ACTA SOCIETATIS ZOOLOGICAE BOHEMICAE [1)]

Acta Soc. Zool. Bohem. Vol. 59, No. 1-2 issued 1995 June 22

ISSN 0862-5247 47678

Published and distributed by the Czech Zoological Society. Orders should be sent to the Czech Zoological Society, Viničná 7, CZ-128 00 Praha 2, Czech Republic. Printed by the Čihák tisk, Štěrboholská 21, CZ-102 00 Praha 10, Czech Republic

Annual subscription (Volume 59, 1995, 4 issues):

Institutional subscription:	Europe: USD 80.00
Other countries:	USD 90.00
Private subscription:	Europe: USD 40.00
Other countries:	USD 50.00
Czech Republic:	Kč 120,- (excl. postage)

This issue was supported by the Český literární fond (Czech Literary Foundation).

[1)] A direct continuation of:
(i) Vol. 1 (1927-1932): Zpráva o činnosti československé zoologické Společnosti za léta 1927-1932
(ii) Vol. 2-53 (1933-1989): Věstník československé Společnosti zoologické *(Věst. Čs. Společ. Zool.)*
(iii) Vol. 54-56 (1990-1992): Acta Societatis Zoologicae Bohemoslovacae *(Acta Soc. Zool. Bohemoslov.)*

Acta Soc. Zool. Bohem. **59:** 1-16, 1995
ISSN 0862-5247

Testate amoebae (Protozoa: Rhizopoda) from a primary mountain rain forest in the Tam-Dao region (Vietnam)

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Received January 13, 1995; accepted February 9, 1995
Published June 22, 1995

Taxonomy, new taxa, ecology, faunistic, testacea, tropical rain forest, soil, Vietnam

Abstract. From 17 samples of soil and leaf litter from a primary mountain rain forest in the Tam-Dao area 126 species, varieties and forms of testate amoebae were **determined**. The variety *Cyclopyxis quadratus* var. *grandis* var. n. and the species *Hyalosphenia tamdaoensis* sp. n. and *Trinema staryi* sp. n. are new for the science. All of the found species are new for the fauna of Vietnam. 34 species and varieties were first found in Asia. Relative similarity of testacean communities on the studied area in general and heterogeneity on the single microhabitats were **determined** on the basis of Sørensen's index of faunistical similarity at the species and genera levels.

INTRODUCTION

This paper is result of a study of testate amoebae fauna in soil and litter samples from a primary mountain rain (foggy) forest in the Tam-Dao region. These samples were collected by Dr J. Starý (Institute of Soil Biology AS CR) during his study stay in Vietnam in Octobre 1988.

This paper is the first contribution what engage with soil testate amoebae fauna from this country. Golemansky (1979) studied the marine supralittoral psammal testacean fauna of the sand beaches in the southern part of Vietnam (Chinese Sea coast).

From the south-eastern Asia there are many works which supply the basic knowledge of the testate amoebae fauna from this area:

Borneo - Hoogenraad & de Groot (1942);
China - Bartoš (1963a), Fielde (1887), Lammerman (1907), Tai (1931), Wang (1925), Wang & Nie (1934), Zanyin Gaw (1941);
India - Carter (1864, 1865), Naidu (1966), Nair (1968), Nair & Mukherje (1968), Rao (1928);
Japan - Couteaux (1978), Edmonson & Kingman (1913, 1914), Hada (1969), Sudzuki (1971a, b, 1978a, b);
Java - Bartoš (1963b), Hoogenraad & de Groot (1940, 1942), van Oye (1922, 1949);
Malaysia - Chardez (1979), Sudzuki (1973);
Nepal - Bhatia (1930), Bonnet (1977), Laminger (1972), Penard (1907);
Papua - New Guinea - Bonnet (1980b), Daday (1901);
Philippines- Bonnet (1980a);
Singapore - Ghosh (1928);
Sri Lanka - Daday (1898);
Sumatra - Brues (1939), Dammermann (1948), Green et al. (1976), Harnisch (1933, 1951), Heinis (1928);
Thailand - Bonnet (1981).

The greater part of these works deal with testate amoebae fauna from mosses and waters. Only a few papers describe the soil testate amoebae communities (e.g. Bonnet 1980, 1981; Laminger 1972).

The presented paper is the first work about the soil testate amoebae fauna from Vietnam, but also a contribution to the knowledge of the soil testate amoebae from the tropical south-eastern Asia.

DESCRIPTION OF THE STUDIED AREA

The studied samples were collected in the course of October, 1988 in the environs of the Tam-Dao city in the north mountain area of Vietnam (Fig. 1). The investigated locality lies cca 90 kilometers north from Hanoi (106° - 106°30' E, 21°31' - 22° N). The samples were collected in the altitude cca 1200 a. s. l. Mean year value of the precipitation is 2000 mm, mean year value of the temperature is 20°C. This locality is a undisturbed primary mountain rain (foggy) forest on the slopes of limestone mountains. Floristically and faunistically it is here the boundary between the Palearctic and Indomalaysian areas and the environs of the Tam-Dao city is characterized by a mixture of elements of both geographical areas (it is known for instance by Oribatid mites and Lepidopters).

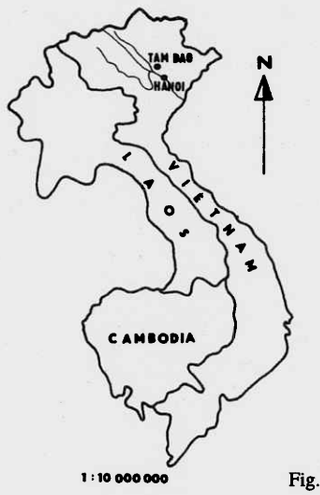

Fig. 1. Sketch-map of the study area.

The samples were collected in the primary mountain rain forest on the following sample sites:

182 - very moist, desintegrated wood matter, mixed with mineral particles and litter, high content of iron and manganese salts, dark rusty brown colour.
183 - upper undisturbed leaf litter layer with mineral particles and arthopodic moder.
184 - partial disintegrated leaf litter mixed with arthropodic moder.
185 - partial disintegrated leaf litter mixed with mineral particles, dark rusty brown colour.
186 - disintegrated, very moist leaf litter mixed with arthropodic moder and mineral particles.
188 - humic soil horizon with mineral grains.
189 - very disintegrated leaf litter.
190 - very disintegrated wood matter mixed with excrements of arthropods and mineral particles.
191 - disintegrated wood matter mixed with rusty brown ferric soil.

192 - fermentation layer of humic soil horizon, a mixture of disintegrated leaves, twigs and mineral particles.
193 - upper litter layer, undisintegrated leaves, petioles and rind.
195 - very disintegrated leaf litter mixed with excrements of arthropods and with dark rusty brown mineral particles.
196 - arthropodic moder, dark brown.
197 - pure arthropodic moder.
198 - undisintegrated leaf litter.
199 - disintegrated leaf litter mixed with arthropodic moder.
200 - undisintegrated leaf litter with rusty brown mineral particles.

All of these samples were removed on the relative small area in a primary mountain rain forest and they render the variability in this relatively homogenous ecosystem.

RESULTS

List of determined species

The numbers behind the scientific names of species are the numbers of sample sites. Numbers in brackets marked the frequency of single species. All species found are new for the fauna of Vietnam. The symbol "*" marks a new species for Asia, the symbol "**" new for science.

Arcella arenaria Greeff, 1866 - 197 (5.9)
* *Arcella costata* var. *angulosa* (Perty) Playfair, 1918 - 196 (5.9)
* *Arcella polypora* Penard, 1890 - 189 (5.9)
Arcella vulgaris Ehrenberg, 1832 - 185, 190, 192, 195, 196, 200 (35.3)

Assulina muscorum Greeff, 1888 - 182, 183, 189, 190, 193, 196, 200 (41.2)
* *Assulina muscorum* var. *denticulata* Chardez, 1964 - 183, 196 (11.8)
* *Assulina muscorum* var. *stenostoma* Schönborn, 1964 - 196 (5.9)
Assulina seminulum (Ehrenberg) Leidy, 1879 - 185 (5.9)

Centropyxis aculeata (Ehrenberg) Stein, 1857 - 191, 193, 195, (17.6)
* *Centropyxis aculeata* var. *oblonga* Deflandre, 1929 - 186 (5.9)
Centropyxis aerophila Deflandre, 1929 - 189, 192 (11.8)
Centropyxis aerophila var. *microstoma* Decloitre - 196, 197, 198 (17.6)
Centropyxis aerophila var. *minuta* Chardez, 1964 - 190, 196, 197, 199 (23.5)
Centropyxis aerophila var. *sphagnicola* Deflandre, 1929 - 199 (5.9)
Centropyxis cassis (Wallich) Deflandre, 1929 - 186 (5.9)
* *Centropyxis cassis* var. *minima* van Oye, 1958 - 190 (5.9)
Centropyxis constricta var. *minima* Decloitre, 1954 - 195 (5.9)
* *Centropyxis cornuta* Decloitre, 1961 - 183 (5.9)
Centropyxis deflandriana Bonnet, 1959 - 184, 185, 193, 195, 196, 197, 198, 199, 200 (52.9)
Centropyxis ecornis (Ehrenberg) Leidy, 1879 - 183 (5.9)
Centropyxis elongata (Penard) Thomas, 1959 - 184, 190 (11.8)
Centropyxis latideflandriana Bonnet, 1979 - 186 (5.9)
Centropyxis orbicularis Deflandre, 1929 - 197 (5.9)
* *Centropyxis ovalis* Decloitre, 1974 - 184 (5.9)
Centropyxis parvideflandriana (Bonnet) Bonnet, 1979 - 183, 185, 188, 189, 191, 197, 199, 200 (47.1)
Centropyxis platystoma (Penard) Deflandre, 1929 - 184 (5.9)
Centropyxis protecta Bartoš, 1963 - 190 (5.9)
Centropyxis stenodeflandriana Bonnet, 1979 - 183, 184, 185, 186, 190, 193, 198, 199 (47.1)

* *Corythion aerophila* Decloitre, 1950 - 183 (5.9)
Corythion dubium Taránek, 1881 - 183, 184, 185, 186, 188, 189, 191, 198, 200 (52.9)
Corythion pulchellum Penard, 1890 - 190, 197, 200 (17.6)

Cyclopyxis ambigua Bonnet & Thomas, 1960 - 185, 196 (11.8)
Cyclopyxis eurystoma Deflandre, 1929 - 193, 197 (11.8)
* *Cyclopyxis eurystoma* var. *grandis* Decloitre - 190 (5.9)
Cyclopyxis humilis Bonnet, 1962 - 197 (5.9)
Cyclopyxis kahli Deflandre, 1929 - 183, 191, 200 (17.6)
Cyclopyxis kahli var. *cyclostoma* Bonnet & Thomas, 1960 - 197, 199 (11.8)
** *Cyclopyxis* ***quadratus*** var. *grandis* var. n. - 189 (5.9)
Cyclopyxis stephanostoma Bonnet, 1980 - 195 (5.9)
Cyclopyxis trilobata Bartoš, 1963 - 185, 189, 192, 193 (23.5)

Deharvengia papuensis Bonnet, 1979 - 199 (5.9)

Difflugia lucida Penard, 1890 - 197 (5.9)
* *Difflugia minutissima* Penard, 1904 - 184 (5.9)

Difflugiella crenulata (Playfair) **Grospietsch,** 1964 - 186 (5.9)
Difflugiella crenulata var. *globosa* (Playfair) Grospietsch, 1964 - 184 (5.9)
* *Difflugiella horrida* Schönborn, 1965 - 182 (5.9)
* *Difflugiella oviformis* (Penard) Bonnet & Thomas, 1955 - 182 (5.9)
* *Difflugiella oviformis* var. *fusca* (Penard) Bonnet & Thomas, 1955 - 184 (5.9)
* *Difflugiella pussila* (Playfair) Grospietsch, 1964 - 192 (5.9)

* *Euglypha acanthophora* var. *equis* Decloitre, 1956 - 196 (5.9)
Euglypha bryophila Brown, 1911 - 195 (5.9)
Euglyha ciliata (Ehrenberg) Leidy, 1878 - 188 (5.9)
Euglypha ciliata var. *glabra* Wailes, 1915 - 197, 199 (11.8)
Euglypha compressa var. *glabra* Wailes, 1915 - 192 (5.9)
Euglypha cristata Leidy, 1879 - 183, 184, 185, 188, 189, 190, 192, 193, 195, 196, 197, 198, 199, 200 (82.4)
Euglypha cristata for. *decora* **(Ehrenberg)** Jung, 1942 - 183, 191, 193 (17.6)
* *Euglypha cristata* var. *lanceolata* Playfair, 1917 - 192, 196, 197, 199 (23.5)
Euglypha filifera Penard, 1890 - 192 (5.9)
* *Euglypha filifera* var. *pyriformis* Wailes, 1915 - 185, 195, 196, 197 (23.5)
Euglypha laevis (Ehrenberg) Perty, 1849 - 183, 184, 185, 186, 188, 189, 190, 192, 196, 197, 198, 199, 200 (76.5)
Euglypha polylepis (Bonnet) Bonnet & Thomas, 1960 - 192 (5.9)
Euglypha rotunda Wailes & Penard, 1911 - 183, 184, 189, 190, 191, 196, 197, 198, 199 (52.9)
Euglypha rotunda var. *minor* Wailes, 1915 - 186, 193, 195 (17.6)
* *Euglypha rotunda* var. *obliqua* Decloitre, 1956 - 185, 196 (11.8)
Euglypha strigosa (Ehrenberg) Leidy, 1879 - 185, 186, 188, 191, 193, 196, 197, 200 (47.1)
Euglypha strigosa var. *glabra* Wailes, 1915 - 183, 196, 200 (17.6)
* *Euglypha strigosa* var. *heterospina* (Penard) Wailes & Penard, 1911 - 184, 185, 191, 200 (23.5)
Euglypha tuberculata Dujardin, 1841 - 184, 185, 189, 190, 192, 196, 197, 198, 200 (52.9)
* *Euglypha tuberculata* var. *minor* for. *subcylindrica* Decloitre, 1955 - 197 (5.9)
Euglypha tuberculata var. *subcylindrica* (Playfair) Decloitre, 1962 - 185, 198 (11.8)

* *Heleopera alsiosa* Couteaux & Chardez, 1981 - 200 (5.9)
* *Heleopera minuta* Schönborn, 1965 - 185, 188, 189, 190, 192, 196, 198, 199, 200 (52.9)
Heleopera penardi Bonnet & Thomas, 1955 - 186, 195, 196 (17.6)
Heleopera petricola Leidy, 1879 - 183, 186, 190, 192, 196, 199, 200 (41.2)
Heleopera petricola var. *amethystea* Penard, 1902 - 183, 184, 192, 195, 196, 197, 199 (41.2)
Heleopera picta Leidy, 1879 - 186, 188, 199, 200 (23.5)
Heleopera sylvatica Penard, 1890 - 184, 185, 193, 196, 197, 200 (35.3)

Hyalosphenia insecta Harnisch, 1938 - 196 (5.9)
Hyalosphenia papilio (Leidy) Leidy, 1879 - 195 (5.9)
* *Hyalosphenia schoutedeni* van Oye, 1956 - 198 (5.9)
* *Hyalosphenia schoutedeni* var. *rotundata* van Oye, 1958 - 182 (5.9)

Hyalosphenia subflava Cash, 1909 - 182, 186, 188, 198, 200 (29.4)
** *Hyalosphenia tamdaoensis* sp. n. - 196 (5.9)

Nebela bohemica Taránek, 1882 - 183, 195 (11.8)
Nebela caudata Leidy, 1879 - 186 (5.9)
Nebela collaris (Ehrenberg) Leidy, 1879 - 183, 198 (11.8)
Nebela dentistoma Penard, 1890 - 185, 189 (11.8)
Nebela lageniformis Penard, 1890 - 183, 195, 196, 199 (23.5)
Nebela militaris Penard, 1890 - 195, 197, 200 (17.6)
Nebela ***penardiana*** Deflandre, 1936 - 183, 186, 193, 195 (23.5)
Nebela tincta (Leidy) Awerintzew, 1906 - 182, 184, 185, 188 (23.5)
Nebela tubulosa Penard, 1890 - 196, 197, 198 (17.6)
Nebela wailesi (Wailes) Deflandre, 1936 - 192 (5.9)

Phryganella acropodia (Hertwig & Lesser) Hopkinson, 1909 - 183, 185, 192, 193, 195, 197, 199 (41.2)
* *Phryganella acropodia* var. *depressa* Playfair, 1917 - 196 (5.9)

Placocista jurassica Penard, 1905 - 185 (5.9)
Placocista lens Penard, 1899 - 190, 200 (11.8)

Plagiopyxis callida Penard, 1910 - 185, 188, 189, 190, 191, 192, 193, 195, 196, 197, 198, 199, 200 (76.5)
Plagiopyxis declivis Thomas, 1955 - 190, 196 (11.8)
Plagiopyxis intermedia Bonnet, 1959 - 198, 200 (11.8)
Plagiopyxis minuta Bonnet, 1959 - 197 (5.9)
Plagiopyxis oblonga (Bonnet & Thomas) Bonnet & Thomas, 1960 - 184, 191 (11.8)
Plagiopyxis rostrata Bonnet, 1974 - 198 (5.9)

Quadrulella quadrigera (Wailes) Deflandre, 1936 - 190 (5.9)

Sphenoderia fissirostris Penard, 1890 - 182, 183, 184, 185, 186, 195, 200 (41.2)

Trachelcorythion pulchellum Bonnet, 1979 - 184, 190, 193 (17.6)

Tracheleuglypha acolla Bonnet & Thomas, 1955 - 183, 185, 192, 193, 195, 197 (35.3)
Tracheleuglypha dentata (Vejdovský) Deflandre, 1928 - 185, 186, 188, 191, 192, 193, 197 (41.2)
* *Tracheleuglypha dentata* var. *elongata* (Playfair) Gauthier-Lièvre & Thomas, 1958 - 188, 193, 195, 196, 200 (29.4)

Trigonopyxis arcula (Leidy) Penard, 1912 - 183, 185, 193, 197, 200 (29.4)
Trigonopyxis microstoma Hoogenraad & de Groot, 1948 - 199 (5.9)

Trinema complanatum Penard, 1890 - 182, 183, 184, 185, 186, 188, 189, 190, 192, 193, 195, 196, 197, 198, 199, 200 (94.1)
Trinema complanatum var. *aerophila* (Decloitre) Bonnet & Thomas, 1960 - 182, 183, 185, 191, 193, 195, 196, 197, 199 (52.9)
* *Trinema complanatum* var. *elongata* Decloitre, 1973 - 183, 190, 192, 193, 196, 197 (35.3)
Trinema complanatum var. *globulosa* Chardez, 1959 - 184 (5.9)
* *Trinema complanatum* var. *inflata* Decloitre, 1970 - 196, 197 (11.8)
Trinema complanatum var. *platystoma* Schönborn, 1964 - 197 (5.9)
Trinema enchelys (Ehrenberg) Leidy, 1878 - 182, 183, 185, 186, 188, 189, 190, 191, 192, 193, 195, 196, 198, 199, 200 (88.2)
Trinema enchelys var. *aerophila* Decloitre, 1950 - 190, 192 (11.8)
* *Trinema enchelys* var. *nasurticola* Decloitre, 1962 - 197 (5.9)
Trinema grandis (Chardez) Golemansky, 1963 - 188, 192, 193, 195, 196, 197, 200 (41.2)
Trinema lineare Penard, 1890 - 183, 184, 185, 186, 188, 189, 191, 192, 193, 195, 196, 197, 198, 199, 200 (88.2)
* *Trinema lineare* var. *grandis* Decloitre, 1971 - 190, 192 (11.8)

Trinema lineare var. *truncatum* Chardez, 1964 - 183, 192, 198 (17.6)
** *Trinema staryi* sp. n. - 183, 191, 192, 195 (23.5)

* *Valkanovia delicatula* (Valkanov) Tappan, 1966 - 196 (5.9)

Faunistical and ecological characteristics of testate amoebae assemblages

On the basis of a soil and leaf litter samples analysis from the primary rain forest in the northern part of Vietnam 126 species, varieties and forms of testate amoebae were determined. These testate amoebae belong to 10 families and 23 genera. The most abundant families were Euglyphidae (34 species), Centropyxidae (29 species), Hyalospheniidae (24 species) and Trinematidae (17 species). From the genera *Euglypha* (21 species), *Centropyxis* (20 species), *Trinema* (14 species) and *Nebela* (10 species) were most abundant. In the Fig. 2 the distribution of the most abundant 7 testate amoebae families in single samples is represented.

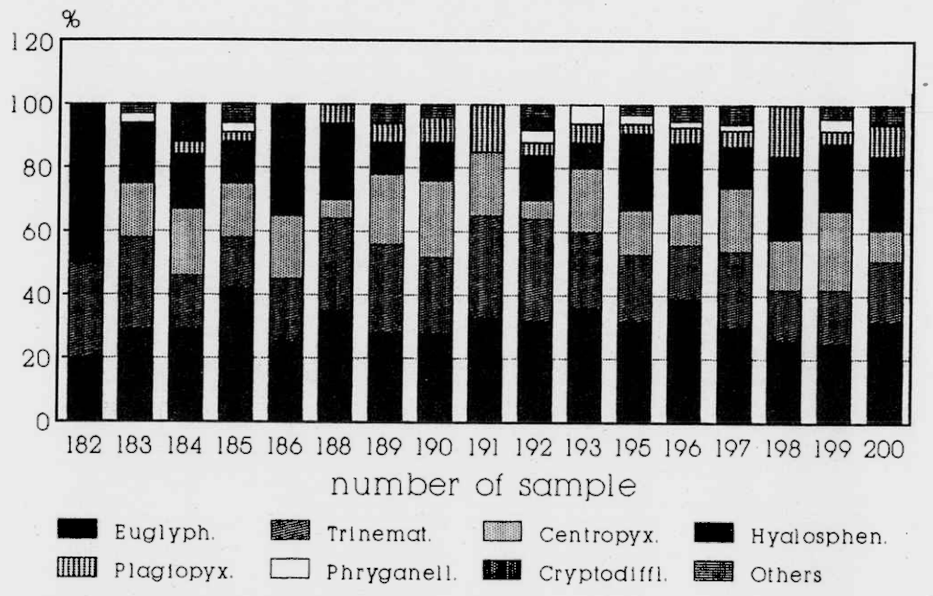

Fig. 2. Distribution of the testate amoebae families in the samples.

Comparing the determined data with the literature about the south-eastern Asia testaceans it is evident that the testate amoebae fauna of Vietnam has similar parameters. It is rich in species composition, but less genera and families are represented here (for example: Bonnet, 1981 - Thailand - 104 species, 31 genera; Bonnet, 1980 - Philippines - 110 species, 38 genera; Bonnet, 1980 - Papua-New Guinea - 121 species, 35 genera; Bonnet, 1977 - Nepal - 130 species, 37 genera; Bartoš, 1963 - Java - 77 species, 21 genera).

In the studied communities families which are common in the forest soils in temperate zone are absent (Microchlamyidae, Paraquadrulidae, Lesquereusiidae, Amphitrematidae, Gromiidae and Cyphoderidae) or in the soils of tropical zone (Distomatopyxidae, Lamtopyxidae). In the represented families are absent many genera (for example *Geopyxella, Schwabia, Pseudawerintzewia, Bulinullaria, Pontigulasia, Cryptodifflugia*).

Frequency over 50 % was reached in the species *Centropyxis deflandriana, Corythion dubium, Euglypha cristata, E. laevis, E. rotunda, E. tuberculata, Heleopera minuta, Plagiopyxis callida, Trinema complanatum, T. complanatum* var. *aerophila, T. enchelys* and *T. lineare.*

The composition of the studied communities was in principle similar to the composition of the testate amoebae communities in the cited papers (the majority of the members in the families Centropyxidae, Euglyphidae, Hyalospheniidae and Trinematidae). Differences were found in rare species.

In the studied testate amoebae communities several very well determined groups of species were represented. The first group is composed of cosmopolitan species (often euryvalent species), which are common in all ecosystems on the Earth (for example *Centropyxis aerophila, Corythion dubium, Assulina muscorum, Euglypha laevis, E. rotunda, Phryganella acropodia, Trinema complanatum, T. enchelys, T. lineare*). The second group are "tropical" species, which were known up to this time from the tropical zone only (for example *Centropyxis latideflandriana, C. protecta, C. stenodeflandriana, Cyclopyxis quadratus* var. *grandis* var. n., *C. stephanostoma, C. trilobata, Deharvengia papuensis, Heleopera alsiosa, Hyalosphenia tamdaoensis* sp. n., *H. schoutedeni, H. schoutedeni* var. *rotundata, Plagiopyxis rostrata, Quadrulella quadrigera, Trinema enchelys* var. *aerophila, T. enchelys var. nasurticola* and *T. staryi* sp. n.). The rest are specialized species (moss-inhabiting, sphagnum-inhabiting), which were determined up to this time in some continents and probably these species are cosmopolitan.

From ecological groups especially the species of the moist and very moist substrates (no aquatic species) were represented here - for example *Assulina muscorum, Centropyxis aculeata, Cyclopyxis humilis, Difflugia lucida, Euglypha cristata* and its varieties, *E. filifera, Hyalosphenia papilio, Trigonopyxis arcula.* The euryvalent species were represented with *Centropyxis aerophila, Cyclopyxis kahli, Euglypha laevis, E. rotunda, Corythion dubium, Nebela militaris, Heleopera petricola, Phryganella acropodia, Tracheleuglypha acolla* and *Trinema lineare.* The soil species were found in the low numbers (for example *Centropyxis cornuta, C. ovalis, Cyclopyxis eurystoma* var. *grandis, Heleopera alsiosa, Trinema lineare* var. *grandis*).

The samples of soil and litter were removed so that the variability of biotope was recorded (undisintegrated leaf litter, disintegrated leaf litter, arthropodic moder, very moist humic soil, moist soil without plant cover and plant rests). The communities in the studied biotope were relatively unsimilar and heterogenous. For evaluating community homogeneity (or heterogeneity) the Sørensen index of faunistical similarity at the species and genera levels (Fig. 3 and Fig. 4) was applied. On the species level (Fig. 3) the lowest similarity among the sample 182 and all other samples (8.3 - 27.6 %) was determined. The highest similarity was found between the samples 188 and 200 (58.3 %). Altogether the faunistical similarity on the species level was relatively low. On the genera level of Sørensen index of faunistical similarity (Fig. 4) the lowest value was found among the sample 182 and other samples (15.4 - 62.5 %). The highest values of faunistical similarity were determined among the samples 188 and 198 (94.1 %), 185 and 200 (93.3 %), 183 and 185 (88.9 %), 195 and 196 (88.0 %). The faunistical similarity on the genera level was more expressive than that on the species level. Those data give evidence that the testate amoebae communities in the soil and litter of primary rain forest are very dependent on microhabitats. Single microhabitats are different in physical and pedological characteritics and these differences determine the composition of the testate amoebae community on the individual habitat. In the Table 1 number values of species and genera are presented. These data verify the heterogeneity of the testate amoebae communities in the soil and litter of the primary rain forest near Tam-Dao.

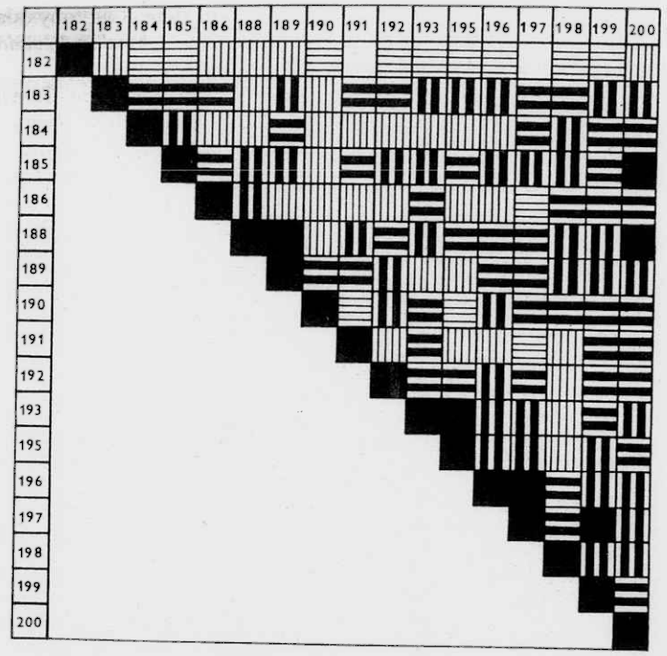

Fig. 3. Sørensen's index values at the species level.

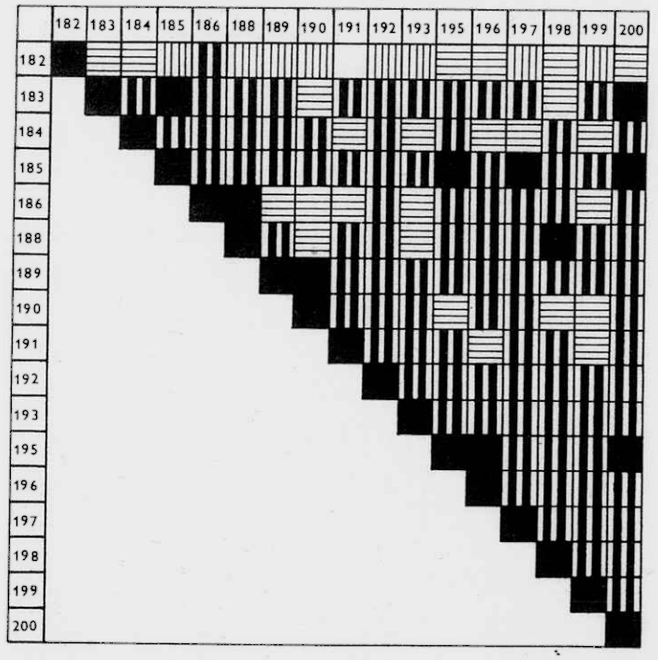

Fig. 4. Sørensen's index values at the genera level.

Abundances, numbers of species and genera in particular samples were very different (Table 1). The lowest abundance was found in the sample 182 (58 500 ex.g^{-1}), the highest one in the sample 196 (144 900 ex.g^{-1}). The lowest number of species was determined in the sample 182 (10 species), the highest one in the sample 196 (41 species). The lowest number of genera was found in the samples 182 and 191 (6 genera), the highest one in the samples 185 and 200 (15 genera).

The LF index after Bonnet (1964) (Table 1) - Testaceafilosa/Testacealobosa ratio - was, except the sample 186, negative (LF: from -0.4 to -0.03). This fact gives evidence that in the individual testate amoebae communities the membres of the Testaceafilosa were predominat. The majority of members of Testaceafilosa group is (after Bonnet) the mark of the unstabilized (quickly developing) soil testate amoebae community.

The dimensions of the shells of all determined species were measured in the upper limit of the in the literature cited dimensions. Little shells were rare in species populations. In testate amoebae communities many varieties of typical species which differ in their sizes were determined (for example *Cyclopyxis eurystoma* var. *grandis, C. quadratus* var. *grandis, Tracheleuglypha dentata* var. *elongata, Trinema complanatum* var. *elongata, T. lineare* var. *grandis*). The new

species *Trinema staryi* is up to this time the greatest species of this genera. The majority of large forms of testaceans is a symptom of good ecological and life conditions in the studied area (high moisture, temperature, sufficient number of food etc.).

Descriptions of new species for science

Cyclopyxis quadratus var. *grandis* **var. n.** (Fig. 5)

DESCRIPTION. Shell by ventral view tetragonal (square, oblong or trapezium) with rounded edges. By side view shell vaulted, almost hemisphaerical. The organic matter of shell covered with large, flat, polygonal mineral particles. The shell translucent, light brown-gray or light rusty brown. The **aperture** round or breath oval with undulated rim, uninvaginated, in the centre of the bottom side of the shell. From the nominate form *Cyclopyxis quadratus* Decloitre differ with its large dimensions only.

PROTOPLASM. Not observed, only empty shells or encysted individuals were observed. In encysted individuals there is only one dark brown globular cyst, with smooth surface in the shell.

Table 1. Number of species (NS), number of genera (NG), abundance in ind . g^{-1} (A) and values of LF-index (LF) in single samples.

Sample No.	NS	NG	A	LF
182	10	6	58 500	-0.40
183	31	10	88 800	-0.16
184	24	10	81 000	-0.08
185	31	15	96 000	-0.16
186	20	9	76 200	0.00
188	17	9	65 700	-0.29
189	18	10	73 800	-0.11
190	21	12	94 500	-0.14
191	15	6	59 700	-0.33
192	28	11	74 400	-0.36
193	25	11	95 400	-0.20
195	29	12	108 600	-0.03
196	41	12	144 900	-0.17
197	39	14	124 500	-0.03
198	20	9	72 900	-0.10
199	24	10	68 400	-0.25
200	31	15	89 700	-0.03

DIMENSIONS. Length 148 - 158 µm, breadth 146 - 157 µm, heigth 70 - 76 µm, diameter of aperture 62 - 69 µm (biometrical characteristics see Table 2).
HOLOTYPE DIMENSIONS. Length 150 µm, breadth 149 µm, heigth 72 µm, diameter of aperture 63 µm (Fig. 5a and 5e)

LOCUS TYPICUS. Vietnam, Tam-Dao, primary mountain rain forest, sample No. 189, very disintegrated leaf litter. Leg. J. Starý. 12 individuals (7 empty shells, 5 encysted individuals).

ECOLOGY. *Cyclopyxis quadratus* (nominate form) was found in the leaf litter of the vine and "arbre de Judée" in the neigbourhood of the Var city in France. A new variety was determined in very disintegrated leaf litter from a tropical rain forest. It is clear, that the nominate form and new variety are fixed on the disintegrated leaf litter.

TYPE MATERIAL. Holotype and 2 paratype slides are deposited in the author's collection of permanent slides, Istitute of Soil Biology, Academy of Sciences of the Czech Republic, České Budějovice.

DERIVATIO NOMINIS. New variety is called according the size difference from the nominate form *Cyclopyxis quadratus.*

Table 2. Biometrical characteristics of *Cyclopyxis quadratus* var. *grandis* var. n. (x - arithmetical mean, M - median, s - standard deviation, V - coefficient of variation in %, Min - minimum, Max - maximum, n - number of investigated individuals, all dimensions in µm)

	x	M	s	V	Min	Max	n
length	153.75	155.00	3.36	2.19	148.0	159.0	12
breadth	151.66	152.00	3.45	2.27	146.0	157.0	12
heigth	72.75	72.50	2.26	3.11	70.0	76.0	12
diameter of aperture	66.00	66.00	2.25	3.42	62.0	69.0	12

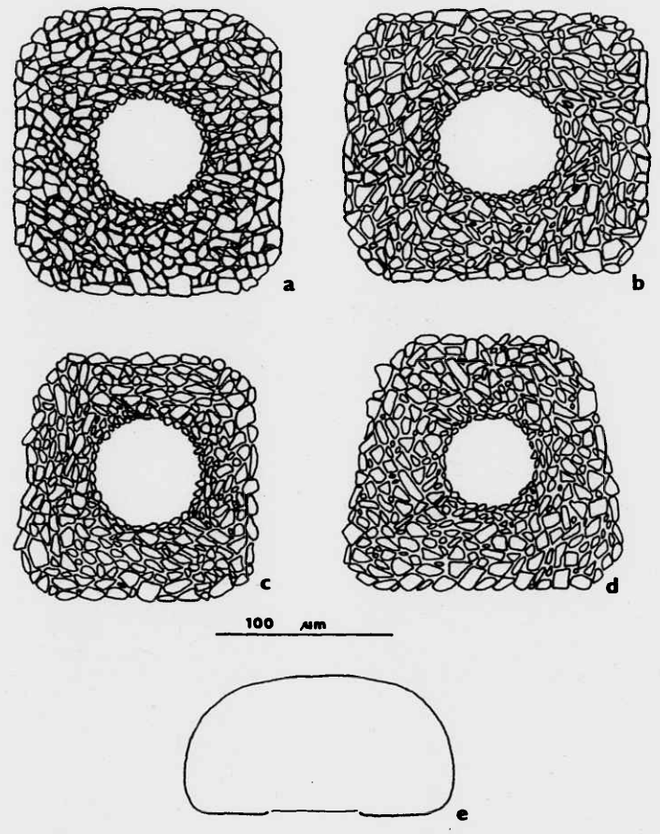

Fig. 5. *Cyclopyxis quadratus* var. *grandis* var. n. (a, b, c, d - ventral view; e - lateral view).

Hyalosphenia tamdaoensis **sp. n.** (Fig. 6)

DESCRIPTION. Shell bilaterally symmetrical,long, narrow oval, egg-shaped or vase-shaped, on the cross section bean-shaped or kidney-shaped. Dorsal side vaulted, ventral side depressed, depression elliptical. Shell from the organic matter only, with relative robust shell wall, surface smooth. Lateral pores absent. Shell pellucid, translucent, light yellow or yellow-orange. Aperture small, elliptical, with thick rim.
PROTOPLASM. Not observed, only empty shells were observed.
DIMENSIONS. Length 107 - 115 µm, breadth 31 - 36 µm, thickness 9 - 15 µm, thickness of the shell wall 1 - 2.5 µm, aperture 9 - 11 x 3 - 6 µm, elliptical depression 76 - 88 x 17 - 23 µm (biometrical characteristics see Table 3).
HOLOTYPE DIMENSIONS. Length 110 µm, breadth 32 µm, thickness 10 µm, thickness of the shell wall 1.5 µm, aperture 10 x 4 µm, elliptical depression 79 x 20 µm (Fig. 6 a - d).

Table 3. **Biometrical characteristics** of *Hyalosphenia tamdaoensis* sp. n. (explanatory notes see Table 2)

	x	M	s	V	Min	Max	n
length	110.75	110.50	2.33	2.10	107.0	115.0	8
breadth	33.34	33.00	1.59	4.79	31.0	36.0	8
thickness	12.00	12.00	1.93	16.06	9.0	15.0	8
breath of aperture	9.63	9.00	0.92	9.51	9.0	11.0	8
length of aperture	3.88	3.50	1.13	29.02	3.0	6.0	8

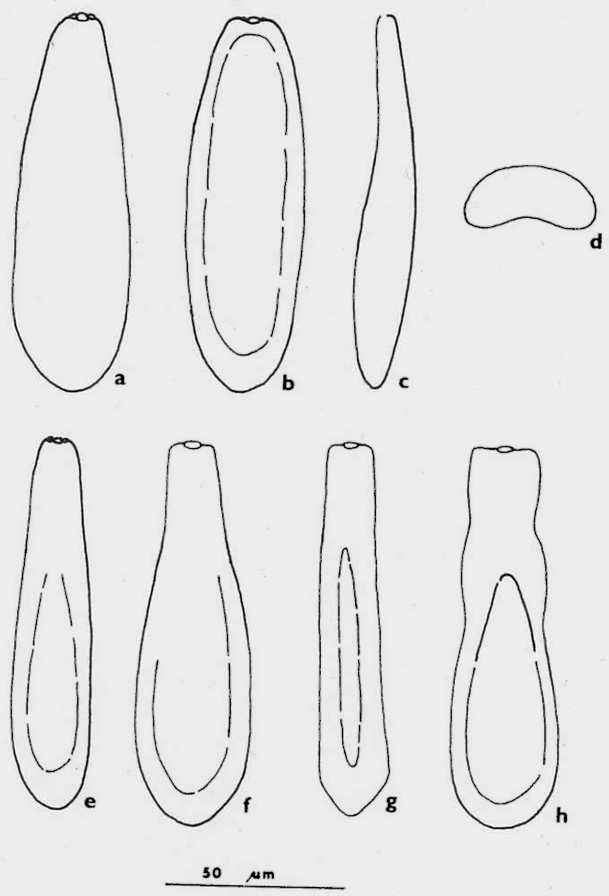

Fig. 6. *Hyalosphenia tamdaoensis* sp. n. (a - dorsal view; b, e, f, g, h - ventral view; c - lateral view; d - cross section).

LOCUS TYPICUS. Vietnam, Tam-Dao, primary mountain rain forest, sample No. 196, arthropodic moder mixed with the very disintegrated leaf litter, leg. J. Starý. 8 empty shells.

ECOLOGY. The shell shape signalizes, that this species is the soil inhabitant with the typical ecological adaptation (thin, arched shell, small **aperture**). This species is probably attached to humic soil horizon.

TAXONOMICAL COMMENTS. Shells of this species are similar to those of the *Hyalosphenia subflava, H. schoutedeni* and *H. gigantea* de Graaf. The new species differs in its dimensions the following ones (greater than *H. subflava* and *H. schoutedeni,* smaller than *H. gigantea*), further on a different pseudostom shape (**aperture** is smaller in its dimensions than the **apertures** of all three above-mentioned species), loss of lateral pores and general shape (depression of the shell).

TYPE MATERIAL. Holotype and two paratype slides are deposited in the author's collection of the permanent slides, Institute of Soil Biology, Academy of Sciences of the Czech Republic, České Budějovice.

DERIVATIO NOMINIS. The species name *"tamdaoensis"* was elected after the studied locality (Tam--Dao).

Trinema staryi **sp. n.** (Fig. 7)

DESCRIPTION. Great shell in the ventral and lateral view drop-shaped, dorsoventrally strong depressed. Shell from hyaline, colourless organic matter. On the surface of the shell there are great isolated round plates, the spaces among them are filled with small round plates. The shell translucent, pellucid, colorless. The **aperture** rounded, great, in the narrow and low part of the shell. The periphery of the **aperture** are bordered with small dents.
PROTOPLASM. Translucent, pellucid, colorless. One nucleus, 1 - 5 vacuoles. Pseudopodia filopodia-type, thin, thread-like, in different lengths, non-anastomose. Epipodia thin, thread-like.
DIMENSIONS. Length 196 - 248 µm, breadth 148 - 212 µm, thickness 48 - 64 µm, diameter of **aperture** 64 - 79 µm, diameter of great plates 16 - 20 µm, diameter of small plates 2 - 4 µm (biometrical characteristics see Table 4).
HOLOTYPE DIMENSIONS. Length 240 µm, breadth 206 µm, thickness 55 µm, diameter of **aperture**, 69 µm, diameter of great plates 17 µm, **diameter** of small plates, 2 µm (Fig. 7 a - b).

LOCUS TYPICUS. Vietnam, Tam-Dao, primary mountain rain forest, samples 183, 191, 192 and 195, humic soil horizon, mixture of the disintegrated leaf litter and mineral particles. Leg. J. Starý. 30 shells were measured. In samples were founded many empty shells and live individuals.

ECOLOGY. This species is probably connected with the moist humic soil horizon. The flattened shell signalize the tolerance to the moisture fluctuations. The food of this species was composed of bacteria and organic detritus (after the food vacuoles content).

Table 4. Biometrical **characteristics** of *Trinema staryi* sp. n. (explanatory notes see Table 2)

	x	M	s	V	Min	Max	n
length	224.63	228.50	16.05	7.15	196.0	248.0	30
breadth	175.93	176.50	20.94	11.90	148.0	212.0	30
thickness	56.03	55.50	4.83	8.62	48.0	64.0	30
diameter of aperture	71.10	73.00	4.46	6.27	64.0	79.0	30

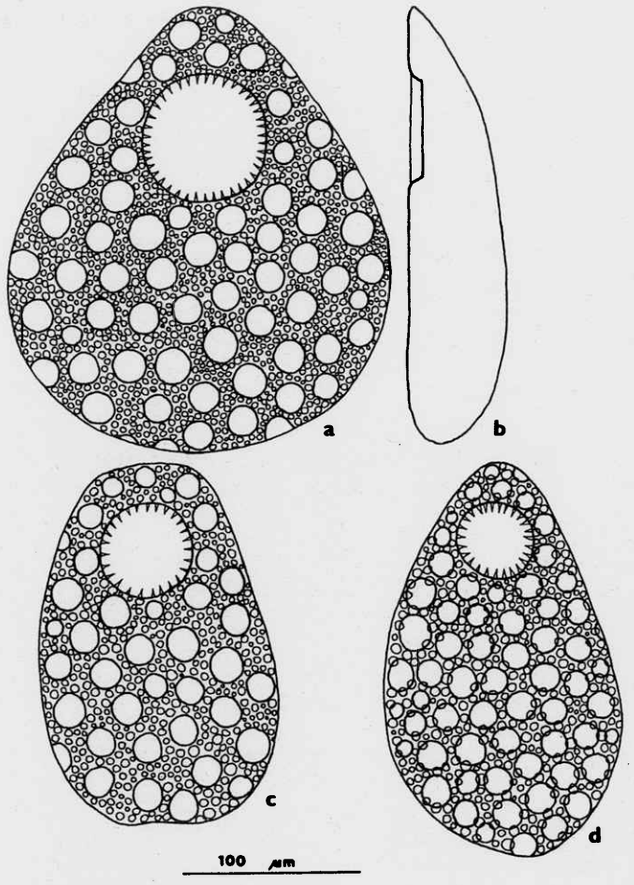

Fig. 7. *Trinema staryi* sp. n. (a, c, d - ventral view; b - lateral view).

TAXONOMICAL COMMENTS. This species is similar (in the shape) to *Trinema grandis* and differ from it by the dimensions (the greatest member of the genus *Trinema*) and by the plates arrangement on the shell surface.

TYPE MATERIAL. Holotype and 4 paratype slides are deposited in the author's permanent slide collection, Institute of Soil Biology, Academy of Sciences of the Czech Republic, České Budějovice.

DERIVATIO NOMINIS. This species is dedicated to the soil oribatid mites specialist Dr Josef Starý from the Institute of Soil Biology, České Budějovice.

Acknowledgements

I thank to Dr Josef Starý (Institute of Soil Biology, AS CR, České Budějovice) for the providing soil and litter samples to the study of testate amoebae fauna of Vietnam, to Dr Josef Rusek (Institute of Soil Biology, AS CR, České Budějovice) for the criticism to this manuscript and to Mr Josef Kult for the linguistic corrections.

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Acta Soc. Zool. Bohem. **59:** 17-39, 1995
ISSN 0862-5247

Geographic variation in three species of *Myotis* (Mammalia: Chiroptera) in South of the Western Palearctics

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Received December 20, 1994; accepted February 9, 1995
Published June 22, 1995

Biometrics, bats, geographic variation, clines, Mediterranean, biogeography

Abstract. A morphometrical study of a large sample (1348 specimens) of three *Myotis* spp. (*M. myotis, M. blythi, M. nattereri* s.l.) revealed in all three taxa a clinal variation in cranial measurements from the Western Mediterranean via Central Europe and Balkans to the Eastern Mediterranean. The trend of size increase from West to East terminated in the Ponto-Caspian region. Nevertheless, being the marginal populations excluded, the geographically dependent morphometric variation is insignificant. Hence, the populations of Central Europe, Balkans and Eastern Mediterranean are relativelly homogenous as to their variation pattern and, in contrast to those of Ponto-Caspian region and/or of the Western Mediterranean show no isolation-by-distance variation.

INTRODUCTION

The pattern of geographic variation ranks among the most important characteristics of any taxon. It may provide a complex information on internal structure of the taxon, its adaptation dynamics and/or on history of its distribution. Anyhow, such a type information is accessible only through a detailed analysis of quite a large material of population samples covering both the distribution range of the taxon and the traits responsible for its phenotypic variation as completely as possible (Gould & Johnston 1972, Thorpe 1985, 1987).

In bats, such studies are often limited due to actual rarity of most species and scarcity of materials, particularly those of the **marginal** populations. Thus, it is not surprising that only very few studies are available that deal with geographic variation of chiropteran species in details, and analyze also the possible factors responsible for the observed patterns of variation (Findley & Wilson 1982, Findley 1992). As concerns **vespertili**onids that became subject of such studies much more frequently than any other bats, such investigations have been undertaken e.g. with *Pipistrellus hesperus* (Findley & Traut 1970), *Myotis lucifugus* and *M. fortidens* (Findley & Jones 1967), *Myotis californicus* (Bogan 1975), *Eptesicus fuscus* (Burnett 1983), *Myotis blythi* (Strelkov 1972) or with *Myotis daubentoni* (Bogdanowicz 1990).

Studying morphometric variation in two W-Palearctic sibling species, *Myotis myotis* and *M. blythi*, we found (similarly to the above mentioned studies) a clear cline variation in size (Benda & Horáček 1995), parallel in both the species. **Appearan**ce of such a parallelism can generally be regarded a phenomenon of a considerable interest. It may either reflect mutual ecological relations between the species (e.g. in form of a character displacement) or **appearan**ce of a geographical gradient in some environmental currents affecting the respective populations. The previous paper (Benda & Horáček 1995) discussed the former possibility, this one is focused to the latter aspect. To assess a validity of the latter alternative, one should enlarge a set of the species under comparison with some other sympatric forms not coming in actual ecological interactions. In respect to