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Research article

The invasion continues: *Hierodula tenuidentata* (Mantodea), *Leptoglossus occidentalis* (Hemiptera) and *Pelopidas thrax* (Lepidoptera) already on the island of Alonnisos

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Abstract: During a brief visit of Alonnisos Island in 2022 some insect species (mainly butterflies) were observed and photographed. Three of them are new for the island's fauna – the giant Asian mantis *Hierodula tenuidentata* Saussure, 1869, western conifer seed bug *Leptoglossus occidentalis* Heidemann, 1910, millet skipper *Pelopidas thrax* (Hübner, [1821]). Their establishment on the island is not a surprise, but it well illustrates the expansion of these species in the Mediterranean area. A list of the observed butterflies is also provided.

Keywords: Alonnisos, Bulgaria, butterflies, Greece, insects, invasive alien species, new records

Introduction

Alonnisos is a small (about 64 km^2) Greek Aegean island, and after Skiathos and Skopelos is the third member of the Northern Sporades archipelago. For the protection of unique biodiversity and habitats the National Marine Park of Alonnisos and Northern Sporades was established, including Alonnisos and six smaller islands. Now it is the largest marine protected area in Europe. Alonnisos is an area of great interest not only for the conservation of the marine species, but also with great ecological and biological value for the terrestrial fauna and flora. The paper presents the result of a brief entomological survey carried out in the late summer 2022 at Alonnisos Island. It includes data for three invasive species of different insect groups which are new for the islands fauna together with a list of 17 species of butterflies recorded. The aliens could be a problem for the local biodiversity.

Material and methods

Specimens were observed and photographed in the autumn of year 2022 during family holidays of the authors. The list of localities contains the relevant toponyms, a short description of the habitat, altitude, coordinates and dates of the observations. Altogether, 16 localities were visited on Alonnisos and in the list of species a number of each locality is included [in brackets], as indicated on the map (Fig. 1). Most of the insects were photographed in the nature or netted for identification and released. Several specimens were observed dead on the roads. The photos were taken by Olympus Stylus TG-4 and Panasonic Lumix FZ82 cameras. A specimen of the invasive alien species *Leptoglossus occidentalis* Heidemann, 1910 is deposited in the entomological collection of the National Museum of Natural History, Bulgarian Academy of Sciences, Sofia (NMNHS).

Results and discussion

Mantodea: Mantidae

Hierodula tenuidentata Saussure, 1869

Greece, Alonnisos Island: [07] near Megalos Murtias beach, 39.1442004°N, 23.8468078°E, 8–10.ix.2022,

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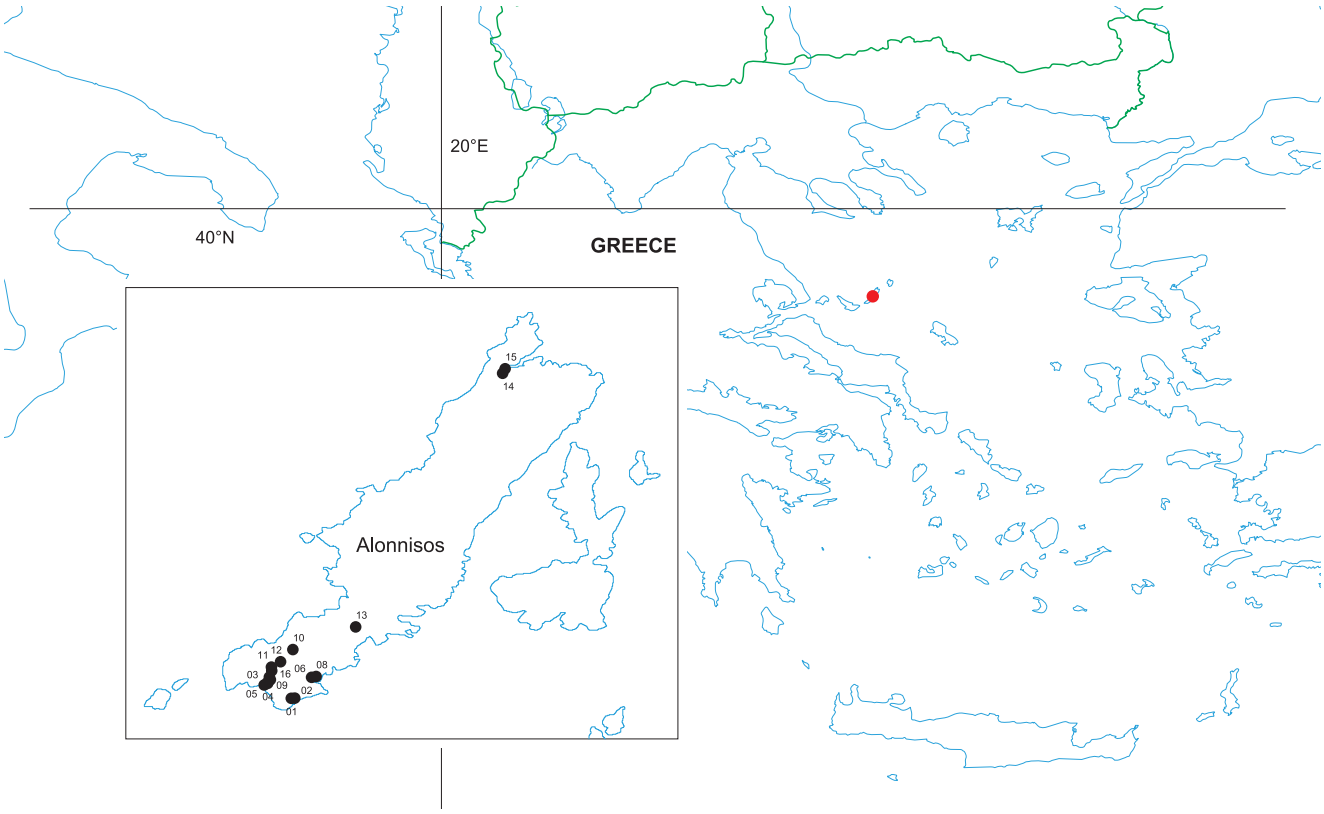

Fig. 1. Map of the localities on Alonnisos, generated with QGIS 3.8 Zanzibar, Mac OS X version.

Fig. 2. [01] SW of Patitiri, 39.1354712°N, 23.8558149°E. EUNIS habitat type S51 – Mediterranean maquis and arborescent matorral. Habitat of *Leptoglossus occidentalis, Colias croceus, Chilades trochylus, Leptotes pirithous, Vanessa cardui*.

Fig. 3. [05] Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E. EUNIS habitat type S51 – Mediterranean maquis and arborescent matorral. Habitat of *Carcharodus alceae, Pieris rapae, Chilades trochylus, Leptotes pirithous, Cacyreus marshalli, Maniola jurtina, Limenitis reducta*.

Fig. 4. [15] Gerakas Beach, 39.2709290°N, 23.9437200°E. EUNIS habitat type N221 – Gravel beach communities of the Mediterranean region and S51 – Mediterranean maquis and arborescent matorral. Habitat of *Hipparchia senthes*.

Fig. 5. Giant Asian mantis *Hierodula tenuidentata* Saussure, 1869.

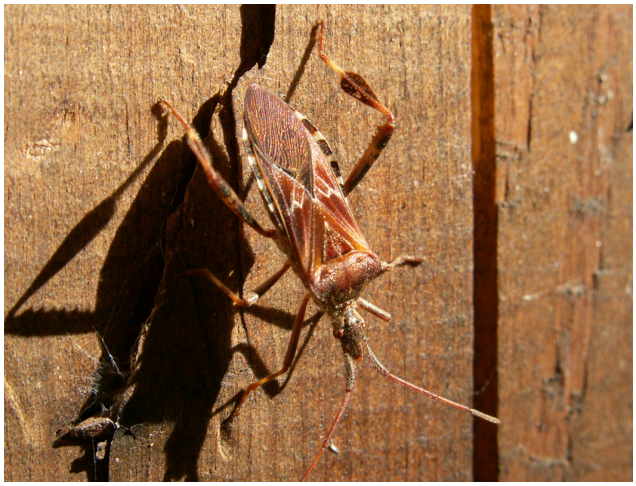

Fig. 6. Western conifer seed bug *Leptoglossus occidentalis* Heidemann, 1910.

many specimens of both sexes observed (Fig. 5). Other records: Bulgaria, Kresna Gorge, Kresna Inn, 233 m, 41.782617°N, 23.155683°E, 6 larvae, 8.vii.2022; Kresna Gorge, near Oshtava crossroad, 215 m, 41.764383°N, 23.152433°E, 3 oothecae, 8.vii.2022.

Following the opinion of Battiston et al (2018) here we accept that *Hierodula tenuidentata* Saussure, 1869 and *H. transcaucasica* Brunner von Wattenwyl, 1878 are probably synonyms and we are using the older valid name. In one decade, since the first record (2008, Crete: Schwarz & Ehrmann, 2018), the species spread throughout almost all the Balkan countries, where now became quite common especially under Mediterranean conditions (Cianferoni et al., 2018; Pintilioaie et al., 2021; van der Heyden, 2021; Vujic et al., 2021; Kulijer et al., 2022; Martinović et al., 2022). Recorded from the nearby Skopelos Island (Cianferoni et al., 2018; Schwarz & Ehrmann, 2018). The native range of *Hierodula tenuidentata* include China, Nepal, North India, Central Asia (Afghanistan, Pakistan, Iran, Tajikistan, Turkmenistan, Kazakhstan) and Caucasus (Armenia, Georgia) from where it has become invasive by spreading rapidly to the Black Sea Region and Eastern Mediterranean.

Hemiptera: Heteroptera: Coreidae

Leptoglossus occidentalis Heidemann, 1910

Material examined: 1 ♀ (Fig. 6), Greece, Alonnisos Island: [01] (Fig. 2) SW of Patitiri, 35 m a.s.l., 39.1354712°N, 23.8558149°E, 8.ix.2022, beating from *Pinus halepensis,* N. Simov leg.

Western conifer seed bug *Leptoglossus occidentalis* is an invasive alien species of North American origin. The species was first recorded in Europe in 1999 in Vicenza, Italy (Bernardinelli & Zandigiacomo, 2001). In one decade the species spread throughout almost all of Europe and invaded practically almost all Balkan countries (Gogala, 2003; Tescari 2004; Rabitsch 2008, 2010; Hradil, 2008; Kment & Baňař, 2008; Protıć, 2009; Simov, 2008, 2012; Fent & Kment, 2011; Petrakis, 2011; Werner 2011, Winkelmann & Bahr 2011, Kulijer, 2016; Kulijer & Ibrahimi, 2017; van der Heyden, 2017, 2018, 2019). The species was first recorded in continental part of Greece in 2008 (Petrakis 2011; Winkelmann & Bahr, 2011) and in the next ten years reached Greek islands of Crete and Corfu (van der Heyden, 2017, 2018).

Mediterranean forests, woodlands and scrubs, and temperate coniferous forests represent one of the typical and the most suitable habitats of *Leptoglossus occidentalis* in the invaded areas (Zhu et al., 2014). Therefore it is not surprising that *L. occidentalis* has been found on the Aegean island of Alonnisos. The closest published Greek localities are in Evia, about 55 kilometres on a bee line from Alonnisos (Petrakis, 2011). The strong flight abilities of western conifer seed bugs (Rabitsch, 2008, 2010; Simov et al. 2012) could be the main reasons for its easy spread in Alonnisos and probably in the Northern Sporades at whole. Other pathways of introduction and dispersal as human activities: ornamental trade and movement as

Fig. 7. Millet skipper *Pelopidas thrax,* ♂.

"stowaways" in transport vehicles and goods seems a bit off.

Lepidoptera: Hesperiidae

Pelopidas thrax (Hübner, [1821]) (Fig. 7)

Greece, Alonnisos Island: [16] between Paralia Megalos Mourtias to Alonnisos, 39.1429911°N, 23.8473118°E, 10.ix.2022, 1 ♂.

This one is the first record for the species from the Sporades Islands. *Pelopidas thrax* ranges from the eastern Mediterranean to Africa and across subtropical and tropical Asia to Indonesia. In Greece it is previously known from the eastern part of the Aegean Sea – from Dodecanese and some North Aegean Islands (Cuvelier, 2009, Cuvelier & Mølgaard, 2012, Langourov et al, 2021), recently discovered also in the continental part – Nestos Delta, Kavala, Sithonia Peninsula and Mount Chortiatis, near Thessaloniki (Kefaleli & Mamais, 2022). The species is also widespread along the Turkish coast (Hesselbarth et al., 1995; personal observations). This species is multivoltine – usually from April to November, but all year round in some places, or in the tropics.

Altogether 46 species of butterflies had been known from the island, but without precise localities – refer to the map capturing the distribution of this particular species in Greece by Pamperis (2021, as accessed of 10 December 2022).

Other butterfly species recorded during our visit in Alonnisos Island are as follows:

Hesperiidae

Carcharodus alceae (Esper, [1780]) – Greece, Alonnisos Island, [05] (Fig. 3) Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E, 6.ix.2022.

Papilionidae

Papilio machaon Linnaeus, 1758 – Greece, Alonnisos Island: [12] E Alonnisos, 39.1505019°N, 23.8514126°E, 8.ix.2022.

Pieridae

Pieris rapae (Linnaeus, 1758) – Greece, Alonnisos Island: [04] between Alonnisos and Megalos Mourtias Beach, 39.1416080°N, 23.8461150°E, 5.ix.2022; [05] (Fig. 3) Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E, 6.ix.2022.

Colias croceus (Geoffroy in Fourcroy, 1785) – Greece, Alonnisos Island: [01] (Fig. 2) SW of Patitiri, 39.1354712°N, 23.8558149°E, 8.ix.2022; [10] NE Alonnisos, 39.15553°N, 23.85649°E, 8.ix.2022.

Gonepteryx cleopatra (Linnaeus, 1767) – Greece, Alonnisos Island: [02] Paralia Megalos Mourtias, 39.1355469°N, 23.8572476°E, 8.ix.2022, 1 ♂.

Lycaenidae

Chilades trochylus (Freyer, [1845]) – Greece, Alonnisos Island: [01] (Fig. 2) SW of Patitiri, 39.1354712°N, 23.8558149°E, 8.ix.2022, 1 specimen; [05] (Fig. 3) Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E, 3.ix.2022, 4 specimens.

Leptotes pirithous (Linnaeus, 1767) – Greece, Alonnisos Island: [01] (Fig. 2) SW of Patitiri, 39.1354712°N, 23.8558149°E, 7.ix.2022, 8.ix.2022; [05] (Fig. 3) Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E, 3.ix.2022;[07] between Paralia Megalos Mourtias to Alonnisos 39.1442004°N, 23.8468078°E, 10.ix.2022.

Cacyreus marshalli Butler, 1898 – Greece, Alonnisos Island: [04] between Alonnisos and Megalos

Fig. 8. Two-tailed pasha *Charaxes jasius,* ♂.

Mourtias Beach, 39.1416080°N, 23.8461150°E, 3.ix.2022, 2 specimens; [05] (Fig. 3) Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E, 5.ix.2022, 2 specimens; [06] Patitiri, 39.1440929°N, 23.8641584°E, 9.ix.2022, 3 specimens. The species was introduced accidentally from South Africa to the European Mediterranean (initially in Majorca on the Balaeric Islands) in 1988, and in 1993 reached the European mainland, where it spreads further as a pest of cultivated Pelargonium. During the past 25 years, the butterfly has colonised much of North Africa and southern Europe and now is widespread in the Mediterranean region. The species is multivoltine – on wing from March/April to November.

Polyommatus icarus (Rottemburg, 1775) – Greece, Alonnisos Island: [09] between Paralia Megalos Mourtias to Alonnisos, 39.1468000°N, 23.8477851°E, 10.ix.2022; [13] N of Chrisi Milia, 39.1648119°N, 23.8822849°E, 9.ix.2022.

Nymphalidae

Charaxes jasius (Linnaeus, 1767) (Fig. 8) – Greece, Alonnisos Island: [03] Paralia Megalos Mourtias, 39.1409409°N, 23.8446687°E, 3.ix.2022, 3 specimens; [08] Patitiri, 39.1444411°N, 23.8660352°E, 3.ix.2022, 1 specimen.

Maniola jurtina (Linnaeus, 1758) – Greece, Alonnisos Island: [05] (Fig. 3) Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E, 5.ix.2022, 7.ix.2022, 10.ix.2022; [11] Alonnisos, 39.1483062°N, 23.8476498°E, 10.ix.2022.

Hipparchia senthes (Fruhstorfer, 1908) – Greece, Alonnisos Island: [10] NE Alonnisos, 39.15553°N, 23.85649°E, 8.ix.2022, 1 specimen; [15] (Fig. 4) Gerakas Beach, 39.2709290°N, 23.9437200°E, 8.ix.2022, 2 specimens.

Hipparchia syriaca (Staudinger, 1871) – Greece, Alonnisos Island: [13] N Chrisi Milia, 39.1648119°N, 23.8822849°E, 9.ix.2022, 1 specimen.

Limenitis reducta Staudinger, 1901 – Greece, Alonnisos Island: [05] (Fig. 3) Paralia Megalos Mourtias, 39.1420522°N, 23.8460738°E, 3.ix.2022, 1 specimen, 10.ix.2022, 1 specimen.

Vanessa atalanta (Linnaeus, 1758) – Greece, Alonnisos Island: [06] Patitiri, 39.1440929°N, 23.8641584°E, 9.ix.2022.

Vanessa cardui (Linnaeus, 1758) – Greece, Alonnisos Island: [01] (Fig. 2) SW of Patitiri, 39.1354712°N, 23.8558149°E, 8.ix.2022; [07] between Paralia Megalos Mourtias to Alonnisos, 39.1442004°N, 23.8468078°E, 10.ix.2022; [09] between Paralia Megalos Mourtias to Alonnisos, 39.1468000°N, 23.8477851°E, 10.ix.2022; [14] Gerakas Beach, 39.2690599°N, 23.9426899°E, 8.ix.2022.

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