

The Giant Asian Mantis *Hierodula tenuidentata* Saussure, 1869 spreads in Italy: a new invasive alien species for the European fauna? (Insecta Mantodea)

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ABSTRACT

The presence of the Giant Asian Mantis, *Hierodula tenuidentata* Saussure, 1869 (Insecta Mantodea), is here reported for the first time in Italy. A well settled and probably wide spread population of this species is here described in detail, evaluating the increase in the number of individuals in the recent years and its adaptability to the European continental climate and to anthropized environments. The synonymy of this species with *H. transcaucasica* Brunner von Wattenwyl, 1878 is here discussed and some considerations on the potential impacts on the local ecosystems and its future spreading in Europe as an invasive species are here given.

KEY WORDS

Conservation; Distribution; *Hierodula*; Alien Species; Mantodea.

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INTRODUCTION

The Giant Transcaucasian Mantis (*Hierodula transcaucasica* Brunner von Wattenwyl, 1878) originally described for the North-East of Iran, showed a typically Asian distribution until a few years ago: Afghanistan, Caucasus, Iran, Central Asia (Ehrmann, 2002; Battiston & Massa, 2008) until reaching westward the Crimea (Werner, 1916) where, however, after Werner's reporting, it was no longer recorded, if not in recent years, with a considerable presence and a potential expansion in Ukraine (Pushkar & Kavurka, 2016). In the southernmost areas of its range, it has been recorded in Eastern Turkey since the seventies (Ehrmann, 2011) approaching the Mediterranean Europe.

Between 2015 and 2018, *H. transcaucasica* was

recorded as in expansion in several Balkan locations reaching the Greek islands (Cianferoni et al., 2018; Romanowski et al., in press). Until the recent expansions to the West this species has been little considered in the scientific literature: the male allotype was only described recently (Battiston & Massa, 2008) and its taxonomic identity has been rediscussed in the last years suggesting the synonymy with the Giant Asian Mantis *H. tenuidentata* Saussure, 1869 (Ehrmann, 2011; Ehrmann & Borer, 2015; Schwarz et al., 2018). The distribution of *H. tenuidentata* is traditionally located between India and Central Asia (Schwarz et al., 2018), but the synonymy with *H. transcaucasica* would expand it to Caucasus reaching the Mediterranean.

In this scenario, the doubtful attribution of some specimens recently recorded in Europe (Cianferoni

et al., 2018, van der Heyden, 2018a, 2018b), created additional confusion on this mantid, its distribution and its status of alien or native species: imported with cargos from Asia or arrived with a natural expansion from Caucasus.

The taxonomy of these mantids is here discussed presenting new data in support of the synonymy between the two species and the presence of several new records in different locations of Northern Italy. This work describes and discusses the first Italian stable and reproductive population found in the Po valley, with a first overview on its possible impacts on the local ecosystems and spread potential in Italy and Europe.

MATERIAL AND METHODS

The presence of *H. tenuidentata* was recorded in the Po Valley in two ways. First, the presence of individuals and oothecae posted or reported on social media (Facebook, Messenger, iNaturalist) was recorded and listed. In this case the observations used were verified through clear photographic material where the diagnostic characters were evident or a direct contact with the author of the observation and a following on-site verification, were possible. Second, the population located in the province of Cremona was investigated in detail, using field surveys and transects for the count of the number of specimens and oothecae in the area where the presence of this species was observed. To have a first estimate of the increase of the local population over the years, a standardized count (1 hour of slow walking) over a define transect of 900 meters has been done, recording separately the recently laid oothecae (not hatched) and the old oothecae laid in the past years (already hatched).

ABBREVIATIONS. coll. = collection; juv. = juvenes; ex/x = specimen/s; obs. = personal observation.

RESULTS

For the province of Cremona (Italy), a total of 33 individuals and 119 oothecae were recorded in an area of about 200 km²: Calvatone: 17.IX.2018, 1 female, coll. Leandri; 17.IX.2018, 1 ootheca, obs.; 5.IX.2018, 1 female, obs.; Cingia de Botti: 12.IX.2018, 1 female,

obs.; 29.VII.2018, 1 juv., obs.; 9.X.2018, 1 female, coll. Leandri; 9.X.2018, 1 ootheca, coll. Leandri; 9.X.2018, 2 oothecae, obs.; Cremona: 7.X.2018, 1 female, obs.; Drizzona: 13.VIII.2018, 1 female, 2 males, obs.; Piadena: 25.VI.2018, 1 juv., obs.; 30.IX.2018, 1 female, obs.; 5.X.2018, 3 oothecae, obs.; San Giovanni in Croce: 1.XI.2017, 1 ootheca, obs.; 10.IX.2018, 1 female, coll. Leandri; 12.IX.2018, 1 ex, coll. Leandri; 14.IX.2016, 1 female, obs.; 16.VIII.2018, 1 female, coll. Leandri; 18.VIII.2018, 1 female, obs.; 18.VIII.2018, 1 male, obs.; 19.IX.2018, 1ex, obs.; 24.VIII.2018, 1female, obs.; 24.VIII.2018, 1 juv., obs.; 26.IX.2018, 1 female, obs.; 27.IX.2018, 1 female, coll. Leandri; 27.IX.2018, 1 female, obs.; 27.IX.2018, 2 oothecae, coll. Leandri; 3.IX.2018, 1 ex., obs.; 30.IX.2018, 1 female, obs.; 5.X.2018, 103 oothecae, obs.; 5.X.2018, 5 female, coll. Leandri; 7.X.2018, 5 oothecae, obs.; 7.VII.2018, 1 juv., obs.; 14.X.2018, 1 female, obs.; Scandolara Ravara: 25.VIII.2018, 1 male, obs;

Canneto sull'Oglio (Mantova province): 28.VI.2018, 1 juv., obs.

In addition to the discovery of oothecae already hatched and laid in the past years, adult specimens have been recorded in the area since 2016, demonstrating its ability to overwinter and reproduce (Figs. 1–3) continuously with a stable population. The count of the oothecae in the transect recorded 18 oothecae laid in the past years and 69 still unhatched and undamaged, presumably laid in 2018, with an estimated increase in the population of 383% in this year over the past.

The collecting and observation areas in the province of Cremona show a marked preference of this species for the few wooded areas (Fig. 4: 75%), over the other environments included in strongly cultivated countryside landscape. Wooded strips were preferred especially as an habitat suitable for the aggregation of the females when approaching the ootheca laying time (Fig. 2). This situation is expected, since this species has repeatedly shown a preference for deposition on trees or stable vegetation, unlike for example *Mantis religiosa* Linnaeus, 1758, which seems to prefer more flat and hard surfaces such as stones or man-made artefacts (Battiston, unpublished data). Wandering individuals showed on the contrary a preference for vegetated environments but also with high anthropogenic impact such as house gardens and vegetable gardens (Fig. 5: 52%).



Figure 1. Male and female of *Hierodula tenuidentata* mating in San Giovanni in Croce (Cremona, Italy), date 18.VIII.2018. Photo C. Balestreri.

Figure 2. *Hierodula tenuidentata* laying an ootheca in San Giovanni in Croce (Cremona, Italy), date 26.IX.2018. Photo F. Leandri.

Figure 3. Group of oothecae of *Hierodula tenuidentata* just laid on *Rubus* sp. in San Giovanni in Croce (Cremona, Italy), date 5.X.2018. Photo F. Leandri.

TAXONOMICAL REMARKS

The synonymy of *H. transcaucasica* with *H. tenuidentata* has been discussed in recent years

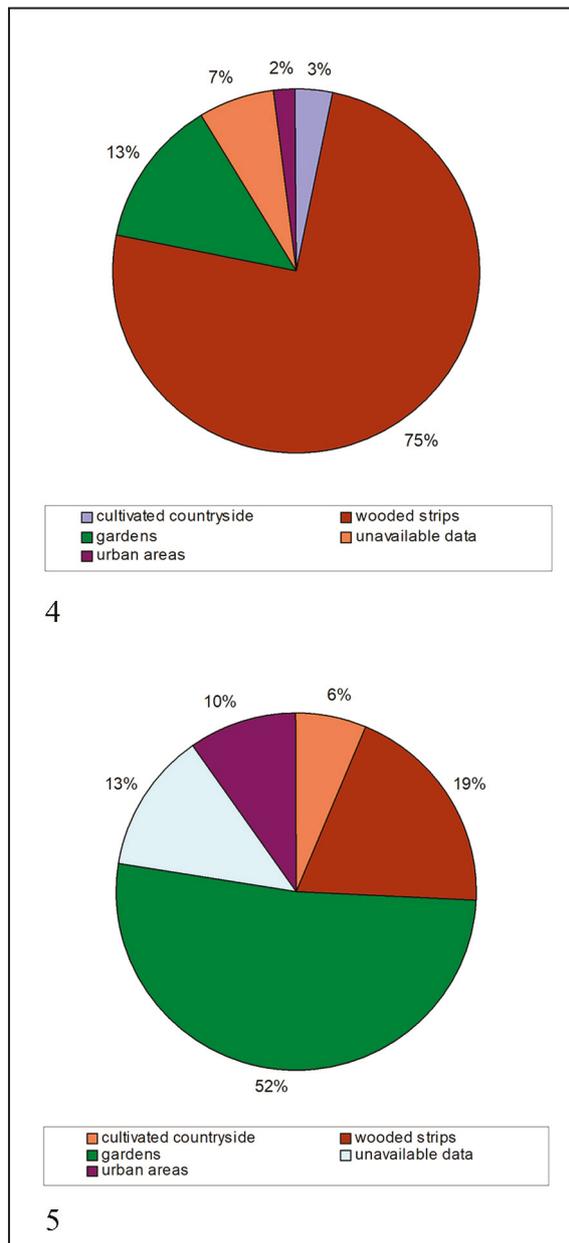


Figure 4. Habitat of the observation of individuals and oothecae of *Hierodula tenuidentata* from the Cremonese population (Italy), identified as: cultivated countryside, gardens, wooded strips, urban areas and unavailable data.

Figure 5. Habitat of the observation of wandering individuals of *Hierodula tenuidentata* from the Cremonese population (Italy), identified as: cultivated countryside, gardens, wooded strips, urban areas and unavailable data.

(Ehrmann, 2011; Ehrmann & Borer, 2015) in particular referring to the comparison with the female type housed in the NHMW and some specimens collected in Nepal (Schwarz et al., 2018). However these authors pointed out that a comparison with many more specimens across the distributional ranges of both species was needed to confirm this status. At present, other than approximate remarks to shape and dimensions, the only objective character useful to separate the two species: *H. transcaucasica* from *H. tenuidentata* is the presence of completely black discoidal spines on the fore femora in the first and spines black only in the tip in the latter (Giglio-Tos, 1911, 1927). In our research, by the discontinuity from their natural ranges, we examined many specimens collected in the wild coming from what is probably a single isolated population. In the natural variability of this population we examined specimens with all the possible shades in the shapes, sizes and spines: from entirely black spines to spines black only in the tip. This last character is clearly not valid to separate these species. The examination of the male genitalia of a partially black-spined specimen, resulted with no appreciable differences with the black-spined male allotype genitalia described from Caucasus (Battiston & Massa, 2008). For these reasons we decide to support the synonymy and consider *H. tenuidentata* a single species distributed from India to Europe.

DISCUSSION

Considering the rapid spreading of this species to the western countries in recent years, starting from the Caucasian areas to Europe, its arrival in Italy was predictable, even if the dynamics are still not clear at present. Considering the present distribution of this species in Europe ranging from Ukraine to Greece and reaching west Albania (Van der Heyden, 2018), but with the apparent absence of data for the Dalmatian area, despite the recent mantidological investigations (see e.g. Romanowsky & Romanowsky, 2014; Rebrina et al., 2014; Pavićević et al., 2014) and monitoring on social media, which would represent in some way a spatial continuity with the native range of this species, it is probable that this is not a natural expansion of the Ukraine populations but of a man-mediated transport. Since this species is not

commonly reared as pet, and therefore its voluntary release in nature seems improbable, the arrival through mercantile channels seems the most probable hypothesis, with dynamics, however, all to be ascertained. The fact that in the Cremonese area there is a vital population active since at least 2016 able to overwinter in an area characterized by a continental climate such as the Po Valley suggests that the origin is from populations located at the same latitudes, in the northernmost areas of this species, like Ukraine or the Caucasian provinces of Russia, but it is not possible to exclude a commercial route of passage for Greece, an important commercial window over the whole Mediterranean area.

The impact of this species on the Italian as well as on the European ecosystems is also currently unknown. It should however be emphasized that in the area here considered other mantid species are present: *Mantis religiosa* with a well established population and, since few years, and in smaller numbers, even the more Mediterranean dwarf mantid *Ameles spallanzania* Rossi, 1792, a more uncommon species, but also in a slow expansion phase from the Mediterranean towards the Continental Europe (Leandri et al., 2013). The abundance of oothecae here discovered (Fig. 3) and the well settled population of *H. tenuidentata*, are compatible if not greater than a well settled population of *Mantis religiosa*. This may presage a possible competition between these species, for space and resources, considering the strong ecological proximity of these two species, both well adapted to an already well anthropized environment and the almost perfect overlapping of the life cycle with wintering oothecae and adults active between August and October. The systematic proximity also lead to assume a possible interference in reproduction. Both are species where sexual cannibalism and attraction through pheromones, whose species-specificity is still under investigation, are well used in matings. It is known that the males of *Mantis religiosa* respond positively to the pheromonic signals coming from other mantids species, even if not phylogenetically closely related, such as *Tenodera* Burmeister, 1838 (Leito & Brown, 2008). It is therefore easy to suppose that *H. tenuidentata*, may represent a potential obstacle to the reproduction of the native species, and representing for them a real threat, as already observed in other mantid species victims of competition with invasive alien species (Fea et al., 2013).

The impact of this species on the other animals are also unknown but *Hierodula* is a voracious predator, more massive than *Mantis religiosa*, able to prey a large number of invertebrates and also small vertebrates, showing a remarkable ability to adapt to different preys and with a strong potential impact on local communities (Battiston et al., 2018). Moreover between September and October 2018 some occasional and unconfirmed records of this species have been posted on the internet in the area of Parma, continuous to the Cremonese area, showing that the presence of this species in Italy may be underestimated and ready to spread in other European countries using commercial routes. In this sense the citizen-science based monitoring is strongly encouraged to be able to follow the rapid spreading of this species.

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