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# Sa Gleda cave (Majorca, Balearic Islands) and its fauna, with description of a new species of Oncopoduridae (Collembola)

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## ABSTRACT

A new species of *Oncopodura* (Collembola: Entomobryomorpha: Oncopoduridae) from a cave in Majorca is described. The new species can be distinguished from other species of the genus by the following characters: four distal leaf-shaped sensilla on antennal segment IV and another one on the basal part; PAO small, as a single vesicle; dens with distal outer hook-like spine; mucro with four teeth, with the basal one very sharp; basal part of dens with a large spine on the inner side; claw with a long lateral tooth. The discovery of this new species resulted from the speleological work that was carried out in the cave.

## RESUMEN

Se describe una nueva especie de *Oncopodura* (Collembola: Entomobryomorpha: Oncopoduridae), encontrado en una cueva de Mallorca. La nueva especie se distingue de otras especies del género por los siguientes caracteres: cuatro sensillas distales en forma de hoja en el segmento antennal IV, y otra más en la parte basal del mismo segmento; PAO pequeño, en forma de vesícula simple; dens con espina distal externa en forma de gancho; mucrón con cuatro dientes, con el basal muy afilado; parte basal del dens con una espina grande sobre el lado interno; uña con un largo diente lateral. El descubrimiento de esta nueva especie es el resultado de los estudios espeleológicos llevados a cabo en la cueva.

Key words: Collembola, *Oncopodura*, new species, cave fauna, Majorca, Spain.

Palabras clave: Collembola, *Oncopodura*, nueva especie, fauna cavernícola, Mallorca, España

## INTRODUCTION

The cave (Sa Gleda cave) took its name from whitish clay named "Gleda" or "Greda", formerly used for laundry. This clay can be found in the 'Dolina de Hundimiento' (entrance hall) (Fornós et al 1989). The first speleological works were carried out in 1974 by the speleologists of the Speleo-Club Mallorca (SCM), and later published by Fornós et al (1989). The Majorcan speleologist Francesc Ripoll (SCM) carried out the first immersion in the entrance lake, discovering the hall now bearing his name, as well as the central aerial hall. In the 90's (1990-1996) the "Francesc Ripoll Hall" was occasionally explored by different groups from Great Britain (Clarke 1991-1992) without any significant findings. The Welsh speleo-diver Martyn Farr drew sketch of the known paths, with over 250 m of sub-aquatic routes (Farr 1997-1998). By the end of 1997, the speleological group 'Grup Nort de Mallorca' (GNM), began the topographic work of the underwater portions. Several campaigns carried out by the GNM between 1998 and 2007 contributed to increase the overall length of the routes

and the general knowledge of the cave. By the end of 2006, a small grant within the projects for Biodiversity Conservation 2007 (Fundació "Sa Nostra", Caixa Balears) made it possible to begin the systematic study of the terrestrial fauna by the speleologists Mateo Vadell (EST Speleological Group), and the speleo-divers Francesc Gràcia, Bernat Clamor and Mateu Febrer (GNM) (Vadell et al, in press).

## METHODS

### *Sample Site*

The Sa Gleda cave is located in the "Manacor marine", Majorca (Spain) (Fig. 1), in a private state belonging to Son Josep Nou, 36 m above sea level, 1.7 km inland. The cave is inside an ARIP ('Area Rural de Interés Paisajístico', Rural Area of Landscape Interest), and has been declared LIC ('Lugar de Importancia Comunitaria') with code ES5310054 (Pons et al 2001). The cave developed in very karstifiable calcarenitic materials from upper Miocene, and can be defined as a web of

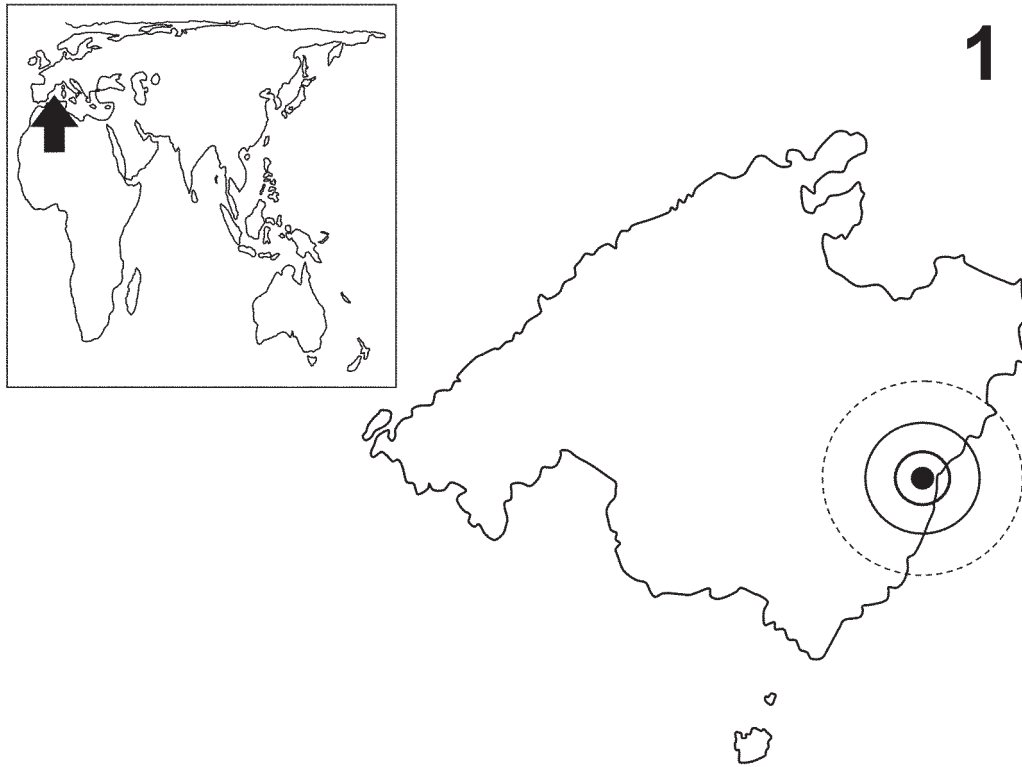


Fig. 1- Location Map of the Study area.

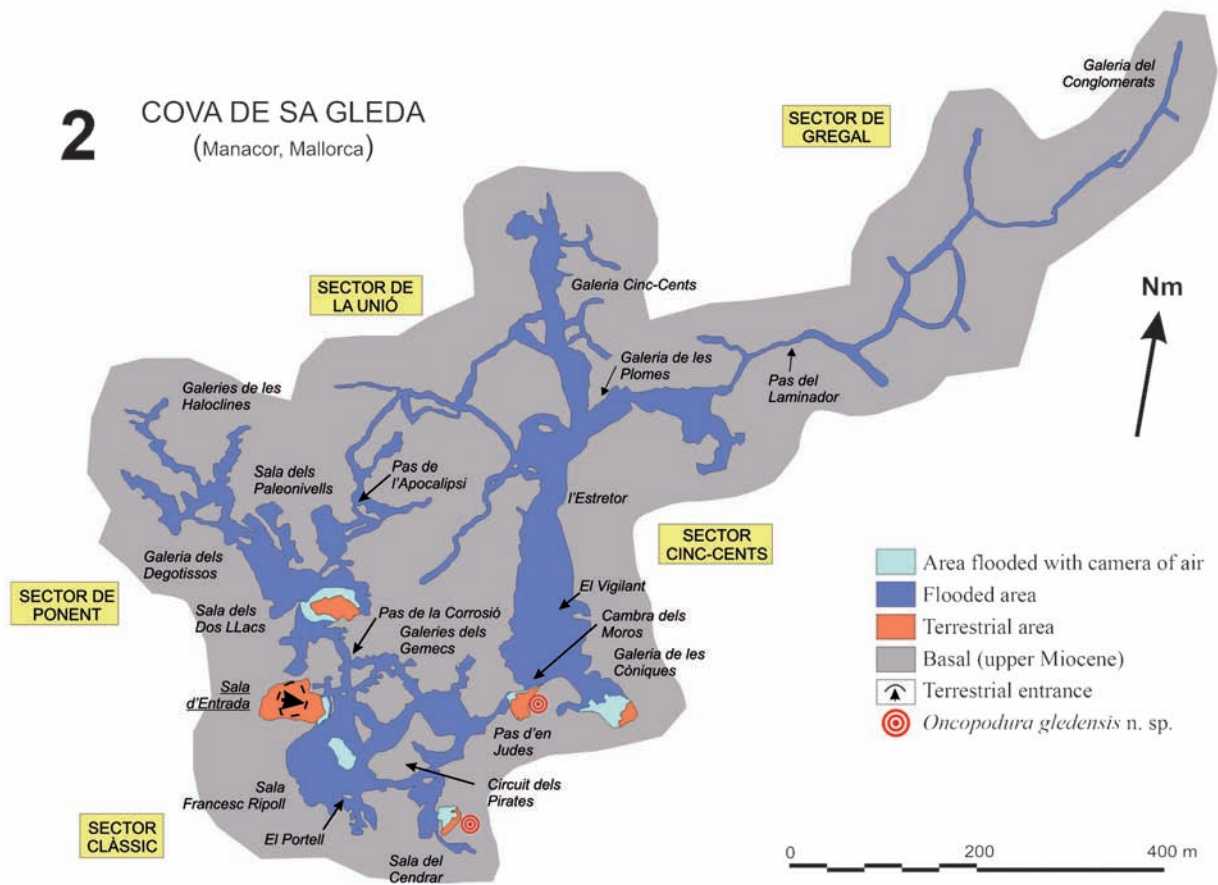


Fig. 2- Location of the “Sa Gleda” cave. Topography and location of the different halls within the cave (modified from Gràcia et al 2007).

phreatic galleries and sinking halls. Currently, the topography includes 10,500 m path length, with a maximum depth below phreatic level of about 25 m. The entrance hall communicates with a group of labyrinthine galleries and halls totally underwater, except for the areas described below (Fig. 2). Access to these sampled halls and galleries requires speleo-diving techniques.

**Sala d'Entrada** ('Entrance Hall'). This hall opens outside through a spectacular sink (30 x 18 m), that communicates with another big hall (72 x 44). Its location, right in the middle of a small gully, makes it subject to flood in case of heavy rainfall. In the lower level there is a semicircular lake. The sinking cone, specially the central area, corresponding to the opening, is covered by a fig tree group (*Ficus carica*), bryophytes and pteridophytes such as *Adiantum capillus-veneris* and *Asplenium sagittatum*. Abundant algae are visible on the flowstones and blocks in the central area of the doline (Fig. 3). The area around the entrance is a pinewood, which contributes, along with flood sediment carried through the gully, organic matter to the outermost area of the hall. The overhang cliffs have been colonized by *Columba* sp., whose droppings constitute an important organic source.

**Sala del Cendrar.** It is a 60 x 40 m hall that can be accessed after a 270 m dive from the lake of the entrance hall. A third hall on the E side is aerial, rising above the

water level, with its N side covered with flowstones projecting under water. The remainder of the aerial surface is covered with blocks and stones.

**Sala dels Dos Llacs.** It is the only aerial area of the whole 'Sector de Ponent' (West sector), located 150 m from the entrance lake. It is a 54 x 40 m sink hall without speleothems, although there are white blocks fallen from the walls and roof. Its surface is unrelated to the 'Sala d'Entrada'. All fauna captured here required several sampling attempts.

**Cambra dels Moros.** It was generated by a sinking blocks slope. It is located 250 m from the entrance lake, and it is characterized by its steep inclination and its detached blocks and stones. It is connected with a sink visible from outside (Fig. 4).

**Galeria de les Còniques.** Located eastward, at the end of a diving path about 330 m from the entrance lake, 45 x 28 m in size. It has a flat, slightly sloping, earthy surface, where furrows originated by the water that came from an ancient doline (now uncommunicated) above, are visible. The presence of ceramic bits, vertebrate bones and mouse excrements support this hypothesis. The west side has a large slope, rising 15 m between big fallen blocks. The perimeter of the entire collapse area exceeds 100 m.

Until now, data about the fauna of this cave com-



Fig. 3- Sampling work in the 'Sala d'Entrada' (Photo by M. A. Barceló, EST).



plex were related to the aquatic fauna. Ginés and Ginés (1977) had recorded *Salentinella* sp. (Amphipoda: Gammaridea: Salentinellidae), Fornós et al (1989) mentioned *Bogidiella balearica* (Amphipoda: Gammaridea: Bogidiellidae), *Salentinella angelieri*, *Typhlocirolana moraguesi* (Isopoda: Flabellifera: Cirolanidae), *Jaera italica* (Isopoda: Asellota: Janiridae), *Monodella argentarii* (Crustacea: Thermosbaenacea: Monodellidae) and *Thermocyclops dybowskii* (Crustacea: Copepoda: Cyclopidae), and Pretus (1989) published a paper citing all the previously mentioned species but *T. dybowskii*.

At present, the systematic sampling work that began in 2006 continues with both direct and indirect sampling (bait traps with beer and cheese). This has resulted in the capture of 26 species belonging to 14 orders (Table 1).

*Oncopodura gledensis*, sp. nov.

(Figs 5-10)

*Type-locality.* SPAIN (Majorca), Sa Gleda cave (Cambra dels Moros and Sala del Cendrar). In the first hall, the specimens were captured 15 m inland, over a rotten and soaked wood piece, in total darkness and high humidity. UTM Coordinates: 523805 N, 4372315-36 E.

*Type-material.* - Holotype (male), mounted on slide, code MZ-SAGLEDA01-01, 7<sup>th</sup> october 2007, F. Gràcia leg.; three Paratypes in the same slide, and two in slide MZ-SAGLEDA01-02.

*Material deposited.* - MZNA (Museum of Zoology, University of Navarra).

*Etymology.* - The specific name derives from the name of the cave where the specimens were captured.

Other material studied (from the same cave): one specimen, 16<sup>th</sup> to 23<sup>rd</sup> December 2006, beer baited trap, B. Clamor leg. (MZNA with code MZNAMV03-03); four specimens on slides, 17<sup>th</sup> to 25<sup>th</sup> March 2007, cheese baited trap, F. Gràcia leg. (CMV-MBCN).

*Diagnosis*

Four distal leaf-shaped setae on antennal segment

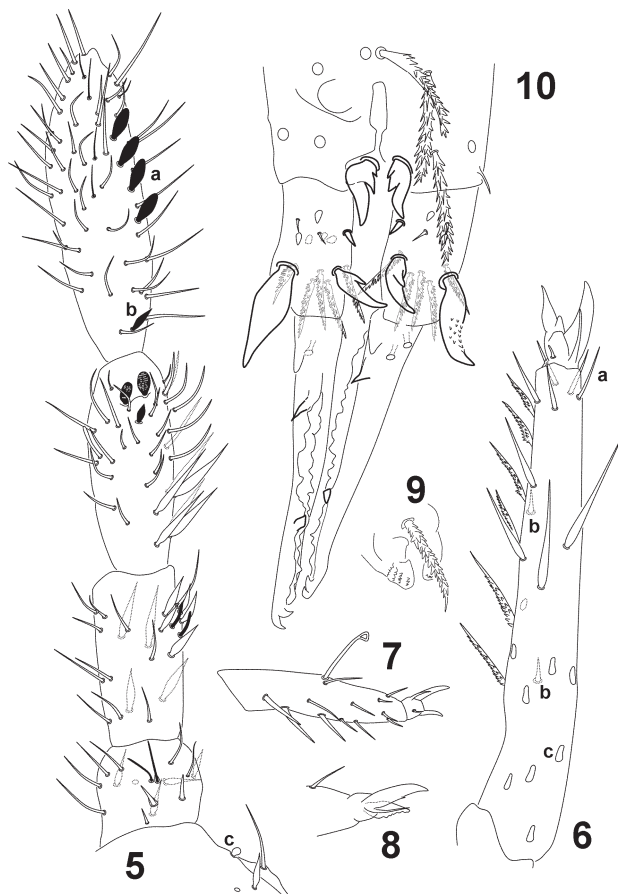


Fig. 4- Access to the hall 'Cambra dels Moros' (Photo by F. Gràcia, GNM).

IV, and one, pointed and smaller, on the basal part. PAO small, as a single vesicle. Dentes with distal hook-like spines. Mucro with four teeth, the basal one very sharp. Basal part of dentes with a large spine on the inner side. Claw with a long lateral tooth.

*Description*

Background colour white, without any pigmentation. Length: 0.58 mm without antennae. Antennae length ratio I:II:III:IV = 1:2:2.5:3.4. Antennae without scales, and similar in length to the cephalic diagonal. Eyes absent and PAO small, as a single vesicle. On the antennal segment IV, in addition to the four leaf-shaped sensilla (Fig. 5, a), there is a broad and pointed sensillum near the base (Fig. 5, b). According to this, the species should be placed into the group *O. tricuspidata* (Deharveng, 1988). A leaf-shaped sensillum is located under the sensilla of sensory organ of antennal segment III. Labrum with 5, 5, 4 setae, and 4 prelabral setae. The body chaetotaxy is typical for the genus and the group of species;



Figs 5-10 - *Oncopodura gledensis*, sp. nov. 5. Antenna (a, distal leaf-shaped sensilla; b, basal pointed leaf-shaped sensillum; c, PAO). 6. Tibiotarsus, unguis and unguiculus of leg III (a, smooth setae on distal part; b, spine-like setae; c, alveoli of lack setae). 7. Tibiotarsus of leg II (a, spatulated seta). 8. Detail of the unguis and unguiculus. 9. Retinaculum. 10. Distal portion of furcula.

Table 1 - Relation of the terrestrial fauna captured in the 'Sa Gleda' cave.

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MOLLUSCA  
Pulmonata  
*Acanthinula aculeata* (O.F. Müller, 1774) (G.X. Pons and D. Vicens det.)

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CRUSTACEA  
Isopoda  
*Trichoniscus pusillus provisorius* Racovitza, 1908 (Ll. García det.)

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ARACHNIDA  
Araneae  
*Leptoneta infuscata* Simon, 1872 (M. Vadell det.)  
Pseudoescorpiones  
*Roncus* af. *caralitanus* Gardini, 1981 (J.A. Zaragoza det.)

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MYRIAPODA (M. Vadell det.)  
Chilopoda, Lithobiomorpha  
*Lithobius piceus tabacarii* Negrea and Matic, 1973  
*Lithobius fagei* Demange, 1961  
Chilopoda, Geophilomorpha  
*Geophilus* af. *insculptus*, Attems, 1895  
Paupoda, Tetramerocerata  
*Stylopaupodus* (*S.*) *pedunculatus* (Lubbock, 1867)

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COLLEMBOLA (R. Jordana and E. Baquero det.)  
Poduromorpha  
*Mesaphorura critica* Ellis 1976  
Entomobryomorpha  
*Parisotoma notabilis* (Schäffer, 1886)  
*Isotomurus palustris* (Müller, 1776)  
*Heteromurus nitidus* (Templenton, 1835)  
*Oncopodura gledensis* sp. nov.  
Neelipleona  
*Megalothorax minimus* Willem, 1900  
Symphypleona  
*Disparrhopalites patrizii* (Cassagnau and Delamare-Deboutteville, 1953)

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DIPLURATA (A. Sendra det.)  
Diplura  
*Plusiocampa fagei* Condé, 1955  
*Campodea* (*Dicampa*) *catalana* Denis, 1930

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INSECTA  
Diptera (M. Vadell det.)  
*Sciara* sp.  
*Megaselia* sp.  
Coleoptera  
*Ocys* (*Ocys*) *harpaloides* (Audinet-Serville, 1821) (V. Ortuño det.)  
*Laemostenus* (*Pristonychus*) *algerinus algerinus* (Gory, 1833) (V. Ortuño det.)  
*Akis acuminata* (Fabricius, 1787) (M. Palmer det.)  
*Blaps lusitanica* Herbst, 1799 (M. Palmer det.)  
Cucujidae (genus and species undetermined)

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for example, 0/1, 2/0, 1, 0, 0, 0 trichobothria. Tibiotarsus (Fig. 6) with five smooth distal setae, ciliated and basally swollen setae on the rest of segment, and a spatulated seta on tibiotarsus II (Fig. 7, a). The unguis is not slender, with a very small internal tooth, and a very long latero-external tooth (Fig. 8). The unguiculus can be serrated externally, and has a basal lobe. Ventral tube with 3+1 distal setae, without latero-basal tubercles. Retinaculum with 4+4 teeth and a single ciliated seta (Fig. 9). Furcula slightly shorter than half body; ratio manubrium/dens

1:1.18. Special manubrial and dental setae as in figure 6. Dental distal spines with a fine denticulation (Fig. 10, a). Manubrium with four teeth: two apical, one medial, and one basal, very sharp.

#### TAXONOMIC DISCUSSION

The main characters of this new species are similar to those of *O. cavernarum* Stach, 1934 (Yugoslavia)

and *O. delhezi* Stomp, 1974. Similarly to them, it would belong to the *O. tricuspadata* group (Deharveng, 1988), while showing nevertheless a combination of characters that suggests it to be considered as a different species: *O. delhezi*, cited by Gama from Majorca (1984), lacks PAO, the unguis and their lateral teeth are larger, and they are provided with only two distal spines on dentes (Stomp 1974). Gama, in her paper, say that the observed specimens are different from the Stomp original description, and from the small description provided seem similar to the new species described in this paper; *O. cavernarum* has a very slender unguis, and their dental spines show a very different morphology. *O. jugoslavica* has two spines on the inner side of distal dentes, and its PAO is four-lobed. Among all the species belonging to the *O. tricuspadata* group the geographically closer species are *O. meridionalis* Cassagnau, 1959 (Pyrenees: Couplan Valley), *O. occidentalis* Bonet, 1931 (Pyrenees: Huesca, Spain and Campan, France), and *O. tricuspadata* Cassagnau, 1964 (Pyrenees). The new species differs from *O. meridionalis* due to its four roundish olfactory sensilla on antennal segment IV, and to the four-lobed PAO; it differs from *O. occidentalis* due to a set of characters: the four straight and cylindrical sensilla on antennal segment IV, the two elliptical sensilla and the one looking more like a small spine to be found on antennal segment III, the one leaf-shaped and the two cylindrical sensilla on antennal segment II, the manubrium without basal internal and external teeth, and the unguis without internal tooth; finally, it differs from *O. tricuspadata* due to the slenderness of the row of distal sensilla and to the basal roundish sensillum on antennal segment IV, to the shortness of the spatulated seta on tibiotarsus II, similar in length to the closest spine, and by the three-lobed PAO.

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ral de les Balears), Lluç Garcia (Museu Balear Ciències Naturals) and Juan Antonio Zaragoza (Departamento de Ecología, Facultad de Ciencias, Universidad de Alicante) for the specimen identification. We also appreciate the work of the reviewers whose remarks improved this paper.

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