

Bionomic strategies in Lepidoptera, risk of extinction and nature conservation projects

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Summary

A short review of some theoretical aspects of the risk of extinction and conservation of Lepidoptera is given. Bionomic strategies and habitat conservation are discussed.

The nature conservation and bioindicator values of the world fauna of vulnerable taxa of Lepidoptera are very high. About 50-60% of species are bound to natural ecosystems that are endangered. The theoretical criteria for risk of extinction and conservation should follow ideas of bionomic (selection) strategies and ecological succession. The only way of preserving diversity of vulnerable species of Lepidoptera is the complex "in situ" conservation in reserves of natural and seminatural landscapes. The most important taxa for habitat conservation seem to be K-strategists associated with climax ecosystems having a small range of geographical distribution (cf. SPITZER & LEPS 1988). The migratory species, mostly r-strategists, are less threatened. Entomological and conservation aspects of "stress tolerant" or "adversity" species (GRIME, 1974; SOUTHWOOD, 1977; HOLM, 1988) are little known, but the risk of extinction might be high in most cases.

What is a risk of extinction in Lepidoptera ?

We would like to consider the theoretical problems of risk of extinction and conservation of Lepidoptera based mainly on results of our field studies :

Extinction is a scale-dependent concept. The distinction between extinction of a local population and decrease in the number of subpopulations is quite arbitrary and depends on the scale considered. PIMM, JONES & DIAMOND (1988) consider only local extinction of birds, whereas the priority of conservation biology is to protect all species prone to global extinction. Species that frequently exhibit local extinctions may rarely experience global extinction.

For many species, local extinction and recolonisation of a new site is part of their bionomic strategy. It would be interesting to know the association between recolonization rates and bionomic strategy. Those species categorised as r-selected, usually exhibit pronounced population fluctuations and many of them are migrants and good colonisers (MACARTHUR & WILSON, 1967; PIANKA, 1970; SOUTHWOOD, 1977).

Our data on noctuid moths (Table 1, 2) show that population variability (expressed as the temporal coefficient of variation) is positively correlated with the potential population growth rate (SPITZER, REJMÁNEK & SOLDÁN, 1984) and with geographic range (SPITZER & LEPS, 1988). The same conclusion was reached by GLAZIER (1987). Species with a large geographic range rarely become extinct. After outbreaks, many important migratory pests may become locally extinct, e.g. the cosmopolitan black cutworm *Agrotis ipsilon* HFN. (SPITZER, 1972; KASTER & SHOWERS, 1982).

Non-migratory butterflies and moths with small geographical ranges usually exhibit low population variability, low population growth rate and typically occupy climax habitats (SPITZER & LEPS, 1988; LEPS & SPITZER, 1990). For such species (cf. some papilionids, Table 3), local extinction (even at a very low rate) may have fatal consequences, because their vagility and ability to recolonize new sites is low, e.g. *Papilio hospiton* GN. (Table 3, COLLINS & MORRIS, 1985). Most locally endangered species fall into this category (WELLS, PYLE & COLLINS, 1983; COLLINS and MORRIS, 1985).

It is highly probable, that low vagility and small geographical range carries a high risk of global extinction. But for conservation a careful analysis of the ecological determinants and life history traits of each vulnerable species is necessary: the species at risk of global extinction mostly occupy limited climax habitats that are being destroyed by man.

Our analysis of data for moths and butterflies and that of PIMM *et al.* (1988) for birds reveal similar correlations. However, unlike PIMM *et al.* (1988) we stress the scale dependence of the extinction concept. Conservationists are mainly concerned with preventing the global extinction of a species or a subspecies.

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Table 1

Relationships between certain life history traits of populations of noctuid moths, based on 17 years light trapping data from South Bohemia
 PGR — potential population growth rate, GR — size of geographical range, scaled 1 to 6, see SPITZER & LEPS (1988),
 CV — coefficient of year to year variation in abundance

Correlation between PGR and GR	0.75**	n = 31
Correlation between GR and CV	0.33**	n = 67
Correlation between PGR and CV	0.30	n = 28
Mean value of CV of migratory species	1.31*	n = 8
Mean value of CV of sedentary species	0.91*	n = 58

** Value significant at $P < 0.01$.

* The two values differ at $P < 0.05$, t-test.

Table 2

The migratory status of noctuid moths in South Bohemia that have extremely high ($CV > 1.5$) and extremely low ($CV < 0.65$) coefficients of variation
 Only species with a mean annual catch greater than 6 individuals are considered

Species	Migratory status	Mean annual catch	Coefficient of variation
<i>Orthosia cruda</i> D. & S.	sedentary	89.5	2.597
<i>Diarsia rubi</i> VIEW.	sedentary	240.9	2.254
<i>Opigena polygona</i> D. & S.	migratory	19.7	1.970
<i>Agrotis ipsilon</i> HFN.	migratory	21.9	1.909
<i>Cosmia trapezina</i> L.	sedentary	11.0	1.892
<i>Diarsia brunnea</i> D. & S.	sedentary	6.9	1.601
<i>Phlogophora meticulosa</i> L.	migratory	10.4	1.557
<i>Tholera decimalis</i> PODA	sedentary	82.4	0.648
<i>Photodes pygmina</i> HW.	sedentary	14.3	0.626
<i>Apamea ophiogramma</i> ESP.	sedentary	18.0	0.620
<i>Agrotis exclamationis</i> L.	sedentary	313.0	0.615
<i>Autographa gamma</i> L.	mixed *	65.4	0.611
<i>Orthosia gothica</i> L.	sedentary	127.1	0.605
<i>Photodes fluxa</i> HB.	sedentary	8.7	0.602
<i>Charanyca trigrammica</i> HFN.	sedentary	49.8	0.582
<i>Hoplodrina alsines</i> BRAHM.	sedentary	197.2	0.573
<i>Mythimna pudorina</i> D. & S.	sedentary	87.2	0.546
<i>Photodes minima</i> HW.	sedentary	18.0	0.540
<i>Oligia strigilis</i> L.	sedentary	34.5	0.537
<i>Hoplodrina blanda</i> D. & S.	sedentary	118.0	0.536

* *A. gamma* is polyvoltine and each population consist of migratory and sedentary forms that compensate for the year to year fluctuations (NOVÁK and SPITZER 1972). Migratory populations fluctuate more than sedentary (autochthonous) ones. The fluctuations of the Central European mixed populations are usually low with outbreaks at intervals of 20-30 years (last one in 1963) caused by immigrations from southern Europe.

Table 3
European swallowtail butterflies of the genus *Papilio* and their risk of extinction

Species	Migratory status	No. of families of food plants	Distribution	Risk of extinction	
				global	local
<i>P. machaon</i> L.	migratory	3	most of Palaearctic and part of Nearctic	none	vulnerable
<i>P. hospiton</i> GN	sedentary	1	endemic to Corsica and Sardinia	high	endangered
<i>P. alexanor</i> Esp.	sedentary	1	southwest Palaearctic only	small	vulnerable or endangered

From COLLINS & MORRIS (1985), WELLS *et al.* (1983), SPITZER (unpublished).

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