Boletín de la Sociedad Entomológica Aragonesa (S.E.A.), nº **51** (31/12/2012): 217–220.

PRESENCE OF THE FAMILY NEVRORTHIDAE (NEUROPTERA) IN THE IBERIAN PENINSULA

Oscar Gavira[1], Salvador Sánchez[2], Patricia Carrasco, Javier Ripoll & Salvador Solís

[1] Corresponding author: ogavira@hotmail.com
[2] Asociación Cultural Medioambiental Jara. C/Príncipe de Asturias nº1-bis, Local 2, 29100 Coín (Málaga, España).

Abstract: The first record of the family Nevrorthidae is reported from the Iberian Peninsula. This finding extends the known distribution of the family in the Mediterranean region and represents its westernmost known population. The specimens found are larval forms, and while they confirm the presence of the family in the area, do not permit to identify the species. The locality is a mountain stream with permanent clean water belonging to a coastal peridotitic range (Sierra Alpujata, Málaga, Spain) in an excellent state of conservation.
Key words: Neuroptera, Nevrorthidae, chorology, ecology, Mediterranean basin.

Presencia de la familia Nevrorthidae (Neuroptera) en la Península Ibérica
Resumen: Se presenta la primera cita de la familia Nevrorthidae en la Península Ibérica. Este hallazgo amplía la distribución conocida de la familia en la cuenca Mediterránea y representa la población más occidental conocida. Los ejemplares encontrados corresponden a formas larvarias, y aunque confirman la presencia de esta familia en el territorio no permiten identificar la especie. Estos ejemplares se localizaron en un arroyo de montaña de aguas limpias y permanentes, en una sierra litoral peridotítica (Sierra Alpujata, Málaga, España) con un excelente estado de conservación de los ecosistemas.
Palabras clave: Neuroptera, Nevrorthidae, corología, ecología, cuenca mediterránea.

Introduction

According to the latest data (Beutel *et al.*, 2010), the family Nevrorthidae Nakahara, 1915 includes 14 species belonging to three genera: *Nevrorthus* Costa, 1863, with four species distributed throughout the Mediterranean region; *Nipponeurorthus* Nakahara, 1958, with eight species occurring in Japan, China and Taiwan; and *Austroneurorthus* Nakahara, 1958, with two species localized in eastern Australia. Aspöck & Aspöck (1994) have suggested that the current distribution could be the result of the fragmentation and reduction, through the process of continental drift, of an ancient and wider distribution at the edges of the Pangea continent. The relictual distribution of those species and their great morphological similarity, both in the adult and larval stages, suggest that Nevrorthidae species belong to "old" genera (Aspöck & Aspöck, 1994); indeed those authors consider Nevrorthidae to be "living fossiles". In addition a great similarity has been found between the extant species and the fossil forms (Wichard *et al.*, 2010). Several phylogenetic studies positioned Nevrorthidae at the base of Neuroptera, as sister group of all other taxa (Aspöck *et al.*, 2001; Aspöck, 2002; Aspöck *et al.*, 2003; Haring & Aspöck, 2004; Aspöck & Aspöck, 2008; Beutel *et al.*, 2010), situation suggesting even a suborder of its own: Nevrorthiformia.

The four species of the genus *Nevrorthus* which are present in the Mediterranean also show a vicariant distribution (Aspöck & Aspöck, 1983; Monserrat, 2005a): *N. apatelios* H. Aspöck, U. Aspöck et Hölzel, 1977, spreads over the Balkan Peninsula (Greece, Albania, Bulgaria, Macedonia, Bosnia-Herzegovina, Serbia and Montenegro), northeast corner of Italy (Letardi *et al.*, 2006) and Slovenia (Jones & Devetak, 2009); *N. fallax* (Rambur, 1842) is endemic to Corsica and Sardinia; *N. hannibal* U. Aspöck et H. Aspöck, 1983, appears along the coast of Algeria and Tunisia (North Africa); and finally, *N. iridipennis* Costa, 1863, is present in Sicily and the southern tip of the Italian Peninsula (Calabria). Therefore, the populations of *N. hannibal* and *N. fallax* are the closest to the iberian ones.

The presence of the Nevrorthidae in the Iberian Peninsula was ruled out by Monserrat (1984) which considers erroneous previous records by Navás, referred to *"Neurorthus" iridipennis* Costa, 1863 (Navás, 1934, 1935), which would correspond to *Sisyra iridipennis* Costa, 1884, a species present in the locations cited by Navás (Monserrat, 1984, 2005b), with which it shares the specific name, author and at the time, also the family, having been included in Sisyridae (tribe "Neurorthini"). According to Monserrat (1984) subsequent citations of the species in the Iberian Peninsula are therefore invalid. Aspöck & Hölzel (1996) highlight the "surprising" lack of Nevrorthidae in Spain as well as in Morocco where suitable habitats exist. Recently, Oscoz *et al.* (2011) do not include the family among the freshwater macroinvertebrates of Spain. Therefore this paper is the first to confirm the occurrence of Nevrothidae in the Iberian Peninsula.

Nevrorthidae larvae in the Iberian Peninsula

Nevrorthidae larvae show a unique morphology within Neuropteroidea (Fig. 1). They clearly differ from Megaloptera (Corydalidae and Sialidae) by the presence of maxillo-mandibular stylets, and from aquatic (Sisyridae) and amphibians (Osmylidae) Neuroptera in which those maxillo-mandibular stylets are not converging at the apex. Moreover the prothorax of Nevrorthidae is divided into two hinged parts, the anterior one being long and narrow, forming a "neck" (Zwick, 1967). The taxonomical importance of the larva was recognized when Nakahara (1958) suggested it was possible that the knowledge of the immature stages may necessitate the elevation of the subfamily "Neurorthinae" (in-

cluded in Sisyridae) to the rank of family. Subsequently, Zwick (1967) created "Neurorthidae" after the discovery and description of *Nevrorthus fallax*'s larva.

During a study of the macro-invertebrates community present in the Rio Grande catchment (Malaga, Southern Spain), a larva of Nevrorthidae, measuring 11.8 mm of total length, was found in a stream of Sierra Alpujata (Coin, Malaga, 18 April 2011). A year later, in the same locality three more larvae were collected, with lengths of 8 mm (23 April 2012), 8.5 mm and 9.5 mm (7 May 2012) (Fig. 1). At each visit, it was only possible to find one or a couple of Nevrorthidae larvae, suggesting a low density of individuals in this section of the stream. One of these specimens was deposited at the National Museum of Natural Sciences in Madrid, catalog number MNCN_Ent 75372, which was the first known specimen in the colection. Genus and species identification are based on the study of wing venation and male genitalia (Nakahara, 1958; Aspöck *et al.*, 1977; Aspöck & Aspöck, 1983); so that for the time being, specimen's identity remains unsolved. This finding broadens the distribution of the family Nevrorthidae in the Mediterranean basin, being the westernmost known population and the farthest of all those in the Mediterranean basin (Fig. 2).

Ecology

Those larvae of Nevrorthidae were found in an area consistent with the description of the general ecology of the family (Nakahara, 1958; Zwick, 1967; Aspöck *et al.*, 1977, 1980; Aspöck & Aspöck, 1983, 1994; Letardi *et al.*, 2006; Jones & Devetak, 2009). The habitat can be described as a mountain stream, of permanent water regime with clean waters, belonging to a coastal range with terrestrial ecosystems in good condition of conservation.

The Sierra Alpujata is a small coastal range of 1074 m, composed mainly of peridotite, a rock that binds to its rarity rather demanding ecological conditions for plant life due to its high concentration in magnesium and heavy metal, among other reasons. The fact that soil built on peridotitic bedrock cannot be cultivated determines the historical absence of human settlements. As a consequence, the mountain maintains a high degree of naturalness, but despite its importance, lacks a figure of protection to ensure its long term conservation.

Nevrorthidae larvae were collected in the north of the Sierra Alpujata, in the UTM grid square 30S 033405, about heights ranging between 430 and 450 m above sea level, in a stream of permanent water that runs the contact between the peridotites and gneisses. An analysis of water (results in Table I) shows no contamination by eutrophication.

The nearest meteorological station is located 6 km away in Coin (altitude of 209 m) with an average annual temperature (AAT) of 18.4 ºC and a average annual rainfall (AAR) of 615.4 mm (Valle Tendero *et al.*, 2004). Therefore, it is possible to estimate that the locality belongs to a transition zone between bioclimatic belts (Rivas-Martínez, 1983): thermomediterranean (AAT between 17 and 19 ºC) and mesomediterranean (AAT between 13 and 17 °C); and the ombrotype (Rivas-Martínez, 1983) corresponds to subhumid (AAR between 600 and 1000 mm/year).

The vegetation of the area depends, broadly speaking, to the lithology of the land. On one hand, peridotite bedrock is dominated by shrubland and pine forest of *Pinus pinaster*

Table I. Physicochemical variables of water, measured with kit VISOCOLOR® ECO on 4 May 2012 (the value of temperature was taken at 18:10h). / **Tabla I. Principales variables físico-químicas del agua**, medidas utilizando un kit VISOCOLOR® ECO el 4 de mayo de 2012 (el valor de la temperatura se tomó a las 18:10h).

Temperature	15ºC
pH	8
General Hardness (GH)	12ºd
Carbonate Hardness (KH)	15ºd
Ammonia (NH_4^+)	0 mg/L
Nitrite (NO_2^-)	0 mg/L
Nitrate (NO_3^-)	1 mg/L
Phosphate (PO_4^{3-})	0,6 mg/L

Aiton, on the other hand, gneisses support cork oak forest of *Quercus suber* L. The stream has currently a high degree of conservation, with a great development of the willow galleries *Salix pedicellata* Desf., which dominates the vegetation of the stream, covering almost completely the channel (Fig. 3). In the understory, common bracken *Pteridium aquilinum* (L.) Kuhn is abundant, appearing also endemics species such as *Galium viridiflorum* Boiss. & Reuter (Table II).

Among vertebrates, there are occasional sights of white-throated dipper (*Cinclus cinclus*), a species associated with clean waterways and abundant macroinvertebrates to feed on (Peris *et al.*, 1991; Echegaray, 2006). The area is also home to Penibetic salamander (*Salamandra longirostris*), Perez's frog (*Pelophylax perezi*) and Natterjack toad (*Bufo calamita*). It is notable that no fish was detected in the studied river section.

Given the excellent condition of the stream, macroinvertebrate fauna is also rich, providing an index value IBMWP (Alba-Tercedor *et al.*, 2002) of 283 points (18 April 2011), well above 100 points considered for a status "Very Good". Highlights are the great diversity of Plecoptera and Trichoptera families, and a large number of predators, mainly represented by Odonata, including the notable species *Oxygastra curtisii* (Dale, 1834).

On August 30th, 2012, a devastating fire was unleashed, scorching much of the Sierra Alpujata. We unknow the effects this fire may have had, or may have in the future, for the survival of this species in the mountain.

Acknowledgments

This finding was made possible thanks to the cooperation and funding of Asociación Cultural Medioambiental Jara (Coin, Malaga), which leads biological studies in the Rio Grande, and the economic contribution of Maecenas Fund "We are Learning, We are Teaching". We have to grateful to Florent Prunier for the revision and contributions to this paper.

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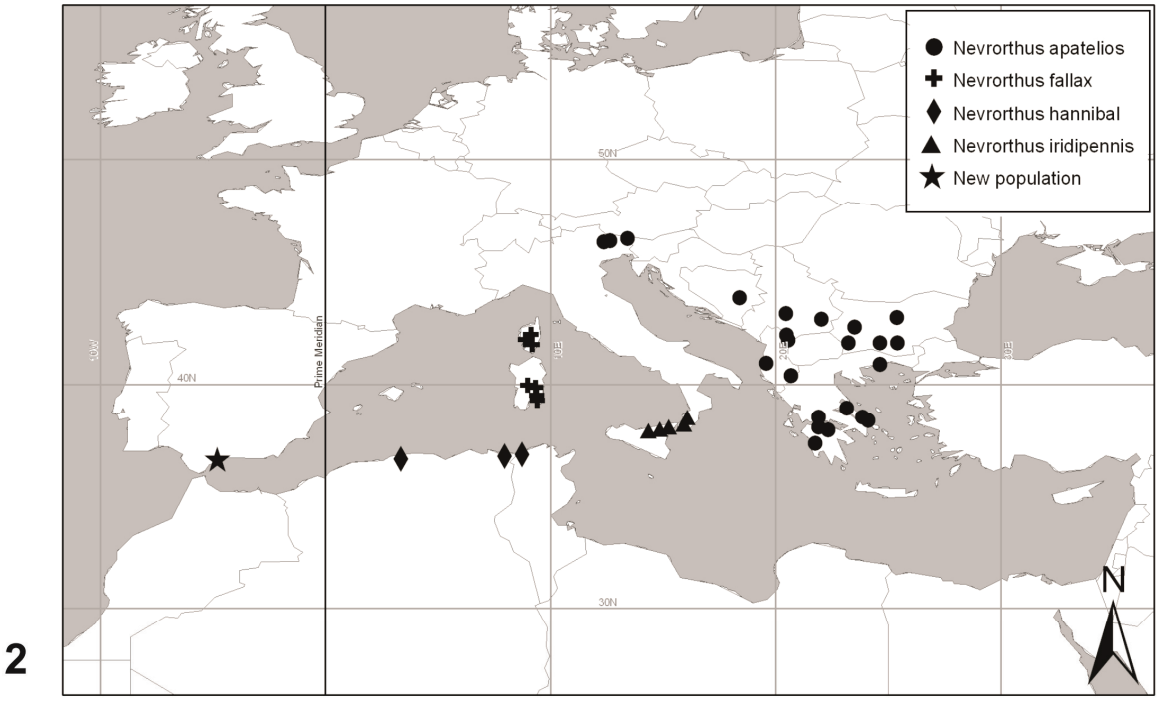

Fig. 1. Reconstruction of the larva of Nevrorthidae through photographs of details. Length: 9.5 mm. **Fig. 2.** Distribution of Nevrorthidae in the Mediterranean basin (Aspöck & Aspöck, 1983; Jones & Devetak, 2009) and localization of the new population. **Fig. 3.** Habitat of Nevrorthidae in Sierra Alpujata.

Fig. 1. Reconstrucción de la larva de Nevrorthidae mediante fotografías de detalle. Longitud: 9,5 mm. **Fig. 2.** Distribución de la familia Nevrorthidae en la región Mediterránea (Aspöck & Aspöck, 1983; Jones & Devetak, 2009) y localización de la nueva población. **Fig. 3.** Hábitat de Nevrorthidae en Sierra Alpujata.

Table II. Inventory of the riparian vegetation in the study area. Vascular plants present in lower abundance in inventory 1: *Allium triquetrum* L., *Daphne gnidium* L., *Juncus articulatus* L., *Ruscus aculeatus* L., *Smilax aspera* L., *Stellaria media* (L.) Vill.; in inventory 2: *Adenocarpus telonensis* (Loisel.) DC., *Arrhenatherum elatius* (L.) J. Presl & C. Presl subsp. *baeticum* Romero Zarco, *Carex* cf. *pendula* Hudson, *Centranthus macrosiphon* Boiss., *Cistus albidus* L., *Cistus salviifolius* L., *Dactylis glomerata* L., *Festuca lasto* Boiss., *Halimium atriplicifolium* (Lam.) Spach, *Holcus lanatus* L., *Lactuca viminea* (L.) J. & C. Presl, *Rubia agostinhoi* Dansereau & P. Silva, *Trachelium caeruleum* L., *Ulex baeticus* Boiss. / **Tabla II. Inventario de la vegetación riparia de la zona de estudio.**

Inventory	1	2
Date	23/04/2012	15/06/2012
Locality (UTM)	30S 033405	30S 033405
Exposition	N	N
Slope (º)	10	10
Altitude (m)	430	440
Coverage (%)	100	90
Area (m^2)	100	500
Lithology	Peridotite and gneiss	Peridotite and gneiss
Species	**Coverage (%)**	
Salix pedicellata Desf.	81-100	81-100
Pteridium aquilinum (L.) Kuhn	61-80	41-60
Polypogon viridis (Gouan) Breistr.	-	21-40
Galium viridiflorum Boiss. & Reuter	≤10	11-20
Rubus ulmifolius Schott	≤10	11-20
Scirpoides holoschoenus (L.) Soják	≤10	11-20
Carex distans L.	11-20	-
Adiantum capillus-veneris L.	≤10	≤10
Brachypodium sylvaticum (Hudson) Beauv.	≤10	≤10
Mentha suaveolens Ehrh.	≤10	≤10
Nerium oleander L.	≤10	≤10
Oenanthe crocata L.	≤10	≤10

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