

NOTES ON THE *DUVALIUS* SPECIES OF THE TAYGETOS
MASSIF (PELOPONNESE, SOUTHERN GREECE),
WITH DESCRIPTION OF THE MALE FEATURES
OF *DUVALIUS (DUVALIUS) MIREI* DEUVE, 2001
(Coleoptera, Carabidae)

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INTRODUCTION

Taygetos is a narrow, elongate limestone massif that fringes the extreme south-western coast of Peloponnese (West Sparta, South Greece); very isolated, and rich of snow, water and forests, this mountain reaches its highest altitude at Profitis Elias top 2405 m. For its geographic position and peculiar geo-morphological features, this mountain attracted the attention of entomologists since the XIXth century: not casually, it is the type locality of some of the most interesting carabid beetles of the southern Balkan peninsula, as the giant *Carabus (Procerus) duponchelii* (Dejean, 1831), *Nebria taygetana taygetana* Rottenberg, 1874, and *Omphreus (Paromphreus) krueperi* Reitter, 1885.

Nevertheless, the carabid fauna of this massif is not yet adequately known so far: just as an example, very recently Wrase & Assmann (2008) had the opportunity to describe a new micropterous dromiine carabid species, *Philorhizus marggii*, living in the pastures at high altitude of Profitis Elias.

Concerning the subterranean carabids, until 1979 two only species were described: the endogean anilline *Caecoparvus muelleri* (Ganglbauer, 1900), and the microphthalmous trechine *Duvalius diaphanus* (Rottenberg, 1874).

In July 1978, the senior author of this contribution (A.C.), with his

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wife Germana, explored Taygetos on the western side. They discovered the Varvara cave at 1650 m, and reported from it a new interesting subterranean species: the carabid trechine *Duvalius taygetanus* Casale, 1979. Furthermore, at 2100 m about, under big stones near the snow, they sampled a male individual of *Duvalius diaphanus*, previously known from females only. The male genitalia of this species were described and illustrated by Casale (1979).

Later, Casale visited other times this massif: in particular, in June 1979 with the French biospeleologist L.C. Genest (Grenoble), and again in July 1983 with his wife and daughter. The main result, thanks to some pit traps placed in the Varvara cave by L.C. Genest and A. Vigna Taglianti, was the discovery of a new *Duvalius* species syntopic with *D. taygetanus*: *Duvalius genesti* Casale & Vigna Taglianti, 1984, and the sphodrine *Laemostenus (Antisphodrus) casalei* Dubault & Lassalle, 1991; furthermore, the cholevid leptodirine *Muelleriella taygetana* Casale, 1983, the first and only leptodirine beetle described so far from Peloponnese (Casale 1983).

Until recent years, however, a representative of the genus *Duvalius* was the most mysterious taxon known so far from the Taygetos massif. In fact, in 1977, P. Bruneau de Miré collected on this mountain at high altitude, amongst several individuals of *D. diaphanus*, a female individual very similar in general features to the latter, but distinguishable for some characters that will be stressed below. Both the senior author of this contribution (A.C.), and L.C. Genest, had the opportunity to examine this specimen, but decided to await the discovery of a male individual for its description. Finally Deuve (2001), from this only female, described *D. (Duvalius) mirei* new species, illustrated its diagnostic features in comparison with those of *D. (D.) diaphanus*, and stressed the close relationship of the latter with the new species.

More recently, the junior author of this contribution (T.L.), during one of his explorations of caves, mountains and islands in Greece (see Lebenbauer 2004), sampled in Taygetos Mt. a series of *Duvalius* specimens, including some males, perfectly corresponding to the description of the female holotype of *D. mirei*.

Therefore, we are able to describe the features of male genitalia of this species. Furthermore, we re-examined two of the female specimens of the type series of *D. diaphanus*, and we can confirm the correct attribution to this species of the male individual described by Casale (1979).

MATERIAL AND METHODS

The following data come from some specimens (including type material) of the four *Duvalius* species treated in the present contribution.

Male genitalia were dissected, dehydrated in ethanol, cleared in cold KOH, examined and illustrated, using standard techniques before their definitive inclusion on microscope slides. Line drawings were made using a camera lucida attached to stereomicroscopes Wild M-5, and a microscope Leitz Orthoplan. The photographs of habitus were obtained using a digital camera Canon G6 attached to a stereomicroscope Zeiss Stemi 2000, and a Leica MZ16 stereomicroscope with a Leica DFC-490 digital camera attached. Several individual images of *D. mirei* were focus-stacked by using ZereneStacker. Final post-processing and extraction was done in Adobe PSCS3.

ACRONYMS. TL: body Total Length, from the anterior margin of clypeus to the apex of elytra, measured along the suture. L: overall Length, from apex of mandibles to apex of elytra, measured along the suture. PL/PW: ratio Length of Pronotum, as linear distance from the anterior to the basal margin, measured along the midline/maximum Width of Pronotum, as greatest transverse distance. EL/EW: ratio Length of Elytra, as linear distance from the basal ridge to the apex, measured along the suture/maximum Width of Elytra. TL/AL: ratio body Total Length/Length of Antennae. A6L/A6W: ratio Length/Width antennomere 6.

COLLECTIONS. DEI: Deutsches Entomologisches Institut, Müncheberg (Germany); MNHN: Muséum National d'Histoire Naturelle, Paris (France); CCa: Casale collection, University of Sassari (Italy); CLe: Lebenbauer collection, Seebenstein/Schiltern (Austria).

TAXONOMIC TREATMENT AND MORPHOLOGICAL TERMS. In this contribution, the genus *Duvalius* is treated in the widest sense, i.e. as a unit including all subgenera reported from Greece (Casale et al. 1996; Moravec et al. 2003; Lorenz 2005). In spite of this choice, the limits of these subgeneric groups are not always defined.

The median lobe of aedeagus is synonym of phallus of authors. Endophallus is synonym of inner sac of authors.

Duvalius (Duvalius) diaphanus (Rottenberg, 1874)

Trechus diaphanus Rottenberg, 1874: 328

Trechus (Trechus) diaphanus Apfelbeck, 1904: 136

Duvalius (Duvalius) diaphanus Jeannel, 1928: 565

LECTOTYPE ♀ (here designated), labelled: "Taygetos Raymond", "Typus", "Coll. Letzner Rottenberg", "Syntypus", "diaphanus type", "Coll. DEI Müncheberg", "Duvalius diaphanus Rottenb." (DEI) (fig. 2).

PARALECTOTYPE ♀, labelled: "Taygetos, Raymond", "Typus", "Type", "Muséum Paris, coll. R. Jeannel 1931", "Trechus diaphanus Rttbg", "Coll. Letzner, Rottenberg" (MNHN) (Deuve, pers. comm.).

NOTE. The original description was based on three female specimens (see also Jeannel, 1928); the syntype (lectotype) female individual (in DEI) that we examined is according to the original description (Rottenberg, 1874), and to the figures in Jeannel (1928), Casale (1979) and Deuve (2001) (see figs 1-4).

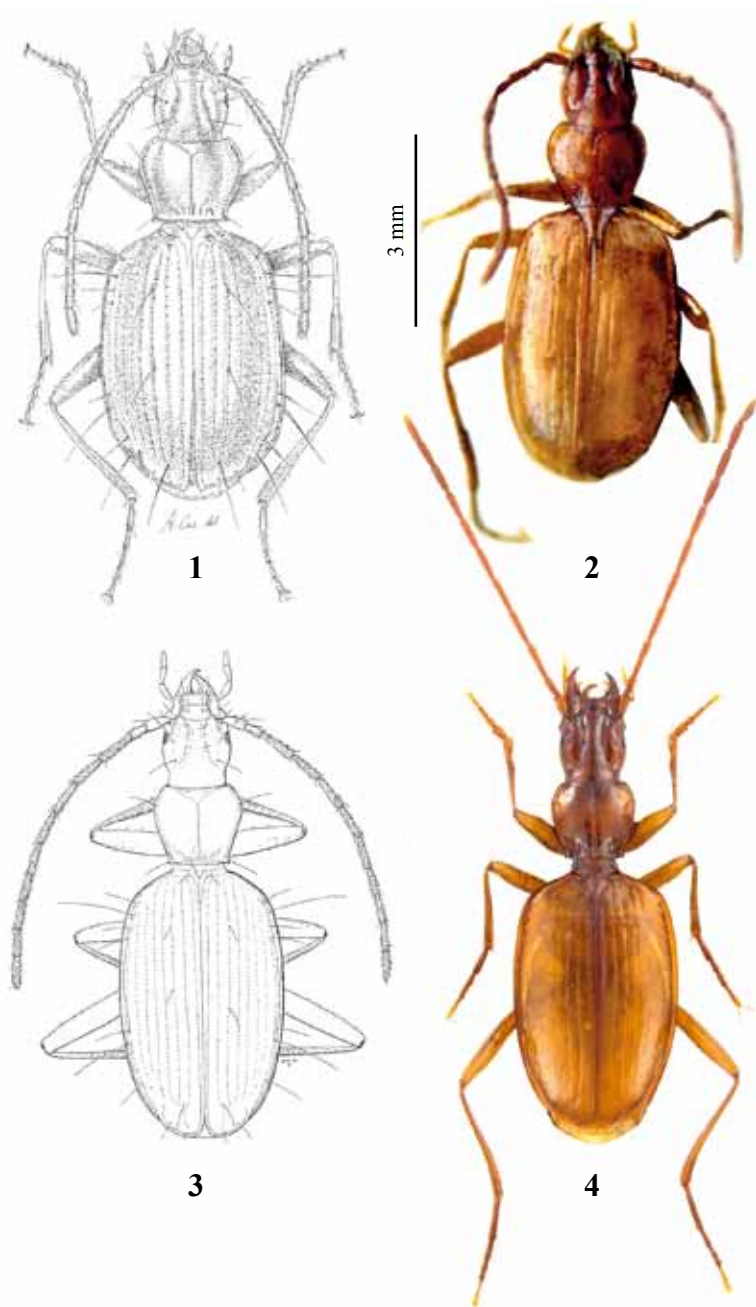
ADDITIONAL EXAMINED MATERIAL. One male individual labelled: "GR - Peloponneso, M. Taygetos m 2100 5.VII.1978 Casale leg." (CCa). This male individual was sampled under a big stone near the snow in alpine pasture, just above the refuge ("kataphygio") of the Alpine Club of Sparte.

Duvalius (Duvalius) mirei Deuve, 2001

HOLOTYPE ♀, from "Grèce, Péloponnèse, mont Taygète, près du refuge, bord de névé, 2000 mètres, Philippe Bruneau de Miré et Leonidas Tsacas, 15 juillet 1977" (Deuve 2001) (MNHN).

ADDITIONAL EXAMINED MATERIAL. 5 ♂♂, 4 ♀♀, and remains of a female individual, from "GR, Peloponissos, Lakonia, Taygetos 2350 m V.05-VI.06 Leg. T. Lebenbauer" (CLe, CCa).

All these specimens were collected by T.L. through pit traps in a small cave at 2350 m near the top of Taygetos (Profitis Ilias 2405 m), a small pit -15 m depth, close to the footway between Varvara and the top, very cold with ice inside, without soil at the bottom and only partially dark. The associated subterranean fauna was represented by a carabid



Figs 1-4 – *Duvalius (Duvalius) diaphanus* (Rottenberg, 1874), male individual (after Casale 1979) (1) and female Lectotype (2); *D. (D.) mirei* Deuve, 2001, female Holotype (after Deuve 2001) (3) and male individual (4).

beetle, *Tapinopterus* sp., and the cholevid beetle *Muelleriella taygetana* Casale, 1983.

RESULTS

MALE FEATURES OF *DUVALIUS (DUVALIUS) MIREI* DEUVE, 2001

General features as in fig. 4, according to the original description by Deuve (2001) from the female holotype (fig. 3).

Measurements and ratios (in one male individual): L: 7.0 mm; TL: 6.5 mm; PL/PW: 0.94; EL/EW: 1.59; TL/AL: 1.17; A6L/A6W: 3.8.

As a rule in male individuals of *Duvalius* species, fore tarsomeres 1-2 moderately dilated and toothed on the inner side.

Male genitalia as in figs 7-8. Median lobe of aedeagus in lateral aspect regularly curved and moderately narrowed apically; parameres elongate, each with four apical setae; endophallus with copulatory piece widely bilobed both at base and apex, with a reduced bundle of scales in the middle.

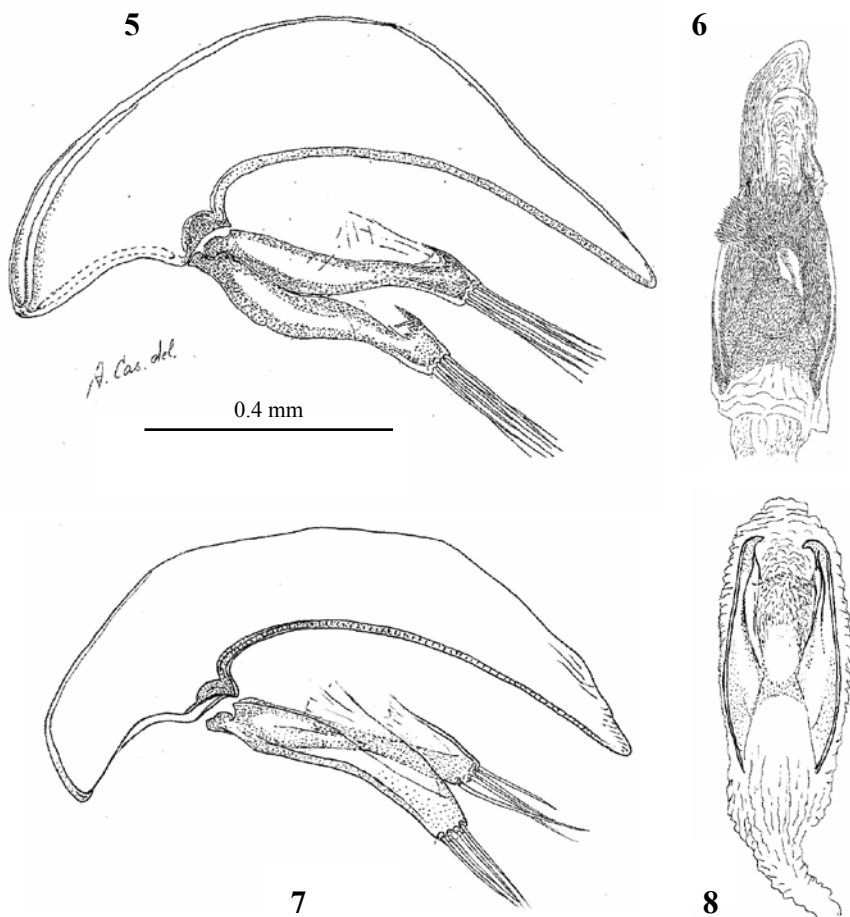
DISCUSSION AND CONCLUSIONS

The discovery of some male individuals of *D. mirei*, and the examination of their male genitalia, confirmed the close relationships of the latter with the sympatric and syntopic species *D. diaphanus*, as hypothesised by Deuve (2001).

This datum is very interesting: in fact, it is very rare that two or more subterranean carabid beetles of the same species group, similar in size, shape, and degree of troglomorphic adaptation to the subterranean environment, colonize the same subterranean habitat (caves or Shallow Hypogean Zone). This general rule is valid also for other subterranean beetles, as Cholevidae Leptodirini (Sbordoni et al. 1982).

An exception is offered just in an other massif of Southern Greece, the Kyllene Mt. in Peloponnese, where three sibling *Duvalius* species of the *wichmanni* species group (*D. kyllenicus* Scheibel, 1937, *D. lucarellii* Casale & Vigna Taglianti, 1993, and *D. casalei* Sciaky, 1992) are sympatric, showing a case of true adaptive radiation to different habitats (Casale et al. 1996).

Concerning the two species treated in this contribution, besides the pre-zygotic isolation offered by different morphological features in the



Figs 5-8 – *Duvalius (Duvalius) diaphanus* (Rottenberg, 1874), male genitalia, left lateral aspect (5) and copulatory piece, dorsal aspect (6); *D. (D.) mirei* Deuve, 2001, male genitalia, left lateral aspect (7) and copulatory piece, dorsal aspect (8).

male genitalia, some ecological barriers and different adaptive features seem to be able to isolate them: it is a fact that only one female individual of *D. mirei* (the holotype of the species) was sampled by De Miré amongst several individuals of *D. diaphanus*, but not any individual *D. diaphanus* was sampled by one of the authors (T.L.) amongst several *D. mirei* individuals that allowed the present description. Furthermore, the only male individual of *D. diaphanus* sampled by the senior author (A.C.) was found in an alpine pasture at 2100 m under big stones near the

snow, whereas the series of *D. mirei* was sampled by the junior author (T.L.) in a cold cave at higher altitude (2350 m), in extreme environmental conditions (see above). Therefore, this fact indicates that *D. mirei* is a more specialised subterranean element, in agreement with its marked troglomorphic features (body slenderer, eyes smaller in size, antennae and legs much more elongate in comparison with the body length).

From the biogeographical point of view, the Taygetos massif confirms its role of isolated refuge, important centre of speciation, and “South Aegean” area in the Southern Balkan peninsula, with a carabid fauna closely related to the Northern and Central Greece but also to Crete and the South Western Anatolia. As recalled in Introduction, concerning Carabidae Trechini four *Duvalius* species known so far are sympatric in this mountain: *D. (Duvalius) diaphanus* (Rottenberg, 1874), and *D. (Duvalius) mirei* Deuve, 2001, near the snow and in cold caves above 2000 m; and *D. (Duvalius) taygetanus* Casale, 1979 and *D. (Duvalius) genesti* Casale & Vigna Taglianti, 1984, syntopic in the Varvara cave in alpine zone at 1650 m.

The *D. (Duvalius) diaphanus* species group, in the sense of Casale (1979), Casale et al. (1996), and Deuve (2001), appears as the most isolated species group of the genus *Duvalius* in Greece, apparently close to cave dweller taxa of SW Anatolia (*D. huetheri* Jeannel, 1934), maybe also to North African taxa (“*Trechopsis*” in the sense of Jeannel, 1934) (see also Vigna Taglianti 1980; Casale & Vigna Taglianti 1999), and includes presently two large sized (7 mm about), microphthalmous species, very similar to each other.

The four *Duvalius* species sympatric in the Taygetos massif, and in particular the two sibling species *D. (Duvalius) diaphanus* and *D. (Duvalius) mirei*, cited and treated in this contribution, can be distinguished by the following key:

1. Eyes absent; species smaller in size (4.0-6.2 mm).....2
- Eyes reduced but evident; large sized species (7 mm about).....3
2. Larger in size (5.4-6.2 mm); body fully glabrous, with wider and depressed elytra.....
.....*D. (D.) taygetanus* Casale, 1979
- Smaller in size (4.0-4.7 mm); genae pubescent, elytra narrow and convex.....
.....*D. (D.) genesti* Casale & Vigna Taglianti, 1984
3. Head robust; genae swollen, regularly curved; frontal furrows deeper, markedly divergent in the posterior half; neck constriction evident; eyes elongate, sub-elliptical. Antennae relatively short, extended backwards reaching the middle of elytron (TL/AL: 1.46); antennomeres 4-10 relatively stout, shorter and wider (A6L/A6W: 3.0). Pronotum large sized, cordiform, markedly transverse (ratio PL/PW: 0.79), with its maximum width at the anterior fourth; lateral sides widely curved anteriorly, shortly sinuate in front to the basal

angles. Elytra shorter and wider (ratio EL/EW: 1.43); humeral angle rounded, but evident; basal area of disc not depressed; apical carinula narrow, scarcely convex. Legs moderately elongate, femora robust and thickened (figs 1-2). Male genitalia (figs 5-6): median lobe of aedeagus in lateral aspect markedly angulate in the middle, abruptly narrowed apically; parameres robust, thickened, each with six apical setae; endophallus with copulatory piece bilobed at base, narrowed in front, covered by a dense bundle of spines.....*D. (Duvallius) diaphanus* (Rottenberg, 1874)

- Head elongate; genae moderately swollen, obliquely narrowed in the posterior half; frontal furrows shallower, regularly and obliquely divergent in the posterior half; neck constriction moderate; eyes rounded, more reduced in size. Antennae elongate, extended backwards reaching the apical sixth of elytra (TL/AL: 1.17); antennomeres 4-10 elongate and slender (A6L/A6W: 3.8). Pronotum smaller, elongate-cordiform, almost as long as wide (ratio PL/PW: 0.94), with its maximum width at the anterior fifth; lateral sides markedly constricted to the base, parallel sided in front to the basal angles. Elytra longer and narrower (ratio EL/EW: 1.59); humeral angle vanished; basal area of disc depressed, apical carinula thickened at sides and markedly convex. Legs very elongate, femora markedly slender and thin (figs 3-4). Male genitalia (figs 7-8): median lobe of aedeagus in lateral aspect regularly curved and moderately narrowed apically; parameres elongate, each with four apical setae; endophallus with copulatory piece widely bilobed both at base and apex, with a reduced bundle of scales in the middle (fig. 8).....*D. (Duvallius) mirei* Deuve, 2001

ACKNOWLEDGEMENTS. For important data and loan of material, we are particularly indebted to Thierry Deuve (MNHN) and Lothar Zerche (DEI). For the assistance in preparing photographs and tables, we thank Dr. Ivo Manca and Dr. Paolo Marcia (Department of Zoology, University of Sassari), Dr. Harald Schillhammer (Natural History Museum, International Research Institute for Entomology, Vienna). We thank also Harald Mixanig (Klagenfurt, Austria), who discovered the small cave on Taygetos cited in text, in which the small series of *D. mirei* was sampled by T.L.

SUMMARY

Four species of genus *Duvallius* (sensu stricto) are known so far from caves and upper hypogean zone (M.S.S.) in the Taygetos massif (Peloponnese, Southern Greece): *Duvallius (Duvallius) taygetanus* Casale, 1979, *D. (D.) genesti* Casale & Vigna Taglianti, 1984, *D. (D.) diaphanus* (Rottenberg, 1874), and *D. (D.) mirei* Deuve, 2001. Two of them, *D. diaphanus* and *D. mirei*, are large sized, sibling species with reduced but still evident and pigmented eyes, syntopic at high altitude above 2000 m a.s.l.. The male features and characters of the male genitalia of *D. mirei* are here described for the first time, and compared with those of *D. diaphanus*. Furthermore, a key for identification of the four sympatric *Duvallius* species known so far from Taygetos Mt. is provided.

RIASSUNTO

Note sulle specie del genere Duvallius del massiccio del Taigeto (Peloponneso, Grecia meridionale), con descrizione dei caratteri del maschio di Duvallius (Duvallius) mirei Deuve, 2001 (Coleoptera, Carabidae).

Quattro specie del genere *Duvallius* (sensu stricto) sono note fino ad ora di grotte e di ambiente sotterraneo superficiale (M.S.S.) nel massiccio del Taigeto (Peloponneso, Grecia meridionale): *Duvallius (Duvallius) taygetanus* Casale, 1979, *D. (D.) genesti* Casale

& Vigna Taglianti, 1984, *D. (D.) diaphanus* (Rottenberg, 1874), e *D. (D.) mirei* Deuve, 2001. Due di esse, *D. diaphanus* e *D. mirei*, sono specie estremamente simili fra loro, di grandi dimensioni, con occhi ridotti ma ancora evidenti e pigmentati, sintopiche in alta quota oltre i 2000 m s.l.m. Le caratteristiche generali e i caratteri dei genitali maschili di *D. mirei* sono qui descritti per la prima volta, e confrontati con quelli di *D. diaphanus*. Inoltre, è fornita una chiave per l'identificazione delle quattro specie note di *Duvalius* simpatriche sul Monte Taigeto.

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