Redescription of the queen of *Anochetus ghilianii* (Spinola, 1851) (Hymenoptera, Formicidae)

Alberto Tinaut[1], Keith Bensusan[2] & Rhian Guillem[2&3]

1. Department of Animal Biology. Faculty of Sciences. University of Granada, 18071 Granada. Spain. hormiga@ugr.es
2. Gibraltar Ornithological & Natural History Society & Gibraltar Botanic Gardens, PO Box 843, Gibraltar.
3. Department of Animal and Plant Sciences, University of Sheffield, Sheffield S10 2TN, UK.

Recibido: 18-01-2011. Aceptado: 11-03-2011
ISSN: 0210-8984

ABSTRACT

The queen of *Anochetus ghilianii* is redescribed with specimens from southern Spain, as descriptions and illustrations of this caste provided so far are incomplete. Some observations on the ecology and distribution of the species are also provided.

Key words: *Anochetus ghilianii*, queen, redescription.

RESUMEN

Redescripción de la hembra de *Anochetus ghilianii* (Spinola, 1851) (Hymenoptera, Formicidae)

En este artículo se redescribe a la hembra de *Anochetus ghilianii* ya que las descripciones y dibujos que se conocían de ella eran bastante incompletos. La redescripción se hace a partir de varios ejemplares procedentes del sur de España. Se aportan además diversas observaciones sobre su ecología y distribución.

Palabras Clave: *Anochetus ghilianii*, hembra, redescripción

INTRODUCTION

Anochetus ghilianii (Spinola, 1851) has long been held to be endemic to both shores of the Strait of Gibraltar. On the Iberian Peninsula, it is

only known from a thin stretch of land in close proximity to the coast in Cádiz province and Gibraltar. Based on our results following many years of sampling in southern Iberia, including intensive surveying from 1982-1988 (TINAUT, 1989) and 2008-2009 (see TINAUT RANERA *et al.*, in press), the distribution of this species appears to be limited to the area of Cádiz province between the Barbate river in the west and the Guadiaro river in the east, as well as Gibraltar. It does not appear to penetrate any further north than the parallel at 36º 15': it only occurs south of Vejer de la Frontera (Atlantic coast) and Sotogrande (Mediterranean coast). Within this area, it is frequently encountered near the coast, especially during the wetter months of the year between the autumn and spring. Its distribution in northern Morocco is more widespread. Although most records are centred on the Tangier Peninsula, more recent records show that the species is also present from the Rif to the Middle Atlas and along the Atlantic Littoral south to Sidi Bettache (CAGNIANT, 2006; corresponding to 33º34'06" N, 6º53'29" W; UTM: 29S 0695722/3716287).

The biology of *A. ghilianii* is poorly known, but based on our experience and its similarity with other species in the genus, we consider it a species with partially endogean habits, hence its presence closer to the ground surface when the soil is humid. However, individuals are frequently found in leaf litter samples in Gibraltar, indicating that some foraging occurs above the soil surface. Since these samples are taken during daytime, it is evident that foraging is at least partly diurnal. The presence of workers on the soil surface is corroborated by visual records and pitfall trapping (see Appendix for list of records).

Individuals and colonies of *A. ghilianii* are most frequently found under rocks, especially large ones, although a nest entrance was found at the base of a grass tussock in Gibraltar (Appendix). On the Iberian side of the Strait, the species shows a preference for open or matorral habitats (both the lower, garigue type matorral and the tall, dense maquis) but appears to avoid true woodland and forest. We have not recorded it higher than 390m in Gibraltar (GUILLEM & BENSUSAN, 2009) or Spain (Appendix). It appears to tolerate higher elevations in Morocco: we encountered *A. ghilianii* at 670m within cork oak *Quercus suber* forest in Bouhachem in the western Rif (Appendix) and CAGNIANT (2006) reported it from Bab Taza in the Rif (ca. 950m) and in the Middle Atlas.

The genus *Anochetus* Mayr, 1861 is known from 92 extant and eight fossil species, most of which have a tropical or subtropical distribution. There are six Palaearctic species, two in China: *A. risii* Forel, 1900 and *A. yunnanensis* Wang, 1993, one on Iran: *A. evansi* Crawley, 1922 and three species in the Mediterranean area: *A. ghilianii*, *A. sedilloti* Emery, 1884

from Tunisia to western India and *A. bytinskii* Kugler & Ionescu, 2007 from Israel (BOLTON, 2010).

The female reproductive caste is only known for some 20% of species described (BOLTON, 2010). This is probably due to the "interstitial" nature (a term used by BROWN, 1978) of most of the species in the genus, the similarity between queens and workers and the fact that most species only possess ergatoid females. The queen of the Mediterranean species *A. bytinskii* was described in the original description of that species by KUGLER & IONESCU (2007), whilst FOREL (1900) wrote a brief but useful description of the queen of *A. sedilloti* based on specimens collected in the west of India. KUGLER & IONESCU (2007) also cited FINZI (1939) as author of the description of the female of *A. sedilloti*, but did so in error (A. Ionescu, *pers. comm.* 2010). SAUNDERS (1890) noted a form of *A. ghilianii* with ocelli, but mistook these for "the intermediate form" or "curious transitional form" between worker and queen, adding that his colleague J.J. Walker had not been able to find the "true" queen caste. EMERY (1909) provided a brief diagnosis of the queen of *A. ghilianii* and KUGLER & IONESCU (2007) illustrated the head and included some characters in their identification key. GÓMEZ *et al.* (2010) provide photographs of a specimen. However to date, a complete, thorough and unified description of the queen of this species has been lacking.

The capture of four queens, and the infrequency with which this caste is encountered, has prompted us to present a thorough description of the queen of *A. ghilianii* in this paper.

MATERIALS AND METHODS

Samples were collected from near the shrine of Nuestra Señora de la Luz near Tarifa (UTM: 30S 0264119/3996772, 64 m a.s.l., two nests, 20-03-2010), near the stream of Puerto del Higuerón near La Linea (UTM: 30S 0291851/4012341, 23 m a.s.l., one nest, 21-03-2010) and Punta Carnero (UTM: 30S 0280055/3994196, 30m a.s.l., one nest, 19-03-2010). Specimens from the first two sites are deposited in the collection of the Departamento de Biología Animal at the Universidad de Granada (ref: col. Tinaut 1.977 y 4.908). The specimen from the third site is in the private collection of Rhian Guillem (col. No. RG-10-000).

We took the following biometric measurements (Fig. 1): total length excluding mandibles (TL), head length and head width (HL, HW), scape length (SL), mandibular length and width (ML, MW), maximum length of compound eye (EL) and length and width of the first gastral segment

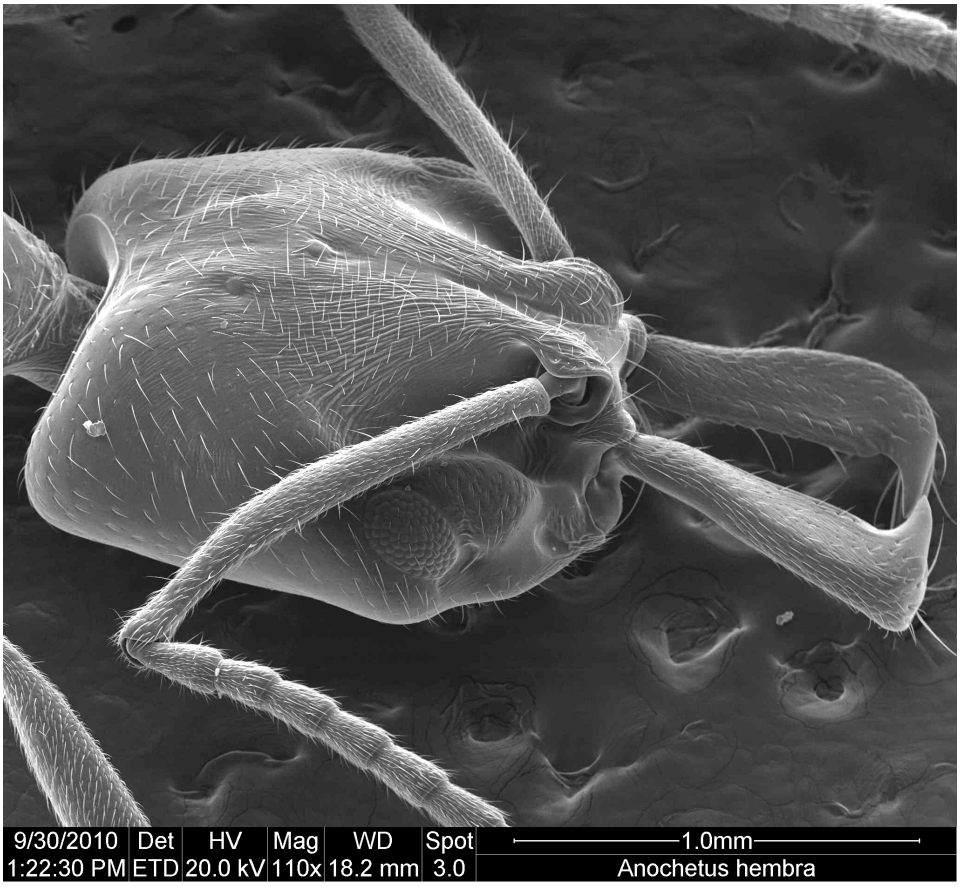

Figure 1. Head of queen of *A. ghilianii*.
Figura 1. Cabeza de la hembra de *A. ghilianii*.

(G1L, G1W). All measurements were taken through a stereomicroscope. TL was measured at 19x magnification. All other measurements were made at 58x magnification. Biometrics were taken by a single person to minimise error. Measurements were taken from queens and workers for the purpose of comparison. One of the specimens (ref: 4.908) was prepared and used to produce electron micrographs and has been deposited in the collection in its conductive coating.

In addition, we compared our specimens to three workers of *A. bytinskii* (paratype specimens) donated by Armin Ionescu (Tel Aviv University, Israel) and one worker of *A. sedilloti* deposited in the collection of the Museum d'Histoire Naturelle of Genève (Switzerland).

DESCRIPTION OF QUEEN

Biometrics (mm): TL = 6.21-6.63, HL = 1.34-1.47, HW = 1.34-1.47, SL = 1.29-1.31, ML = 0.78-0.84, MW = 0.26, EL = 0.24-0.26, G1L = 0.86-0.88, G1W = 0.91-1.02.

Ergatoid; general morphology similar to workers but larger: TL = 1.07-1.58 x TL of workers. Colour brownish amber; slightly darker on the gaster, the clypeal region and the antennae. Tegument shining and covered in suberect chaetae that are abundant throughout the body and legs. Legs and antennae with a shorter pubescence. Head with longitudinal striations between the antennae, barely reaching the vertex (Fig. 1). Mandibles similar to workers but slightly more robust: ML = 3.00-3.27 x MW in queen; 3.75-4.30 x MW in worker. Ten small denticles discernible along inner surface of mandibles of worker; up to six smaller, barely discernible denticles in queen, towards base of mandible (Fig. 2 A). Three easily visible ocelli (Fig. 3 A). Compound eyes with chaetae between the ommatidia, slighter larger than in worker: EL = 0.16-0.18 x HL in queen; 0.13-0.16 x HL in worker. Head larger than worker: HL = 1.00-1.26 x HL of worker; HW = 1.04-1.31 x HW of worker. G1L longer and G1W wider than in worker: G1L = 1.22-1.46 x G1L of worker; G1W = 1.18-1.55 x G1W of worker. Antennal scape slightly shorter than head (SL = 0.89-0.99 x HL); funiculus with eleven rectangular segments, becoming longer towards the apex (Fig. 1).

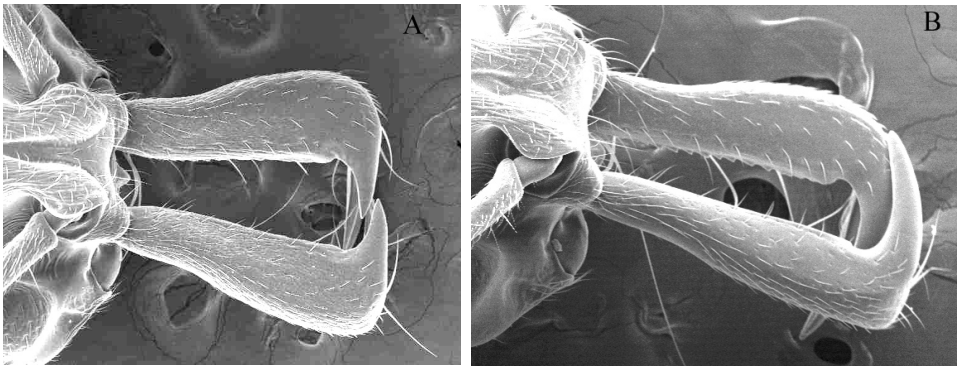

Figure 2. Mandibles of queen (A) and worker (B) of *A. ghilianii*.
Figura 2. Detalle de las mandíbulas de la hembra de *A. ghilianii* (A) y de la obrera de *A. ghilianii* (B).

Thorax with a smooth and shining pronotum. Mesonotum smooth, especially the mesopleurae, with distinguishable scutum and small propo-

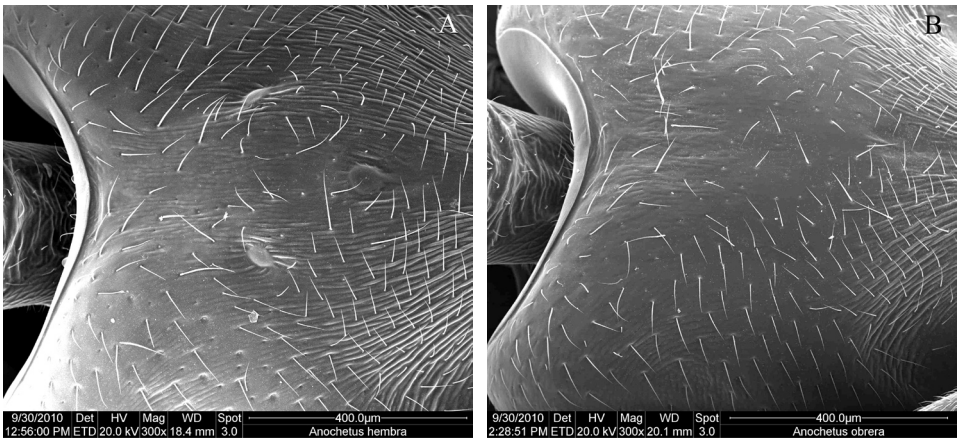

Figure 3. Head of queen, showing the clearly visible ocelli (A), and worker (B) of *A. ghilianii*.
Figura 3. Detalle de la cabeza de *A. ghilianii* en el que pueden apreciarse los ocelos para la hembra (A) y la obrera (B).

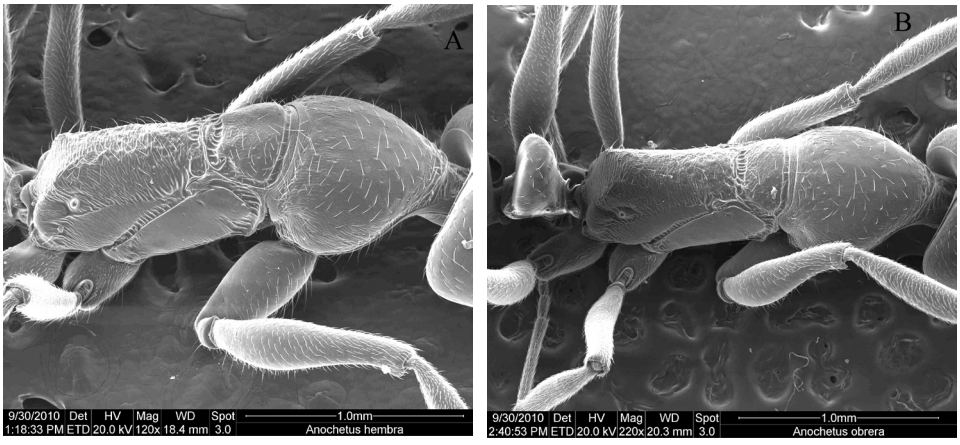

Figure 4. Thorax of the queen, showing the reduced propodeum (A), and worker (B) of *A. ghilianii*.
Figura 4. Tórax de la hembra de *A. ghilianii* (A) en donde puede verse el reducido esclerito perteneciente al propodeo y obrera (B).

deum which is separated from the suture by a depression with longitudinal ridges. A similar suture separates the mesonotum from the propodeum. Surface of propodeum with varicose rugulae from the petiolar insertion to the mesopropodeal suture. Two well-marked angles on the posterior end of the notum (Fig. 4 A).

Petiole smooth and shining, with short chaetae on the anterior surface and no chaetae on the posterior surface. Apex slightly excavated (Fig. 4 A).

Gaster smooth and shining with numerous long, subdecumbent chaetae distributed over the entire surface. First segment slightly more convex than the rest, as is typical in the Ponerinae (Fig. 5).

Two specimens were dissected. Each had two ovaries with each ovary containing six ovarioles (Fig. 6).

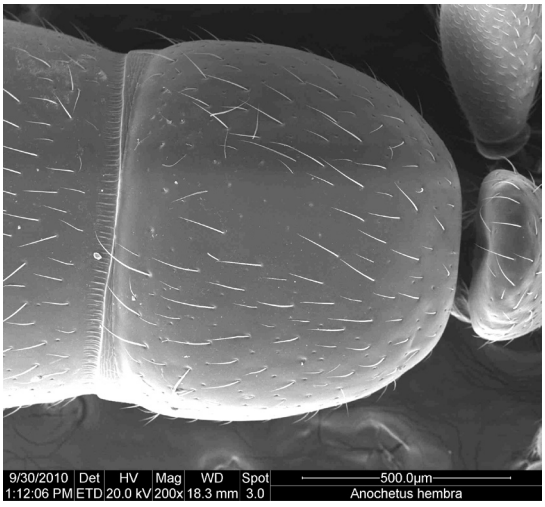

Figure 5. First gastral segment of queen of *A. ghilianii*.
Figura 5. Primer segmento gástrico de la hembra de *A. ghilianii*.

Figure 6. Ovarioles of queen of *A. ghilianii*.
Figura 6. Ovariolas de la hembra de *A. ghilianii*.

DISCUSSION

BROWN (1978) states that the majority of the queens in the genus *Anochetus* are ergatoid. KUGLER & IONESCU (2007) describe the queen of *A. bytinskii* with remnants of wings. Their illustrations give the impression that the wings are vestigial and inadequate for flight. Also, the mesonotum and metanotum appear poorly developed, according well with queens of ergatoid morphology (TINAUT & RUANO, 1992), even if vestiges of wings are still present. All four queens of *A. ghilianii* are completely apterous, with a reduced propodeum representing the only vestige of the thorax that is typical in reproductive castes of hymenopterans (Fig. 4).

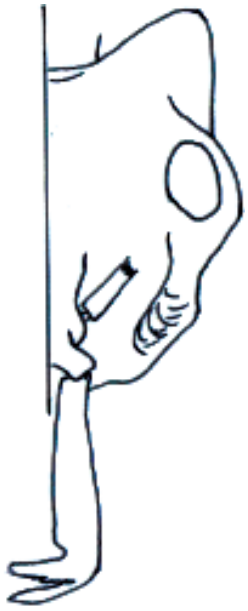

Figure 7. Head of worker of *Anochetus sedilloti*, frontal view (cotipo, Museum d'Histoire Naturelle of Genève).
Figura 7. Vista frontal de la cabeza de una obrera de *Anochetus sedilloti* (cotipo, Museum d'Histoire Naturelle of Genève).

Differences between the queens of *A. ghilianii* and *A. sedilloti* are primarily based on the length of the scape, which does not reach the occipital border in *A. sedilloti*, and in the size of the eyes, which are substantially larger in *A. sedilloti* than in *A. ghilianii*, as is the case in workers (Fig. 7). Thoracic profile can be used to separate *A. bytinskii* from *A. ghilianii*. *A. bytinskii* has a rounded thoracic profile, whereas that of *A. ghilianii* is angled.

The description of *A. bytinskii* and key provided by KUGLER & IONESCU (2007) make no mention of the presence or absence of ocelli in the queen of the three Mediterranean species of *Anochetus*. However, it is significant to highlight that, whereas three ocelli are present and easily visible in *A. sedilloti* and *A. ghilianii*, *A. bytinskii* lacks ocelli (A. Ionescu, *pers. comm.* 2010). Another interesting point is that the queen of *A. sedilloti* has apparently normal wings and its pronotum is striated and punctured in part (FOREL, 1900). This last feature is absent in the other two species. Therefore, the queen of *A. ghilianii* is characterised by the complete absence of wings, its three clearly visible ocelli, smooth pronotum and clearly angled propodeum. It can be separated from its workers by its slightly larger size, particularly that of the head and the first gastral segment, the latter also being slightly darker than in workers. In addition, the interior border of the workers' mandibles has a series of small denticles that are tiny or absent in the queens (Fig. 2). However, the presence of

ocelli in the queen is perhaps the best way of differentiating these from the worker caste at present.

The four queens described here were all found forming part of a compact group with 20-30 workers. Due to a complete lack of knowledge of the biology or nest structure of this species, we are unable to speculate as to the significance of these small groups of workers around the queen and whether or not nests are monogynous.

Anochetus ghilianii is considered 'Vulnerable' in Spain due to its restricted distribution (MARTINEZ & TINAUT, 2005; TINAUT RANERA, 2008; TINAUT RANERA *et al*., in press). The absence of wings in the queen strengthens this assessment, as a lack of connectivity between patches of suitable habitat would result in complete severance of populations and impede colonisation/recolonisation by the female reproductive caste.

ACKNOWLEDGEMENTS

We are especially grateful to Jonathan Avilés for his ability in maintaining one of the colonies collected in captivity and in perfect condition. We also thank Armin Ionescu for his comments and for donating specimens of *Anochetus bytinskii*. Part of this work has been funded by the 'Proyecto Atlas de Especies Vulnerables' of the 'Dirección General de Biodiversidad del Ministerio de Medio Ambiente' of Spain.

REFERENCES

BOLTON, B., 2010. Barry Bolton's Synopsis of the Formicidae and Catalogue of Ants of the World. In: http://gap.entclub.org/. VERSION: 1st July 2010.

BROWN, W.L., 1978. Contributions toward a Reclassification of the Formicidae. Part VI. Ponerinae, Tribe Ponerini, Subtribe Odontomachiti. Section B. Genus *Anochetus* and Bibliography. *Studia Entomologica*, 20 (1-4): 549-652.

CAGNIANT, H., 2006. Liste actualisée des fourmis du Maroc (Hymenoptera: Formicidae). *Myrmecologische Nachrichten*, 8: 193-200.

EMERY, C., 1909. Beiträge zur Monographie der Formiciden des paläarktischen Faunengebietes (Hym.). *Deutsche Entomologische Zeitschrift*, 8: 355-376.

FINZI, B., 1939. Materiali zoologici dell'Eritrea raccolti da G. Müller durante la spedizione dell'Instituto Sieroterapico Milanese e conservati al Museo di Trieste. Parte 3. Hymenoptera: Formicidae. *Atti del Museo Civico di Storia Naturale di Trieste*, 14: 153-168.

FOREL, A., 1900. Les formicides de l'Empire des Indes et de Ceylan. Part 6. 3me sous famille Ponerinae. *Journal of the Bombay Natural History Society*, 13: 52-65.

GÓMEZ, K., A. BARRERA & X. ESPADALER (eds.) http://www.formicidae.org/. Accessed on 20-11-2010.

GUILLEM, R. & K. BENSUSAN, 2009. *Tetramorium parvioculum* sp. n. (Formicidae:

Myrmecinae), a new species of the *T. simillimum* group from Gibraltar. *Boletín de la Sociedad Entomológica Aragonesa*, 45: 157-161.

MARTÍNEZ, M.D. & A. TINAUT, 2005. *Anochetus ghilianii* (Spinola, 1851). In: Verdú J.R. & Galante E. (eds.) *Libro Rojo de los Invertebrados de España.* Dirección General de Conservación de la Naturaleza, Madrid (*online version*).

KUGLER, J. & A. IONESCU, 2007. *Anochetus bytinskii*, a new ant species from Israel (Hymenoptera: Formicidae). *Israel Journal of Entomology*, 37: 287-298.

SAUNDERS, E., 1890. Aculeate *Hymenoptera* collected by J.J. Walker Esq., R.N., F.L.S., at Gibraltar and in North Africa. *Entomologist's Monthly Magazine*, 26: 201-205.

TINAUT, A., 1989. Contribución al estudio de los Formícidos de la región del estrecho de Gibraltar y su interés biogeográfico (Hym. Formicidae). *Graellsia*, 45: 19-29.

TINAUT, A. & F. RUANO, 1992. Braquipterismo y apterismo en Formícidos. Morfología y biometría en las hembras de especies ibéricas de vida libre (Hymenoptera Formicidae). *Graellsia*, 48: 121-131.

TINAUT RANERA, A., 2008. *Anochetus ghilianii* (Spinola, 1851). In: Barea-Azcón, J.M., Ballesteros-Duperón, E. & Moreno, D. (eds.) *Libro Rojo de los Invertebrados de Andalucía.* Consejería de Medio Ambiente, Junta de Andalucía, Sevilla, pp. 1174-1176.

TINAUT RANERA, A., F.RUANO DÍAZ, Mª D. MARTÍNEZ IBÁÑEZ, K. BENSUSAN & R. GUILLEN. En prensa. *Anochetus ghilianii* (Spinola, 1851). Pp. 99-103. En: Verdú, J.R., Numa, C. y Galante, E. (Eds). *Atlas y Lista Roja de los Invertebrados amenazados de España (Especies Vulnerables)*. Dirección General para la Biodiversidad, Ministerio de Medio Ambiente, Madrid.

APPENDIX:

Records of *Anochetus ghilianii* cited in the main text.

Lathbury Parade Ground, Gibraltar. 36°07.081' N, 5°20.704' W; UTM 30S 0288938/3999623; 127m. Leg. C.Perez & K.Bensusan 11-03-2008. 2 ex. worker, sieving leaf litter under *Pistacia lentiscus* in open habitat with scattered shrubs.

Jews' Gate, Upper Rock Nature Reserve, Gibraltar. 36°07.290' N, 5°20.811' W; UTM 30S 0288798/4000027; 152m. Leg. C.Perez & K.Bensusan 20-03-2008. 2 ex. worker, sieving leaf litter under *Pistacia lentiscus* within high maquis.

Windmill Hill Flats, Gibraltar. 36°07.005' N, 5°20.708' W; UTM 30S 0288933/3999445; 115m. 10-04-2008. Nest entrance with workers located at base of a tuft of grass in open habitat. R.Guillem.

Windmill Hill Flats, Gibraltar. 36°06.867' N, 5°20.712' W; UTM 30S 0288953/3999222; 110m. 26-06-2008. Leg. C.Perez & K.Bensusan 26-06-2008. 1 ex. worker, sieving leaf litter under *Pistacia lentiscus* in open habitat with scattered shrubs.

Sierra del Cabrito, Cadiz, Spain. 36°04.060' N, 5°33.057' W; UTM 30S 0270262/3994466; 387m. Leg. R.Guillem & K.Bensusan 14-02-2009. Nest located under large rock in clearing amongst *Erica* scrub, bordering woodland of *Quercus suber*.

Signal Station Road, Upper Rock Nature Reserve, Gibraltar. 36°08.269' N, 5°20.749' W; UTM 30S 0288942/4001874; 300m. Leg. C.Perez & K.Bensusan 20-05-2009. 1 ex. worker, sieving leaf litter under *Euphorbia characias* within high maquis.

Bouhachem, Rif, Morocco. 35°22.370' N, 5°34.337' W; UTM 31S 733682/3917428; 670m. Leg. R.Guillem & K.Bensusan 30-01-2010. Under rock within woodland of *Quercus suber*.

Governor's Lookout, Upper Rock Nature Reserve, Gibraltar. 36°08.540' N, 5°20.752' W; UTM 30S 0288935/4002285; 240m. Leg. R.Guillem & K.Bensusan 25-05-2010. 1 ex. worker in pitfall trap; cleared area of open habitat amongst high maquis.

Windmill Hill Flats, Gibraltar. 36°07.058' N, 5°20.846' W; UTM 30S 0288728/3999548; 110m. 28-05-2010. A few workers observed on soil surface under leaf litter, whilst clearing this to install pitfall traps; mosaic of garigue and open habitat with scattered large shrubs.

Windmill Hill Flats, Gibraltar. 36°07.058' N, 5°20.846' W; UTM 30S 0288728/3999548; 110m. Leg. R.Guillem & K.Bensusan 30-05-2010. 2 ex. worker in pitfall traps; mosaic of garigue and open habitat with scattered large shrubs.