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### Four new species of the *Diphascon nobilei* group (Eutardigrada, Hypsibiidae)

Giovanni Pilato<sup>a</sup>, Maria Grazia Binda<sup>a</sup>, Roberto Bertolani<sup>b</sup> & Oscar Lisi<sup>a</sup>

<sup>a</sup> Department of Animal Biology "Marcello La Greca" of the University of Catania, Catania, Italy

<sup>b</sup> Department of Animal Biology of the University of Modena and Reggio, Modena, Italy

<sup>c</sup> Department of Animal Biology "Marcello La Greca" of the University of Catania, Via Androne 81, 95124 Catania, Italy E-mail:

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## Four new species of the *Diphascon nobilei* group (Eutardigrada, Hypsibiidae)

GIOVANNI PILATO<sup>1</sup>, MARIA GRAZIA BINDA<sup>1</sup>, ROBERTO BERTOLANI<sup>2</sup>,  
& OSCAR LISI<sup>1</sup>

<sup>1</sup>Department of Animal Biology “Marcello La Greca” of the University of Catania, Catania, Italy, and <sup>2</sup>Department of Animal Biology of the University of Modena and Reggio, Modena, Italy

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### Abstract

The existence of a group of species similar to *Diphascon* (*Diphascon*) *nobilei* is shown. These species have some common characteristics: a well-evident drop-shaped thickening between the buccal tube and the pharyngeal tube, pharyngeal bulb, more or less elongate, with three rod-shaped macroplacoids and microplacoid, claws of the hind legs different from those of the first three pairs of legs in having a very wide basal portion and indented basal margin, basal spurs also present on the external claws and, in some cases, also on the internal claws of the first three pairs of legs. Four new species of this group are described: *Diphascon* (*D.*) *serratum*, *D.* (*D.*) *nelsonae*, *D.* (*D.*) *platyungue*, and *D.* (*D.*) *hydrophilum*. They differ from one another in the dimensions and shape of the claws; in some cases the difference also affects the value of the *ptd* index relative to the insertion point of the stylet supports, the buccal and the pharyngeal tube length or the macroplacoid length.

**Keywords:** *D.* (*D.*) *hydrophilum* sp. n., *D.* (*D.*) *nelsonae* sp. n., *D.* (*D.*) *nobilei*, *D.* (*D.*) *platyungue* sp. n., *D.* (*D.*) *serratum* sp. n., *Diphascon nobilei* group, Tardigrada

### Introduction

*Diphascon* (*D.*) *nobilei* (Binda, 1969) was described for Sicilian specimens (locus typicus: Gela) and has been reported for some other Italian localities (Binda and Pilato 1971; Bertolani et al. 1977, 1987, 1995; Bertolani 1982, 1984, 1988, 2002; Maucci 1986; Pilato et al. 1989; Bertolani and Rebecchi 1996) and for Turkey (Maucci 1975), Australia (Pilato and D’Urso 1976), Spain (Maucci and Durante Pasa 1984), Poland (Dastych 1988), and Russia (Biserov 1991). We noted that Binda (1969), in the description of the species, wrote that eyes are present, but that specimens from other localities lack them (Bertolani et al. 1977; Dastych 1988). Some authors cited the species but did not specify whether eyes were present or not. To date this difference has been attributed to individual variability; to verify

this hypothesis, we examined specimens from many localities. We compared these specimens with the typical material and we noted that all these specimens were characterized in having three macroplacoids and microplacoid, claws of the hind legs different from those of the first three pairs of legs in having a very wide basal portion (particularly the posterior claws) with clearly indented basal margin, whereas they differ in many characters from the typical material. We concluded that it is justified to describe here four new species: *Diphascon (D.) serratum*, *D. (D.) nelsonae*, *D. (D.) platyungue*, and *D. (D.) hydrophilum*.

## Materials and methods

Besides the holotype of *D. nobilei* (found in a moss sample developing on sand dunes (Gela), we examined specimens from some other Italian localities and from various habitats: from mosses collected in two localities on Mt Etna: Pietra Cannone (Fornazzo) and Serra La Nave, and in two Aeolian Islands (Lipari and Panarea); from sediment of a puddle (Nebrodi Mts: Contrada Cutò), from mosses on sand dunes in pine-wood (Latium: Latina: Sabaudia); from chestnut wood leaves (Emilia: Modena: Civago); from a meadow (Marche: Sibillini Mounts: Mt Vettore: shelter Zilioli (2150–2250 m); from sediments of the Fossa stream (Emilia: Modena: Rocca Santa Maria); from sediments of the cave Grotta del Pettiroso (Trieste, Aurisina).

The holotype and some paratypes of all the new species, mounted in polyvinyl lactophenol, are deposited in the collection of Binda and Pilato (Dipartimento di Biologia Animale “Marcello La Greca” dell’Università di Catania); some paratypes are deposited in the collection of Roberto Bertolani (Dipartimento di Biologia Animale dell’Università di Modena e Reggio).

As stated by Pilato and Binda (1997/98), in the study of the species of the subgenus *Diphascon*, it is useful to use the index *ptd*, that is the percentage ratio between the length of a structure and the length of the buccal tube, measured from the anterior margin of the stylet sheaths to the end of the drop-shaped thickening present between the buccal tube and the pharyngeal tube. As regards the buccal tube, besides its length in  $\mu\text{m}$ , we used the *pbf* index, that is the percentage ratio between its length (measured as mentioned above) and the total length of the bucco-pharyngeal tube (pharyngeal apophyses excluded).

## Results

As with *D. (D.) nobilei*, all the new species considered have the typical characters of the genus *Diphascon* and the subgenus *Diphascon*, i.e. claws of *Hypsibius* type, bucco-pharyngeal apparatus of *Diphascon* type, buccal tube without ventral lamina and with apophyses for the insertion of the stylet muscles in the shape of semilunar hook symmetrical with respect to the frontal plane, pharyngeal tube with a spiral thickening, evident drop-shaped thickening between the buccal tube and the pharyngeal tube, peribuccal lamellae and peribuccal papulae absent. As mentioned above, they are also characterized in having three macroplacoids and microplacoid, claws of the hind legs different from those of the first three pairs of legs in having a very wide basal portion (particularly the posterior claws) with clearly indented basal margin.

***Diphascon (Diphascon) nobilei*** (Binda, 1969)  
(Figure 1; Table I)

*Material examined*

Gela (Caltanissetta): holotype (slide N. 1118); Pietra Cannone (Mt Etna, Fornazzo): four specimens.

The description of the species is confirmed but we noted the presence of granules of pigment also in the position of the eyes. We suspect that in the description of Binda (1969) these granules were mistaken for eyes. The holotype is mounted in polyvinyl lactophenol and therefore it is not possible to solve this problem, it is therefore necessary to find other specimens.

In the description, Binda (1969) wrote that one accessory point is present on the main branches of the claws; we noted that the orientation of the claws makes it difficult to see the accessory points, but on one claw two accessory points seem to be present.

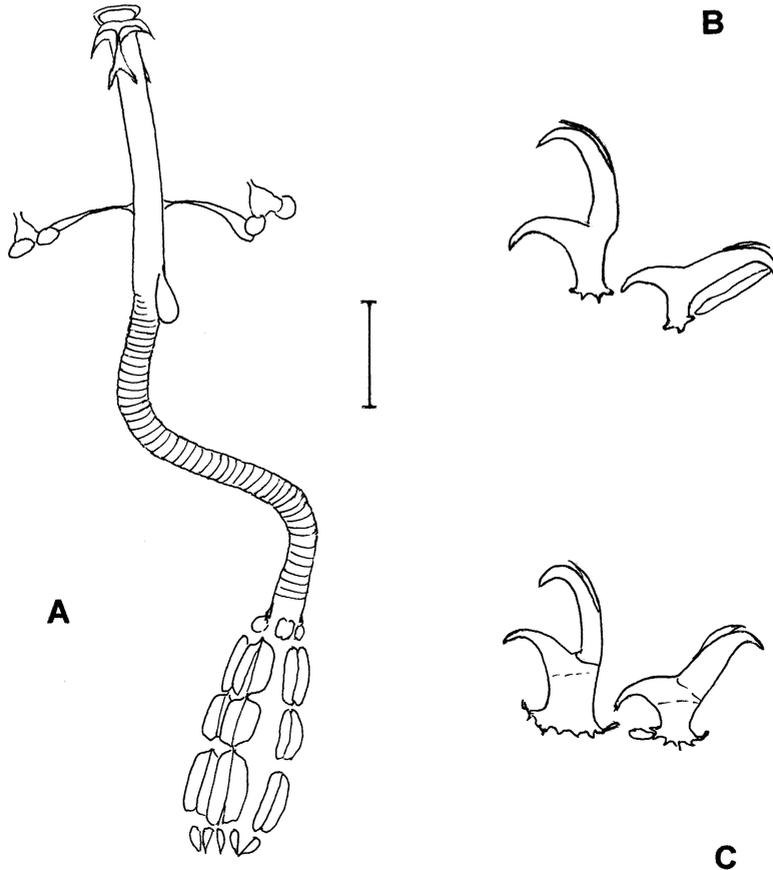


Figure 1. *Diphascon (D.) nobilei* Binda, 1969. (A) Bucco-pharyngeal apparatus; (B) claws of the third pair of legs; (C) claws of the fourth pair of legs. Scale bar: 10  $\mu$ m.

Table I. Length (in  $\mu\text{m}$ ) of some structures of *D. nobilei* Binda, 1969, *D. serratum* sp. n., *D. nelsonae* sp. n., *D. platyungue* sp. n., and *D. hydrophilum* sp. n.

|                            | <i>nobilei</i> | <i>serratum</i> | <i>nelsonae</i> | <i>platyungue</i>      | <i>hydrophilum</i> |
|----------------------------|----------------|-----------------|-----------------|------------------------|--------------------|
| Body                       | 370            | 217             | 231–310         | 194–238                | 213–307            |
| Bucco-pharyngeal tube      | 59.5           | 49.9            | 46.4–57.3       | 45.2–53.1 <sup>a</sup> | 46.0–49.4          |
| Buccal tube                | 25.7           | 21.6            | 21–24.3         | 20.8–23.2              | 20.9–23.3          |
| <i>pbf</i>                 | 43.2           | 43.3            | 45.2–42.4       | 46.0–43.7 <sup>a</sup> | 45.4–47.2          |
| Tube diameter              | 2.7            | 2.5             | 2.0–2.6         | 1.7–2.3                | 1.8–2.2            |
| <i>ptd</i>                 | 10.5           | 11.6            | 9.5–10.7        | 8.2–9.9                | 8.6–9.4            |
| <i>ptd</i> stylet supports | 60.7           | 67.2            | 63.7–61.8       | 62.9–62.7              | 64.4–63.1          |
| Placoid row                | 18.6           | 18.5            | 17.7–21.2       | 16.1–17.3              | 14.5–18.1          |
| <i>ptd</i>                 | 72.3           | 85.6            | 84.3–87.2       | 77.4–74.6              | 69.4–77.7          |
| Macroplacoid row           | 16.1           | 16.5            | 15.5–18.9       | 14.1–15.6              | 11.9–15.8          |
| <i>ptd</i>                 | 62.6           | 76.4            | 73.8–77.8       | 67.8–67.2              | 56.9–67.8          |
| First macroplacoid         | 5.4            | 4.9             | 4.3–5.3         | 3.8–4.2                | 3.8–4.9            |
| <i>ptd</i>                 | 21.0           | 22.7            | 20.5–21.8       | 18.3–18.1              | 18.2–21.0          |
| Second macroplacoid        | 4.1            | 4.6             | 4.0–5.2         | 3.6–4.0                | 3.7–4.6            |
| <i>ptd</i>                 | 15.9           | 21.3            | 19.0–21.4       | 17.3–17.2              | 17.7–19.7          |
| Third macroplacoid         | 6.3            | 6.9             | 6.5–7.4         | 5.7–7.0                | 4.5–5.8            |
| <i>ptd</i>                 | 24.5           | 31.9            | 30.9–30.4       | 27.4–30.2              | 21.5–24.9          |
| Microplacoid               | 2.1            | 1.8             | 1.6–1.7         | 1.7–?                  | 1.8–1.7            |
| <i>ptd</i>                 | 8.2            | 8.3             | 7.6–7.0         | 8.2–?                  | 8.6–7.3            |
| II, III internal claw      | 10.2           | 6.4             | 7.0–9.7         | 6.1–6.9                | ?–?                |
| <i>ptd</i>                 | 39.7           | 29.6            | 33.3–39.9       | 29.3–29.7              | ?–?                |
| II, III external claw      | 15.8           | 8.6             | 10.5–13.7       | ?–8.6                  | 14.8–16.1          |
| <i>ptd</i>                 | 61.5           | 39.8            | 50.0–56.4       | ?–37.1                 | 70.8–69.1          |
| IV anterior claw           | 12.4           | 7.3             | 7.9–9.8         | 6.5–7.1                | 8.9–10.4           |
| <i>ptd</i>                 | 48.2           | 33.8            | 37.6–40.3       | 31.2–30.6              | 42.6–44.6          |
| IV posterior claw          | 16.0           | 9.2             | 11.5–?          | 8.5–9.8                | 14.5–15.8          |
| <i>ptd</i>                 | 62.2           | 42.6            | 54.8–?          | 40.9–42.2              | 69.4–67.8          |

<sup>a</sup>The pharyngeal tube is slightly stretched and therefore the buccal tube, as %, appears slightly shorter.

The claws have wide branches and, as a consequence, they appear stout (Figure 1B, C); on the hind legs the basal portion of the claws is wide with well-visible basal spines; smaller basal spines are present on the claws (both external and internal) of the first three pairs of legs (Figure 1B).

In Figure 1A the bucco-pharyngeal apparatus is shown. In Table I the dimensions of some structures of the holotype are indicated.

***Diphascon (Diphascon) serratum* sp. n.**  
(Figure 2; Table I)

*Material examined*

Mt Etna: Serra La Nave (1715 m): two specimens: holotype (slide N. 1877) and paratype.

*Description of the holotype*

Body length 217  $\mu\text{m}$ , colourless, cuticle smooth without pearls; eyes seem to be absent. The specimens were mounted in polyvinyl lactophenol more than 30 years ago, and no specification about the presence of eyes is indicated on the label.

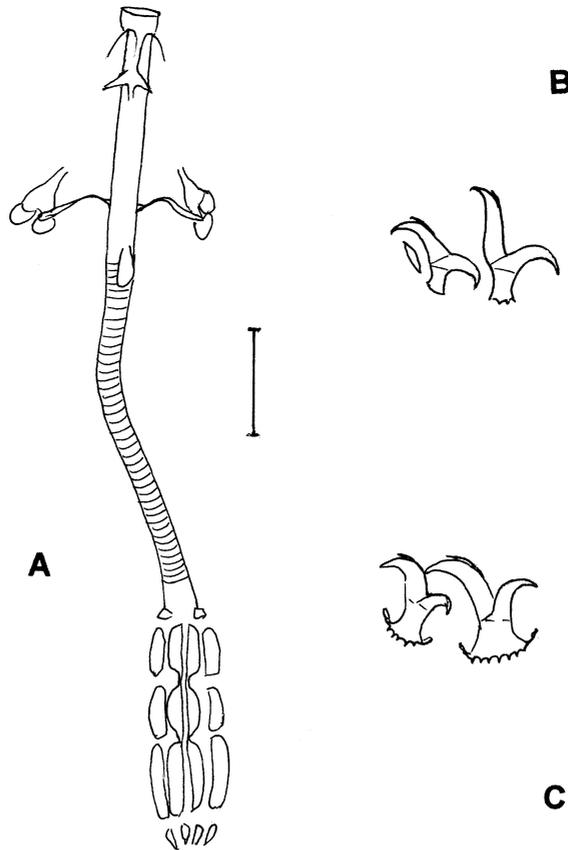


Figure 2. *Diphascon* (*D.*) *serratum* sp. n. (A) Bucco-pharyngeal apparatus; (B) claws of the third pair of legs; (C) claws of the fourth pair of legs. Scale bar: 10  $\mu$ m.

The bucco-pharyngeal apparatus is shown in Figure 2A. The bucco-pharyngeal tube, measured from the anterior margin of the stylet sheaths to the base of the pharyngeal apophyses, is 49.9  $\mu$ m in length; the buccal tube, measured from the anterior margin of the stylet sheaths to the end of the drop-shaped thickening is 21.6  $\mu$ m in length ( $pbf=43.3$ ) and 2.5  $\mu$ m wide ( $ptd=11.6$ ). The stylet supports are inserted on the buccal tube at 67.2% of its length ( $ptd=67.2$ ). The pharyngeal bulb has apophyses, three rod-shaped macroplacoids and microplacoid; the septulum is absent. The entire placoid row is 18.5  $\mu$ m in length ( $ptd=85.6$ ) including the microplacoid, 16.5  $\mu$ m ( $ptd=76.4$ ) excluding it; the first macroplacoid is 4.9  $\mu$ m long ( $ptd=22.7$ ), the second 4.6  $\mu$ m ( $ptd=21.3$ ), the third 6.9  $\mu$ m ( $ptd=31.9$ ), the microplacoid 1.8  $\mu$ m ( $ptd=8.3$ ).

The claws (Figure 2B, C) have wide branches and as a consequence they appear stout. The claws of the hind legs (particularly the posterior claws) have an enlarged basal portion medially and laterally prolonged in a cuticular thickening and basal spines (Figure 2C). Basal spines are also present on the external claws of the first three pairs of legs (the basal margin of the internal claws is smooth). Well-developed accessory points are present on the main branches of all claws. The internal claws are 6.4  $\mu$ m long ( $ptd=29.6$ ) on the second and third pair of legs, the external claws of the same pairs of legs are 8.6  $\mu$ m long ( $ptd=39.8$ ); on the hind legs the anterior claws are 7.3  $\mu$ m long ( $ptd=33.8$ ) and the posterior claws 9.2  $\mu$ m ( $ptd=42.6$ ).

On the first three pairs of legs a cuticular bar is present near the base of the internal claws. Eggs not found.

The paratype is similar to the holotype; in Table I the dimensions of some structures of the holotype and of the known paratype are indicated.

### *Etymology*

The name *serratum* refers to the indentation of the basal margin of the claws.

### *Remarks*

*Diphascon serratum* sp. n. differs from *D. nobilei* in having a longer bucco-pharyngeal tube with respect to the body length, stylet supports inserted on the buccal tube in a more caudal position (Table I), longer placoids both with respect to the body size and to the buccal tube length (Table I), shorter claws with less-evident basal spines (absent on the internal claws of the first three pairs of legs) (Figures 1, 2).

## ***Diphascon (D.) nelsonae* sp. n.**

(Figure 3; Table I)

### *Material examined*

Emilia: Modena: Civago: eight specimens: holotype (slide N. 4928) and paratypes in chestnut wood leaves; Aeolian Island: Lipari (one specimen in a moss) sample, Panarea (two specimens in a moss sample).

### *Description of the holotype*

Body length 231  $\mu\text{m}$ , colourless, eyes absent, cuticle smooth without pearls. Bucco-pharyngeal apparatus is shown in Figure 3A. The bucco-pharyngeal tube is 46.4  $\mu\text{m}$  long; the rigid buccal tube 21  $\mu\text{m}$  long ( $pbf=45.2$ ) and 2  $\mu\text{m}$  wide ( $ptd=9.5$ ). The stylet supports are inserted on the buccal tube at 63.7% of its length ( $ptd=63.7$ ). The pharyngeal bulb (29  $\mu\text{m}$   $\times$  18.6  $\mu\text{m}$ ) has small apophyses, three rod-shaped macroplacoids and microplacoid, the septulum is absent. The first macroplacoid is 4.3  $\mu\text{m}$  long ( $ptd=20.5$ ), the second 4.0  $\mu\text{m}$  ( $ptd=19$ ), the third 6.5  $\mu\text{m}$  ( $ptd=30.9$ ), microplacoid 1.6  $\mu\text{m}$  ( $ptd=7.6$ ); the entire placoid row 17.7  $\mu\text{m}$  in length ( $ptd=84.3$ ) including the microplacoid, 15.5  $\mu\text{m}$  ( $ptd=73.8$ ) excluding it.

The claws (Figure 3B, C) have accessory points on the main branches; the claws of the hind legs (Figure 3C) have the basal portion enlarged with the basal margin indented and prolonged in one medial and one lateral thickening. The branches are normally developed and not particularly wide. On the first three pairs of legs (Figure 3B) the external claws have a slightly developed basal indentation; the basal margin of the internal claws is smooth.

The internal claws are 7  $\mu\text{m}$  long ( $ptd=33.3$ ) on the second and third pairs of legs, the external claws of the same pairs of legs are 10.5  $\mu\text{m}$  long ( $ptd=50$ ); on the hind legs the anterior claws are 7.9  $\mu\text{m}$  long ( $ptd=37.6$ ) and the posterior claws 11.5  $\mu\text{m}$  ( $ptd=54.8$ ).

A cuticular bar is present near the internal claws on the first three pairs of legs. Two exuviae with three and four smooth eggs were found.

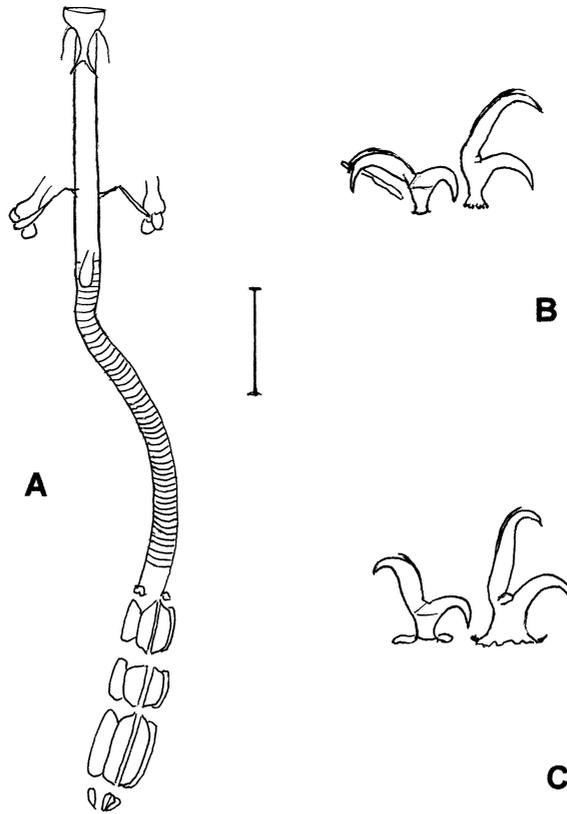


Figure 3. *Diphascon (D.) nelsonae* sp. n. (A) Bucco-pharyngeal apparatus; (B) claws of the second pair of legs; (C) claws of the fourth pair of legs. Scale bar: 10  $\mu$ m.

The paratypes are similar to the holotype. In Table I the dimensions of some structures of the smallest and of the largest measured specimens are indicated.

#### *Etymology*

The species is named *nelsonae* in honour of the tardigradologist, our dear friend, Diane Nelson (Department of Biological Sciences, East Tennessee University, Johnson City).

#### *Remarks*

*Diphascon nelsonae* sp. n. differs from *D. nobilei* in the following features: entire placoid row, and particularly the second and third macroplacoid, longer both with respect to the body length and to the buccal tube length (Table I), claws more slender with longer secondary branches, claw basal spines less evident (absent in the internal claws of the first three pairs of legs).

The new species differs from *D. serratum* in having the support of the stylet inserted on the buccal tube in a more cephalic position (Table I), claws longer (Table I) and more slender with longer secondary branches, anterior and posterior claws of the hind legs are more different in shape and size from one another (Table I; Figures 2, 3).

***Diphascon (D.) platyungue* sp. n.**  
(Figure 4; Table I)

*Material examined*

Marche: Mt Vettore (Ascoli): Shelter Zilioli (2250 m): holotype (slide N. 4926) and three paratypes in meadow; Zilioli cross (2150 m) (three specimens in meadow); Latium: Sabaudia (Latina) (three specimens from mosses on sand dunes in pine-wood).

*Description of the holotype*

Body length 194  $\mu\text{m}$ , colourless, eyes absent, cuticle smooth without pearls. Bucco-pharyngeal apparatus shown in Figure 4A. The bucco-pharyngeal tube, measured as indicated in the description of *D. serratum*, is 45.2  $\mu\text{m}$  long; the rigid buccal tube 20.8  $\mu\text{m}$  long ( $pbf=46$ ) and 1.7  $\mu\text{m}$  wide ( $ptd=8.2$ ). The stylet supports are inserted on the buccal tube at 62.9% of its length ( $ptd=62.9$ ). The pharyngeal bulb (27.4  $\mu\text{m} \times 19 \mu\text{m}$ ) has small apophyses, three rod-shaped macroplacoids and microplacoid, the septulum is absent. The entire placoid row is 16.1  $\mu\text{m}$  in length ( $ptd=77.4$ ) including the microplacoid, 14.1  $\mu\text{m}$  ( $ptd=67.8$ ) excluding it. The first macroplacoid is 3.8  $\mu\text{m}$  in length ( $ptd=18.3$ ), the second 3.6  $\mu\text{m}$  ( $ptd=17.3$ ), the third 5.7  $\mu\text{m}$  ( $ptd=27.4$ ), microplacoid 1.7  $\mu\text{m}$  ( $ptd=8.2$ ).

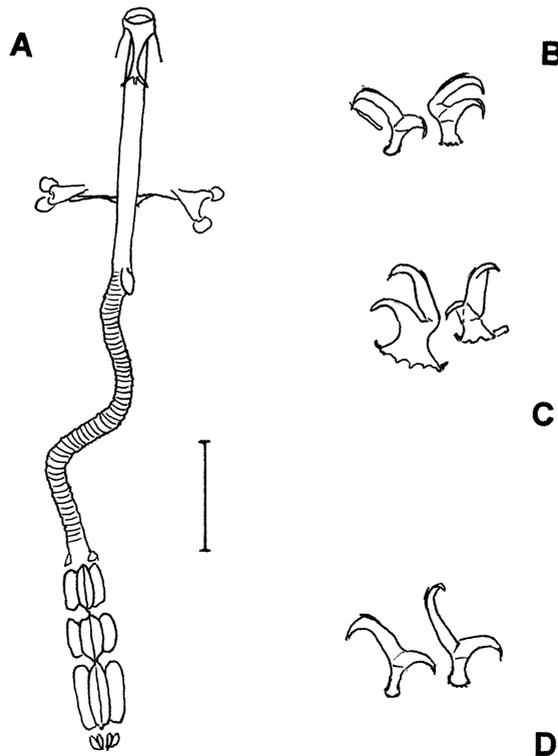


Figure 4. *Diphascon (D.) platyungue* sp. n. (A) Bucco-pharyngeal apparatus; (B) claws of the third pair of legs; (C) claws of the fourth pair of legs; (D) claws of the second pair of legs of a paratype. Scale bar: 10  $\mu\text{m}$ .

The claws (Figure 4B–D) have accessory points on the main branches. The claws of the hind legs (Figure 4C), particularly of the posterior claws, have the basal portion extremely enlarged; their branches are short; the indented basal margin of both internal and external claws appear prolonged in one medial and one lateral thickening. On the first three pairs of legs (Figure 4B, D) the external claws have an indented basal margin, the internal claws have a smooth basal margin. The internal claws are  $6.1\ \mu\text{m}$  long ( $ptd=29.3$ ) on the second and third pairs of legs, the external claws of the same pairs of legs are not measurable due to their unfavourable orientation (in other specimens the value of the  $ptd$  index relative to these claws is 36–39.3); on the hind legs the anterior claws are  $6.5\ \mu\text{m}$  long ( $ptd=31.2$ ) and the posterior claws  $8.5\ \mu\text{m}$  long ( $ptd=40.9$ ). A cuticular bar is present near the internal claws on the first three pairs of legs.

Eggs not found.

The paratypes are similar to the holotype. In Table I the dimensions of some structures of the smallest and of the largest measured specimens are indicated.

### *Etymology*

The name *platyungue* refers to the shape of the basal portion of the hind legs.

### *Remarks*

*Diphascon platyungue* sp. n. differs from *D. nobilei* in having claws shorter with respect to the buccal tube length (Table I), claws of the hind legs with a wider basal portion, internal claws on the first three pairs of legs without basal spines.

The new species differs from *D. serratum* in having the stylet supports inserted on the buccal tube in a more cephalic position (Table I), narrower buccal tube, shorter placoids (Table I), claws of the hind legs with a wider basal portion.

The new species differs from *D. nelsonae* in the following features: slightly longer buccal tube and, as a consequence, lower values of the  $ptd$  index relative to placoid row and to the claw length (Table I); claws shorter and less slender with shorter secondary branches, claws of the hind legs with a clearly larger basal portion (Figures 3, 4).

### ***Diphascon (D.) hydrophilum* sp. n.**

(Figure 5; Table I)

### *Material examined*

Modena: Rocca Santa Maria: one specimen in sediments of the Torrente Fossa (holotype, slide N. 4927); Modena: Levizzano: three specimens in sediments of the Guerro stream; Trieste: Aurisina: seven specimens in sediments of the cave Grotta del Pettiroso.

### *Description of the holotype*

Body length  $307\ \mu\text{m}$ , colourless, eyes absent, cuticle smooth without pearls. Bucco-pharyngeal apparatus is shown in Figure 5A. The bucco-pharyngeal tube is  $49.4\ \mu\text{m}$  long; the rigid buccal tube  $23.3\ \mu\text{m}$  long ( $pbf=47.2$ ) and  $2.2\ \mu\text{m}$  wide ( $ptd=9.4$ ). The stylet supports are inserted on the buccal tube at 63.1% of its length ( $ptd=63.1$ ). The pharyngeal bulb ( $32.7\ \mu\text{m} \times 24\ \mu\text{m}$ ) has small apophyses, three rod-shaped macroplocoids and

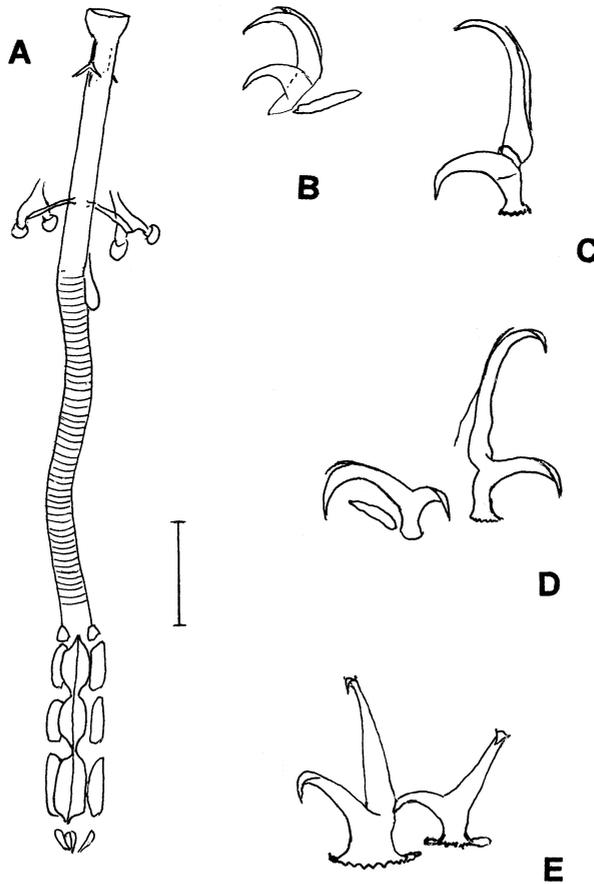


Figure 5. *Diphascoen (D.) hydrophilum* sp. n. (A) Bucco-pharyngeal apparatus; (B) internal claw of the second pair of legs; (C) external claw of the second pair of legs; (D) claws of the second pair of legs of a paratype; (E) claws of the fourth pair of legs. Scale bar: 10  $\mu$ m.

microplacoid, the septulum is absent. The first macroplacoid is 4.9  $\mu$ m long ( $ptd=21.0$ ), the second 4.6  $\mu$ m ( $ptd=19.7$ ), the third 5.8  $\mu$ m ( $ptd=24.9$ ), microplacoid 1.7  $\mu$ m ( $ptd=7.3$ ); the entire placoid row 18.1  $\mu$ m long ( $ptd=77.7$ ) including the microplacoid, 15.8  $\mu$ m ( $ptd=67.8$ ) excluding it.

The claws (Figure 5B–E) with accessory points on the main branches; the external claws are long and slender. The claws of the hind legs (Figure 5E) have the basal portion enlarged with the basal margin indented and prolonged in one medial and one lateral thickening. The external claws on the first three pairs of legs (Figure 5C, D) have an indented basal margin. They are 16.1  $\mu$ m in length ( $ptd=69.1$ ) on the second and third pair of legs; the internal claws are not measurable due their unfavourable orientation; we measured them in a specimen having the buccal tube 24.5  $\mu$ m long where they are 9  $\mu$ m long ( $ptd=36.7$ ); on the hind legs the anterior claws are 10.4  $\mu$ m in length ( $ptd=44.6$ ) and the posterior claws 15.8  $\mu$ m ( $ptd=67.8$ ). A cuticular bar is present near the internal claws on the first three pairs of legs. Eggs not found.

The paratypes are similar to the holotype. In Table I the dimensions of some structures of the smallest and of the largest measured specimens are indicated.

*Etymology*

The name *hydrophilum* refers to the fact that the species was found in water.

*Remarks*

*Diphascon hydrophilum* sp. n. differs from *D. nobilei* in the following features: stylet supports inserted on the buccal tube in a more caudal position (Table I); slightly higher value of the *pbf* index relative to the buccal tube length (Table I); lower value of the *ptd* index relative to the placoid row length as a consequence of the shortness of the third macroplacoid (Table I); longer and slender claws (Figures 1, 5; Table I); the internal claws on the first three pairs of legs without basal spines.

The new species differs from *D. serratum* in having a slightly higher value of the *pbf* index relative to the buccal tube length (Table I); stylet supports inserted on the buccal tube in a more cephalic position (Table I), shorter third macroplacoid, lower value of the *ptd* index relative to the placoid row length (Table I), longer and more slender claws with longer secondary branches (Figures 2, 5).

The new species differs from *D. nelsonae* in having a slightly higher value of the *pbf* index relative to the buccal tube length (Table I), lower value of the *ptd* index relative to the placoid row length as a consequence of the shortness of the third macroplacoid (Table I), longer and more slender claws (Figures 3, 5; Table I).

The new species differs from *D. platyungue* in having a slightly shorter bucco-pharyngeal tube (both the buccal tube and the pharyngeal tube are shorter in relation to the body length) (Table I), shorter third macroplacoid, claws very different in size and shape (the claws of *D. hydrophilum* are longer and more slender, and those of the fourth pair of legs have the basal portion less enlarged) (Table I; Figures 4, 5).

**Conclusions**

It seems necessary to check the specific diagnosis regarding specimens lacking eyes that in the past were attributed to *Diphascon nobilei*, both from Italy and other geographic areas. The Italian fauna has been enriched by four species, one of which is found in freshwater.

As a consequence of our statements one can conclude that a group *nobilei* can be recognized within the genus *Diphascon*, subgenus *Diphascon*. To this group five species can be surely attributed to date: *Diphascon nobilei*, *D. serratum* sp. n., *D. nelsonae* sp. n., *D. platyungue* sp. n., and *D. hydrophilum* sp. n. Some other species of the subfamily Itaquasconinae are similar to them as regards the shape of the claws of the hind legs and the marginal indentation of these claws: *D. (D.) birklehofti* Schuster, 1999, *D. (Adropion) higginsii* (Binda, 1971), *D. (Adropion) greveni* Dastych, 1984, *Platicrista angustata* (Murray, 1905) (Pilato 1973); others have the claws of the hind legs (particularly the posterior claws) with an enlarged base but with a smooth basal margin, e.g. *D. (Adropion) scoticum* Murray, 1905 (Pilato 1974, 1975), or have the basal portion of that claw not enlarged but with an indented margin, e.g. *D. (Adropion) mirabile* Dastych, 1984. But all these species differ due to relevant characters from those of the *nobilei* group: *D. (D.) birklehofti*, *D. (A.) higginsii*, *D. (A.) greveni*, and *D. (A.) mirabile* have a septulum; the last species also has a pseudoseptulum; *D. (A.) greveni*, *D. (A.) scoticum*, *D. (A.) mirabile*, and *Platicrista angustata* lack a cuticular drop-shaped thickening between the buccal tube and the pharyngeal tube; in *D. (A.) higginsii* a very small, flat thickening is present, very difficult to

see; *P. angustata* has apophyses for the insertion of the stylet muscles in the shape of flat ridge stylet furcae. Due to these differences *D. higginsi*, *D. greveni*, *D. mirabilei*, and *D. scoticum* are attributed to a subgenus (*Adropion*) different from that (*Diphascon*) to which the *nobilei* group is ascribed, and *P. angustata* is attributed to a different genus, and we consider this systematic arrangement justified. In conclusion, the presence of hind claws with an enlarged basal portion, together with their basal indentation, can be noted in species of different subgenera or also of different genera, and therefore we think that this particular shape of the hind claws in some cases can be due to evolutionary convergence. *Diphascon* (*D.*) *birklehofti* differs from the species of the *nobilei* group only in the presence of the septulum; the presence or absence of the septulum is a variable character within the genus, but we think it opportune to speak of “group of species” only when some species appear very similar to each other and differ only in some details. Based on this criterion, we think it opportune not to consider *D. birklehofti* as certainly belonging to the *nobilei* group.

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### References

- Bertolani D, et al. 1977. Studi ecologici e paleoecologici nella palude della Chioggiola presso Pavullo nel Frignano. In: Pavullo e il Medio Frignano Modena. Modena: Aedes Muratoriana. p 1–47.
- Bertolani R. 1982 Tardigradi (Tardigrada). Guide per il riconoscimento delle specie animali delle acque interne italiane, 15 AQ/1/168. Rome: C.N.R. p 1–104.
- Bertolani R. 1984. Tardigradi muscicoli delle dune costiere italiane, con descrizione di una nuova specie. Atti della Società Toscana di Scienze Naturali Memorie, S. B XC, 139–148.
- Bertolani R. 1988. Tardigradi delle acque dolci, con riferimento ai corsi d’acqua della Lunigiana e della Garfagnana. Bollettino del Museo di Storia Naturale Lunigiana 6–7:133–138.
- Bertolani R. 2002. First report of tardigrades within hypogeal caves. Bollettino dell’Accademia Gioenia di Scienze Naturali, Catania 35(361):649–654.
- Bertolani R, Guidetti R, Rebecchi L. 1995. Ulteriore contributo alla conoscenza dei Tardigradi delle Marche e dell’Umbria. Atti della Società Toscana di Scienze Naturali Memorie, S.B 101:21–34.
- Bertolani R, Manicardi GC, Gibertoni D. 1987. Tardigradi della Riserva naturale di Torricchio e dei Monti Sibillini (Marche, Italia). La riserva naturale di Torricchio 7:15–34.
- Bertolani R, Rebecchi L. 1996. The tardigrades of Emily (Italy), II. Monte Rondinaio, A multihabitat study on a high altitude valley of the northern Apennines. Zoological Journal of the Linnean Society London 116:3–12.
- Binda MG. 1969. Nuove dati su Tardigradi di Sicilia con descrizione di due nuove specie. Bollettino dell’Accademia Gioenia di Scienze Naturali, Catania, S. IV, IX 9:623–633.
- Binda MG. 1971. Su alcuni Tardigradi muscicoli del Nord-Africa. Bollettino dell’Accademia Gioenia di Scienze Naturali, Catania, S. IV, X 9:759–765.
- Binda MG, Pilato G. 1971. Nuova osservazioni sui Tardigradi delle Isole Eolie. Bollettino dell’Accademia Gioenia di Scienze Naturali, Catania, S. IV, X 9:766–774.
- Biserov V. 1991. An annotated list of Tardigrada from European Russia. Zoologische Jahrbücher Systematik 118:193–216.
- Dastych H. 1984. The Tardigrada from the Antarctica with description of several new species. Acta Zoologica Cracoviensia 27(19):377–436.
- Dastych H. 1988. The Tardigrada of Poland. Monografie Fauny Polski 16:1–255.
- Maucci W. 1975. Tardigradi muscicoli della Turchia. (Secondo contributo). Bollettino del Museo Civico di Storia Naturale, Verona 1:107–150.
- Maucci W. 1986. Tardigrada. Fauna d’Italia, Calderini, Bologna 24:1–338.
- Maucci W, Durante Pasa MV. 1984. I tardigradi della penisola Iberica. Miscellanea Zoologica VIII:67–80.

- Pilato G. 1973. Precisazioni e rettifiche alla descrizione di alcune specie di Tardigradi e considerazioni su alcuni problemi inerenti al loro studio. Bollettino dell'Accademia Gioenia di Scienze Naturali, Catania, S. IV, XII 1-2:157-175.
- Pilato G. 1974. Studio su *Diphascon scoticum* J. Murr., 1905 (Eutardigrada) e alcune altre specie ritenute ad esso affini. *Animalia* 1:73-88.
- Pilato G. 1975. On the taxonomic criteria of the Eutardigrada. *Memorie dell'Istituto Italiano di Idrobiologia* 32(Suppl):277-303.
- Pilato G, Binda MG. 1997/98. A comparison of *Diphascon (D.) alpinum* Murray, 1906, *D. (D.) chilense* Plate 1889 and *D. (D.) pingue* Marcus, 1936 (Tardigrada), and description of a new species. *Zoologischer Anzeiger* 236:181-185.
- Pilato G, Catanzaro R, Binda MG. 1989. Tardigradi delle acque dolci siciliane, V. Nota. *Animalia* 16:121-130.
- Pilato G, D'Urso V. 1976. Contributo alla conoscenza dei Tardigradi d'Australia. *Animalia* 3:135-145.
- Schuster R. 1999. A new species of the genus *Diphascon* (Tardigrada) from Germany. *Acta Biologica Benrodis* 10:21-25.