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First Report of *Saga pedo* (Pallas, 1771) in the Euganean Hills Regional Park (Veneto, Italy) and some note on its biology (Ensifera Tettigoniidae Saginae)

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ABSTRACT The presence of *Saga pedo* (Pallas, 1771) (Ensifera Tettigoniidae Saginae), in the Euganean Hills area (Veneto, north-eastern Italy) is reported here for the first time. Observations were conducted between 2023 and 2025 in dry grasslands located in several municipalities of the area. The environment, characterized by xerothermophilous vegetation, hosts a diverse community of orthopteroid insects, potential prey of the species. Additional notes are provided on developmental stages, observation times, and some behavioral aspects. The occurrence of *S. pedo* in the Euganean Hills represents the first confirmed record for this area and expands the known distribution range of the species in Veneto region. This finding confirms the high biogeographical and conservation value of the Euganean Hills system. Consequently, it is recommended that Euganean dry grasslands be reconsidered among the habitats deserving priority protection due to the presence of *S. pedo*, and that entomological surveys be continued to assess the stability of the local population.

KEY WORDS Behaviour; CETS; Conservation; Euganean Hills; *Saga pedo*.

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INTRODUCTION

For several years, Montegrotto Terme Butterfly House (Butterfly Arc) and Esapolis Museum of Padua have undertaken initiatives to study insects and other invertebrates of the Euganean Hills area. To this end, various collaborations have been promoted with young naturalists from Esapolis Museum, along with participation in the CETS project (European Charter for Sustainable Tourism of the Euganean Hills Regional Park). Within this framework, new species of macro-invertebrates previously unrecorded from the area have been discovered, such as the two-tailed pasha *Charaxes jasius* Linnaeus, 1767 (Lepidoptera Nymphalidae), and the leech *Haemopis elegans* Moquin-Tandon, 1846, (Annelida Hirudinea) (Beretta et al., 2022; Bagno, 2023). Behavioral and cognitive aspects of species typical of the park's habitats have also been described (Scaccini & Uliana, 2024). In March 2024, the documentary "Il Microcosmo dei Colli Euganei" (Moretto & Doremi, 2024) was released, including footage of a *Saga pedo* (Pallas, 1771) specimen (Ensifera Tettigoniidae Saginae) filmed in the Euganean Hills Regional Park in July 2023.

According to a recent review of all *S. pedo* records in Italy, including data from the citizen science platform iNaturalist (www.inaturalist.org) (Brandmayr et al., 2025), this species had never

previously been reported from the hilly systems extending southeastward from the Vicentine Prealps, namely the Berici and Euganean Hills. In this note, the confirmed presence of a population of this rare species is reported for the first time in the Euganean Hills.

Saga pedo *(Pallas, 1771) (Ensifera Tettigoniidae Saginae)*

The predatory bush-cricket *Saga pedo* (Pallas, 1771), belonging to the family Tettigoniidae, is a parthenogenetic species distributed from the Pyrenees across southeastern Europe to western Siberia and the Caucasus (Figs. 1–4). It feeds on various invertebrates, mainly other orthopterans and mantids (Kaltenbach, 1970; Fontana & Cussigh, 1996; Massa et al., 2012; Lemonnier-Darcemont et al., 2016).

Saga pedo is a xerothermophilous species of medium altitudes that, in Italy, does not exceed 950 m a.s.l. (Fontana et al., 2002; Galvagni & Prosser, 2004). It shows both diurnal and nocturnal activity and is associated with natural and semi-natural grasslands (Holuša et al., 2013). The species prefers relatively open habitats with herbaceous vegetation and scattered shrubs, where it moves with limited agility and performs relatively short jumps. Eggs hatch in spring, and nymphs undergo nine molts before reaching the final adult stage (Fontana et al., 2002). Some eggs may hatch one or two years after being laid (Massa et al., 2012; Hochkirch et al., 2016), a strategy that allows survival through unfavorable years. Parthenogenesis in *S. pedo* is considered an adaptation to transient and extreme habitats: it ensures colonization ability even from a single individual and provides a demographic advantage by avoiding the costs of sexual reproduction (Cuellar, 1977; Tilquin & Kokko, 2016).

Saga pedo is the only species of the genus *Saga* Charpentier, 1825 known from the Italian fauna (Galvagni & Prosser, 2004; Massa et al., 2012). The adult reaches 100–120 mm in length, including the ovipositor. It is easily recognized by its large size and uniform coloration, usually light green or grayish, including the legs; along both lateral margins of the thorax and abdomen runs a narrow

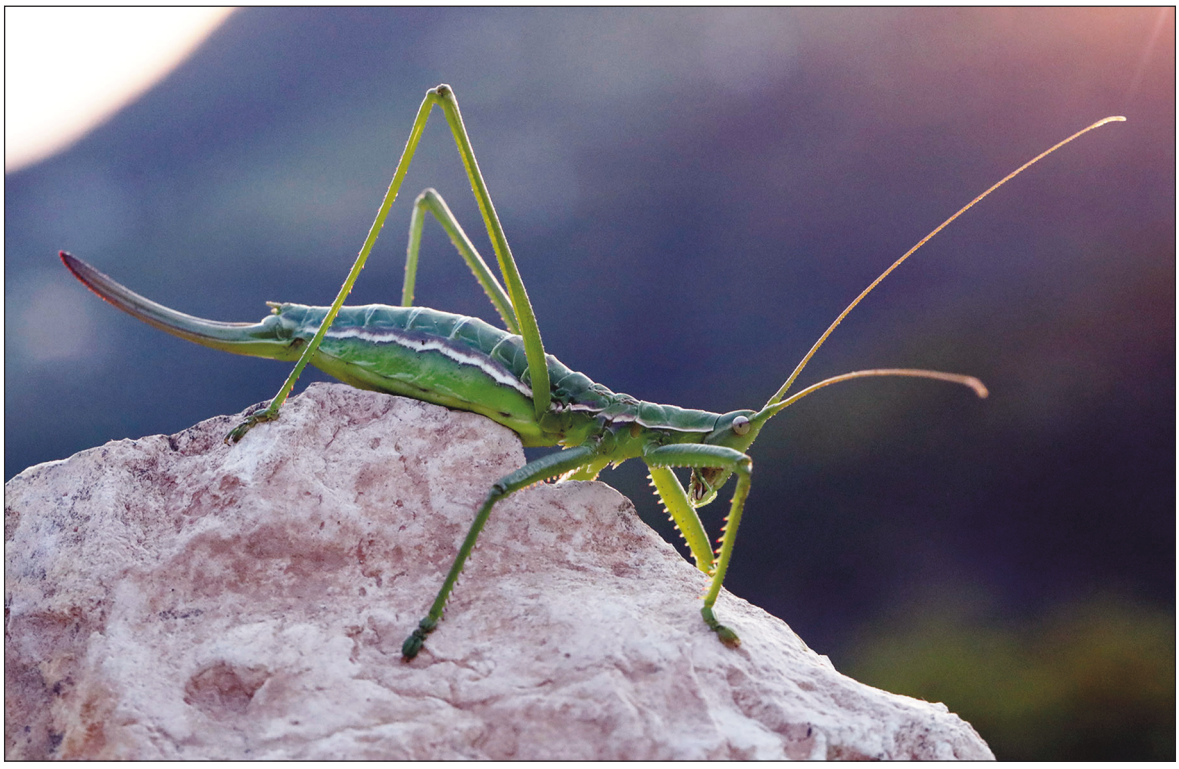

Figure 1. *Saga pedo* from Euganean Hills Regional Park (Veneto, Italy).

whitish-yellow stripe. The head is elongated, with a hypognathous mouthpart and strong mandibles; robust spiniform structures are present on the femora and tibiae of the anterior and median legs (Fontana et al., 2002; Buzzetti & Fontana, 2004). Antennae are long, filiform, and very slender; the ovipositor is long, strong, and saber-shaped.

This species is threatened with extinction and is listed in Appendix II of the Bern Convention and in Annex IV of the EU Habitats Directive 92/43/EEC (habitat 6210: semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) with a rich presence of orchids). It is also recognized by Regional Law No. 56 of April 6, 2000 (Tuscany) and by Regional Law 15/2006 "Provisions for the Protection of Minor Fauna" (Emilia-Romagna). Furthermore, it has been designated as a species deserving immediate and absolute protection by the Italian government (Presidential Decree implementing Directive 92/43/EEC, G.U. 248 23/10/1997 suppl. ord. 219).

Saga pedo is vulnerable due to high habitat fragmentation and continuous population decline (Hochkirch et al., 2016). The main threats include overgrazing, pesticide use, fires, and afforestation (Lemonnier-Darcemont et al., 2009; Anselmo, 2019).

The Euganean Hills (Veneto, Italy)

The Euganean Hills system consists of about sixty hills of mainly volcanic or subvolcanic origin, generally conical or hemispherical in shape, rising in isolation from the Venetian plain, North Italy (Astolfi & Colombara, 2003; Gamba et al., 2020). The highest peak is Mount Venda (601 m a.s.l.). The entire area lies within the province of Padua, except for Mount Santo di Lovertino (128 m a.s.l.), which belongs to the province of Vicenza. The climate has often been described as "Mediterranean" (Del Favero & Lasen, 1993), although lacking certain characteristic features such as the seasonal distribution of precipitation and the intense summer drought. Mean annual temperatures range from 13.0 °C in Monselice (13 m a.s.l.), one of the southernmost and most exposed localities, to 11.1 °C near the summit of Mount Venda at 575 m a.s.l. Mean annual precipitation ranges between 800 and

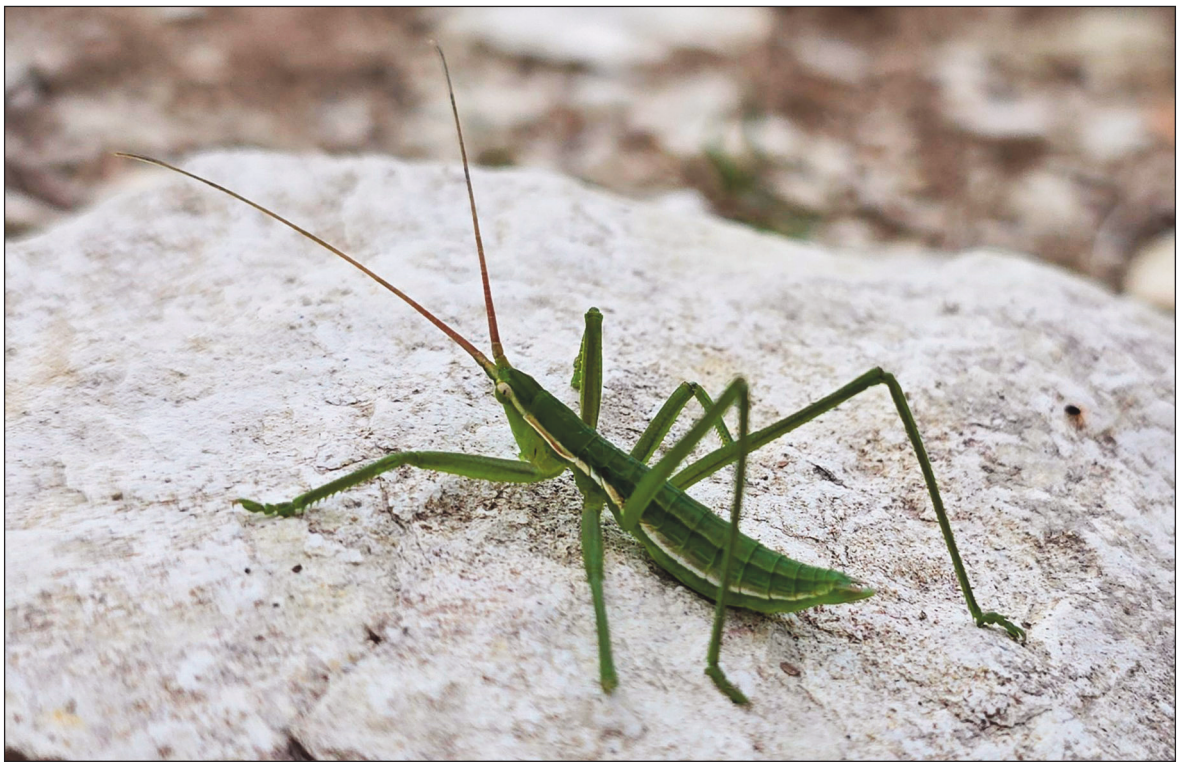

Figure 2. Nymph of *Saga pedo* from Euganean Hills Regional Park (Veneto, Italy).

950 mm, with peaks in spring and autumn while the minimum values are recorded in the summer and winter (Sitzia et al., 2018). The (sub)Mediterranean character of the Euganean climate is particularly evident in the partially evergreen and sclerophyllous phanerophytic flora, including typical Mediterranean shrub species such as *Quercus ilex* L. (though with limited distribution), *Arbutus unedo* L. *Erica arborea* L., *Cistus salvifolius* L. and *Pistacia terebinthus* L. Such vegetation occurs at nearly all elevations, mainly on south-facing slopes and siliceous substrates, where it forms dense scrub or integrates into oak and chestnut woodlands. Oak forests, particularly chestnut stands, are widespread and favored by acidic soils, corresponding to *Melampyro vulgati–Quercetum petraeae* (Del Favero, 2004). At higher, north-facing elevations, significant populations of beech occur locally. *Robinia pseudoacacia* L., stands are also common, resulting from the degradation of chestnut woods or recolonization of grasslands. On basic substrates, mixed hop-hornbeam and oak woods prevail, in the variant characterized by smoke tree (*Buglossoido purpureocaeruleae–Ostryetum carpinifoliae*, subassociation with *Cotinus coggygria* Scopoli), not differing significantly from those found in the neighboring Berici and Lessini Hills (Del Favero, 2004). Dry grasslands and Mediterranean scrub are common in disturbed areas or on shallow soils (Gamba et al., 2020). Agricultural landscapes are mainly composed of vineyards and olive groves, sometimes uniquely interspersed with jujube, almond, and other minor fruit trees. In contrast, grassland formations and annual crops are sharply declining (Scortegagna, 2021).

Figure 3. A specimen of *Saga pedo* from Euganean Hills Regional Park (Veneto, Italy) with a darker color variant (pronotum and tergites).

This area benefits from protection as a regional park and includes numerous habitat types of conservation interest. Sedimentary and paleoecological evidences attest to the role of the Euganean Hills as a glacial refuge, contributing to their high biodiversity and importance for saproxylic taxa of particular interest (Scaccini & Uliana, 2017; Gubler et al., 2018; Gamba et al., 2020; Boltshauser-Kaltenrieder & Tinner, 2024).

Presence of Saga pedo *in the Euganean Hills*

Between 2023 and 2025, several field surveys were carried out in areas south of the Euganean Hills Regional Park, particularly in the municipalities of Arquà Petrarca, Baone, Cinto Euganeo, and Monselice.

This area hosts dry grasslands locally known as “vegri” (Sitzia et al., 2018), environments in which the presence of *Saga pedo* could plausibly be expected (Fig. 1). The first finding, recorded in July 2023, and subsequent observations come from one such area, the Mottolone Plateau (45°16’50.2”N, 11°42’20.2”E), and its extensions toward the SSW, between 150 and 230 m a.s.l., within the municipality of Arquà Petrarca. The surveyed area covers approximately 0.2 km². In 2024 and 2025, surveys continued at the same site starting in April. In both years, numerous *S. pedo* nymphs were observed, mainly at dusk and in the evening (Fig.

2). During observations, minimum temperatures were around 12 °C and maximum around 27 °C. Specimens were collected both by sweep-netting and by visual search. Nymph presence was concentrated in the upper part of the north-facing slope, although a few individuals were also found elsewhere along the ridge, including the southern slope, characterized by more diverse herbaceous vegetation and greater abundance of potential prey, particularly orthopterans. Adults showed the typical green coloration with two whitish-pink lateral stripes on the body, while a single individual exhibited a darker color variant with dark ornamentation on the pronotum and tergites (Fig. 3). These colorations are typical for the species and are thought to be influenced by substrate characteristics (Lang, 1930; Kaltenbach, 1970; Schall, 2002).

Behavioral observations

Although the species is mainly active during evening and nighttime hours, adults also show diurnal movements. Their large size makes them more detectable in environments where vegetation is sparse and composed of low herbs or scattered shrubs and small trees. Adults disturbed during movement display a swaying gait: they move very slowly, rocking their legs before taking a step. This swaying motion is commonly observed in highly cryptic animals such as mantids and stick insects with cryptic or disruptive coloration. Such behavior is interpreted as a strategy to reduce predator detection or to disguise normal movement, thereby inducing misidentification by predators - or through a combination of both mechanisms. For this reason, it is sometimes described as a form of "motion camouflage" (Bian et al., 2016; Kelty-Stephen, 2018). It was also observed that the ovipositor is used as a mechanical support during jumping. This structure is folded under the abdomen by a strong flexion of the terminal abdominal segments, which assume a U-shape (Fig. 4). When disturbed, the ovipositor is rapidly extended, releasing stored elastic energy. This sudden movement provides additional thrust that combines with the propulsion generated by the hind legs. The ovipositor thus acts as an elastic and lever-like element, increasing the

Figure 4. *Saga pedo* from Euganean Hills Regional Park (Veneto, Italy): ovipositor folded under the abdomen.

body's initial acceleration and enabling a fast, sudden escape - otherwise difficult for an animal of such size and weight.

CONCLUSIONS

The orthopteran fauna of the Euganean Hills has been the subject of previous faunistic studies (Galvagni, 1956; Cogo et al., 2002); however, the presence of *Saga pedo* had never been documented in the area. This lack of records may be due to the species' elusive behavior, its mainly nocturnal habits, and the low population densities of adults. Moreover, *S. pedo* may be absent for long periods from previously occupied sites, owing to its ability to persist at very low densities and to produce eggs with delayed hatching over several years (Schall, 2022). At the same time, several authors have linked the recent increase in *S. pedo* records across Italy to a genuine range expansion, likely favored by ongoing climate change. This interpretation is consistent with the recent findings of other thermophilous insect species in the Euganean area, such as the aforementioned *Charaxes jasius* (Lepidoptera: Nymphalidae), whose northward expansion has likely been supported by rising winter minimum temperatures (Beretta et al., 2022). The habitat where *S. pedo* was found hosts rare or relict taxa, such as the Padua rue, *Haplophyllum patavinum*, Linnaeus (Rossi di Schio et al., 2005) and the beetle *Platycerus caraboides* Linnaeus, 1758, (Scaccini et al., 2017), highlighting the high biogeographical value of the hill complex and its role as a refuge for species of conservation interest. In particular, the presence of *S. pedo*, listed in Annex IV of the Habitats Directive (92/43/EEC), underscores the need to reconsider conservation and management measures for these habitats, already under specific protection by the Euganean Hills Regional Park.

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