Taeniopteryx hubaulitii Aubert, 1946 (Plecoptera, Taeniopterygidae): Updating the Current Known Distribution in the Iberian Peninsula and Assessing its Regional Vulnerability

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**Taeniopteryx hubaulti Aubert, 1946 (Plecoptera, Taeniopterygidae): updating the current known distribution in the Iberian Peninsula and assessing its regional vulnerability**

Simone Guareschi 1,2, Adrián Ramos-Merchante 2,3, Carmen Ruiz-Delgado2 & Andrés Mellado-Díaz 2

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**Abstract:** The known distribution of *Taeniopteryx hubaulti* Aubert, 1946 (Plecoptera, Taeniopterygidae) in the Iberian Peninsula is updated and a new record extends its known range to a new area (Aragón, central Pyrenees). The vulnerability of the species was evaluated regionally by applying a specific categorical system for aquatic invertebrates. The results indicate that the species can be considered as moderately vulnerable, and possible threats are discussed.

**Key words:** Plecoptera, Taeniopterygidae, biodiversity, glacial refugia, aquatic ecosystems, Spain.

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**Introduction**

Ten species of the genus *Taeniopteryx* Pictet, 1841 (Plecoptera, Taeniopterygidae) are reported for Europe (Graf et al., 2009), three of them in Spain: *T. schoenemundi* (Mertens, 1923), known in central and northern Spain and northern Portugal, *T. nebulosa* (Linnaeus, 1758), with scarce records in NE Spain; and *T. hubaulti* Aubert, 1946, cited only in a few localities of the Iberian Peninsula (Catalan Pyrenees and Sierra Nevada).

*Taeniopteryx hubaulti* has been commonly cited in Central and Eastern Europe (Graf et al., 2009; Tierno de Figueroa et al., 2003), while Macedonia and Spain seem to be the southern limits of its distribution. In some European countries, *T. hubaulti* has been stressed as an endangered or vulnerable species given its local and restricted distribution (e.g., Bojková et al., 2013; Tyufekchieva et al., 2013; Petrović et al., 2014), whereas in Spain it has been considered a rare and relict species along the Pyrenees (Puig et al., 2011). Furthermore, *T. hubaulti* has been suggested to be a good example of cold stenotherm species, a useful indicator of climate change, and thus deserves specific population monitoring studies (Puig et al., 2011). Nymphs may be distinguished by their characteristic dorsal prominent processes along the thoracic tergites, similar to spinous processes (Tierno de Figueroa et al., 2003).

In order to provide important insights into the conservation of *T. hubaulti*, we aim to update its distribution throughout the Iberian Peninsula and to make a quantitative assessment of its regional vulnerability for the first time.

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**Methods**

Benthic invertebrates were collected in 2017 along the Eséra river (Benasque, Autonomous Community of Aragón, GPS WGS84, 31T 304322 4728594, 1756 m.a.s.l.) as part of routine biomonitoring programmes in the Ebro River Basin. Following the Spanish national protocols (MAGRAMA 2013), macroinvertebrate sampling was performed using a hand net (mesh size 500μm) and preserving invertebrates in 96% ethanol. Common physicochemical parameters were measured in situ: conductivity, temperature, pH and dissolved oxygen concentration.

In order to quantitatively evaluate the extinction risk of *Taeniopteryx hubaulti*, a vulnerability value was assigned following the methodology proposed by Sánchez-Fernández et al. (2008). This categorisation system has been specifically proposed for aquatic insects and has been used in other aquatic taxa in Spain (e.g., Millán et al. 2014). The risk of species extinction covers six equivalent criteria with score values between 0 and 3 (Table I). The six criteria are: general distribution (GD), Iberian distribution (ID), rarity (R), persistence (P), habitat rarity (HR) and habitat loss (HL). These last two criteria were assessed using an “expert panel” (details and categories in Sánchez-Fernández et al., 2008). Having calculated the species’ vulnerability value (as the sum of the scores of each criterion), it was assigned one of these four vulnerability categories: low (0–4); moderate (5–8); high (9–13); very high (14–18).
Results and Discussion

A nymph of *Taeniopteryx hubaulti* (approx. 6 mm, Fig. 1) was collected along the Ésera River at the end of September 2017. The accompanying macroinvertebrate fauna included 30 families (five Plecoptera families). Values for the physicochemical variables at the sampling site were: conductivity= 107.4 µS/cm, pH= 7.8, dissolved oxygen saturation= 95.0 % and water temperature= 10.6 ºC. The river stretch was characterised by mineral substrate (mainly cobbles), while the riparian area presented characteristic mountainous vegetation, such as evergreen trees, with relevant zones of shrubs and high-altitude grasslands. Following the macroinvertebrate-based index IBMWP and the WFD classification (RD 817/2015, BOE 219), the sampling site showed a “very good” ecological status.

This new record represents the first report of *Taeniopteryx hubaulti* in the province of Huesca and in Aragón, and extends the current known distribution of the species to the Central Pyrenees. To date, *Taeniopteryx hubaulti* has been cited only in a few other localities in Spain (Catalan Pyrenees and Sierra Nevada) in the nymphal stage. In the Catalan Pyrenees, it was first detected in the Bonaigua stream (Noguera Pallaresa River basin, Puig, 1984). More than 20 years later its presence was confirmed as a “very good” ecological status.

In Spain, mature *Taeniopteryx hubaulti* nymphs were recorded in cold freshwater streams with low conductivity values and altitudes above 1400-1500 m.a.s.l. In France, Fochetti and Nicolai (1996) referred to a locality at 1600 m.a.s.l. while Berthélémy (1966) collected *Taeniopteryx hubaulti* between 480 and 900 m.a.s.l.

Following the vulnerability categorisation system (Table I), *Taeniopteryx hubaulti* was identified as a moderately vulnerable species in Spain (value=7). The final score was strongly affected by the 0 points obtained in the categories “habitat rarity” (because headwater streams are not considered rare ecosystems) and “persistence” (because despite its low abundance, the species was recently detected in 2010 and 2017). A similar evaluation could be obtained using IUCN criteria, basically due to its restricted area (range of occurrence <20,000 km², category Vulnerable), but by considering the small total number of records (area of occupancy probably around 500 km²), even the category Endangered could be reached. However, problems related with scarce or lacking data (e.g., demographic evolution, population size, immigration rates and mature stage abundance) make problematic a complete *Taeniopteryx hubaulti* assessment by using only IUCN criteria, and can even prevent it because populations have not been systematically monitored.

This rheophilic stonefly species is confirmed as rare in Spain not only due to its restricted distribution area, but also because of its scarce abundance. Just one nymph was collected during our sampling, and the same has occurred in other countries and study areas (e.g., Slavevská-Stamenkovič et al., 2016). The species’ winter flight period in the southernmost localities of its European distribution (Tierno de Figueroa et al., 2018) and its habitat preferences for high altitudes with difficult access (e.g. snowy and cold mountain areas) could make it difficult to detect the species.

According to Tierno de Figueroa et al. (2010), increased air and water temperatures related to climatic change may
reduce habitat availability for cold-water aquatic species such as *T. hubaulti*. The records obtained in National Parks (Aiguéstortes and Sierra Nevada) stress the relevance of these protected areas for preserving aquatic biodiversity. Iberian nature reserves have already been stressed to perform relatively well in supporting invertebrate taxonomic diversity (Guarreschi et al., 2015). Nevertheless, inclusion in protected areas does not automatically guarantee species protection and global change may also affect the future climate representativeness of Iberian nature reserves (Sánchez-Fernández et al., 2013). Furthermore in mountainous areas, human activities like ski resorts, tourism or winter sports can represent current and additional factors which could affect the conservation of these restricted *T. hubaulti* populations.

Future research and monitoring programmes are suggested to better determine the population status and long-term persistence of *T. hubaulti* in the Spanish Pyrenees and Sierra Nevada if we consider that these mountainous systems are glacial refugia for more northern cold stenotherm species and are, thus, crucial in biodiversity conservation programmes.

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Fig. 1. Panorâmica de la localidad de muestreo (2017) y detalles de la ninfa acuática de *Taeniopteryx hubaulti*.  

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