Staphylinidae

Jaroslav Boháč[1], Jan Matějíček[2], Rudolf Rous[3]

[1]*Jihočeská univerzita, Zemědělská fakulta, Na Zlaté stoce, 370 05 ČeskéBudějovice, e-mail: jardabo@seznam.cz,*
[2]*Formánkova 436, 500 11 Hradec Králové 11, e-mail: honzama@tiscali.cz, Heleny Malířové 12, 160 00 Praha 6*

Abstract: On the territory of CR live currently 1406 species of the family Staphylinidae. From the total number of the species occurring in this territory 124 species were enlisted among critically endangered (CR), 228 species among endangered (EN) and 204 species among vulnerable (VU) (Boháč, Matějíček, Rous, in press). Extinct species weren't documented. Staphylinidae are especially very sensitive detectors of the changes of hygric conditions in the landscape. The most important formation groups of habitats for Staphylinidae according to the occurrence of the endangered species are in the sequence of their meaning: forests, wetlands and shore vegetation, secondary grasslands and heathlands, springs and mires, alpine treeless habitats, cliffs and boulder screes, scrubs.

Introduction

There live 1406 species of the family Staphylinidae currently in the Czech republic. (Boháč a kol. 1993, Rous 1993, Boháč & Matějíček 2003, Boháč et al. in press). After the enlistment of the subfamilies *Dasycerinae, Scaphidiinae* and *Pselaphinae*, formerly separately featured families, to the family *Staphylinidae*, it is the most abundant beatles group on our territory. The group has never been from our territory completely monographically processed. As single subfamilies were processed by Smetana (1958) *Xantholininae* and *Staphylininae* and by Boháč (1985, 1985a, 1986) the subfamily *Paederinae*. It is possible to determine our species according to German determination keys concerning central Europe (Lohse 1964, Freude 1971, Benick 1974, Besuchet 1974), that have been up-dated many times (Assing & Schulke 2001). A lot of studies concerning taxonomy, bionomy, distribution and faunology of Staphylinidae on our territory have been published over the last twenty years by many authors, especially (in alphabetical order) by J J. Boháč, M. Dvořák, L. Hromádka, J. Janák, M. Kocian, Z. Likovský, P. Nohel, A. Smetana. and others (Boháč & Matějíček 2003). Many data about the occurrence and bionomy of Staphylinidae concerning our territory are included especially in monographs of in German writing authors (Horion 1949, 1963, 1965, 1967, Koch 1989). Currently a database of the Staphylinidae distribution on our territory and a conversion of these data to a form of a square survey of the territory of CR is under construction (Boháč & Matějíček 2003). More then 135.000 data are stored. Classification and nomenclature of the red list Staphylinidae was taken from the studies by Assing & Schulke (2001) and Boháč et al. (2004). Staphylinidae occur virtually in all kinds of terestric ecosystems. Perhaps one half of all species lives in litter and forms an important part of soil fauna. Only about 17,7 % species of our fauna belong to ubiquity species living also in habitats highly effected by man (Boháč et al. 2004). On the contrary many species is bound on original forests, wetland habitats or steppes. Staphylinidae are often bound on nests of social insect or minute mammals and birds. Knowledge of ecological demands of central European species and the presence of the genera in all half-natural and man effected ecosystems is the reason, that this beetles are sensitive bio-indicators of anthropogenic changes in the environment (Boháč 1999). From the total number of 1406 species occurring on our territory were 124 species enlisted among critically endangered (CR), 228 kind among endangered (EN) and 204 species among vulnerable (VU) (Boháč et al. in press). Of these 556

species were 510 assignated to a habitat. By the others 46 species is the habitat preference meanwhile unknown.

Indication importance of the group

Staphylinidae are bionomically a very heterogeneous group occurring virtually in all types of terestric habitats (Boháč 1999a). Many wetland species can live for a long term also below the water surface. Pursuant to the dietary specialization are Staphylinidae divided to five life form classes (table 1) (Boháč 1999a). According to the specialization is there a prevalence of zoophagous beetles. A considerable part of Staphylinidae (about 20 % species of our fauna) however can be characterizes as mycetophagous or saprophagous. Smaller part of Staphylinidae (about 10 % species of our fauna) may be characterized as phytophagous or myrmecophilous. By monitoring of the spectrum of life forms of Staphylinidae and their communities in 155 habitats was found, that the number of life forms changes from four (sandy ruderals) to eleven (truncated meadow). Most life form were found in natural or semi natural habitats (forests, steppes, non regulated rivers and streams, mountain meadows, shores of ponds). For each type of habitat it is possible to determine a characteristic spectrum of individuals of definite life forms (Krivoluckij & Boháč 1989, Boháč1999a). The spectrum of life forms of imago Staphylinidae indicates a variety of ecological characteristics environment and anthropogenic interference of the habitats and landscape. Higher number of life form occur in semi natural habitats less effected by man. Hierarchical classification of life forms of larvae of Staphylinidae is analogical to the imagoes, except of that there is in addition even a new class of parasites according to the ectoparasitic life style of the larvae of the Genus *Aleochara*.

Table 1. Life forms of European Staphylinidae (according to Boháč 1999a).

Class: Zoophags
Subclass: Epigeobionts
Groups: Epigeobionts running, big (type *Staphylinus*)
Epigeobionts running, small (type *Philonthus*)
Subclass: Stratobionts
Groups: living on soil surface and in litter (type *Othius*)
Living in litter (type *Medon*)
Living in litter andunder bark (type *Dinaraea*)
Living in underground corridors (type *Quedius*)
Living in caves (type *Apteranillus*)
Subclass: Geobionts
Groups: Geobionts running and raking (type *Phytos*us)
Soil geobionts (type *Meotica*)
Subclass: Psamocolimbets
Groups: shore (type *Stenus*)
Living on light and sandy soil (type *Astenus*)
Subclass: Petrobionts (type *Lesteva*)
Subclass: Torphobionts (type *Pachnida*)
Class: Phytophags
Groups: Dendrochortobionts (type *Eusphalerum*)
Shore (type *Bledius*)
Class: Saprophags
Groups: living in litter (type *Omalium*)
Living on soil surface, small (type *Oxytelus*)
Living in caves (type *Ochthephilus*)

Class: Mycetophags (type *Gyrophaebna*)
Class: Myrmecophilous a termitophilous
Groups: symphilous (type *Atemeles*)
synechtros (type *Lamprinodes*)
synoecents (type *Thiasophila*)

For the use of Staphylinidae as detectors of changes of the biodiversity in habitats count following data:

1. Main abiotic and biotic factors influencing the structure of communities of Staphylinidae in central European cultural landscape are given (moisture, vegetation cover, temperature, geological substrate, dispersion abilities, predation and competition) (Boháč 1999a). This allows a better interpretation of ecological research of the communities of Staphylinidae.
2. Introduction of Staphylinidae beetle (Coleoptera, *Staphylinidae*) for bio-monitoring of the anthropogenic influence in the landscape in central Europe (Boháč 1999a). The method of ecological analyses of communities was introduced. This method subsists in dividing the species in communities into ecological groups according to their sensibilities and in the comparison of the records in many habitats. Further were introduced another techniques of ecological analyses of communities (frequency of ecological groups regarding their relationships to the naturality of the habitat, frequency of species with summer and winter activity, the ratio of winged and unwinged species, different groups according to the size of their bodies, thermo- and hygropreferences and zoogeographical distribution). Staphylinidae are in some cases more sensitive bio-indicator than *Carabini*. The mentioned method is also convenient for other groups of epigeic invertebrates.
3. Introduction of biotic index of the anthropogenic interference of the communities of epigeic invertebrate (Boháč 1990). This index is successfully used for Staphylinidae and Carabidae beetles and may be used for other groups of invertebrate animals.
4. Implementation of the system of life forms of Staphylinidae based on their dietary specialization and spatial distribution in the soil. This system allows more objective assessment of changes in communities of Staphylinidae not only in light of changes of the number of species and individuals. It can be used in a modified form for Carabidae.
5. Division of Staphylinidae in size groups, allowing the description of the size structure of their communities. This dividing could allow in the future, except of other ecological characteristics, to judge the competition among three meaningful and dominant group of soil invertebrates – spiders, Carabini and Staphylinidae.
6. By the Staphylinidae communities of chosen types of by man effected and unaffected ecosystems was described the degree of their anthropogenic influence (Boháč 1999a). A response of Staphylinidae on some chosen management types on cultural landscape, especially on the application of fertilizers and some biocides, structure of the cultural landscape and villages, the influence of pollutants on chosen habitats, influence of drainage of habitats, influence of failing in health of mountain spruce ecosystems etc., on communities of Staphylinidae.
7. Findings of long-term changes in Staphylinidae fauna of the capital Prague and the probable causes of the extinction of some species (Boháč & Matějíček 2003b). This is especially the adjustment of shores, changes in forest and agricultural economy, ingrowths of the landscape and change in water regime (absence of mowing and pasture), extinction of grasslands, sandy areas, sand pits and natural water regime, changes in agricultural buildings use, stables and cellars and a direct liquidation of localities through buildings. This findings signify especially in light of long-term policy of biodiversity protection in Prague.
8. Findings, that some dietary groups of Staphylinidae notably cumulate some heavy metals (lead, mercury) and may be used as bio-indicators of their increasing content in ecosystems. These sorts enable the progress of these heavy metals in the food web (Boháč 1999a).

Occurrence of the rarest species in ČR (example *Olisthaerus substriatus*)
Olisthaerus substriatus (Paykull 1790). The only locality NPR Boubínský prales and its neighborhood, expressive bindings on the remains of mountain original spruce forests, in biogeographical view it was the last islet in CR. It was treated as extinct (Albrecht et al. 2003). However the occurrence was certified by Boháč and Matějíček (2002). A boreal species with the centre of enlargement in northern Europe and in northern parts of North America. Except of mentioned regions it is known rarely from Alps, Carpathian Mountains, Crimea and Altai.
Photo and map of enlargement.

Occurrence of rare species (genera) with more localities (example *Eusphalerum alpinum alpinum* Heer)
Eusphalerum alpinum alpinum Heer 1839. Subspecies is known only from subalpine and alpine positions of western boarders. Second subspecies (*E. alpinum obenbergeri*) is known from Carpathian Mountains. Bound on treeless habitats, the development of larvae is not known, probably bound on a definite species of vascular plants. Imagoes feed on pollen. This species is endangered above all by the tourism in the highest parts of western mountains.
Photo and map of enlargement.

List of formation groups with a brief characteristic and importance for the appropriate group
Number of species of the Red book occurring in the major formation habitats is given in table 2. The most important formation groups of habitats for Staphylinidae in light of the occurrence of endangered species are in the sequence according to their importance: forests, wetlands and riverine vegetation, secondary grasslands and heathlands, springs and mires, alpine treeless habitats, scrubs and boulder screes, scrubs.

Table 2. Main formation groups of habitats of Staphylinidae with the number of species of Red book in them.

Habitat	Number of species of Staphylinidae of the Red book
Streams and water bodies	0
Wetlands and riverine vegetation	147
Springs and mires	43
Scrubs and boulder screes	4
Alpine treeless habitats	40
Secondary grasslands and heathlands	79
Scrubs	3
Forests	194

V - streams and water bodies
Although there are no water species among Staphylinidae like e.g. by other groups of water beetles (diving-beetles, scavenger beetles and others) have watercourses and water bodies for them a big importance (see further). Many species (e.g. the whole subfamily *Steninae*) are able to move on the surface analogous to Gerridae and through special exudants decline the surface tension of the water and thereby may be propel forward. Some species have a plastron (genera *Stenus, Deinopsis*), which allows them the movement and long-term stay under the water surface.

M - wetlands and riverine vegetation
Many genera and even subfamilies of Staphylinidae is bound through their bionomy on this type of habitats (majority of the species from the subfamily *Steninae, Euaesthetinae*, species from the genera *Carperlimus, Bledius, Ancyrophoru, Paederus, Lobrathium, Gymnusa, Myllaena, Ischnopoda, Calodera, Porocyusa*, etc ..). Some species of the subfamily *Steninae* are bound accurately on specific vegetation riverine communities. Riverine vegetation of torrents treats many red book species. What's however also essential to Staphylinidae, they frequently live also on shores without vegetation (petrobiont species of the genera *Lesteva, Ancyrophorus*) or in fine alluvial sands (genera *Stenus, Hydrosmecta, Thinoecia, Aloconota* and others). Some species (e.g. *Quedius auricomus, Dianous coerulescens* are bound on mosses and liverworts growing directly in streams). Liquidation and desiccation of habitats is one of the main causes of endangering of Staphylinidae in our country.

R - springs and mires
Springs and mires are a crucial habitat for some species of Staphylinidae, especially the so-called tyrphobionts (occurring and are bound during their larval development only on peat-bogs) and tyrphophils (prioritizing this type of habitat) (Boháč & Bezděk in press).

S - Cliffs and boulder screes
For Staphylinidae are important rocky steppes with the occurrence of thermophilous species, that find here in the landscape often last refuges. Boulder screes are important habitats for psychrophilous species of Staphylinidae and species of alpine treeless habitats (e.g. *Leptusa brancsiki*). Genuine troglobionts among Staphylinidae occur on Balkan, but in caves we can find many darkness preferring species (e.g. *Lesteva hanseni, Ancyrophorus aureus*, etc ..)

A - alpine treeless habitats
Majority of our boreoalpine and boreomountainous (e.g. majority of species from the genera *Eusphalerum, Anthophagus, Leptusa*) are bound just on this type of habitats. They are endangered by the ingrowths of habitats and tourism activities (build-up of leisure amenities, eutrophization, transport, etc ..).

T - secondary grasslands and heathlands
Majority of the myrmecophilous species (species bound on ants) occur just in thermophilous secondary grasslands. Their ingrowths was probably the main cause for the extinction of some hostess species of ants and thereby the extinction of these myrmecophilous species (see myrmecofphilous coleoptera in Prague, Boháč & Matějíček 2003, Boháč & Kučera 2004). Salty areas are quite a crucial habitat for many species of Staphylinidae. Some genera (e.g. genus *Bledius*), whose larvae feed on halophytous algae and diatoms, are on this type of habitat completely dependent. These species are of cardinal importance for some other species of carnivorous invertebrates (e.g. halophilous Carabini species *Dyschirius*), that persecute them.

K - scrubs
The importance of scrubs in light of protection of endangered species of Staphylinidae isn't known very well. Meaning of *Sarothamus scoparius* as an important habitat was proved.

L - forests
Considerable number of endangered species of Staphylinidae is bound on original forests, old warren trees with ant nests (e.g. *Thoracophorus corticinus*), bird and mammal nests (e.g. *Veleius dilatatus, Philonthus fuscus*, etc ..). Another important endangered group of Staphylinidae living under tree bark is bound on dead trunks, where it persecutes insect pests

(e.g. engraver beetles) (e.g. *Zeteotomus brevicornis*). Many endangered species live in dead wood and especially then in fruiting bodies of many species of fungi (genera *Bolitobius, Lordithon, Mycetoporus* etc.). These species may be carnivorous (food on fly larvae) or mycetofagous. Preservation of original forests, warren trees and dead trees is crucial for survival of endangered species of Staphylinidae bound on forest.

Factors threatening to appropriate groups

Currently are this especially factors caused by human activity. About the influence of these factors are we informed by studies in single habitats (e.g. Boháč et al. in press) or monitoring of long-term changes of their biodiversity (Boháč & Matějíček 2003). Long-term monitoring o f the occurrence of Staphylinidae of Prague since 1869 to the present proved, that from the total number of 730 ascertained species during the time of the monitoring 80 species got extinct. On the contrary five invasive species penetrated from other faunistic regions. Main factors influencing the changes in fauna of Staphylinidae in Prague were: regulation of shores, changes in forest and agricultural economy, ingrowths of landscape and change in water relations (absence of skiving and pasture), disappearance of grasslands, sandy areas, sand pits and natural water relations, changes in the use of agricultural buildings, stables and cellars and a direct liquidation of localities through a building development. Most important factors, that threaten Staphylinidae are (in sequence according to their meaning) following:

1. Direct liquidation, damage or change of localities
• Disforestation biotope
• Supplying natural composition of forests by forests of economical determination
• Stripping of old trees (hollow trees), many Staphylinidae beetles are bound on microhabitats in these and around these trees
• Felling old avenues, the same reason as in the previous point
• Build-up of all sorts and liquidation of habitats, especially in the surroundings of cities
• Desiccation of wetlands of all kinds, this is currently not so actual, many locations are revitalized or planned to be
• Ingrowths of meadows forest steppe formations of thermophyticum (Mediterranean species sensitive to changes of microclimate and some species bound on social insects are vanishing), important at present, luck of management
• Eutrophization of habitats through excessive fertilization
• Acidification of soil from industrial production and automobile transport
2. Global civilization stress on the environment
• Changes in soil quality (acidification, eutrophization, deposition of pollutants)
• Changes in climate, especially with an influence to the vegetation cover, few data

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