

---

## **Biogeographical and ecological determinants of the central European peat bog Lepidoptera : The habitat island approach to conservation**

Karel SPITZER

Institute of Entomology, Czech Academy of Sciences, Branišovská 31, CZ-370 05 České Budějovice,  
Czech Republic

### **Summary**

Oligotrophic peat bogs form characteristic habitat islands within the temperate forests of central Europe. These isolated relict bog ecosystems are similar to some subarctic and subalpine biomes ("edaphic forest-tundra") in being determined in the Holocene and by recent local ecology. The ecological determinants are interactions of suitable edaphic and climatic factors. Most of the tyrphobiontic and tyrphophilous Lepidoptera species have taxonomic affinities to boreal and subarctic zones. The "archipelago" of South Bohemian oligotrophic bogs is ideal for case studies, and model conservation projects.

---

### **Bog habitat island : outline of ecological history**

Central European oligotrophic peat bogs (e.g. Mrtvý luh bog, Fig. 1) are isolated ecosystems similar in structure and function to subarctic wet forest-tundra (= "edaphic forest-tundra" sensu HUSTICH, 1957, see also TUHKANEN, 1984). In southern latitudes of the temperate forest zone, such peat bogs are characteristic azonal ecosystems, occurring in isolated and discrete patches in "average" landscape originally covered by forest. The habitat island development of most central European bogs, e.g. in South Bohemia, dates from the early Holocene (JANKOVSKÁ, 1980) and the bogs became more acid and ombrotrophic during the Holocene ecological succession. The island-like characteristics have resulted from the interaction of both climatic and edaphic factors. Recently, the local cold/warm and wet/dry "continental" environment has been the main factor favouring the survival of relict cold adapted (stress tolerant and K-selected) biotas. Because of their different ecological histories each large bog is unique in its species composition (e.g. insects) and their taxonomic status (subspecies and geographical races). These central European oligotrophic bogs can be classified under the vegetation association: *Pino rotundatae-Sphagnetum* (see NEUHÄUSL, 1972 ; SPITZER, 1975 ; MIKKOLA & SPITZER, 1982, etc.). The linkage between insect community and vegetation



Fig. 1. The habitat island of Mrtvý luh bog, ca. 300 ha of edaphic “forest-tundra”, Šumava Mts., 740 m.

association is very close, e.g. Lepidoptera associated with *Ledum palustre* (*Lyonetia ledi* Stt., *Olethreutes lediana* L., *Eupithecia gelidata* Möschl.) and *Vaccinium uliginosum* (*Anarta cordigera* Thnbg., *Lithophane lamda* F., *Colias palaeno* L.).

### Ecological grouping of peat bog Lepidoptera : stenotopic species

1. Tyrphobionts (PEUS, 1932; SPITZER, 1975; ROHÁČEK, 1982; MEINEKE, 1985; MIKKOLA & SPITZER, 1982; GELBRECHT, 1988, etc.) are obligatorily associated with peat bogs in temperate and southern boreal zones. Their most important ecological requirements are micro (meso) climatic and edaphic conditions (*Eugraphe subrosea* Steph. is a typical example, Fig. 2). Some bog Lepidoptera are closely associated with the habitat because of their foodplants (e.g. strictly monophagous species that feed on *Ledum palustre*, *Vaccinium uliginosum* and *Eriophorum vaginatum*). In some cases monophagy is recent, induced by the Holocene vegetation succession, which resulted in the extinction of certain plants (see SPITZER *et al.*, 1991 — *Eupithecia gelidata* Möschl.). There is a general trend to a weaker tyrphobiontic association towards the northern and alpine timber lines (MIKKOLA & SPITZER, 1982).

2. Tyrrophilous biotas are plants and animals that are not restricted to peat bogs. Such peatland species colonise other wetlands, wet forests, heathlands



Fig. 2. Larva of *Eugraphe subrosea* (Steph.), a local geographical race of the Mrtvý luh bog, Šumava Mts.

and meadows, but achieve their greatest population abundance in peat bogs (see PEUS, 1932 ; Lepidoptera are listed by SPITZER, 1975 ; 1981 ; MIKKOLA & SPITZER, 1975 ; GELBRECHT, 1988).

### Why is a peat bog “island” unique?

The recent habitat island structure of central European bogs is a unique product of the ecological succession in the Holocene. The relict biotas of bogs, plants and invertebrates especially, have lived here from the early Holocene or even the late Glacial stadials (PEUS, 1932 ; COOPE, 1970 ; JANKOVSKÁ, 1980). Such organisms are very vulnerable to extinction because they do not occur in other habitats. Changes in the local environment (water level, chemistry of water and peat, etc.) of a peat bog can cause the extinction of the local tyrphobiotic taxa associated with a particular habitat island. Such changes are irreversible because it is not possible to recreate the evolutionary history that gave rise to the biodiversity of a specific bog. A good example is the recent fate of subalpine bogs in the Krkonoše Mountains, which 14 years ago were sprayed with insecticide to suppress a forest pest. The relict and endemic (subspecies) insect fauna probably disappeared (e.g. *Pachnobia alpicola* (Zett.) a tyrphophilous relict noctuid of the subalpine zone). The habitat is now irregularly colonised by some opportunistic insect species. Insecticides and other chemicals are likely to prove fatal to the existence of such tyrphobiotic insect communities.

## Conclusions for conservation management

The best conservation strategy for peat bogs and their Lepidoptera communities is a “no action strategy” — other than preserve good hydrological conditions. Generally, the hydrology is the most important factor. The bog ecosystem is fragile and any human impact is likely to prove fatal for some components of the fauna and flora. Species of Lepidoptera are the best bioindicators. Monitoring of the hydrological and other environmental conditions is necessary, if a bog is situated in a predominantly man made landscape.

### *Rules for conservation of central European peat bogs :*

1. Maintain the hydrological conditions that prevent successional change from wetland to closed pine forest. Wet edaphic “forest-tundra” formation appears to be the optimal state (see also MEINEKE, 1985).
2. Ban the use of chemicals (insecticides, herbicides, etc.) close to the localities.
3. Conserve all of the “habitat islands”. For example, in the case of the unique “archipelago” of peat bogs in the Šumava Mountains (see WELLS *et al.*, 1983 ; SPITZER, 1981) the whole archipelago needs to be conserved.

## Scientific and educational values of peat bog communities of Lepidoptera

It is difficult to separate the “educational” from the purely “scientific” value of central European bogs. The following scientific and educational priorities should be included in the scientific conservation programme :

1. A model study of habitat islands and their relict Lepidoptera communities based on the theory of island biogeography.
2. The use of peat bogs as sites for testing s-selection (stress tolerant taxa) and r- and K-selection hypotheses.
3. Studies of relict endangered species of Lepidoptera and their subspecies.
4. Evolutionary differentiation of the insect populations within and between “archipelagos” of bogs (e.g. *Colias palaeno* L. and *Eugraphe subrosea* Steph.).

## References

- HUSTICH, I., 1966. On the forest-tundra and the northern tree-lines. *Ann. Univ. Turku* A2, 36 : 7-47.
- COOPE, G. R., 1970. Interpretation of Quaternary insect fossils. *Ann. Rev. Entomol.* 15 : 97-120.
- GELBRECHT, J., 1988. Zur Schmetterlingsfauna von Hochmooren in der DDR. *Ent. Nachr. Ber.* 22 : 49-56.
- JANKOVSKÁ, V., 1980. Paläogeobotanische Rekonstruktion der Vegetationsentwicklung im Becken Třeboňská pánev während des Spätglazials und Holozäns. 151 pp. Academia, Praha.
- MEINEKE, J.-U., 1985. Die Situation Moorgebundener Gross-Schmetterlingsarten in Nordrhein-Westfalen. *Telma* 15 : 75-100.

- MIKKOLA, K. & SPITZER, K., 1983. Lepidoptera associated with peatlands in central and northern Europe : a synthesis. *Nota lepid.* 6 : 216-229.
- NEUHÄUSL, R., 1972. Subkontinentale Hochmoore und ihre Vegetation. Studie ČSAV (Praha) 13 : 1-121.
- PEUS, F., 1932. Die Tierwelt der Moore unter besonderer Berücksichtigung der europäischen Hochmoore. Handbuch der Moorkunde (Berlin) 3 : 1-277.
- ROHÁČEK, J., 1982. Acalypterate Diptera of peat bogs in North Moravia (Czechoslovakia). Part 1. *Cas. Slez. Muz. Opava (A)* 31 : 1-21.
- SPITZER, K., 1975. Zum zoogeographisch-ökologischen Begriff der südböhmischen Hochmoore. *Verh. 6. Int. Sympos. Entomofaun. Mitteleuropa (The Hague)* : 293-298.
- SPITZER, K., 1981. Ökologie und Biogeographie der bedrohten Schmetterlinge der südböhmischen Hochmoore. *Beih. Veröff. Naturschutz Landschaftspflege Bad.-Württ.* 21 : 125-131.
- SPITZER, K., JAROŠ, J. & SVENSSON, I., 1991. Geographical variation in food plant selection of *Eupithecia gelidata* Möschler, 1860 (Lepidoptera, Geometridae). *Entomol. Fenn.* 2 : 33-36.
- TUHKANEN, S., 1984. A circumboreal system of climatic-phytogeographical regions. *Acta Bot. Fenn.* 127 : 1-50.
- WELLS, S. M., PYLE, R. & COLLINS, N. M., 1983. The IUCN Invertebrate Red Data Book. Gland, Cambridge.

# ZOBODAT - [www.zobodat.at](http://www.zobodat.at)

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Nota lepidopterologica](#)

Jahr/Year: 1994

Band/Volume: [Supp\\_5](#)

Autor(en)/Author(s): Spitzer Karel

Artikel/Article: [Biogeographical and ecological determinants of the central European peat bog Lepidoptera : The habitat island approach to conservation 45-49](#)