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Properties of Carabid and Staphylinid Communities in Central European and Mediterranean Cities

The study of the urban fauna is practically and theoretically important not only due to urgent necessity of optimalization of the relations between man and his environment in urban landscape, but it offers a good occasion for investigation of degradation and regeneration of plant and animal communities in such extent and conditions in which an experiment would not be possible. The degraded communities from cities can supply important reference data for more reliable interpretation for different bioindicative investigations.

The aim of present paper is to show the succession of some properties of carabid and staphylinid communities in the urban landscape, to deal briefly some properties of built up areas influencing the structure, of the communities and to present a model of coincidence of bioindicative criteria during degradation and regeneration of a community.

The material used in this study was sampled by the pitfall trapping in Brno and Bratislava on 39 localities in the city interior. Nine communities from free landscape were choosen as reference communities. The material totals 55 138 individuals of both families. Besides, an intesive study was carried out in Madrid (31 sites in city interior) and in its surroundigs (17 sites) during summer 1985. The material from Spain totals 10 239 individuals. All localities were choosen as to characterize the variability of urban environment as much as possible.

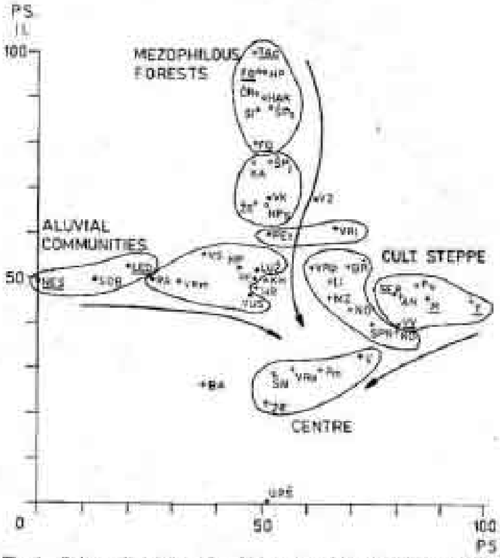

Fig. 1 Polar ordination of Carabid communities from Brno and Bratislava and from reference localities in free landscape. (o – forest communities, o – alluvial communities, + – communities of cultural steppe, PS – proportional similarity, TAc – Tilieto Aceretum, FQ – Fageto Quercetum, LED – Ulmeto Fraxineto carpineum, NES – natural Phragmitetum, VV – vineyard, M – mais, T – tobacco, other abreviations mean streets and squares in Brno and Bratislava)

Classification of Carabid and Staphylinid Communities in Bratislava and Brno

Altogether 48 communities from both cities and free landscape were subjected to the hierarchical classification by the unwaighted average linkage method and to the polar ordination combined with more similarity functions. All, hierarchical and non hierarchical classifications confirm the existence of three principal types of the communities in both cities, viz the communities of the alluvial forests, of mesophilous forests and of cultural steppe. Under the anthropogenous pressure, more or less degraded communities develop within each type. They lose subsequently their original species spectrum and converge to the only type of strongly degraded or chronically pionier communities close to the fauna of cultural steppe and exhibiting a characteristic structure. Such communities occure anywhere without respect to permanent ecotopic conditions (sensu ZLATNÍK 1966). The polar ordination of carabid communities according to their proportional similarity is presented here as an example of such succession. The logical synthesis of results of all classifications made leades to distinguishing of three or four subtypes within each type. These subtypes express the degree of anthropogenous influencing of the communities. Besides, there exist some intermediate subtypes characterizing some ecotonal communities. There are close relations between individual subtypes and they are symptomatic of individual types of urban greenery. Their mutual relations and succession are shown in the table 1. The ecological characteristics of each type and subtype are presented below.

TYPE A – communities of the forest geobiocenoses of hydrical series z and m (ZLATNÍK, RAUSER 1966). Characteristic species *Carabus granulatus*, *Bembidion biguttatum*, *B. unicolor*, *Trechus secalis*, *Patrobus excavatus*, *Pterostichus niger*, *P. vulgaris*, *P. nigrita*, *P. anthracinus*, *P. strenuus*, *P. diligens*, *Agonum moestum*, *A. obscurum*, *A. assimile*, *Staphylinus erythropterus*, *Philonthus decorus*, *Tachinus rifipes*, *Lathrobium spp.*, *Oxytelus rugosus*; on the water's edges *Bembidion articulatum*, *B. semicupreum*, *Dyschirius spp.*, *Platystethus spp.*, *Stenus spp.*, *Bledius spp.*

Subtype A 1 – natural communities with characteristic spectrum of hygrophilous and euryhygrophilous species, abundance and biomass high, alpha diversity and equitability high, lognormal distribution of species/abundance relation, big species present, proportion of flying naturally higher than in mesophilous forests, sex ratio inpredictable.

Subtype A 2 – intermediatelly (reversibilly) damaged communities with preserved species, spectrum, alpha diversity and equitability low, loggeometrical distribution of species/abundance relation, females dominate in abundant species, dominance of *Patr. excavatus*, *Ag. assimile* and *Nebr. brevicollis* increases, big species disappeare.

Subtype A 3 – strongly damaged communities with a proportion of xenoecious species, abundance and biomass low, alpha diversity and equitability increases, males tend to dominate in abundant species, wingless species or big species sporadic.

Subtype A 2/B 2 – ecotonal communities from line formations along streams in the city interior, zoocenologically convergent to subtypes A 2 – A 3, by biomass to subtype B 2, alpha-diversity and equitability high, abundance and biomass vary in dependece of immigration of *Carabus coriaceus*, *C. nemoralis*, *C. hortensis*, *Abax ater* etc.

Type F – communities of the forest geobiocenoses of hydrical series n and o in veg. tiers 1 and 2. Characteristic species: *Carabus coriaceus*, *C. hortensis*, *C. nemoralis*, *C. ullrichi*, *Abax ater*, *A. parallelus*, *A. ovalis*, *Molops piceus*, *Pterostichus oblongopunctatus*, *Ocypus tenebricosus* or *O. biharicus*, *O. similis*, *Othius punctulatus*, *Omalium rivulare*, *O. caesum*, *Oxytelus sculpturatus*.

Subtype F 1 – natural communities, cumulative abundance and biomass high in relation to trophicity ranges A–D (ZLATNÍK, RAUŠER 1966), alpha diversity and equitability high, sex ratio unpredictable, apterous and big species well represented, presence of species with small distributional areas in Central Europe, lognormal or loggeometrical distribution of species (abundance relation, xenoecious species sporadically.

Subtype F 2 – reversibly damaged communities, species spectrum preserved, alpha diversity and equitability lower, loggeometrical distribution of species/abundance relation, wingless and big species sporadic, tendence to dominance of females in abundant species, species with small distributional areas disappeare.

Subtype F 3 – strongly damaged forest communities with poore species spectrum and autodominance of *Abax ater*, big species absent, many xenoecious species, alpha diversity low, females dominate in more abundant species.

Subtype F 3/C 3 – strongly damaged or slightly regenerated communities with balanced representation of more tolerant forest species and field species, simultaneous occurence of *Abax ater* and *Harpalus spp. Amara spp.*, euryecious staphylinids present.

TYPE C – communities of cultural steppe characterized by a large spectrum of species (*Carabus scheidleri*, *C. violaceus*, *C. ullrichi*, *C. cancellatus*, *Broscus cephalotes*, *Bembidion lampros*, *B. properans*, *Trechus quadristriatus*, *Amara spp.*, *Harpalus spp.*, *Zabrus tenebrioides*, *Pterostichus cupreus*, *P. vulgaris*, *Calathus spp.*, *Dolichus halensis*, *Agonum dorsale*, *Brachynus crepitans*, *B. explodens*, *Xantholinus linearis*, *Tachyporus spp.*, *Drusila canaliculata*, *Omalium rivulare*, *O. caesum*, *Oxytelus sculpturatus*. etc.

Subtype C 1 – this subtype characterized by presence of *Carabus spp.* or *Calosoma auropunctatum* is actually absent in South Moravia and Slovakia.

Subtype C 2 – intermediately damaged communities with obligate absence or extremly sporadic occurence of *Carabus spp.* or *Calosoma auropunctatum*, with codominance of *Harp. rufipes* and *Pt. vulgaris* or *Pt. cupreus*, with low alpha diversity, females dominant in abundant species, cumulative abundance and biomass high, absence of the species with small distributional areas, the species spectrum varies according to the timing of individual cultures and breeding cycle in carabids.

Subtype C 3 – strongly damaged or slightly regenerated communities from open areas in city centre, proportionally rather similar to subtype C 2, but with lower cumulative abundance and biomass, *H. rufipes* is frequently autodominant.

Subtype C 4 – extremly strong damaged or chronically pionier communities in small greenery patches in the city. Representation of individual species balanced, abundance and biomass very low, alpha diversity and equitability high, loggeometric distribution of species/abundance relation, big species, wingless species or species with small areas absent, higher representation of hygrophilous species.

Subtype C 3/B 3 – communities with predominating representants of fauna of cult. steppe and with pre-

sence of the species requireing more permanent vegetational cover (*Leistus ferrugineus*, *Calathus* spp., *Carabus violaceus*, and *C. intricatus*) appeare sometimes.
Subtype C3/A – communities in the city centre with dominance of field species but with strikingly increased representation of some hygrophilous species (*Agonum obscurum*, *Bembidion spp.*, *P. niger*). Other characteristics in both last subtypes are similar as in the subtype C4.

Carabid and Staphylinid Communities in Madrid

There are many analogies in the pattern of succession of carabid and staphylinid communities in Central European towns and in Madrid. The communities in its interior belong to three types analogous to those in Bratislava and Brno, viz. communities close to evergreen forests dominated by Quercus rotundifolia (s. c. encinares), to alluvial or litoral formations and to cultural steppe.
The fauna of the forests or matorral of Quercus rotundifolia consists of three dominant species – *Calathus granatensis*, *C. mollis* and *Harpalus wagneri* accompanied by larger spectrum of species like *Pterostichus globosus*, *Acinopus picipes*, *Ditomus sphaerocephalus*, *Microlestes abeilli*, *Amara aenea* etc. The cumulative abundance of carabids fluctuates extremly. In Casa de Campo (a large park in the suburb of Madrid), which can be considered as an artificially regenerated forrest, the only dominant species becames *Cal. granatensis* (round 95 %). *Calathus mollis* disappeare, other species are represented only individually and *Calathus fuscipes* penetrates the community. The cumulative abundance is high (750 ind/trap during 40 days), alpha diversity low. This community is analogous to the subtype F2. The communities in more shadowy gardens in the modern quarters are dominated by *Calathus fuscipe* accompanied by *Amara aenea*, *Microlestes spp.* and the tenebrionide *Stenosis angustatus*. *Calathus granatensis* is absent in such habitats. The dry, strongly insolated places in city interior are inhabited by *Calathus ambiguus*, *Ophonus rotundarus*, *Acinopus picipes* and *Ditomus clypeatus* and tenebrionids *Dichilus subcostatus*, *Crypticus viaticus* and *Scaurus scicticus*. The cumulative abundance is low and equitability high in such places. Some moderately humid sites are inhabited by *Ditomus capito*, *Harpalus rufipes*, *Badister bipustulatus*, *Trechus quadristriatus* and *Ocypus aethiops*. These communities are analogous to subtype F3 – C3. In contrast to Central Europe, *Harp. rufipes* is not abundant in the city, though it is dominant in mais fields in the surroundings (alluvium of Tajo near to Aranjuez).
The litoral or alluvial communities are rich and relatively similar to those in Central Europe. The species *Carabus melancholicus*, *Chlaenius festivus*, *Ch. variegatus*, *Anisodactylus nemorivagus*, *A. binotatus*, *Diachromus germanus*, *Stenolophus teutonus* and *Agonum ruficorne* are dominant. Only *Agonum ruficorne*, *Stenolophus teutonus* are more tolerant and occure along natural or artificial creeks in the relatively natural park Casa de Campo. In more anthropogenously condition appeare *Nebria brevicollis*, similarly as in Central Europe.
The fauna of cultural steppe seems to be more variable in "natural" conditions than in Central Europe. In irrigated mais field it is nearly identical, in the cereals it exhibits considerable degree of endemism. (*Acinopus sabulosus*, *Pterostichus crenulatus*, *P. globosus*). The most tolerant species seem to be *Harpalus distinguendus*, *Acinopus picipes* and *Microlestes abeilli*, which together with *Ocypus olens*, *Xantholinus linearis* inhabit open ruderal areas in the centre. Their communities are analogous to the subtype C3. The daily intensively watered grasslands represent besides the areas without any vegetation (very frequent) the most anthropogenously influenced habitats. Their communities are extremly poore and consist of *Xantholinus linearis*, *Tachyporus solutus* and *Ocypus olens*. They are analogous to the subtype C4.
Although the species composition of carabid and staphylinid communities in Madrid differs considerably from that in Brno and Bratislava, it can be concluded, that there exist, in more general level, the same patterns in the succession of urban fauna in both zoogeographical regions.

The Influence of some Properties of Built up Areas on Carabidae and Staphylinidae

The factor analysis (Fig. 2) shows that the relation between some properties of built up areas on some ecological characteristics is free. There is a very close cluster of buildings hight, buildings density and of the distance of a sampling site from the city border. It was found that the buildings hight above 25–30 m or buildings density more than cca 30 % effects negatively on the surviving of communities of both families in the city. However, low values of one factor can effectively compensate the negatice influence of other. This is the case of modern housing estates, where are good predispozitions to arizing of communities of relatively high biotical value. In contrast to investigations on other animals in the city, the area of studied sites had not a visible effect on the structure of Carabid and Staphylinid communities. This is due to influence of many other, hardly separable factors.

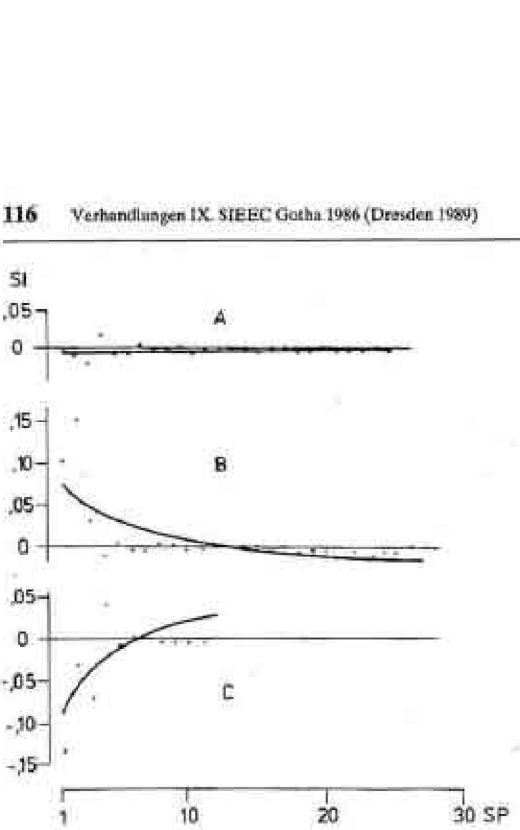

Fig. 2 Factor analysis of influence of some properties of built up areas on carabid and staphylinid communities. (h – buildings hight, F – buildings density, d_{ex} – distance from city margine, d_{re} – distance from similar habitat in the city exterior, d_{in} – distance from a greenery area in the city interior, C – carabids, S – Staphylinids, H' – alpha diversity, a – abundance, b – biomass.)

With the effect of buildings hight and density is closely bound the inhibitive effect of the streets tangential to a greenery area on the migration of beetles. An occasional observation in Brno showed that the radial streets allowe the beetles penetrate deeply the city centre.

A Tentative Model of the Coincidence of More Bioindicative Criteria

The detailed historical analysis of the development of vegetation cover in each sampling site, which leads in some places in Brno and Bratislava continuously even to 14. century, showed that there exist simultaneously communities exhibiting seemingly the same ecological properties. However, some of them are in the state of certain degree of degradation, while others have reached certain degree of regeneration. Historical data showed that a community can regenere spontaneously even in urban condition (ŠUSTEK 1979, 1984). The comparison of more degraded and regenerated communities allowed to conclude that the degradation and regeneration represent, in the idealized form, two mutually symmetrical proceses. The decision if a community is in the process of degradation or regeneration is possible only on the basis of long term monitoring or on the basis of historical data. The statical ecological characteristics as such can not give reliable informations about it. The same value of a criterium can be characteristic for more states of a community (e. g. abundance, biomass, alpha diversity) and can be reliable interpreted only together with other criteria.

On the basis of above considerations, a model of coincidence of more bioindicative criteria during the degradation and regeneration of a community can be tentatively proposed (Table 2). Independently on species composition, the model distinguishes three stages of degradation and regeneration, which represent in the time mutually symmetrical pairs with approximately similar properties, viz. natural and regenered communities, intermediately (reversible) damaged or regenerated communities and strongly damaged and chronically pionier communities and strongly damaged and chronically pionier communities. The gradient of the changes between individual stages is continuous and can be divided more in details, if a bioindicative criterium it allowes. As two illustrative examples, three characteristic cases of body size structure of carabid and staphylinid communities and sex ratio patterns in carabids are presented in the figures 3 and 4. The validity of this model is limited on the habitats in the oak to oak beech vegetation tier (ZLATNÍK, RAUŠER 1966). The unfavourable abiotic factors in higher veg. tiers can have similar effects on a community as anthropogenous ones. Certain limitation are also given by the fact that some ecological properties of a species can compensate negative effects of others. E. g. the big

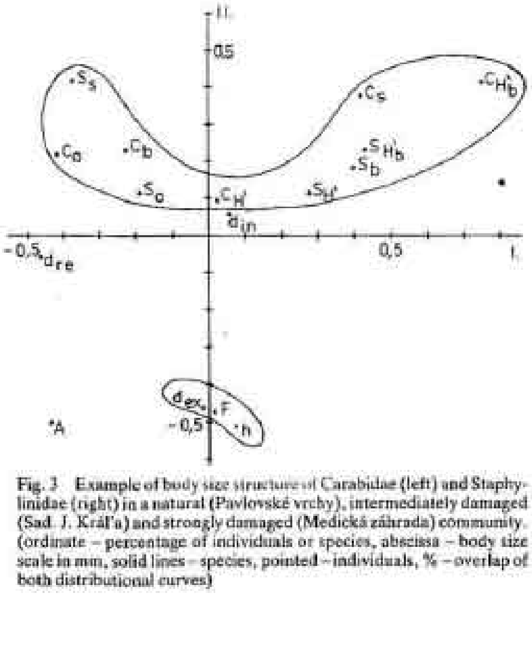

Fig. 3 Example of body size structure of Carabidae (left) and Staphylinidae (right) in a natural (Pavlovské vrchy), intermediately damaged (Sad. J. Kráľa) and strongly damaged (Medická záhrada) community. (ordinate – percentage of individuals or species, abscissa – body size scale in mm, solid lines – species, pointed – individuals, % – overlap of both distributional curves)

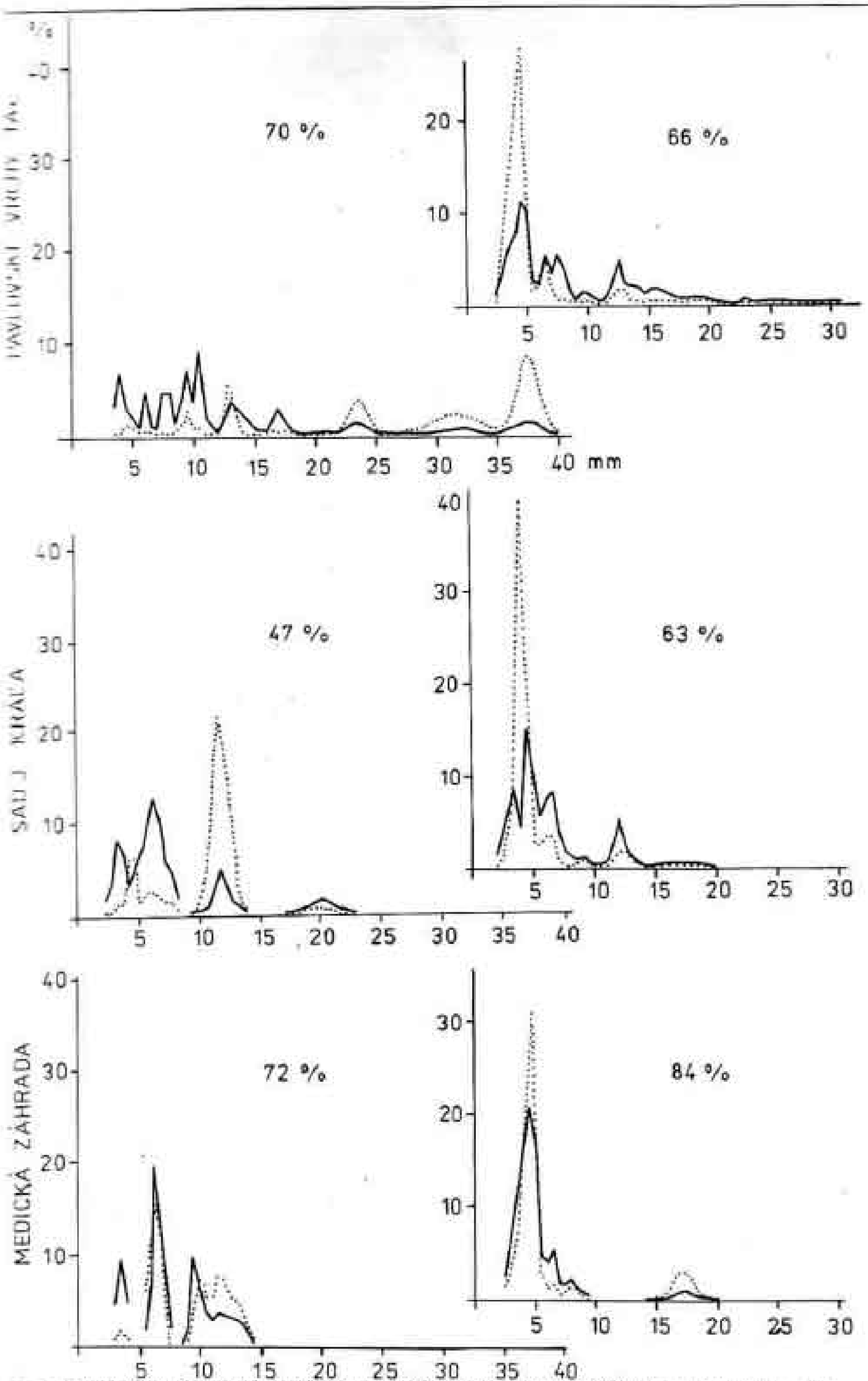

Fig. 4 Example of sex ratio pattern in carabids in a natural (A), intermediatelly damaged (B) and strongly damaged community (C). [SI – sex ratio, SI = $(f_i - m_i)N$, m and f – males and females, of i-th species, N – total of individuals].

wingless staphylinids *Ocypus tenebricosus* and *O. biharicus* are in Brno and Bratislava limited only in natural or moderately dedraded communities, while the flying species *Ocypus olens* is frequent in the centre of Madrid even in the streets without vegetation.

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Table 1 Succession of carabid and staphylinid communities in Bratislava and Brno

STREETS AND SQUARES IN THE CITY CENTRE WITHOUT VEGETATION

F 3
STRONGLY DEGRADATED OR REGENERATING REMNANTS OF FORESTS IN THE CITY

F 3/C
PARKS IN THE CITY CENTRE WITH HIGH AND DENSE TREES

C 4 + C 3/A
SMALL PATCHES OF TOWN GREENERY AND FLOWER BEDS IN THE CITY CENTRE

C 3
PARKS IN THE CITY CENTRE WITH DOMINANT GRASS AREAS WITH SPARSE TREES AND BUSHES

A 3
STRONGLY DEGRADATED OR REGENERATING REMNANTS OF ALUVIAL FORESTS IN THE CITY MARGIN

C 3
GARDENS IN THE RESIDENTIAL QUARTERS AND FREE AREAS IN HOUSING ESTATES

C 3/F
OLD GARDENS AND ORCHARDS IN THE PERIPHERIES

F 2
FOREST PATCHES ENCLOSED IN THE BUILT UP AREAS WITH THE SPECIES SPECTRA CLOSE TO NATURAL CONDITIONS

C 2
CULTURAL STEPPE IN THE CITY EXTERIOR AND IN THE MARGINS OF THE PERIPHERIES IN ITS ACTUAL STATE

A 2
ALUVIAL FORESTS AND STANDS ALONG THE STREEMS WITH THE SPECIES SPECTRA CLOSE TO NATURAL CONDITIONS

F 1
FOREST GEOBIOCENOSES OF THE OAK AND BEECH/OAK VEGETATION TIERS, OF THE TROPHICAL RANGES A-D AND OF HYDRICAL SERIES n AND o

A 1
FOREST GEOBIOCENOSES OF THE OAK AND BEECH OAK VEGETATION TIERS, OF THE TROPHICAL RANGES B/C-D AND OF THE HYDRICAL SERIES z AND m

Table 2 Coincidence of some bioindicative criteria in degradation and regeneration of carabid and staphylinid communities in oak – oak beech vegetation tier.

BIOINDICATIVE CRITERIUM	STATUS OF THE COMMUNITY		
	DEGRADATION →		
	NATURAL OR CLOSE TO NATURAL CONDITIONS	REVERSIBILLY DEGRADATED	STRONGLY DEGRADATED
	← REGENERATION		
	SECONDARLY CLOSE TO CONDITIONS OR REGENERATED	INTERMEDIARLY REGENERATED	INITIAL STADIA OF REGENERATION OR CHRONICALLY PIONIER COMMUNITY
species spectrum	high number of characteristic species or of euryecious species, xenoecious species only in the ecotons, their number depends on beta diversity	higher number of xenoecious species, number of characteristic species preserved or slightly lower	determined by the properties of more natural communities in the surrounding. Tendency to less predictable communities with simultaneous occurence of the species with different ecol. properties
species number	high C: 20–25 S: 20	preserved lower	low C: 5–20 S: 5–20
abundance and dry biomass in individuals ind/trap. year and g/trap. year, respectively	Very variable and influenced by competition with other groups. In relation to natural production conditions decreases – from the range A to D – from the serie m to o – from the lower veg. tiers to the higher ones Abundance: C: 40–400 S: 50–100 biomass: C: 4–17 g S: 0.3–2	preserved or higher	lower low Abundance: C: 10–100 S: 10–50 biomass: C: 0.3–2 S: 0,03–0.5

Table 2 continuation

alpha diversity and equitability in bits	high, decreases with the increase of abiotical pressure J = 0.7 H' = 3	2.2–2.6 lower low J = 0.4–0.5 H' = 2.0	relatively high J = 0.7–1.0 H' = 2.0–2.6
theoretical distributions of the species' abundance relation	lognormal under higher abiotical pressure loggeometrical	lognormal loggeometrical	loggeometrical loggeometrical logpoissonian
body size structure	distribution continuous within whole body size scale Concentration of individuals in lower octaves overlap: 55–70 %	discontinuous in local minima between higher octaves overlap: 30–55 %	higher octaves empty discontinuities between low octaves only low octaves occupied, secondarly continuous distribution overlap: 70–100 %
areographical structure	presence of more species with small distributional areas overlap of qualitative and quantitative representation: 55–70 %	few species with small distributional areas overlap: 30–60 %	only the species with great distr. areas persist in damaged communities or appeare as the first in the regenerating ones overlap: 70–100 %
presence of hygrophilous species in the hygrical rowes	o: max 5 % of individuals n: occasionally, like in o z: always present m: dominate, 80–90 % of ind. overlap: 70–80 %	o and n: occasionally z and m: decreases overlap: 50–60 %	the relative representation increases and becames balanced with the relative abundance meso- and heliophilous species overlap: 70–100 %
life form of Carabids	walking zoophagous epigeobionts always presents, relative biomass 60 % relative abundance of zoophagous stratobiont living in litter and burrying into soil 40–50 % in the hydrical rowes m and z the relative abundance of zoophagous stratobionts living in litter and soil surface 60–80 % in less influenced geobiocenoids of cultural steppe is high relative abundance of myxophagous harpaloid geochortobionts and myxophagous stratochortobionts overlap: 70–80 %	less abundance and biomass of zoophagous stratobionts living in litter and burrying into soil higher in all cenoses, in the hydrical rowes z and m also of the zoophagous stratobionts living in litter and in soil surface overlap: 50–60 %	occasionall absent representation of individual life forms is balanced, but in concret cases little predictable increase representation myxophagous harpaloid geochortobionts and stratochortobionts overlap: 70–100 %

Table end

sex ratio in Carabidae	inpredictable according to the rank of a species in the community, tends to 1 : 1	dominance of females in abundant species increases	dominance of females in abundant species decreases secundarly	dominance of males in nearly all species
ability of fly in Carabidae	in the hydricity series o: and n: apterous species 90–100 % z: and m: also in natural conditions 40–80 % cultural steppe: 70–100 % of flying species	representation of nonflying species decreases	last non flying species disappeare	only flying species

Explanations: trophical ranges: A – oligotrophic, B – mesotrophic, C – eutrophic nitrophilous, D – eutrophic alcaliphilous; hydrical series: o – dry, n – normal, z – hygrophilous, m – wet; overlap: proportional similarity between qualitative and quantitative representation of species according to areographical types, relation to humidity, life forms and body size structure.

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Zur synökologisch-mathematischen Beschreibung eines urbanen Gradienten unter besonderer Berücksichtigung der Coleoptera

Der folgende Beitrag behandelt vor allem einige methodische Fragen der Auswertung synökologischer Daten, ohne die Vielzahl der Einzeldaten ausführlich darstellen zu können.

ODUM (1985) hat eine umfangreiche Liste mit Merkmalen für gestreßte Ökosysteme vorgelegt. Fünf der insgesamt 18 Punkte betreffen dabei die Struktur von Tier- und Pflanzengesellschaften, u. a. nennt er die Verkürzung von Nahrungsketten aufgrund fehlender Prädatoren und einen Rückgang der Speciesdiversität. Alle diese typischen Merkmale sollten auch in urbanen Systemen nachweisbar sein. Nachdem unsere ersten Arbeiten in Leipzig prinzipiell diese Trends bestätigten – z. T. klare Aussagen jedoch auf der Basis üblicher Parameter nur schwer möglich waren – galt es, jeder Fläche eines urbanen Gradienten einen definierten Wert (als Maß für den urbanen „Streß“) zuzuweisen. Dazu verwendeten wir zunächst den von KLAUSNITZER (1981) postulierten A-E-Gradienten, der den Übergang vom Wald über Dauergrasland bis zur Steinwüste widerspiegelt. In der Praxis sind jedoch die unterschiedlichen Einflüsse (Stressoren) kaum zu trennen, so daß die ermittelten Werte eher einen allgemeinen Urbanitätsgradienten repräsentieren. Für die nach KLAUSNITZER und RICHTER (1983) errechneten Gradientenwerte konnten lineare Korrelationen mit einer Reihe synökologischer Parameter erhalten werden. Sie liefern somit eine Skalierungs- und Bewertungsmöglichkeit der einzelnen Flächen eines Gradienten. Als besonders gut korreliert erwies sich dabei in früheren Untersuchungen an Carabiden die Homogenität (B), d. h. das zeitliche Differential der Diversität gegen die Gesamtdiversität.

In der letzten Zeit wurde versucht, bei der Untersuchung von Ruderalflächen möglichst viele Arthropodengruppen einzubeziehen. Bereits auf der Basis nur sehr grob sortierten Materials läßt sich das Gradientenmodell anwenden. Klassifizierungen von Flächen nach ihrer urbanen Beeinflussung sind mit bis zum Familienniveau determinierten Material möglich. Abb. 1 zeigt den Zusammenhang zwischen Gradientenwert und Homogenität bzw. Diversität für die Carabidae von 4 Ruderalstellen. Im Zusammenhang mit den Carabidae war es von Interesse, zu prüfen, ob eine Übertragung der Werte des neuen Flächensets (Ruderalflächen) auf die früheren Werte (Grün-