ARE *Empusa pennata* AND *Bolivaria brachyptera* REALLY PRESENT IN CROATIA? A REPLY TO KRANJČEV (2013) WITH A CRITICAL REVIEW OF THE MANTID TAXA FOUND IN CROATIA

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Radovan Kranjčev (2013) published a paper on Croatian Mantodea containing a considerable number of data that need to be discussed. In this reply corrections of mantid misidentifications, as well as of some given statements, are presented, certain doubtful records are discussed and comments on a number of overlooked papers are given. Also, a critical review of some further problems concerning Croatian Mantodea fauna is presented, as well as a rather short historical overview of investigations of this insect order in Croatia.

Key words: reply, misidentifications, comments, literature, Mantodea

F. REBRINA, R. BATTISTON i J. SKEJO: Jesu li vrste *Empusa pennata* i *Bolivaria brachyptera* doista prisutne u Hrvatskoj? Odgovor Kranjčevu (2013) s kritičkim osvrtom na vrste bogomoljki prisutne u Hrvatskoj. Entomol. Croat. Vol. 18. Num. 1–2: 17–25

Radovan Kranjčev (2013) objavio je rad o bogomoljkama Hrvatske u kojem je iznesen znatan broj podataka koje je potrebno raspraviti. U ovom odgovoru doneseni su ispravci determinacija nekih bogomoljki, kao i određenih navoda, raspravljeni su neki upitni nalazi i dani su komentari na neke previđene radove. Također, predstavljen je osvrt na tekuće probleme vezane uz faunu bogomoljki Hrvatske, kao i vrlo kratki povijesni pregled istraživanja ovog reda kukaca u Hrvatskoj.

Ključne riječi: odgovor, neispravne determinacije, komentari, literatura, Mantodea

Introduction

Historically, we can consider Charpentier's (1825) and Fieber's (1853) records of *Mantis religiosa* (Linné, 1758) for the entirety of Southern Europe as the first records of a mantid species for Croatia. More precise records of mantids were given for the first time by Frauenfeld (1861) – *Ameles spallanzania* (Rossi, 1792) (as *Mantis*

Spallanzaniana) for the whole of Dalmatia and *Mantis religiosa* for Rijeka (= Fiume). Bučić (1885) added *Ameles decolor* (Charpentier, 1825) and *Empusa fasciata* (Brullé, 1832) (originally recorded as *Empusa egena* Charp.). Novak (1888) additionally confirmed previous findings. From 1886 (Bučić) to 1967 (Us) only the four above mentioned species (*Mantis religiosa, Ameles decolor, Ameles spallanzania* and *Empusa fasciata*) were known from Croatia. These species were confirmed by some later authors as well (e.g. Pungur, 1899; Padewieth, 1900; Redtenbacher, 1900; Adamović, 1964). Us (1967) reported two more species for Croatia, namely *Empusa pennata* (Thunberg, 1815) from Istria and *Geomantis larvoides* Pantel, 1896 from the Dubrovnik area. Thereafter, the Mantodea fauna of Croatia counted six species in all. Agabiti et al. (2010) reported *Ameles heldreichi* Brunner von Wattenwyl, 1882 from the southernmost part of the country (Kučište, Pelješac peninsula). Kment (2012) confirmed the suspected presence of *Iris oratoria* (Linné, 1758) in Croatia (on Brač and Korčula islands).

The last contribution to Croatian mantid fauna was published by Kranjčev (2013) and in this paper an additional species was reported for Croatia – *Bolivaria brachyptera* (Pallas, 1773). Apart from this finding, Kranjčev (2013) also confirmed the presence of *Ameles heldreichi, Empusa pennata* and *Geomantis larvoides* and presented new localities for those species. In the paper he presents the results of the research conducted from 2005 to 2012, with 36 localities visited altogether, and reports the presence of 9 Mantodea species in Croatia, one of which (*Bolivaria brachyptera,* Miomantinae) is reported for the first time for the national fauna. Furthermore, Kranjčev (2013) gives some comments on general morphology and oothecae morphology of the species reported, adding also information about their life history. He supports his findings with 12 photographs (8 showing general habiti of the species and 4 portraying their oothecae).

In the paper by Kranjčev (2013) we observed some data incongruities that included: 1) mantid misidentifications, some of them representing allegedly very important findings, 2) complete omission of a couple of faunistically essential publications dealing with Croatian mantids, and 3) some implausible statements regarding the life history and morphology of certain species that could create confusion in further studies. The aim of this paper is to give an informative review of Croatian species of mantids, with the purpose of verifying and updating the knowledge of those species in Croatia and as a support for further studies of its fauna.

Materials and Methods

In order to write this reply we consulted all the relevant literature on Croatian Mantodea available in electronic or printed form, obtained via the internet or through correspondence with other experts in this area. Material deposited in the Fran Rebrina and Josip Skejo private collections in Zagreb, collected during field trips in more than 30 different localities in Croatia from the year 2012 to 2014, was also studied and considered important in supporting our conclusions. All available

published information, combined with some hitherto unpublished data obtained by the authors of this paper, was thoroughly compared with results presented in Kranjčev (2013) and the paper was thus verified in accordance with the aims stated above. For updated nomenclature we consulted Mantodea Species File Online (Otte et al., 2014).

Results and Discussion

First of all, we must note that certain photos in Kranjčev's (2013) paper (Fig. 3 – Fig. 11) do not match their descriptions, perhaps as a result of a technical mistake. To make this part of the paper more intuitive, we decided to divide it into separate paragraphs, each one containing a brief discussion of misidentifications, overlooked literature and implausible statements for a given species presented in Kranjčev (2013). The paragraphs follow the order in which they appear in the afore-mentioned paper.

Mantis religiosa (Linné, 1758)

Kranjčev (2013) stated that this species is found in »warm and dry habitats« (»Na toplim i suhim staništima…«). It is, however, important to add that, since *M. religiosa* is a eurivalent species, it is found in a wide spectrum of habitats in Croatia (e.g. salty swamps on Cres island, exceptionally dry semi-desert of Kloštarski peski, wet meadows by the Krka river, cold montane grassland near Zavižan in Northern Velebit NP (Rebrina & Skejo, unpublished data), montane grasslands with sparse vegetation on Mt Dinara (Rebrina et al., in press)). The species shows great variability in coloration, appearing in various shades of green and brown (including golden-brown), as well as grey, yellow and sometimes even ochre, with a great number of intermediate forms, not exclusively »in green and grey-brown« (»…u zelenoj i sivosmeđoj boji…«) as stated in Kranjčev (2013).

Ameles spallanzania (Rossi, 1792)

First of all, Kranjčev (2013) overlooked the first literature data of this species in Croatia (Frauenfeld, 1861), as well as other early findings (e.g. Bučić, 1886, Novak, 1888), when he stated that »this species was recorded a long time ago on Palagruža island by Galvagni (1902) as (syn.) *Ameles objecta* (Cyrillo, 1787)« [sic] (»Zabilježena je već davno na otoku Palagruži (Galvagni, 1902) pod imenom (syn.) *Ameles objecta* (Cyrillo, 1787)« [sic]). Also, Kranjčev (2013) obviously overlooked quite a number of previously published localities for this species (Bučić, 1886, Novak, 1888, Adamović, 1964, Us, 1967, Kment, 2012) when he stated that »it is found individually and rather rarely« (»Nalazi se pojedinačno i relativno rijetko…«). In the paper, *A. spallanzania* is reported from seven localities, all of them in the southeastern part of Croatia (Mljet, Vis, Vela Palagruža islands, Dubrovnik, Konavle and Makarska), except for a single finding from the central southern part of the country (Ravni kotari region). However, it can be added here that we recorded this species all along

the Croatian coast from Istria to the southernmost part of the country and on a large number of islands (including northern, central and southern Adriatic islands) (Rebrina & Skejo, unpublished data).

Ameles decolor (Charpentier, 1825)

Dalmatian coast marks the eastern border of the range of *A. decolor* (Agabiti et al., 2010) and Kranjčev's (2013) findings add some new localities for this species in Croatia. In a considerable number of localities we also confirmed its syntopic presence with *A. spallanzania* (Rebrina & Skejo, unpublished data).

Ameles heldreichi Brunner von Wattenwyl, 1882

The presence of this species in Croatia was confirmed for the first time in 2010 (Agabiti et al.), the only known locality being Kučište on the Pelješac peninsula. Kranjčev (2013) reported the species from five new localities (Mljet island, Starigrad-Paklenica, Dubrovnik-Žarkovica, Dubrovnik-G.Brgat and Visočani). At two of them Kranjčev (2013) recorded *A. heldreichi* syntopically with *A. decolor*. The coast of the Western Balkans is the eastern border of the distribution of *A. decolor* and the western border of the distribution of *A. heldreichi* (Agabiti et al., 2010). These two species are a part of monophyletic *A. decolor* aggregate (Agabiti et al., 2010). It is suspected that in the Croatian part of the Adriatic coast these two species hybridize (Skejo, Rebrina, Battiston & Schütte, unpublished data). Although *A. heldreichi* shares a lot of external and internal (phallic) morphological characters with *A. decolor* and *A. dumonti* Chopard, 1943 (Harz & Kaltenbach, 1976; Battiston & Fontana, 2005; Agabiti et al, 2010; Battiston et al., 2010), its protonymphs nevertheless emerge from the ootheca in a way more similar to *A. spallanzania* than to *A. decolor*, as stated in Kranjčev (2013): »The protonymphs of *A. heldreichi* emerge from an ootheca individually along its ridge.« (»Protonimfe izlaze pojedinačno uzduž grebena.«). However, this fact alone is sufficient only for distinguishing the ootheca of *A. heldreichi* from that of *A. decolor* (where only one opening on the dorsal prominence remains after the protonymphs emerge; Battiston et al., 2010), but not from that of *A. spallanzania* as well (where the entire dorsal ridge remains open after the hatching, as in *A. heldreichi*; Battiston et al., 2010). Taking into consideration the shape of *Ameles* oothecae in general, which is highly variable and not species-specific, there is no way to distinguish two species with the same hatching pattern in terms of ootheca morphology (Battiston, unpublished data). We consider Kranjčev's (2013) findings of *A. heldreichi* doubtful and as records they should be taken with caution, since the author did not provide any photo or drawing of male genitalia that would confirm the presence of *A. heldreichi* and not *A. decolor* or a hybrid between those two species. Namely, male genitalia are the sole unquestionable distinguishing character between *A. heldreichi* and *A. decolor*, since other morphological characters are highly variable (Agabiti et al., 2010; Battiston et al., 2010). There are still many open questions regarding this mantid group and further conclusions about the species in the contact zone are to be derived from future exhaustive surveys on this group along the Croatian coast.

Geomantis larvoides Pantel, 1896

First of all, there is no photo in Kranjčev's (2013) paper that represents *Geomantis larvoides*. The only photo of an apterous mantid (Fig. 9) with a description »*Bolivaria brachyptera* (Pallas, 1773)« most likely portrays a nymph of *Ameles spallanzania.* Namely, the pronotum in *A. spallanzania* is rather short and wide (length: width ratio < 2), while in *G. larvoides* it is considerably more slender (length: width ratio > 2). Also, in *G. larvoides* the eyes are round and slightly prominent, while in *A. spallanzania* they are conical and very prominent (Harz & Kaltenbach, 1976; Battiston & Fontana, 2005; Agabiti et al., 2010; Battiston et al., 20120), as visible on Kranjčev's photo (Fig. 9). Therefore, we consider there is a little possibility that Kranjčev (2013) was indeed dealing with *G. larvoides* in his survey. Moreover, in his list of localities and findings, Kranjčev (2013) presented only a single new locality for the species (Starigrad-Paklenica-Marasovići), while in the photo description for *G. larvoides* another locality is mentioned (Hvar island-Velika Stiniva). The presence of this species at both localities is highly doubtful, since Kranjčev (2013) did not provide any plausible evidence for it.

Bolivaria brachyptera (Pallas, 1773)

This species is present in Europe only in the southernmost part of the Balkan peninsula and near the western coast of the Black Sea (Harz & Kaltenbach, 1976; Battiston et al., 2010). The species has not been found in Macedonia (Chobanov & Mihajlova, 2010), Albania (Jaskula, 2014) or Montenegro (Us, 1967). The photo in

Figure 1. *Bolivaria brachyptera* male, Georgia, photo: Paolo Fontana. In: Battiston et al., 2010.

Kranjčev's (2013) paper which is supposed to represent a female of *Bolivaria brachyptera* seems to portray a nymph of *Ameles spallanzania* instead (see comments under *G. larvoides*) and the next photo, to which the afore mentioned description (»*Bolivaria brachyptera* (Pallas, 1773)«) is presumably related, represents a female of *Ameles* sp. from the *A. decolor* aggregate (*A. decolor* or *A. heldreichi*), but certainly not *B. brachyptera*. Firstly, alae in *B. brachyptera* are longer than tegmina, which is not the case in the picture (Fig. 10). Moreover, the fore tibiae of the photographed animal are smooth, while in *B. brachyptera* they should bear spines along the ventral margin. Also, the eyes are round and very slightly prominent in *B. brachyptera*, while they are some what conical and strongly prominent in the *Ameles* sp. in the photo (compare with Figure 1, above; for morphological characters of *B. brachyptera* we also consulted Harz & Kaltenbach, 1976 and Battiston et al., 2010). Thus, it can be concluded that, in spite of this research and taking into consideration all the previous Mantodea investigations in Croatia, it is highly unlikely that *B. brachyptera* is present in the country.

Empusa fasciata Brullé, 1832

The species is common in the coastal region of Croatia from Istria to the southernmost part of the country, and deep inland too, as shown by some of our records (Rebrina & Skejo, unpublished), which is confirmed by Kranjčev's (2013) statement that »in Croatia it is widespread in the Mediterranean and Sub-Mediterranean area from Istria to Konavle« (»U Hrvatskoj je raširena u sredozemnom i subsredozemnom području od Istre do Konavala…«) and that »it is found at furthest inland (20 to 50 km from the sea)« (»Nalazi se najdalje u kopnenom dijelu Hrvatske (20 do 50 km od mora)…«). The author stated that »the males of the species are winged, while females are wingless« (»Mužjaci su krilati, a ženke su bez krila.«). This information is undoubtedly incorrect, since both sexes in *Empusa* species are macropterous (long-winged), the most notable morphological difference between the sexes being the different antennae – pectinate in males and filiform in females (Harz & Kaltenbach, 1976). Kranjčev (2013) also stated: »The biology of this species has been recently investigated (Gomboc, 2000), but the author did not provide a clear photograph of its ootheca.« (»U novije vrijeme istražena je biologija ove vrste (Gomboc, 2000), ali autor nije pružio jasnu fotografiju njezine ooteke.«). We do not agree with this statement, since its biology was investigated much earlier (Kaltenbach, 1963) and since Gomboc (2000) provided a reasonably good photo (Fig. 2 = Abb. 2) of this species' ootheca. Moreover, a clear photo (Fig. 23C) and the description of ootheca of *E. fasciata* are provided in Battiston et al. (2010).

Empusa pennata (Thunberg, 1815)

Kranjčev (2013) states that »this is a rare and local Mediterranean species in Croatia« (»Rijetka je i lokalna sredozemna vrsta u Hrvatskoj…«), while adding that »it can be clearly distinguished by a unique ootheca« (»Sigurno se razlikuje po jedinstvenoj ooteci.«). However, there are no literature data supporting this statement and neither is any information cited by the author. Moreover, the author reported

a finding of *E. pennata* from the natural history department of Zadar National Museum (locality: Starigrad-Paklenica) based on a juvenile specimen. However, it is difficult to distinguish *E. pennata* from *E. faciata* in the nymphal stage, mainly because the mid coxal process (which is the main diagnostic character; Harz & Kaltenbach, 1976; Battiston et al., 2010) is not fully developed yet. Us' (1967) records of *E. pennata* from Istria were supposedly also based on a misidentification. According to our research in the past 3 years (which included Istria as well), *E. fasciata* is the only *Empusa* species present in Croatia (Rebrina & Skejo, unpublished data), while *E. pennata* is a Western Mediterranean species with the easternmost point of its distribution in Northern Italy (Battiston et al., 2010). Therefore, Kranjčev's (2013) records of this species are highly doubtful and most likely based on misidentification of *E. fasciata*. Thus, we omit this species from the checklist of Croatian Mantodea (Tab. 1.), until strong evidence is given for the presence of this species in Croatia.

Iris oratoria (Linné, 1758)

Kranjčev (2013) stated that »to the present day there are no records of this species in Croatia« (»Do danas u Hrvatskoj nema nalaza…«) which is incorrect, because the author overlooked a very important paper (Kment, 2013) which offered the first exact records of this species in Croatia (Brač and Korčula island). Also, in his list of Croatian Mantodea, Kranjčev (2013) placed this species in the family Mantidae, while it is presently regarded as belonging to a separate family – Tarachodidae (Otte et al., 2014).

Conclusions

As a sum of the above stated facts, combining all the available literature data with the authors' own records and observations, we present here an annotated checklist of Croatian Mantodea, with a suggestion of a Croatian vernacular name for each species. From this list we omitted *Empusa pennata* (Empusidae) and *Bolivaria brachyptera* (Mantidae). The species are sorted in a systematic order according to Otte et al. (2014) (Tab. 1).

Tab. 1. An annotated checklist of Croatian Mantodea with vernacular names proposed.

Family	Subfamily	Genus and species	Vernacular name
Empusidae	Empusinae	*Empusa fasciata*	(istočna) krunasta bogomoljka
Mantidae	Mantinae	*Mantis religiosa*	obična bogomoljka
	Amelinae	*Ameles decolor*	zapadna patuljasta bogomoljka
		Ameles heldreichi	istočna patuljasta bogomoljka
		Ameles spallanzania	zdepasta patuljasta bogomoljka
	Miomantinae	*Geomantis larvoides*	beskrilna zemna bogomoljka
Tarachodidae	Tarachodinae	*Iris oratoria*	dugina bogomoljka

Finally, we consider it rather important to conclude this short overview by suggesting a list of perspectives for future studies and problems still to be solved, in order to promote further scientific research on the Mantodea fauna and taxonomy in Croatia:

Find more localities for *Iris oratoria* and *Geomantis larvoides;*

Make a comprehensive molecular and morphological study of Croatian *Ameles*, with the goal of finding some cryptic taxa, search for evidence for the hybridization of *A. heldreichi* and *A. decolor*, and define the northernmost border of the distribution of *A. heldreichi* in this part of Europe.

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