

UDK 595.371(497.16)

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**AMPHIPODA (CRUSTACEA MALACOSTRACA) OF THE LOVČEN  
MASSIF AND ITS SCIENTIFIC SIGNIFICANCE**  
(Contribution to the Knowledge of the Amphipoda 211)

ABSTRACT

The fauna of the epigeal and hypogean *Amphipoda* (13 taxa) of the Lovćen massif in Crna Gora (Montenegro) is presented, including its scientific significance. New data of an endemic genus and species, *Accubogammarus algor* (G. Kar. 1973) are given, and the problems of the protection are discussed

IZVOD

**AMPHIPODA (CRUSTACEA MALACOSTRACA) MASIVA LOVČEN I  
NJEN NAUČNI ZNAČAJ**  
(211, Prilog poznavanju Amphipoda)

Dat je pregled faune, površinskih i podzemnih *Amphipoda* (13 taksona) masiva Lovćen u Crnoj Gori, kao i njen naučni značaj. Prezentirani su novi podaci o endemskom rodu i vrsti *Accubogammarus algor* (G. Kar. 1973), te problemi zaštite faune *Amphipoda* ovog regiona.

INTRODUCTION

The region of the Lovćen massif in Crna Gora (Montenegro, Yugoslavia) considered in this work (sitting between Boka Kotorska - Budva - Cetinje - Rijeka Crnojevića) is mainly covered by the calcareous rocks containing numerous caves and other carstic formations.

In the situation that this region is supplied by very abundant atmospheric precipitations (over 2.500 mm pro year), this region is very rich in the subterranean carstic waters, and poor in the surfacing (epigeal) stream waters. The waters of almost all

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springs and the subterranean waters drain out either into the basin of the Skadar Lake (Rijeka Crnojevića, Obod Cave, etc.), or into the Boka Kotorska Bay and Budva, through the springs along the coast of the sea (Skurda spring, Ljuta spring, etc.), small torrents or in the submarine or oko's.

The Lovćen massif belongs to the west Balkan refuge zone with preserved numerous tertiary elements, exterminated in other parts of Europe during the periods of the glaciations. For this reason, the fauna of this region in general, including that of the *Amphipoda*, is very various and rich.

Despite the fact that the fauna of Amphipoda of Lovćen massif is still not completely known, the existing data based on our personal studies and these from literature, indicate the existence of 13 taxa belonging to 11 genera and 4 families of *Amphipoda* (*Gammaridae*, *Bogdiellidae*, *Niphargidae*, *Crangonyctidae*).

#### REVIEW OF KNOWN AMPHIPODA SPECIES FROM LOVČEN MASSIF

The fauna of *Amphipoda* of Lovćen massif is consisting of various elements:

##### I TERTIARY ELEMENTS.

This species belonging to this group represent the taxa existing there in the epigean or hypogean waters since the tertiary period:

*METOHILA CARINATA* Absolon 1927, an endemic hypogean monotypic genus known in CRNA GORA from Obodska pećina - cave near Cetinje (G. K a r a m a n, 1974, 1974b). This species is known also from HERZEGOVINA: subterranean waters of Musnica River (A b s o l o n, 1927); Bileca (S. K a r a m a n, 1953, G. K a r a m a n, 1974); Dejanova pećina - cave near Bileca (G. K a r a m a n, 1974). Locus typicus: Bileca.

*TYPHLOGAMMARUS MRAZEKI* (Schäferna 1906), an endemic monotypic hypogean genus, found in CRNA GORA in following localities of Lovćen massif; Gornja Grbocica Cave between Virpazar and Rijeka Crnojevića (G. K a r a m a n, 1988), Lipska pećina - cave near Cetinje (S c h ä f e r n a, 1906; 1922; S. K a r a m a n 1932, 1953; G. K a r a m a n, 1972); well near village Njeguši (Cetinje-Kotor) (S c h ä f e r n a 1906, 1922); Obodska pećina - cave near Rijeka Crnojevića (S k e t, 1958). This species is known also from CROATIA: spring near Šibenik (S p a n d l, 1926), spring Rudnica, Kamenica, cave near Slunj (G. K a r a m a n, 1972), spring in the cave under waterfall Krcic (spring of Krka River) (G. K a r a m a n, 1972, 1988) and HERZEGOVINA: Vjetrenica cave in Popovo polje and spring of Trebišnjica river (S. K a r a m a n, 1932; 1953, G. K a r a m a n 1972, 1973a, 1974); Popovo polje (S p a n d l, 1926). Locus typicus: Lipska pećina - cave.

*ACCUBOGAMMARUS ALGOR ALGOR* (G.Karaman 1973) is endemic hypogean genus known only from the subterranean waters of CRNA GORA: Stanina pećina - cave near Vučji Do (between Nikšić and Trebinje) (G. K a r a m a n 1973a, 1974, 1974b) and from Cave in Josova Glavica, Njeguši (present work). Locus typicus: Stanina pećina - cave.

The another hypogean subspecies, *Accubogammarus algor jalzici* G. Karaman 1988 is known from the cave in Gromaca near Dubrovnik, Croatia.

*LAUROGAMMARUS SCUTARENSIS* (Schäf. 1922) is an epigean endemic genus and species known from various localities in the basin of Skadar Lake only, including the river Rijeka Crnojevića (Obodska rijeka - river) and its spring (G. K a r a m a n 1974b, 1978, 1981, 1984a; J a k o b i 1981; Podseljani, Donja Gorica (S t o c k, 1968). Locus typicus: Ribnica river in Podgorica.

*NIPHARGUS BREVICUSPIS BREVICUSPIS* Schell. 1937, endemic hypogean

taxon known only from the cave Gornja Pokljuka in Knezlaz above Risan in Boka Kotorska (S c h e l l, 1937, G. K a r a m a n, 1968, 1974b). Locus typicus: Gornja Pokljuka - cave.

*NIPHARGUS BREVICUSPIS SKETI* G. Karaman 1966, an endemic subterranean taxon of Lovćen massif, known from Grbočica cave near Trnovo (Virpazar - Rijeka Crnojevića) (G. K a r a m a n, 1966), springs on Lovćen Mt; Lipska pećina cave (G. K a r a m a n, 1974b). Locus typicus: Grbočica cave.

*NIPHARGUS VJETERNICENSIS KUSCERI* S. Karaman 1950 is an endemic subterranean subspecies of Crna Gora and Herzegovina, known in Crna Gora from springs in Boka Kotorska; springs in Ljuta near Kotor (Boka Kotorska) (S. K a r a m a n, 1950, G. K a r a m a n, 1967, 1984); Skurda springs in Kotor (G. K a r a m a n, 1984); Gurdic spring in Kotor (new). Otherwise, this taxon settles the space between Podgorica (=Titograd) - Danilovgrad - Nikšić - Mratinje in Crna Gora and that to Bregava (Stolac) in Herzegovina. Locus typicus: Ljuta spring near Kotor, Boka Kotorska (G. K a r a m a n, 1984).

The form *N. vjet. kuscerei* forma *bilecanus* S. Kar. 1953 is known from subterranean waters in region of Bileća and Dabar valley (Ljeljesnica cave), Herzegovina (G. K a r a m a n, 1984).

The nominal subspecies, *N. vjeternicensis vjeternicensis* S. Karaman 1950, is known from the Vjetrenica cave and some other localities in Herzegovina (G. K a r a m a n, 1984).

*GAMMARUS BALCANICUS* Schäferna 1922 is an epigeal species known from the studied region from the bed of Rijeka Crnojevića river (=Obodska rijeka) (G. K a r a m a n, 1969a, 1977a). Otherwise, this species is widely distributed in numerous spring, rivers and lakes over Crna Gora. *G. balcanicus* is one very variable species, forming various local forms, and it settles southeastern Europe, and partially central and eastern part of Europe (see G. K a r a m a n & P i n k s t e r, 1987). Locus typicus: springs in Kolašin.

## II. GLACIAL AND POSTGLACIAL ELEMENTS.

The taxa of this group settled subterranean and epigeal waters during or after the periods of glaciation. In other parts of Crna Gora there are several taxa belonging to this group, but from Lovćen massif only one taxon is known:

*SYNURELLA AMBULANS* (F. Müller 1846), one semisubterranean, relatively common species, settled entire Balkan peninsula and eastern part of Europe. This taxon was collected in Lovćen massif in some localities: Spring on Ivanova Korita (Lovćen); spring on Sv. Trojica above Kotor (G. K a r a m a n, 1974a). Locus typicus: Greifswald, Germany.

This very variable taxon is known from Crna Gora in two forms: an epigeal form (*S. ambulans s. str.*), with well developed eyes and body-pigment, and the hypogean form, *S. ambulans f. subterranea* S. Kar. 1931, with reduced eyes and pigment of the body. All collected specimens on Lovćen massif belongs to the epigeal form (*S. ambulans s. str.*). Along the coast of Skadar lake, on the places under the influence of the subterranean streamwaters, appears *S. ambulans f. subterranea* (G. K a r a m a n, 1974a).

One endemic subterranean taxon of this genus, *Synurella intermedia monteneigrina* G. Kar. 1974, is known from the basin of Skadar lake only (Golubovci, Podgorica, Danilovgrad), always in the cold subterranean waters. We suppose that this taxon probably settles much larger area of Crna Gora. Locus typicus: Golubovci near Podgorica.

## III. MARINE ELEMENTS.

Taxa of this group penetrated from the sea settling brackish and fresh waters in various geological periods. In Lovćen massif appear some of these elements:

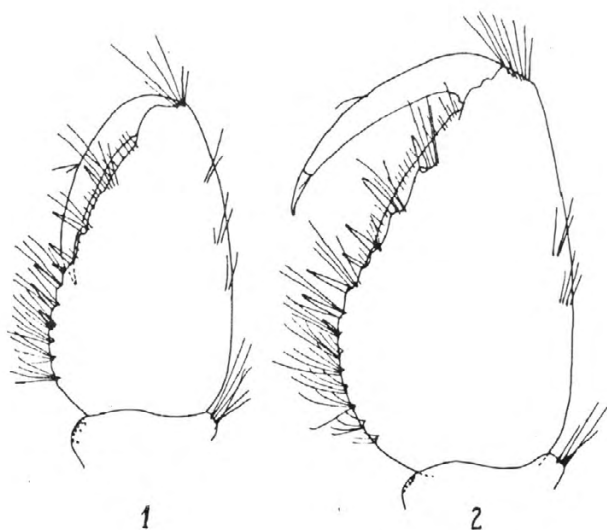
*ECHINOĞAMMARUS VENERIS* (Heller, 1865). This epigeic taxon appears, within the studied area, in the brackish and freshwater springs and torrents of Lovćen massif: Springs in village Brajići above Budva (new); spring on Sv. Trojica above Kotor; Boka Kotorska (springs on Glavati near Prčanj; springs in Morinj; springs in Orahovac; springs in Ljuta; springs in Perast and Risan; springs in Verige; springs near Herceg Novi); torrents in Budva; spring near Reževići monastery near Budva (G. Karaman, 1969) (see G. Karaman, 1960a, 1982, and unpubl. data); Rijeka Crnojevića river (Schäfer, 1922 sub *E. pungentiformis*: G. Karaman, 1969a). *E. veneris* is the Mediterranean endemic species, widely extended in the eastern part of the basin of the Mediterranean sea, from Italy to Israel. Locus typicus: Spring Venus on Cyprus island.

*BÖGIDIELLA (MEDIĞIDIELLA) DALMATINA* S. Karaman 1953 is an endemic subterranean species for the eastern coasts of the Adriatic Sea. Within our studied area, this taxon is known from the fresh and brackish-water springs along the seashore in Boka Kotorska and Jaz near Budva (G. Karaman, 1973b, 1974b, 1982). Locus typicus: Lapad (Dubrovnik), Croatia.

*RHIPIDOĞAMMARUS KARAMANI* Stock 1971 is brackish water semisubterranean species. Within the studied area, this species is known from various springs along the sea-coast in the Bokakotorska Bay (G. Karaman, 1969; Karaman & Ruffo 1977; G. Karaman, 1982). Endemic Mediterranean species, widely extended in the springs along the coast of the Adriatic Sea and western part of the Mediterranean Sea. Locus typicus: Miomo, Corsica island.

*NEOĞAMMARUS ADRIATICUS* G. Karaman 1973 is one brackish water semisubterranean species existing in the brackish water-springs along the sea-shore. Within the Lovćen massif, this taxon is known from Bečići near Budva. Endemic species for the coast of the Adriatic Sea (G. Karaman, 1982). Locus typicus: Bečići near Budva.

Fig. 1.  
*Accubogammarus  
algor algor*  
G. Kar. 1973,  
cave  
in Josova  
Glavica,  
male 11.9 mm:  
1 = gnathopod 1;  
2 = gnathopod 2.



TAXONOMICAL PART  
ACCUBOGAMMARUS ALGOR ALGOR (G. Karaman 1973)

Fig. I

*Typhologammarus algor* G. Karaman 1973 : 495, fig. 3 (1-7).

*Accubogammarus algor* G. Karaman 1974a : 5; G. Karaman 1974b: 55, fig. VI, 8-14; Barnard & Barnard 1983: 87, 505.

*Accubogammarus algor algor* G. Karaman 1988 : 64, fig. I, 1-6.

MATERIAL EXAMINED: CRNA GORA: Cave in Josova Glavica, Njeguši near Cetinje, July 30, 1990, 4 spec. (leg. S. Ognjenović & S. Micic).

REMARKS. The taxon *Accubogammarus algor algor* was described based on knowledge of only one specimen, ovig. female, collected in Stanina pećina - cave near Vučji Do. Consequently, the males and the variability of this taxon were completely unknown. For this reason we shortly redescribed this taxon, based on specimens from new locality, Josova Glavica cave:

FEMALE ovig. 14 mm: Body stout. Metasomal segments 1-3 with 6-8 longer dorsoposterior marginal setae each. Urosome low, urosomite 1 with dorsolateral setae only (setae are in parentheses), urosomite 2-3 with seate and spines, as follows:

(1)	(1)	(1)	(1)
1(2)	(1)	(1)	2(2)
1(3)	—————		1(3)

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

Lateral cephalic lobes narrowly subrounded (not broadly as in ssp. *jalzici*), eyes absent.

Antenna 1 nearly reaching the body, peduncular segments 1-3 progressively shorter; main flagellum consisting of 30 articles (most of them with 1 aesthetasc). Accessory flagellum 3-segmented, shorter than last peduncular segment of antenna 1.

Antenna 2: peduncular segment 5 only slightly shorter than 4 (much shorter in ssp. *jalzici*), both with 3 transverse groups of setae longer than diameter of articles themselves; flagellum slender, consisting of 15 articles. Antennal gland cone long, nearly reaching 2/3 of last peduncular segment of antenna 2.

Labrum entire, labium without inner lobes. Mandible with triturative molar. Mandibular palp segment 1 smooth, segment 2 with cca 17 seate; segment 3 shorter than 2, subfalciform, with 1 group of A and B setae, 2 C-setae (C setae absent in ssp. *jalzici*), 17 D-setae and 5-6 distal E-setae.

Left and right palp of maxilla 1 slender, reaching half of spines of outer plate (shorter in ssp. *jalzici*), bearing 6 distal setae each.

Gnathopodes 1-2 large, gnathopod 1 remarkably smaller than 2. Segment 6 of both gnathopods pyriform, with row of palmar spines (broader in ssp. *jalzici*).

Pereopods 3-7 long and slender (stout and shorter in ssp. *jalzici*).

Epimeral plates 2-3 pointed ventroposteriorly, with 3-4 subventral spines each.

Pleopods 1-3 with progressively shorter peduncle bearing 3-4 retinacula each (formula: 4-4-3); posterior margin of peduncle of pleopods 1-2 with several bunches of setae only; peduncle of pleopod 3 with 2 distal and 1 subdistal spine and 4 pairs of marginal setae below them.

Uropod 1: peduncle with 1 basifacial spine; dorsointernal row of spines absent (only setae are present); both rami with short lateral and distal spines.

Uropod 2: outer ramus with distal spines and 1 lateral seta only, inner ramus with distal and 1 lateral spine.

\* Uropod 3 short, not exceeding tip of rami of uropods 1-2; peduncle as long as outer ramus; both rami 1-segmented, inner ramus hardly shorter than outer one (shorter in ssp. *jalzici*).

Telson short and broad, incised nearly to the basis; each lobe with 1 distal spine intermixed with 1-2 short setae.

MALE 11.9 mm: Generally is similar to the females, but segment 6 of gnathopods 1-2 slightly stronger (fig. 1).

Metasomal segments 1-3 with 7-10 longer dorsoposterior marginal setae each.

Main flagellum of antenna 1 consisting of 25 articles bearing 1 aesthetasc each.

Maxilla 1: left and right palp narrow, reaching half of spines of outer plate, with 2-3 distal setae each.

Epimeral plates 2-3 with 4 subventral spines each. Pleopods like these in females.

Urosomites 1-3 with spines and setae as follows:

1(4)	0(2)	1(4)
1(2)	—	1(1)
2(2)	—	2(2)

Based on all taxonomical characters, the specimens from Josova Glavica cave are similar to the subspecies *A. algor algor* by almost all characters, except the number of setae on palp of maxilla 1 in male like that in ssp. *N. algor jalzici*. The further discoveries of new material from other localities will show the exact taxonomical relations between both subspecies as well as the limits of the variability of this species.

## CONCLUSIONS

The subterranean fauna of *Amphipoda* from Lovćen massif, regarding its surface, is rich in the number of taxa (13 taxa) belonging to 11 genera and 4 families of *Amphipoda* (*Gammaridae*, *Bogdiellidae*, *Niphargidae*, *Crangonyctidae*). Among them are 4 endemic genera and 7 endemic species or subspecies. But, the subterranean waters of this region are very vulnerable because of the unsolved problem of the sewage system of Cetinje town, which sewage is going through the subterranean natural cave-system into Obodska pećina cave system and Obodska rijeka - river.

On the other hands, the captures of many springs and waters for domestic purposes, are destroying the natural beds of many springs and torrents, leaving many epigean and hypogean animals without its living habitat, clean water.

For this reason, all anthropogenical activity in the future in the area of the Lovćen massif, including its National Park Lovćen, must be very careful and scientifically programmed.

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## R E Z I M E

AMPHIPODA (CRUSTACEA MALACOSTRACA) MASIVA LOVĆENA I  
NJEN NAUČNI ZNAČAJ  
(211. Prilog poznavanju Amphipoda)

Područje masiva Lovćen u Crnoj Gori, obuhvaćeno našim istraživanjima, pokriva prostor između Boke Kotorske - Budve - Rijeke Crnojevića i Cetinja. Na ovom području, koje je obilato padavinama, a izgrađenom većinom od karbonatnih stijena sa dobro razvijenim svim karstnim formacijama posebno pećinama, dobro je razvijena mreža podzemnih voda.

Kako proučavano područje pripada zapadnobalkanskoj refugijalnoj oblasti, fauna *Amphipoda* masiva Lovćen je relativno bogata i raznovrsna: do sada je utvrđeno 13 taksona svrstanih u 11 rodova odnosno 4 familije, među kojima ima sačuvanih tercijalnih elemenata, zatim elemenata koji su dospjeli ovdje za vrijeme ili posle glacijalnih perioda, kao i morskih elemenata koji su u raznim geološkim periodima prodirali u bočatne i slatke vode manje ili više udaljene od mora.

Od zapadnobalkanskih endema su utvrđeni rodovi: *Metohia* Abs. (*Metohia carinata* Abs. 1927, koja naseljava samo Crnu Goru i Hercegovinu), rod *Typhlogammarus* Schäf. (*T. mrazeki* Schäf. 1906, koji naseljavaju Crnu Goru, Hercegovinu i Dalmaciju), rod *Accubogammarus* G. Kar. poznat samo iz Crne Gore (*A. albor albor* G. Karaman 1973) i zaleda Dubrovnika (ssp. *jalzici* G. Kar. 1988), i rod *Laurogammarus* G. Kar. (*L. scutarensis* [Schäf. 1922], endem bazena Skadarskog jezera).

Među taksonima ovog područja, *Niphargus breviscuspis breviscuspis* Schell. 1937 i *N. breviscuspis sketi* G. Kar. 1966 su endemi masiva Lovćen, dok je takson *Niphargus vjeternicensis kusceri* S. Kar. 1950 endem Crne Gore i Hercegovine.

Vrste: *Gammarus balcanicus* Schäf. 1922, *Echinogammarus veneris* (Heller 1865) i *Synurella ambulans* (F. Müller 1846) imaju mnogo šire rasprostranjenje u srednjoj i južnoj Evropi, a vrsta *Rhipidogammarus karamani* Stock 1971 naseljava priobalno područje zapadnog Mediterana i Jadranskog mora.

Vrste *Bogidiella dalmatina* S. Kar. 1953 i *Neogammarus adriaticus* G. Kar. 1973 su endemi obalnog područja Jadranskog mora, uključujući i Boku Kotorsku.

Fauna *Amphipoda* masiva Lovćen je ograničena na čiste površinske i podzemne vode, pa je na taj način veoma osjetljiva i podložna degradaciji zbog veoma intenzivnih antropogenih utjecaja, posebno neriješenog problema otpadnih voda grada Cetinja, čije sve otpadne vode poniru kroz prirodni sistem ponora i pećina do Obodske rijeke, odnosno Rijeke Crnojevića. S druge strane, nekontrolisano kaptiranje izvora i vodenih tokova za ljudsku upotrebu, ostavlja površinske i podzemne vrste *Amphipoda* bz njihove prirodne sredine i uslova za opstanak.

Stoga sve antropogene aktivnosti u narednom periodu, na području masiva Lovćen, kao i samog Nacionalnog parka "Lovćen", moraju biti veoma pažljivo i naučno programirane, kako bi se zaštitio biodiverzitet ovog područja.

