The Lepidopterous fauna of Nature Reserve Friendship.

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Introduction

Through ages the butterflies and moths have been the target of peoples interest. A fragile moth has been thought to represent the vulnerability of nature, which it in fact well is. Moths react rather rapidly to different environmental changes in nature and very often irreversibly. Our forests, declining more and more rapidly in area, give less and less opportunities to study the species of old primevals. Some possibilities to this are offered in the different parts of Nature Reserve Friendship (Juntunen & Isokääntä 2000).

The aim of this article is to give guidelines of the moth monitoring which we have carried in Nature Reserve Friendship.

Study areas and methods

Studies and monitoring of lepidoptera in the Nature Reserve Friendship's area were started in 1991. Basic inventories lasting through the flying season were carried out in six subareas as follows; Elimyssalo in 1991, Iso-Palonen-Maariansärkät in 1992, Juortanansalo-Lapinsuo in 1993, Lentua in1994, Ulvinsalo in 1995 and Kostamus in 1997 (see also Leinonen 1991, 1992, 1993 manuscript and Leinonen et al 1998). After the basic inventory some sporadic observations on certain species have been done and in some spots it was moved to continuous trapping in order to get time serial data.

Study methods were: catching by lights, by baits, by malaise trap, netting and linetransects. We used light traps with generator and permanent electricity equipped with 160 W blended light lamp and 125 W halogen lamp. Baittrapping was both permanent and active. Two trap-types were used. The new Oulu-model, with two baits: red-wine vinegar and more traditional beer-based bait. The Oulu-traps were used only in Juortanansalo area. The traditional Jalas-model bait-trap was used in all the other areas with beer-based liquid. With Malaise- trap (model Bioquip. USA) we collected only in one summer at Elimyssalo, and it brought some new microlepidopterans for this area. One of the most used method has been the netting, always when we moved on the field during day or night and it was also used for larvae. For monitoring the butterflies we used the linetransect method (see Pollard et al 1975, Kullberg 1995, Kuussaari et al 2000). It was counted all the observed individuals from a stripe of five meters wide. The counting was done once a week according to suitable weather from May to September.

Weather demands were; minimum temperature +13° C, counting time between 10 and 14 a'clock, rainless day, most preferably sunny weather and no hard wind. In average, the countings numbered ten per summer per transect.

We counted alpha-diversity and HQI indexes. The alpha-diversity was calculated using the formula S= alpha log(1+N/alfa) (see Taylor et al. 1976). With Kruskal-Wallis test we tested the differences between sites in these values. To fullfill the alpha-diversity we have developed together with Finnish Environment Institute a certificate index of forest quality. Habitat Quality Index-report will be published in NORD-series from Nordic council of ministers (Söderman et al 2000). A habitat quality index has been developed to value different forest habitats as a tool for landscape planning and identifying the importance of various woodlands for preserving biodiversity. The total test material covers some 680 species and 3 million individuals from the Moth Monitoring Scheme. The theoretical maximum index value is 48, in practice they are close to 20 when both northern taiga indicators and nemoral decicuous forest indicators are used. It has six criteria, which are expressing following things: 1. Healthy large forest stands. 2. Regular inflorescence of main tree species. 3. Abundance of epiphytic lichens and acceptable limit of deposition of atmospheric pollution. 4. Presence of typical taiga forest 5. Presence of typical nemoral deciduous wood stands 6. Equilibrium between populations in the habitat mosaics (see also Söderman et al. 2000).

(R.Leinonen)

Figure 1. All bait traps had to be lifted to five metres height in Ulvinsalo oving the bear.

During the study, especially at Ulvinsalo, we pumped now and then to some small trouble. Close to Ulvinsalo there lived a bear, which had got a nick name "Big thick". It had been tempted to carcass for photographing by adding feed sugar-liquid and that had Mr. Thick preserved to his memory. Our bait liquid is rather similar to feed sugar-liquid. Even a trap lifted by line to five metres was not let untouched by him! After this bear's visit we had to lift traps without lines to five metres height (Fig. 1).

Results

The total number of species observed was 711, where from macrolepidopterans are represented by 296 species and microlepidopetrans by 415. This makes about two thirds of the whole species number of Kainuu biogeographical province. Totally we identified 85 000 individuals. In macrolepidoptera also sexes were separated. The high numbers found at Elimyssalo and Ulvinsalo can be explained by the fact that close to these areas there has been permanent light traps, at Viiksimo from 1991 onwards and at Rajakangas from 1994 onwards (Leinonen 1991, Söderman et al 1994, 1995)(table1).

Table 1. Total captures of lepidoptera species in different subareas in Nature Reserve Friendship.Abbreviations: ELI= Elimyssalo, ISO= Iso-Palonen- Maariansärkät. IUO= Iuortananslo- Lapinsuo. LEN= Lentua. ULV= Ulvinsalo and KOS= Kostamus.

	ELI	ISO	JUO	LEN	ULV	KOS
Microlepidoptera species	340	174	128	178	261	239
Macrolepidoptera species	238	172	148	190	209	196
Lepidotera species	578	346	276	368	470	435

All the subareas of the Nature Reserve Friendship are located in the middleborealzone and the moth composition follows more or less the typical fauna of those areas (Kashevarov 1996). There are, however, some northern and some southern species which give a nice breath to the species list. Representatives of northern species are *Lasionycta skraelingia* and *Apamea maillardi*. The closest known site for *L.skraelingia* is at Kittilä about 400 km to the NorthWest. The species *A. maillardi* instead has an occurrence also at Häme, otherwise it is a clear northern species in Finland (Huldén et al 2000). *L.skraelingia* was observed in Juortanansalo and Elimyssalo area and *A.maillardi* in Juortanansalo and Ulvinsalo. Representatives of southern species were *Lobophora temerata*, *Aethalura punctulata* and *Allophyes oxyacanthae*. They were observed in Rajakangas near Ulvinsalo. The proportion of spreading species looks like to be rising along the eastern frontier.

The Dotted carpet (Alcis jubatus) is typical indicator species for abundant of Alectoria and Usnea species in the Nature Reserve Friendship.

Next some species with special interest are presented. The Dotted carpet (*Alcis jubatus*), which has rather rich numbers in the spruce forests with abundant *Alectoria* and *Usnea* species in the Nature Reserve Friendship. It is living just on the lichens (Mikkola et al 1989a). The occurrence of *Caryocolum schleichi* at Kostamus is surprising, because it is said to live only on *Dianthus arenarius*, which so far has not been reported from that area. We suppose it to live also on other *Dianthus* species, which may be growing there. The nearest population of *C. schleichi* is to be found at Sotkamo, Räätäkangas, about 150 km west from Kostamus (Somerma 1997). The rarest observation is the one larva of *Xestia brunneopicta*, which however, has still a small question mark, because the larva has not yet been described at all. The species was found at Oulanka in 1983 as a new one to whole Europe (Mikkola et al 1989b). At the same site it was also collected two larvae, which differ from the nearest relative, *X. gelida*, by certain characters. That larva found at Elimyssalo on spruce is similar to those two larvae. The case must, however, still be inspected by ex ovo breedings.

Light traps at Nature Reserve Friendship area have been implanted to the Finnish Moth Monitoring network which was started at 1993 (Väisänen 1993, Somerma 1993, Söderman et al 1994, 1995).

From the Moth Monitoring material it has been calculated inventory-diversity, i.e. alpha- diversity. It had a low value in the present area. This is influenced by the fact that the number of species is not high. This is a weak point of alpha-diversity. It does not give any weigth to the species, but the alfa is counted based on species and individual numbers. Correspondingly low values have also occurred around large cities. Higher than average values can be found among other places in grove center areas. In the time serials of alpha we can observe the low values of year 1994, which was rainy and altogether a "bad" summer (Fig. 2). At this moment it seems to be increasing. In long collecting series (Mäntyharju, Lahti ja Kajaani) alpha-diversity seems to follow a rhythm of ten years (Söderman et al 1999). Currently in Kainuu monitoring sites the alpha-diversity-values are going upwards. Although the alpha-values at Kajaani seem to be

somewhat higher than in the other places they do not differ significantly, when corresponding years (i.e. 1994-99) are surveyed(P=0.073). Instead if we include all the data then Kajaani difffers significantly from the other two sites, but this is not so remarkable because the collecting series is so much longer at Kajaani than in the other places.

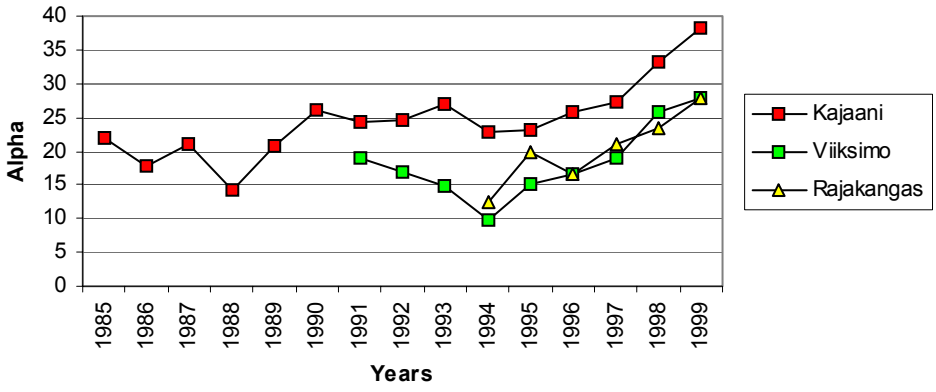

Figure 2. Time series of alpha- diversity in Kajaani, Viiksimo and Rajakangas sites.

One of the special features of Nature Reserve Friendship is the abundance of *Xestia*-species. The Kajaani point is between economic forest and a garden, the point of Viiksimo between economic forest and a ruderate area and point of Rajakangas close to the nature park of Ulvinsalo. It is the only area of these where we found *X. sincera*, most tightly bound to old primeval spruce forests (see e.g. Imby & Palmqvist 1978). *X. alpicola*, *speciosa* and *rhaetica* all three species show the superiority of Rajakangas what comes to the yearly catches (Fig. 3).

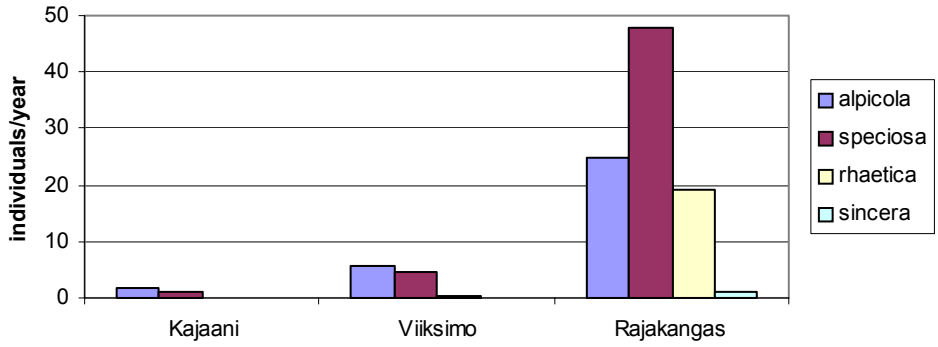

Figure 3. Comparison of Xestia*-species between three monitoring sites in Kainuu.*

When we survey the impact of the large Russian primevals upon the forest islets on Finnish side, we can notice some features. At Ulvinsalo we did not observe anymore *Xestia gelida* and *X. distensa* most clearly bound to these old forests. Also the catch of *X. rhaetica* was a little bit lower than in the two other sites, Juortanansalo and Malahvia, which are in continuous connection to Russian side (table 2). This macrocorridor connection or its lacking is one of our coming targets, because it may have an influence upon the observed difference. The Malahvia area does not belong to Nature Reserve Friendship, but it is an extension of it. Also this area is an important part of the Green belt zone (Leinonen & Itämies 2000).

Table 2. Xestia-species in three sites in Green belt zone.

	Malahvia	Juortana	Ulvinsalo
alpicola	9	13	14
speciosa	376	574	426
rhaetica	32	28	12
gelida	1	0,3	0
sincera	2	1	1
distensa	0,1	0,3	0

Next a little bit of application of above mentioned facts by aid of three time series of light traps is from Moth Monitoring. One site is Kajaani, which is relatively even and fluctuates only based on weather conditions and or environmental changes. The HQI-values of Rajakangas make a sicsac, due to *Xestia* species, between odd and even years. While the point of Tankavaara on the other hand fluctuates on an even year rhythm (Fig. 4). This flight pattern is well known in Finland (Mikkola 1976, Pulliainen & Itämies 1988).

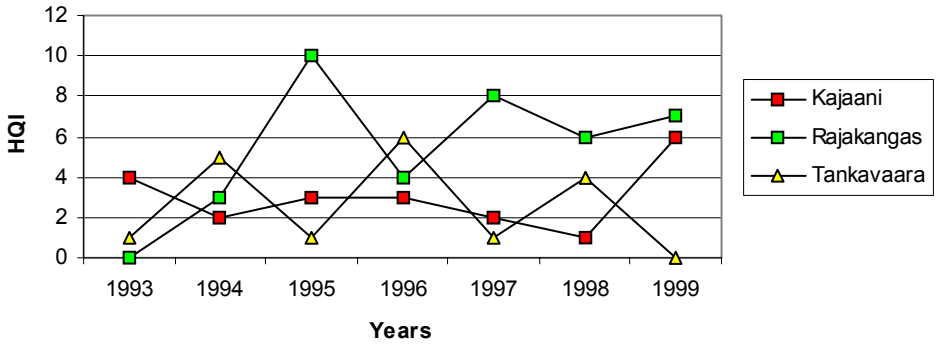

Figure 4. Time series of HQI-index in three monitoring sites in Finland.

The fluctuation of *Xestia* flight years is thus clearly seen in the values of index. Based on the test results three years is adequate to produce a reliable level. Years after that do not remarkably increase the value of index. In cumulative values the counting of dominance aspect must be based on five years moving average, because after that all traps usually get the maximal points (2 points) on this dominance criteria.

Conclusions

Summarising we can say some features from the moth fauna of Nature Reserve Friendship. The area is mainly natural taiga forest. We have found several old primeval forest species. The area has high quality biodiversity, especially in the point of view of research. The straight connection via the macrocorridors to the large Russian primevals makes the populations steady and makes it possible even for demanding species to have living conditions also on the Finnish side.

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References

Huldén, L. (ed.), Albrecht, A., Itämies, J., Malinen, P. & Wettenhovi, J. 2000: Suomen suurperhosatlas, Finlands storfjärilsatlas, Atlas of Finnish Macrolepidoptera, 328 p. Helsinki.

Imby, L. & Palmqvist, G. 1978: De svenska Anomogyna-arternas utseende, biologi och utbredning, Entomologica Tidskrift 99: 97-107.

Juntunen, K. & Isokääntä, O. (eds.) 2000: Elimyssalolta Vienansalolle, Wilderness nature on the Kainuu-Viena Karelian border, 152 p. Vammala.

Kashevarov, B. 1996: Comparative analysis of biodiversity in the Finnish- Russian Friendship Nature Reserve. In: Cerovsky, J. (ed.). Biodiversity Conservation in transboundary protected areas in Europe, 56-61. Praha.

Kullberg, J. 1995: Päiväperhosten käyttö ympäristön seurannassa, Vesi- ja ympäristöhallinnon julkaisuja, sarja A 194, 34 p.

Kuussaari, M., Pöyry, J. & Lundsten, K-E. 2000: Maatalousympäristön päiväperhosseuranta, seurantamenetelmä ja ensimmäisen vuoden tulokset, Baptria25: 44-56.

Leinonen, R. 1991: Ystävyydenpuiston perhosinventointi, osa 1, Elimyssalon alue. Vesi- ja ympäristöhallituksen monistesarja 344, 133 p.

Leinonen, R. 1993: Ystävyydenpuiston perhosinventointi, osa 2, Iso-Palonen- Maariansärkkien alue. Vesi- ja ympäristöhallituksen monistesarja 481, 166 p.

Leinonen R. 1994: Ystävyydenpuiston perhosinventointi, osa 3, Juortanansalo- Lapinsuon alue. Käsikirjoitus, 100p., Kajaani.

Leinonen R., Itämies J. & Kutenkova, N. 1997: Lepidoptera of the Nature Reserve Friendship. In Lindholm, T., Heikkilä, R. & Heikkilä M. (eds.). Ecosystems, fauna and flora of the Finnish Russian Nature Reserve Friendship, 235-256. The Finnish Environment 124..

Leinonen, R. & Itämies, J. 2000: Notes on the moth fauna (Lepidoptera) in the Finnish Green belt zone as indicated by bait traps. Oulanka Reports 23: 31-39.

Mikkola, K. 1976: Alternate-year flight of northern Xestia species (Lep., Noctuidae) and its adaptive significance. Ann. Ent. Fennici 42:191-199.

Mikkola, K., Jalas, I. & Peltonen, O. 1989a: Suomen perhoset, Mittarit 2, Suomen Perhostutkijain Seura, 280 p. Hanko.

Mikkola, K., Sinervirta, M. & Vaalamo, K. 1989b: Xestia brunneopicta (Matsumura) new to Europe (Lepidoptera, Noctuidae), Notulae entomologicae 69: 33-37.

Pollard, E., Elias, D.O., Skelton, M.J. & Thomas, J. 1975: A method of assessing the abundance of butterflies in Monks Wod National Nature Reserve in 1973. Entomologist's Gazette 26: 79-88.

Pulliainen, E. & Itämies, J. 1988: Xestia communities (Lepidoptera, Noctuidae) in eastern Finnish Forest Lapland as indicated by light trap sampling. Holarctic Ecology 11: 235-240.

Somerma, P., Söderman, G. & Väisänen R. 1993: Valtakunnallisen yöperhosseurannan opas. Vesi- ja ympäristöhallituksen monistesarja 487. 58 p.

Somerma, P. 1997: Suomen uhanalaiset perhoset. Suomen Ympäristökeskus – Suomen Perhostutkijain Seura. Ympäristöopas 22. 336 p.

Söderman, G., Väisänen, R., Leinonen, R. & Lundsten, K-E. 1994: Valtakunnallisen yöperhosseurannan 1. vuosiraportti. Finnish Moth Monitoring Newsletter 1 (1993). Vesi- ja ympäristöhallitus – Suomen Perhostutkijain Seura, 78 p. Tampere.

Söderman, G., Lundsten, K-E., Leinonen, R. & Liukko, U-M.1995: Valtakunnallisen yöperhosseurannan 2. vuosiraportti. Finnish Moth Monitoring Newsletter 2 (1994). Vesi- ja ympäristöhallitus – Suomen Perhostutkijain Seura. 74 p. Tampere.

Söderman, G., Leinonen, R., Lundsten, K-E. & Tuominen-Roto, L. 1999: Yöperhosseuranta 1993-97. Suomen ympäristö 303. 64 p.

Söderman, G., Leinonen, R., Talvi, T. & Talvi, T. 2000: Habitat Quality Indicators and indices based on Invertebrate Communities. Nature Monitoring in the Eastern Baltic/2. Tema Nord 613. 49 p. Copenhagen.

Taylor, L.R., Kempton, R. A. & Woiwod, I. P. 1976: Diversity statistics and the log-series model. Journal of Animal Ecology 45, 255-272.

Väisänen, R. 1993: Valtakunnallinen yöperhosseuranta. Moth monitoring network of light traps established in Finland. Baptria 18: 9-11.