Ants from the Montnegre–Corredor Natural Park (NE Spain) with description of the male *Lasius cinereus* Seifert (Hymenoptera, Formicidae)

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Espadaler, X. & Roig, X., 2000. Ants from the Montnegre–Corredor Natural Park (NE Spain) with description ot the male *Lasius cinereus* Seifert (Hymenoptera, Formicidae). *Misc. Zool.*, 23.2: 45–53.

Ants from the Montnegre–Corredor Natural Park (NE Spain) with description ot *the male* Lasius cinereus *Seifert (Hymenoptera, Formicidae).*— A survey was conducted on the myrmecofauna of this protected zone near Barcelona (NE Spain). A total of 50 species was found. *Lasius lasioides* (Emery) and *Lasius cinereus* Seifert are added to the fauna of Catalonia. The males of this latter species are described for the first time; their smaller size separates them from the otherwise similar males of *L. grandis* Forel. The head and scape are proportionately longer in *L. cinereus.* One sample of *Lasius (Chthonolasius)* was unusual since it contained two sharply distinct phenotypes differentiated by the pubescence, biometry and degree of flattening of appendages. One form is provisionally identified as *L. umbratus* (Nylander); the other form is tentatively associated with *Lasius rabaudi* Bondroit. The presence of the invasive Argentine ant (*Linepithema humile* Mayr) at one of the borders of the park calls for monitoring of its eventual spread and we suggest a rehabilitation of the area presently occupied by this ant.

Key words: Ants, Formicidae, *Lasius cinereus, Lasius lasioides, Chthonolasius,* Male.

(Rebut: 11 XII 00; Acceptació condicional: 4 IV 01; Acc. definitiva: 30 VI 01)

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ISSN: 0211–6529

Introduction

The need to protect and document biodiversity is deeply felt nowadays (Wilson, 1988; Tilman, 2000). Species richness —the number of species in a site— is the most commonly considered facet of biodiversity although this single number cannot portray the whole complexity of the term biodiversity (Purvis & Hector, 2000). Ants are one of the main groups that have been used as indicators of habitat recovery (Andersen 1997; Majer & Beeston, 1996) and some key species have proven to be involved in the loss of arthropod biodiversity (Holway, 1998; Human & Gordon, 1997); these few invasive pest ants may even play a negative role in vertebrate species (Suárez et al., 2000).

The compilation of species catalogues and facilitation of public access to these data are among the main objectives of the Catalan strategy for conservation and sustainable use of biodiversity (EDB) (Anonymous, 1999). Here we took the step towards completing the myrmecofauna of a preserved zone near Barcelona, along the lines of previous works on protected areas such as the national parks of Cazorla (Espadaler, 1997a), Garraf (Espadaler, 1992) or Montseny (Espadaler, 1986). The finding of an invasive ant at the border of the park calls for a continued survey of its eventual spread into the limits of the reserve. During the survey the unknown male of one species (*Lasius cinereus* Seifert) was discovered and two species were added to the Catalan fauna. In addition, an enigmatic sample was found with two different *Lasius* (*Cthonolasius*) phenotypes coexisting under the same stone. The possible significance of this finding is discussed.

Material and methods

The Montnegre–Corredor National Park (area 15,000 ha) comprises two massifs that run in parallel to the Mediterranean coast reaching a maximum altitude of 795 m. Mean cumulative annual rainfall is from 620 mm to 880 mm (Martín & Moreno, 1996; A. Bombí, pers. comm.) and mean monthly temperatures are from 7.8° in January to 22.3° in July and August (data from 1977–1998). Vegetation is mainly Mediterranean, with evergreen oak (*Quercus ilex*), cork oak (*Quercus suber*), stone pine (*Pinus pinea* L.) and Aleppo pine (*Pinus halepensis* Mill.). There remain some interesting spots with central European or Atlantic character, with species such as the bell heather (*Erica cinerea* L.), silver birch (*Betula pendula* Roth), common beech (*Fagus sylvatica* L.) or *Cardamine heptaphylla* (Vill). Both massifs have been inhabited since the stone age and since 1986 there has been an increasing, though not numerous, flow of visitors, particularly at on weekends (Gordi, 1996). This pressure is mainly on the Corredor massif, which is much more easily reached by car.

Ant sampling was performed on seven collecting days, from mid July to mid October, with a total of 66 hours. The survey was qualitative and not carried out with a quantitative goal in mind. The main objective was to determine which ant species are present in this area. At every sampling station a careful search was done on top soil, under stones, in rock crevices, among fallen twigs and sticks, under tree bark and in dead branches still on the tree. Digging enabled partial retrieval of nest inhabitants. A representative dry-mounted collection of all species was deposited at the Vallgorguina Park Office.

List of the stations surveyed (fig. 1)

Montnegre massif

1. Vall de Fuirosos (dense wood, at 1km before an abandoned quarry); 2. Vall de Fuirosos (open wood, at 1 km past an abandoned quarry); 3. Vall de Fuirosos (Can Bac); 4. Vall de Fuirosos (Bosc dels Castanyers); 5. Sant Martí del Montnegre (hermitage); 6. Vilardell, Les Gatalledes; 7. Sot de Can Xifré (Riera de Montnegre); 8. Sant Martí del Montnegre (Coll Negre); 9. Serra de Montnegre (Roureda d'En Preses); 10. Serra de Montnegre, southern slope–Urbanització Les Fonts del Montnegre (route to the Turó Gros); 11. Serra de Montnegre, southern slope–Urbanització Les Fonts del Montnegre (dense wood); 12. Serra de Montnegre (wood of *Quercus canariensis*); 13. Serra de Montnegre–punt geodèsic (Turó Gros); 14. Entrance to the

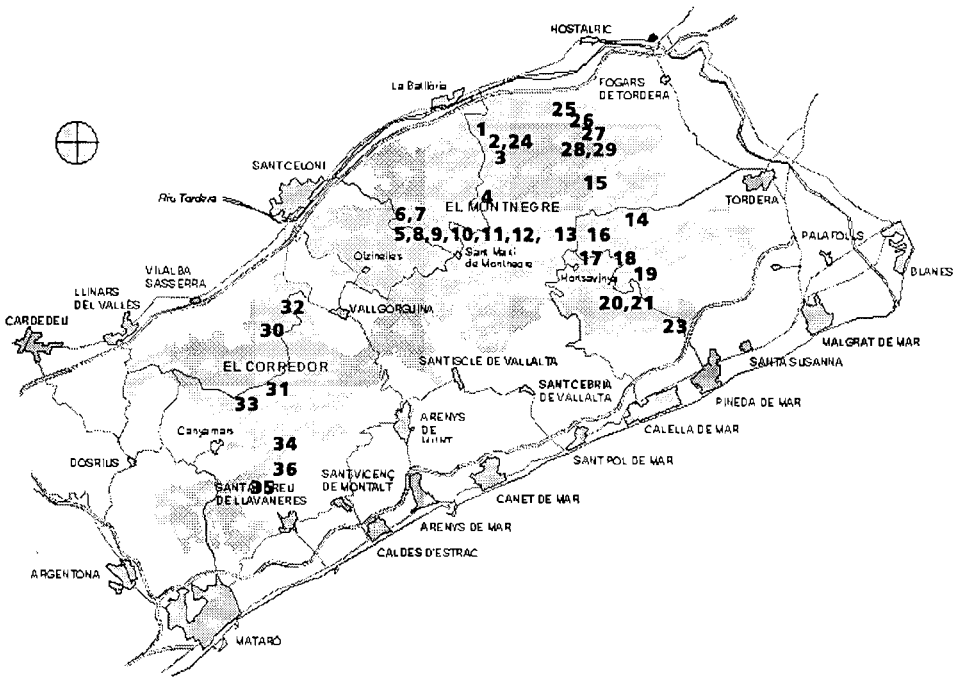

Fig. 1. Distribution of localities (see Material and methods for numbers of stations) visited. Shaded pattern indicates the Natural Park of Montnegre–Corredor.

Distribución de las localidades visitadas (ver Material and methods para los números de las estaciones). El sombreado indica la superficie ocupada por el Parque Natural del Montnegre–Corredor.

Park from Tordera (Can Noia); 15. Urbanització Roca Rossa (en route to Puig de la Batalla); 16. Sant Llop; 17. Between Sant Llop and l'Ermita de l'Erola; 18. Ermita de l'Erola; 19. Coll del Porc; 20. Before Can Mas (crossing with GR); 21. After Can Mas (oak cork wood); 22. Next to Can Pallofa; 23. Limit of the Park (before crossing the motorway); 24. Font de Sant Jordi (under Turó del Fum); 25. Vall de Ramió–Ca l'Oller; 26. Vall de Ramió–Can Molera; 27. Vall de Ramió–under Puig Pelat; 28. Vall de Ramió–Can Ramió; 29. Vall de Ramió–Sot de l'Home Mort.

Corredor massif

30. Can Pradell de la Serra; 31. Santuari del Corredor (towards the recreation area); 32. Dolmen de Pedra Gentil; 33. Santuari del Corredor (recreation area); 34. Serra de Can Bruguera (before Can Bruguera); 35. Serra de Can Bruguera (Font de la Moreneta); 36. Serra de Polseruc (from Can Bruguera to Mal Pas).

Results

Twenty genera and fifty species (table 1) were censored from the Natural Park. The specific composition was mainly Mediterranean although some elements were distinctly septentrional (*M. rubra, M. graminicola, L. emarginatus, Lasius (Chthonolasius* sp.) 46 species were detected from the Montnegre massif; 25 species for the smaller and drier Corredor massif. Findings do not imply less

Table 1. Ant species and stations where found (see Material and methods for numbers of stations) at the Natural Park of Montnegre-Corredor, Barcelona (Spain).
Especies de hormigas y localidades (ver Material and methods para los números de las estaciones) en el Parque Natural del Montnegre-Corredor, Barcelona (España).

Ant species	Stations
Subfamily Ponerinae	
Hypoponera eduardi (Forel, 1894)	1, 16, 18
Ponera coarctata (Latreille, 1802)	8
Subfamily Myrmicinae	
Aphaenogaster subterranea (Latreille, 1798)	1, 4, 5, 6, 8, 11, 17, 24, 26, 31, 35, 36
Crematogaster sordidula (Nylander, 1849)	27
Crematogaster scutellaris (Olivier, 1792)	1, 4, 6, 7, 10, 16, 24, 25, 26, 29, 31, 32, 35, 36
Leptothorax angustulus (Nylander, 1856)	31
Leptothorax lichtensteini Bondroit, 1918	1, 6, 8, 10, 11, 21, 35
L. nylanderi (Förster, 1850)	9, 12
L. rabaudi Bondroit, 1918	25, 27
L. racovitzai Bondroit, 1918	2, 8, 10
L. recedens (Nylander, 1856)	6, 14, 17, 25, 29, 32
L. unifasciatus (Latreille, 1798)	1, 8, 10
Messor barbarus (Linné, 1767)	13, 23, 25
M. bouvieri Bondroit, 1918	30
M. capitatus (Latreille, 1798)	3, 5, 18, 24, 33
M. structor (Latreille, 1798)	22
Myrmecina graminicola (Latreille, 1802)	7, 16
Myrmica rubra (Linné, 1758)	7
M. sabuleti Meinert, 1861	1
M. specioides Bondroit, 1918	25
Pheidole pallidula (Nylander, 1849)	1, 6, 8, 10, 14, 18, 19, 20, 21, 22, 23, 24, 25, 29, 32, 33, 34, 35
Solenopsis sp.	2, 6, 14, 16, 20
Stenamma debile (Förster, 1850)	16
T. impurum (Förster, 1850)	5, 13, 15, 16
T. semilaeve André, 1883	25, 35
Subfamily Dolichoderinae	
Dolichoderus quadripunctatus (Linné, 1771)	1, 7
Linepithema humile (Mayr, 1868)	23
Tapinoma ambiguum Emery, 1925	25
Tapinoma nigerrimum (Nylander, 1856)	3, 10, 16, 18, 22, 24, 28, 33

Table 1. (Cont.)

Ant species	Stations
Subfamily Formicinae	
Camponotus aethiops (Latreille, 1798)	5, 20, 22, 23, 26, 33
C. cruentatus (Latreille, 1802)	1, 5, 6, 7, 10, 14, 18, 19, 20, 21, 25, 29, 32, 36
C. fallax (Nylander, 1856)	24, 36
C. lateralis (Olivier, 1792)	2, 5, 6, 10, 16, 17, 19, 24, 26, 29, 32
C. piceus (Leach, 1825)	31
C. pilicornis (Roger, 1859)	10, 18, 24, 31
C. truncatus (Spinola, 1808)	1, 4, 16, 36
C. sylvaticus (Olivier, 1792)	14, 27
Formica cunicularia Latreille, 1798	25
F. gagates Latreille, 1798	1, 17, 21, 24
F. gerardi Bondroit, 1917	5, 6, 10, 14, 21, 26, 29, 35, 36
F. rufibarbis Fabricius, 1793	16, 23, 26, 30
F. subrufa Roger, 1859	27, 30
Lasius cinereus Seifert, 1992	24
L. emarginatus (Olivier, 1792)	4, 7, 10, 13, 15, 16, 20, 25, 26, 34, 35, 36
L. grandis Forel, 1909	14, 16, 17, 23, 25, 26, 28, 35
L. lasioides (Emery, 1869)	4, 5, 29
L. umbratus cfr. + *L. rabaudi* cfr.	7
L. myops Forel, 1894	6, 8, 14, 24, 26, 32, 35, 36
Plagiolepis pygmaea (Latreille, 1798)	1, 5, 6, 19, 21, 25, 29, 30, 32
Polyergus rufescens (Latreille, 1798)	33

biodiversity for the Corredor massif, as the number of stations visited there (seven) was lower as compared to the 29 from the Montnegre massif.

Lasius lasioides (Emery) and *Lasius cinereus* Seifert are reported for the first time in Catalonia.

Lasius lasioides was collected foraging on living trees (*Castanea sativa, Quercus ilex*) and nesting in dead wood (*Quercus suber*); the behaviour was fugitive, hiding deep in crevices, as described by Seifert (1992). *Lasius cinereus* was found under stones next to a temporarily dry stream at a much lower altitude (100 m) than was previously known (430–1430 m) from the original description. Its behaviour was aggressive. Males were present in mid July. They were previously undescribed. Males from the Montnegre (14 VII 1999; n = 4) and from El Muntanyà (B) (18 VII 2000; n = 7) were used. Description of the female is still wanting.

Description of the male of *Lasius cinereus* Seifert, 1992

n = 11 (measures in mm±sd).

Abbreviations as in SEIFERT (1992).

HL 0.67±0.01, HW 0.78±0.02, HW / HL 1.16±0.04, SL 0.53±0.01, SL / HL 0.78±0.02, SL / HW 0.67±0.02. Thorax and gaster concolor_brownish; head dark brown contrasting with the body; appendages and mandibles yellowish brown. Pilosity less developed than in workers. Seta count on scape 2.8±1.2; seta count on fore tibia 0.9±1.1. Surface sculpture dull in the head, shinier in thorax and gaster. Frontal suture conspicuous. Clypeus without a median carina. Mandibles with well marked pre-apical cleft; masticatory border gently curved from the apex to the basal border; denticles lacking. Dorsal margin of petiole with a shallow to deep, variable, concavity. Fore-wing length 4.1–4-3 mm.

Genitalia show the general aspect for *Lasius* (Clausen 1938) (CLAUSEN, 1938), without any major distinctive feature. Subgenital plate 0.13x0.03 mm, with 12–14 hairs on the poorly defined setiferous lobes that do not push out beyond the posterior margin of the plate; external paramera with 36–42 hairs; calx of volsella with 20 hairs and volsella with a spinulose tip; aedeagus with 21–25 teeth; penicilli cylindrical. The males of *L. cinereus* are similar in general aspect to the males *L. grandis*. As a comparison, we measured 11 males, from three nests, of this last species. HL 0.80±0.03, HW 1.00±0.02, HW / HL 1.25±0.04, SL 0.68±0.03, SL / HL 0.84±0.03, SL / HW 0.67±0.01. Fore wing lenth 4.8–5.0 mm. Males of both species can be definitely separated by size: HL, HW and SL do not overlap. Absolute measures are bigger in *L. grandis*, as could be expected by the relative worker size of both species, and the indices show that the scape and the head are proportionately longer in *L. cinereus*. Penicilli are club-shaped and longer in *L. grandis*.

Lasius (Chthonolasius) sp.

At one of the stations visited (# 7; altitude 260 m, 17 IX 1998) 37 workers of *Lasius (Cthonolasius)* were captured from under a stone at 50 cm from a small stream; vegetation is composed of *Alnus glutinosa*, *Laurus nobilis* and *Platanus* sp. Workers were exceptionally large and very rapid in movements. On two other occasions this site was unsuccessfully revisited. At a third attempt (11 VII 2000) several workers were found foraging under the rotten leaves on the soil; we were able to follow some galleries up to 20 cm deep into the soil before losing them. Workers were isolated in the galleries and were lemon-scented and fast-moving. These workers were identified using the extensive revisions of SEIFERT (1988, 1990, 1997). An intriguing finding was that apart from its dubious identity, workers from the first sample showed two very distinct morphologies:

Form A

n = 17 (measures in mm±s.d.)

HW 1.26±0.04, HL 1.24±0.03, SL 1.18±0.03, HL / HW 0.98±0.01, SL / HL 0.95±0.01, SL / HW 0.93±0.01, GHL 0.106–0.119, PDG 42.1±4.8 (n = 11).

This form is characterized by the extremely elongated and flat scapes, flat tibiae, sparse gaster pubescence and sparse head frons punctures; the gaster and head surface are very shiny; funicular segments elongated; scale lower, with a poorly defined indentation.

Form B

n = 20 (measures in mm±sd)

HW 1.27±0.05, HL 1.26±0.03, SL 1.16±0.03, HL / HW 0.99±0.01, SL / HL 0.91±0.01, SL / HW 0.91±0.01, GHL 0.106–0.126, PDG 10.2±1.9 (n = 11).

This form has shorter and less flat scapes and tibiae, much denser gaster pubescence and denser frons head punctures; the head and gaster surface are shiny but due to the dense pubescence they seem duller; funicular segments shorter; scale higher, with a well marked indentation.

The indices HL / HW, SL / HL and SL / HW are statistically different at P = 0.05 level: for HL / HW, T_{35} = 2.8, P = 0.008; for SL / HL, T_{35} = 7.8, P < 0.001; for SL/HW, T_{35} = 4.7, P < 0.001 (T tests, sequential Bonferroni corrected for multiple comparisons). The first sample (1998) comprised 17 workers form A and 20 workers form B; the second sample (2000) comprised 33 workers (B). The

significance of the coexistence of two different phenotypes is at present unknown (but see below).

The epizoic fungus *Aegeritella tuberculata* Bałazy et Wiśniewski was present on both forms.

Discussion

The males of *L. cinereus* are not to be confused with any of the other known Iberian *Lasius* males from the group of species in which workers have a high number of hairs on dorsal plane of scape [*L. niger* (L.), *L. emarginatus* (Olivier), and *L. grandis* Forel]. The very small size of *L. cinereus* males and the elongated head allow for an unambiguous naming. The unidentified *Chthonolasius* sample poses two problems: 1. The unexpected presence of two distinct morphological forms and 2. Its specific identity.

Concerning the first point, three possibilities exist: 1. Workers belong in two different species that were foraging at the same point; 2. Workers belong in two genetic lines: one group are normal workers descending from the queen mated with an homospecific male and the other group are descendants from a heterospecific mating of the same queen; 3. As a case of temporal parasitism, workers belong to two different species, coexisting in a single nest due to temporal parasitism of one queen over an heterospecific nest. The first possibility is simple but highly improbable as it calls for the coexistence of two species of *Chthonolasius* on a very reduced space, a stone of some 30x20 cm; in addition, *Chthonolasius* nests are very scarce everywhere. The second possibility is similar to the *Lasius jensi* Seifert and *L. umbratus* (Nylander) case discussed by Seifert (1999), whose nuptial flights occur in the same season and on largely overlapping daily hours. Accepting this, however, means that a group of workers are hybrid in origin and this would imply that a single queen accepted two different males, one homospecific, another heterospecific. The third possibility is that, in the first sample, workers from the host society still existed and, thus, we found two different forms —which would be different species!—; two years later, when the second sample was captured, workers from the host species would have died away and the society was then composed of a single form, the descendants from the hyperparasitic queen. This would be a similar situation as in *L. (Dendrolasius) fuliginosus* (Latreille) whose queens found the colony with the aid of *L. (Chthonolasius) umbratus* (Nylander) which is itself a temporary parasite of *Lasius* (s. str.) (Buschinger, 1986) (Buschinger, 1986). Until workers and associated queens are available, any of the above possibilities remains speculative.

The specific identity of these ants is also problematic. Form B is related to or conspecific with *Lasius umbratus*. In effect, the general characteristics of form B and of *L. umbratus* are concordant, but size, estimated by head measures, is much bigger in form B than is known to date (Seifert, 1988; table 2) and its scape is proportionately longer. In our opinion, and until we obtain associated queens, it is more parsimonious to accept that the morphological differences stated above are not of specific value and, instead, are extensions to the *L. umbratus* concept of Seifert (1988). Form A is quite different from any known ant worker morphology. There is a high probability that the name *L. rabaudi* Bondroit is involved. For this species, only the single type queen type is currently known (Seifert, 1997, but see Collingwood, 1991) and workers are unknown. With Seifert's worker's key (Seifert, 1988), form A goes to couplet 5 and then to *L. rabaudi* or, by addition of (Seifert, 1997), to *L. nitidigaster* Seifert. This latter species is distributed in Central and Eastern Europe; *L. rabaudi* is known exclusively from the queen type (Seifert, 1997) and from a queen and male from Jaca (Huesca, Spain) (Collingwood, 1991). To this scarce material we add two winged queens drowned in a swimming pool at Sant Llorenç de Morunys (Lleida, Spain; 5 VII 1983, Espadaler leg.) and three queens and one male taken on flight at Mines d'Osor (Girona, Spain; 18 VI 1988, Muñoz leg.); these two latter samples were identified by direct comparison with the type queen at Bondroit's collection. If *L. nitidigaster*, as stated by Seifert (1997) is limited to Central and Eastern Europe, and *L. rabaudi* is a SW European or Iberian species and if queen characters are reflected in the

workers, then form A could conceivably be assigned to the unknown workers of *L. rabaudi*. Its enormous size, very long scape and funiculus segments, and very diluted gaster pubescence make these ants highly distinct among *Chthonolasius* species. Only additional research will settle this question.

The number of species censored is roughly a third of all those known for Catalonia. Two species are new for the Catalan region, thus, attached to the non-assigned sample of *Lasius*, 158 ant species are known to date in Catalonia (Espadaler, 1997b). The biogeographical composition of myrmecofauna is similar to other animal groups surveyed within the borders of the park (reptiles: Roig et al., 1998; small mammals: Flaquer & Arrizabalaga, 1998). A majority of Mediterranean elements was censused and a small group (*Stenamma, Myrmica, Myrmecina*) with European affinities relegated to the most humid spots, next to permanent or nearly permanent rivulets. The habitat of *Lasius cinereus*, an Iberian endemic presently known from four localities (two in Castellón, one in Murcia and the present one), should be protected as it is readily accessible by car. The female caste of this species is still wanting. The habitat of *Lasius rabaudi* cfr. should also be protected as it is the single known precise location for workers, hence a nest, of this species.

The invasive Argentine ant merits continued monitoring of its possible spread within the park borders. As has been shown by Suárez et al. (1998), human disturbances are a key circumstance in its dispersal and subsequent effects upon the local fauna. Rehabilitation of the small area that is invaded could be undertaken at present without much cost. Once well established, pests are extremely difficult to control and virtually impossible to eliminate (Mack et al. 2000).

Resumen

Hormigas del parque natural del Montnegre-Corredor (NE España), con descripción del macho de Lasius cinereus *Seifert (Hymenoptera, Formicidae)*

Se ha realizado un censo de las especies hormigas encontradas en el ámbito del Parque (fig. 1, tabla 1). Resulta un total de 50 especies agrupadas en 20 géneros, que constituyen la tercera parte de las conocidas para Cataluña. Describimos el macho, desconocido, de *Lasius cinereus* Seifert. Se diferencia del de *L. grandis*, especie que le es más cercana morfológicamente, por el menor tamaño y escapo proporcionalmente más largo en *L. cinereus*. *Lasius lasioides* (Emery) y *Lasius cinereus* Seifert, representan citas nuevas para la fauna catalana. Una muestra de obreras de *Lasius (Cthonolasius)* comprende obreras con dos morfologías claramente distintas por la pubescencia, biometría y grado de compresión de los apéndices. Una de las formas se identifica provisionalmente como *L. umbratus* y la otra se adscribe tentativamente a *Lasius rabaudi* Bondroit. La presencia de la hormiga argentina (*Linepithema humile*) en los límites del Parque requiere un seguimiento y sería procedente la rehabilitación de la zona actualmente ocupada por esta especie invasora.

Acknowledgements

We thank the Parc Natural del Montnegre-Corredor (Diputació de Barcelona "Barcelona City Hall") for permission to conduct research within the Park and Antoni Bombí for critical documentation, Dr. Alain Pauly (Brussels, Belgium) for providing access to the Bondroit collection and Amanda Evans for correction of the text.

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