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1) A direct continuation of:
First record of *Sinanodonta woodiana* (Mollusca: Bivalvia) in the Czech Republic

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**Abstract.** In 1996 the first specimens of the bivalve *Sinanodonta woodiana* (Lea, 1834), which is native to East and South-East Asia, were found in the Czech Republic. One living specimen and two empty shells were found in an oxbow of the Dyje River near Breclav (South Moravia, code of mapping square 7267).

First record, Mollusca, Bivalvia, *Sinanodonta woodiana*, South Moravia, Czech Republic

**INTRODUCTION**

*Sinanodonta woodiana* (Lea, 1834) is a species native to eastern and southeastern parts of Asia (Zadin 1952). In Europe, the first specimens were probably found in Romania after 1970. In 1994 the first specimen (only one) was found in Slovakia near the village Čičov in the inundation area of the Danube (Košel 1995).

**RESULTS**

The first specimens of *Sinanodonta woodiana* (Lea, 1834) were found in an oxbow of the Dyje River near Breclav (South Moravia, Danube River Basin, code of mapping square 7267). This oxbow is connected with the riverstream. On September 9, 1996, one living specimen in a shallow location and empty shells of two specimens, were found among empty shells of *Unio tumidus* Philipsson, 1788, *Unio pictorum* (Linnaeus, 1758), *Anodonta anatina* (Linnaeus, 1758), *Anodonta cygnea* (Linnaeus, 1758), *Pseudanodonta complanata* (Rossmüller, 1835) and *Dreissena polymorpha* (Pallas, 1771). Numerous shells of the first four bivalves were found, along with empty shells of 3 specimens of *Pseudanodonta complanata* and several shells of *Dreissena polymorpha.* Bivalves were probably eaten by *Ondatra zibethicus.* Both empty shells of *Sinanodonta woodiana* were collected and are in author's collection. The proportions of shells were as follows: 65×49×31 mm, 85×62×35 mm and 132×85×48 mm.

*Sinanodonta woodiana* was probably transported to Europe by the fishes *Hypophthalmichthys molitrix* and *Aristichthys nobilis* which are hosts of glochidia of this species (Sárkány-Kiss 1986). Therefore the occurrence of this bivalve depends on the presence of these two species of fishes. *Aristichthys nobilis* occurs in the lowest part of the Dyje River Basin (Lusk et al. 1996). Information about hosts among our native fishes has not been documented. It is possible that other localities, especially in the Dyje River Basin, will be found.

**Acknowledgements**

I would like to thank my wife Lenka for her help with the research at this locality.
REFERENCES


Results of the Czech Biological Expedition to Iran.
Part 1. Notes on the distribution of amphibians and reptiles.

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Abstract. Preliminary results of herpetological research carried out by the Czech Biological Expedition „Iran 96“ to Western and Central Iran are presented. The expedition took place between April 20 and May 20, 1996. Material was collected in 34 localities distributed in 11 provinces of Iran and in a single locality in Eastern Turkey (the Kars vilayet). The localities were characterized by 30 environmental variables and grouped into four distinct habitat types: (1) true deserts of Persian Gulf, (2) true deserts of Central Iran, (3) xerophilous woodlands including secondarily desertified landscapes, (4) mesophilous Hyperastan woodland. A good correspondence between the habitat types and species composition of the herpetofauna is shown. We recorded 5 species of anurans, 3 species of turtles, 34 species of lizards (8 agamids, 10 gekkonoids, 10 lacertids, 4 scincoids and 2 anguidae) and 26 species of snakes. Habitat requirements and distribution of individual species are discussed.

Distribution, habitat requirements, Amphibia, Reptilia, Palaeartic Region

INTRODUCTION

Iranian herpetofauna was traditionally a subject of zoological research and thus a number of more or less extensive publications providing distributional data and keys to Iranian amphibians and reptiles is available (e. g. Anderson 1963, 1974, 1979, 1985, Bannikov et al. 1977, Forcart 1950, Latifi 1991, Leviton et al. 1992, Mertens 1940, 1956, 1957, Minton et al. 1970, Nilson & Andren 1981, Schleich 1977, Schmidt 1939, Tuck 1971, Weist 1951 and others). These publications represent a solid scientific basis for herpetological research that has become increasingly popular in the course of the last few years. However, as evident from a number of recent publications (e. g., Bosch 1993, Eiselt 1995, Fritz 1994, Moravec 1994, Moravec & Černý 1994, Rastegar-Pouyan 1996, Schmidlter 1994, Schultz & SteINFartz 1996a, b, Wünsch & Fritz 1996) there are still questions concerning the distribution and taxonomy of Iranian amphibians and reptiles that are to be resolved.

The aim of the present paper is to summarize the preliminary results of herpetological research carried out during the Czech Biological Expedition to Iran (from April 20 to May 20, 1996).
Material and Methods

All the animals and records of their presence evaluated in this paper were collected by the author and other participants of the expedition Iran 96. In the field, captured individuals were preliminarily determined and thoroughly recorded by the senior author (D. F.). Most of them were photographed and/or video-recorded. The specimens selected for museum collections (further referred as specimens) were killed and stored in 80% alcohol. The remaining ones (further referred as individuals captured) were either released on their native locality or transported to Prague and further studied in captivity. Later on, the material was catalogued and determined by two authors (D. F. & J. C.). The specific and/or subspecific determinations and taxonomy were then carried out, revised by the second author (J. M.)

The material is deposited in the collections of the National Museum in Prague (catalogue series NMP5V), and in the collections of Department of Zoology, Faculty of Science, Charles University, Prague (catalogue series CUP/REPTIARA, CUP/AMPHIARA). Catalogue numbers for each specimen are listed below under the Species Account.

List of localities

Studied localities are described in the list below and depicted in Fig. 1. Transliteration of local Iranian names was adopted from Sharafi (1999). The final identification of localities in the field was reviewed by some of the authors (D. F. & J. C.).

1. Markan 8 km N Ev Ogilby by road (38°52' N 45°18'E), Azerbayjan-e-Gharbi province, 24 April and 13 May, 1000 m, 8, 12, 15, 17, 25, 20, 23, 27
2. Jafar Abad in SE of Kashan (33°35' N 51°53'E), Esfahan province, 26-27 April, 800 m, 7, 10, 15, 16, 21, 24, 25, 26, 30
3. Naran 25 km N by road (33°31' N 51°54'E), Esfahan province, 27 April, 800 m, 7, 10, 15, 25, (17)
4. Esfahan (32°39' N 51°54'E), Esfahan province, 27 April, 800 m, 7, 10, 15, 25, (10)
5. Qazvin (32°28' N 51°59'E), Qazvin province, 27-28 April, 2000 – 2200 m, 5, 8, 10, 15, 17, 25, (21, 30)
6. Mezin Hame (35°19' N 51°08'E), Fars province, 28 April, 1600 m, 6, 10, 15, 25
7. Qeshm Abad 3 km SW by road (30°14' N 52°12'E), Fars province, 28-29 April, 1200 m, 6, 11, 20, 25, 27, 28, (16, 26)
8. Pasargad (33°28' N 52°10'E), Fars province, 29 April, 1800 m, 6, 12, 15, 24, 26, (30)
9. Porsapah (Takht-e-Jamshid village) (29°56' N 52°54'E), Fars province, 29 April, 1500 m, 6, 12, 15, 17, 24, 26
10. Sirand 10 km E by road (30°05' N 52°55'E), Fars province, 29 April, 1700 m, 5, 12, 15, 17, 21, 27, 28
11. Qeshm Agha river Eli Dashie-e-Arzan by road (29°45' N 52°09'E), Fars province, 30 April, 1500 m, 6, 12, 15, 20, 26, 27, (25)
12. Dasht-e-Arzan 10 km E by road (29°40' N 51°59'E), Fars province, 1 May, 1800 m, 3, 12, 15, 25, 31, (17)
14. Abshar (30°23' N 51°30'E), Fars province, 3-4 May, 1000 m, 4, 12, 17, 26, 30
15. Qur Sharom (29°44' N 51°34'E), Bishapur om., Fars province, 3 May, 800 m, 4, 12, 15, 17, 20, 23, 25, 26, 30
16. Bishapur cave (29°44' N 51°34'E), Qur Sharom om., 3 May, 1000 m
17. Bandar-e-Ganaveh (29°34' N 50°31'E), Bushehr province, 3 May, 20 m, 9, 11, 23, 30
18. Boroujen (29°16' N 51°13'E), Bushehr province, 3 May, 20 m
19. Chabok 15 km NW Bandar-e-Ganaveh by road (29°40' N 52°25'E), Bandarshahr province, 3-5 May, 9, 11, 16, 26
20. Chah-e-Zahidi (arakur) (32°00' N 48°31'E), Khuzestan province, 5-6 May, 100 m, 9, 11, 16, 25, 31, (21, 28)
21. Shish (32°11' N 48°14'E), Khuzestan province, 6 May, 190 m, 9, 11, 16, 24, 25, 30, (23)
22. Ghofmanan 30 km W Khurram Abad by road (33°25' N 48°12'E), Zagros Mts., Lorestan province, 6-7 May, 1000 m, 3, 12, 17, 26, 28, 31, (20)
23. Ghafor 35 km SE of Hamadan (34°40' N 48°45'E), Hamadan province, 7-8 May, 2000 m
24. Avaj 50 km NNE by road to Takistan (35°24' N 49°13'E), Zanjan province, 8 May, 1800 m, 7, 10, 15, 17, 25, 30
25. Veh Abad (36°14' N 51°15'E), Alborz Mts. N slopes, Mazandaran province, 8-10 May, 1800-2500 m, 2, 13, 17, 21, 28, 29, 31, 32, (33)
26. Chahak 15 km S by road (36°20' N 51°22'E), Alborz Mts. N slopes, Mazandaran province, 10 May, 800 m, 2, 13, 17, 20, 23, 31
27. Chahak 25 km S by road (36°28' N 51°24'E), Alborz Mts. N slopes, Mazandaran province, 10 May, 200 m, 1, 13, 17, 20, 21, 32
28. Chahak (36°38' N 51°25'E), Caspian Sea coast, Mazandaran province, 10 May, 20 m, 1, 13, 21, 22, 28
29. Chahak 10 km NEE by road (36°48' N 50°40'E), Alborz Mts. N slopes, Mazandaran province, 10-11 May, 480 m, 1, 13, 32, (17, 21)
30. Ramsar (38°55' N 50°40'E), Mazandaran province, 11 May, -20 m, 1, 13, 19, 22, 28
31. Langarud (37°31' N 50°08'E), Gilan province, 11 May, -20 m, 1, 13, 22, 27, 30
32. Asalem 12 km W by road (37°44' N 48°57'E), Talesh Mts., N slopes, Gilan province, 11-12 May, 280 m, 1, 14, 20, 21, 22, 28, 29, 32, (17, 30)
Fig. 1. Map of the Iran with localities of the records. For legend see List of localities.
33. Asalem 26 km W by road (37°46′N 48°59′E), Talesh Mts., N slopes, Gilan province, 12 May, 1890 m: 2, 14, 29, 32, (23).
34. Khalikhil 32 km W of Asalem by road (37°56′N 48°32′E), Talesh Mts., N slopes, Gilan province, 12 May, 2050 m: 2, 14, 29, (23).
35. Kvi (37°34′N 48°22′E), Azarbaycan-e-Shariq province, 12 May, 1900 m: 4, 12, 15, 25, 26, (23).
36. Sarab 20 km NE (37°55′N 47°35′E), Azarbaycan-e-Shariq province, 12–13 May, 1000 m.
37. Matadi 25 km SE by road (38°25′N 45°46′E), Azarbaycan-e-Shariq province, 13 May, 900 m: 8, 11, 15, 25.
38. ev Oghly (38°58′N 45°01′E), Azarbaycan-e-Gharb province, 13 May, 1000 m: 8, 12, 15, 25.
39. Karkari env. (40°10′N 42°36′E), Kars province, Turkey, 14 May, 1980 m: 8, 12, 17, 20, 25, 26, 28.

Habitat
The description of habitat was performed by a botanist (J. S). The habitat parameters were selected without any a priori reference to fauna and/or knowledge about the composition of animal species on a given locality. Each locality was characterized by the presence or absence of 30 habitat features. The list of habitat features with assigned numbers is given in the Appendix 1. The habitat of each locality is described by the sequence of appropriate numbers. The numbers of features of only local, small-scale, and or marginal importance are given in parentheses. The results of habitat description are given under the List of Localities (see the above list).

Data processing
Faunistic data concerning localities in Iran are presented as Species Account commented by taxonomic remarks. The data obtained in a single locality in Eastern Turkey, which was excluded from further analysis, are given in Appendix 2.

The relationship between habitats and fauna is presented in synoptical tables. We adopted the method of synoptical tables which was used for processing both faunistic and habitat data (performed by J. S.). This classification method is widely used in Zonoh-Montefeltor approach of physozology.

Two independent classifications of localities were made and their results were compared. The localities were classified according to (a) their habitat features, and (b) recorded species of reptiles and amphibians. Both classification procedures were performed "blind". The results were used for the evaluation of relationship between habitat type and herpetofauna.

**SPECIES ACCOUNT**

Explanation: locality numbers are followed by abbreviated locality names (for full names see List of localities Catalogue numbers and names of collectors are given in parentheses.

**AMPHIBIA**

*Anura*

*Batrachidae*

*Bufo surdus luristanicus* K. Schmidt, 1952

*Material*: 53 spec.


*Bufo viridis* ssp. Laurentini, 1768

*Records*: 7. Qadib, Abd, 1 ind. captured (Král & Kašan); 25. Vali Abad, 1 ind. captured (Kašan).

**Hyliidae**

*Hylo sauvignyi* Audouin, 1827

*Records*: 10. Sivand, 2 ind. captured (Hély & Frynta); 11. Qereh Aghaîj river, vocalization (Frynta); 14. Asahar, vocalization (Frynta); 21. Gholaman, 1 spec. (Frynta).
Ranidae

*Rana* „ridibunda“ Pallas, 1771

**Material.** 4.

**Records.** 11. Qarch Aghaj river, vocalization (Frynta); 14. Abshar, 1 spec. (Frynta); 15. Bushapur, 3 spec. (CUP/AMPH/IRA/010–012; Frynta); 16. Choqa-Zaibil, 1 spec. (CUP/AMPH/IRA/058, Frynta); 22. Gholaman, 1 ind. captured (KafRan); 31. Langarud, observation (Frynta & KafRan).

**Note.** The Iranian marsh frog has been traditionally assigned to *Rana ridibunda* Pallas, 1771 (synonym *R. r. susana* Boulenge, 1905 has been occasionally used for the population from SW Iran). Recently, populations from western Turkey, Israel and the Nile delta were recognized as *Rana levantina* Schneider et al., 1993, which is probably the younger synonym of *Rana bedriagae* Camerano, 1882. Before the elucidation of the taxonomy of *R. ridibunda* complex in the Middle East we prefer to use the traditional name.

*Rana macrocnemis* Boulenge, 1885

**Material.** 1.

**Records.** 25. Vali Abad, 1 ind. captured (Kafian); 29. Chorti, 1 spec. (CUP/AMPH/IRA/013, Frynta).

**Note.** Subspecies *R. m. pseudodalmatina* Eiselt et Schmidttler, 1971 was described from the Mazanderan province.

Reptilia

Testudines

Emydidae

*Emys orbicularis* (Linnaeus, 1758)

**Records.** 31. Langarud, observation (Kodym).

**Note.** According to Fritz (1994) the population inhabiting south coast of the Caspian Sea belong to the subspecies *E. o. orientalis* Fritz, 1994.

Mauremys caspica* (Gmelin, 1774)

**Records.** 7. Qadar Abad, observation (Krdl); 20. Choqa-Zaabil, observation (Vohralik).

**Note.** Because a new subspecies *M. c. ventrimaculata* Wischuf et Fritz, 1996 was recently described from the southern Iran we prefer to use the binomen here.

Testudinidae

*Testudo graeca* Linnaeus, 1758

**Material.** 1.

**Records.** 7. Qadar Abad, 1 spec. (CUP/REPT/IRA/069, Livkopev); 1 ind. (Šejna); 10. Sivand, 1 ind. captured (Hrudsky); 13. Yasuj, 2 ind. captured (Kafian, Čihákova).

**Note.** Adults from Sivand and Yasuj had an elongate more or less uniformly brown shell with upturned, emarginate posterior margin. In these characters they correspond to the subspecies *T. g. zarubnyi* Nikolskij, 1896.

Squamata

Lacertilia

Agamidae

*Laudakia caucasica* (Eichwald, 1831)

**Material.** 2.
RECORDS: 24. Aqil, 1 ind. captured (Kühn); 1 spec. (CUP/REPT/IRA/010, Lešekopová & Frýnta); 25. Vahl Abad, 1 spec. (NMP6V 35679, Král & Kodym).

Note. Juvenile specimens with 170 (locality 21) and 150 scales (locality 22) around the body.

*Laudakia nupta nupta* (De Filippi, 1843)

*Material.* 2 spec.

*Records.* 5. Qamishlo, 1 spec. (NMP6V 35678, Kafián & Lešekopová); 9. Paisonouna, 1 ind. captured (CUP/REPT/IRA/004, Král); 12. Dafir-Arnab, 1 ind. observed and videotaped (Fug;); 13. Yasuj, 2 ind. captured (Lešekopová); 1 ind. observed (Frýnta & Chátková); 1 ind. captured (Pitule); 14. Abhar, 1 ind. captured (Pitule); 15. Qar Sharr, 1 ind. observed (Frýnta & Chátková); 19. Chahak, 1 ind. captured (Lundström); 22. Gholaman, 1 ind. observed (Kafián & Frýnta).

*Phrynocephalus persicus de Filippi, 1863*

*Material.* 1.


*Phrynocephalus scutellatus* (Olivier, 1807)

*Material.* 4.

*Records.* 2. Jafar Abad, 1 spec. (NMP6V 35680/1, Kafián); 2 spec. (CUP/REPT/IRA/001, Kafián); 5. Qamishlo, 2 ind. captured, 2 spec. (NMP6V 35680/2, CUP/REPT/IRA/002, Kühn).

*Trachysaurus agilis* (Olivier, 1804)

*Material.* 4.

*Records.* 2. Jafar Abad, 1 spec. (CUP/REPT/IRA/008, Kafián); 3. Naftan, 2 spec. (NMP6V 35552, CUP/REPT/IRA/005, Šejna & Hody); 19. Chahak, 1 spec. (CUP/REPT/IRA/009, Šejna); 3 ind. captured (Kafián).

Note. With respect to the difficult taxonomy of the complex *T. agilis-isolepis-saquinolentus, we use T. agilis sensu lato.*

*Trachysaurus persicus* (Blanford, 1881)

*Material.* 1.

*Records.* 20. Choqa-Zanbil, 1 ind. observed (Hody); 1 spec. (CUP/REPT/IRA/010, Kafián).

*Trachysaurus ruderalis* (Olivier, 1804)

*Material.* 5.

*Records.* 5. Qamishlo, 2 spec. (NMP6V 35555/1–2, Šejna); 2 spec. (NMP6V 35555/3, CUP/REPT/IRA/006, Frýnta & Chátková); 9. Pasargat, 1 spec. (CUP/REPT/IRA/007, Kafián); 13. Yasuj, 1 ind. captured (Kafián).

*Uromastyx loricata* (Blanford, 1874)

*Records.* 19. Chahak, 2 ind. captured (Frýnta & Chátková); 2 ind. captured (Kráľ), 2 ind. captured (Pitule); 1 ind. captured (Lešekopová); 1 ind. captured (Voľíček); 5 ind. captured (Kodyn & Kafián); 20. Choqa-Zanbil, 1 ind. observed (Kráľ).

Gekkonidae

*Agamura persica* (Duménil, 1856)

*Records.* 4. Esfahan, 1 ind. captured (Pitule); 5. Qamishlo, 3 ind. captured (Pitule, Pohulová & Šejna).

*Asaccus cf. eliasae* (F. Werner, 1895)

*Material.* 8.

*Records.* 20. Choqa-Zanbil, 4 ind. captured (Pitule); 2 ind. captured (Šejna); 8 spec. (NMP6V 35681/1–4, CUP/REPT/IRA/041–044, Frýnta).

Note. This gecko is related to *Asaccus eliasae* and *Asaccus kermanshaensis* Rastegar-Pouyani, 1996. However, it differs in pholidotic characters from both these taxa. A thorough description will be given elsewhere.
Bunopus tuberculatus Blanford, 1874

**Material:** 6.

**Records:** 19. Chahak, 2 spec. (NMPS V 35682/1–2, Kafan), 2 ind. captured (Chahakova), 2 spec. (CUP/REPT/IRA/027–028, Frynta), 4 ind. captured (Shana), 8 spec. (NMPS V 35682/3–4, Kril); 20. Chica-Zanthi, 1 ind. captured (Frynta).

Cyrtopodion agamurodes (Nikolskij, 1899)

**Material:** 3.


**Note:** According to Šcerbak & Golubjev (1986), this species has been reported from the Kerman province only. Our localities are situated further westwards in the Fars province.

Cyrtopodion gasteropholis (F. Werner, 1917)

**Material:** 2.


Cyrtopodion scalari (Heyden, 1827)

**Material:** 2.


**Note:** Although a widespread species throughout the Middle East, it has not previously been reported from the Esfahan province (Anderson 1974, Šcerbak & Golubjev 1986).

Hemidactylus persicus J. Anderson, 1872

**Material:** 1.

**Record:** 14. Abhar, 1 spec. (NMPS V 35545, Shana).

Tropidocolotes heleneae (Nikolskij, 1907)

**Records:** 20. Chica-Zanthi, 1 ind. captured (Pitale), 22. Gholaman, 2 ind. captured (Shana), 2 ind. captured (Heli), 1 ind. 1 captured (Kril).

**Note:** Subspecies T. heleneae fasciatus Schmidt et Schmidtl, 1972 was described from the ostans Kordestan-Kermanshah and Khuzeistan-Lorestan.

Tropidocolotes latifi Leviton et Anderson, 1972

**Material:** 1.

**Record:** 10. Sivand, 1 spec. (CUP/REPT/IRA/095, Khilan).

**Note:** The distribution of this species is poorly known (cf. Moravec & Černý 1994), our record considerably extends the range in the southwest direction. In the locality No. 5 (Qanisalau) an additional Tropidocolotes with coloration resembling our specimen of T. latifi was observed and photographed.

Tropidocolotes persicus persicus (Nikolskij, 1903)

**Material:** 1.

**Record:** 19. Chahak, 1 spec. (NMPS V 35687, Shana).

Lacertidae

Eremias persica Blanford, 1874

**Material:** 3.

**Records:** 3. Natanz, 1 spec. (CUP/REPT/IRA/033, Frynta), 2 spec. (NMPS V 35649/1–2, Kudym & Kril).

Eremias sp.

**Material:** 8.

**Records:** 5. Qanisalau, 4 ind. captured, 8 spec. (NMPS V 35689/1–4, CUP/REPT/IRA/036–038, CUP/REPT/IRA/066, Frynta & Chahakova), 3 ind. captured (Leidepaw).
Note: Undetermined species related to *E. persica*. A thorough description will be given elsewhere.

**Lacerta chlorogaster** Boulenger, 1908

**Material**: 7

**Records**: 29. Chorti, 1 ind. captured (Brány); 2 ind. captured (Sáslad), 3 spec. (NMP/V 35548/1–3, Čižkovský); 2 ind. captured (Pitulie); 4 spec. (CUP/REPT/LAC/104–106, CUP/REPT/LAC/147, Frynta).

**Lacerta defilippi** (Camerano, 1877)

**Material**: 57

**Records**: 25. Vala Abad, 8 spec. (NMP/V 35547/1–8, Kral); 4 ind. captured (Pitulie); 8 ind. captured and 45 spec. (CUP/REPT/LAC/9–53, Frynta, Čižkovský & Plegr)

**Lacerta princeps princeps** Blanford, 1874

**Material**: 3


**Lacerta striigata** Eichwald, 1831

**Material**: 1

**Records**: 25. Vala Abad, 1 jug. and captured (Săma), 1 spec. (CUP/REPT/IRA/067, Žitkovský); 28. Chales, sea coast, 1 ind. observed (Plegr); 29. Chorti, 1 ind. observed (Plegr), 1 ind. observed (Săma), 31. Langarud, 5 ind. observed (Frynta).

**Lacerta sp.**

**Material**: 1

**Records**: 34. Khalkhal, 1 spec. (CUP/REPT/IRA/060, Kafan)

**Note**: Undetermined species resembling *L. reddet* Boettger, 1892. A thorough description will be given elsewhere. Rostral shield in contact with the frontal nasal one. Nostrils are not in contact with rostral shield. 10 preanal shields are arranged in a symmetric manner. Two of them (medial) are enlarged.

**Mesalina cf. watsonana** Stolterfoht, 1872

**Material**: 3

**Records**: 2. Jafar Abad, 1 spec. (CUP/REPT/IRA/047, Žitkovský), 1 spec. (NMP/V 35550, Frynta); 6. Hane Houré, 1 spec. (CUP/REPT/IRA/046, Frynta)

**Note**: The specimens examined have a free collar with enlarged marginal scales.

**Ophisops elegans** Ménestréil, 1832

**Material**: 16


**Note**: All specimens have two postnasals. Dark vertebral line is usually inconspicuous or absent. In animals from the localities 8, 12, and 37 a short vertebral line reaches maximally shoulder.

**Scincidae**

**Ablepharus pannonicus** (Fitzinger in Lichtenstein, 1823)

**Material**: 2

**Records**: 5. Qamashlu, 1 ind. observed (Brány); 10. Givan, 1 spec. (CUP/REPT/IRA/056, Frynta); 12. Dush-t-e-Arzan, 1 ind. captured (Brány), 13. Yasuj, 2 ind. captured (Brány), 1 ind. observed (Frynta).
Eumeces schneideri princeps Eichwald, 1839

Material: 1

Records: 1. Makran, 1 spec. (Kafan).

Mabuya „aurata“ (Linnaeus, 1758)

Material: 1

Records: 1. Makran, 1 spec. (NMP6V 35555, Oulouj); 14. Abshar, 2 ind. captured (Şeyna & Kafan), 4 ind. observed (Čiriškovo & Frynia); 22. Gholaman, observation (Fryna & Kafan); 1 ind. captured (Şeyna).

Note: Awaiting a clarification of the complex taxonomy of *M. aurata* complex we give a tentative determination. It should be mentioned that scincids of the genus *Mabuya*, most probably *M. „aurata“* were observed in additional five localities: 7. Qari Abad (Şeyna); 10. Siwand (Fryna); 12. Dustane-Arzan (Fryna); 13. Yacaj (Kafan & Laičepović); 15. Qas Sharon (Kafan).

Ophiomorus persicus (Steindachner, 1867)

Material: 2

Records: 10. Siwand, 2 spec. (NMP6V 35557, CUP/REPT/IRA/062, Kril).

Anguidae

Anguis fragilis colchicus (Nordmann, 1840)

Material: 4

Records: 29. Chahar, 1 ind. observed (Pultis), 5 ind. observed (Kafan); 32. Asalem 12 km W, 1 spec. (NMP6V 35557, Kril); 23. Chahar 26 km W, 2 spec. (CUP/REPT/IRA/021–022, Kafan), 1 spec. (CUP/REPT/IRA/068, Şeyna).

Ophisaurus apodus (Pallas, 1775)

Records: 26. Chahar 45 km S, 1 ind. captured and 1 dead found on the road (Kril & Kafan); 27. Chahar 25 km S, 1 ind. observed (Oulouj); 29. Chahar, 1 ind. observed (Şeyna); 32. Asalem 12 km W, 1 ind. captured (Kril).

Serpentes

Typhlopidae

Typhlops vermicularis Merrem, 1820

Material: 5

Records: 8. Pasargat, 1 spec. (NMP6V 35558, Kril); 10. Siwand, 1 spec. (CUP/REPT/IRA/032, Kafan); 14. Abshar, 1 ind. captured (Şeyna); 22. Gholaman, 1 ind. captured (Şeyna), 1 ind. captured (Kril), 1 ind. captured, 1 spec. (NMP6V 35559, Kril); 24. Avunj, 1 ind. captured (Fryna); 27. Chahar 25 km S, 1 spec. (CUP/REPT/IRA/045, Kafan); 35. Kivi, 2 ind. captured, 1 spec. (CUP/REPT/IRA/040, Şeyna).

Leptotyphlopidae

Leptotyphlops macrorhynchus (Jan, 1861)

Material: 1


Boidae

Eryx jaculus (Linnaeus, 1758)

Records: 10. Siwand, 1 ind. observed (Kril).

Note: *Eryx jaculus familiaris* Eichwald, 1831 is recognized from NW Iran by some authors.
Colubridae

Coluber najadum najadum (Eichwald, 1831)
Material: 2

Coluber ravergeri Reuss, 1834
Material: 1
Record: 25. Vali Abad, 1 spec (CUP/REPT/IRA/011, Kral).

Coluber rhodorachis (Jan, 1865)
Material: 1
Records: 5. Qamishli, 1 spec (CUP/REPT/IRA/015, Sado & Frynta).
Note: The specimen collected has a distinct longitudinal reddish stripe. Populations of this pattern are often understood as nonnontypical subspecies.

Coluber schmidtii Nikolskij, 1909
Material: 1

Coronella austriaca austriaca Laurenti, 1768
Material: 2
Records: 28. Vali Abad, 1 spec (NMP6V 35562/1-2, Kral), 1 spec (CUP/REPT/IRA/104, Komareck), 27. Chalus 25 km S, 1 ind captured (Hudy), 32. Asalem 12 km W, 1 ind observed (Kral).

Eirenis punctatolineatus (Boettger, 1892)
Material: 1

Elaphe persica Werner, 1913
Material: 1
Records: 29. Chort, 1 ind captured (Kaftan), 1rv spec (NMP6V 35561, Kodym).

Lytorhynchus ridgewayi Boulenger, 1887
Material: 1
Record: 6. Hrire Hivre, 1 spec (CUP/REPT/IRA/035, Hudy).

Malpolon monspessulanus insignitus (Geoffroy St. Hilaire, 1809)
Material: 1
Record: 22. Ghosaman, 1 spec (NMP6V 35676, Kral), 1 ind observed (Sejna).

Psammophis lineolatum Brandt, 1838
Record: 5. Qamishli, 1 ind captured (Kodym).

Psammophis schokari (Forskal, 1775)
Material: 1

Natrix natrix (Linnaeus, 1758)
Material: 2
Records: 29. Chort, 1 ind with coloration „perca“ captured (Kaftan), 31. Langarud, 2 spec with a standard slightly melanistic coloration (CUP/REPT/IRA/017–018, Frynta)
**Matrix tessellata** (Laurenti, 1768)

**Material:** 2

**Records:** 10. Svarid, 1 spec (NMV 35568, Volf), 25. Vali Abad, 1 ind. captured (Kafan), 30. Ramsar, 1 ind. observed (Frynta). 31. Langarud, 1 spec. (CUP/REPT/IRA/019, Sado)

**Pseudocyclophis persica** (Anderson, 1872)

**Material:** 3


**Note:** Regarding mainly the colour pattern 2–3 subspecies are distinguished by some authors (see e.g. Bannikov et al. 1977). The coloration of two subadult specimens from loc. 7 corresponds to the nominotypical form (head and neck with three more or less fused dark bands, body uniformly light). However, the adult specimen from loc. 12 differs from the previous ones in having unicolored head, which is only slightly darker than the body. This colour pattern is reported for the males of the eastern subspecies *P. p. waltieri* (Boettger, 1888), nevertheless the mentioned specimen has lower number of subcaudals (70 versus 75–110 given by Bannikov et al. 1977 for *waltieri*). Thus the current knowledge of the taxonomy of *P. persica* seems not to be sufficient.

**Spalerosophis diadema schikaziana** Jan, 1865.

**Records:** 7. Qader Abad, fragments of the skin (Kodym)

**Spalerosophis microlepis** (Jan, 1865).

**Records:** 5. Qarnhali, 1 ind. captured (Kafan)

Viperidae

**Aghistrodon intermedius caucasicus** (Nikolskij, 1907)

**Material:** 1

**Records:** 25. Vali Abad, 1 spec. (NMV 35563, Král), 1 ind. captured (Kafan), 1 ind. observed (Ohuch), 29. Chorn, 1 ind. captured (Sejna)

**Echis carinatus** (Schneider, 1801)

**Records:** 19. Chorn, 2 ind. captured (Kafan), 1 ind. captured (Sejna)

**Note:** The subspecific status has not been determined.

**Vipera lebetina obtusa** Dwigubsky, 1832

**Records:** 7. Qader Abad, fragments of the skin (Kodym); 22. Ghosman, 1 ind. captured (Kafan)

**ECOLOGICAL REQUIREMENTS AND BIOGEOGRAPHIC PATTERN**

When classified according to habitat parameters, the localities split into the four well-defined groups (Tab. 1). Parameters of both landscape (Landscape vegetation units, Rainfall) and local (Local habitat features) level contributed to the classification, however, the former level played the major role. Resulting groups of localities are characterized as follows: A-area of the Persian Gulf, B-areas of "true" deserts, C-areas of xerophilous woodland including secondarily deforested desert landscapes, D-area of mesophilous Hyrcanian woodland in the Alborz Mts, the Talesh Mts, and the Caspian coast.

In spite of the limited amount of our material and also the fact that some localities were selected unintentionally (e.g., some camping or resting sites), the distribution of amphibian and reptile species in individual localities showed a clear pattern. The same distinct groups of locali-
Table 1: Synoptical table of environmental features in the individual localities. Abbreviations: Groups of localities A - area of the Persian gulf, B - areas of "true" deserts, C - areas of xerophilous woodland including secondary deforested desert landscapes, D - areas of mesophilous Hyrcanian woodland in Ahor and Mt. Taleh, and the Caspian coast, X - large scale features, A - small scale or marginal features. For localities and environmental features see list of localities.

| Number of locality | 20 | 21 | 19 | 17 | 7 | 9 | 2 | 8 | 24 | 4 | 3 | 5 | 38 | 6 | 32 | 15 | 35 | 11 | 12 | 1 | 22 | 13 | 14 | 10 | 32 | 25 | 29 | 27 | 31 | 34 | 29 | 31 | 28 | 39 |
| 11                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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| 26                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 24                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 35                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 23                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 12                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 4                 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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| 20                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 29                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 26                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 4                 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 13                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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| 30                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 27                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 21                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 17                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 14                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| 17                |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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| 3                 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

The features as above (A-D) and six main groups of species were obtained by an independent procedure (classification according to species) Thus, both classifications produced unequivocal and, moreover, mutually corresponding results. These facts can be attributed to considerable contrasts among landscapes and zoogeographical regions in studied area.

Clustering of localities according to species corresponds well with the vegetation regions according to Zohary (1973), and with incidental rainfall. It seems that Zohary's classification of landscape into vegetation units has a good explanatory value also for the herpetofauna. The most interesting example that can be demonstrated by our data is Zohary's differentiation between primary desert areas and desert areas resulting from anthropogenous deforestation. In spite of the general features of both desert types, herpetofauna of the former areas is characterized by specific forms (e.g., *Phrynocephalus* spp., *Eremias* spp., *Mesalina cf. watsoniana*, *Agama* spp.), while the herpetofauna of the latter ones fairly resembles that of the territories still covered by xerophilous forest.
Table 2. Synoptical table of animal species in the individual localities. For abbreviations see Table 1.

<table>
<thead>
<tr>
<th>Localities</th>
<th>AAAA</th>
<th>BBBB</th>
<th>CC C C</th>
<th>DDDD</th>
<th>EEEE</th>
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<tr>
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<td>x</td>
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<td>x</td>
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<tr>
<td>Locality 5</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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</tr>
</tbody>
</table>

Legend:
- A: Aves
- B: Reptilia
- C: Amphibia
- D: Annelida
- E: Mollusca
- F: Arthropoda
- G: Chordata
- H: Non-identified
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APPENDIX 1

Survey of habitat features


APPENDIX 2

Data collected in the locality 39. Karakurt, Turkey

*Lacerta* sp.

RECORD: 1 spec (CUP/REPT/IRA/061, Frynta)

NOTE: Juvenile specimen belonging to *Lacerta ruddi* Boettger complex.

*Eryx jaculus* (Linnaeus, 1758)

RECORD: 1 and captured (Frynta)

*Coluber najatium* cf. *dahli* Schinz, 1833

MATERIAL: 2

RECORD: 3 spec (NMSP/35564/1-2, Král)

NOTE: The colour pattern of the 1st specimen corresponds to the pattern of *C. n. dahli*. In the case of the 2nd specimen, the 1st pair of neck spots is fused and other spots are small and inconspicuous.

*Eirenis modestus* (Martin, 1838)

MATERIAL: 3

RECORD: 1 and captured (Kafšan), 4 nd. captured (Král), 5 nd. captured (Šejna), 3 nd. captured (Potulí), 2 spec (CUP/REPT/IRA/012, CUP/REPT/IRA/063, Skafran), 1 spec (NMSP/35567, Král)

*Natrix tessellata* (Laurenti, 1768)

MATERIAL: 1

RECORD: 1 spec (NMSP/35569, Kodym), 1 nd. captured (Frynta)

*Vipera wagneri* Nilson et Andrén, 1984

RECORD: 2 nd. captured (Kafšan), 3 nd. captured (Král, Šejna, Potulí)
BOOK REVIEW


The author is professor of anatomy at the University in Lübeck. First edition of this book has been published in 1950. In addition to German editions, translations into English (3 editions), Italian (3 editions), Spanish (4 editions), Japanese (2 editions), Greek, Portuguese and French appeared in print. As stated in the preface, this edition the text has been updated, and modified according to the comments of readers. The volume is composed of 27 non-numbered chapters. Each chapter is arranged in the way that the left page is focused on textual part, and the right page presents the figures, composed (mostly of three-phase micrographs. In addition to light microscope photographs in colour, there are black-and-white transmission and scanning electron microscope figures.

Introductory chapters examine the variety of cell forms. Described are the spinal ganglia, multipolar nerve cells, smooth muscle cells, fibrocytes and fibroblasts, Purkinje cell, eocyte, and vegetative ganglion cell. Following chapters discuss structures of the nucleus, the cytoplasm and cellular organelles — miscellaneous forms of endoplasmic reticulum, NADH granules, Golgi apparatus, myohependrons, and lysosomes. Further on extracellular and paraextracellular substances — architecture of cytoskeleton, plasmalemma differentiation, cell-to-cell contact structures, cell division process and chromosomes are looked at.

Characterization of tissue and organ systems follows when describing epithelial tissues, exocrine glands epithelium, fibrous and supporting cartilage and bone tissues, smooth, striated and cardiac muscle cells, nervous system tissues, blood vessels, lymphatic system, the blood, endocrine glands, the digestive, respiratory and urinary systems, reproductive organs, the skin and related, sense organs, and central and autonomous nervous systems.

In conclusion there is an annex of 17 tables overviewing histological staining solutions (Mayar, Heidenhain, Masson-Goldner, von Gieson, Weigert, Mann, Rema), classification of various forms of superficial epithelial cells, morphological differentiation of squamous and mucous salivary glands, morphological characteristics of salivary and tear glands, differential diagnosis and signs of miscellaneous fibre, muscle tissue, various sections of the digestive tract, kidney tubules, trachea and bronchial tree, lymphatic, cavity and glandular organs, and a variety of skin regions.

Based on a continuing tradition of eight editions and many international translations within more than 40 years, this handy pocket-sized volume represents a beautifully illustrated textbook. It provides a practically oriented guide to students and those who will update their knowledge of cytology, histology and microscopic anatomy.

Jančich Jirá
New *Clinidium* species from Ecuador (Coleoptera: Carabidae: Rhysodini)

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Abstract: *Clinidium mareski* sp. n., from Ecuador is described and the diagnostic characters illustrated. The species belongs to the C. maingi group of the monotypic subgenus. The current determination key of subgenus *Clinidium* Karg, 1835 is modified to include the new species.

Taxonomy, description, Coleoptera, Carabidae, Rhysodini, *Clinidium mareski* sp. n., Neotropic region

INTRODUCTION

A large material of carabid beetles, collected by J. Marek (Prague, Czech Republic) in South America and kindly donated by him to me, contains many interesting species, among them several undescribed. The only species belonging to the tribe Rhysodini was found in Ecuador, prov. Cotopaxi, on northern slopes of Mt Corazón. This species is apparently new and it is described below.

The rhysodid fauna of South America was recently studied only by Vulcano & Pereira (1975), and of course by Bell & Bell (1978, 1985) in their excellent revisions of the world fauna of Rhysodini.

The morphological terms used in this study are adopted from Bell & Bell (1978, 1985).

*Clinidium* (Clinidium) *mareski* sp. n.

**Type Material.** Holotype (male), allotype (female), and paratypes (1 male without antennae and 1 female) - all labelled "Ecuador, Mt Corazon, 3500m, 17–21.viii.1992, leg. J. Marek & P. Schedl". Holotype and allotype are deposited in the author's collection, paratypes in the collection of the University of Vermont, Burlington, Vermont, USA

**Description.** Length 7.7–8.4 mm. Antennal stylet moderately long, about 0.2 as long as antennomere XI, acuminate; tufts of minor setae present on antennomeres VI–X, basal setae present on antennomeres VI–X, sparse on antennomere VI; antennomere I with dorsal pollinose subapical band. Head (Fig. 1) approximately as long as wide; frontal grooves narrow, deep, pollinose; median lobe narrow, triangular, its tip slightly behind level of anterior margin of eye, narrowly but distinctly separated from antennal lobe; temporal lobes convergent posteriorly, forming obtuse median angles, posterior margin bordered with pollinosis; eyes crescentic, relatively large, about 0.55–0.60 length of temporal lobe; antennal groove complete, pollinose; one temporal seta arising from large pollinose puncture touching posterolateral pollinose border of temporal lobe; two pairs of postlabial setae.

Pronotum (Fig. 2) long, about 1.5 times longer than wide, widest behind middle; median groove deep, narrow, with slight expansion in basal 0.33 of length and with large, oval anterior median pit; basal impression narrow, deep, closed posteriorly; discal striae deep, slightly curved,
extending anteriorly beyond middle of pronotum, marginal groove deep, visible in dorsal view, number of marginal setae varies from 3 to 5 (most often 5), angular seta absent, notopleural suture glabrous, sternopleural groove nearly complete, precoxal setae absent, prosternal projection with apex shallowly bilobed, with deep U-shaped groove

Elytra moderately elongate, striae impressed, punctate, elytral suture deeply invades in basal 0.15 of length, intercalary stria abbreviated posteriorly, ending blindly at level of anterior end of preapical tubercle (Fig. 3), other striae entire, preapical tubercle truncate or slightly sinuate posteriorly, apical tubercle inflated, contiguous, natural and parasutural striae with one seta each in posterior 0.25 of length, intercalary stria with row of 4–5 setae, meta tubercular stria with 2–3 setae near apex, marginal stria with 3–4 setae posteriorly, preapical tubercle with one seta (rarely on one side with 2 setae), apical tubercle with one seta (in female allotype with 2 setae), metasternum with deep, complete median sulcus, this sulcus with deep pit in posterior 0.25 of length, female with transverse sulci complete in sternites III–IV, interrupted on midline in V–VI (Fig. 4), female with large lateral pit in sternite IV, male with transverse sulci complete in sternites III–VI or interrupted on midline in sternite V, transverse sulci in sternum VI not joined with submarginal groove (but almost joined in the female paratype), sternite VI with 2 setae, female with two V-shaped, short grooves near posterior margin of sternite VI, delimiting a median tubercle, which is visible in lateral view, tubal spurs slightly unequal, male’s mesotibial calcar narrower at base than metatibial one, but generally of the same shape (Figs 5, 6), male without ventral tooth in anterior femur and without proximal tooth in protibia

Differential Diagnosis. The new species belongs to the C. insigne group of the nonunotypical subgenus, which differs from other species groups of this subgenus by the following combination of characters (Bell & Bell, 1985). Tufts of minor setae are present on antennomeres VI–X and eyes are crescentic. The group was formed up to the present time by four species

Clinodactylus dubius Grouvelle, 1903 from Ecuador is morphologically very different from remaining species of C. insigne group (including C. mareki). It differs by shape of temporal lobes, which are divergent posteriorly, by very long antennal stylet, by presence of tubercle in very large anterior median pit and by acute proximal tooth on male’s protibia

C. horoguese Bell, 1970 from Puerto Rico differs from remaining species by metasternum not sulcate and by intercalary stria entire

C. insigne Grouvelle, 1903 from Ecuador and C. howdenorum Bell & Bell, 1985 from Trinidad are according to Bell & Bell (1985) closely related species and they seem to be most closely related (or the most similar) to the C. mareki sp n, sharing the diagnostic combination of characters intermediate between them. C. howdenorum has narrow head, which is longer than wide, median and antennal lobes are not connected, three temporal setae are present, marginal groove bearing 8 setae, parasutural stria bearing 10 setae, intercalary stria with 9 setae, marginal stria with 10–12 setae, four setae are present in sternite VI, male with lateral pit in sternite IV, female without median tubercle in sternite VI, delimited by short, broadly U-shaped groove, which is parallel to submarginal groove (R T Bell, pers. comm.) C. insigne has connected median and antennal lobes, head is as long as wide, bearing only one temporal seta, marginal groove with 6 setae, parasutural stria without setae, intercalary stria bearing 3–5 setae and marginal stria 6–7 setae, sternite VI with 2 setae, male without lateral pit in sternite IV, female without median tubercle in sternite VI. C. mareki shares with C. insigne reduced number of setae on head, pronotum, elytra and sternite VI, and proportions of head. Differences are in not connected median and antennal lobes and in the presence of median tubercle in sternite VI in female, which is delimited by V-shaped grooves (x C. howdenorum) in the former species.
COLLECTION CIRCUMSTANCES. The type specimens were found on northern slopes of Mt. Corazon, near the upper forest limit, in a dead, dry, charred, rotten stem.

NAME DERIVATION. The species is named in honour of my friend J. Marek, who collected the type series.

To include the new species in the key of Bell & Bell (1985, p. 94), the couplet 9 must be changed as follows:

9 (8) Median and anterlor lobes connected, parasutural stria without setae, median tubercle in sternite VI of female absent

9a Medium and anterlor lobes not connected; parasutural stria with at least one seta; sternite VI of female with median tubercle

9b Temporal setae are three, head longer than wide; parasutural and intercalary striae with 9–10 setae each. Sternite VI with 4 setae

9b' Only one temporal seta, head as long as wide; parasutural stria with one seta; intercalary stria with 4–5 setae. Sternite VI with 2 setae

C. unguis Bell & Bell

Pics 1–6. Clytus aeneus sp. n. 1 – head, dorsal view, 2 – pronotum, 3 – elytral apex, 4 – sternites IV–VI, female, 5 – metatibia, male, 6 – metatibia, male. Scale bar 1.0 mm
Acknowledgements

I wish to thank Jaroslav Marek (Prague, Czech Republic) for providing me with the material of Carabidae from the Neotropical region and Ross T. Bell (The University of Vermont, USA) for sending me the literature and some unpublished data about morphology of species mentioned in the present paper.

REFERENCES

New data on taxonomy and distribution of Palaearctic, Oriental and Neotropical Ischnopsyllidae (Siphonaptera), Nycteribiidae and Streblidae (Diptera)

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Abstract Phthirium szechuanum turkestanicum subsp. n. is described, Basila (Paracyclopodiidae) burmensis Theodor, 1954 is characterized in the male sex. Additional morphological, taxonomic and/or faunistic data are given for 11 species of Ischnopsyllidae, 20 species of Nycteribiidae and Brachystoma undulatum Kondratjev, 1878 (Streblidae). The distributional area of mentioned species is stated.

Taxonomy, distribution, Ischnopsyllidae, Nycteribiidae, Streblidae. Hormopyla trux, Phthirium szechuanum turkestanicum subsp. n., Basila (Paracyclopodiidae) burmensis, Neotropical region, Oriental region, Palaearctic region

Results of the elaboration of samples of bat-fleas and bat-flies from the Czech Republic, Slovenia, Bulgaria, Middle Asia (S Kazakhstan, Uzbekistan, Kyrgyzstan), the Baikal Lake, NW India, Laos, Cambodia and Cuba are given. I am much obliged to Z. Früthbauer (sample from Cambodia), J. Horáček and S. N. Rybin (sample from S Kyrgyzstan), A. Reiter (sample from the Baikal Lake), J. Horáček (sample from Slovenia), T. Scholz (sample from central Laos) and Jorge de la Cruz (sample from Cuba), who provided part of the material studied. The material is deposited in coll. Hůrka, Department of Zoology, Charles University, Praha and in the Silesian Museum, Opava (sample from Slovenia).

Ischnopsyllidae

Ischnopsyllus (Ischnopsyllus) intermedius (Rothschild, 1898)


I revised the identification of one female specimen from SE Kazakhstan (Grodkovka near Dzhambul; published as L. intermedius by Hůrka (1984a). The specimen belongs in reality to L. plumatus. The easternmost localities of L. intermedius represent the Caucasus and the Ural Mts.

Ischnopsyllus (Ischnopsyllus) plumatus Ioff, 1946


The numerous material enables to determine the most positive distinguishable characters in females of L. plumatus (a) and L. intermedius (b).
a: 22–32 (mostly 23–28) bristles in double row on sternum VII; intercalary setae in the major rows on abdominal tergites 2–3 times shorter than long main bristles; both head and appendix of spermatheca more slender (Hürka 1976: fig. 17); dilated part of the duct of spermatheca more slender (Hürka 1976: fig. 15).
b: 11–21 (mostly 13–17) bristles in irregular row, sometimes partly doubled, on sternum VII, intercalary setae in the major rows of abdominal tergites 5–8 times shorter than long main bristles; both head and appendix of spermatheca robust (Hürka 1976: fig. 16); dilated part of the duct of spermatheca broader (Hürka 1976: fig. 14).

**Distribution.** Turkmenistan, S Kazakhstan, Kyrgyzstan.

*Ischnopsyllus (Ischnopsyllus) octactenus* (Kolenati, 1856)

**Kyrgyzstan.** Osh, cave No 30, *Pipistrellus pipistrellus alauda* Thomas, 20 m, 1 F, S N Rybin leg.

**Distribution.** West Palearctic species, ranging from Morocco, Spain and Great Britain to Middle Asia and Afghanistan.

*Ischnopsyllus (Ischnopsyllus) variabilis* (Wagner, 1898)

**Czech Republic.** Moravian, Lednice, pond Prstotisky rybník (7266), netting, 26. iv 1983, *Pipistrellus rubidus* (Kayerling & Blasius), 1 M, 1 F (from 2 female bats), *Myotis daubentoni* (Kuhl), 1 F (from 5 female bats), T. Scholz leg.

**Distribution.** Continental Europe eastward to the Ural and Volga rivers, Turkey, Ciscaucasia, N Caucasus, Transcaucasia.

*Ischnopsyllus (Hexacentopsylla) hexactenus* (Kolenati, 1856)


**Distribution.** Europe, northern parts of Asia eastward to Transbaikalia.

*Ischnopsyllus (Hexacentopsylla) petropolitanaus* (Wagner, 1898)

**Russia.** Alg. Mts., Kara-Gey, 3000 m, *Plecoptera subrotunda* warth Thomas, 14 viii 1984, 1 M, 1 F (from 2 bats), 1 Hemich leg., K. Kurokawa, distr. Osh, nursing colony of *Epitesicus serotinus* (U. Thomas), 17 iv 1985, 1 F (from 30 bats), S N Rybin leg.

**Distribution.** Sankt Peterburg, Kazakhstan, Uzbekistan, Tadjikistan, Kyrgyzstan.

*Myodopsylla tricellis* Jordan, 1929


**Distribution.** Finland, Russia (eastward to Lake Baikal), E Kazakhstan, N Mongolia, NE China, NE Korea.
Rhinolophopsylla unisectinata unisectinata (Taschenberg, 1880)


**Distribution.** West, S and SE Europe, Asia Minor, Crimea, Caucasus, Middle East, Turkmenistan, SW Afghanistan.

*Rhinolophopsylla unisectinata turcestaniae* Ioff, 1953


**Distribution.** S Kazakhstan, Uzbekistan, S Kyrgyzstan, Tajikistan, NE Afghanistan.

*Nycteridopsylla pentactena* (Kolenati, 1856)


**Distribution.** West, central and eastern Europe.

*Hormopsylla trux* Jordan, 1950

*CUBA* Prov. Oriente, Santiago de Cuba, *Tadarida (Nyctinomops) macrotas* Gray, 1 M, Jorge de la Cruz leg.

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Fig. 1 - *Hormopsylla trux* Jordan, male genitalia.

25
A poorly known species described from Peru (male holotype and female allotype) from unidentified bat. The found male agree with the description and illustration of this species by Hopkins & Rothschild (1956: 214–215, figs 364, 366). Thoracic and abdominal combs with 32, 13, 23, 16, 16 and 15 spines; clasper bears 2 large bristles, both laterally flattened, for details in male terminalia see Fig. 1 (apical bristle of the anterior lobe of movable process broken).

Nycteribidae

*Nycteribia* (Nycteribia) *allotopa* Speiser, 1901

Laos, Kao-Guan distr., Ban Thakoe, S vin 1989, 7 bsp. (Vesperatlon), 2 F, T Scholz leg.

The shape of the dorsal genital plate in both females (Fig. 2) is intermediary between those in populations from Sumatra (Maa 1967: fig. 66) or Philippines (Theodor 1967: fig. 66) and those of populations from Japan (Maa 1967: fig. 67), Formosa (Theodor 1967: fig. 67) or Afghanistan (Härd & Povolný 1968: fig. 2 c). *One specimen has the surface of tegite 2 almost bare, the second specimen has most of the surface covered with short setae*. Laos represents the new finding place of *Nycterebula* Speiser.

**Distribution.** The species, originally described from the East Sumatra, is recorded from a large distributional area, ranging from E Afghanistan in the west to Japan (Honshū) in the east, and Indonesia and Australia in the south, occurring in the southeastern part of the Palaeartic region, and widely distributed in the Oriental and Australian regions. Several local forms were reported from this vast area, some of which described as subspecies, differing mainly in details of genitalia of both sexes. The entire complex is much in need of a revision.

*Nycteribia* (Nycteribia) *dentata* Theodor, 1967


**Distribution.** E Afghanistan, NW India (Jammu & Kashmir). The type locality of this species represents the Bumbroo cave, Matai, Pahalgam Road in Kashmir.

*Nycteribia* (Nycteribia) *korenati* Theodor & Moscona, 1954


**Distribution.** European species distributed from S Scotland and S Scandinavia to N Portugal, N Italy, Macedonia and Romania; eastern limit presently 28–29° E.

*Nycteribia* (Nycteribia) *latreillii* (Leach, 1817)


DISTRIBUTION. Continental Europe (northward to 51–52° N), N Africa, SW and Middle Asia eastward to E Kazakhstan.

**Nycteribia (Nycteribia) parvula Speiser, 1901**


Similarly as *N. allotopa* Speiser, also *N. parvula* occurs on their large distributional area in local forms, differing mainly in details of genitalia of both sexes. The specimens examined agree in main characters (Figs 3–5) with those described by Theodor (1967) from Formos. Laos was not yet reported as a finding place of this species.

**Nycteribia (Nycteribia) pedicularia Latreille, 1796**

**Nycteribia (Nycteribia) quasiocellata Theodor, 1966**

**Nycteribia (Nycteribia) lindbergi Aellen, 1959**

**Nycteribia (Acrocholidia) lindbergi Aellen, 1959**

KYTEKZIstan. Dakh distr., Myotis myotis (Tomes), N. S. Rybin leg. Sasyk-Uungur caves, 12 viii 1988, 6 F (from 4 bats); Dange, 14 vii 1988, I M, 1 F (from 1 bat), Barytovay cave, 13 viii 1988, 3 M, 6 F (from 5 bats); Davachan-Uungur cave, 15 viii 1988, 1 M, 3 F (from 5 bats); Azhdir-Uungur cave, Myotis myotis (Tomes), 5 viii 1984, 13 F (from 16 bats), I. Horecek leg.

**Uzbekistan. Samarkand cavi., Amankutan, Myotis myotis (Tomes), 9 vii 1989, 1 F (from 4 bats), K. Horecek leg.**

**Uzbekistan.** Species of Middle and Central Asia found in SW Uzbekistan, S Kyrgyzstan, E Kazakhstan, Tadzhikistan, Afghanistan and N India (NW Himalaya, Darjeeling).
Nycteribia (Acrocholdia) vexata Westwood, 1835

Slovenia, Kokevje-Rodolj-kamen, Myotis bechsteinii (Kohli), 2 v. 1993, 1 F (from 4 male bats), Z. Robak leg., J. Robakick det

Hungary, NE Rodopi Mts., Medzhokovets Mts., Myotis blythi (Tomes), 14 vii 1986, 2 M, 2 F (from 3 bats), Knudovnik (30 km S Khashkovo), Myotis nattereri (Borkh.), 21 vi 1986, 4 M (from 1 bat), Kamen Bryag, Black Sea coast, Myotis blythi (Tomes), 11 vii 1986, 1 M, 1 F (from 2 bats), all K. Hurbak leg.

Distribution: Continental Europe (northward to 52–53° N), N Africa and SW Asia eastward to Iran (Elburz Mts.) and Turkmenistan (Bakhardskaya cave).

Phthiridium biarticulatum Hermann, 1804

Kyrgyzstan, Osh dist., Asyan, cave No 12, Rhinolophus ferrumequinum (van Cheesman), 23 vii 1983, 1 M (from 1 bat), N. S. Rybin leg.

Kyrgyzstan, Osh dist., Kalsekaya cave, Rhinolophus ferrumequinum (van Cheesman), 19 vii 1985, 1 F (from 1 bat), N. S. Rybin leg., T. Yu. Miyan, Rhinolophus ferrumequinum (van Cheesman), 17 vii 1987, 1 F (from 1 bat), 21 vi 1988, 2 M, 2 F (from 3 bats), 14 vii 1988, 1 M (from 1 bat), 14 VIII 1988, 2 M, 3 F (from 3 bats), N. S. Rybin leg.

Kyrgyzstan, Kustalika cave, Rhinolophus ferrumequinum (van Cheesman), 18 vii 1987, 2 M (from 1 bat), N. S. Rybin leg., Komgut cave, Rhinolophus ferrumequinum (van Cheesman), 21 vii 1987, 1 M (from 1 bat), N. S. Rybin leg.

Distribution: A West Palaearctic species, distributed in southern half of Europe, N Africa and SW Asia, eastward to Kyrgyzstan, Tadjikistan and Afghanistan. In Middle Asia this fly prefers Rhinolophus ferrumequinum (and perhaps also R. bohacei) as a host.

Phthiridium similis Mürka, 1984

Kyrgyzstan, Osh dist., Kyzyl-Kijak cave (170 km SW Osh), 1 vii 1988, Rhinolophus aff. Hipposideros (Boehm.), 1 M (from 1 bat), N. S. Rybin leg.

Distribution: The species was described from N Tadjikistan and found also in S Kyrgyzstan (Okhina cave near Kadamdhzay, 120 km SW Osh).

Phthiridium szechuanum turkestanicum subsp. n.

Length 1.8–2.2 mm. Colour light brown.

Head with 4 setae at the dorsal anterior margin. 7–12 notopleural setae, usually a gap between 2 (1, 3) anterior and the following setae. Postspiracular sclerite with 4–6 setae.

Male abdomen as in P. szechuanum Thodor, but surface of tergite 6 with 1–2 short setae. Abdominal clittidium with 35–40 spines. Sternite 2 with a group of 25–31 spines, median spine in 3 rows, those in the second and third row above twice as long as those in the first row. Genitalia in general as in P. szechuanum but apices of surstyly (elapsers) slender, aedeagus not bent in the basal part and with more curved, not bifid apex (Figs 6, 7), parameters (pragontes) with less curved apical process and with more shallow position of its ventral margin, 2 setae on the inner side of the ventral basal corner (Figs 6, 8).

Female abdomen in general as in P. szechuanum. Abdominal clittidium with 36–41 spines (45 in P. szechuanum). Setae on the surface of sternites 5 and 6 more numerous (4–6, 1–2 in P. szechuanum). Genital plate as in Figs 9, 10, 11.

Differential diagnosis: P. szechuanum turkestanicum subsp. n. differs from P. szechuanum Thodor in the shape of aedeagus and parameters and in some characters in chaetotaxy.

Etymology: The name of the subspecies is derive from its occurrence in the late Turkestanian.
Figs 2–12. 2—_Nycteribia alliata_ Speiser, dorsal genital plate; 3—_N. parva_ Speiser, ventral and dorsal genital plates; 4, 5—_N. parva_, paramere, aedeagus; 6–8—_Phidippus szechuanum turkestanicum_ subsp. _n._ male genitalia (6, 7—Tuya-Mayur, 8—Amankutan); 9–11—_P. szechuanum turkestanicum_ subsp. _n._, dorsal genital plate (9, 10—Tuya-Mayur, 11—Amankutan); 12—_Sparassidae barneaudi_ Theodore, male genitalia.
**Basilia (Basilia) blainvillii amiculata** (Speiser, 1907)

Cambodia. Takeo, Taphozous longimanus Hardwicke, 10 in 1984, 1 F, 19 in 1984, 1 F. Z. Prudhoe leg.

**DISTRIBUTION.** The species inhabits tropics of the Old World. Oriental subspecies is known from India (West Bengal, Maharashtra, Rajasthan, Gujarat), Sri Lanka, Burma, Cambodia, Malaysia (Labuan) and Indonesia (Sumatra, Java). From Cambodia given by Klein (1970) from the Phnom Penh region (Prek-Phnom), host Taphozous longimanus longimanus Hardwicke.

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**Basilia (Basilia) italica** Theodor, 1954

*Slovenia* Kocevje-Lukna, M. myracronys (Kuhl), 2 Jan 1993, 1 M, 1 F (from 1 female bat), Z. Rehak leg.

Both specimens agree in the morphological characters with the descriptions of this rare species, only apical part of aedeagus of studied male is slightly narrower than figured by Aellen (1955) and Theodor (1967).

**DISTRIBUTION.** The species has been found in France, Switzerland, Italy, Slovenia (new locality), Slovakia and Poland.

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**Basilia (Basilia) nana** Theodor & Moscyna, 1954

*Slovenia* Kocevje-Rodtske kamen, M. basilineum (Kuhl), 2 and 3 Jan 1993, 4 M, 5 F (from 5 male bats), Kocevje Lukna, M. kochsteinii (Kuhl) 4 Jan 1993, 4 M, 1 F (from 2 male bats), Noctua cinerea (Kuhl), 2 Jan 1993, 1 F (from 1 male bat), Plecotus auritus (Linnæus), 2 Jan 1993, 1 M (from 1 male bat), Z. Rehak leg.

**DISTRIBUTION.** Europe (from SE Great Britain and S Sweden to N and E Spain, Switzerland, Slovenia and Beligaria), Israel, Jordan (Amir & Qumsiyeh 1993), Azerbaidjan.

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**Basilia (Basilia) nattereri** (Kolenati, 1857)

*Czech Republic* Moravia mer., dist. Zadovice, Bohn, garrickep's lodge (5163), nursing colony of Myoxus nattereri (Kuhl), 30 Dec 1996, 2 M, 1 F (from 1 female bat), A. Reiter leg.

**DISTRIBUTION.** Kolenati based his description of this species probably on the Moravian sample. The recent finding confirms the occurrence of B. nattereri in southern Moravia, on its evidently main host. The species has been found in Spain, France, Switzerland, Germany, Czech Republic, Romania and Crimea till now.
**Basilia (Basilia) rybini rybini** Hürka, 1969


**Distribution.** The nominotypical subspecies was described from eastern Kazakhstan; east border of the Lake Baikal represents further place of origin. In Russia, *Basilia rybini japonica* Theodor is known from Japan (Hokkaido).

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**Basilia (Paracyclopodia) burmensis** Theodor, 1954


Theodor (1954) described *Paracyclopodia royli burmensis*, based on female specimens from Burma, and included also specimens from Laos in this subspecies. In 1967 Theodor repeated the characteristic female features of this taxon, given as *Basilia (Paracyclopodia) royli burmensis* Maa (1977) considered B. (P.) *burmensis* Theodor and B. (P.) *royli* (Westwood) for species proper, as well as B. (P.) *chlamydophora* Speiser, considered by Theodor (1967) for synonymy with B. (P.) *royli*

Three female specimens from Laos agree in all distinguishing chaetotactic features given by Theodor (1954, 1967) for the taxon *burmensis*. Short setae on the surface of tergal plate 1 extend to the posterior margin; lateral parts of tergal plate 2 covered with setae; ctenidium consists of 39–43 spines, additional 7–8 setae at each side of ctenidium; posterior margin of sternite 5 bears 17–18 setae; each plate of sternite 7 with 1–2 setae; 11–13 notopleural setae, anal sclerite with 6–7 short and 2 longer setae. Size 2.45–2.70 mm.

In five males following features have been found: 11–14 notopleural setae; tergites 2 and 3 in all specimens with distinct setae on the surface (tergite 2: 14–23, tergite 3: 7–17), in two specimens also tergite 4 with few setae on the surface, tergites 5–7 only with 2–4 short lateral setae; postspicular sclerite finger-like, with 1–2 setae; ctenidium consists of 36–45 spines, 2–3 additional setae at each side of ctenidium; sclerite 5 with a double row of 13–15 short spines at the posterior margin. Size 2.45–2.70 mm. Genitalia as in Fig. 12, aedeagal guide (phallobase) with additional strong setae in apical third of dorsal margin.

B. (P.) *burmensis* Theodor differs from B. (P.) *royli* (Westwood) in the male sex mainly by setose surface of tergites 2, 3, 4, and by the chaetotaxy of aedeagal guide.

**Distribution.** According to Maa (1977) the species has been found in Burma, Thailand, Vietnam and Indonesia (Sulawesi, Java). Laos represents a new finding place of this fly.

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**Penicillidia (Penicillidia) dafouri dafouri** (Westwood, 1835)


The specimens from Jammu & Kashmir agree in chaetotactic characters with specimens from Middle Asia (number of notopleural setae 8–9, number of setae at posterior margin of the dorsal genital plate 7–8).

**Distribution.** Continental Europe, N Africa, West and Middle Asia, West Himalaya (India: Jammu & Kashmir, Uttar Pradesh).

### Penicilliida monoceros Speiser, 1900

*Russia: Siberia, Lake Baikal, Syneye Noi peninsula and Anthusa, Burtuy, Myoxus dundurien (Kuh.), 1–6 vii 1902, 1 F (from 5 bats), Myoxus skomorokh Osgen., et al. Myoxus brandt (Eversmann), 27–29 vii 1902, 1 M, 2 F, A Rotor leg.*

**Distribution.** A north Palaeartctic species found in Scandinavia, Denmark, N Germany, Czech Republic, Russia (Kaliningrad, Sankt Peterburg distr., Ural Mts., Lake Baikal), NE Kazakhstan, C Mongolia and N Japan.

### Streblidae

*Brachytarsina (Brachytarsina) amboinensis amboinensis Rondani, 1878*

*Laos: Kep-Oudom distr., Ban Thatkao, 8 viii 1989, 2 host (Vesproctotanidae), 1 M, 1 F, T Schoetz leg.*

This variable species was described from Ambon (Ambon, Moluccas, Indonesia). It is widespread in the Oriental and Australian regions, but not yet known from Laos.

**Distribution.** W India (Maharashtra), Sri Lanka, Nicobar Islands, Burma, Thailand, Laos, Taiwan, Okinawa Islands, Ryukyu Islands, Philippines (Luzon, Tablas, Mindanao), Malaysia (Pahang, Selangor), Indonesia (Java, Timor, Ambon). Several endemic subspecies were recognized in the Australian Region (New Guinea, Solomon Islands, New Caledonia, New Hebrides, Australia).

The fly occurs mainly on several species of the bat genus *Miniopterus*.

### References


BOOK REVIEW


Both editors are professors — at University in Erlangen-Nürnberg and at Veterinary College in Hannover (Germany). The list of contributors contains 21 acknowledged experts affiliated with institutes for microbiology, parasitology and tropical medicine in western federal states of Germany. As the editors emphasize in the preface, the last decade molecular biology has undergone dramatic development. However, in the field of major parasitic diseases many factors remain to be elucidated. Research of molecular immunology and molecular and cellular biology makes an interdisciplinary approach inevitable. Only application of modern techniques of immunology and molecular biology brings essentially new contributions to specialized knowledge of parasitology and genetics. Many new specific parasite antigens have been defined. Moreover, recombinant antigens improve essentially laboratory diagnosis and constitute promising candidates for preparation of anti-parasite vaccines. Mechanisms of parasite evasion and suppression of the host immune response such as immunosuppression and marked immuno-suppression have been elucidated. The volume is composed of 12 chapters offering information on major parasitic diseases of man and livestock animals. Stressed here are molecular definitions of antigens and the host immune response. Cytokines and other factors acting in host-parasite interaction are also listed here.

Chapter 1 is devoted to African trypanosomes — their morphology and life cycles, genome organization and transcription, antigenic variation and invariant surface antigens, and diagnostic and therapeutic procedures. A chance for effective vaccine preparation against African trypanosomes appears poor with respect to variable surface glycoproteins. However, the causative agent of African sleeping sickness reacts to be subjects of most intensive research.

Chapter 2 examines the biology and immunology of host-parasite interactions in causative agents of cutaneous and visceral leishmaniasis. Leishmania mexicana complex, L. braziliensis complex, L. major, L. tropica and four other Leishmania species. Characterized here is the genome organization in Leishmania and their immunological properties. The technique of genetic manipulations enables studies on pathogenicity of procyclic and metacyclic stages. Homologous recombination enables development of attenuated parasitic strains and preparation of a more effective vaccine.

Chapter 3 provides new information on echinococcus. Emphasis of this chapter is to explain differences between Echinococcus dispar and E. multilocularis, Furthermore, the identification of EIA antibody in saliva and the preparation of effective vaccines.

Chapter 4 is concerned with cestodes. Among about 900 cestode species, cestodes of domestic poultry and pigs as well as in most extensive research at present.

Chapter 5 deals with toxoplasmotes which represents one of the most extensively distributed parasitic zoonoses on the global scale. Besides general information, genome organization is outlined here. Particular cellular structures and organelles such as inclusions, granular, microtubules, microsporidium and mitochondria have their corresponding genes and physiological function. Listed here are factors involved in immune responses and its evasion and evasion mechanisms.

Chapter 6 surveys the highly complex subject of immune reactions involved in malaria when discussing a variety of recently discovered parasite proteins and antibodies against sporozoites and merozoites.

Chapter 7 on babesiosis follows mainly on their biology, genome organization, immunity, evasion mechanisms and new diagnostic techniques.

Following chapters 8–13 move into the area of helminthiasis of importance for human and veterinary medicine, namely schistosomiasis, taeniasis, echinococcosis, diphyllobothriasis and filariasis. Covered here are the genome of particular helminth genera and species, immune interactions in hosts and intermediary hosts, evasion mechanisms, antigen structure and new diagnostic procedures as the polymerase chain reaction.

Each chapter is concluded with an extensive list of original scientific reports. Illustrations consist of 23 microphotographs and schematic line drawings featuring life cycles of various protozoan parasites and helminths, biological and chemical structures, culturing protocols, genetic processes and graphs. In 10 summary-type tables included are schemes of life cycles overviews of specific names of parasite agents, molecular biology analyses of genes and their products, and names of commercially available vaccines. This volume is a representative of otherwise not very numerous monographs of this type offering a concise information on explosive advances and progressively forthcoming trends in modern parasitology.

Ándraš Jáva
Afroisometrus gen. n. from Zimbabwe (Scorpiones: Buthidae)

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Abstract. Afroisometrus gen. n., with the type species Lycus minshullae Fitzpatrick, 1994 is described. The new genus is related to the genus Isometrus Hemprich & Ehrenberg, 1828, from which it differs by the absence of subocular tubercle and the presence of three keels on the dorsal surface of the metasoma. It differs from the genus Lycus C. L. Koch, 1845 in the absence of tibial spurs on the third and fourth legs.

Taxonomy, description, new genus, new combination, Scorpiones, Buthidae, Afroisometrus gen. n., Lycus minshullae, Afrotropical region

Afroisometrus gen. n.
(Figs 1–3, Table 1)

Type species: Lycus minshullae Fitzpatrick, 1994.

Etymology. Denotes affinity to the genus Isometrus and the geographic distribution.

Description. A combination of characters differentiates this genus from all other genera of the family Buthidae. The basic trichobothrial pattern is beta (Fitzpatrick 1994: 25, fig. 6 and Sissons 1990: 72, fig. 3.3), the third and fourth legs are without tibial spurs (Sissons 1990: 74, fig. 3.8A), the sternum is subtrangular (Fitzpatrick 1994: 24, fig. 2), and tibia and tarsomeres of the first through third legs bear setae which are not arranged into a bristlecomb. This complex of characters is exhibited by the genus Isometrus Hemprich & Ehrenberg, 1828, but Afroisometrus gen. n. has three keels on the dorsal surface of the third through sixth metasomal segments, lacks a subocular tooth, and has 12 pectinal teeth.

The first and second metasomal segments bear 10 keels, the third and fourth segments bear 8 keels, and the fifth segment lacks keels. Other characters are given in the description of Afroisometrus minshullae (Fitzpatrick, 1994) below.

Affinities. Differentiation from the genus Isometrus and inclusion in the Sisson’s (1990: 96) key of genera of the family Buthidae is as follows:

- Subocular tooth present, metasoma with one keel.
- Subocular tooth absent, metasoma with three keels.

Afroisometrus minshullae (Fitzpatrick, 1994) comb. n.
(Figs 1–3, Table 1)

Lycus minshullae Fitzpatrick, 1994: 24–25

Table 1. Measurements in millimeters of holotype of *Afrusomatus murchsallae* (Fitzpatrick) comb. n. Line denoted „post- nal tooth” contains numbers of both left and right teeth separated by a colon.

<table>
<thead>
<tr>
<th></th>
<th><em>Afrusomatus murchsallae</em> (Fitzpatrick, 1994) comb. n. holotype</th>
</tr>
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<tbody>
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<tr>
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<td>width</td>
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<tr>
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<td>width</td>
<td>1.4</td>
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<tr>
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<td></td>
</tr>
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<td>2.2</td>
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<td>1.3</td>
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<td>Pectinal teeth</td>
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</table>

Figs 1–3. *Afrusomatus murchsallae* (Fitzpatrick) comb. n., holotype: Fig. 1, tibia of pedipalp; Fig. 2, movable finger; Fig. 3, fixed finger.
DESCRIPTION. The length of the holotype is 27.3 mm. Measurements of the carapace, telson, segments of the metasoma and of the pedipalps, and numbers of pectineal teeth are given in Tab. 1. For the position and distribution of trichobothria on the pedipalps see Fig. 1 and Fitzpatrick 1994: 25, figs 4–8. Cutting edges of movable and fixed fingers are shown in Figs 2–3. Other characters are given in the diagnosis of *Afroisometrus* gen. n. and the description of *Afroisometrus minshulliae* (Fitzpatrick 1994: 23–28) above.

DISCUSSION

Fitzpatrick placed *Afroisometrus minshulliae* in the genus *Lychas* but noted certain differences. He stated that *Lychas minshulliae* has tibial spurs on the third and fourth legs, but the female holotype examined by me lacks any such spurs. This important character indicates a relationship closer to *Isometrus* than to *Lychas*. However, the differences between *Afroisometrus minshulliae* and *Isometrus* are profound enough to warrant erection of *Afroisometrus* gen. n..

Acknowledgements

I would like to thank M. J. Fitzpatrick of the Natural History Museum in Bulawayo, Zimbabwe, for the loan of holotype of *Lychas minshulliae*, and Jifi Zidek (New Mexico Tech, Socorro, USA) for help with the language.

REFERENCES


BOOK REVIEW


The author is an acknowledged authority in the field of helminthology affiliated with the Museum of Zoology in Berlin. The previous (1975) published companion volume No. 62 covered the nematode orders Rhabditoidea and Ascariideoidea. In this volume the author presents a second monograph on nematode helminths of vertebrates published in the series Die Tierwelt Deutschlands (founded by Friedrich Dahl in 1923) dealing with superfamily Strongylidea and Ankylostomatidea, burrowing nematodes belonging to the order Strongylidea (other sources introduce the order as suborder Strongylidea). Strongylids and hookworms cause diseases in domestic and wild animals as well as to humans, some of them having extreme importance for hygiene and economy. Thus, the investigation devoted to exact determination of particular nematode species is essential for knowledge of development and spreading of these parasites as well as for prevention and control of helminthiasis caused by them.

The volume is well-illustrated by 27 figures composed of 170 line drawings. 62 nematode species are listed here in total. They have been often described under different names, introduced as synonyms. Descriptions of nematode species featured in this volume are based upon collections of the Museum of Zoology in Berlin and other research institutions in Belgrade, St. Albans, Lyon, Budapest and Budapest.

The special part merits attention upon descriptions of particular taxonomical groups, superfamilies, families, subfamilies, genera, subgenera and species. The superfamily Strongylidea includes the families Strongylidae, Chabertiae and Synagreidae. The superfamily Ankylostomatidea includes the family Ankylostomatidae, commonly known as hookworms. Chapters on particular taxonomical groups are correlated with detailed morphological characteristics. Moreover, keys for determination of superfamilies, families, subfamilies, genera, subgenera and species are given. For example, the genus Strongylus has been divided into three subgenera: Strongylus (Ascaris), Strongylus (Oesophaga) and Strongylus (Strongylos). The genus Oesophagostomum includes four subgenera: Oesophagostomum (Hysterurus), Oesophagostomum (Barcla) Oesophagostomum (Protostomum) and Oesophagostomum (Oesophagostomum), etc. The genus Ankylostoma has been divided into four subgenera, only the nematoid species is looked at. Besides re-description of morphology including measurements of particular organs, outlined here are type names, occurrence and localization in hosts, life cycles and geographical distribution. The line drawings illustrate anterior ends of mouth parts, the buccal capsule, respectively, typical of the order Strongylidea, and posterior parts of females and males with characteristic expanded copulatory bursa composed of lobes, rays and the genital cone. The volume is concluded with a list of host species together with their parasites and with a comprehensive list of references.

As stated above, strongylids and hookworms represent an important group of causative agents of diseases in humans and animals. In this volume only species occurring in Germany and adjacent regions are listed. Beyond the scope of this presentation it may be stressed that human hookworms affect 1.5% of the world population and represent major pathogens in countries with warm and moist climates since prehistoric times (for review see Helminthologia, 1992, p 58). The canine hookworm Ancylostoma caninum and some members of the genera Uncinia and Brachynema have been diagnosed causing creeping eruption (cutaneous larva migrans) in people visiting tropical areas and sub-tropics. The gapeworms (Syngamus) that live in the upper air passages of various species of poultry, game birds and ruminants may cause sporadic respiratory disorders (syngamiasis or larva migrans) in humans. Various species of nodular worms (Oesophagostomum) are common parasites of mammals. O. bifurcatum has been reported recently as causative agent of serious intestinal disorders with high incidence rate in some African counties.

Designed for researchers in biological, medical and veterinary sciences, this comprehensive and practically oriented monograph supplements classic textbooks of medical and veterinary helminthology or parasitology.
Results of the Czech Biological Expedition to Iran.
Part 2. Arachnida: Scorpiones, with descriptions of *Iranobuthus krali* gen. n. et sp. n. and *Hottentotta zagrosensis* sp. n. (Buthidae)

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Received September 10, 1996, accepted October 10, 1996
Published April 1, 1997

Abstract Distribution data are presented for *Androctonus amurensis baluchicus* (Pocock, 1900), *Camposcincus matricomus* (Birula, 1905), *Hottentotta saxicola* (Simon, 1889), *Hottentotta schach* (Berle, 1905), *Mesobuthus expurt* (C. L. Koch, 1839), *Odonobuthus dorato* (Thorell, 1876), *Odonobuthus coloratiporus* Pocock, 1897, *Odonobuthus sp. n. 7*, *Parasyrachus giolfrisensis* (Kraepelin, 1903), *Parasyrachus giolfrisensis* (Kraepelin, 1903), *Parasyrachus giolfrisensis* (Kraepelin, 1903), *Parasyrachus giolfrisensis* (Kraepelin, 1903), *Parasyrachus giolfrisensis* (Kraepelin, 1903), *Parasyrachus giolfrisensis* (Kraepelin, 1903)

INTRODUCTION

Thanks to organizational efforts of Mrs Zdena Hodková of Prague, the Czech Biological Expedition Iran 1996 took place between 20.IV. and 20.V.1996 (for details see Frynta et al. 1997). Members of the expedition collected 153 scorpions belonging to 13 species, 9 genera, and two families. The last comprehensive study of Iranian scorpions (Farzampan 1988) lists 23 species, 17 genera (of which, however four are nomina nuda), and two families. For the map includes all localities that produced insects and arachnids see Frynta et al. 1997.

Explanatory notes: M = male, F = female, A = specimens preserved in 75% alcohol, E = dry-mounted specimens. Unless noted otherwise, the material is deposited in the author’s collection.

RESULTS

*Androctonus amurensis baluchicus* (Pocock, 1900)

Material Iran, Esfahan prov., alt. ca 800 m, SIE of Kasban, Jafar Abad vill. env., 33°55' N 51°53' E, Loc No 2, 26.27.IV.1996, Immature MA, leg. M. Kaltan

Comments. This subspecies was described from Pakistan, northern Baluchistan (Pocock 1900: 16), and was subsequently found in Afghanistan (Vachon 1959: 125, Kovářik 1993: 201) and
Iran (Vachon 1959: 125, Vachon 1966: 209, Habibi 1971: 42). Farzanpay (1988: 35) doubted the presence of *A. amoreuxii* (Audouin, 1825) in Iran and thought that specimens identified by Habibi as *A. amoreuxii* are only a local form of *A. cruxicauda*. Therefore, he did not include *A. amoreuxii* among the Iranian taxa.

The immature male examined is 58 mm long and has 28 and 30 pectinal teeth.

Vachon and Habibi (Vachon 1966: 209, Habibi 1971: 42) listed also the subspecies *A. amoreuxii finitimus* (Pocock, 1897) from Iran. However, I concur with Farzanpay (1988) in that this subspecies most likely does not occur in Iran, and therefore it is not included in the checklist below.

**Compsobuthus matteissenii** (Birula, 1905)


**Comments.** *Compsobuthus matteissenii* was described by Birula (Birula 1905: 142) as a subspecies of *C. acutecarinatus*. The species is well characterized by the pronounced difference in length of the metasoma between males and females, which is present also in immature specimens. This character unequivocally differentiates *C. matteissenii* from *C. acutecarinatus*. In the latter the metasoma is of approximately the same length in both sexes. In contrast to *C. rugosulus*, in *C. matteissenii* the cutting edges on movable fingers of the pedipalps lack external granules.

*C. matteissenii* occurs in Iraq and Iran (Vachon 1966: 211), and in Turkey (Kovařík 1996: 53).

**Hottentotta sauleyi** (Simon, 1880)


**Comments.** *Hottentotta sauleyi* was described by Simon (1880: 378) as *Buthus sauleyi*. Simon gave total length of 93 mm and 29–33 pectinal teeth. The females I have examined are 75 and 93 mm long and have 24–27 pectinal teeth. The two immature males are 32 mm long and have 28–32 pectinal teeth.

This species has been so far known from Iraq and Iran (Kovařík 1992: 183), but there is also one male from Afghanistan (labelled as from: „Djebel us Saraj”) in my collection.

**Hottentotta schach** (Birula, 1905)

**Material.** Iran, Fars prov., alt ca 1700 m, 10 km E of Sivand vill., 30° 05' N 52° 55' E, Loc. No. 10, 29 – 30 IV 1996, 1FA, leg. M. Kafan, 1ME, leg. V. Šego.

**Comments.** *Hottentotta schach* was described by Birula (Birula 1905: 134) as *Buthus schach*. Birula gave total length of 130 mm and 29 pectinal teeth for the female and 101 mm and 34–35 pectinal teeth for the male. The female examined is 120 mm long and has 26 and 27 pectinal teeth, whereas the male is 110 mm long and has 33 and 34 pectinal teeth.

This species is known only from Iran and Iraq.
Hottentotta zagrosensis sp. n.
(Figs 1–3, 14, Table I)

Type Material. Holotype — male, allotype and paratypes Nos 1–4 labelled: Iran, Fars prov., alt. ca 1000 m, Zagros Mts., Abshar vill., env., 30°23' N 51°30' E, Loc. No. 14, 2–3 V 1996; holotype and paratype No. 1 leg. J. Píhalová, allotype and paratype No. 2 and No. 3 leg. V. Šeprina, paratype No. 4 leg. D. Král. Paratype No. 1 and its ecdysis mounted dry, other type specimens preserved in 75% alcohol. Type specimen currently housed in the author's collection, will be deposited in the Department of Invertebrate Zoology, National Museum (Natural History), Prague.

Type Locality. Iran, Fars prov., alt. ca 1000 m, Zagros Mts., Abshar vill., env., 30°23' N 51°30' E. Specimens were collected in a dry river bed with rocky banks, fields, and scattered oaks of Quercus brantii.

Etymology. Named after the Zagros Mts., to which the species appears to be restricted.

Description. The total length is 102 mm in the male holotype, 103 mm in the female allotype, and 83 mm in the immature male paratype No. 1, whose ecdysis measures 63 mm. Paratypes Nos 2–4 measure 62, 66, and 50 mm, respectively. The habitus is shown in Fig. 14. Measure-
ments of the carapace, telson, segments of the metasoma and of the pedipalps, and numbers of pectinal teeth in the holotype and allotype are given in Table 1. The male has 34 and 35 pectinal teeth, the female (allotype) has 31 and 33 pectinal teeth, and immature specimens (paratypes Nos 1–4) have 27–36 pectinal teeth. For the position and distribution of trichobothria on the pedipalps see Figs 1–2. The position of the trichobothrium Eb3 on the manus of the tibia (Fig. 1) is variable. Fig. 1 shows its position in the holotype. The allotype and paratypes have this trichobothrium situated in the same plane as trichobothrium Et or closer to trichobothrium Eb. Trichobothria Eb3, Esb, Esb of tibia (Fig. 1), and d2 of femur (Fig. 2) are smaller than others.

Nearly the entire animal is hirsute. Pedipalps, the dorsal surface of the mesosoma, legs, lateral and ventral surfaces of metasomal segments, and the vesicle are densely hirsute, whereas the ventral surface of the mesosoma is hirsute only sparsely and the dorsal surface of the metasoma, ventral surface of femur and patella of pedipalps, and segments of telson lack hair cover. The male has longer and narrower metasomal segments than the female (Tab. 1).

Fig. 14. *Hottennota zagrosensis* sp. n. (holotype). Dorsal aspect.
Color is black except reddish brown tibia of pedipalps. Sometimes yellow ends of the first and second tarsomeres, marbled coxa and trochanter on the ventral side of mesosoma, and yellowish-brown pecten.

The cheliceras have dorsal protuberances which are less conspicuous in immature specimens. The posteroventral part of the cheliceras is smooth and black, but in immature specimens it is reticulated.

The femur of pedipalps has five keels and a row of granules in the middle part of the internal surface. The ventral surfaces of femur and patella are smooth to glossy. The patella has eight keels. The tibia lacks keels. The movable fingers of the pedipalps have 16 cutting edges (Fig. 3).

The mesosoma has three keels on the dorsal surface and two keels on the ventral surface with the exception of the seventh segment, whose ventral surface bears four well-marked keels.

The first and second segments of metasoma bear 10 keels, the third segment bears 8 or 10 keels, the fourth segment bears 8 keels, and the fifth segment bears only 5 keels. The dorsal surface is smooth and glossy, with the fifth segment bearing two short, inconspicuous keels. A subaculear tooth is absent, but the ventral surface of the aculeus bears five rows of granules.

**Affinities.** The described features distinguish *Hottentotta zagrosensis* sp. n. from all other species of the genus. The uniformly black color differentiates *Hottentotta zagrosensis* sp. n. from all other Iranian *Hottentotta* Birula, 1908 and most other species of the genus. The same coloration is present only in *H. franzowerneri gentili* (Pallary, 1924) from Morocco and *H. judaicus* (Simon, 1872) from Israel, the Jordan and Syria.

*H. judaicus* is easily distinguished from *Hottentotta zagrosensis* sp. n. by its sparse hair cover, by having only 13–14 cutting edges on the pedipalps (Levy & Amitai 1980: 57), and by the number of pectinal teeth that in *H. judaicus* number 22–27 in the female and 27–32 in the male (Levy & Amitai 1980: 55). Another difference is in the dorsolateral keels of the first through fourth metasomal segments, which in *Hottentotta zagrosensis* sp. n. consist of minute, low, and always apically rounded granules of even size. In *H. judaicus* as well as *H. f. gentili* these keels consist of taller granules that increase in size posteriorly, with the second through fourth granules tall and pointed.

Of these black species of *Hottentotta*, the new species *H. zagrosensis* sp. n. is most similar to *H. f. gentili*, namely in the hair cover. However, *H. f. gentili* is less hirsute on the aculeus of telson and on the dorsal surface of the mesosoma. In *H. f. gentili* the movable fingers of the pedipalps have 14–15 cutting edges, and there are 26–31 pectinal teeth in females and 32–38 in males (Vachon 1952: 236).

**Iranobuthus gen. n.**

(Figs 4–10, 15, Table 1)

**Type species.** *iranobuthus krai* sp. n.

**Etymology.** The generic name combines relationship to the genera of the *Buthus* type and the geographic distribution and it is a masculine in gender.

**Description.** A combination of characters differentiates this genus from all other genera of the family Buthidae. The basic trichobothrial pattern is beta (Fig. 9 and Sissom 1990: 70, fig. 3.3). The third and fourth legs bear tibial spurs (Sissom 1990: 74, fig. 3.8). The pectines bear fulcrum (Sissom 1990: 93, fig. 3.17 D). The movable fingers of pedipalps have cutting edges and four proximal to terminal granules (Fig. 4). The fixed finger of the chelicera has two ventral denticles. The dorsal surface of mesosomal segments bears three keels (Fig. 15). The carapace has distinct carinae (Fig. 15). The trichobothrium ch is situated on the fixed finger of pedipalps and
Tab 1 Measurements in millimeters of *Iransobathus krali* gen. sp. n. and *Helleniscope sugrassenii* sp. n. Line denoted "pectoral teeth" contains numbers of both left and right teeth separated by a colon.

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<td>3 3. 3 1. 0</td>
<td>3 5. 3 4. 0</td>
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</table>

does not reach on the manus as in genus *Kraepelinia* Vachon, 1974 (Fig. 6 and Vachon 1974: 950, fig. 238). The ventral surface of the metasoma lacks protuberances characteristic of the genus *Odontobuthus* Vachon, 1950 (Pocock 1900: 17, fig. 8b). The central medial and posterior median carinae on the carapace join to form a continuous linear series of granules at the posterior margin. The carapace lacks posterior lateral keels (Fig. 15 and Sissom 1990: 92, figs 3.17 a–c).

*Iransobathus* gen. sp. n. is further characterized by the number and distribution of trichobothria on the pedipalps (Figs 5–10), size (total length of 82 mm), the presence of only dorsal granulated keels on the second through fourth metasomal segments, and other features included in the description of *Iransobathus krali* sp. n. below.

**Affinities.** *Iransobathus* gen. sp. n. is easily distinguished from *Compsobuthus* Vachon, 1949 and *Darchenia* Vachon, 1977 by its size. The holotype of *Iransobathus krali* sp. n. is 8 2 mm long, whereas *Darchenia* from Africa (Louro 1995: 197) is only 20.5 mm long (Vachon 1977: 289) and *Compsobuthus* species range between 20 and 50 mm. Moreover, *Darchenia* has the trichobothrium db of pedipalps situated between trichobothria et and est (Vachon 1977: 289), whereas *Iransobathus* gen. sp. n. has its trichobothrium situated between trichobothria est and esb (Fig. 6). *Compsobuthus* has trichobothrium db in a position similar to *Iransobathus* gen. sp. n., but farther away from trichobothrium est. In *Compsobuthus* the cutting edges on movable fingers of the pedipalps range from 9 to 12 and pectinal teeth range from 12 to 29, but most species have
less than 20 *Iranobuthus* gen. n. has 14 cutting edges (Fig 4) and 31 pectinal teeth. Marked differences can be discerned also in the habitus.

The genera *Androctonus* Hemprich & Ehrengberg, 1828, *Buthus* Leach, 1815, *Hottentotta* and *Mesobuthus* Vachon, 1950 are of similar size, but *Iranobuthus* gen. n. differs from them in that the central medial and posterior medial carinae on the carapace join and form a continuous linear series of granules at the posterior margin, and the carapace lacks posterior lateral keels (Fig. 15 and Sissom 1990 92, figs 3 17 a-c).

**Iranobuthus kraii** sp. n.
(Figs 4–10, 15, Table 1)

**Type material.** Holotype male preserved in 75% alcohol, labelled: Iran, Fars prov., alt ca 1700 m, 10 km E of Sivand vill 30° 05' N 52° 55' E, Loc. No. 10, 29–30 IV 1990; leg. D. Kraii. It is currently in the author’s collection, but will be deposited in the Department of Invertebrate Zoology, National Museum, Prague.

**Type locality.** The holotype was found under stone on a limestone hillside covered with xerophytic vegetation.

Fig. 15 *Iranobuthus kraii* gen. et sp. n. (holotype) Dorsal aspect
ETYMOLOGY. Named after the collector.

DESCRIPTION. The holotype is 82 mm long and has 31 pectinal teeth. The habitus is shown in Fig. 15. Measurements of the carapace, telson, segments of the metasoma and of pedipalps, and numbers of pectinal teeth are given in Table 1. For the position and distribution of trichobothria on the pedipalps see Figs 1–2.

The base color is yellow, with only the vicinity of the medial and posterior eyes and the aculeus being black.

The carapace has keels and several solitary granules. Three pairs of lateral eyes are situated in a row distant from the carapace margin.

The third and fourth legs possess tibial and pedal spurs. The entire first and second tarsomeses are covered with long, dense hair, whereas the tibia is hirsute only on the inner surface, and the trochanter and femur bear only several scattered hairs.

The metasoma has three median keels. The keels of individual tergites each terminate in a larger granule that overlaps the hind margin of the tergite. In addition, the hind margin bears a transverse row of granules.

The metasoma bears several scattered hairs. The first and second metasomal segments possess 10 keels each, of which four keels on the first segment and six keels on the second segment are smooth and blunt. Only four dorsal keels on the second segment and four dorsal and two lateral keels on the first segment are covered with blunt granules which do not merge. The last granule is slightly larger and pointed. The third and fourth metasomal segments bear eight keels, of which the two dorsal ones are covered with minute, non-merging granules. The ventral surface of the fifth metasomal segment has one keel composed of minute granules and several scattered granules. The telson is smooth, without a subocular tubercle and with several scattered hairs.

AFFINITIES. Differential diagnosis of the new species is included in the generic diagnosis.

**Mesobuthus eupus** (C. L. Koch, 1839)


COMMENTS. Mesobuthus eupus is widely distributed in Turkey (e. g. Kovařík 1996: 54) to Mongolia (e. g. Stahnke 1967: 61) and forms many subspecies, nine in Iran alone (Farzanpay 1989: 38, 1986: 333–335). Some of the subspecies are controversial and a revision of the entire species is needed (Farzanpay 1988: 38). The hitherto published criteria are at the most part inadequate for precise determination below the species level. For this reason I have not attempted such determination, although the material includes at least two subspecies (M. e. cf. eupus from most of the localities and M. eupus subsp. from Chahak and Chahak-Zanbil).
Odontobuthus doraiæ (Thorell, 1876)
(Fig 11)


Comments: Odontobuthus doraiæ was described as Buthus doraiæ (Thorell 1876: 107) and later became the type species of the genus Odontobuthus Vachon, 1950. This genus has only two species: O. doraiæ and O. odonturus.

Thorell (1876) stated that O. doraiæ has a total length of 74 mm and 20–22 pectinal teeth. The male from Iran is immature, with a total length of 53 mm and 31–32 pectinal teeth.

O. doraiæ is known from Iran, Iraq (Brulé 1917: 239), and Pakistan (Mimno. 1974: 28).

Odontobuthus odonturus Pocock, 1897
(Figs 12–13)


Comments: Odontobuthus odonturus was described as Buthus odonturus (Pocock 1897: 104) based on a male from India with a total length of 58 mm and 28–29 pectinal teeth. Pocock (1897) distinguished it from O. doraiæ on three lobes laterally terminating the fifth metasomal segment: O. doraiæ has only two such lobes.

The genus Odontobuthus is well characterized by protuberances on the ventral side of the metasomal segments (Pocock 1900: 17, fig. 8b), but it is often characterized also by a short row of five to seven smaller granules on the tips of movable fingers of the pedipalps (Fig. 11) — e.g. in Sisson's (1990: 98) key of the family Buthidae. However, the number of granules is intraspecifically variable. An examined male of O. odonturus from Iran has three such granules, whereas a female (leg. D. Král) has three granules on the left movable finger (Fig. 13) but only two external basal granules on the right movable finger (Fig. 12), like species of the genus Mesobuthus Vachon, 1950. Another female has four terminal granules on the right movable finger, but on the left finger no such granules precede the first granular row.

The females are 82 and 86 mm long and have 25–28 pectinal teeth, the male is 73 mm long and has 32 pectinal teeth. Apart from India and Iran, the species is known also from Pakistan (Brulé, 1917: 239).

Orthochirus sp. n. 9


Comments: O. croceus differs from these Iranian specimens in the absence of external granules on the movable fingers of the pedipalps. Orthochirus sp. n. 9 has eight cutting edges with seven external granules on the movable fingers and differs in coloration as well. It is almost entirely black, with only the tubia of pedipalps and metatarsus of legs yellow and fingers of the pedipalps yellow to yellowish brown. The specimens are up to 40 mm long and have 18–20 pectinal teeth.
I surmise that this is a new species but defer formally describing and naming it until criteria for differentiating among the species and subspecies of *Orthochirus* become less equivocal. A revision of the genus *Orthochirus* has been repeatedly advocated (Levy & Ammiri 1980: 94, 1988: 116, Kovářík 1993: 203, Kovářík 1996: 181). Although Tikader & Bastawade presented a key to the species of *Orthochirus* from India (Tikader & Bastawade 1983: 113), they used variable characters and included *Orthochirus* melanurus (Keiser, 1874) whose status is dubious.

**Paraorthochirus glabrispons (Kraepelin, 1903)**

**Material:** Iran, Hamadan prov., ca 2000 m, 35 km S of Hamadan, Gonbad vill. env., 34° 40' N 48° 45' E, Loc No 23, 78 V 1996, 1M 1F Juv. A. leg V Sceja

**Comments:** *Paraorthochirus glabrispons* was described as *Rutheolus glabrispons* (Kraepelin 1903: 564), later placed in the genus *Orthochirus* Karsch, 1891, and in turn transferred to the genus *Paraorthochirus* Lourenço & Vachon, 1995 (= *Pseudoorthochirus* [sic] Lourenço & Vachon 1995: 304) based on the presence of *trichobothrium d2* on the dorsal surface of the femur.

Kraepelin gave the type locality at „Mascat“ (Kraepelin 1903: 565), but Lourenço & Vachon (1995: 298) list it as „sud de la Perse“ in my opinion, this species occurs only in Iran.

According to Kraepelin (1903: 564), *Paraorthochirus glabrispons* has 19–21 pectinal teeth whereas Lourenço & Vachon (1995) found 18–20 pectinal teeth in the female and 21–24 in the male. The adult male examined in this study has a total length of 38 mm and 24 pectinal teeth, the female has a total length of 41 mm and 20 pectinal teeth, and an immature male has a total length of 17 mm and 21 pectinal teeth.

**Paraorthochirus gossponti Lourenço & Vachon, 1995**

**Material:** Iran, Fars prov., alt ca 1000 m, Zagros Mt., Abshar vill. env., 30° 23' N 51° 30' E, Loc No 14, 2–3 V 1996, 2Juv. M, leg V Sceja

**Comments:** *Paraorthochirus gossponti* was described from Bandar-Langeh, Iran (Lourenço & Vachon 1995: 301). The occurrence of two specimens at Abshar vill. env shows that the species occupies a larger area.

The two examined juveniles are 23.5 mm (male) and 17 mm (female) long and have 22 and 20 pectinal teeth, respectively.

**Hemiscorpius lepturus Peters, 1862**


**Comments:** *Hemiscorpius lepturus* was described from Baghdad, Iraq (Peters 1862: 426). From *H. maindroni* Kraepelin, 1901, which appears to have been incorrectly listed from Iran, *H. lepturus* differs in overall length and the number of pectinal teeth. According to Kraepelin (1901: 16), the male of *H. maindroni* reaches 38 mm and has 12–13 pectinal teeth, and the
female reaches 33 mm and has 9–10 pectinal teeth, Kraepelin (1899, 142) gave a total length of up to 66 mm and 15–16 pectinal teeth for the male and up to 45 mm and nine pectinal teeth for the female of *H. lepturus*. The newly collected males of *H. lepturus* from Iran reach 64 mm and have 14–16 pectinal teeth, whereas the females reach 57 mm and have 7–16 pectinal teeth (most frequently 9–11, twice 8, and once 7, 13 and 16, respectively).

**CHECKLIST OF SCORPIONS FROM IRAN**


**Buthidae** Simon, 1879

<table>
<thead>
<tr>
<th>Species</th>
<th>Locality</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Androctonus australis innesi (Pocock, 1900)</td>
<td></td>
<td>(11, 13, 15, 29)</td>
</tr>
<tr>
<td>Androctonus cassinii laevipes (Olivier, 1807)</td>
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<td>(12, 13, 15, 16, 17, 22, 23, 26)</td>
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<tr>
<td>Apothelema pterygocercus (Fleminger, 1932)</td>
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<tr>
<td>Buthoides leptochelis leptochelis (Hornick &amp; Ehrben, 1829)</td>
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<td>(13, 15, 18, 23)</td>
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<tr>
<td>Buthoides radleri (Simon, 1892)</td>
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<td>(13, 15, 18)</td>
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<tr>
<td>Camponcodes ascicornatus (Simon, 1881)</td>
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<td>(17, 18, 29)</td>
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<tr>
<td>Comapedipes matthisse (Brulà, 1905)</td>
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<td>(13, 15, 18, 23, 29)</td>
</tr>
<tr>
<td>Comapedipes raygothi (Pocock, 1900)</td>
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<td>(13, 15, 18, 23)</td>
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<tr>
<td><em>Heterometrus australis</em> (Pocock, 1895)</td>
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<td><em>Heterometrus paruarius</em> (Pocock, 1895)</td>
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<tr>
<td>Heterometrus sauci (Simon, 1880)</td>
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<td>(13, 15, 23, 26, 29)</td>
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<td>Heterometrus schach (Brulà, 1905)</td>
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<td>Heterometrus zagorensis sp. n.</td>
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<td><em>Iracauhita</em> kraft gen. n. ct sp. n.</td>
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<td><em>Iracauhita</em> pulpit (Brulà, 1903)</td>
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<td><em>Lobithes</em> kessleri Brulà, 1998</td>
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<td><em>Mesobuthus</em> sp. sp. harranneus (Brulà, 1990)</td>
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<td><em>Orthochirus</em> scrobiculatus melanosoma (Kessler, 1874)</td>
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<td><em>Orthochirus</em> scrobiculatus parvus (Brulà, 1900)</td>
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<td><em>Orthochirus</em> scrobiculatus spinosus (Grube, 1873)</td>
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<td><strong>Orthochirus</strong> sp. sp. ?</td>
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Paravorhochirus globiferus (Kraepelin, 1903) (18, 29)
Paravorhochirus guajiroi Lourenço & Vachon, 1995 (27, 29)
Paravorhochirus stokwelli Lourenço & Vachon, 1995 (27)

Scorpionidae Peters, 1862
Habibella guillardi Vachon, 1974 (19, 23)
Habibella persica (Birula, 1903) (13, 15, 17, 18, 23)
Hemiscorpius lepicurus Peters, 1862 (13, 15, 17, 18, 23, 29)
Scorpio marinus brongniartii Birula, 1910 (15)
Scorpio marinus tormesensis (Pocock, 1902) (2, 13, 15, 18, 23)

Diplocentridae Pocock, 1893

Nebo heptamerus Francisko, 1980 (20)

DISCUSSION

Also described from Iran is Androctonus crassicauda orientalis (Vachon 1966: 210, Habibi 1971: 43), however I concur with Fet (1988: 79) in that this subspecies is a synonym of A. crassicauda.

Hottentotta alicolata and H. jayakari are questionable, because they are listed for Iran only by Farzanpay (1988: 37) without localities to ascertain their occurrences.

Farzanpay (1988: 38) questioned the occurrences of subspecies Mesobuthus euperus macbethi, M. e. pachysoma, M. e. periculis, M. e. tranus, and M. e. thoresi in Iran. However, all the exception of M. e. macbethi these subspecies have been found in Iran by Fet (1988: 10).

The above list does include Orthochirus acrobaticus medius (Kessler, 1874), although Fet (1994: 529-530) regards this subspecies as questionable. Also equivalent is the sternal species O. s. dentatus and O. s. persa (see Orthochirus sp. n. ? above and Fet 1988: 11).

Minnows (1974: 36) listed from Iran also Hemiscorpius maizoni Kraepelin, 1901. This species is excluded from the above list because I am not aware of any specific occurrence in Iran and the type locality is Muscat, Oman.

In addition, Farzanpay (1988: 41) lists for Iran, Simonoides farzanpayi, a "gen. and sp. to be described by Vachon". However, Vachon never described this genus and species, which is a nomen nudum similarly to the genera Olivierius, Razianus, and Sassanidatus also lately Farzanpay (1986: 334, 1988: 39, 40, 41).

Vachon (1966) lists for Iran 15 species, 9 genera, and 2 families. Habibi (1971) lists 131 subspecies, 24 species, 11 genera, and 2 families. Farzanpay (1988) lists 23 species, 17 genera (of which, however, four are nomina nuda), and 2 families. In this paper I list 49 subspecies, 32 species, 18 genera, and three families. However, the occurrence of two species and five subspecies is uncertain.

Acknowledgements

I thank Ivan Hrdý, Milan Kafka, David Král, Jana Poborská, Václav Pociš, and Vladislav Šaňa of Prague for permission with specimens collected by them in Iran, Matúš Kocian for the habitus drawing of Hemiscorpius kraiši n. sp. 1st Pavel Krasný for the habitus drawing of Hottentotta zygosoma sp. n.; and Jii Zlinský (New Mexico Tech, Smo USA) for helping with the language.
A review of Chinese *Aphodius* species (Coleoptera: Scarabaeidae). Part 3|
description of two new *Agolus* species with a key to Chinese and
Himalayan species of this subgenus

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Abstract. Two new species, *Aphodius* (Agolus) *hengshuensis* sp. n. from Yunnan and *A. (A.) zangian sp. n. from Tibet, are described. Epipharyngeal structures and external male genitalia of all *Aphodius* Mulsant et Rey, 1869 species so far known from China, the Himalayas and Middle Asia (except *A. (A.) muntiyalvi* Pattnaik, 1988) are figured. Taxonomic position of *Neogolus* W. Koshtantschikov, 1912 is briefly discussed. Lectotypes for *Aphodius* (Agolus) *jalcaurus* W. Koshtantschikov, 1912, *A. (A.) haroldi* D. Koshtantschikov, 1994, and *A. (A.) zangian* W. Koshtantschikov, 1912 (all housed at Zoological Institute, Russian Academy of Sciences, St. Petersburg) are designated. A previously unpublished key to *Agolus* species known from China and the Himalayas is modified to include new species described here and species known from Middle Asia.

**Taxonomy, new species, lectotype designation, key, distribution, Coleoptera, Scarabaeidae, Aphodius, Agolus, Palaeartic region**

**INTRODUCTION**

The present part of the series of reviews concerning the Chinese *Aphodius* Illiger, 1798 species is a supplement to the first part (Kral 1995) dealing with Chinese and Himalayan representatives of the subgenus *Agolus* Mulsant et Rey, 1869. Since the first part (Kral 1995) I have the possibility to study further recently collected material from the regions under study resulting in new *Agolus* species described here. Study of the material deposited in the collections of the Zoological Museum of the Russian Academy of Sciences in St. Petersburg makes it possible to designate lectotypes and paralectotypes for some *Agolus* species described by Dmitriy or Wassil D. Koshtantschikov (Koshtantschikov 1894, 1912). The paper includes also a modified key for the *Agolus* species known so far from China, the Himalayas and Middle Asia.

**MATERIAL AND METHODS**

Terminology concerning epipharyngeal structures was adopted from Dellacasa (1983).

The following sources (after Arnott et al. 1993) identify the collections housing the material examined:

DKCP — Czech Republic, Praha, David Kral collection.
MNHG — Suess, Genève, Museum d'Histoire naturelle (Lobi).
ZMAS — Russia, St. Petersburg, Zoological Museum, Academy of Sciences (*B. M. Katavic, M. G. Volvickich*).

Specimens of the newly described species are provided with one red printed label: "[Name of a taxon] sp. n. HOLOTYPE, ALLOTYPE or PARATYPE with No. d, David Kral det. 1997". In the case of lectotype and paralectotype designation, each specimen bears a red printed label: "[Name of a taxon], LECTOTYPE or PARALLECTOTYPE with No. d, David Kral design 1997". Exact label data are cited for the types only, separate labels are indicated by slashes (/). Author's remarks and supplementations are found in square brackets, [p] — preceding data within quotation are printed, [i] — the same but handwritten, MS — manuscript, HT — holotype, PT — paratype.
SYSTEMATIC PART

*Aphodius (Agollus) hengdunensis* sp. n.
(Figs 1, 13, 14)

**Type Material.** Holotype and paratypes Nos 1, 2—male, labelled "YUNNAN, 28 vi [19]96, 28°20'N 98°59'E, 4400-4500 m: Hengdun mts—part BAIMA" Deposted in DKCP

**Description.** Male. Body length 3.5–3.7 mm, H/T—3.6 mm. Body subparallel, moderately convex, moderately shiny, with microreticulation. Colour reddish brown, disc of head, antennal club, pronotum except for anterior and lateral parts, and elytral suture darkened. Dorsal surface entirely bare.

Head almost semicircular, anterior clypeal margin broadly sutured at middle, anterior angles widely rounded, almost indistinctly upturned, sides regularly broadly rounded, notched before genae. Genae rounded, lateral margin almost straight, distinctly exceeding eyes outwards, with several light, long setae. Clypeal surface moderately depressed near anterior angles, medial frontal hump only slightly pronounced, with microreticulation, frontal suture not visible. Punctures simple, coarse, moderately irregularly spaced, separated by more or less their diameter posteriorly in occiput becoming rather finer and sparse.

Epharynx (Fig 1). Epistoma and peneotomae slightly sclerotized. Epistoma broad, nearly square-shaped, with transversal group of numerous sensillae basally. Helus bare Cophya with 2 very long and thick medial setae and 3–4 relatively shorter and thick lateral setae. Chaetotaxy with 2–3 irregular rows of thick short setae gradually decreasing in size posteriorly. Chaetotaxy and aeroparia with numerous long setae.

Pronotum moderately convex, wide subparallel, scarcely narrowed anteriorly, anterior angles rounded, slightly projecting anteriorly, sides weakly diverging over anterior third, then almost straight, subparallel, posterior angles broadly rounded. Anterior margin and base with out margline lines, lateral margin distinctly bordered, marginal line extending basally along posterior angle, reaching elytral suture. Surface with microreticulation, punctuation simple, consisting of coarse, rather irregularly spaced punctures, separated by once to about twice their diameter, discally intermixed with several fine ones.

Scutellum triangular, longer than wide, unpunctate.

Elytra only very slightly dilatate posteriorly, widest just behind middle, humerus not dentate. Striae distinctly impressed, striae punctures only very slightly crenating intervals margins regularly spaced, separated by about once their diameter. Intervals flat, microreticulate, with fine punctures arranged in two irregular longitudinal rows, narrow interval 1 only slightly as gustate apically.

Macropterus, wings functional.

Prothorax with three wide, distinctly protruding external teeth and group of four external denticles basally, ventromedial edge with row of small denticles equal in size, terminal spur stout, long, acute apically, bent anteroventrally, inserted approximately against middle tooth, reaching about 0.3 of protarsomere 2. Apical margin and two well expressed transversal carinae of meso- and metathorax finintegrate with strongly unequal setae. Basimetasoma is distinctly shorter than upper terminal spur, lower terminal spur simply pointed. Basimetasomere hardly shorter than upper terminal spur and subequal to next three metatarsomeres combined.

Aedeagus. See Figs 13, 14.

Female unknown.

**Differential Diagnosis.** *A (A) hengdunensis* sp. n is closely related to *A (A) takin* Král, 1996 (see Discussion) and is distinguished from it by having the following diagnostic characters.
relatively smaller (body length 3.5–3.7 mm) and paler species, head convexity, pronotum, elytra with microreticulation and only moderately shiny, basimeso- and basimetratermes more short than upper terminal spur, different shape of parameres (Figs 13, 14), and different epipharyngeal structures (Fig. 1). In comparison A (4) taken exerts the following characters relatively larger (body length 5.8–6.4 mm) and dark color, dorsal surface without microreticulation, entirely shiny, basimeso- and basimetratermes equal in length to upper terminal spur, different shape of parameres (Figs 15, 16) and different epipharyngeal structures (Fig. 3). For differentiation from other Chinese and Himalayan species see the key below.

Collection circumstances All the three specimens were collected in an alpine zone from unconsolidated stones on northern extremely steep slope ca 2–5 m from snow fields together with Carabus wagneri Fairmaire, 1882 and Nebria sp. (Carabidae).

Name derivation The new species is named in reference to the area of its origin, the Hengduan mountains.

*Aphodius (Agolius) takin* Król, 1995
(Figs 3, 15, 16)

*Aphodius (Agolius) takin* Król, 1995 102, 105–107, figs. 1–4 (Fig. 1–4 erroneously figured epipharynx of *A. (Parachryso) impressimaculatus* Fairmaire, 1888)

**Type locality** China, Sichuan, 50 km NEE Songpan (Król 1995)

**Epipharynx** (Fig. 3) Epttorma and paramorosae only very slightly sclerotized. Epttorma broad not distinctly separated laterally from chaetopodium, and with transversal group of numero sensillae basally. Helus with 8–9 short and thick setae. Corypha with 4–5 long and thick setae. Chaetopodia with 2–3 irregular rows of long and thin setae gradually decreasing in size posttidally. Chaetopodia and acroptera covered with numerous long and fine microtrichiae. Acalathopera with 1–3 long and thin setae.

*Aphodius (Agolius) zangbo* sp. n.
(Figs 2, 8, 11, 12)

**Type material.** Holotype and paratype – both males, labelled China, E-Tibet (=Xizang), 19–28 6° ‘08 [1995], Mt N Nyingchi, 29° 56’–45° 39° 57’ 2’, 3900–4600 m. Deposited in DCP.

**Description.** Male. Body length 3.8 mm (HT) and 4.0 (PT). Body subparallel, strongly convex, shiny, without microreticulation. Colour blackish, anterior margin of elytrae and anterolateral area of pronotum, and scutellum brownish. Elytron with pale discal area, interval 1, humeral area, area along lateral margin reddish brown, and the following dark, almost black pattern: (i) short oblong basal spot in interval 5 reaching completely base, (ii) oblique discal spot reaching completely base in interval 4 basally, and approximately 0.75 of elytral length in interval apically, (iii) oblique lateral spot in intervals 5–8, extending to humeral umbone basally and same distance as discal one, apically (Fig. 8).

Head almost semicircular, clypeal margin broadly, shallowly sinuate at middle anterior angles widely rounded, almost definitely upwardly, sides regularly broadly rounded notched before genae. Genae rounded, distinctly exceeding eyes externally. Clypeal surface moderately depressed near anterior angles, medial convexity only slightly pronounced, frontal suture indicated by short medial line. Punctuation consisting of coarse, dense, irregularly distributed, rather fused punctures, punctures posteriorly of frontal suture finer, not fused, separate by approximately their diameter.
Epipharynx (Fig. 2). Epitorma and pternotormae slightly sclerotized. Epitorma broad, nearly quadrate-shaped, with transversal group of numerous sensillae basally. Helus with numerous short and thick setae. Corypha with 4 very short and thick setae. Chaetoparia with longitudinal group of short and thick setae in anterior half, with 2–3 irregular rows of very short and thick setae posteriorly, and with several long and thin setae along lateral margin. Chaetopodium with numerous long microtrichiae. Acroptaria and acaenoparia with numerous long and fine setae. Ipophoba with 4–5 short and thin setae.

Pronotum strongly convex, almost parallel-sided; anterior angles rounded, almost not projecting anteriorly; sides broadly rounded up to broadly rounded posterior angles. Anterior margin and base without marginal lines, lateral margin distinctly bordered, marginal line extended basally along posterior angle, reaching elytral stria 5. Punctuation simple, consisting of coarse, deep, moderately irregularly distributed punctures, mostly separated by approximately their diameter; basally and laterally punctuation becoming rather sparser, finer and more irregularly spaced.

Scutellum triangular, longer than wide, with several coarse punctures.

Elytra convex, only very slightly dilate posteriorly, widest just behind middle, humerus finely denticulate. Striae distinctly impressed, strial punctures distinctly creasing intervals margins, regularly distributed, separated by about their diameter, punctures becoming denser apically. Intervals almost flat, with fine punctures arranged in two irregular longitudinal rows; narrow interval 1 convex and only slightly angustate apically.

Macropterus, wings functional.

Protibia with three wide, distinctly protruding external teeth and group of 4–5 external denticles basally; ventromedial edge with only 2–3 subobsolete denticles; terminal spur stout, long, acute apically, bent moderately anteroventrally, inserting approximately against medial external tooth, reaching hardly 0.3 of protarsomere 2. Apical margin and both well pronounced transversal carinae of meso- and metatibiae fimbriate with strongly unequal setae. Basitrodistarsomere equal to upper terminal spur, lower terminal spur simply pointed. Basitrodistarsomere hardly longer than upper terminal spur and subequal to next three tarsomeres combined.

Aedeagus. See Figs 11, 12.

Female unknown.

DIFFERENTIAL DIAGNOSIS. The new species is similar to A. (A.) takin and A. (A.) hengduanensis sp. n. (see Discussion). It differs from these two species in the following diagnostic characters: body strongly convex, elytra bicoloured with blackish pattern (Fig. 10), punctuation of pronotum simple and of uniform shape of parameres (Figs 11, 12) and epipharyngeal structures (Fig. 2), of the two compared species body only moderately convex, elytra unicoloured without blackish pattern, punctuation of pronotum double, coarse intermixed with fine, different shape of parameres (Figs 13–16) and epipharyngeal structures (Fig. 1 and 3). For the differentiation from other species known from China and the Himalayas see the key below.

COLLECTION CIRCUMSTANCES. Both type specimens were collected from dung (probably of yak) on an open alpine pasture at elevation of approximately 4200 m.

NAME DERIVATION. “Zangbo” is the Tibetan name for the Brahmaputra river running through the area of the type locality, noun in apposition.
Aphodius (Agolius) falcispinus W. Koshantschikov, 1912
(Figs 7, 9, 10)


Aphodius (Melanogolius) falcispinus Reitter, 1872: 237, nec Waterhouse, 1875: 85


Restricted type locality: "In den Bergen des Chinischen Turkestan" (Dellacasa 1983)

Type material examined: Lectotype and 3 paralectotypes, all males, by present designation: "Polu Grombo[e]wski 20 IV (19) 30 [h] / Neogolius / falcispinus / [W Koshantschikov’s MS] det W. Koshantschikov [p]". All specimens in ZMAS.

Other material examined: China: Arno 1884 Prawulsky, 3 males, Arno 1884 Prawulsky / Mont Prawulsky / 1 IV 295/5 5900–8000, 2 males, Arno 1886 G Prawulsky, 3 males, Central Asia Arno, 1 male. All specimens in ZMAS.

Epharynx: (Fig 7) Epitoma and peritomae only very slightly sclerotized. Epitoma not distinctly separated laterally from chaetopodum. Helus with several sensillae. Corypha with 6 short and thich setae. Chaetopodum with internal row of long and thin setae gradually decreasing in size toward crests, and two more or less irregular rows of shorter and thinner setae. Chaetopodum in addition to numerous microtrichae with 6–7 thick setae. Acroterum with long, thin setae. Acanthopara with thin and relatively shorter setae. Hoplopha with group of very short and fine setae.

For further material examined see Král (1995).

Aphodius (Agolius) haroldi D. Koshantschikov, 1894
(Figs 4, 17, 18)


Type locality: Kámen – Gebärge (Koshantschikov 1894)


Other material examined: Kazakhstan: Isleyk-kul Kámen Gebärge, 5 males, 1 female in ZMAS.

Epharynx: (Fig 4) Epitoma and peritomae slightly sclerotized. Epitoma broad with distinctly concave lateral margins, and with group of numerous fine sensillae basally. Helus with group of numerous microtrichae. Corypha only with 2–3 short and thick setae. Chaetopodium in anterior third with row of 7–8 short and thick setae, gradually decreasing in size posteriorly, and with large group of numerous fine and thin setae medially and posteriorly. Chaetopodium anteriorly with 4–5 long and thick setae, posteriorly with longitudinal group of numerous...
short and thick setae. Acanthoparia with 2–3 long and thick setae. Ipophoba with group of microtrichiae.

For further material examined see Král (1995).

**Aphodius (Agolius) intersittialis** D. Koshantschikov, 1894

(Figs 6, 21, 22)

*Aphodius (Holmes) intersittialis* D. Koshantschikov, 1894; Schmidt, 1922: 168, 182; Balitshans, 1964: 219, 239–240

*Aphodius (Holmes) intersittialis* Nikolayev, 1980: 65; 1987: 113,


**Type Locality.** Varsaut, Jagnob (Koshantschikov 1894).

**Type Material Examined.** Tajikistan [p]; Gissarshki area. [nats.] Roni (correctly Romei) - 1200 m 21. V [197] leg. J. Pawlowsk [h; poratypa]; [yellow label] / *Aphodius* (Agolius) robustus sp. n. det. Z. Stebracka [p], 3 females in MHNG.

**Further Material Examined.** Tadjikistan: Penm, Chorokhi, 20.08.1971, leg. V. Mikhailov [label written in Cyrillic script], 1 male in DKCP; kpr. Pave 1 [nats.] Garishkou, 15.06.1969, leg. V. Chkaraunov [label written in Cyrillic script], 3 males in ZMAS.

**Epipharynx** (Fig. 6). Epitorma and epimertormae only very slightly sclerotized. Epitorma broad not distinctly separated laterally from chaetopodium, and with transversal group of numerous sensillae basally. Helus bare. Corypha with two very long and thick medial setae and two relatively shorter and finer lateral setae. Chaetoparlia only with row of 4–5 very short, but relatively thick setae in anterior half. Chaetopodium and acroptaria with numerous long microtrichiae. Acanthoparia with one long and thick seta. Ipophoba with 2–3 fine short setae.

**Aphodius (Agolius) orinus** W. Koshantschikov, 1912

(Figs 5, 19, 20)


*Aphodius (Engolius) haroldl ab. orinus* M. Dellebasa, 1986: 386.

*Aphodius (Agolius) orinus* Král, 1995: 104–105, figs 5, 6 (type n)

**Type Locality.** Himalaya Gebiet, Rotang Pass (Koshantschikov 1912).

**Type Material Examined.** Lectotype and paralectotype No 1 males, by present designation: "Rotang Pass [h] / Ag. Haroldl var. orinus 6 m / W. Koshantschikov MS det. W. Král 2010 [p]; paralectotype No 1, male, by present designation: "Kashmir 1965 [h, yellow label] / Ag. Haroldl var. orinus 6 m / W. Koshantschikov MS det. W. Koshantschikov [p]; All in ZMAS.

**Other Material Examined.** India; NW-India; Himachal Pradesh (ca 40 km N of Manali), btw. Manali / Rotang pass, alp meadow, 3900–3800 m, 18 VI 1996, K & B Blózynę [leg.], 1 male in DKCP.

**Epipharynx** (Fig. 5). Epitorma and epimertormae slightly sclerotized. Epitorma broad, about pentagonal-shaped, with transversal group of numerous sensillae basally. Helus bare. Corypha with 5–6 long and thick setae. Chaetoparia with row of 6–8 thick setae in anterior half and longitudinal group of numerous microtrichiae posteriorly of proplegmatium. Chaetopodium with 5–6 thick setae gradually decreasing in size posteriorly, and numerous relatively long microtrichiae. Apophoba with 2–4 very short and stout setae. Acanthoparia with 3–4 setae gradually decreasing in size laterally.

For detailed redescription and further material examined see Král (1995).
Key to *Agelius* species known from China, the Himalayas and Middle Asia

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(2)</td>
<td>Prenotum base completely bordered. Terminal spur of pronotum in male falciform, strongly bent ventrally. China: Gansu, Qinghai, Xinjiang; Kazakhstan, Mongolia and southern parts of Siberia</td>
<td><em>A. (A.) falciferus</em> W. Koshtatschikov, 1912</td>
</tr>
<tr>
<td>2(1)</td>
<td>Basal border of pronotum at middle broadly interrupted. Terminal spur of pronotum in male simply acute, only slightly bent ventrally</td>
<td></td>
</tr>
<tr>
<td>3(8)</td>
<td>Anterior clypeal margin distinctly sinuate medially. Genae markedly protruding externally, distinctly separated by space from clypeus. Females unknown</td>
<td></td>
</tr>
<tr>
<td>4(5)</td>
<td>Head convexity, pronotum and elytra with microreticulation, only moderately shiny. Basisternal and basisternal semeare shorter than upper terminal spur of meso- and metatibia, resp. China: Yunnan</td>
<td><em>A. (A.) hengduanensis</em> sp. n</td>
</tr>
<tr>
<td>5(4)</td>
<td>Dorsal surface without microreticulation, comparatively more shiny. Basisternal and basisternal somere equal to or hardly longer than upper terminal spur of metatibia</td>
<td></td>
</tr>
<tr>
<td>6(7)</td>
<td>Body moderately convex, elytra unicoloured without blackish pattern. Punctuation of pronotum double coarse, interrupted with fine. China: Shansi</td>
<td><em>A. (A.) yakhs Krall, 1925</em></td>
</tr>
<tr>
<td>7(6)</td>
<td>Body strongly convex, elytra bicoloured with blackish pattern (Fig. 10). Punctuation of pronotum simple and coarse. China: E Xiang</td>
<td></td>
</tr>
<tr>
<td>8(3)</td>
<td>Anterior clypeal margin subtruncate, not or very slightly sinuate. Genae not so markedly protruding externally, not separated by space from clypeus</td>
<td><em>A. (A.) zangbo</em> sp. n</td>
</tr>
<tr>
<td>9(10)</td>
<td>Elytra with microreticulation, almost alutaceous. Himalayas (Uttar Pradesh)</td>
<td><em>A. (A.) ornus</em> W. Koshtatschikov, 1912</td>
</tr>
</tbody>
</table>

Fig. 23. Map with known distribution of the subgenus *Agelius* Muller et Rey in China, the Himalayas and adjacent areas.
The subgenus Agolius contains presently, including two new species described here, 31 taxa (23 species and 8 subspecies), all confined to the Alpine areas of the Palaeartic region (Dellaccia 1988, Kraft 1995, Pittino & Bailerio 1994, 1996). A. (A.) fulcispinis is the only hitherto known species preferring other biotopes such as lowlands pastures of Central Asia.

Seven species are presently known from China, the Himalayas, and Central and Middle Asia. These species can be divided from morphological point of view in the following three groups also approximately corresponding to the zoogeographical aspect (see the map in Fig. 23):

1. **group 1** (A. hengduanensis sp. n., A. takin, A. zangbo sp. n.)
   - clypeus rounded, distinctly emarginate anterely
   - genae separated by smooth from clypeus
   - pronotum without basal margin line
   - terminal spur in male prothorax simply acute
   - eastern and southeastern part of the Tibetan plateau (Sichuan, Yunnan)

2. **group 2** (A. fulcispinis)
   - clypeus rounded, not emarginate anterely
   - genae not separated by smooth from clypeus
   - pronotum base completely bordered
   - terminal spur in male prothorax falciform
   - Central Asia (Mongolia and adjacent regions, southernmost to NE Xizang)

3. **group 3** (A. haroldi, A. interstitialis, A. montisjulidi, A. arinus)
   - clypeus subtruncate, not emarginate anterely
   - genae not separated by smooth from clypeus
   - pronotum without basal margin line
   - terminal spur in male prothorax simply acute
   - Middle Asia (Pamir–Alai and Tan Shan mountain system), western Himalayas

All the three groups possess relatively uniform epipharyngeal structures (see Figs 1–7) and shape of aedeagus (see Figs 9–22). Parameres are simply built, straight, anteriorly more or less bent anteroventrally, apex simply pointed. The only exception is manifested in A. (A.) montisjulidi Pittino 1988 having parameres with outstanding apical membrane appendices (Pittino 1988: figs 7, 8). Species inhabiting rest of the areal (mountainous areas of Europe, the Caucasus, and northeastern Turkey) seem to be mostly related to group 3, representatives of which display most of the characteristic features (mentioned in group 3) to be the same. However, shape of parameres is very complicated in several species and some of them possess terminal spur of prothorax of different shape or anterior clypeal margin subinsectiform (see Dellacasa 1983: 131–138, 317–341; figs 183–207, 728–796).

In 1912, the subgenus Neagolius was erected by W. Koshantschikov for single species Aphe- dius fulcispinis W. Koshantschikov, 1912 based on completely bordered basal margin of promo-
tum and terminal protubial spur in male being falciform. This concept is also accepted in the monograph by Schmidt (1922), Balthasar (1964) and Mariani (1979) consider for mentioned species only the subgenus Agolius (= Neagolius). On the other hand, Dellacasas (1983, 1988) and authors of some further papers not concerning the species spectrum from the whole distribution area distinguish the subgenus Agolius with A. abaxiatus Bonelli, 1812 and A. bonninsiard Hérald, 1860 with terminal protubial spur in male short, not robust — reaching not to base of protarsomere 2, and with marginal line of pronotal base reaching to elytral humerus) and the subgenus Neagolius (rest of species spectrum sharing terminal protubial spur in male long and robust — reaching to middle of protarsomere 2, and marginal line of pronotal base reaching approximately to elytral stra 5). Representatives of above groups 1 and 3 have terminal protubial spur in male of transitional nature being simply acute and relatively short (reaching mostly to 0.3 of protarsomere 2). The shape of parameres and epipharyngeal structures of individual species also display no distinct dividing line justifying the existence of two separate subgenera. A. falcispinus, the type species of the subgenus Neagolius, is the only relatively more different species with completely bordered pronotal base (not expressed in any other known species of the group) and with falciform terminal protubial spur. In addition this species is not known to inhabit habitats at high elevation.

Based on the current knowledge of morphology of the species discussed the group can be appreciated (perhaps except for A. falcispinus) as homogeneous and therefore it is treated as one subgenus Agolius (= Neagolius) in the present paper. In addition it must be said, that the area of China and the Himalayas is, with regard to current inadequate knowledge in alpha-taxonomy, much richer in species than it is seen from enumeration of so far described species (22 : 7 for species inhabiting Europe, the Caucasus and Turkey). An adequate interpretation of phylogenetical relations would be satisfactorily resolved only after discovery of further Agolius species inhabiting these areas of high mountains.

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Metazoan parasites of fishes from the section of the Vltava River supposed to be affected by the operation of the Temelin nuclear electric power-station, Czech Republic

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Abstract. Between 1986 and 1988, a total of 357 fishes of 15 species collected from the Vltava River near the site of the planned discharge of heated effluent water from the Temelin nuclear power-station (South Bohemia, Czech Republic), were examined for the presence of metazoan parasites. A total of 38 species of metazoan parasites were recorded. The most numerous were monogeneans represented by 28 species of 6 genera (Dactylogyroidea, Gyrodactyloidea, Ancycrocephaloidea, Telemothida, Diphyllobothriidea, Paragonimidea). Other recorded ectoparasites were the leech Piscicola geometra, the trematode Echinostoma revolutum and Argulus foliaceus and occasionally glocida larvae of clams. The endoparasites fauna comprised 10 species of adult cestodes from 6 genera (Caryophyllidea, Bothoidea, Khawia, Triuncophora, Heterocephalidea, Proteocephalidea), 6 species of adult and larval trematodes belonging to 5 genera (Rhabdocoela, Phyllodistomum, Busodera, Diplostomum, Cotylurus), 7 species of adult nematodes of 5 genera (Contracotyloidea, Haplobothria, Philometra, Camallanus, Hapalodiplosis), and 3 acanthocephalan species of the genera Acanthocephaloidea and Notocotylidea. Dactylogyra acheiroides, Dactylogyra similis, Gyrodactylus kühneri and Paragonimus allanti were recorded from the Czech Republic for the first time. Dactylogyra simulans, Dactylogyra kühneri and Philometra kutinae were not previously known from the Elbe River drainage system in the Czech Republic. The relative poor parasite fauna of fish, particularly the trematode fauna, reflected the influence of considerable pollution and eutrophication in the section of river under investigation. These unfavourable conditions probably resulted in a substantial elimination of the mollusc intermediate hosts of trematodes. Qualitative and quantitative changes in the composition of the parasite fauna of fishes in this river section can be expected, due to ecological changes caused by the operation of the nuclear power-station.

Metazoan parasites, fish, water pollution, nuclear power-station, Temelin, Czech Republic

INTRODUCTION

In view of the high density of settlement and considerable agricultural activity in the Czech Republic, the industrial application of nuclear power requires detailed environmental impact assessment during the construction and operation of power-stations. Since these problems are of a priority social interest, considerable attention has been paid to them. In connection with the construction of the nuclear power-station Temelin in southern Bohemia, the Institute of Parasitology of the then Czechoslovak Academy of Sciences participated in coordinated broad investigations within the framework of the agreement between the then Czechoslovak Commission for Atomic Energy and the Czechoslovak Academy of Sciences. One research project was designed to study the influence of temperature pollution and eutrophication of water on qualitative and quantitative changes in the composition of the parasite fauna of fish.

The influence of heated waters on the parasite fauna of fishes has been reported previously in connection with the construction of large electric power-stations. Numerous papers have ap-
peared in recent years, mainly dealing with the presence of the parasite fauna in fish cultured in heated freshwater or brackish-water reservoirs and the influence of this environment on the seasonal cycles of the occurrence and maturation of fish parasites. Such publications have originated, for example, in Poland (Grabda-Kazubiska 1974, Pojmanska et al. 1980, Pojmanska 1984a,b, 1985a,b, Pojmanska & Dzika 1987), Russia (Strizhak 1972, Golovin 1977), Sweden (Thulin 1980, Holmgren & Thulin 1989), USA (Hure 1976) or Brazil (Kohn & Fernandes 1988, Kohn et al. 1988). Influence of water pollution on the parasite fauna of fish and the use of fish parasites as biindicators of water quality are dealt with, for example, in the papers by Möller (1987), Khan & Thulin (1991), Koskivaara et al. (1991), Kuperman (1992), Poulin (1992), Bucke (1993), Gelnar et al. (1994) and MacKenzie et al. (1995).

Temelin nuclear power-station will be supplied by cooling water from the newly built reservoir Hříškovice. The outlet waters, the temperature of which should be up to 33 °C during summer, will be released into the Vltava River near the village of Nezmaňov. During a maximum release, the water temperature in this section of the Vltava has been forecast to increase by 2.2 °C in the summer and 5.5 °C in the winter, however, because of poor mixing, there is expected to be an accumulation of warm water on the surface and, consequently, a greater increase in temperature in the upper layers of the water.

In addition to an increase in water temperature, there is another factor that will apply in the connection with the construction and operation of the power-station, which may influence both its ichthyofauna and the fauna of other aquatic organisms. At the time of this investigation, the Vltava River in the region of České Budějovice was highly polluted, mainly by outlet waters of the paper mill at Větrní, so that the water quality in the river was not adequate for use by the power-station. A new waste-water treatment plant has been built recently at Větrní, which has improved considerably the water quality of the Vltava. Probably, this will reflect in the presence of more species of both fish parasites and their hosts.

In view of these facts, it was decided to study changes in the parasite fauna of fishes in this locality at three stages: 1. recording the state of the parasite fauna of fishes in the Vltava River section under investigation before construction of the waste-water purifying plant; 2. recording changes in the parasite fauna following launch of the purification plant; and 3. study of the composition of the parasite fauna following putting the Temelin nuclear electric power-station into operation.

In 1986, work on the first stage was initiated by two research teams of the Institute of Parasitology of the then Czechoslovak Academy of Sciences. Ichthyoparasitological investigations were carried out over an approximately five-kilometre long section of the Vltava River near the village of Nezmaňov, where the electric power-station effluent will be released into the river. Both protozoan and metazoan parasites were studied (protozoans were investigated by the research team headed by Jiří Lom). Since little attention has been paid to the parasite fauna of fishes in the Vltava River, especially in the region of South Bohemia, and because the existing data are often based on occasional findings, it was necessary to obtain new, original data for the evaluation of the current state of the occurrence of fish parasites. The present paper reports the results relating to fish metazoan parasites. Details of this work can be found in the unpublished project report by Moravec et al. (1988).

MATERIAL AND METHODS

Fishes for parasitological examinations were obtained from an approximately 5 km long section of the Vltava River near the village of Nezmaňov (Fig 1), mostly by electrofishing, less often by angling. Fish samples were taken monthly throughout the year. The most numerous fish in the samples was bream, Abramis brama (the most frequent fish species in the locality), in
which we tried to follow possible seasonal changes in the populations of its parasites, in addition to recording the qualitative composition of its parasite fauna. From 1986–1988, a total of 365 fish specimens belonging to 15 species of 4 families were examined from this locality. The numbers of individual fish species sampled varied with locality. The numbers of fishes examined for the presence of endoparasites and ectoparasites were different, because time constraints meant that not all of the fishes examined for endoparasites could also be examined for ectoparasites and vice versa.

Immediately after the catch fish were transported in barrels in the original river water to the Institute of Parasitology in České Budějovice, where they were killed, then examined within 2 days for the presence of metazoan parasites by standard helminthological methods. The following 15 species of fishes were examined (the first figure gives the number of fish specimens examined for endoparasites, the second one those examined for metazoan ectoparasites): Cyprinidae: *Abramis brama* (L.) = 15/120, *Blicca bjoerkna* (L.) = 10/5, *Alburnus alburnus* (L.) = 30/25, *Aspius aspius* (L.) = 5/4, *Leuciscus cephalus* (L.) = 40/41, *Leuciscus leuciscus* (L.) = 37/5, *Rutilus rutilus* (L.) = 48/40, *Sardina erythrophthalmus* (L.) = 2/2, *Carassius carassius* (L.) = 1/1, *Cyprinus carpio* L. = 4/10, *Osthe gobio* (L.) = 2/2, *Esox lucius* L. = 7/5, *Anguilla anguilla* (L.) = 3/3, *Percidae: Perca fluviatilis* L. = 39/32, *Scardinius erythrophthalmus* (L.) = 10/11. A total of 357/366 fish specimens were examined from this locality.

Parasites of individual groups were fixed and further processed using current helminthological methods. The parasite material is deposited in the helminthological collection of the Institute of Parasitology, Academy of Sciences of the Czech Republic, in České Budějovice.

Fig. 1 Map of the Vltava River section under study. Figures 1 and 2 show sites of catching fishes.
RESULTS

A total of the following 88 species of metazoan parasites were found in fishes of the Vltava River section under investigation in 1986–1988.

Monogenea

1. Dactylogyrus achmerowi Guße, 1955
   Host: Cyprinus carpio; localization: gills; prevalence: 10% (1 fish infected/10 fishes examined); intensity: 13 specimens. In September.

2. Dactylogyrus auriculatus Nordmann, 1832
   Host: Abramis brama; localization: gills; prevalence: 29% (15/120); intensity: 1-48. From March to August.

3. Dactylogyrus cordus Nybelin, 1936
   Host: Leuciscus leuciscus; localization: gills; prevalence: 40% (2/25); intensity: 2-5. In October.

4. Dactylogyrus crucifer Wagener, 1857
   Host: Rutilus rutulus; localization: gills; prevalence: 50% (10/20); intensity: 2-20. From March to November.

5. Dactylogyrus diformis Wagener, 1857
   Host: Sardinia erythrophthalmus; localization: gills; prevalence: 50% (1/2); intensity: 4. In September.

6. Dactylogyrus distinguendus Nybelin, 1937
   Host: Abramis brama; localization: gills; prevalence: 1% (1/120); intensity: 1. In August.

7. Dactylogyrus extensus Mueller et Van Cleave, 1932
   Host: Cyprinus carpio; localization: gills; prevalence: 70% (7/10); intensity: 4-137. Throughout the year.

8. Dactylogyrus falcatus (Wedl, 1857)
   Host: Abramis brama; localization: gills; prevalence: 18% (22/120); intensity: 1-16. Throughout the year. Also in Rutilus rutulus; prevalence 3% (1/40); intensity: 1. In September.

9. Dactylogyrus fallax Wagener, 1857
   Host: Rutilus rutulus; (L.); localization: gills; prevalence: 3% (1/40); intensity: 1. In March.

10. Dactylogyrus folkmannae Ergens, 1956
    Host: Leuciscus cephalus; localization: gills; prevalence: 20% (8/41); intensity: 1-10. In February, June and September.

11. Dactylogyrus fratermus Wagener, 1909
    Host: Alburnus alburnus; localization: gills; prevalence: 74% (20/27); intensity: 1-19. Throughout the year.

12. Dactylogyrus micracanthus Nybelin, 1937
    Host: Leuciscus cephalus; localization: gills; prevalence: 2% (1/41); intensity: 1. Also in Rutilus rutulus; 3% (1/40). 1. In March and October.

13. Dactylogyrus minor Wagener, 1857
    Host: Alburnus alburnus; localization: gills; prevalence: 41% (11/27); intensity: 1-5. Throughout the year.

14. Dactylogyrus minutus Kulwicie, 1927
    Host: Cyprinus carpio; localization: gills; prevalence: 10% (1/10); intensity: 10. In September.

15. Dactylogyrus manoides Guße, 1966
    Host: Leuciscus cephalus; localization: gills; prevalence: 27% (1/41); intensity: 1-4. Throughout the year.

16. Dactylogyrus namus Dogiel et Bychowsky, 1934
    Host: Rutilus rutulus; localization: gills; prevalence: 15% (6/40); intensity: 2-7. In spring, summer and autumn.

17. Dactylogyrus naviculodes Ergens, 1956
    Host: Leuciscus cephalus; localization: gills; prevalence: 2% (1/41); intensity: 1. In October.
18. *Dactylogyrus parvus* Wegener, 1909
   Host: *Alburnus alburnus*; localization: gills; prevalence: 3% (6/207); intensity: 1-4. In April, August and September.

   Host: *Leuciscus cephalus*; localization: gills; prevalence: 2% (1/41); intensity: 2. In October.

20. *Dactylogyrus rutilis* Gläser, 1965
   Host: *Rhodeus rutilus*; localization: gills; prevalence: 8% (3/40); intensity: 1-5. In spring and summer.

21. *Dactylogyrus similis* Wegener, 1909
   Host: *Rhodeus rutilus*; localization: gills; prevalence: 17.5% (7/40); intensity: 2-10. In March, April and September.

22. *Dactylogyrus sphyrna* Linstow, 1878
   Hosts: *Blicca bjoerkna*; localization: gills; prevalence: 100% (3/3); intensity: 1-5. In August. Also in *Rhodeus rutilus*; 5% (2/40); and *Abramis brama*; 3% (4/120); t-4. In late summer and early autumn.

23. *Dactylogyrus suecicus* Nybelin, 1937
   Host: *Rhodeus rutilus*; localization: gills; prevalence: 18% (7/40); intensity: 2-10. In March, April and September.

24. *Dactylogyrus tuba* Linstow, 1878
   Host: *Aestus apterus*; localization: gills; prevalence: 25% (1/4); intensity: 1. In September.

25. *Dactylogyrus vistulae* Prost, 1957
   Host: *Leuciscus cephalus*; localization: gills; prevalence: 22% (9/41); intensity: 1-5. From February to June and from September to October.

   Host: *Leuciscus cephalus*; localization: gills; prevalence: 7% (3/41); intensity: 1-2. In June and September.

27. *Dactylogyrus wunderi* Bychowsky, 1931
   Host: *Abramis brama*; localization: gills; prevalence: 4% (19/472); intensity: 8-32. From March to November.

28. *Dactylogyrus zandei* Bychowsky, 1933
   Host: *Abramis brama*; localization: gills; prevalence: 34% (41/120); intensity: 1-26. From March to November.

   Host: *Rhodeus rutilus*; localization: gills; prevalence: 15% (6/40); intensity: 2-8. From March to April and from July to September.

30. *Tetragonchus monneronii* (Wagener, 1857)
   Host: *Esox lucius*; localization: gills; prevalence: 100% (10/10); intensity: 7-151. From September to November.

31. *Ancyrocephalus paradoxus* Creplin, 1839
   Host: *Stizostedion lucioperca*; localization: gills; prevalence: 91% (10/11); intensity: 1-28. From February to April and from October to November.

32. *Ancyrocephalus percae* Jerga, 1966
   Host: *Perca fluviatilis* L.; localization: gills; prevalence: 6% (2/32); intensity: 1. In June and October.

33. *Gyrodactylus carassius* Malmberg, 1957
   Hosts: *Leuciscus cephalus*; localization: fins and gills; prevalence: 7% (3/43); intensity: 1-25. Also in *Alburnus alburnus*; 7% (2/27); t-4. In April.

34. *Gyrodactylus cyprini* Ditaro, 1964
   Host: *Cyprinus carpio*; localization: fins, skin and gills; prevalence: 10% (1/10); intensity: 67. In April.

35. *Gyrodactylus elegans* Nordmann, 1832
   Host: *Abramis brama*; localization: gills; prevalence: 16% (43/270); intensity: 1-372. From May to September.
36. *Gyrodactylus gobii* Shulman, 1953  
Host: *Gobio gobio*, localization: fins; prevalence: 50% (1/2); intensity: 22 in February.

37. *Gyrodactylus gobotensis* Gläser, 1974  
Host: *Gobio gobio*, localization: fins; prevalence: 100% (2/2); intensity: 6-27 in February.

38. *Gyrodactylus gracilisihamatus* Malmberg, 1964  
Host: *Leuciscus cephalus*, localization: fins; prevalence: 2% (1/44); intensity: 4 in April.

Host: *Cyprinus carpio*, localization: fins and skin; prevalence: 10% (1/10); intensity: about 1000 Also on *Raninus rutilis*; localization: fins, 3% (1/40), 2 in April.

40. *Gyrodactylus kearnii* Ergens, 1989  
Host: *Leuciscus cephalus*, localization: fins; prevalence: 3% (1/41); intensity: 1 in April.

41. *Gyrodactylus kherulensis* Ergens, 1974  
Host: *Cyprinus carpio*, localization: fins; prevalence: 10% (1/10); intensity: 1 in September.

42. *Gyrodactylus laevis* Malmberg, 1957  
Host: *Leuciscus cephalus*, localization: gills; prevalence: 2% (1/41); intensity: 1 in April.

43. *Gyrodactylus leuciscii* Žižnán, 1964  
Host: *Rutilus rutilus*, localization: fins, prevalence: 3% (1/40); intensity: 1 in February.

44. *Gyrodactylus lucii* Kulakowskaja, 1951  
Host: *Esox lucius*, localization: fins; prevalence: 20% (1/3); intensity: 2 in November.

Host: *Stizostedion lucioperca*, localization: fins, skin and gills; prevalence: 73% (3/11); intensity: from 2 up to several hundreds Also on *Percula flavolineata*, 16% (3/2); 1-2 in February, April, October and November.

46. *Gyrodactylus markuzkulensis* Gvozdev, 1950  
Host: *Gobio gobio*, localization: gills; prevalence: 100% (2/2); intensity: 1-3 in February.

47. *Gyrodactylus osoblachensis* Ergens, 1963  
Host: *Leuciscus cephalus*, localization: gills, prevalence: 2% (1/41); intensity: 1 in April.

48. *Gyrodactylus prostrae* Ergens, 1963  
Host: *Leuciscus cephalus*, localization: fins and gills; prevalence: 12% (5/41), intensity: 1-16. Also on *Leuciscus leuciscus*, 20% (1/5), 1, and *Rutilus rutilus*, 3% (1/40); 1 in February, April and October.

49. *Gyrodactylus vimbii* Shulman, 1953  
Host: *Abramis brama*, localization: gills and fins; prevalence: 10% (12/120); intensity: 1-246, From May to July.

50. *Gyrodactylus* sp. 1  
Host: *Gobio gobio*, localization: fins; prevalence: 50% (1/2); intensity: 1 in February.

51. *Gyrodactylus* sp. 2 (belonging to *G. vimbi* complex)  
Host: *Percina flavolineata*, localization: fins, prevalence: 3% (1/33); intensity: 1 in February.

52. *Gyrodactylus* sp. 3 (resembling *G. hronorus* Žižnán, 1964 considered a species inquirenda)  
Host: *Alburnus alburnus*, localization: gills; prevalence: 4% (1/27); intensity: 1 in June.

53. *Paradiplozoon alburni* Khotenovsky, 1982  
Host: *Alburnus alburnus*, localization: gills; prevalence: 4% (1/27); intensity: 2 in March.

54. *Paradiplozoon ergensi* (Pejčoch, 1968)  
Host: *Leuciscus cephalus*, localization: gills; prevalence: 22% (9/41); intensity: 1-17 From February to April and from September to October.
55. *Paradiplozoon homoion homoion* (Bychowsky et Nagibina, 1959)
Hosts: *Rutilus rutilus*; localization: gills; prevalence 30% (12/40); intensity 1-5. Also on *Leuciscus cephalus*; 40% (2/5); 1-2; and *Alburnus alburnus*; 48% (13/27), 1-16. From February to April and from July to September.

56. *Paradiplozoon pavlovskii* (Bychowsky et Nagibina, 1959)
Host: *Aspius aspius*; localization: gills; prevalence 59% (9/4); intensity 2-4. In March and September.

57. *Paradiplozoon sp.* (Diporopsae)
Hosts: *Buca bukowska*; localization: gills; prevalence 67% (2/3); intensity: 1. Also on *Leuciscus leuciscus*; 20% (1/5), 1-2. In September.

58. *Diplozoon paradoxum* Nordmann, 1832
Host: *Alburnus brama*; localization: gills; prevalence 60% (7/12); intensity: 1-16. From March to November.

**Cestoda**

59. *Caryophyllaeus brachycollis* Janiszewski, 1931
Host: *Leuciscus cephalus*; localization: intestine; prevalence: 2% (4/18); intensity: 1. In May.

60. *Caryophyllaeus fimbriceps* Ammenkova-Chiopina, 1919
Host: *Alburnus alburnus*; localization: intestine; prevalence: 3% (1/30); intensity: 1. In May.

61. *Caryophyllaeus laticeps* (Pallas, 1781)
Host: *Alburnus alburnus*; localization: intestine; prevalence: 25% (38/151); intensity: 1-4. From March to November.

62. *Caryophyllaeides femmica* (Schneider, 1902)
Hosts: *Rutilus rutilus*; localization: intestine; prevalence: 13% (9/84); intensity: 1-3. Also in *Leuciscus cephalus*; 6% (3/49), 1-3. In March, October and December.

63. *Khawia sinensis* Heil, 1935
Host: *Cyprinus carpio*; localization: intestine; prevalence: 50% (4/8); intensity: 1-6. In June and September.

64. *Bothrioccephalus lanceolatus* (Goeze, 1782)
Host: *Anguilla anguilla*; localization: intestine; prevalence: 33% (1/3); intensity: 5. In September.

65. *Triaenophorus nodulosus* (Pallas, 1781) plerocercoids
Host: *Percina flavissima*; localization: liver; prevalence: 5% (2/39); intensity: 1. In September.

66. *Proteocephalus torulosus* (Batsch, 1782)
Hosts: *Aspius aspius*; localization: intestine; prevalence: 67% (2/3); intensity: 3-32. Also in *Alburnus alburnus*; 2% (2/30); 1, and *Rutilus rutilus*; 4% (2/48). 1. From March to May.

67. *Proteocephalus macrocephalus* (Creplin, 1825)
Host: *Anguilla anguilla*; localization: intestine; prevalence: 33% (1/3); intensity: 6. In September.

68. *Proteocephalus sp.* juv.
Hosts: *Perca fluviatilis*; localization: intestine; prevalence: 3% (1/3); intensity: 1. Also in *Squaliobarbus lacoperus*; 10% (1/10). 1. In February and May.

**Trematoda**

69. *Phyllodistomum dogielii* Pigulewsky, 1953
Host: *Alburnus alburnus*; localization: urinary bladder; prevalence: 7% (2/30); intensity: 1. In May and August.

70. *Bunodera lacoperae* (Müller, 1776)
Hosts: *Squaliobarbus lacoperus*; localization: intestine and pyloric caeca; prevalence: 40% (4/10); intensity: 10-25. Also in *Perca fluviatilis*; 1, 5% (2/39); 3-17. In January, February, April and October.
71. Rhododendron ulmifolium (Ziegler, 1893)
Hosts: Paracolostomum luteum, localization: intestine, prevalence 18% (7/39), intensity 1–9. Also in Sturnodromus incopereca, 10% (1/10). In January, February, and October.

72. Cytolurus pleatus (Rudolph, 1882) metacercaria
Host: Abramis brama, localization: abdominal cavity, prevalence 2% (1/51). Intensity 1 in September.

73. Cytolurus platycephalus (Crepin, 1825) metacercaria
Host: Stizostedion luciperca, localization: abdominal cavity, prevalence 10% (1/10). Intensity 1 in February.

74. Diplodromus sp metacercariae

Nematoda

75. Philometra abdominalis Nybelin, 1928
Hosts: Leuciscus cephalus, localization: beneath mesentery of swimbladder (males and young females) and abdominal cavity (females), prevalence 33% (16/48). Intensity 1–69. Also in Leuciscus leuciscus, 33% (13). Intensity 1–26. In April and May.

76. Philometra ovata (Zeder, 1803)
Host: Anguilla anguilla, localization: beneath mesentery of swimbladder (males and young females) and abdominal cavity (females), prevalence 57% (86/151). Intensity 1–24. Blicca bjoerkna, 10% (1/10). Intensity 1–9. Rutilus rutilus, 3% (1/48). Intensity 1–26. Only males were recorded from the three last named hosts. Throughout the year.

77. Camallanus lacustris (Zoëga, 1776)
Hosts: Paracolostomum luteum, localization: intestine and pyloric caecum, prevalence 15% (6/39). Intensity 1–10. Also in Sturnodromus incopereca, 10% (1/10). In June, September, October, and December.

78. Rhabdocoelus denudatus (Dujardin, 1845)

80. Raphidascaris acus (Bloch, 1779)
Host: Esox lucius, localization: intestine, prevalence 2% (2/7). Intensity 1–2. In May and October.

80a. Raphidascaris acus (Bloch, 1779) larvae
Hosts: Abramis brama, localization: intestinal, prevalence 5% (15/31). Intensity 1. Also in Rutilus rutilus, 2% (1/48). In February, May, June, August, and September.

81. Pseudocapillaria lomnitorum (Dujardin, 1843)

Acanthocephala

82. Acanthocephalus anguillae (Müller, 1780)

83. Acanthocephalus lucii (Müller, 1776)
Hosts: Phoxinus phoxinus, localization: intestine, prevalence 28% (11/39). Intensity 1–9. Also in Sturnodromus incopereca, 10% (1/10). In January, February, April, June, and October.
84 *Neoechinorhynchus rudis* (Muller, 1780)
Hosts: *Abramis brama*, localization: intestine, prevalence 2% (3/151), intensity 1. Also in *Esox lucius*, 14% (1/7), 1 in May and November.

**Hirudinea**

85 *Piscicolia geometra* (Linnaeus, 1761)
Host: *P erso fluviatilis*, localization: fins, prevalence 6% (2/32), intensity 1 in January.

**Mollusca**

86 *Glochidiunm* sp (larva)

**Crustacea**

87 *Ergasilus sieboldi* Nordmann, 1832
Hosts: *Abramis brama*, localization: gills, prevalence 11% (13/120), intensity 1 *Aspis aspis*, 25% (1/4), 58 *Rutilus rutilus*, 2% (1/46), 6 *Esox lucius*, 20% (1/5), 11 *Stenosteus lucioperca*, 9% (1/11), 6 From March to May and from September to October.

88 *Argulus foliaceus* (Linnaeus, 1758)
Hosts: *Abramis brama*, localization: gills, prevalence 2% (2/120), intensity 1 *Cyprinus carpio*, 20% (2/10), 1-2 *Leuciscus cephalus*, 2% (1/41), 1 in April, May and September.

**Survey of examined fishes and their parasites**

**Esox lucius**
*Tetraocephalus mononemum*, *Gyrodactylus luciopercae*, *Raphidascaris acus*, *Neoechinorhynchus rudis*.

**Anguilla anguilla**
*Biparticeps claviceps*, *Protocephalus macrocephalus*, *Diplotrema sp.* met.

**Rutilus rutilus**
*Dactylogyrus crucifer*, *D. falcatus*, *D. fallax*, *D. macrocanthus*, *D. numus*, *D. ranus*, *D. simius*, *D. sphura*, *D. suecicus*,
*D. crassirhabda*, *Gyrodactylus keltamnenis*, *G. luciopercae*, *G. praeclara*, *Paradiplostomum heterophyes*, *Myxosoma canadense*, *Diplotrema sp.* met., *Phylometra ovata*, *Raphidascaris acus lary.*

**Leuciscus cephalus**

**Leuciscus leuciscus**
*Dactylogyrus cristatus*, *Gyrodactylus luciopercae*, *Paradiplostomum sp.* met., *Phylometra abdominalis*.

**Aspis aspis**
*Dactylogyrus cristatus*, *Paradiplostomum sp.* met., *Phylometra abdominalis*.

**Aspis aspis**
*D. leucas*, *Paradiplostomum prutenicum*, *Protocephalus p淖licatus*, *Diplotrema sp.* met., *Phylometra ovata*, *Ergasilus sieboldi*.

**Scardinus erythrophthalmus**
*Dactylogyrus difformis*, *Diplotrema sp.* met.
Alburnus alburnus

Gobio gobio
Gyrodactylus gobio, G. geotra, G. markabidentis, Gyrodactylus sp. 1.

Blennio lwoensis
Dactylogyrus sphyrnae, Paradiplostomum sp. juv., Philometra ovata, Rhabdocoelia minuscula, Acanthocephalus anguillae

Abramis brama

Cyprinus carpio

Perca fluviatilis
Ancyrocephalus percaris, Gyrodactylus lucoperca, Gyrodactylus sp. 2, Trichocephalus nodulosus plett., Proteocephalus sp. juv., Bunodera lucopercae, Rhipidocotyle illesne, Camallanus lucifugus, Acanthocephalus lucii, Piscicola geometra, Glochidium sp.

Stizostedion lucioperca
Ancyrocephalus lucoperca, Gyrodactylus lucoperca, Proteocephalus sp. juv., Bunodera lucoperca, Rhipidocotyle illesne, Diplostomum sp. met., Cotylurus platycephalus met., Camallanus lucifugus, Acanthocephalus lucii, Ergasilus sieboldii, Glochidium sp.

CONCLUSIONS

Examinations of 365 fish specimens of 15 species collected from the Vltava River section near the planned heated effluent from the Temelin nuclear power station, carried out in 1986–1988, revealed the presence of 88 species of metazoan parasites. The occurrence of several additional parasite species cannot, however, be excluded because only small numbers of some fish species were examined. Nevertheless, even these results give an idea of the general state of the fauna of metazoan parasites of fish in the study section of the Vltava River.

Monogeneans were represented by six genera: Dactylogyrus by 29 species, Gyrodactylus by 20 species, Ancyrocephalus by 2 species, Tetraonetes and Diplostomum each by one species and Paradiplostomum by four species. Most of them are host specific parasites, only some were found on more than one species of host fishes. Some of the present findings are remarkable, supplementing present knowledge about the geographical distribution of species. Dactylogyrus achmerowi and Gyrodactylus khenalens, two species found on carp were, for the first time, recorded from the Czech Republic (Gelnar & Lav 1991), as well as Paradiplostomum alburni and Dactylogyrus cf. cubelleri from bleak and ruff, respectively. Dactylogyrus falcatus is reported for the first time from the Elbe River drainage system.

The cestode fauna was found to be represented by ten species from six genera. Proteocephalus sp. juv. from perch-like fishes is probably P. percaris (Müller, 1780). The life cycles of these cestodes involve either oligochaetes or planktonic crustaceans as intermediate hosts.

In contrast to the cestodes, the trematode fauna appears to be rather species poor, formed of only three species of adult trematodes, Rhipidocotyle illesne, Physilostomum digactyl and Bun-
Acanthocephalans were represented by three species. Whereas both *Acanthocephalus* species, developing through the benthic isopod *Asellus aquaticus L.*, were rather frequent in fishes, *Neochinorhynchus rutilis*, utilizing ostracods as intermediate hosts, occurred only rarely.

Nematodes parasitic in fishes were represented by seven species from five genera *Philometra*, *Hartmannella*, *Rhabdochona* and *Camallanus* members develop through planktonic crustaceans (copepods), *Rhabdochona denudata* through ephemeropterans, and *Raphidascaris acus* utilizes mostly small corynods as intermediate hosts, the life cycle of *Pseudocapillaria tomentosa* has not yet been elucidated.

Metazoan parasites were recorded from all species of fishes examined. The highest numbers of species were found in *Leuciscus cephalus* (23), *Rutilus rutilus* (21) and *Abramis brama* (18), these fish species belonged to the most frequently caught fishes in the locality.

In view of the numbers of fishes examined in the course of the year, the seasonal cycles in occurrence and maturation could be followed only in a few parasite species, mostly those from *Abramis brama*. Pronounced seasonality was recorded, for example, in many ectoparasites of bream, mainly monogeneans. Of the endoparasites, the findings of some species, e.g. cestodes of the genus *Proteocephalus*, trematodes *Buodera lucoperca* or nematodes of the genus *Philometra* and *Raphidascaris acus*, showed distinct seasonal cycles in maturation, as observed in other localities.

It was possible to observe, on comparing with other localities, a certain decrease in the number of parasite species, particularly of endoparasites.

Even though a detailed ichthyological study has not been carried out in this locality, the poor fauna of fish parasites might be associated with both a disappearance or a strong reduction of populations of some previously frequent fish species, e.g. barbel, and with a qualitative and quantitative pooress of the fauna of some groups of aquatic invertebrates serving as obligatory intermediate hosts for many parasites, as a result of serious water pollution. This is probably the main cause of the conspicuously poor fauna of fish trematodes, the life cycles of which depend on the presence of mollusc intermediate hosts. Of course, it is necessary to take into account that, due to migrations, some fishes might acquire infection by parasite species recorded by us outside the Vltava River section under study, for example from the tributary streams or the upper part of the Orlik water reservoir.

Nevertheless, it can be expected that the improvement of living conditions for aquatic organisms in this section of the Vltava River after the start of working of the clarification plant at Větřní will result in a more diverse composition of the fish parasite fauna. Consequently, the fish parasite fauna might serve, to a certain degree, as an indicator of the water quality.

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Development of the female internal reproductive system in *Hyocoris cimicoides* (Heteroptera: Nepomorpha: Naucoridae)

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Abstract. Oogonial and gross morphology of ovaries and their ducts were studied in nymphal instars 1–5 and variously aged adult females of *Hyocoris cimicoides* L., 1758 of Central European populations. Ovarioles of instar 1 and 2 are not differentiated; the ovaries are formed by a homogenous mass of oogonia which is localized in the second abdominal segment. The onset of intensive growth of ovarioles was observed in the late instar 5 although ovarioles differentiated in instar 3 and they contained fully differentiated oocytes and oogonial syncytium connected with first egg chambers in instar 4. Growth of ovarioles and oogenesis are fully ceased during the overwintering quiescence (from late November to early March in the populations studied). Mature (chorionated) eggs start to appear from the first decade of April. The rudiments of lateral oviducts are apparent even in the first instar. Two ampullar invaginations of the ecdysial part of duct system (common oviduct and vagina & spermatheca) are discernible in nymphs from the instar 3. Spermatheca in its nearly definitive shape appears in the late instar 5. Structure and development of internal reproductive system in *Hyocoris cimicoides* is compared to available data on other aquatic bugs and morphological data are correlated with events of mating, oviposition and life cycle.

Development, morphology, histology, ovarioles, efferent ducts, oogenesis, life cycle, overwintering, sexual strategy, nymphs, adults, apomorphies, Heteroptera, Naucoridae

INTRODUCTION

Although the first precise comparative study dealing with the gross morphology and histology of internal reproductive systems of adults in some aquatic bugs was published before 60 years ago (see Larsén 1938), the available information on the development of nepomophan gonads and their ducts are yet relatively scarce in present time. Only Papáček & Soldán (1987) studied development of this system in detail in the one model species — *Notonecta glauca*. The mentioned authors summarized this published data on this subject as well.

*Hyocoris cimicoides* is a very common predaceous water bug of lentic biotopes. It is one of the only two Central European species (*Plea monticola* (Pleidae) is the second one) having an obligatory diapause. Adults usually overwinter in bottom habitats in completely inactive state (Papáček 1989). Spermatogenesis and development of the male gonads and their ducts has already described by Papáček & Gelhá (1989). The position and general arrangement of mature ovaries of *H. cimicoides* were studied by Larsén (1938). It is true that Rawat (1939) pointed out some ontogenetic aspects of reproductive organ in this species, but there was no complete information on the development of ovaries and of the effect of obligatory diapause on the reproductive events of this species in general. The present paper helps to fill this gap.
MATERIAL AND METHODS

Specimens of the tracter bug, *Heteropsylla cossoni*, both nymphs and adults, were collected from March 1994 to November 1996 at seven locations in South Bohemia including the winter months (regularly at three locations in the vicinity of České Budějovice). Further specimens kept (from eggs to adults) in an outdoor aquarium from 1994 – 1995 were used too. They were fixed with Bouin fixative and dissected under a stereoscopic microscope in 95% ethanol. Dissected reproductive organs and their major microstructures (organs dehydrated in isopropanol and embedded in Euparal) were used for the study of morphology and for measurement of individual parts of the reproductive system. The oldest and largest oocytes or eggs respectively, was always measured in all ovarioles of both ovaries in the specimens examined (n = 2 x 7 = 14 oocytes in specimens measured; cf. Fig 13). Oogenesis and histology of ducts was studied on 4–6 μm paraffin sections stained with Harris haematoxylin–eosin (whole abdomens cut in nymphs of instars 1 and 2).

It is not possible to distinguish the true age of specimens during the instars 1–3. As in older nymphs (instars 4–5) preferably specimens immediately before or after eclosion were studied. Their age was estimated according to cuticular changes in specimens of defined age kept in aquarium. Interval for the study of development of reproductive system in adult females was two weeks or three weeks in the winter months (December – February) respectively. The terminology used here is derived mainly from Bünning (1994) and Larin (1938).

RESULTS

Development of ovaries

The ovarial rudiments in nymphs of the first and second instars measured about 0.1–0.2 mm. They are situated in the second abdominal segment and surrounded by fat body. Individual ovarioles are still not differentiated. Histologically, these rudiments are seen as a homogenous mass of germ cells showing some mitotic activity. Differentiation of the ovarioles starts in the nymphs of the third instar. Seven ovarioles of not equal length can be distinguished at the end of this instar. The whole ovariole is formed only by germarium (Figs 4, 5). Length growth of ovarioles is apparent during the fourth instar, when trophic syncytium in the germarium starts to be formed as well. A short vitellaria with about 4–6 small, still not linearly arranged previtellogenic oocytes can be distinguished in nymphs of the fifth instar (Fig. 3).

Ovaries of teneral adult females are very similar to those in last instar nymphs although the ovarioles are now relatively longer. Germ cells are restricted to a narrow band in the distal portion of the germarium at that time. About 4–7 linearly arranged oocytes with clearly visible trophic cords are distinguishable in two to four week-old females, from mid September to mid August. Vitellogenesis evidently starts in one or two of the oldest oocytes although they are still of the same size as the younger ones. Till the beginning of diapause (about mid November) 14–15 egg chambers are gradually formed, the proximal ones being at least twice the length of younger chambers. Yolk granula conceal nuclei in 1–3 oldest oocytes. The young (proximal) egg chambers are connected with the short follicular stalks (sensu Bünning 1994) (Plate 1, Fig. B). Both the development of the ovaries (growth of vitellarium) and vitellogenesis completely cease throughout diapause, i. e. from mid November to about mid March. From mid March, an intensive length growth of ovarioles can be observed. Secretion of chorion takes place from the end of March till mid April (Fig. 12) depending on climatic conditions at the individual locality. Oviposition starts from mid April. Mature eggs, when still inside the ovariole, are arranged to utilize space in the most „economic“ manner with always the opposite orientation of the chorionic micropylar respiratory plate in the following egg (Fig. 11). The growth of the oldest (distal) oocytes is apparent from Fig. 13. The oldest oocytes of overwintering (= diapausing) females are about 1 mm long, it is on nearly one half of the length of chorionated definitive eggs. The smaller (37% of length of chorionated eggs) distally localized oocytes were found in females overwintering in one locality under extremely unfavourable conditions in Pacov highland in South Bohemia during the winter of 1995–96 (pool with 0.2–0.4 m high column of water completely iced during December, January and most of February).
The epithelium of the egg chambers undergoes rapid changes during vitellogenesis, and during secretion of the chorion. The follicular epithelium of the proximal egg chamber (namely in adult females before overwintering) is very high and columnar (Plate 1, Fig. B). Egg chambers of vitellogenic eggs have evidently a cubic follicular epithelium (Plate 1, Fig. C). Epithelial cells shortly before chorional secretion start are more or less cubic and binucleate (Plate 2, Fig. D). The last phase in development of the follicular cells is one of postsecretory degeneration (Plate 2, Fig. E).

**Development of lateral oviducts and ectodermal efferent ducts**

The lateral oviducts of nymphs of the first and second instars are connected with the ovaries and each ends in a blind terminal ampulla between the eighth and ninth abdominal segments. The rudiments of vagina and spermatheca start to invaginate from ectodermal tissues in the third instar nymph (Fig. 1). In nymphs of the fourth instar, two ectodermal invaginations are apparent. The anterior one of these represents the rudiment of the common oviduct, while the posterior one, corresponding to a single invagination in younger nymphs, represents the ectodermal anlage of vagina and spermatheca. The spermathecal rudiment of the nymphs of fourth instar is

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Figs 1–5. Development of the internal reproductive organs in nymphs of *Thysanura eucnemis* (dorsal view, semischematic). 1 — terminal part of the anlage of efferent ducts in nymphs of instar 3, left lateral oviduct omitted. Ectodermal invagination (— posterior invagination in nymphs of the instar 4, compare Fig. 2) represents the vaginal and spermathecal anlage. 2 — terminal part of the efferent duct anlage in nymphs of the instar 4, left lateral oviduct omitted. 3 — the reproductive system of nymphs of the instar 5, left ovary omitted. 4 — right ovary in nymphs of instar 3. 5 — right ovary with unequal length of individual ovarioles in nymphs of instar 4. Cavities or ampullae of mesodermal origin are lined horizontally (spermathecal rudiment) or dotted, respectively. co — rudiment of common oviduct, ge — germarium, bu, bu — hypodermis of the 8th or 9th abdominal sterna, lo — rudiment of lateral oviduct, ov — ovary, se — spermatheca or its rudiment, va — vagina, vs — vitellarium.
an elongated, suck-like asymmetric formation, apparently longer than the anlage of the vagina (Fig. 2). The cavities of the future efferent ducts remain still unconnected in nymphs of the fifth instar (Fig. 3) although they represent the consistent outflow ways in the outer view. In the same instar, the spermatheca undergoes an intensive growth and is apparently divided into spermathecal duct and spermathecal body (= spermathecal bulbus). The spermathecal body is only a little more voluminous than the duct. Both the lateral and common oviducts possess the usual structure consisting of an outer layer of muscles and an inner epithelial layer. The inner follicular epithelium is conspicuously folded, enabling considerable extension of the walls of these ducts.

**Notes on the structure of spermatheca**

According to Larsen (1938), three portions of spermatheca can be distinguished: the canal (= ductus), the vesicula (= medial expanded portion, = proximal part of spermathecal bulbus) and the api cal gland (= distal portion, = apical part of spermathecal bulbus). The spermathecal duct is provided with cylindric secretory cells with large light vacuoles well visible even at low power in micropreparations. The distal part of the spermatheca, apart from its secretory function, can also serve as a reservoir for mature spermatoxoa after copulation. The spermatoxoa are currently found in the spermatheca of females after diapause in April. However, spermatheca of females before overwintering can contain mature spermatoxoa as well although very rarely.
The arrangement of spermatozoa in the spermathecal bulb is worthy of attention. In its distal part, the spermatozoa are arranged parallelly while showing an irregular arrangement in the proximal part. Small papillae apparent on the inner surface of the proximal spermathecal part probably serve as a comb for the separation of individual spermatozoa (Fig. 8).

**DISCUSSION AND CONCLUSIONS**

**Structures of reproductive system – differentiation and ontogenetic changes**

If we compare our present data with the fragmentary pieces of knowledge on the other water bugs (especially with *Notonecta glauca* L., 1758 (Notonectidae) (cf. Papáček & Soldán 1987), *Enithares Spinola, 1837*, *Antops Spinola, 1837*, (Notonectidae), some Corixidae, *Aphelocheirus australis* (Fabricius, 1803) (Aphelocheiridae), *Plea minutissima* Leach, 1817 (Pleidae) and *Helotrephes semiglobatus* Stål, 1858 (Helotrephiidae) (Kerktis 1926, Larsén 1938 – and our recent yet unpublished data), we arrive at the following coincidences and differences in morphological and developmental characters.

The differentiation of ovarioles starts in most water bugs in the second or third instar, in *J. camicoides* as well. The trophic synembryon starts to be formed in either instar 2 or 3 in the

![Diagram](image-url)
germarium of telotrophic ovarioles of most aquatic bugs. The formation of the trophic symcystum in *I. cimicoides* starts, somewhat later, in the fourth nymphal instar. In *I. cimicoides*, the first egg chambers in a vitellarium with previtellogenic oocytes form in the fifth instar, but vitellogenesis starts relatively late, in 1–2 months old adult females.

The ovarioles in *I. cimicoides* show an irregular growth in nymphs, especially in the fourth and fifth nymphal instars. However, the ovarioles of mature females are of the same length.

Descending, mature eggs (females in April), which are asymmetric, are arranged in a special space-saving way in the lateral oviducts. The origin of the separate, following descending eggs is from different ovarioles. In our opinion, the process of opposite orientation of separate eggs in lateral oviducts can be genetically programmed, and manipulated by musculature of pedicel and distal portions of ovarioles. This process is an unique functional character within the aquatic bugs. It can be judged as an autapomorphy of *Ilyocoris* or in Naucorinae (*Naucoris, Ilyocoris*) respectively.

Judging from Rawat's (1939) and Papiček's & Soldán's (1987) data on the development of the common oviduct, vagina and spermatheca, these organs develop in the same way in *Ilyocoris* and *Notonecra*. The progressive development of these structures from two ectodermal invaginations occurs in instar 4 and 5. Some morphological and histological features of the spermatheca in adults was described by Larsen (1938). We can add the following facts. The spermatheca invaginates in the same asymmetrical way in *Ilyocoris, Aphelocheirus, Notonecra, Plea* and *Helotrephes*. The asymmetrical invagination of the spermatheca can be considered a
synapomorphy of Naucoridae, Aphelocheiridae, Notonectidae, Pleidae and Heteropodidae (= Naucoridea, Notonectoidea and Pleoidea)

**Life cycle, overwintering and oogenesis**

Kramer (1935), Papáček (1988) and Papáček & Hauškrová (1987) stated that premigrational development and oogenesis in *I. cimicodes* is strongly dependent on temperatures in the field. Larsen (1938) found degenerative changes in the ovarioles of overwintering females of *Notonecta* exposed to extremely hard winter conditions. Our finding of overwintering females with extremely small oocytes at Pačov highland in South Bohemia suggests also that hard winter conditions can influence growth of oocytes in *Ilyocoris* as well. However, by our data it is no possible to distinguish the two main possibilities, (1) small oocytes of overwintering females was affected by reductive degenerative changes, (2) the overwintering females from the one locality under our study was only „very late“ adults with early stage of oogenesis before overwintering. Growth of oocytes and vitellogenesis completely ceased during the whole overwintering diapause. However, growth, vitellogenesis and chorion secretion of eggs occur rapidly after overwintering. For example, the growth of oocytes doubles during a three or four week period in March and April.

The males of *I. cimicodes* reach sexual maturity in the autumn, and part of their population overwinters (Papáček & Gelčík 1989). Spermatogonia were found even in the spermarche in a some of immature females collected before overwintering. These facts show the „hei-hedging“ sexual strategy (sensu Tauber et al. 1986) of *I. cimicodes*, which is selected by two antagonistic pressures – sexual competence of mature spermatogonia and uncertainty of survival of individual specimens during overwintering.

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