.

- By re-visiting the grasslands 2011-2012, it is possible to contribute to the evaluation of the ecological effects of both the national RDP, and the conservation efforts done by Upplandsstiftelsen and other actors.
- Analyses of the data from the two surveys can further contribute to finding methods for identification of value-areas for biodiversity, and to focussing on indispensable management components which need to maintained or re-introduced. The analyses can thus be regarded as an applied example of knowledge-based conservation, in turn a base for a revision of the NRDP and of European CAP in general.

METHOD

For the second inventory 2011-13, a stepwise approach for data collection is used. The steps (described below and in Figure 1) are causally linked. Restoration and management form the overall habitat structure which influences the butterfly population, both through microclimate and host-plants/nectar plants. For each site, information is collected according to the following:

Photo 3. Manual light-trapping was used together with netting (see cover) to discover the butterfly fauna at each site, including nocturnal species.

1. Step one: Changes of habitat management since the first survey.

2. Step two: Ecological changes of the habitat as result of the management changes in step one.

3. Step three: Changes of the potentials for favourable conservation status of the butterfly fauna, as result of the ecological habitat changes in step two.

4. Step four: Actual changes of the butterfly fauna since the first survey, as result of the habitat changes in step three.

Regarding step four, butterfly fauna, focus was on species of macro- and micro-lepidoptera of particular conservation interest, for example nationally red-listed species, regionally threatened species, or species being indicative for certain species-rich habitats.

Information in step one and two can always be collected. Information in step three can usually be collected, although some types of data may be uncertain because of unsuitable weather conditions or large between-year variation. Observations of actual changes of butterfly populations, step four, can only be made with certainty under favourable conditions and may therefore be missing at some sites.

Figure 1. Stepwise evaluation of potentials for the butterfly fauna. See text for explanation.

FIELD MANUAL

1) CHANGES OF HABITAT MANAGEMENT AND OTHER LAND USE

a) Restoration measures

i) Clearing of the shrub layer in order to favour the grass sward (note the type and intensity of clearing, i.e., what has been cleared and to what extent)

ii) Clearing of the tree layer in order to favour the grass sward (note the type and intensity of clearing, i.e., what has been cleared and to what extent)

iii) Clearing of the tree layer in order to favour veteran trees, shrubs or other structures in the tree- or shrub layers (note the type and intensity of clearing, i.e., what has been cleared and to what extent. Note also which structures that seem to have been the target for the measure)

iv) Fencing in order to expand or control the grazing (note what seems to have been the target for the measure)

v) Other restoration measures (describe)

b) Changed management

i) Resumed management (note the type of management, e.g., mowing, grazing, late grazing, lawn mowing)

ii) Changes of management type (note the type of change, e.g., new type of grazing animal, mowing instaed of grazing, late grazing instead of continuous, considerably increased or decreased intensity of grazing)

iii) Ceased management (if possible, note when cessation took place)

iv) Other management changes (describe)

c) Other habitat changes related to land-use

(note the type of change, e.g., tree plantation, fertilisation, new buildings, roads, forestry logging, drainage, cultivation)

2) ECOLOGICAL CHANGES OF THE HABITAT AS RESULT OF THE MANAGEMENT CHANGES

a) Sun exposition and wind

i) Change of tree layer (note the canopy projection [Categories: 0–25%, 26–50%, 51–75%, 76–100%, mosaic of gaps and groves] and describe how it has changed since last survey)

ii) Change of shrub layer (note the ground cover [Categories: 0–25%, 26–50%, 51–75%, 76–100%, mosaic of gaps and groves] and describe how it has changed since last survey)

iii) Estimated sun and wind conditions as result of the tree and shrub layers

(1) Sun exposure (on a three-category scale: Exposed [sun exposed most of the day and most of the site]; Intermediate exposure [approx. half of the day or half of the site]; Shadow [most of the day or most of the site].)

(2) Wind exposure (on a three-category scale: Shelter, Intermediate shelter, Wind-exposed)

b) Field layer, grass sward

i) Change of cover of grass sward

(1) Change of grass sward cover since last survey (if possible by estimating approx. percentage change, otherwise note only increase or decrease)

(2) Causes (if the grass sward cover has changed, note the most plausible causes for the change, e.g., denser tree cover, too intense grazing, clearing of shrubs)

ii) Changes of vegetation properties

(1) Change of vegetation height and litter depth (note whether the vegetation height seems to have increased or decreased, and the same for the litter depth, i.e., the layer of old plant material)

(2) Change of vegetation composition (note estimated changes of the vegetation composition, e.g., increased or decreased dominance of grasses or rushes on the cost of herbs, increased dominance of certain species, or decreased abundance of certain species which earlier were conspicuous in the vegetation. For increase/decrease of more rare species, e.g. host-plants for butterflies, see step 3, below.)

(3) Change of vegetation disturbance (note whether the vegetation the intensity of disturbance by grazing, mowing or other, has increased or decreased since last survey)

iii) Other vegetation changes (describe, e.g., changed soil moisture, more bare soil)

c) Other habitat structures which have been affected by changed management

i)Veteran trees and similar (note if possible the approximate number of trees that are either overgrown, dead, or rescued by clearing measures; otherwise note if the number of trees in the different categories has increased or decreased)

ii) Biologically important shrubs (note the change of status, e.g., regarding exposure)

iii) Other (describe, e.g., changed exposure of wetland, rocks, certain types of wood)

d) Landscape (optional)

Describe important changes of the site's neighbouring areas.

3) CHANGES OF POTENTIALS FOR BUTTERFLIES AS RESULT OF THE ECOLOGICAL CHANGES

a) Local butterfly-climate

Describe briefly the microclimatic status of the site regarding climate variables being important for butterflies (wind-exposure, sun-exposure), either in general or for specific species occurring at the site. If possible summarise the description in terms of very suitable, suitable, unsuitable for butterflies.

b) Important host-plants for butterfly species present at the site

i) Abundance of host-plants (note for each host-plant species: abundant, medium abundant, scarce, and if possible large increase, increase, stable, decrease, large decrease).

ii) The host-plants' function for butterflies (describe the suitability for butterflies: suitable, less suitable because of… e.g. too intensely grazed, too little sun exposure etc).

iii) Concluding host-plant potential (summarise for each of the most important butterfly-species the site's potential regarding host-plants, in terms of very suitable, suitable, unsuitable).

c) Nectar resources, flower richness

i) Abundance of nectar plants (note nectar-plant abundance: abundant, medium abundant, scarce, and if possible large increase, increase, stable, decrease, large decrease. Note also if the resource differs between early-season-flying and late-flying species).

ii) The nectar-plants' function for butterflies (describe the suitability for butterflies: suitable, less suitable because of… e.g. too intensely grazed, too little sun exposure etc).

iii) Concluding nectar-plant potential (summarise the site's potential regarding nectar-plants, in terms of very suitable, suitable, unsuitable).

d) Other habitat conditions important for butterflies

Describe other conditions, e.g. for species dependent on other food sources than

host-plants, on specific hibernation conditions etc.

e) Landscape (Optional)

Describe major changes of the potential for butterflies, e.g. broken dispersal routes, increase or decrease of neighbouring populations (which may serve as dispersal cores), increase or decrease of suitable habitat close to the site etc.

4) CHANGES OF THE BUTTERFLY FAUNA AS RESULT OF THE CHANGED HABITAT POTENTIAL

a) Species specific for patches of host-plants or other substrate, microhabitats etc (can be found by directed search on the specific resource)

i) Quantitative changes (note if possible for each species the total number of suitable resource patches at the site, and the number of patches on which the species was found. Note if possible coordinates for the visited patches, or show on a map where they are situated)

ii) Qualitative summary of the changes. Describe for each species its conservation status in terms of:

(1) Abundance (abundant, medium abundant, scarce)

(2) Trend (large increase, increase, stable, decrease, large decrease since previous inventory)

(3) Causes (Likely explantations for the status and trend)

b) Species specific for the site but less obviously connected to certain patches of resources (can be found by site-scale netting or light-trapping)

i) Qualitative summary of the changes. Describe for each species its conservation status in terms of:

(1) Abundance (abundant, medium abundant, scarce)

(2) Trend (large increase, increase, stable, decrease, large decrease since previous inventory)

(3) Causes (Likely explanations for the status and trend)

SITES INCLUDED IN THE SURVEY 2012–2013

Numbers in brackets refer to earlier inventory during the years noted.

- Boda. 2002–2003
- Brudskäret middle, Långalma. 2002–2004
- Brudskäret north, Långalma. 2002–2004
- Brudskäret south, Långalma. 2002–2004
- Eriksdal, Gräsö. 1996–1997
- Grönsinka, Kallriga. 1996–1997
- Havsvik, Raggarön. 2003–2004

- Kattskär, Gräsö. 1996–1997
- Kråkan, Söderboda, Gräsö (5). 1996–1997
- Laduskär, Tvärnö. 1996–1997
- Långalma 1996–1997
- Lönnholmen, Gräsö. 1996–1997
- Muskargrund, Gräsö. 1996–1997
- Norrboda harbour, Gräsö (3). 1996–1997
- Notvallen, Sandika 1996–1997
- NV part of Fagerön (50). 1996–1997
- NV part of Fagerön (50a). 1996–1997
- Olasskär. 2005
- Roparnäs, Sandikaön. 1996–1997
- Rönngrund, Kallriga. 1996–1997
- Stenalma. 1996–1997
- Storskäret, Kallriga. 1996–1997
- Svinnö. 1996–1997
- Söderökulla. 1996–1997
- Tuskö. 2004
- Vargudden, Kallriga. 1996–1997

Land-owners are informed about the evaluation through (paper)mail.

RESULTS

EFFECTS OF RESTORATION AND MANAGEMENT

The 26 sites were distributed among management and restoration measures as shown in Table 1. Most of the sites had been subject to restoration measures since the first survey. The type of restoration and subsequent management (usually grazing) differed between sites. Some of the sites were restored using "normal" measures, such as clearing of shrubs and trees followed by resumed grazing in previously unmanaged grasslands – often rather intense grazing in order to remove unwanted vegetation and shoots of cut trees. In other sites special attention was paid to the butterfly fauna, either to particular species of interest or to the fauna in general. For example, shrubs and groves of trees were left for shelter and the management was adjusted to fit butterflies, e.g. by applying late onset of grazing or fine-tuning the grazing intensity.

Table 1, blue part. Number of sites in different categories of change from first survey to second survey 2012–2013. Pink part: Number of sites showing Very good/Good/Poor suitability for butterflies, for the listed habitat characters.

	Abandoned at first survey				Managed at first survey			
	Restored			Not restored	Restored			Continued management
	Special butterfly measures	Normal restoration	Some butterfly measures		Special butterfly measures	Normal restoration		
						Extensive restoration	Moderate restoration	
	4	3	1	6	3	2	5	2
Microclimate	2/2/0	3/0/0	0/1/0	1/0/5	2/1/0	2/0/0	3/2/0	0/1/1
Host plants	3/1/0	1/2/0	0/1/0	0/1/5	2/1/0	1/1/0	3/1/1	0/1/1
Nectar resources	2/2/0	1/0/2	0/1/0	0/0/6	2/0/1	1/1/0	37622	1/0/1

Photo 4–5. Right: Rich flowering in June 2012 at the Boda site, restored and managed with careful consideration of shelter and supply of host plants and nectar plants.

Left: Dense shrub layer and thich litter before restoration at Boda. April 2004.

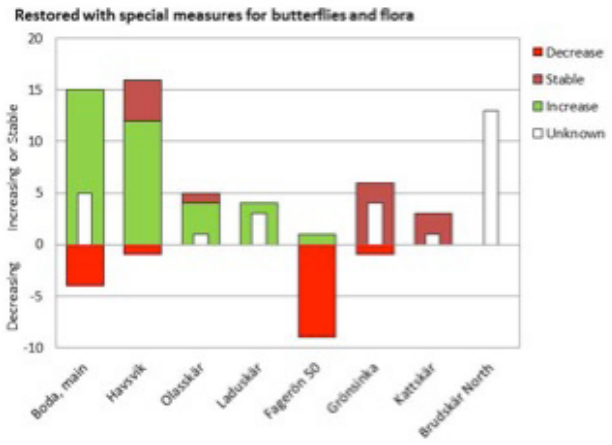
In the abandoned grasslands not subject to restoration measures, the most critical habitat characters microclimate, host plants, and nectar resources were deteriorated, showing poor suitability for the butterfly fauna. The cause of decline was encroachment of shrubs and trees. In contrast, restored sites showed positive or stable trends and good or very good suitability (Table 1). If restoration was made without special attention to butterflies, nectar resources, and to some extent host plants, were sometimes affected negatively by too intense grazing.

Only two sites were grazed during the whole period without restoration measures. One of the sites was negatively affected by encroachment of trees and shrubs, the other by too intense grazing.

The effects on habitat properties was reflected in corresponding responses of the butterfly fauna (Figure 1). Abandoned sites showed pronounced decline of several demanding species. The butterfly fauna indicated a difference between "normal restoration" and restoration with special attention to butterflies, as described above. Under normal restoration rather few species responded with increasing populations, compared to restoration in which clearing and subsequent management aimed at creating good microclimate and suitability of host plants and nectar plants.

In both types of restoration some species declined. However, in butterfly-oriented restoration, the causes of decline were always general and related to national decline or fluctuation, while in normal restoration 70 per cent of the observed negative population trends were caused by too intense grazing or trampling of host plants.

Figure 2. Number of butterfly species showing positive, negative, or stable trends in grasslands subject to three main types of land-use, represented by the three panels (the third on next page). Note that negative values show number of decreasing species.



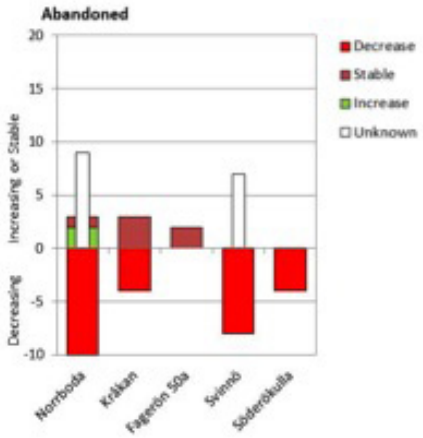


Figure 2. See previus page.

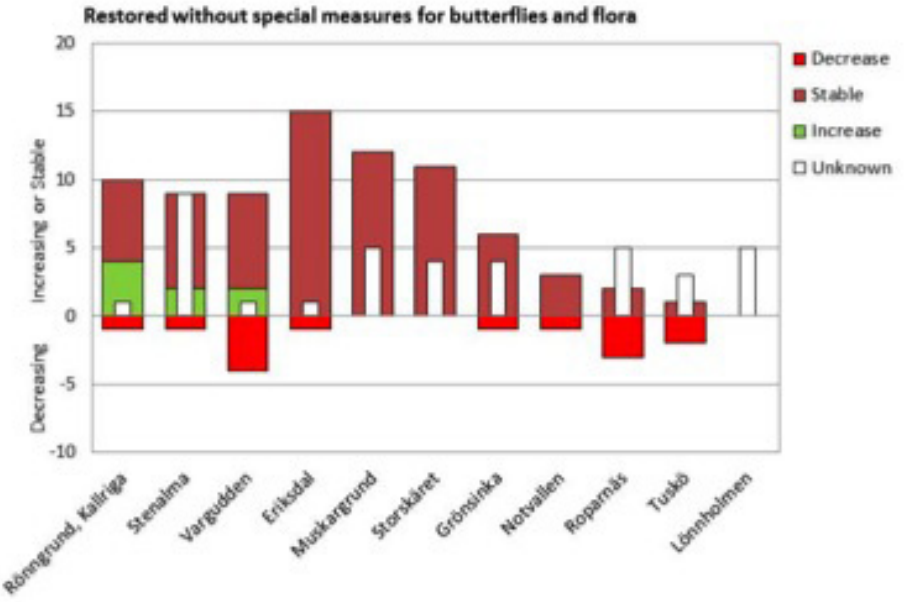


Photo 6. Grazing intensity suitable for butterflies at Eriksdal. 19 September.

CONCLUSIONS

The study shows that without initiatives from conservation authorities or NGOs, it is not likely that abandoned grasslands at the Swedish coast become restored for resumed grazing. On the other hand, if such initiatives are taken, it is possible to rapidly turn negative trends for butterflies and plants to positive, provided that the restoration and subsequent management are designed based on ecological knowledge, here, regarding butterflies and flora. Particularly successful has been to create sun-exposed but sheltered grasslands, and to apply late onset of grazing, from mid-July.

Without such design, there is a considerable risk of unwanted negative effects on populations, e.g. from too eager clearing of bushes and trees, and too intense or early grazing.

Photo 7. Grazing too intense for butterflies. Roparnäs 17 August.

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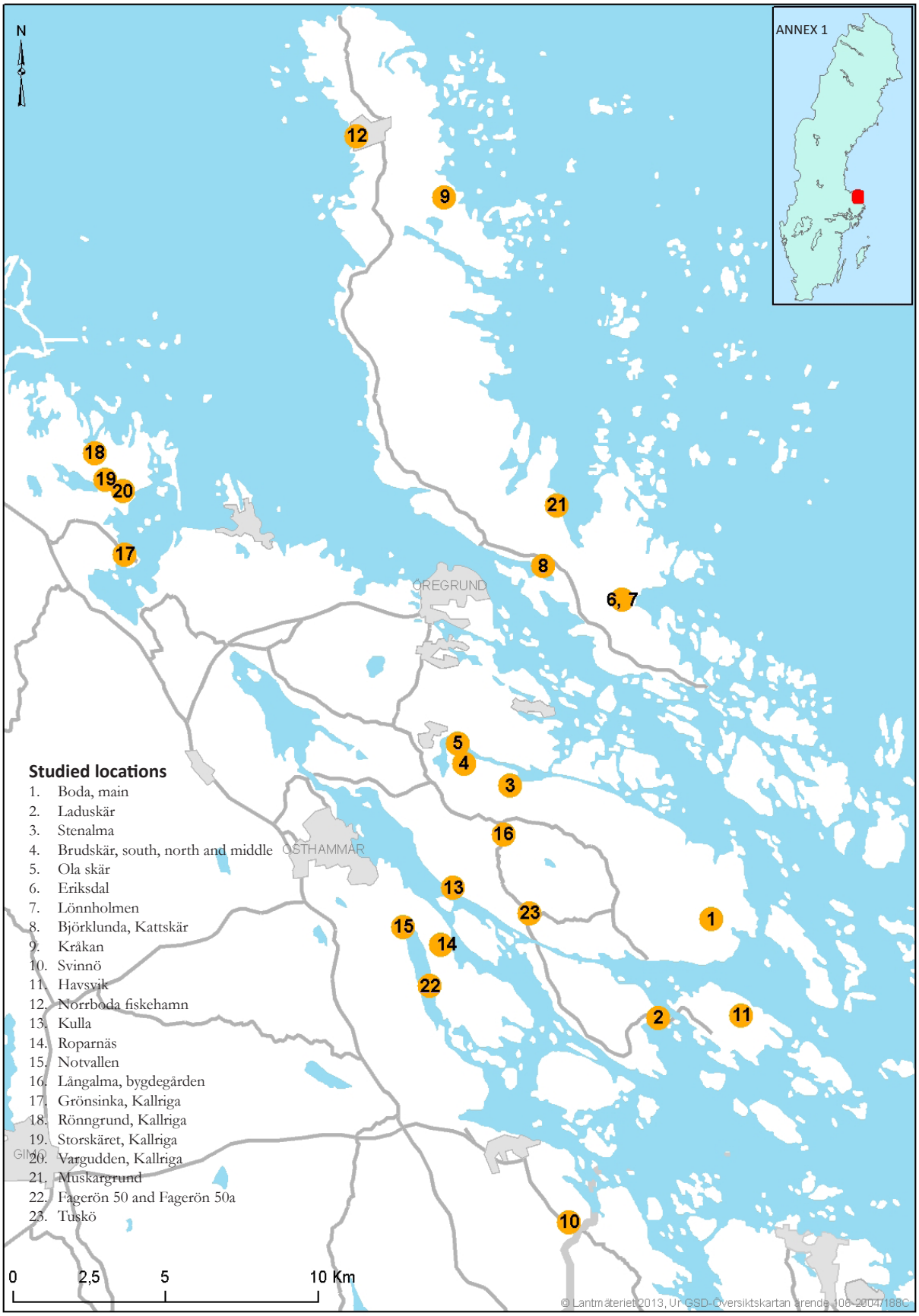
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21
8
6, 7
ÖREGRUND
5
4
3
16
ÖSTHAMMAR
13
23
1
15
14
22
2
11
10
Studied locations
1. Boda, main
2. Laduskär
3. Stenalma
4. Brudskär, south, north and middle
5. Ola skär
6. Eriksdal
7. Lönnholmen
8. Björklunda, Kattskär
9. Kråkan
10. Svinnö
11. Havsvik
12. Norrboda fiskehamn
13. Kulla
14. Roparnäs
15. Notvallen
16. Långalma, bygdegården
17. Grönsinka, Kallriga
18. Rönngrund, Kallriga
19. Storskäret, Kallriga
20. Vargudden, Kallriga
21. Muskargrund
22. Fagerön 50 and Fagerön 50a
23. Tuskö
0
2,5
5
10 Km
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