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Monitoring of butterflies within a landscape context in south-eastern Sweden

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Summary

Monitoring of butterflies is often directed only towards grassland fauna. Species associated with other habitats, as well as the impact of the surrounding landscape, are often neglected. The aim with this study was, in contrast, to perform and evaluate a landscape-based monitoring method for butterflies in diverse habitats and more specifically (i) to evaluate the impact of environmental variables on butterfly abundance, (ii) to compare the distribution of butterflies in different habitats, and (iii) to analyse data from the study with the aim of improving the method. Eight randomly placed study sites (750 m x 750 m) located in south-eastern Sweden were used. The vegetation composition (tree cover, percentage of coniferous and deciduous forest, shrubs, dry, mesic, damp and wet land) inside the squares was analysed using aerial photos and habitats along transects were categorized in the field. The butterfly composition varied depending on the landscape composition. Tree cover had the largest impact on butterfly abundance with a negative relationship between abundance and increasing tree cover. The most species-rich habitats were other grasslands (abandoned fields and fallows), clear-cuts, semi-natural grasslands, and bogs, each habitat also harbouring unique species. Clear-cut was the habitat harbouring the highest abundance and other grasslands the highest diversity of butterflies. Semi-natural grasslands, where the nationally-based monitoring of butterflies in Sweden currently is being performed, constitutes <1% of the total land area in Sweden, indicating a current bias in monitoring directed towards only a part of the species pool. The landscape-based kind of monitoring presented here can, if performed regularly, increase our knowledge of how

structural changes of landscape affect butterflies and thereby improve conservation efforts.

Keywords: conservation, semi-natural grasslands, landscape perspective, *Lepidoptera*, rarefaction, habitat.

Introduction

Since the end of the Second World War, an already intensified farming in Sweden, as well as in the rest of Western Europe, has escalated and led to a monotonous landscape. Grasslands, wetlands and other habitats with high biodiversity have nowadays to a large extent been turned into arable fields and forest plantations (Ihse, 1995). Butterflies are one group of organisms that has been negatively affected by this change in land use. A decline has been seen all over Western Europe in butterfly species richness (Pullin, 1995; Van Swaay and Warren, 1999). How land is used affects butterflies in different ways and the loss of suitable habitat is of major concern in terms of conservation (Schneider and Fry, 2005). Butterflies are known to respond fast to environmental changes compared to other taxa like birds and vascular plants (Thomas et al., 2004) and even small changes in the environment can affect butterfly diversity and abundance.

Monitoring of butterflies is mostly focused on grassland habitats (e.g. Bergman et al. 2004; Bourn and Thomas, 2002; Pöyry et al., 2005; Öckinger et al., 2006; Öckinger and Smith, 2006), creating a bias of information which might also lead to a bias in conservation efforts aimed at grassland fauna. As virtually all habitats in Europe contain threatened butterfly species (van Swaay et al., 2006), focusing on only a certain group of butterflies creates a risk that non-target species will disappear without any notice. With monitoring using a landscape perspective, which sometimes is preferred (Schneider and Fry, 2005), it is possible to reduce the bias.

As part of fulfilling the Swedish national environmental objectives “A Rich Diversity and Animal Life” and “A Varied Agricultural Landscape” (www.miljomal.nu/), a monitoring programme named NILS (The National Inventory of Landscapes in Sweden) was launched in 2003 by the Swedish government and the

Swedish Environmental Protection Agency. The programme covers terrestrial environments all over Sweden and documents landscape composition (amount of arable fields, forest etc.), landscape elements such as stone walls and solitary trees as well as the occurrence of some groups of species (<http://nils.slu.se/>). By conducting inventories every fifth year, the aim is to detect how changes in nature composition at a landscape level affect species and individual richness. Butterflies in NILS are only monitored in semi-natural grasslands identified by the Swedish nationwide survey of grasslands. An enlargement of the present method incorporating a wider range of land use also for butterflies, may give a more complete picture of the nation-wide situation. Regarding butterflies, national programmes also exist in for example Finland (Saarinen et al., 2003), the Netherlands (van Swaay et al., 1997), Switzerland (Weber et al., 2004) and in the UK (Dennis et al., 1999). None of these programs monitor butterflies in randomly located plots across the landscape. In Finland and the UK, for example, a grid system of quadrates are implemented in which professional and amateur lepidopterists subjectively place their transects, possibly leading to a bias directed towards easily accessible and/or butterfly rich habitats. Also in the Swiss monitoring scheme where transects follows diagonals in the surveyed squares, the non-randomness includes following of paths and field borders when it is possible. However, the UK butterfly monitoring scheme has recently started a pilot project

The aim of this study was to test a landscape-based monitoring method based on random sampling for butterflies in diverse habitats and to analyse the importance of different landscape variables, as well as the method per se. As described above, using random sampling is new, and consequently there is a paucity of information about what type of analyses are appropriate and what results to expect. More specifically, we

wanted to (i) evaluate the impact of environmental variables on butterfly abundance, (ii) compare the distribution of butterflies in different habitats and (iii) analyse data from the study with the aim of improving the method.

Material and methods

Study site

The field work was conducted during the summer of 2006 in southeast Sweden (Figure 1). The monitoring scheme NILS has seven, randomly-placed study sites in the region (henceforward called “the NILS- squares”), each covering a landscape square of 1.1 km x 1.1 km with a smaller one covering 750 m x 750 m in the middle. The vegetation composition differed between sites, but together they constituted a representative sample of the nature in the region, with intensively-managed agricultural land in a band from west to northeast and with coniferous forests in north and south. The squares, whose exact location is not disclosed, are named by nearby towns.

Figure 1. Location of the study sites in the county of Östergötland, SE Sweden, and illustration of a landscape square.

An additional square, not included in NILS, was accessed in Tinnerö, near the city of Linköping, to be used to evaluate butterfly diversity over several visits during a season. Henceforth, data from Tinnerö is included only when clearly stated. Otherwise, only the seven NILS-squares were included in the analyses.

Quantifying landscape structure and habitats

Vegetation composition in the squares were assessed by senior photogrammetrists at the Swedish University of Agricultural Sciences (SLU), Umeå, using colour infrared aerial photos, scale 1:30 000, taken between 2002 and 2003. Following certain procedures and definitions in the interpretation of the aerial photos (Allard et al., 2003), each habitat inside the squares were indicated with a polygon and received a unique number and environmental description. From the large number of variables assessed, the following were considered relevant for the corresponding butterfly data collected: (i) area (m²), (ii) the percentage of tree cover (the sum of *Picea abies* (L.) H.Karst., *Pinus sylvestris* L. and deciduous trees), (iii) percentage of shrubs, dry, mesic, damp and wet land of each polygon.

In addition to the interpretation of aerial photos that covered the whole squares, field categorisations of the grassland polygons were made in the field when crossed by the line transect for the butterfly recording. Clear-cuts (obvious signs such as stumps, few fully grown trees, ruderal plant species); wetlands (wet ground covered by *Sphagnum* spp., other flora characterized by *Rhododendron tomentosum* Harmaja., *Vaccinium uliginosum* L. and *Vaccinium oxycoccos* L.) and other grasslands (abandoned fields and fallows) were categorized. We also used the database TUVÅ from The Swedish Board of Agriculture (<https://eidservice.sjv.se/tuva2/site/index.htm>) to identify unfertilized semi-natural grasslands of national value within the squares.

This database is based on a nation-wide survey 2002-2004 of semi-natural grasslands with value for conservation.

Butterfly recordings

Along the border of the inner square, all butterflies (*Lepidoptera*) and burnet moths (*Zygaenidae*) were recorded with the line transect model used by Pollard (1977); the border-transect was walked at an approximate pace of 50 m per minute and all individuals found within 5 m in front and to the sides were recorded. During the time for identification, the monitoring was paused and later resumed. Double count of an individual was avoided as much as possible but could not be eliminated. Some areas like arable fields, gardens, cemeteries and deep wet marshes were excluded, following the NILS guidelines (<http://nils.slu.se/>), for reasons of safety and land-owner privacy.

Because *Leptidea reali* Reissinger and *Lepidea sinapis* L. as well as *Plebeius argus* L. and *Plebeius idas* L. are hard to distinguish even when captured, each pair was, in this study, recorded as one single taxon (*Leptidea r/s* and *Plebeius a/i*). Nomenclature of butterfly species follows Eliasson et al. (2005).

To facilitate walking in a straight line along the border and to assign a butterfly observation to a polygon, a field map (scale 1:5000), a compass and a GPS receiver (Garmin GPS 60) were used.

All NILS-squares were visited six times between the 8th of June and the 18th of August under predominantly sunny conditions from 17°C and above and without strong wind (≤ 5 on the Beaufort scale). Time for monitoring started no earlier than 9 am and ended before 5 pm (Central European summer time, UTC+2) according to Wikström et al (in press). The intervals between the visits were 8-14 days, depending on weather. During warm periods, the intervals were in the lower range to reduce the risk of missing

possible peaks in abundance. Due to bad weather in May, no monitoring could be performed and some early spring species were therefore probably missed.

In the additional study site, Tinnerö, the same method was used but with 12 walks and shorter intervals between visits.

Analyses

Role of environment

As an initial step to analyse the association of different species to the environmental variables and the overall landscape composition, a principal component analysis (PCA) was performed using the CANOCO 4.5 software (ter Braak and Šmilauer, 2002). PCA is a multivariate method based on linear assumptions (Gauch, 1982) and is preferable to use when the species data has low beta diversity (Gauch and Whittaker, 1972), as in this case. The environmental variables were taken from all polygons at the sites and not only from the polygons crossed by the transect. The study sites were also included in the analysis so that a possible species association to the sites could be seen. In the calculation, species data were log-transformed to diminish the influence of a few species with high abundance.

To further evaluate the environmental variables and to test if and how they contributed to the variation in butterfly abundance, a generalized linear model, GLM (Poisson distribution, log link function), was made using STATISTICA software version 7.0 (StatSoft Inc., 2004). Since the length of the walked transect in each polygon differed, the number of individuals found was expressed as number of individuals per 100 m transect. The variable “tree cover” consisted of the sum of “*Pinus sylvestris*”, “*Picea abies*” and “deciduous trees” so these three variables were therefore

excluded from the model (to evaluate their effect separately, the analysis was re-run). The output contributed to a linear regression with the variable with highest impact on butterfly abundance.

As species richness is sensitive to sampling area, a linear regression was avoided. Instead, a 3D-graph with an additional third axis, with length of transect, was made for illustration.

Comparing semi-natural grasslands with other habitats

To identify potential species preferences to certain habitats, a compilation of the richest polygons in terms of individuals per 100 m transect and species was conducted. The three habitats with the highest species richness were selected. Comparisons were made with the findings in polygons consisting of grasslands identified by the nationwide survey of grasslands, hereafter called semi natural grasslands. Such grasslands are currently the only habitat where nationally-based monitoring of butterflies in Sweden is being performed (Glimskär et al., 2006).

How number of visits affects the species richness detected

As the number of species found during a limited number of visits in most cases underestimates the true species richness, the rarefaction method first proposed by Sanders (1968; later revised by Hurlbert, 1971), was used to estimate the total species richness. With the rarefaction method, it is possible to compare the number of species at different localities when the sampling effort varies, in this case between the NILS-squares and the one in Tinnerö. For calculations, the internet-accessible Species Richness Estimators Eco-Tool (Russel, 2006), based on the techniques described in Colwell and Coddington (1994) and Colwell et al. (2004), was used. Chao 2 was chosen

as non-parametric estimator as it performs well on small samples (Colwell and Coddington, 1994) and has been considered as the least biased estimator dealing with total species richness (Bruno and Moore, 2005). The average number of species found at each visit was expressed as a proportion of the estimated total species richness. An additional rarefaction curve was made based on the average value of the parameters from the line equations of each site.

To estimate the proportion of butterfly species found at different sampling intensities (i.e. numbers of visits), records from different visits at each site were combined according to a time period scheme. For one (1) visit, the count at each site made around the first or second week of July was chosen, since the Swedish butterfly fauna for the area is at its peak during that period (Söderström, 2006). For two (2) visits, the six counts made were divided into a first and a second half of the season. To get an average value, counts were combined in all possible combinations, i.e. count 1 with count 4, 5 and 6, and so forth. For three visits, counts were divided into three parts of the season. For four visits, counts 2, 3 and 4 were always included and combined with remaining counts. For five visits, when one count had to be excluded, an arbitrary estimation was made of which to exclude depending on dates and lengths of intervals.

For Tinnerö, the average of 20 random combinations of counts was taken for 2-10 visits and 12 combinations for 1 and 11 visits.

Results

In total, 2234 individuals belonging to 54 species were observed. Of those, 1425 individuals and 53 species were associated with the NILS-squares (6 visits to 7 squares) and 819 individuals belonging to 34 species with the Tinnerö-square (12 visits). The

number of individuals in the NILS squares varied between 384 and 88 and the species between 31 and 21. For total information on species and abundances, see Appendix.

Role of environment

The PCA showed large differences in butterfly assemblages between sites (Figure 2). Rök, Hjärterum and Östra Ryd were the sites most associated with open land consisting of semi-natural grasslands and arable fields while Tranås, Gusum and Kisa were more forest-dominated (Table 1, Figure 2a). Rejmyre, linked to shrubs and wet land, contained a high degree of forest but large areas with clear-cuts and bogs as well (Table 1, Figure 2a).

The butterfly species showed a clear spread among the environmental variables. Species association to particular landscapes could be seen. *Pieris* spp. were for example linked to areas with high degree of arable fields and *Pararge aegeria* L. to forested landscapes.

The GLM of the butterfly abundance association to environmental variables showed that practically all variables and study sites significantly contributed to explain the number of individuals/100 m (Table 2). Tree cover was the variable with highest explanatory power of butterfly abundance.

There was a negative linear relationship between butterfly abundance and increasing tree cover (Figure 3), with the latter accounting for about 28% of the variation in abundance. Other variables like “dry land”, with the second highest Wald statistic in this analysis, showed no such linear relationship. A similar analysis was also made with “tree cover” divided into “*P. abies*”, “*P. sylvestris*” and “deciduous trees” (data not shown), presenting the highest Wald statistic for *P. sylvestris* (2213). The

negative linear relationship with butterfly abundance was, however, lower than for tree cover alone ($R^2=0.179$).

Figure 2. PCA illustrating (a) the study sites and ten associated environmental variables and (b) the butterfly species. Only the 27 species with highest impact on the model are shown. Eigenvalues for PC1 and PC2 were 0.462 and 0.195, respectively.

Figure 3. Abundance of butterflies versus total tree cover. Data from visited polygons in seven NILS-squares in SE Sweden. The equation of the line is $y = 1.21 - 0.0093x$, $r^2 = 0.278$, 95% confidence interval.

The number of species increased with decreasing tree cover and, as expected, with length of transect (Figure 4). Areas with up to 50% tree cover had the highest amount of butterfly species, but the span was wide and butterflies could be seen over the whole range. Species number seemed to plateau at approximately 200 meters of transect.

Figure 4. Butterfly species richness at different tree cover and length of transect in seven NILS-squares. (Distance Weighted Least Squares, stiffness 0.49)

Comparing semi-natural grasslands with other habitats

The habitats richest in butterflies all consisted of polygons with relatively low tree cover (Table 3). Semi-natural grasslands, that made up 16% of the transect length, harboured half the number of species and about a fifth of the individuals, in comparison with clear-cuts, bogs and other grasslands together. Of the individual habitats, clear-cuts harboured

the highest abundance of butterflies and other grasslands the highest diversity. Every habitat had several unique species only found in that particular habitat.

How number of visits affects the species richness detected

All study sites followed an estimated logarithmic curve without an asymptote being reached (Figure 5). In the NILS-squares, the percentage increase after each visit followed a similar pattern but the start and ending of the curves differed. The range of found species for the NILS-squares after the first, third and sixth visits was between 14 and 49%, 39 and 76% and 64 and 91%, respectively, of the estimated total richness. Tinnerö followed a similar pattern but with a maximum after twelve visits with 83% of the estimated species richness detected. The average curve of all eight sites ranged from 28 to 77% for the six first visits. In comparison, there were minor differences between the average curve and the curves for each site.

Discussion

The results from this study highlight the fact that butterflies use a wide variety of grassland habitats in the landscape and this has implications for butterfly monitoring. Obviously, a large part of the landscape holds butterfly resources and habitats. Most environmental variables chosen contributed significantly to the butterfly abundance, though both the GLM (Table 2) and the plot of number of individuals versus tree cover (Figure 3) indicated that tree cover had a larger effect on butterfly abundance than other variables. The majority of individuals were found in areas with tree cover up to approximately 50%, which is in conformity with the findings in Schneider and Fry (2005).

Figure 5. Percentage of estimated total species richness found with different numbers of visits (solid line). Number of species in the sites was based on an average value from combinations of visits (cf. Material and method 3.4.3). The dotted line is an average curve based on the line equations from all sites. $y_{average}=28.334+62.441*\log_{10}(x)$. Total richness of sites was calculated with the non-parametric estimator Chao 2.

Comparing butterfly distribution in different habitats

The composition of butterfly species varied depending on landscape structure. Open, agriculturally-dominated sites like Rök, Hjärterum, Östra Ryd and Tinnerö, have a composition with typical grassland species like *Maniola jurtina* L., *Coenonympha pamphilus* L. and *Issoria lathonia* L. Some of these were totally absent in the more forested sites (Kisa, Gusum, Tranås and Rejmyre), which, on the other hand, harboured species like *Pararge aegeria*, *Boloria euphrosyne* L., *Callophrys rubi* L. and *Plebeius argus/idas*. These species use host plants and/or habitats that are most abundant in forested landscapes. Rejmyre, the site with largest amount of bog, harboured *Colias palaeno* L. and *Papilio machaon* L., specialists of wetlands, (Söderström, 2006) and they were not found at the other sites.

Even though more or less every habitat has unique butterfly species, nationally-based monitoring of butterflies in Sweden is only made in semi-natural grasslands. These sites cover less than 1% of the total land area in Sweden (The Swedish Board of Agriculture, 2007) but consequently 100% of the area where monitoring is being performed. Semi-natural grasslands are among the most species-rich habitats (Schneider and Fry, 2005) but the question is if all species in the landscape will be represented if monitoring were only performed there. In this study, that was not the case. The surveyed semi-natural grasslands harboured 22 of the total 53 found species (42%) in the NILS-squares, a number most certainly negatively affected by the low number of polygons covering semi-natural grasslands. Of the habitats examined, all had unique species not present in the other habitats. In clear-cuts, bogs and other grasslands, there were 26 species not found in semi-natural grasslands. A number of these 26 species are considered to be associated with high quality semi-natural grasslands (e.g. *Lycaena*

hippothoe L., *Zygaena* spp., *Argynnis* spp.) (Bink 1992, Franzén and Ranius 2004). As this study has shown that they use also other habitats in the landscape surrounding them, monitoring of the whole landscape may be important to understand population changes also in the semi-natural grasslands. The lack of correlation between species richness of butterflies and amount of semi-natural grassland in a forest dominated boreal landscape found by Bergman et al (2008) may be due to the utilisation of other habitats. Large parts of the landscape hold valuable resources for butterflies even though the resources are regarded as completely unsuitable based on the butterflies' vegetation association, as indicated by Dennis (2004). He describes the resource-exploitation behaviour of *Maniola jurtina* where 78% took place in so called unsuitable biotopes, emphasising the importance of the surrounding landscape for butterflies. Incorporating a wider range of habitats in the monitoring, the understanding about species' vegetation preferences will increase. As the ability to move is essential to population viability (Fahrig and Paloheimo, 1988), knowing which landscape features butterflies utilize, e.g. possible corridors, also outside semi-natural grasslands, will improve the ability for a landscape-based conservation effort (Dover and Settele 2009).

Method discussion

The rarefaction curves can be used to evaluate the required number of visits to make at a site to find a certain percentage of the species pool. With data from several sites, an average rarefaction curve could act as a model for the whole region. Detecting more than two thirds of the species at a site, which can seem acceptable, would require four, maybe five, visits spread over the season in this part of Sweden. After 12 visits, the average curve reached near 100% of the species found, which is in accordance with Dennis (1999). The Tinnerö site showed that more than six visits added little to the

percentage species found and therefore that the additional workload is perhaps not financially justified when money is limiting in nature conservation (Pergams et al., 2004). Monitoring in diverse landscapes, incorporating more than the traditional hotspots, makes it possible to detect changes over a wider range of habitats. It also yields a higher diversity and may give a better understanding of the species association to different habitats. To receive a satisfying amount of data, however, one might need a comparatively higher workload since species-poor habitats also are included. The method may also be difficult to use in areas dominated by arable fields because the existing guidelines in NILS involves excluding arable fields. It might be preferable, if launched full scale, to get permission from landowners to eliminate this bias.

When analysing species associations to environmental variables, data from aerial photography interpretation made for the original NILS survey were used. It partly became difficult analysing the data and several lessons were learned. For example, when using aerial photography as a tool in ecological studies, it is of great importance that the interpretation covers natural elements relevant for the kind of research being performed, in this case for butterflies. Butterflies use many small-scale elements in the landscape. For example, according to the results, forests with high percentage tree cover have a low number of individuals. However, glades inside of these sometimes attract a relatively high number of butterflies. Hence, with butterflies in mind, the polygon classification probably has to be done on a finer scale to be really useful, detecting small glades and bogs, road verges and so on. It is also of great importance that the interpretation is up to date with time of field work. For example, an old-growth forest can one day have a tree cover of 90% and later be a clear-cut area. Of course, that sort of changes can easily be detected during field work, but earlier tree cover estimations,

area calculations etc. become affected and have to be re-done, complicating evaluation of trends over time. With up to date maps, these obstacles and the less accurate and cost effective corrections in the field will be reduced. For NILS, the regular procedure is that the sites will be interpreted one year before field work. In this study, the landscape-squares were interpreted 2002 and 2003, which could have contributed to some difficulties along the way.

Conclusions and implications

This study has verified that monitoring of butterflies using a landscape perspective yields data with higher species richness compared to when only including semi-natural grasslands. Even though butterflies associated with other habitats occasionally can be found when monitoring semi-natural grasslands, their abundance in the landscape will be underestimated. Butterflies belong to a taxon very sensitive to environmental changes and there is a risk that sharp declines in species will go undetected with a single environment approach, especially in times of global warming. The monitoring method used in this study, that means walking across the landscape in straight lines without regard to rides, grasslands etc. may also have an advantage over monitoring methods based on subjectively chosen transects that is used in several other countries. This method may give a better general picture of the quality of the whole landscape for butterflies and highlight differences in utilisation between landscape elements.

Numerous studies have concluded that heterogenic environments enhance the species richness of butterflies (Schneider and Fry, 2001; Krauss et al., 2003; Kerr, 2001; Grill et al., 2005; Ohwaki et al., 2007), but also among other taxa like birds (Söderström et al., 2001), which is due to heterogeneous environments attracting species associated with different habitats (Schneider and Fry, 2005). Clear-cuts seemed to be important for

many species, as supported by Inoue (2003). Even though semi-natural grasslands are the main habitat for many species, this study also shows that they also use more or less temporary habitats outside the permanent grasslands. Monitoring how butterflies use clear-cuts and other habitats in the forested landscape may increase understanding of their abundance in the landscape and have implications for forestry management.

In general, almost all habitats in Europe support threatened butterfly species (van Swaay et al., 2006). This highlights the fact that monitoring should be based within a landscape context including more species than what is presently done.

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Appendix

Appendix 1. Abundance of butterflies and number of polygons and sites where butterflies were found during monitoring in eight landscape-squares in SE Sweden.

		No. of polygons		No. of sites
	Species	Abundance	with occurrence	(max 8)
1	<i>Aphantopus hyperantus</i>	440	124	8
2	<i>Plebejus argus/idas</i>	295	47	3
3	<i>Pieris napi</i>	235	121	8
4	<i>Coenonympha pamphilus</i>	117	52	4
5	<i>Polyommatus icarus</i>	89	41	6
6	<i>Coenonympha arcania</i>	80	48	6
7	<i>Maniola jurtina</i>	69	47	4
8	<i>Argynnis paphia</i>	68	53	8
9	<i>Gonepteryx rhamni</i>	66	42	8
10	<i>Pieris rapae</i>	62	38	4
11	<i>Lasiommata maera</i>	59	36	6
12	<i>Pararge aegeria</i>	58	42	7
13	<i>Brenthis ino</i>	56	28	6
14	<i>Argynnis aglaja</i>	54	34	6
15	<i>Aglais urticae</i>	37	14	7
16	<i>Boloria euphrosyne</i>	35	25	7
17	<i>Ochlodes sylvanus</i>	32	17	5

18	<i>Leptidea reali/sinapis</i>	28	22	6
19	<i>Inachis io</i>	28	21	7
20	<i>Polyommatus amandus</i>	27	21	6
21	<i>Thymelicus lineola</i>	24	15	3
22	<i>Melitaea athalia</i>	23	16	6
23	<i>Polyommatus semiargus</i>	22	11	2
24	<i>Erebia ligea</i>	21	18	7
25	<i>Callophrys rubi</i>	21	10	3
26	<i>Zygaena lonicerae</i>	20	9	5
27	<i>Issoria lathonia</i>	18	13	3
28	<i>Pieris brassicae</i>	18	17	5
29	<i>Hesperia comma</i>	17	11	3
30	<i>Plebejus optilete</i>	17	9	4
31	<i>Anthocharis cardamines</i>	12	8	7
32	<i>Boloria selene</i>	11	8	2
33	<i>Aporia crataegi</i>	9	6	1
34	<i>Polygonia c-album</i>	9	8	5
35	<i>Argynnis adippe</i>	8	6	3
36	<i>Colias palaeno</i>	7	3	1
37	<i>Lycaena virgaureae</i>	7	6	4
38	<i>Lycaena phlaeas</i>	7	7	2
39	<i>Zygaena filipendulae</i>	7	4	2
40	<i>Celastrina argiolus</i>	3	3	2
41	<i>Nymphalis antiopa</i>	3	3	3

42	<i>Hipparchia semele</i>	2	2	2
43	<i>Lycaena hippothoe</i>	2	2	2
44	<i>Lasiommata megera</i>	1	1	1
45	<i>Lasiommata petropolitana</i>	1	1	1
46	<i>Argynnis niobe</i>	1	1	1
47	<i>Arícia artaxerxes</i>	1	1	1
48	<i>Glaucopsyche alexis</i>	1	1	1
49	<i>Cupido minimus</i>	1	1	1
50	<i>Favonius quercus</i>	1	1	1
51	<i>Zygaena viciae</i>	1	1	1
52	<i>Vanessa atalanta</i>	1	1	1
53	<i>Papilio machaon</i>	1	1	1
54	<i>Limenitis populi</i>	1	1	1
Total		2234		