

## Research Article

***Aeshna affinis* Vander Linden, 1820 (Odonata: Aeshnidae) in the Iberian Peninsula: A review of past and recent records, and a larval biometric study**

*Aeshna affinis* Vander Linden, 1820 (Odonata: Aeshnidae) en la península ibérica: revisión de los registros antiguos y recientes, y un estudio biométrico larvario

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**Abstract.** *Aeshna affinis*, known as “Southern Migrant Hawker, Blue-eyed Hawker” is a native odonate species uncommon in many areas of the Iberian Peninsula. Field observations in Andalusia, the southernmost peninsular region, are notably scarce. Several photographs of one larva of this species, as proof of its reproduction in southern Spain, are provided.

**Key words:** Anisoptera; dragonfly; larva.

**Resumen.** *Aeshna affinis*, conocida como “halconero migrador sureño o halconero de ojos azules”, es un odonato nativo poco común en muchas áreas de la península ibérica. Las observaciones de campo en Andalucía, la región peninsular más meridional, son notablemente escasas. Se aportan varias fotografías en detalle de una larva de esta especie, como prueba de su reproducción en el sur de España.

**Palabras clave:** Anisópteros; libélulas; larva.

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## Introduction

*Aeshna affinis* Vander Linden, 1820 ranges from southern Europe to North Africa and from the Middle East to China (Askew 2004). In Europe, it is a Mediterranean species presently showing an increase in density in the north of Europe, probably largely as a result of global warming (Boudot *et al.* 2009; Ott 2010). Seldom abundant, it is most frequent in areas with a continental climate but also permanently present around the Mediterranean, although scarce in much of the Iberian Peninsula and North Africa (Dijkstra *et al.* 2020).

It is not threatened in its entire distribution (Kalkman and Clausnitzer 2018), neither in Europe (Kalkman *et al.* 2010) nor in the Mediterranean region (Riservato *et al.* 2009); it is categorized as Least Concern (LC). However, in North Africa, it is categorized as Vulnerable (VU) (Samraoui *et al.* 2010). Both in Spain as a whole (Verdú *et al.* 2011) and in the Andalusia region (Barea-Ascón *et al.* 2008), *A. affinis* is categorized Deficient Data (DD). Currently, that category seems to be adequate for this species in whole of the Iberian Peninsula.

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According to current knowledge, *Aeshna affinis* prefers mostly standing waterbodies that dry up over the course of summer (Dijkstra *et al.* 2020). In central Europe, it is a characteristic inhabitant of summer-dry temporary waters – vernal ponds – which are typically filled by winter rainfall or snowmelt and desiccated during the summer by evapotranspiration (Schiel and Buchwald 2016). In central Italy, the oviposition was observed in holes in the hardened ground of a dried-up pond (Utzeri and Raffi 1983). With regard to this specific habitat preference, *A. affinis* differs from all other European representatives of the Aeshnidae (Schiel and Buchwald 2016). On the other hand, in Kyrgyzstan (Central Asia), a larval habitat that gave rise to a mass emergence of *A. affinis* was a sunny shallow swamp overgrown with stands of *Schoenoplectus lacustris* (L.) Palla. During summer most of the swamp, or in its entirety after an exceptionally dry winter and a subsequent hot summer, becomes dry (Schröter 2011).

Unlike what was observed in its closest Eurasian relative, *Aeshna mixta* Latreille, 1805, a similar species with which it can sometimes be confused in flight, *A. affinis* does not exhibit any sign of delayed maturation (ovarian diapause) or displacement to refuge sites during summer (Muñoz-Pozo and Ferreras-Romero 1996; Samraoui *et al.* 1998; Samraoui and Corbet 2000; Schröter 2011).

In the Iberian Peninsula, knowledge about the distribution, abundance, and aspects related to the reproduction of this species is currently very uneven. On the Cantabrian coast, from Galicia to the Basque Country (about 700 km away), between 1981 and 2017 there are around 30 citations, all of which refer to observations of adults (Álvarez *et al.* 2012; Ginzarain *et al.* 2013; Vega del Val and Aldama Murga 2018). Most of these citations refer to isolated males, which might be wandering individuals; with no record of reproduction (Álvarez *et al.* 2012).

In Catalonia (Martín *et al.* 2016), *A. affinis* is not common but it is not rare either. From 1988 to 2012, 62 records have been accounted for in 28 squares of 10 x 10 km, between zero and 1,140 m a.s.l. The most used habitats are stagnant waters with abundant vegetation that tend to dry up in summer. Some populations with a high number of individuals have been found. In other localities the constant presence of the species has been verified and five safe breeding events have been recorded. Without a doubt, this is the region in the entire Iberian Peninsula where the greatest coordinated sampling effort has been carried out.

In the northern part of central Spain (Castilla y León), it is not a common species, but it is not rare either (Casanueva Gómez and Campos Sánchez-Bordona 2022). The species in Portugal seems to be scarce, especially in the southern half of the country (Maravalhas and Soares 2013). It was considered as present in this country from the review by Ferreira *et al.* (2006) since previous citations (*e.g.*, Seabra 1942) were considered doubtful. According to Sánchez *et al.* (2009), *A. affinis* is unknown in Extremadura (Western Spain).

In the southern part of central Spain (Castilla – La Mancha), Díaz Martínez and Evangelio Pinach (2016) compiled twenty-two citations in the period 1996 to 2016. All these records were obtained at sites with altitudes higher than 600 m a.s.l., and 64% of them were at sites above 1,000 m. These authors observed an ovipositing single female in several existing holes in the dry mud of a stream bank. Although *A. affinis* is the only representative of the genus that can lay in tandem (Corbet 1962), the females oviposited alone when they arrive at the egg-laying sites in the early morning (Utzeri and Raffi 1983). The current situation of the species in the Spanish Levant (Valencian Community) is unknown: there is a historical record (1911) and a single adult record from the first years of the current century, probably a wandering individual (Baixeras *et al.* 2005).

From 1981 to 2018, in Andalusia, there were only five accepted citations (Prunier *et al.* 2013; Cano Villegas 2019). Three of them are exclusively records of adults, possibly wandering individuals, but in the other two citations, there is evidence of larva, exuviae, and freshly emerged individuals that prove reproduction.

The southern limit of the distribution of *A. affinis* runs along the northern parts of the Maghreb. According to Jacquemin and Boudot (1999), it is not widespread in Morocco, it has only recently been observed in the north of the country, from sea level to 1,200 m altitude in the Rif. El Haissoufi *et al.* (2015) found the species in six of the 116 localities considered, collecting larvae in three of them: two pools and a well-vegetated river, between 203 and 505 m a.s.l. Uncommon in Algeria, it can locally be abundant and is mostly restricted to the northeast (Samraoui and Menai 1999; Samraoui and Corbet 2000). It also is a scarce species in Tunisia. Jodicke *et al.* (2000) collected exuviae in one stream, and Korbaa *et al.* (2018) collected larvae in three streams.

## Materials and Methods

*Aeshna affinis* was recorded for the first time in Andalusia at Algeciras, Cadiz province, by Mac Lachlan (1889) who captured only one adult female. After that record from the 19<sup>th</sup> century, the species has only been cited once in that province in the extreme south of Spain (Ferrerias-Romero and Puchol-Caballero 1984). The record is based on a larva collected on May 25, 1981, by Ferrerias-Romero, in a stretch of headwaters of the river Gaduares, which runs alongside the road A-374, near the village of Villaluenga del Rosario. That site (coordinates: 36.696, -5.380) is located at an altitude of 820 m a.s.l., with a width between 1-5 m, and a depth of 50 cm.

In the laboratory, the anatomic structures were measured using a Nikon SMZ800 binocular stereomicroscope with an eyepiece micrometer; measurements were subsequently reduced to the nearest 0.1 mm. The sex of the larva (female) was determined according to the presence of gonapophyses on the ventral surface of the ninth and tenth abdominal segments.

## Results

The larva object of this biometric study is a female, in the last instar of growth (F-0). Body length is only 34 mm (Fig. 1A, Tab. 1) and the ratio maximum length / minimum width of the prementum is less than 2.5 (Fig. 1B). The supracoxal armature of the prothorax is blunt and short (Carchini 1983) (Fig. 1C). It has lateral spines on segments six to nine of the abdomen, although the spines of the sixth are very small (Fig. 1D). The lateral spines of the ninth abdominal segment reach about 2/3 of the lateral margins of the tenth. The cerci are less than half the length of the paraprocts, and the epiproct is practically straight (Fig. 1E). The ovipositor almost reaches the posterior edge of the tenth segment (Fig. 1D). There is an absence of a coating of allochthonous particles on the body surface, especially on the ventral surface of the abdomen, that might reveal an annual larval growth, or univoltinism (Schiel and Buchwald 2016).

## Discussion

The Spanish Cantabrian coast belongs to the Eurosiberian bioclimatic region (Rivas Martínez 1987). In this northern part of the Iberian Peninsula, the larval habitat could coincide with that observed in central-eastern Europe and central Asia (Dijkstra *et al.* 2020; Schröter 2011), namely, standing waterbodies that dry up over the course of summer, often overgrown with glycohydrophilic low vegetation (*e.g.*, rushes). However, to our knowledge, in northern Spain, conclusive reproductive events (*i.e.*, ovipositing females, collection of F-0 larvae or exuviae) have not been recorded (Álvarez *et al.* 2012) and, consequently, the possible larval habitats are yet unknown.

**Table 1.** Values of the variables measured in the female larva of *Aeshna affinis* from Villaluenga del Rosario (Cadiz province, southern Spain). (1) Identification characteristics used by Askew (2004), (2) by Carchini (1983). All measurements in mm. / Valores de las variables medidas en la hembra de *Aeshna affinis* recolectada en Villaluenga del Rosario (provincia de Cádiz, sur de España). (1) Características para identificación de la especie utilizadas en Askew (2004), (2) empleadas por Carchini (1983). Todas las medidas se presentan en mm.

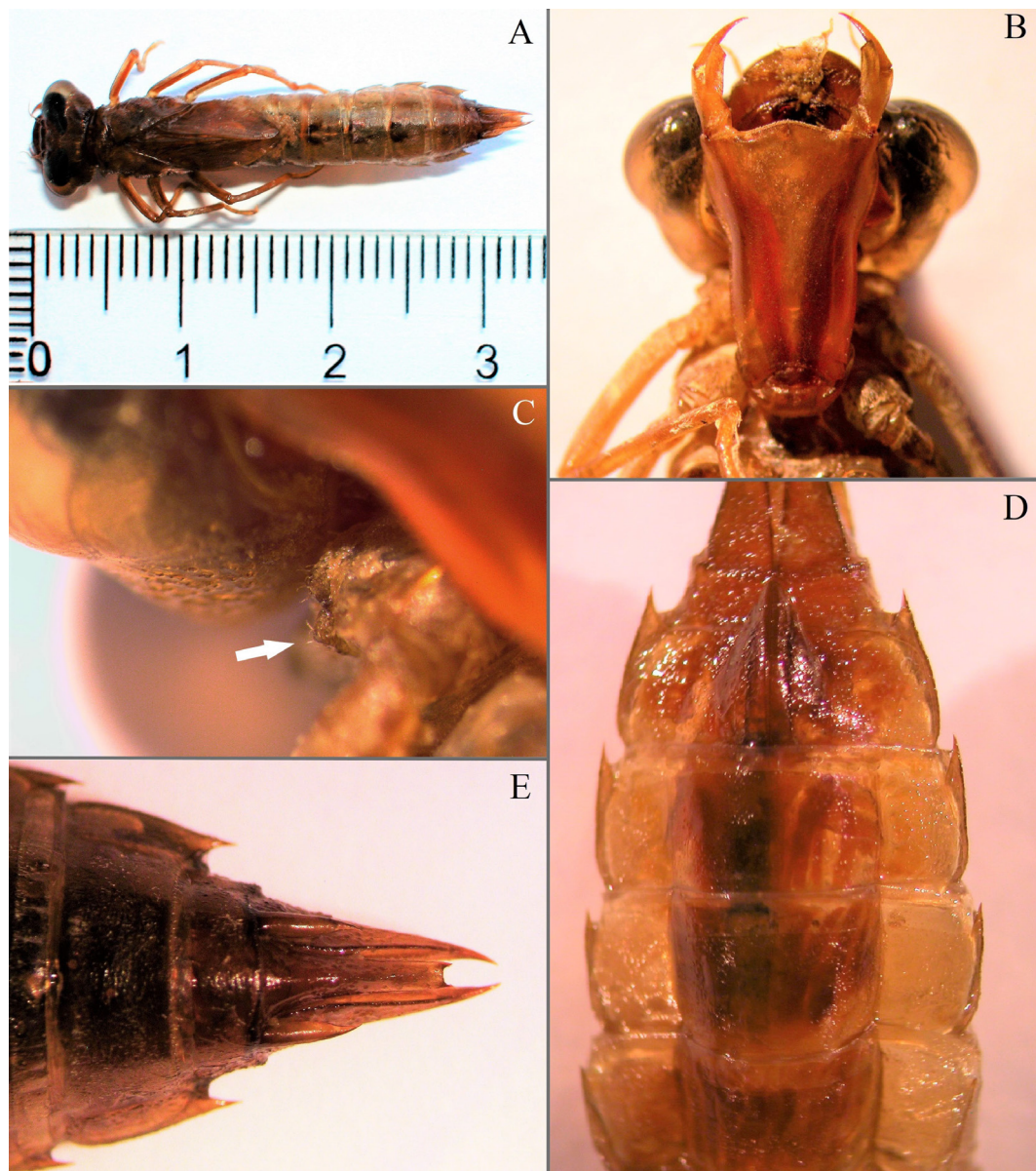
Body length (1)	34.0
Head width	7.5
Prementum length (1 and 2)	5.4
Maximum prementum breadth (1)	3.7
Minimum prementum breadth (2)	2.2
Ratio prementum length / maximum breadth (1)	1.46
Ratio prementum length / minimum breadth (2)	2.45
Length of the left metathoracic wing sheath	8.2
Left posterior femur length	6.1
Segments with lateral spines (1 and 2)	6, 7, 8 and 9
Length of the outer margin of right lateral spine of the ninth segment (1)	2.7
Length of the inner margin of right lateral spine of the ninth segment (1)	0.9
Length of the gonapophyses	2.9
Cercus length (1 and 2)	1.6
Right paraproct length (1 and 2)	3.8
Epipect length (1)	3.0

In the meridional half of the Iberian Peninsula, oviposition was observed (at Arroyo Bonilla, Buenache de la Sierra (Cuenca), 1,130 m a.s.l., Díaz Martínez and Evangelio Pinach 2016), an F-0 larva was collected (at río Gaduares, Villaluenga del Rosario (Cádiz), 820 m a.s.l., Ferreras-Romero and Puchol-Caballero 1984), and two exuviae and a freshly emerged individual (at Laguna de Orcera (Jaén), 1,270 m a.s.l., Prunier 2011) were recorded. Both sites where the ovipositing female was seen and the one where the F-0 larva was found are mountain watercourses, and the third one is a permanent lagoon surrounded by forest; all of them are above 800 m a.s.l. Use of streams as larval habitat has been found in Morocco (El Haissoufi *et al.* 2015) and also in mountains from northern Tunisia (Korbaa *et al.* 2018), sites with fairly similar latitude to the Iberian ones here mentioned.

The specimen, object of this biometric study, was the second record of this species in Andalusia. It shows that the species completed its life cycle in some localities of Cadiz province at least until very late in the 20<sup>th</sup> century. Currently, the species must be considered very rare in Cadiz province or may even have disappeared (Bernal Sánchez 2021). Citations in the Huelva (Huertas Dionisio and Sánchez Rodríguez 2000) and Malaga provinces are considered doubtful (Prunier *et al.* 2013). *Aeshna affinis* has not yet been cited in the other bordering province, Seville.

As it is a migratory species (Dijkstra *et al.* 2020), it is possible that the arrival of allochthonous individuals gives rise to reproductive events in many suitable, different habitats across the Iberian Peninsula. Probably, at sites with lower altitudes towards the north. The triple objective of this note is to show that in the past the species has reproduced in the southernmost of Spain, to identify the physiographic characteristics of Iberian larval habitats, and to contribute to future, safe identifications of Iberian larvae of this species.





**Figure 1.** Body length (A), prementum (B), supracoxal armature of prothorax (C), lateral spines on segments 6 to 9 of the abdomen and ovipositor (D), extremity of abdomen: cerci, paraprocts, and epiproct (E). / Longitud corporal (A), prementón (B), armadura supracoxal del protórax (C), espinas laterales de los segmentos abdominales 6 a 9 y ovipositor (D), extremo final del abdomen: cercos, paraproctos y epiprocto (E).

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