## CONTENTS

<table>
<thead>
<tr>
<th>Article</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIANA M.P. GALASSI, PAOLA DE LAURENTIIS and GIUSEPPE L. PESCE: Some remarks on the genus <em>Microcharon karaman</em> in Greece and description of <em>M. agripensis</em> n. sp. (Crustacea, Isopoda, Microparasellidae)</td>
<td>133</td>
</tr>
<tr>
<td>GORDAN KARAMAN and SANDRO RUFFO: <em>Sinogammarus troglodytes</em> n. gen. n. sp. A new troglobiont Gammarid from China (Crustacea, Amphipoda)</td>
<td>157</td>
</tr>
<tr>
<td>JOSÉ G. PALACIOS-VARGAS and DOUGLAS ZEPPELINI: A new species of <em>Troglobius</em> (Collembola, Paronellidae) from Brazil</td>
<td>173</td>
</tr>
<tr>
<td>AUGUSTO VIGNA TAGLIANTI: A new species of <em>Jufiroa</em> from Sichuan, China (Coleoptera, Carabidae)</td>
<td>179</td>
</tr>
<tr>
<td>ROHIT K. PRADHAN and JAYANT BISWAS: Towards regressive evolution: the periodic colour change behaviour of the troglophilic fish <em>Nemacheilus evezardi</em> (Day)</td>
<td>191</td>
</tr>
<tr>
<td>GIANMARIA CARCHINI, MAURO RAMPINI and VALERIO SBORDONI: Life cycle and population ecology of the cave cricket <em>Dolichopoda geniculata</em> (Costa) from Valmarino cave (Central Italy)</td>
<td>203</td>
</tr>
<tr>
<td>FRANÇOIS GRAF and GUY MAGNIEZ: Roger Husson (1911-1993)</td>
<td>219</td>
</tr>
</tbody>
</table>

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Some remarks on the genus Microcharon Karaman in Greece, and description of M. agripensis n. sp. (Crustacea, Isopoda, Microparasellidae)

Diana M.P. Galassi, Paola De Laurentiis and Giuseppe L. Pesce *

SUMMARY
Several samples of microparasellid isopods of the genus Microcharon Karaman were obtained in groundwater habitats of Greece.
Four species are identified, and taxonomical and zoogeographical remarks on some rare or poorly known taxa are made. One species, herein described as Microcharon agripensis n. sp., is new to Science. M. latus prespensis Karaman, 1954, on account of the different morphology of the first and second male pleopods, and its partially overlapping distribution, in respect to M. latus Karaman, 1934, is definitively raised at specific rank. Supplementary descriptions and illustrations are reported for incompletely described species such as M. latus, M. prespensis stat. nov., M. major Karaman, 1954 and M. othrys Argano & Pesce, 1979. For some species, such as M. latus, M. othrys and M. antonellae Galassi, 1991, SEM preparations of the mouthparts, not well detailed with the optical microscopy, were carried out. According to data from the present study, a paleogeographical scenario of the Balkan Peninsula is briefly depicted in order to sketch the most significative events which led to the colonization and speciation of the Microcharon species in this area.

INTRODUCTION
The genus Microcharon is widespread in the Balkan Peninsula, with 20 named species and subspecies, most of which are present in Greece.
Only the species M. latus and M. prespensis show a wider distribution, in contrast with the high degree of endemism shared by the other Microcharon species.
Our recent collections of microparasellid isopods from different groundwater substrates of Greece led us to carefully examine some incompletely described species such as M. latus Karaman, 1934, M. prespensis Karaman, 1954, M. othrys Argano & Pesce, 1979.

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Description

Body length 1.04-1.49 mm (♀ ♀); 1.36-1.60 (♂ ♂), male holotype: 1.55 mm. Cephalosome slightly longer than broad; pleotelson about as long as broad; chetotaxy as in Fig. 17.

First antenna (Fig. 2), 6-segmented, not sexually dimorphic in the armature; segment 1 bearing 3 setae; segment 2 with 2 lateral sensorial plumose setae and 1 distal and 2 subdistal setae; a long plumose seta is inserted on the distal protrusion of the same segment; segment 3 naked, segment 4 with a little aesthetes and a transformed plumose seta; segment 5 bearing an aesthetes, segment 6 with 1 aesthetes, 1 long plumose, 1 distal and 1 subdistal setae. Second antenna: exopodite with 2 setae, flagellum of 9 segments.

Upper lip (Fig. 11) rounded, with thin setules along laterodistal margins. Lower lip consisting of 2 elongates lobes, as in Fig. 7.

Left mandible (Fig. 8): lacinia mobilis with 4 subconical teeth; pars incisiva with 7 teeth, not equally developed; pars molaris with 3 setae; between lacinia mobilis and pars molaris 2 denticulated spines and 5 setae are inserted.

Right mandible (Fig. 3), lacking lacinia mobilis; pars incisiva with 5 subconical teeth; pars molaris with 3 setae; between pars incisiva and pars molaris there are 3 denticulated spines, 4 setules and 2 plumose setae.

Mandibular palp built as usual in the genus, consisting of 3 segments, distal one bearing 4 claw-like fringed spines and 2 rows of thin cuticular spines; other armature as in Fig. 5.

First maxilla with 2 endites, the outer one (Fig. 10) with 10 distal denticulated spines and 3 thin setules; inner endite (Fig. 6) with 1 apical spine and some distal and subdistal setules.

Second maxilla (Fig. 9) with 3 endites, about of the same length, inner endite the wider; outer and central endites with 4 denticulated setae; inner endite with 5 apical setae and 1 strong pectinate spine; 2 spines and 3 setules are inserted along the inner margin.

Maxilliped: epipodite slender; palp of 5 segments; segments 2 and 3 expanded, segments 4 and 5 slender, segment 4 with 4 setae, segment 5 with 7 setae. Basipodal endite armed as in Fig. 4.

Pereopods (Figs. 13, 20) rather similar in shape, with small differences in the armature, especially of the dactylus (5 setae in P1 vs 4 in P2-P7).

First male pleopod (Fig. 18): with simple apex, more or less
Figs. 2-11 — *M. agripensis* n. sp., females paratypes: 2. first antenna; 3. right mandible; 4. maxilliped; 5. mandibular palp; 6. first maxilla, inner endite; 7. lower lip; 8. left mandible; 9. second maxilla; 10. first maxilla, outer endite; 11. upper lip.
rounded; hyaline edge slightly sticking out the apex of the same pleopod. Exopodite relatively long; basal part slightly enlarged. Distal armature consisting of 7 setae: 1 subdistal and 2 lateral setae, 1 short subapical and 3 apical setae.

Second male pleopod (Fig. 12): sympodite elongate, subovalar and subrounded at mediodistal corner; endopodite recurved, filiform, reaching tip of exopodite.

Second female pleopod (Fig. 16) about as long as broad (mean lenght/width ratio: 1.01; n=3); distal margin with 2 setae and a more or less pronounced, medial notch.

Third pleopod (Fig. 19) as usual in other freshwater species of the genus.

Fourth pleopod rudimentary (Fig. 15).

Uropods (Fig. 14) much longer than pleotelson; endopodite short, more than half as long as the sympodite; exopodite as long as the sympodite.

**Etymology**

Specific epithet after «Agripo», the ancient name of Euboea island.

**Remarks**

*M. agripensis* n. sp. belongs to a morphological group (*profundalis* group sensu Galassi & al., in press) of species, characterized by a hyaline edge sticking out the apex of the first male pleopod. At present, the *profundalis* group includes, besides the new species, the following ones: *M. profundalis* Karaman, 1940, from phreatic and hyporheic waters of former Yugoslav Macedonia; *M. hercegovinensis* Karaman, 1959, from phreatic and hyporheic waters of Hercegovina; *M. phlegethonis* Cvetkov, 1967, from spring waters near Devnja and phreatic waters near Varna, Sevlievo and Rouse (Bulgaria) and *M. bureschi* Cvetkov, 1976, from phreatic waters of Sofia. Within the group, *M. agripensis* n. sp. most closely resembles *M. hercegovinensis*, on account of the construction of the first male pleopod and the morphology and ornamentation of the second female pleopod. The diagnostical differences regard especially the different bend of the apex of the first male pleopod (inner corner drawn down in *M. agripensis* vs the same, straight in *M. hercegovinensis*), the setation of the same pleopod (7 setae in *M.
Figs. 12-20 — *M. agripensis* n. sp., male holotype (12, 18), females paratypes (13-17, 19, 20): 12. second pleopod; 13. first pereopod, dactylus; 14. uropod; 15. fourth pleopod; 16. second pleopod; 17. telson; 18. first pleopod; 19. third pleopod; 20. seventh pereopod, dactylus.
agripensis vs 6 in *M. hercegovinensis*) and the morphology of the inner corner of the sympodite of the second male pleopod (subrounded in *M. agripensis* vs pointed in *M. hercegovinensis*).

From a zoogeographical point of view, the speciation within *profundalis* group could be related to the eastern Paratethys evolution (Rögl & Steininger, 1984; Steininger & al., 1985; Cita & Corselli, 1993). On this regard, the new species shows more similarities with *M. hercegovinensis* and *M. profundalis* than with *M. phlegethonis* and *M. bureschii*. It seems to be plausible that the origin and the age of *M. agripensis* could be related with the speciation of *M. hercegovinensis* and *M. profundalis*, during the more recent (Miopliocene age) fragmentation and drainage of the central-eastern Paratethys (plausible Dacian-Pannonian correlations; Steininger, in litt.), along sud-Dinaric Adriatic and Morava-Vardar Aegeic «channels». Particularly, *M. agripensis* could be originated during the late Miocene - lower Pliocene involution of the Aegean «lago-mare» (Hsü, 1978; Hsü et al., 1973), which partially covered the Euboea island, determining the invasion of »Paratethyan relicts» into the Mediterranean, as mentioned by many authors (Danielopol, 1980; Bianco, 1990; Banarescu, 1991).

**Microcharon major** Karaman, 1954 (Figs. 21-37)

**Material**

3 ♂♂, 2 ♀ ♀; hyporheic habitat, little stream of the Evinos river basin, on the road to Platanos (Etholie); 300 m a.s.l.; water temperature: 21°C, E.c.: 0.240 mS/cm, pH 7.8, salinity: 0.5‰, (Karaman-Chappuis sampling method); 22 June 1990; coll. A. Tiberio & D. Galassi.

**Supplementary description**

Body length about 2.03 mm (range: 1.86-2.17 mm) (♂♂), 1.73 mm (range: 1.67-1.80 mm) (♀ ♀). Pleotelson much longer than broad, with well developed caudal and pleural setae, as in *M. antonellae*; chetotaxy as in Fig. 35.

First antenna (Fig. 21), 6-segmented, not sexually dimorphic in the armature; segment 1 naked, segment 2 with 2 lateral plumose and 2 subdistal setae; a long plumose seta is inserted on the distal protrusion of the same segment; segment 3 naked, segment 4 with
Figs. 21-30 — *M. major* Karaman, 1954. 21. First antenna; 22. first maxilla, inner endite; 23. mandibular palp; 24. maxilliped; 25. second maxilla; 26. lower lip; 27. first maxilla, outer endite; 28. left mandible; 29. upper lip; 30. right mandible.
a little lateral seta, segment 5 with 1 aesthete and 1 seta, segment 6 with 2 setae, 1 aesthete, 2 plumose setae of different length. Second antenna missing in all specimens.

Upper lip (Fig. 29) rounded, with thin cuticular spines along the distal margin.

Lower lip (Fig. 26) consisting of 2 elongated lobes.

Left mandible (Fig. 28): lacinia mobilis with 5 subconical teeth; pars incisiva with 4 teeth; pars molaris with 3 setae; between lacinia mobilis and pars molaris 2 denticulated spines, 5 setules and 2 plumose setae are inserted.

Right mandible (Fig. 30), lacking lacinia mobilis; pars incisiva with 5 subconical teeth; pars molaris with 3 setae; between pars incisiva and pars molaris there are 3 denticulated spines, 3 setules and 2 plumose setae.

Mandibular palp built as in other Microcharon species, consisting of 3 elements, distal one bearing 4 claw-like fringed spines and 2 rows of cuticular spines; remaining armature as in Fig. 23.

First maxilla with 2 endites, the outer one (Fig. 27) with 10 distal denticulated spines and 3 thin setules; inner endite (Fig. 22) with 1 apical spine and numerous distal and subdistal setules.

Second maxilla (Fig. 25) with 3 endites; inner endite the wider; outer and central endites with 4 setae, most of which denticulated; inner endite with 5 apical setae and 1 strong pectinate spine; 1 seta and some thin setules are inserted along the inner margin.

Maxilliped: epipodite slender; palp of 5 segments; segments 2 and 3 slender, segment 4 and 5 with 4 and 5 setae respectively. Basipodal endite as in Fig. 24.

Pereopods (Figs. 32, 34) with small differences in the armature, especially of the dactylus (5 setae in P1 vs 4 in P2-P7); unguli relatively short, close resembling those of M. antonellae.

First male pleopod (Fig. 31) consisting of 2 halves, distally protruding in a marked protuberance, bearing 2 setules; remaining armature of the distal part as follows: 3 distal, outer setae and 2 lateral more developed setae. As pointed out by Galassi (1991) the species was originally (Karaman, 1954) described with 1-2 apical setae; successively, with 1 apical setula by Cvetkov (1967, 1968). Well developed hyaline membrane.

Second male pleopod (Fig. 33): sympodite elongated, subrectangular and pointed at mediodistal corner; endopodite recurved, not filiform, weakly overreaching tip of exopodite.
Figs. 31-37 — *M. major*. 31. First male pleopod; 32. seventh pereopod, dactylus; 33. second male pleopod; 34. first pereopod, dactylus; 35. telson; 36. third pleopod; 37. second female pleopod.
Second female pleopod (Fig. 37) slightly longer than wide; distal margin with a medial notch, armed with 4 setae.

Third pleopod (Fig. 36) as usual in other freshwater species of the genus.

Uropods missing in all the specimens.

Remarks

*M. major* was originally described by Karaman (1954) from hyporheic habitats of Pcinja river (Skoplje) and from Bregalnica stream and some, not more detailed, hyporheic habitats near Prilep (Macedonia). Successively, Cvetkov (1967) recorded the species from hyporheic of Strouma river (Blagoevgrad, Bulgaria). Our finding in Etholie greatly enlarged southward the range of the species, suggesting that *M. major* could be more widely distributed than previously thought.

*M. major*, owing to the morphology of the first and second male pleopods and the armature of the second female pleopod, quite fits the *major* group of species as established by Galassi (1991). The phylogenetic analysis yielded by Coineau (1994) clearly recognized the monophyletic value of the group, although its sister relationships are still not clear. The «intuitive» zoogeographical model, as proposed by Galassi & al. (in press) placed the main speciation event within the group at the Messinian.

*Microcharon latus* Karaman, 1934 (Figs. 39-52; 58a)

Material

1 ♂, 1 ♀; phreatic waters (well), along the main-road Arta-Agrinion, near cross-road to Stanos, Etholie; 6 May 1977, coll. G.L. Pesce, D. Maggi & M. Miranda. 13 ♀♀, 8 ♂♂, hyporheic habitat, little stream of the Evinos river basin; for locality data see *M. major*. Numerous ♀♀ and ♂♂, freshwater well of Kephallinia (Sami, Assos, Argostolion), Corfu (Kassiopi, Ipsos) (for more details on locality data, see Argano & Pesce, 1979).

Supplementary description

Body length 1.61 - 1.76 mm (♀ ♀), 1.23 - 1.43 (♂ ♂). Pleotelson much longer than broad, with well developed caudal and pleural setae; chetotaxy as in Fig. 47.
Fig. 38 — Updated distribution of *M. latus* Karaman, 1934 and *M. prespensis* Karaman, 1954 (● *M. latus*, *M. prespensis*). The arrows indicate the hypothetical dispersion way of the species during the Quaternary continental freshwater flooding.

First antenna (Fig. 39), 6-segmented, not sexually dimorphic in the armature; segment 1 with 3 setae, one of which plumose, segment 2 with 2 lateral plumose and 3 subapical setae; distal protrusion of the same segment bearing a long plumose seta, reaching tip of the antenna, segment 3 naked, segment 4 with 3 setae, segment 5 with 1 aesthete, segment 6 with 1 plumose seta, 1 aesthete and 4 setae of different length. Second antenna lacking in all specimens.

Left mandible (Fig. 42): lacinia mobilis with 3 teeth, pars incisiva with 4 teeth; pars molaris with 3 setae; between lacinia mobilis and pars molaris 2 denticulated spines, 3 setules and 2 plumose setae are inserted.
Right mandible (Fig. 45): pars incisiva with 3 subconical teeth; pars molaris with 3 setae; between pars incisiva and pars molaris there are 3 denticulated spines, 4 thin setules and 2 plumose setae.

Mandibular palp consisting of 3 elements, distal one bearing 4 claw-like fringed spines; remaining armature as in Fig. 40.

First maxilla with 2 endites, the outer one (Fig. 43) with 12 distal spines, most of which denticulated, the inner endite (Fig. 46) bears an apical spine and some thin setules.

Second maxilla (Figs. 44, 58a) consisting of 3 endites, the inner the broader. Outer and central endites with 4 setae, some of which denticulated; inner endite with 1 strong pectinate spine and 4 apical setae. One plumose seta and some thin setules are inserted along the inner margin.

Maxilliped: palp and basipodal endite as in Fig. 41.

Pereopods rather similar in shape, armature of the dactylus as in Fig. 51, except P1 with 5 setae. Unguli relatively long.

First male pleopod (Fig. 48) with simple apex, more or less rounded, inner corner drawn in; distal part bearing well developed setae; armature as follows: 3 apical setae, 1 short subapical one; 3 setae are inserted at the distal third of the same pleopod. Exopodite relatively long, basal part slightly enlarged. Hyaline membrane not distally sticking out the apex of the pleopod.

Second male pleopod (Fig. 49): sympodite elongated, subovalar and subrounded at mediodistal corner; endopodite recurved, filiform.

Second female pleopod (Fig. 50) about as long as broad, with 2 distal setules; distal margin with a faint notch.

Third pleopod as in Fig. 52.

Remarks

*M. latus* s. l. includes, besides the nominal subspecies, *M. latus prespensis*, described by Karaman (1954) as an endemism of Prespa lake.

According to more recent data, *M. latus* s.str. is known from some localities of former Yugoslav Macedonia and of Crna-Gora (Montenegro), Etholie and Ionic islands of Greece. On the other hand, *M. latus prespensis* is recorded from former Yugoslav Macedonia, Epirus, Peloponnesus and some Aegean islands of Greece (Fig. 38).

As suggested by Argano & Pesce (1979), their partially overlapping distribution as well as their well defined diagnostical differences,
Figs. 39-46 — *M. latus* Karaman, 1934. 39. First antenna; 40. mandibular palp; 41. maxilliped; 42. left mandible; 43. first maxilla, outer endite; 44. second maxilla; 45. right mandible; 46. first maxilla, inner endite.
of the same weight if compared to congeners in the Balkan Peninsula, constrained ourself to raise the above taxa to higher specific level. It seems to be plausible that further investigations in this region could enlarge the patchy distribution of these species.

*M. latus* and *M. prespensis* appear to be good dispersers, widely distributed in the Balkan area, in different subterranean biotopes. However, an active migration mechanism, enlarging the original species’ range from the «origin center» is an hypothesis statistically weak, due to the feeble dispersion ability shared by the other *Microcharon* species and by many interstitial stygobionts (Boutin & Coineau, 1990; Dole & Coineau, 1987; Coineau, 1994; Coineau & Boutin, 1992; Holsinger, 1992; Notenboom, 1991). On the other hand, an ancient, continuous range, more or less fragmented since Neogene times, including both islands and mainland populations, appear to be an unlikely explanation for the actual distributional patterns of *M. latus* and *M. prespensis*. In fact, two objections could be raised: 1) marked morphological divergences should be expected between islands and mainland populations; 2) stygobiont *Microcharon* populations, stranded in freshwater habitats should not have survived during the following marine transgressions which partly covered both the coastal mainland and the islands, during the basal Pliocene transgression and the Quaternary interglacial periods.

Therefore, a possible explanation for the distributional pattern of both species is offered by a dispersal scenario due to a passive colonization mechanism, supported by the more recent paleoecological and paleogeographical history of the Balkan area. On this regard, a freshwater flooding from the continental freshwaters (probable «origin center» of the species) to the Ionian sea and especially to the Aegean sea (Dermitzakis, 1990; Kotsakis, 1990; Sondaar et al., 1986), during Quaternary humid (often interglacials) periods (Bethoux, 1984; Thunnel & Williams, 1983; Chamley, 1983; Cramp & Collins, 1988; Cramp et al., 1988) is demonstrated by lithological and biostratigraphical reconstruction of sediments. According to the above data, a relatively recent invasion from mainland to islands for both *M. latus* and *M. prespensis* could be reasonably dated in the Würm interglacial; consequently, their presence in insular coastal habitats could represent a secondary colonization from some continental, more or less ancient, populations. According to Botosaneanu & Holsinger (1991), «dispersal processes of stream
Figs. 47-52 — *M. latus*. 47. Telson; 48. first male pleopod; 49. second male pleopod; 50. second female pleopod; 51. seventh pereopod, dactylus; 52. third pleopod.
meiofauna can be explained mainly by a passive, hydrodinamical model; recruitment in new areas downstream occurs mostly by dispersal through the water; water-column movements, not infaunal migrations, appears to be the most important dispersal mode in streams».

*Microcharon prespensis* Karaman, 1954 stat. nov.

**Material**


The rather brief description, given below, deals with the characters overlooked in the original description as well as with the diagnostic morphological features, within the genus, in respect to *M. latus*.

The main differences regard the morphology of the first and second male pleopods. Particularly, the distal part of the first male pleopod is rounded in *M. prespensis* and with a symmetrical circular bend in each ramus versus a distal part asymmetrical, being the inner corner drawn inward in *M. latus*. Moreover, the second male pleopod shows a sympodite with pointed mediodistal corner (although we observed a little variation of this character, which could be related with a different orientation on slide), when in *M. latus* the same appears to be subrounded. No marked differences were observed in the other morphological characters.

*Microcharon othrys* Argano & Pesce, 1979 (Figs. 53-57, 58b)

**Material**

1 ♂, 1 ♀; freshwater well, along the road Thebes-Lamia, near Scamnos; 10 May 1977, coll. G.L. Pesce, D. Maggi & M. Miranda.
Figs. 53-57 — *M. othrys* Argano & Pesce, 1979. 53. Second maxilla, outer and central endites; 54. mandibular palp; 55. first maxilla, inner endite; 56. first maxilla, outer endite; 57. second maxilla, inner endite.
M. othrys was originally described by Argano & Pesce (1979), without particular attention to mouthparts and to the first male pleopod (Galassi, 1991). The availability of type-material let us to improve some not well detailed characters.

First maxilla consisting of 2 endites, the outer one bearing 10 spines, most of which denticulated (Fig. 56), inner endite (Fig. 55) with 1 apical spine and numerous distal and subdistal thin setules.

Second maxilla with 3 endites; outer and central endites (Fig. 53) bearing 4 denticulated setae, inner endite (Figs. 57, 58b) with 5 apical setae, one of which plumose and 1 strong pectinate spine; 1 plumose seta and some setules are inserted along the inner margin.

Mandibular palp consisting of 3 segments, the distal one bearing 4 claw-like fringed spines; remaining armature as in Fig. 54.

CONCLUSION

The paleogeographical and paleoecological reconstruction of the Hellenic area is the major topic for outline an evolutionary scenario for the stygobiont Microcharon in Greece and in the Balkan Peninsula at all (Banarescu, 1991; Sket, 1994).

The ancient origin of the region as well as the numerous, not well recognizable, paleogeographical events (viz. Neogene marine transgressions, Paratethys involution, Quaternary glacial-interglacial alternance) which followed one another, made the paleohistory of the Hellenic area difficult to assess. Any biogeographical reconstruction fells the effects of such a vagueness. The little ecological and taxonomical knowledge of the Microcharon species does not aid to solve the question.

Nevertheless, the Balkanic Microcharon occur, sometimes in syntopy, in different subterranean biotopes, such as springs, phreatic and hyporheic habitats and limnostygial, showing an interesting niches diversification and high variation of morphological planes. It seems to be plausible that different events in time and space led to numerous colonization's waves and consequently to the present-day distribution and diversification of the genus in this area.
Fig. 58 — SEM preparations of the second maxilla in: a. *M. latus*; b. *M. othrys*; c. *M. antonellae*. 


Sinogammarus troglodytes n. gen. n. sp.
A new troglobiont Gammarid from China
(Crustacea Amphipoda)

Gordan Karaman * and Sandro Ruffo **

SUMMARY

The authors describe Sinogammarus troglodytes n. gen. n. sp. found in two caves in Sichuan province in China, the first Chinese troglobite of the Gammaridae family (sensu Barnard & Barnard, 1983; 1990). The new genus is discussed and compared with the microphthalmous and anophthalmous genera of Gammaridae, heretofore known in the subterranean waters of the Balkan peninsula and the Caucasus region. The genus Sinogammarus is most closely allied to Gammarus Fabricius and Anopogammarus Derzhavin.

The cavernicolous fauna of China is virtually unknown. In particular, only three troglobiont amphipods have been identified in the Chinese Republic: Pseudocrangonyx asiaticus Ueno, 1934, Pseudocrangonyx manchuricus Oguro, 1938 from the subterranean waters in northeastern China, and Bogidiella sinica G. Karaman & Sket, 1990, found in a cave in southern China (G. Karaman & Sket, 1990).

The discovery of a large anophthalmous amphipod in two caves in Sichuan province during a speleological expedition in China organized by the Centro Ibleo di Ricerche Speleo-idrologiche (Ragusa, Sicily), is therefore particularly noteworthy. A study of the material, which was so kindly sent to us for this purpose, has enabled us to establish that this is a new species of Gammaridae (sensu Barnard & Barnard, 1983; 1990) that cannot be assigned to any other known genus.

The present article gives a description of the new species and discusses the new genus.

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Sinogammarus n. gen.

Diagnosis

Body smooth. Urosomites with dorsal groups of spines and setae. Eyes absent. Accessory flagellum of antenna 1 pluriarticulate; flagellum of antenna 2 with calceoli in the male. Mouthparts Gammarus-like: article 3 of mandibular palp weakly falcate, with A, B, D, E setae, left and right maxillae 1 asymmetric, outer plate with ten or eleven poorly toothed spines. Coxae Gammarus-like. Gnathopods 1-2 in male large, scarcely dissimilar to each other: propodus large, suboval, elongate, bearing oblique palm with row of palmar spines. Gnathopods 1-2 in female more dissimilar to each other: propodus of gnathopod 1 suboval, with only one median palmar spine, propodus of gnathopod 2 subtrapezoidal, with almost parallel lateral margins, without median palmar spines. Pereopods 5-7 elongate, relatively slender, basis of pereopods 6-7 with distinct posterodistal rectangular lobe. Uropod 1 peduncle, with one or two basifacial spines. Uropod 2 with unequal rami. Rami of uropods 1-2 with very few spines. Uropod 3 magniramous, rami elongate, lanceolate, setose, outer ramus biarticulate, article 2 reduced or vestigial. Telson Gammarus-like. Coxal gills with peduncle, on pereonites 2-7. Oostegites moderately broad, with long marginal setae.

Type species of genus: Sinogammarus troglodytes n. sp.

Derivatio nominis. From the Latin name for China.

Discussion of affinities

The Gammaridae family (sensu Barnard & Barnard, 1983; 1990) includes a number of genera with microphthalmous or anophthalmous species inhabiting the subterranean water of southern Europe, especially the Caucasus region and the Balkan peninsula. However, to date this family has not included any representative of the subterranean waters of Asia, except for Anatolia. The European and Anatolian species belong partly to the Echinogammarus-Sarothrogammarus-group (e.g. Rhipidogammarus, Tyrrhenogammarus, which are basically Mediterranean) and partly to the Gammarus-group.

The genera in this latter group are Typhlogammarus Schäferna, 1907 (type species: T. mrazeki Schäferna, 1907), Metohia Absolon, 1927
SINOGAMMARUS TROGLODYTES N. GEN. N. SP. 159


Barnard and Barnard (1983) assign these genera, together with *Fontogammarus* S. Karaman, 1931, *Ilvanella* Vigna Taglianti, 1971, and *Tadzocrangonyx* G. Karaman & Barnard, 1979, to the «Meto- hiids» group, which we consider artificial, since phylogenetically different taxa are placed together (Ruffo, 1995).


*Sinogammarus* n. gen. is most certainly allied to the *Gammarus*-group. Among the genera in this group, *Sinogammarus* differs from *Zenkevitchia* and *Albanogammarus* in the number of spines of maxilla 1, which are ten or eleven in *Sinogammarus*, seventeen in *Albanogammarus*, and up to fifty in *Zenkevitchia*. Furthermore, in these last two genera the spines are recurved and finely pectinate, so that the maxillae seem to be modified (particularly in *Zenkevitchia*) to serve as a filter.

*Sinogammarus* is superficially similar to the balcanic genera *Typhlogammarus, Accubogammarus, Metohia*, but *Typhlogammarus* differs in the very different shape of the coxae, the nearly symmetric left and right palps of maxilla 1, the uniarticulate outer ramus of uropod 3 and shorter telson; *Accubogammarus* differs in the short, narrow and symmetric palps of maxilla 1, the partially reduced setae on the inner plate of maxilla 1, different shape of coxae 3-4, uniarticulate outer ramus of uropod 3 and shorter telson; *Metohia* differs in the carinate body, slightly produced epimeral plates, slightly different shape of the coxae and less elongate propodus of gnathopods 1-2 (both in males and females).
The two genera most closely allied to *Sinogammarus* are *Gammarus* and *Anopogammarus*. *Sinogammarus* differs from *Gammarus* only in the larger propodus of gnathopods 1-2, which are slightly dissimilar, in the male, and from *Anopogammarus* (compared only to the type species *A. birsteini*) in the longer inner ramus of uropod 3, the more vestigial article 2 of outer ramus, and the oostegites with normally long marginal setae.

Unfortunately, the description of both species of the genus *Anopogammarus* is quite incomplete (Derzhavin, 1945; Birstein & Levushkin, 1970; cfr. also Barnard & Barnard, 1983); many taxonomical characters have yet to be described, especially those of the female, and consequently cannot be used for comparison. Therefore, we cannot exclude the possibility that *Sinogammarus* is synonymous with *Anopogammarus*, but at present we do not know of any transitional taxa with characters regarding the length of the inner ramus of uropod 3.

On the other hand, the subterranean genera of Gammaridae are relatively similar to one another, and some of them are poorly described. Thus, it is difficult to make a comparison and careful analysis of the status of *Sinogammarus* within the family.

**Sinogammarus troglodytes** n. sp.

(Figs. 1-6)

*Material examined*


The holotype from Liujia Cave (♂ 25 mm MVR Cr 362), dissected and partially mounted in Faure's medium, on slides nr. 3841-3842, have been deposited, with the paratypes, in the Museo Civico di Storia Naturale, Verona.

*Description*

Male, 25 mm long. Body robust, without pigment. Epimeral plates 1-2 (Fig. 4b) with marked posteroventral corner and convex posterior margin; epimeral plate 3 with slightly pointed posteroven-
Fig. 1 — Sinogammarus troglodytes n. gen. n. sp., ♂ holotype 25 mm, Liujia Cave, Sichuan prov. (China). a, head and antennae 1-2; b, flagellum article 4 of antenna 1; c, right mandible; d, incisor and lacinia mobilis of left mandible; e, mandibular palp article 3 on outer face; f, f', right maxilla 1; g, palp of left maxilla 1; h, maxilla 2; i, maxilliped.
tral corner and poorly concave posterior margin; epimeral plates 2-3 with several spines on ventral margin. Urosomites 1-3 (Fig. 4c) relatively low, dorsally poorly elevated, with groups of spines and setae according to following formula (number of setae in parenthesis):

\[
\begin{align*}
1(6) & \quad 1(7) & \quad 1(6) & \quad 1(6) \\
1(7) & \quad 1(5) & \quad 1(6) & \quad 1(6) \\
1(7) & \quad 0(7) & \quad 1(3)
\end{align*}
\]

Urosomite 1 with one small ventral spine near basis of peduncle of uropod 1.

Head (Fig. 1a) with subquadrate lateral lobes and well developed, deep sinus; rostrum short, eyes absent.

Antenna 1 (Fig. 1a) reaching half of body, peduncular articles 1-3 ratio = 1:0.7:0.4; main flagellum with about forty three articles (most articles with one short aesthetasc each (Fig. 1b), accessory flagellum longer than peduncle article 3, with five articles. Antenna 2 (Fig. 1a) shorter than antenna 1, relatively strong, gland cone hardly exceeding tip of peduncular article 3, peduncular article 5 slightly shorter than article 4, with low number of short setae, flagellum slender, with about sixteen articles, bearing low number of short setae and one calceolus each.

Labium subrounded, broader than long. Mandibles strong, with strong triturative molar (Fig. 1c); left mandible with incisor bearing five teeth (Fig. 1d); right mandible molar with one long distal seta, incisor with four teeth, lacinia mobilis bifurcate, pluritoothed (Fig. 1c); mandibular palp triarticulate, strong, article 1 short and smooth, article 2 with about twenty three setae, article 3 slightly shorter than article 2, with two groups of A-setae on outer face, two groups of B-setae on inner face, about thirty D-setae and seven E-setae (Fig. 1c, e). Labium without inner lobes, outer lobes entire. Left and right maxillae 1 asymmetric, but both with triangular inner plate (Fig. 1f, f'), bearing distolateral row of plumose setae and outer plate with then or eleven poorly toothed spines (formula of teeth, from inner to outer margin: 8-6-2-3-2-1-2-2-1-1 or 9-5-5-4-3-1-2-2-1-2); palp of left maxilla 1 (Fig. 1g) narrowed, with seven + one slender spines and four setae, palp of right maxilla 1 (Fig. 1f) broader, with five + one strong spines and one seta. Maxilla 2 (Fig. 1h): both plates narrow, with numerous distal setae, inner plate with diagonal row of plumose facial setae and row of setae on inner margin. Maxil-
Fig. 2 — *Sinogammarus troglodytes* n. gen. n. sp., ♂ holotype 25 mm, Liujia cave, Sichuan prov. (China). a, gnathopod 1; b, c, propodus of gnathopod 1 on outer and inner face; d, gnathopod 2; e, f, propodus of gnathopod 2 on inner and outer face.
liped (Fig. 1i): inner plate short, with three distal and one subdistal spine and numerous setae, outer plate slightly exceeding half of palp article 2, with row of smooth distolateral spines, palpus quadriarticulate, nail markedly shorter than pedestal.

Coxae 1-4 (Figs. 2a, d; 3a; 4a) longer than broad, with short marginal setae; coxa 4 with well developed posteroventral lobe; coxae 5-6 (Fig. 3b, c) with anterior lobe much shorter than posterior one, coxa 7 (Fig. 3d) bilobed, incised nearly in middle.

Gnathopod 1 (Fig. 2a): basis with numerous long setae along both margins, merus with transverse rows of posterior setae, carpus short, triangular, propodus large (Fig. 2b), nearly twice as long as broad, ovate-elongate, tapering distally, palm very oblique and poorly defined from posterior margin, bearing a row of four strong palmar spines, posterior margin below the palm with several spines accompanied by groups of setae and with several facial spines on inner face (Fig. 2c); dactylus long, exceeding half of posterior margin, without setae along outer and inner margins. Gnathopod 2 (Fig. 2d) similar to gnathopod 1: merus with two groups of setae along posterior margin, carpus short, triangular, propodus ovate-elongate, nearly twice as long as broad, with convex palm slightly exceeding half of posterior margin, bearing a row of three median palmar spines and defined by group of corner spines; about ten groups of setae along posterior margin, below the corner spines of the palm, inner face of propodus with several facial setae (Fig. 3e); dactyli slightly exceeding half of propodus, without setae on inner and outer margins.

Pereopods 3-4 (Figs. 3a; 4a): basis with numerous long setae along both margins; merus, carpus and propodus with groups of short setae often accompanied by single or paired short spines, dactylus short and stout, nail much shorter than pedestal, with one short strong seta at inner margin.

Pereopod 5 (Fig. 3b): basis subrectangular, posterior margin nearly straight, with about fifteen weak indentations and rounded posteroventral lobe. Pereopods 6-7 slender (Fig. 3c, d); basis elongate, posterior margin proximally convex, distally narrowed, with about eighteen indentations, with well developed rectangular posteroventral lobe and one spine and two setae on inner face of the submarginal posteroventral portion; merus, carpus and propodus bearing short spines along both margins, accompanied by single short seta; dactyli short (Fig. 3d'), with short spine-like seta at inner
Fig. 3 — Sinogammarus troglodytes n. gen. n. sp., ♂ holotype 25 mm, Liujia cave, Sichuan prov. (China). a, pereopod 3; b, c, d, d', pereopods 5-7; e, e', peduncle of pleopod 1; f, peduncle of pleopod 3.
margin and one short plumose seta at outer margin, nail much shorter than pedestal.

Pleopods 1-3 normal, peduncle (Fig. 3e, e', f) with numerous long setae in proximal portion and two retinacula accompanied by two long setae.

Uropod 1 (Fig. 4c): peduncle longer than rami, with two basifacial spines and dorsoexternal row of spines, dorsointernal row of spines absent, inner ramus slightly longer than outer one, with only one marginal median spine, outer ramus with only one proximal spine. Uropod 2 (Fig. 4c): inner ramus markedly longer than outer one, with 2 marginal spines, outer ramus with only one median spine. Uropod 3 distinctly exceeding tip of uropods 1-2 (Fig. 4c, e): rami lanceolate, bearing long plumose setae along both margins, sometimes accompanied by single spines, outer ramus biarticulate, article 2 vestigial, shorter than adjacent spines and provided with distal setae (Fig. 4e'), inner ramus exceeding 4/5 of outer ramus.

Telson longer than broad (Fig. 4d), incised nearly to the basis, each lobe with two-three distal spines accompanied by several setae longer than the spines themselves and with several groups of setae on dorsal face of the lobes.

Female, 18.2 mm long. Dorsal groups of spines and setae of urosomites 1-3 according to the following formula (number of setae in parenthesis):

- 1(7) 1(8) 1(9) 2(8)
- 3(7) 1(7) 1(7) 2(5)
- 2(6) 0(5) 0(5) 2(6)

Antenna 1 slightly exceeding half of body, main flagellum with about thirty-two articles, usually bearing one short aesthetasc. Antenna 2: gland cone strongly exceeding tip of peduncular article 3, peduncle and flagellum with poorly long setae, flagellum with about fourteen articles, calceoli absent.

Maxilla 1: number of teeth on spines of outer plate, from inner to outer margin: 10-5-4-5-2-5-2-3-2-1-1 or 10-7-6-5-5-5-3-3-1-1.

Coxae 1-4 like those of male, but slightly longer (Figs. 5b; 6a).

Gnathopods 1-2 slightly smaller than those of the male. Gnathopod 1: merus with three groups of setae along posterior margin, carpus short, triangular, propodus subpyriform (Fig. 5a), almost twice as long as broad, palm convex, with only one median palmar spine, defined by groups of corner and subcorner spines (Fig. 5a'), dactylus
Fig. 4 — *Sinogammarus troglodytes* n. gen. n. sp., ♀ holotype 25 mm, Liujia cave, Sichuan prov. (China). a, pereopod 4; b, epimeral plates 1-3; c, urosome; d, telson; e,e' uropod 3.
Fig. 5 — Sinogammarus troglodytes n. gen. n. sp. ♀ paratype 18.2 mm, Liujia cave, Sichuan prov. (China). a, a', propodus of gnathopod 1; b, gnathopod 2; c, c', propodus of gnathopod 2; d, uropod 3. ♀ juv. 12 mm, Diuren cave, Sichuan prov. (China). e, e', uropod 3.
Fig. 6 — *Sinogammarus troglodytes* n. gen. n. sp., ♀ paratype 18.2 mm, Liujia cave, Sichuan prov. (China). a, pereopod 3; b, c, d, d', pereopods 5-7; e, f, uropods 1-2.
slightly shorter than that of male, with one median pair of setae at outer margin. Gnathopod 2 (Fig. 5b): merus with two groups of setae at posterior margin, carpus short and triangular, propodus (Fig. 5c) slightly less than twice as long as broad, with almost parallel lateral margins and nine posterior marginal groups of setae; palm oblique but relatively short, without median palmar spine, with three marginal spines near palmar corner and two short subcorner spines on inner face (Fig. 5c'), dactylus relatively short, with one pair of median setae along outer margin.

Pereopods 3-4 (Fig. 6a) like those of the male but with longer setae along posterior margin.

Pereopods 5-7 (Fig. 6b, c, d) slightly shorter and broader than those of male, especially the basis; merus, carpus and propodus with higher number of lateral setae than those of male.

Uropod 1 (Fig. 6e): peduncle with one basifacial spine, inner ramus distinctly longer than outer one, bearing one median and several distal short spines, outer ramus with distal spines only. Uropod 2 (Fig. 6f): inner ramus markedly longer than outer one, with one median and several short distal spines, outer ramus with distal spines only. Uropod 3 and telson like those of male.

**Variability**

The old spines of outer plate of maxilla 1, with more or less worn-out lateral teeth, have a lower number of lateral teeth than the new spines of the same maxilla (for example, the left maxilla of the female, 18.2 mm long, in the worn-out stage have the following formula of the lateral teeth: 8-6-5-3-4-2-?-2-1-1-1; the new spines of the same maxilla 1 have the following formula: 10-7-6-5-5-5-5-3-3-1-1). Peduncle of uropod 1 with one or two basifacial spines.

The juv. females of up to 12 mm from Diuren Cave agree with the specimens from the Liujia Cave, but article 2 of the outer ramus of uropod 3 can be slightly vestigial or slightly longer on the same specimen, while still being shorter than the spines around it (Fig. 5e, e'). Lobes of the telson with three distal spines each. Gnathopods 1-2 with palm of propodus much more similar to those of the genus *Gammarus*. Epimeral plates 2-3 with ventral spines only, ventromarginal spines absent.
ACKNOWLEDGEMENTS

We wish to express our warmest thanks to Dr. Jolanda Galletti of the Centro Ibleo di Ricerche speleo-idrologiche in Ragusa (Sicily) for having allowed us to study the interesting troglobiont Gammarid she found during the 1993 speleological campaign in China.

LITERATURE CITED

A new species of *Troglobius* (Collembola, Paronellidae) from Brazil

José G. Palacios-Vargas * and Douglas Zeppelini **

**SUMMARY**

*Troglobius brasiliensis* n. sp. from two caves of Brazil is described and illustrated.

The genus *Troglobius* was described originally from caves of Madagascar. The only species known is the type species *T. coprophagus* Palacios-Vargas & Wilson, 1990. Now we have found a new species of this genus in Brazil.

Cave Collembola from Brazil are very poorly known. Palacios-Vargas (1989) reported four new records from Brazil. Species reported from Brazilian caves are: *Acherontides leo* Palacios-Vargas & Gnaspini-Neto, 1992 (Hypogastruridae); *Troglolaphysa aelleni* and *T. hauseri* both of Yoshii (1988) (Paronellidae); *Cyphoderus* sp. (Cyphoderidae) and recently *Mesaphorura iowensis* and *M. yosiii* (recorded by Palacios and Diaz in press).

Information about the families of collembola associated to bat guano deposits was given by Gnaspini-Netto (1989 a, b). A good compilation on the cave fauna from Brazil was done by Trajano and Sánchez (1994) who cited about 160 different taxa including seven families of Collembola.

*Troglobius brasiliensis* n. sp. (Figs. 1-9)

**Description**

Habitus typical of Paronellidae (Entomobryoidea). Length 1.5 mm. Eyeless without pigment. Body with smooth and ciliated setae,
scales and the typical trichobothria. Antennae apparently without any typical sensillae.

Ratio of antenna to head = 1.8:1.0 and antenna to body length = 1:1.7. Antennal segment I without scales. Ratio of antennal segments I-IV as = 1:2.5; 2.5; 3.0. Ant. II without differentiated sensillae, but with scales. Apparently without sensorial organ of Ant. III and with few scales. Ant. IV unsegmented, with rows of setae and without apical bulb and blunt sensillae.

Head, with two pairs of trichobothria. Labrum with 4 rows of smooth setae; all the setae are smooth. Labral formula is: 4:5/5/4. Two small spine's dorsally close to prelabral setae (Fig. 1). Labial triangle with five smooth setae on row A. In posterior row, there is no setae «r». Posterior smooth setae can be named: M1, M2, E, L1 and L2 (Fig. 2).

Distribution of body trichobothria is two on the second segment and three on the third and fourth abdominal segments. Head, thorax, abdomen, and furcula with scales. Legs with ciliated setae. Coxa of leg with one large seta. Trochanteral organ with about 30 setae (Fig. 3). Tenent hairs are shorter than ventral unguis and acuminate; ratio ungues: tenent hair = 1:0.68 (Fig. 4). Unguis with two inner big basal teeth of different size; two median inner teeth and no outer tooth. Unguiculus with outer lamella well developed and the inner small (Figs. 4-6).

Posterior surface of ventral tube with two pairs of long setae and 11 distal pairs of small setae; anterior surface with several moderate setae (Fig. 7). Tenaculum with 4+4 teeth and only one ciliated setae on the corpus (Fig. 8). Furcula composed of manubrium, dens and mucro in the ratio 4.2; 3.5; 1.0. Dens without spines, but with ciliated setae and scales. Mucro is elogate and bears serrations in both edges with about 26 serrations of differente size (Fig. 9).

Variation

Ungues of specimens from Iporanga lack internal teeth. There is also a small variation in setae number of the trochanteral organ.

Discussion

In Troglobius brasiliensis n. sp. the antennae are longer than
Figs. 1-9 - Troglobius brasiliensis n. sp. 1, labrum; 2, labial triangle; 3, throcanteral organ; 4, tip of leg I; 5, tip of leg II; 6, tip of leg III; 7, chaetotaxy of ventral tube; 8, tenaculum; 9, tip of dente and mucro.
in the type species, but antennal segments ratio are more similar in
this species than in *Troglobius coprophagus*.

The new species has the unguis with two inner big basal teeth
of different size: two median inner teeth, in the type species the
basal teeth are small and have no inner teeth.

Both species share the presence of two pairs of large setae in
the posterior part of ventral tube, but *T. brasiliensis* n. sp. has eleven
pairs of small setae at the tip and the other species has only two
pairs.

An important difference in the mucro is the serration, in the
new species is in both edges and in the type species is only in one
side.

Labial chaetotaxy in the two species is the same. The third setae
of posterior row could be setae «R» well developed or «E» as stated
by Palacios-Vargas and Wilson (1990), only the discovery of new taxa
will confirm the correct designation of these setae.

*Type material*

The holotype and one paratype will be deposited at senior author's
institution. Two paratypes will be kept at the Zoological Museum of
Sao Paulo, Brazil. 17-X-1988, E. Trajano col. Only one specimen from
Riveira's valley was studied. 10-II-1989, E. Trajano col.

*Type locality*

The cave of Limoeiro, Medicilandia, Pará, Brazil. Other material
was collected from the cave «Gruta dos Paiva» at the province of
Iporanga, farm Intervales, Sao Paulo, Brazil.

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A NEW SPECIES OF TROGLOBIUS FROM BRAZIL


A new *Jujiroa* from Sichuan, China  
(Coleoptera, Carabidae)

Augusto Vigna Taglianti *

**SUMMARY**

*Jujiroa iolandae* n.sp. is described from Liujia Cave in China (Sichuan, near Huaying, between Chongqing and Nanchong). Strongly depigmented, with very reduced eyes and markedly elongated appendages, it is well distinguishable from Taiwanese and Japanese species, and from the two previously known species from China. One of these, *J. suensoni* from Shangxi, is quite different (its doubtful taxonomic position is perhaps to be referred to another genus or lineage); the other, *J. rufescens* from Jiangxi (Fujian), is more related to the new species, that differs by the longer and more sinuate pronotum, with fore and hind angles much more produced, by the presence of basal pore and the absence of first dorsal seta on elytra, and by the apical tooth acute, long and spine-like.

The new species extends well westwards the range of the genus, hitherto extending from southeastern Japan (five described species from Honshu, Shikoku, Kyushu), to Taiwan (seven species) and, in front, to Chinese Fujian.

The genus *Jujiroa* Uéno, 1952, was described for one species (*Sphodropsis nipponicus* Habu, 1950) from a southwest Japan cave. Previously suggested as member of the Sphodrini tribe (Habu, 1950; Uéno, 1952; Jedlicka, 1961), it was correctly referred to the Platynini by Uéno (1955), Habu (1978) and Casale (1988). Other species of this genus were later described or recorded from southwestern Japan (Uéno, 1955; Habu, 1978; Takakura, 1987; Nakane, 1989), from Southeast (Jedlicka, 1961) and North China (Kirshenhofer, 1990) and, finally, from the high mountains of Taiwan (Uéno & Saito, 1991).

The occurrence of *Jujiroa* in China was established by Casale (1988: 917), pointing out that *Taphoxenus (Sphodropsis) rufescens* Jedlicka, 1961 is not a Sphodrine, but a Platynine. This species, known

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on a single female specimen, from Kiangsi (= Jianxsi, southeastern China) is considered by Casale as probably belonging to this genus. According to Uéno & Saito (1991: 2), his «careful redescription and excellent illustration of the type specimen» allows to state that Jujiroa actually occurs in southeastern China and to suppose a presence also in Taiwan, as verified by Uéno & Saito (1991).

Another Chinese species, Jujiroa suensoni Kirschchenhofer, 1990, was later described, also on a single female specimen, from Shanxi (North China). According to the description and the accompanying photograph by Kirschchenhofer (1990), this new species seems to be quite different from all other of the genus, and does not accord with Jujiroa diagnosis. It is a very large (18.8 mm long) and robust species, with stout appendages and, above all, with simple elytral apex, without sutural denticle protruding: I agree therefore with the opinion of Uéno & Saito (1991: 2), that suensoni belongs to another line of Platynini.

I recently received a sample of two beetles collected in a cave during the speleological expedition to China («Sichuan '93 Project») organized by the Gruppo Grotte Ragusa, Italy. With an unidentified Alleculidae beetle, not belonging to the cave fauna, one Carabidae specimen appeared to be a true Jujiroa, very similar to rufescens: this Sichuan specimen (examined also by A. Casale) belongs to a new species, the second high specialized cave Platynine from China, extending northwards and westwards the range of the genus.

**Jujiroa iolandae** n.sp.

*Diagnosis*

A medium sized (14.5 mm long) species, light reddish brown, with long head, microphthalmic; long, narrow and sinuate pronotum, with sharply protruding acute fore and hind angles; elytra produced in an apical denticle, strong and spine-like; very long antennae; long and slender appendages, tarsi strigose.

Very similar to rufescens, the new species is easily recognizable by the longer and more sinuate pronotum, with much more protruding acute angles, the shape of apical spine, the presence of basal pore and the absence of the first dorsal pore on elytra (Fig. 1).
Fig. 1 - *Jujiroa iolandae* n.sp., from Liujia Cave in Sichuan, holotype: habitus.
Type material


Description

Total length 14.5 mm (13.2 mm from apical margin of clypeus to apical spine of elytron). Concolorous light reddish brown. Microsculpture in fine, almost faint polygonal meshes on the head, obsolete on the vertex, shiny; fine transverse meshes on pronotum; more evident isodiametrical meshes on the elytra, more or less sericeous.

Head ovoid, longer than wide (maximum length, from apical margin of clypeus to pronotum, 2.75 mm; greatest width 2.25 mm, behind eyes); frontal impressions light, short, right, ending in a shallow round fovea at posterior level of eyes; eyes small, slightly convex; genae long, feebly convex; two pairs of supraorbital setae on parallel lines; neck well marked, with rather shallow constriction; labrum transverse, with the apical margin sinuate, trifid for a median projection; mandibles long, rather right; postmentum quadrisetose, with longer inner setae, mentum bisetose, tooth sharply bifid at the tip; glossa bisetose, apically transverse cutted, paraglossae slender, slightly arcuate; antennae very long, total length about 11.5 mm, reaching apical fifth of elytra; scape and third article are the longest, subequal in length, segment 2 the shortest, 1/3 of 1 and 3, segment 4 (the first pubescent) more or less equal as 3, as also 5 and 6, 7-10 gradually decreasing, cylindrical, and terminal, conical, slightly longer than 10.

Pronotum subcordate, narrow, a little wider than long and than head greatest width, about equally narrowed in front and behind: 2.55 mm long (along the mid-line), basal width equal as head greatest width, fore width a little lesser (2.1 mm), the greatest width 2.9 mm (at about two-thirds from base); tegum gently convex, disc depressed, median line well marked, not reaching the two margins; sides widely reflexed throughout, arcuate in front, sinuate at middle, right and parallel towards hind angles; lateral furrows large and deep, smooth, with a side-parallel row of points, marginal, in each furrow; basal furrow large and deep, smooth, with basal foveae
clearly point-shaped; anterior pair of setae absent, postangular pair present, at the hind angles; anterior margin truncate at middle, front angles triangular, acute, sharply produced forwards; base slightly arcuate, hind angles triangular, acute, sharply produced backwards, apically denticle like. Prosternum glabrous, with apophysis depressed, simple, posteriorly narrow, but not sharply edged.

Elytra elongated (8 mm long), wider than pronotum, narrow at base and gradually dilated towards the middle which is the widest (4.4 mm together); basal border posteriorly arcuate, obtuse angulate at the base of third and sixth interval; lateral border rounded at shoulders, effaced; gently sinuate at fore fifth, regularly rounded behind, to the apical sixth; then right and slightly sinuate to the apex; median border a little abbreviate and apically divergent; apex acute, not truncate, mucronate, ending in a strong, acute produced, spine-like tooth; dorsum gently convex; striae well impressed, fairly punctate; intervals slightly convex; basal pore present, at the base of stria 1; interval 3 with two pores, one behind the middle, one at about the apical fifth; marginal series of umbilicate pores 22 in number, the setae 3rd, 15th, 20th being the longest; apical pores 4 in number, one at the apex of interval 3, another at the same level in the apical part of interval 7, and two marginal, shorter, at the outer base of the spine, at the end of striae 1 and 2.

Wings reduced, about to the length of metanotum.

Ventral surface glabrous; sternites bisetose; anal sternite subtruncate at the apex, quadrisetose.

Legs very elongated, especially in hind femora and tibiae (hind tibiae 4.2 mm long); tarsi slender, upper side glabrous, with deep longitudinal striae; segment 4 bilobed in pro- and mesotarsi, emarginate in metatarsus; segment 5 without secundary setae on the dorsal side.

Female genital appendages (Figs. 2-3) of Platynine (sensu stric-to) type; penultimate segment of gonostyli with normal fringe of setae on ventral surface; apical segment elongated, simple, gently curved, without dorsal seta, bearing three short lateral spines.

Male unknown.
Derivatio nominis

It is a pleasure to dedicate this new species, one of the very few specialized cave carabids hitherto known from China, to its lucky and kind collector, dr Iolanda Galletti.

Ecological notes

The type locality, Liujia Cave, is located in the Huaying Area (Sichuan, China), 810 m in altitude, about 80 km northwards of Chongqing and southwards of Nanchong, and about 250 km eastwards of Chengdu.

The cave, of fossil type, with only few dropping sites and pools, is 382 m long and 60 m deep. It is formed by a main tunnel, almost straight, westwards directed, smoothly descending in the first 50 m, followed by a rising ground for 15 m, southwards, and by a plain tunnel, 30 m long, southwestwards, with water pools, and some lateral pits. After this point, the main corridor descends rightly, on fallen stones, in the same southwest direction, for other 130 m. Around 50 m before the end, another corridor begins on the right, turning back northeastwards, for other 100 m with a halfway crossing shorter tunnel, eastwards directed.
From the ecological point of view, this cave seems to belong to the temperate type, rather dry (83% humidity) and warm (14°C water). The fauna seems rather poor, with few moths, crickets, millipedes, snails, but also with highly specialized elements, at least in the aquatic fauna, such as the Amphipoda Gammaridae (see Karaman & Ruffo, 1995, in this volume).

The unique specimen of Jujiroa iolandae n.sp. was found on the soil, in the rising ground before the water pools, at about 70 m from the entrance. The morphological features of this species, at a very high degree of specialization in adaptation to the subterranean life (i.e. depigmentation, microphthalm, long and slender appendages, complete reduction of wings), suggest to consider it as a true cave dweller.

Remarks

Jujiroa iolandae n.sp. is similar to rufescens in its general facies: medium sized (14.5 mm), with elongated and slender body, concolorously reddish brown; long head, little eyes, constricted neck, the same shape of labium and ligula; pronotum lacking in fore lateral seta; elytra not truncate at the apices, but ending with spine; very long appendages, strongly strigose tarsi with bilobed fourth article.

It differs in shallower frontal impressions, much longer antennae (reaching the apical fifth of elytra); pronotum longer, with more strongly sinuate lateral sides and much more protruding and acute both fore and hind angles; elytra with more protruding, acute and spine-like apical denticle; basal pore present at the base of the first interval, the third one with only two dorsal pores, lacking in first: one after the middle, one about at the apical fifth.

As pointed out by Uéno & Saito (1991: 6) J. rufescens seems to be closer to J. nishikawai than to other Taiwanese and Japanese species: but nishikawai, bearing a basal pore at the base of the first elytral interval and two pores on the third at about middle and apical fifth (as in iolandae), clearly differs in elytra truncate at the apices, as is usual in the Taiwanese species, and especially in the shape of pronotum, with rounded apical and basal angles.

It can be clearly argued that Jujiroa iolandae n.sp. belongs to the same species-group as J. rufescens (Jedlicka, 1961). Though each
of these two species are so far known from only single female specimens, they are easily recognizable by morphological characters and they are geographically separated from each other.

The locality of *Jujiroa rufescens*, from «Süd China: Kiansi - Fu-ceu», according to Uéno & Saito (1991: 2), may be on the Wu-Yi Mountains (Wuyi Shan) between Jiangxi (= Kiangsi) and Fuzhou, in Fujian; the locality of *J. iolandae* is the Liujia Cave, near Huaying, lying between Nanchong and Chongqing, in Sichuan, very widely distant to the northwest, more than 1000 km, from the previous locality.

With the finding of this new species, the wide distribution of the genus *Jujiroa* is stretched well westwards: from Japan, in the southwestern Honshu, eastwards to the Tenryû-gawa drainage area (Aichi Pref.), along the Pacific side, to the Kii Peninsula (Ise in the Mie Pref.), to the Islands of Shikoku and Kyushu, westwards to the Gotô Islands; in near all the high mountain of Taiwan; in southeastern China, in Jiangxi, and finally to western China, in Sichuan (Fig. 4).

![Fig. 4 - Distribution of the genus *Jujiroa*: R = rufescens, I = iolandae, ? = «Jujiroa» suensonii.](image-url)
If *J. suensoni* really belongs to this genus, its locality, Mian Shan in Shanxi, appears to be very distant to the north from both the «true» *Jujiroa* Chinese species: about 1300 km northwards from *J. rufescens* and about 1000 km northeastwards from *J. iolandae*. Not only, but the Shanxi region, clearly palaeartic, in North-Central China, is well known to be quite different, from the zoogeographical point of view, from the «transitional zone» Sichuan-Hubei-Hunan-Jiangxi of Southern China. These biogeographical remarks support the idea that the northern species belongs to another lineage of Platynini.

**CATALOGUE**

*Jujiroa* Uéno, 1952

A. Japan species (from caves and upper hypogean zone)

1. *nipponica* (Habu, 1950)
   SW Japan, Shikoku, Kochi Pref.
   Ryugado Cave, Kagami
   (limestone cave)

2. *troglodytes* Uéno, 1955
   Japan, Honshu, Aichi Pref.
   Ja-ana Cave, Shin-ana Cave
   (limestone caves)

3. *elongata* Uéno, 1955
   Japan, Honshu, Mié Pref.
   Gochigoé-no-yoko-ana, Oshawa-no-kaza-ana,
   Kuradani-no-ana Caves, Ise
   (limestone caves)

4. *ooni* Takakura, 1987
   Japan, SE Kyushu
   (evergreen broadleaved forest) W Kyushu

5. *ikezaki* Nakane, 1989
   Gotó Is.
   (lava cave)
6. «an undescribed species»
   (cfr. Uéno & Saito, 1991)

B. Taiwan species
   (not from caves, but in alpine zone)

6. nishikawai Uéno & Saito, 1991
   Central Taiwan
   Mt. Hsiao-hsüeh Shan 2630 m Mt. An-ma Shan 2630 m
   (Ta-hshüeh, Ho-p'ing Hsiang)

7. rectangulata Uéno & Saito, 1991
   Northern Taiwan
   Mt. T'ai-p'ing Shan 1200 m
   (Ta-t'ung Hsiang)

8. orthogenys Uéno & Saito, 1991
   Central Taiwan
   Mt. Mao-mu Shan 2550 m
   (Jen-ai Hsiang)

9. alticola Uéno & Saito, 1991
   Northern Taiwan
   Mt. Nan-hu-ta Shan 3250 m
   (Ho-p'ing Hsiang)

10. shihi Uéno & Saito, 1991
    Central Taiwan
    Mt. Cho-she-ta Shan 2130-2150 m
    (Jen-ai Hsiang)

11. longa Uéno & Saito, 1991
    Southern Taiwan
    Hsiang-yang 2140 m
    (Mt. Kuan-shan, Hai-tuan Hsiang)

12. parvicollis Uéno & Saito, 1991
    Central Taiwan
    Mt. Cho-she-ta Shan 2130 m
    (Wu-chieh Lin-tao, Jen-ai Hsiang)
C. China (from caves or uncertain)

   S China, Kiansi (= Jiangxi)
   Fuceu (Wu-Yi Mt. ?)
   (limestone cave ?)

   China, Sichuan
   Liujiang Cave, Huaying
   (limestone cave)

? *suensoni* Kirshenhofer, 1990
   China, Shanxi
   Mien Shan (= Mian Shan) 37° N 112°30' E
   (limestone cave ?)

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REFERENCES

Towards regressive evolution: the periodic colour change behaviour of a troglophilic fish *Nemacheilus evezardi* (Day)

Rohit K. Pradhan and Jayant Biswas *

**SUMMARY**

Present study is an attempt to know the existence of colour change physiology of the cave fish *Nemacheilus evezardi* (Day) along a circadian time scale. Though, due to subterranean mode of life, practically this function has no survival value. The study has been conducted simultaneously in two different photoperiodic conditions (LD 00: 24 and LD 12: 12 hr). The variation in different states of chromatophore have been computed with respect to different time points of the day. Results suggest that the phenomenon is lying completely disturbed in its *in situ* conditions. Interestingly, circadian rhythm in all the types of chromatophores were validated when the same fish was exposed under LD 12: 12 hr photoperiod.

**INTRODUCTION**

Cave environments are usually characterized by several relatively stable physical, chemical and biological parameters which directly impose their own effects on the cavernicoles. However, perpetual darkness alone is such a characteristic for any subterranean cave, that needs several adjustments to exist a successful life in it. Some of them have lower metabolic rates due to food scarcity (Poulson, 1964; Barr, 1968; Culver, 1982; Huppop, 1985; Biswas, 1991), and show development of various types of extra sensory organs due to non-operation of visual system in the dark (Greenwood, 1967), including almost no temporal adjustments due to the lack of light/dark cycles (Erckens and Martin, 1979; Pradhan et al., 1989; Biswas, 1990, 1993; Biswas et al., 1990a, b, c) etc. Besides it, other light dependent physiological functions, present in some groups of organisms are very interesting to study.

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Chromatophore dependent colour change, is a physiological function according to which, in nature, some organisms e.g., fish, frog and lizard are capable of changing their body colour with reference to its background colouration and/or the intensity of sunlight. In teleost, chromatophore dependent colour change, is a well established phenomenon, due to which the fish becomes pale or dark by bringing about the movement of melanosomes (melanin pigments) to the centre of chromatophore sac; aggregation of melanophores and palling the animal or by dispersion of the pigments in the extended branches of the sac to darken it. Several stimuli are responsible for operating this physiology via neural and/or hormonal pathway (Bagnara and Hadley, 1973; Kavaliers et al., 1980; Reed, 1988; Young, 1935; Owens et al., 1978; Rance and Baker, 1979; Hafeez, 1970; Enam, 1955; Abbott, 1970; Abbott and Favreau, 1971). Nevertheless, light (stimuli) is the main and major factor to act behind this physiology either directly or through the background response on which the animal is placed. Further, skin colour changes can also be seen to be completed in few minutes due to some excitement or due to sudden changes in ambient temperature. However, in teleosts, the chromatophore physiology is either entirely under nervous (Abbott, 1970; Abbott and Favreau, 1971; Schwassmann, 1977) or entirely under hormonal control (Neill, 1940) or through an interplay of both the agencies in various proportions (Healey, 1940). According to Kavaliers and Abbott (1977) the two systems usually act synergistically, but under any required circumstances one may act independently.

*Nemacheilus evezardi* (Day) Cobittidae: Pisces, is a hill stream loach, abundantly found in the river and cave of Kanger Valley National Park. From a pilot study, it has been found that the epigean form of this fish darkens very quickly with little excitement and it is not possible to study the colour change phenomenon of the same without any sophisticated method. However, in the present study a troglophilic counterpart of the same fish *Nemacheilus evezardi* (Day) has been taken as an experimental model. It is a tiny loach with very faint pigmentation and regressed vision. Several comparative reports on morphological, behavioural and physiological parameters from its nearest epigean counterpart *Nemacheilus evezardi* (Day) have placed it in a cavernicolous status (Biswas, 1990, 1993; Biswas et al., 1990a, b, c; Biswas and Pati, 1991). Here, an attempt has been made to study the chromatophore dependent colour
change phenomenon of this same dark adapted fish with respect to the circadian time scale. Attempt has also been made to know the influence of 12:12 hr. LD (light/dark) photoperiod on synchronizing the rhythmic pattern of this phenomenon.

MATERIALS AND METHODS

Cave fish, *Nemacheilus evezardi* (Day) were collected from subterranean cave (Kotumsar), situated at the bank of river ‘Kanger’ in Kanger Valley National Park, India (Lat.: 18°52'09" N; Long.: 81°56'05" E). It is more than 100 meters downwards from the land surface and remains completely dark all along with constant temperature 26 ±1°C. Inside the cave, flooding occurs during the monsoon, otherwise the water ditches of this cave are fed by seepage water throughout the year. Fish from such water ditches were transported to our laboratory at Raipur (Lat.: 21°14' N, Long.: 81°38' E) in a light proof container and maintained in a stock aquarium 75x30x30 cm, inside a completely dark double doored room for more than 3 months as an acclimation period. Before starting the study, total twenty four fishes of approximately same body weight (580 ±5 mg) and snout to vent length (4.00 ±0.5 cm) were randomly removed from the stock aquarium to a separate jar and at each of the following time points viz: 0900; 1300; 1700; 2100; 0100 and 0500 hr four fishes were killed by decapitation. The process for catching, killing and fixing the skin for study was completed in 30 seconds time period. Small pieces of skin from five different places of the dorsal portion of each fish were peeled and glycerine mounts were prepared and sealed with the help of nail polish. Chromatophore states (Hogben, 1936) per 0.5 mm² from the most gathered area of each slide were examined and numerically scored regarding the state of the chromatophores, such as punctate (state-I), punctostellate (state-II), stellate (state-III), reticulostellate (state-IV) and reticulate (state-V). These states are indeed the structure forms which appear during the dispersion/contraction of melanin pigments in the chromatophore sacs. Averages of such chromatophore states for each fish were calculated and final averages for each group of fish at different time points were tabulated. The spread of variance of data was expressed as standard error for each group.

In the IIInd set of this experiment twenty four fishes were again
chosen randomly from the stock aquarium and were transferred to another similar aquarium, exposed to LD photoperiodic schedule with 12 hours of light alternating with 12 hours of darkness (light switched off at 2000 hr and on at 0800 hr) continuously for 21 days. On 22nd day, that is, after 21 days of such acclimatization, fishes were killed and skins peeled and processed for determining the number of chromatophore types. The methods and timing of sampling were essentially the same as described earlier (set-I).

Statistical Methods: Means (±1SE) for each chromatophore type were computed and tabulated as a function of circadian time scale. Data were subjected to one way analysis of variance (Brunning and Kintz, 1977) to prove the time effect. Between groups, comparisons were made with the help of Duncan's multiple range test. Cosinor rhythmometry was employed to determine rhythm parameters (Nelson et al., 1979). In addition, the cosinor parameters (details in Table 1) were also compared between the two treatments (LD 00:24 and LD 12:12) for each state of chromatophore separately.

RESULTS

Results are summarized in Table 1 & 2, Figure 1. Under this section the chromatophore states of the cave fish, per 0.5 mm² skin area, has been described numerically both under continuous darkness schedule (LD 00:24) and after exposing the fish to a photoperiod (LD 12:12) consisting of 12 hours light alternating with 12 hours of darkness.

1) ANOVA followed by Duncan's multiple range test.

a. LD — 00:24 photoperiod — Results of ANOVA didn't reveal statistically significant time effects on numbers of chromatophore for any observed state (State I - V). Nevertheless, the two different time points where the chromatophore states were observed in its peak and nadir were seen to be differed only in first three states (I-III) at 5% level (from DMR tests).

b. LD — 12:12 photoperiod — Statistically significant time effects on the number of chromatophores occurrence were validated
TOWARDS REGRESSIVE EVOLUTION

ACROPHASE MAP

Fig. 1 - Circadian acrophase charts for five different states of chromatophore studied under complete darkness (hatched area) and LD 12:12 hr photoperiod (Light and dark area). Dark dots represent the acrophase time points, vertical bars around the dots define 95% CL, where the rhythm detected was found to be statistically significant (N = 4 × 6 = 24).

only on reticulostellate and reticulate states. However, excluding the chromatophore state-III (stellate) DMR tests revealed a significant difference between the time points when the number of chromatophores were found to be at its highest and lowest concentration.

2) Cosinor analysis

a. LD — 00:24 photoperiod — Statistically significant circadian rhythm was only valid in the occurrence of state-I chromatophore (punctate), with an acrophase timing of -102° (0648 hr) (95% CL -64° & -140°).

b. LD — 12:12 photoperiod — Excluding for the state III chromatophores, a highly significant circadian rhythm was observed in the other states: state I (μ = -101°; 95% CL= -60° & -140°), state II (μ = -79°; 95% CL= -42° & -116°), state IV (μ = -264°; 95% CL -235° & -293°) and state V (μ = -262°; 5% CL= -237° & -287°).
Table 1 — Circadian variations in the number of chromatophore types (Mean ± 1SE) of cave fish *N. evezardi* maintained under continuous darkness (LD 00:24) and LD 12:12 photoperiod.

<table>
<thead>
<tr>
<th>State of chromatophore</th>
<th>Light schedule</th>
<th>Time of day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>09.00</td>
</tr>
<tr>
<td>I</td>
<td>LD 0:24</td>
<td>18.66 ± 1.87</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>15.28 ± 1.77</td>
</tr>
<tr>
<td>II</td>
<td>LD 0:24</td>
<td>08.13 ± 1.49&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>11.87 ± 1.16</td>
</tr>
<tr>
<td>III</td>
<td>LD 0:24</td>
<td>11.43 ± 1.88</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>06.88 ± 0.31</td>
</tr>
<tr>
<td>IV</td>
<td>LD 0:24</td>
<td>03.33 ± 0.88</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>04.00 ± 0.41&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>LD 0:24</td>
<td>01.86 ± 1.16</td>
</tr>
<tr>
<td>V</td>
<td>LD 12:12</td>
<td>02.14 ± 0.29&lt;sup&gt;b,c&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

n=4

<sup>a</sup> Differs from mean value obtained at 09.00 h : P < 0.05
<sup>b</sup> Differs from mean value obtained at 13.00 h : P < 0.05
<sup>c</sup> Differs from mean value obtained at 17.00 h : P < 0.05
<sup>d</sup> Differs from mean value obtained at 23.00 h : P < 0.05

Results from DMR Tests.
Table 2 — Rhythmometry summary based on Least-Square fitting of 24 hr Cosine Function (24 hr=360°) to data illustrated in table 1.

<table>
<thead>
<tr>
<th>Chromatophore States</th>
<th>Light Schedule</th>
<th>Pr&lt;sup&gt;a&lt;/sup&gt;</th>
<th>p&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Mesor&lt;sup&gt;c&lt;/sup&gt;+1SE&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Amplitude&lt;sup&gt;e&lt;/sup&gt; in degree</th>
<th>Acrophase&lt;sup&gt;f&lt;/sup&gt; (Z) in hours 360° = 24 hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Punctate</td>
<td>LD 00:24</td>
<td>36</td>
<td>&lt;0.033</td>
<td>12.58+1.08</td>
<td>4.49</td>
<td>-102</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>27</td>
<td>&lt;0.036</td>
<td>12.24+0.65</td>
<td>2.57</td>
<td>-101</td>
</tr>
<tr>
<td>II Punctostellate</td>
<td>LD 00:24</td>
<td>06</td>
<td>&lt;0.616</td>
<td>09.84+0.93</td>
<td>1.31</td>
<td>-247</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>31</td>
<td>&lt;0.020</td>
<td>10.07+0.45</td>
<td>1.96</td>
<td>-079</td>
</tr>
<tr>
<td>III Stellate</td>
<td>LD 00:24</td>
<td>06</td>
<td>&lt;0.623</td>
<td>09.71+0.89</td>
<td>1.25</td>
<td>-278</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>04</td>
<td>&lt;0.622</td>
<td>07.62+0.17</td>
<td>0.57</td>
<td>-305</td>
</tr>
<tr>
<td>IV Reticulostellate</td>
<td>LD 00:24</td>
<td>08</td>
<td>&lt;0.501</td>
<td>04.68+0.46</td>
<td>0.78</td>
<td>-298</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>40</td>
<td>&lt;0.004</td>
<td>05.81+0.34</td>
<td>1.81</td>
<td>-264</td>
</tr>
<tr>
<td>V Reticulate</td>
<td>LD 00:24</td>
<td>01</td>
<td>&lt;0.919</td>
<td>02.54+0.05</td>
<td>0.25</td>
<td>-056</td>
</tr>
<tr>
<td></td>
<td>LD 12:12</td>
<td>45</td>
<td>&lt;0.001</td>
<td>03.08+0.17</td>
<td>1.02</td>
<td>-262</td>
</tr>
</tbody>
</table>

<sup>a</sup> Percent of total variability contribution by the fitted curve (PR).

<sup>b</sup> From a 'F' test of null amplitude rejection hypothesis (P).

<sup>c</sup> Rhythm adjusted mean of cosine function (Mesor).

<sup>d</sup> Standard error.

<sup>e</sup> Half of the total predictable change (Amplitude).

<sup>f</sup> Time of maximum in fitted cosine function, with local mid-night as reference (Acrophase).
Comparison of rhythm parameters: for punctate chromatophores neither circadian mesor nor amplitude and/or acrophase differed from each other when rhythm parameters of LD 00:24 and LD 12:12 were compared. However, circadian mesor values of only stellate and reticulate states of chromatophores were found to be different between two light treatments (LD 00:24 and LD 12:12 hr) at 5% level. Rest amplitude and/or acrophase could not be compared due to non-rejection of zero amplitude hypothesis under either 00:24 schedule or both (state-III).

DISCUSSION

It is well known that a given species adapted to dissimilar ecosystem behaves differently and exhibits dissimilar physiological activities. The degree of such divergences is directly dependent on the level of difference(s) between/among the ecosystem. And such differences often develop a completely new organism during the course of evolution. As stated earlier, subterranean mode of life requires several adjustments for existence and due to which various examples of regressive/constructive evolution could be observed in those organisms. In the present study, the chromatophore dependent colour change phenomenon is found to be functional with respect to the given photoperiods (12:12 hr) in troglophilic Nemacheilus evezardi (Day). Although in in situ conditions of this fish, all the five states of chromatophores have been observed, but due to the lack of light this function seems not at all dependent on melatonin (pineal hormone), serotonin, dopamine, or any other photo related hormones as it could be in the epigean ones (Bagnara and Hadley, 1973). Perhaps, some other hormonal/neural mechanism(s) are operating in this fish in DD (completely dark) conditions. However, in the present situation no explanation can be given in this regard.

Further, following exposure of the fishes to LD 12:12 photoperiods, it can be seen that in all the states of chromatophores a systematic pace with respect to the time could be observed barring for the stellate type. A maximum dispersion of pigments was noticed during later half of the light phase of LD 12:12 photoperiod. Infact, a gradual change in the chromatophores dispersion states from I to V (punctate to reticulate) with respect to the circadian time scale under 12:12 hr photoperiod could be easily detectable. According to the cosinor analysis this relationship finds corroboration in the
detection of acrophases of reticulostellate (state IV) and reticulate (state V) chromatophores, respectively at -264° (1706 hr) and -262° (1747 hr), and likewise detection of acrophase of punctate (state I) and punctostellate (state V) type chromatophores, respectively at -101° (0673 hr) and -79° (0527 hr).

The importance of time relation in the study of chromatophore dependent colour change phenomenon in teleost has long been recognized (Hogben, 1924). Though the late studies in number of teleost in this regard evidenced that the required duration for complete physiological change from state I to state V or vice versa varies from few seconds to several days (refer Parker, 1943). Maximum pigment concentration was noticed during the dark span of the LD 12:12 hr photoperiod. Thus the phenomenon of dark-time pallor could be stated to be still functioning, though it is operating in a very slow fashion, unlike to its epigean one. However, pigment development, including the colour change phenomenon is a very long process, exhibited by a wide norm of reactions. On the other hand, energy economy is known to be the most important physiological factor for any cavernicole. In such circumstances, the divergence in chromatophore dependent colour change phenomenon between hypogean and epigean population of any species is quite obvious. Does it not show a process of regressive evolution?

Arrhythmicity and/or extinction of a rhythm in any constant conditions does not support/oppose the theory of endogenous circadian system (Aschoff, 1960; Bunning, 1973). Perhaps, the underlying oscillator(s) is in damping state, which could again be restored under the presence of proper ‘zeitgeber’ (synchronizing factor). Results of the present study clearly indicate that in natural continuous dark conditions, the chromatophore physiology of this cave fish is operating at the basal level. The appearance of state I chromatophore (punctate) in a statistically significant circadian fashion and statistically no difference between the other circadian parameters suggest it. In addition, the given LD 12:12 photoperiod also failed to show any statistically difference in the total numbers of punctostellate (state II) from its value, observed under complete dark conditions. Nevertheless, marked differences have been observed in the concentration of later states of chromatophore (state III to V) under the influence of 12:12 hr light/dark schedules.


REED, B. 1968. The control of the circadian pigment changes in the pencil fish: a proposed role for melatonin. Life Sci. 7: 961-973.
Life cycle and population ecology of the cave cricket *Dolichopoda geniculata* (Costa) from Valmarino cave (Central Italy)

Gianmaria Carchini *, Mauro Rampini ** and Valerio Sbordoni *

**SUMMARY**

A *D. geniculata* population inhabiting a natural cave at low altitude near seashore was followed during two years. The population size, distribution in three age classes, spatial distribution, feeding habits were recorded. The life-cycle was found semivoltine, with overlaps between next choorts in each age class. A comparison to other *Dolichopoda* showed that the population of Valmarino cave is one of the best adapted to cave life, and this may be related with both historical and present geographical and ecological conditions of the cave.

**INTRODUCTION**

In Italy *Dolichopoda* cave crickets inhabit both natural caves, and newly opened artificial cavities. Populations from most of the species belonging to this genus can be found in either type of cave, even though natural and artificial caves differ in several ecological factors and in the age of the colonization events (Capolongo, 1966; Baccetti & Capra, 1970; Baccetti, 1982).

Previous studies on the genetic structure of several *Dolichopoda* species have stressed the relatively high genetic divergence existing even between geographically close conspecific populations (Allegrucci et al., 1987). It is therefore expected that physiological and morphological adaptations to either natural or artificial caves could be established and maintained particularly in isolated populations.

The aim of this study is to analyse in detail several ecological, phenological and demographic characteristics of a *D. geniculata*

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population from a natural cave, in order to compare them with similar data from artificial cave populations and to highlight possible alternative adaptive strategies.

MATERIALS AND METHODS

Valmarino Cave is a natural cavity located 15 m above sea level on the Thyrrenian coast near Terracina (Latium). The cave consists of a series of horizontal galleries in calcareous sandstone. The galleries are smooth with almost no fissures and speleothems. These physical features together with the small dimensions of the cave make the by-eye observation of the cave community much easier than in other limestone caves. A detailed topographic, lithological and climatological description of the cave, with a list of the actual fauna can be found in Carchini et al. (1982a). Using topographical methods, the Valmarino cave has been completely mapped and its inner surfaces calculated; the floor surface was 464 square meters and the wall and ceiling surface was 1244 square meters. On the basis of the physical features of the galleries, the cave has been divided in seven sectors (Fig. 1).

The «density plot» method (Seber, 1973) was employed to assess the absolute number of individuals (N) in the population. Permanent counting sites have been assigned in all cave sectors, but only on the cave walls and ceilings, since the cave crickets are rarely found on the floor. The Valmarino cave population was followed for two years. During the first year (May 1973 - April 1974) the population was sampled 9 times over a 341 square meters area. During the second year (May 1974-April 1975) ten samplings were carried out over a 623 square meters area. The cave crickets were counted at the same time by 3 observers, proceeding from the entrance to the end of the cave. According to Seber (1973) the population size N was calculated by: \[ N = \frac{N^o}{p}, \]
where \( N^o \) is the total number of the counted crickets, \( p \) is the ratio between observed surface and total surface of wall and ceilings.

On the same dates of density plot samples the Valmarino population was estimated also by mark-recapture method. Crickets to be marked were captured wherever found in the cave. After capture was completed, a small spot was painted on each individual on the prothorax. Recapture was undertaken 48 hours later. Population
size N was calculated according to Bailey (1951) by $N = \frac{M(T+1)}{(R+1)}$ where $M$ is the number of marked individuals, $T$ is the number of individuals caught on the second day and $R$ is the number of individuals marked the first day and recaptured on the second day.

The population size (N) estimates obtained by the density-plot method were very similar to the one obtained by the mark-recapture method. Because mark-recapture estimates have larger confidence intervals than the density-plot ones, in the following we will chiefly consider the latter. Further details of both estimates of N are reported in Carchini et al. (1982b).

At sampling each individual was assigned to one of three age classes based on mature-sex features and size. These classes included the adults (A), nymphs of determinable sex, usually longer than 7 mm (excluding appendages), called sub-adults (SA) and smaller nymphs of indeterminable sex, called young (Y). It was impossible from field observations to exactly determine the instar of nymphs. However, from laboratory data on post-embryonic development of
other Dolichopoda populations it could be argue that the Y class include the first four instars, and the SA class the remaining five, being the whole nymphal development characterized by nine instars (Di Russo et al., 1987). The absolute number of individuals included in each age class was estimated using the density plot method. The mobile mean (of order 3) was employed to study the seasonal variation in number of each age class and population size. To measure the degree of age heterogeneity the Evenness Index $J'$ was used, being $J' = H'/H_{\text{max}}$, where $H'$ is the well known Shannon diversity index $H' = \sum p_i \log p_i$ and $H_{\text{max}}$ is the same index, calculated for an equal division of specimens into the three age classes.

Information on the time span of each age class was obtained from mark-recapture data. Since the mark is lost at next moult, the time between the marking date and the last observation of that marked individual is an estimate of the time between two following nymphal molts. Conversely, for the adults that span is an estimate of the adult longevity. Because this method can only provide underestimates, we considered as instar spans or adult longevity the longest observed times.

In order to study the spatial distribution of cave crickets in relation to their distance from the cave entrance, the number of individuals found in a near entrance area ($A + B$ sectors, sampling surface 135 square meters) was compared with that of those in a inner topographically similar area ($F$ sector, sampling surface 105 square meters).

A faecal pellet analysis in $D. \text{geniculata}$ Valmarino population was carried out from periodical samples accounting for one yearly period (June 1979 - June 1980). The faecal pellets were obtained by individuals caught and isolated in the cave. The pellets were fixed in 70% alcohol and then opened and prepared for microscopic analysis.

Information on mating behaviour, diet and predatory habits was gathered by direct observation during samples between May 1973 and April 1975, and also from scattered observations carried out from January 1973 to May 1973 and from April 1975 to November 1980.
Population size

Table 1 lists numbers of *D. geniculata* cave crickets observed and estimated in Valmarino cave between May 1973 and April 1975. The number of individuals in each age class (A, SA and Y) and the population size (N), all estimated by density plot method, together with H' values are also reported. Fig. 2 shows the monthly mobile means of N, A, SA and Y.

The average of N for 19 samples in 1973-1975 was estimated 435 by density-plot method and at 427 by mark-recapture method. The seasonal variation in N was noticeable, with a peak in Autumn and a minimum value in the Spring. The variation is obviously due to the cumulative effects of the absolute variations of the three age classes, and mainly from the yearly variation of the Young, linked with the reproduction. However, from the trend of the Adult number in Fig. 2, one could argue for the existence of a longer trend of reduction in number, even if the slope of the regression line of the adult number vs time is not statistically different from 0 (slope = -0.147, t = 0.637, p > 0.25).

Table 1 — Monthly plot density estimate results. \( A_0, SA_0, Y_0 \), number of Adults, Sub-Adults and Young specimens counted within sample surfaces. \( p \), ratio between observed and total areas. A, SA, Y, estimates number of Adult, Sub-Adult and Young specimens. H', Shannon index.

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<th>( Y_0 )</th>
<th>( N_0 )</th>
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Life cycle and age structure

Mating pairs and egg deposition in the Valmarino population were observed occasionally during the winter, spring and autumn. Laboratory data on other *D. geniculata* populations indicate that egg deposition closely follows mating. No direct information is available on the duration of embryonic growth of the Valmarino population. Fig. 2 shows that the Young increased from April to September 1974 resulting from the hatching of a new generation. Therefore, the egg hatching is lengthened for at least six months.

Fig. 2 — Annual trend of the mobile means (of order three) of the number of Dolichopoda geniculata in Valmarino cave. N, A, SA, Y: total adult, sub-adult and young specimens respectively. Abscissa, time in months and years. Ordinate, absolute frequencies.
Fig. 3 — Recaptures of marked *Dolichopoda geniculata* specimens in Valmarino cave. A, SA, Y: adult, sub-adult and young specimens respectively. Abscissa, time in days. Ordinate, absolute frequencies.

Fig. 3 reports the frequency of recaptured individuals of the three age classes in relation to the time span since the marking events. From the highest observed values, we infer a duration of nymphaal instars of about 2 months for the Young, 3 months for the Sub-Adults, and a longevity of 5 months for the Adults.

The number of Youngs decreases from September to April. The decrease is due both to mortality and to recruitment of individuals into the next age class. The time span of the Young age class should sum up to 8 months, because the Young age class includes 4 instars,
Fig. 4 — A model of Dolichopoda geniculata life cycle in Valmarino cave. Only three subsequent yearly generations are showed. Note that three cohorts are often present in the cave at same time. Abscissa, years in Arabian and months in Roman numerals. Ordinate, age classes. For age class limits see text.

and each instar lasts about 2 months. Since the sum of the Young time span with hatching period reaches 14 months, yearly generations of Youngs overlap each other. Accordingly, the number of Youngs observed in the Valmarino cave never drops to zero, even if it shows clear yearly fluctuations.

The Sub-Adult time span is much longer than the Young’s one because the Sub-Adult age class includes 5 instars and each lasts about 3 months, so the total duration should be about 15 months, with an overlap of 3 months between subsequent generations. Moreover the overlap increases because of the long hatching period. Consequently, the yearly generations overlap each other for several months. Accordingly, the Sub-Adults always occur in the cave, their number doesn’t fluctuate as the number of Youngs and their periodicity is clearly not annual.

The Adult age class shows a time span of about 5 months. So, we should expect a lack of adults during some months. Nevertheless, the long hatching period reduces the theoretical time of the Adults absence to 1 month. Actually, the Adults are always present in the Valmarino population, and only a little yearly fluctuation with a minimum in October - November is detectable. The constant presence of Adults in the Valmarino population must be caused by the overlapping of following generations probably due to both different hatching dates and different growth rates among individuals of the same yearly generation. In fact, we observe that some Sub-Adults grow slowly (see Fig. 4), reducing the gap between the subsequent Adult generations.

From laboratory data, the Adults start to reproduce one month after the last moult and continue until their death, so the mating period lasts 4 months. Because of the above mentioned overlap, it may
be possible that mating occurs between individuals from distinct
cohorts, i.e. between individuals from the subsequent generations.

To sum up, the Valmarino cave *D. geniculata* life cycle should take
on average 23 months for the larval stage and 5 for the imaginal one.
In other Rhaphidophoridae cave crickets, the egg duration is 4-12
months long (Sbordoni et al., 1987) and in other *D. geniculata*
populations the embryonic development lasted, on average, 200 +/- 21
days (Di Russo et al., 1987). So we could infer that in Valmarino popu-
lation the egg stage requires several months. In any case, the life
cycle is semivoltine, it requires about 3 years and the growth of the
individuals of the same generation is not synchronous. A hypotheti-
cal model of the Valmarino cave *D. geniculata* life cycle is shown
in the Fig. 4. The considerable time span of the egg hatching, and
the length of time span of Y, SA and A age classes, cause the overlap
between the next generations, for every age class. Consequently, the
evenness value ($J'$), does not fluctuate like the absolute number of
the individuals. It shows only small aperiodic oscillations and an
overall constant trend in time (Fig. 5, regression line slope = 0.00009).

**Spatial distribution**

Crickets are found throughout the cave and, although their den-
sity varies in different sectors, it is very rare to observe individuals
in contact as well as aggregates. Fig. 6 shows the seasonal variations
of the density of individuals in the inner (F) and outer (A+B) sectors
of the cave. The inner sector is always more densely occupied than
the outer, and the difference between the average value of density
is statistically significant ("t" test: $p < 0.003$). Moreover, the outer sec-
tors are more thickly populated during the colder months of the year.
The contrary occurs in the inner sector, where a marked increase in
number of individuals is noticeable during the summer.

**Feeding habits**

Faecal pellets of 230 individuals of different age classes were ana-
lysed to study their diet habits. 20 individuals showed a predominance
of vegetables (not green) remains; 25 individuals had unidentified re-
 mains and the remaining individuals showed a large prevalence of
arthropod parts. The identifiable remains of arthropods were mostly
Lepidoptera scales (into 62 faecal pellets) and bits of
Fig. 5 — Comparison between annual trends in the Evenness (J') of age classes in Valmarino and Villa Ada cave Dolichopoda geniculata populations. Solid circles, Valmarino cave values. Empty circles, Villa Ada cave values. Abscissa, time in months. Ordinate, Evenness values. Dotted straight and sinusoid lines were obtained by minimum square method.

spider cuticle (into 30 faecal pellets), with less numerous Diptera and Coleoptera remains. Bat hairs are also very frequent. Overall faecal pellets seem very similar in appearance to the bat guano found in the cave, when prepared and examined by the same technique.

Information on the feeding habits of *D. geniculata* of the Valmarino cave were also derived from direct observation: there are several reports of individuals feeding on spider exuviae or dead moths, moreover Sub-Adult and Young were mainly found where bat guano was accumulated. So the diet of *D. geniculata* in the Valmarino cave appears to be mostly a saprophagous diet based on food found inside the cave.
LIFE CYCLE AND POPULATION ECOLOGY

Fig. 6 — Comparison between specimens density of Valmarino cave Dolichopoda geniculata in a deep area (sector F) and a near entrance area (sum of A and B sectors). Abscissa, time in months. Ordinate, density values.

COMPARISON WITH OTHER POPULATIONS

Even if several studies have been devoted to population ecology and genetics of Dolichopoda few populations have been investigated to some detail as Valmarino population. However, a comparison with a population of D. geniculata from the artificial cave of Villa Ada is of a special interest since physical features of these two caves are similar and seasonal data on population size, age class structure, spatial distribution and feeding habits were seasonally recorded for two years (Rampini et al., 1983). Table 2 shows the comparison between physical features of the two caves and table 3 some comparable data of. D. geniculata populations.

Population size

The average population size of Valmarino population was surprisingly low for an Insect population. In particular it was about ten times lower than recorded in Villa Ada cave, which shows similar physical features (see Tabs. 2 and 3). This findings supports the general trend of artificial caves populations which are bigger than population from natural caves, even when the ratio between
population size and cave dimension is considered (Carchini et al., 1983).

**Life cycle and age structure**

Data on egg, nymph and adult time span, here inferred by mark-recapture data, were also studied in samples reared in the laboratory. The life cycle observed in samples from artificial caves shows shorter growth times and Adult longevity: 15 months for the larval stage, and 3-4 months for the Adult life span. Therefore the overlap between the next generations in each age class is smaller than in natural cave populations. Consequently, the presence of two separate cohorts is clearly observed in artificial populations, while natural cave populations do not show the separation between the cohorts (Di Russo et al., 1987).

In agreement with the above mentioned features of life cycle, the age structure is more constant in the Valmarino population than in the other studied populations, as displayed by J' values, summarizing the age class composition. A comparison between the two populations from Valmarino cave and Villa Ada cave is shown in Fig. 5. It can be observed that the Valmarino J' values are almost constantly near the maximum, while the Villa Ada values strongly fluctuate seasonally and are rarely near the maximum. This means that the Valmarino population is always equally divided into the three age classes and, conversely, the Villa Ada population is often unequally divided. In fact, in some seasons the Villa Ada population completely lacks of one age class (e.g. the Adults in winter) (Rampini et al., 1983). This particular character was subsequently investigated in 35 natural and 32 artificial cave populations. The natural cave population J' values were significantly (P < 0.001) higher than artificial ones at a Mann-Whitney “U” test (Carchini et al., 1989).

**Spatial distribution**

As reported in the results, cave crickets in the Valmarino cave do not form aggregates and only rarely can individuals be found close to each other. On the contrary, it is always possible to find aggregates of hundreds of individuals in close contact in the Villa Ada cave, even though the size of the cave allows large inter-individual distances. Furthermore, in the Villa Ada cave the outer sectors are the
Table 2 — Comparison between some physical and environmental parameters of the Valmarino and Villa Ada caves.

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<tr>
<td>Vegetation near entrance</td>
<td>Laurus Wood</td>
<td>Olea, Cupressus Bush</td>
</tr>
<tr>
<td>Number of species</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>Guano presence</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

most densely populated, especially during the warm months. On the contrary, in the Valmarino cave the inner sectors host the majority of the population, while a shift towards the outer sectors occurs only in the cold months. Preliminary unpublished studies on several populations show that the two opposite spatial distribution patterns, observed at the Valmarino and Villa Ada caves, are linked with the cave type (natural or artificial), as for the above mentioned characters.

Table 3 — Comparison between the Valmarino cave and the Villa Ada cave Dolichopoda geniculata (Costa) populations. N, population size. L, cave length. H', Shannon index calculated from age class composition. $V_N$, coefficient of variation of population size. $V_{H'}$, coefficient of variation of the Shannon index.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Valmarino Cave</th>
<th>Villa Ada Cave</th>
</tr>
</thead>
<tbody>
<tr>
<td>N, mean</td>
<td>435</td>
<td>4516</td>
</tr>
<tr>
<td>N mean/L</td>
<td>3.51</td>
<td>12.9</td>
</tr>
<tr>
<td>$V_N$ %</td>
<td>30.7</td>
<td>7.9</td>
</tr>
<tr>
<td>H', mean</td>
<td>1.02</td>
<td>0.47</td>
</tr>
<tr>
<td>$V_{H'}$ %</td>
<td>7.0</td>
<td>34.5</td>
</tr>
</tbody>
</table>
Feeding habits

Even though data on faecal pellets of the Villa Ada cave crickets are very limited, the collected data contrast with data of the Valmarino population. Faecal pellets from 14 individuals showed vegetable remains in 8 individuals (2 were green tissues), unidentifiable fragments in 5 and fragments from arthropods cuticle in one individual only. These findings indicate a diet based on foraging outside the cave, in clear contrast with the diet observed in the Valmarino population. Other studies on feeding habits of several, even conspecific, Dolichopoda populations confirm these differences between those inhabiting artificial and those inhabiting natural caves (Di Russo et al., 1991).

CONCLUSIONS

The D. geniculata population of the Valmarino cave showed marked differences compared to the conspecific population of the Villa Ada cave. Similar differences were also highlighted from a broad comparison based on several artificial and natural cave populations (Carchini et al., 1991). To sum up, the overall life cycle features assessed in these Dolichopoda populations agree with two opposite life cycle patterns: a seasonal one and an aseasonal one. The first is characterized by a limited reproductive period, and a conspicuous seasonality both in age structure and nymphal diapause. The second is characterized by continuous reproduction and absence of both seasonality in the age structure and nymphal diapause. These two different patterns are related to differences in feeding habits, the seasonal populations having a diet mainly based on green vegetables and other epigean food sources, and the aseasonal ones a diet mainly based on animal remains, occurring in the cave itself such as bat guano. Moreover, differences in egg number, egg size, fertility and population size were pointed out, all related to the ecological features of the caves, rather than to genetic or geographic distances between populations. As a whole, the differences observed between natural-artificial-cave populations seem to match the "K" and "r" adaptive strategies, the "K" pattern being a result of an adaptation to the life in the caves (Carchini et al., 1991; Di Russo et al., 1994). The Valmarino cave population, compared to Villa Ada and the re-
remaining studied populations from artificial caves, showed the typical traits of the aseasonal life cycle. In a sense, this allows us to consider the Valmarino cave population as one of the best cave-adapted populations studied so far.

Although the life cycle traits are not related to the genetic structure of population (Sbordoni et al., 1991), the reduction of the gene flow between neighbouring populations may have encouraged the establishment of an aseasonal life cycle. Gene flow was found particularly low between populations at low elevation near the seashore (Sbordoni et al., 1985). In fact, several marine transgressions, in the last 1,000,000 years, isolated some coastal areas (Bigazzi et al., 1973) and, added to this, present xerothermic climate does not allow long distance migration outside the cave for the Dolichopoda cave crickets which inhabit coastal zones. The Valmarino cave open at the base of the Ausoni mountains, circumstance that created a confinement when the sea level was higher than now. Furthermore, the cave entrance is at present on the boundary between a cultivated coastal plane and an arid mountain slope facing South, with grass and a few Cupressus trees, often burnt on summer. Therefore, historical factors and present climatic condition limited and limit the gene flow between the Valmarino cave population and the surrounding ones, protecting its adaptation to cave life.

ACKNOWLEDGEMENTS

This study was supported by grants from Italian M.U.R.S.T. and from Italian C.N.R. to G. Carchini and V. Sbordoni. We wish to express our thanks to Dr. N. Falchi for his skilful in drawing the figures.

REFERENCES


Roger Husson (1911-1993)

François Graf and Guy Magniez*

Nous sommes au regret de vous faire part du décès du Professeur Roger Husson, ancien membre de la Société de Biospéologie, survenu le jeudi 30 septembre 1993.


Né à Nancy le 31 mars 1911 et après des études universitaires dans cette ville, Roger Philippe Eugène HUSSON fut nommé Conservateur des Collections du Musée de Zoologie de Nancy dès 1933. Cette même année, il accompagna le Professeur Paul Remy dans une grande expédition biospéléologique dans les Balkans (Sandjack de Novi-Pazar, confins de l'Albanie et du Monténégro, Macédoine grecque...). Il fut nommé Assistant de Biologie Animale à la Faculté des Sciences de Nancy le 1er janvier 1937. Officier de réserve, il passa les années 1940-1945 comme prisonnier de guerre à Grossborn, puis Arnswald et enfin Wietzendorf. Son travail de thèse, soutenu in absentia le 24 juin 1943 à Paris portait sur «La faune des cavités souterraines artificielles». Chef de travaux de Biologie Animale à Nancy le ler octobre 1945, il fut détaché le ler février 1948 comme Maître de Conférences, puis le ler janvier 1950 comme Professeur à l'Université de la Sarre. Le ler octobre 1957, il fut nommé Professeur à l'Université de Bourgogne et titulaire de la chaire de Biologie Générale jusqu'à sa retraite, le 30 septembre 1979.

* Département de Biologie Animale, Université de Bourgogne. 6, Bd. Gabriel, 2100 Dijon, France.
Roger Husson était l’auteur, non seulement de nombreuses publications biospéleologiques, mais également de multiples travaux concernant les faunes de surface (Entomologie forestière, Amphibiens, Crustacés épigés, etc.).

PUBLICATIONS BIOSPÉLEOLOGIQUES DE ROGER HUSSON


Dessin de Constantin Motas, Réunion de la Société Zoologique de France; «Problèmes de la régénération», le 10 mai 1967.


33 - Crustacés Pécaracides des eaux souterraines (Isopodes - Amphipodes), introduction à un film documentaire Kodachrome 16 mm, réalisé à l'Institut de Biologie Animale de l'Université de la Sarre. C.R. 75e Congr. AFAS, Dijon, (1956), 1957 (coll. J. Daum).


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