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An exceptional outbreak of *Macroscytus brunneus* (Fabricius, 1803) (Hemiptera: Heteroptera: Cydnidae) on Linosa island (Pelagian Islands, Sicily)

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Abstract. An exceptional outbreak of the burrowing bug *Macroscytus brunneus* occurred in summer 2017 on Linosa island (Pelagian Islands, Sicily). Huge numbers of specimens, attracted to the lights of the small village, interfered heavily with human activities for almost three months. The few precedent cases reported in literature are reviewed.

Key words: Hemiptera, Heteroptera, Cydnidae, *Macroscytus brunneus*, outbreak, Linosa, Pelagian Islands, Sicily, Italy.

Introduction

The family Cydnidae (Heteroptera) includes more than 750 species distributed worldwide, known mainly from warm and tropical regions (Lis et al. 2000). The family was recently demonstrated to be a polyphyletic grouping (Lis et al. 2017).

Cydnids, or burrowing bugs, are terrestrial insects that live, as suggested by their common name, in the ground, where they move easily thanks to their fossorial anatomy. They feed mainly on roots or, less frequently, as seed-feeders on host plants belonging to several families (Grazia et al. 2015). Some species are reported as harmful to cultivated plants, even if in many cases their impact on attacked plants can be underestimate. In fact, due to the life habits of bugs, their presence may go undetected and the symptoms on plants, that consist in yellowing and drying of leaves, look like nutrient deficiencies (Lis et al. 2000; Grazia et al. 2015). Adults come to lights, sometimes in large numbers.

Macroscytus brunneus (Fabricius, 1803) (Fig. 1) is an oval shaped cydnid, 6.0-9.0 mm long and 3.2-4.8 mm wide, ventrally more convex than dorsally, dorsally shiny, pale to dark brown, hemelytra and posterior margin of pronotum often paler than rest of dorsum, pronotum and scutellum with shallow and sparse puncturation, hemelytra more deeply and thickly punctured, margins of body with long hair-like setae.

The species is widely distributed in a large warm area of the Old World including Central Asia, Arabian Peninsula, Mediterranean Basin and the Afrotropical Region (Lis 2000). In Italy the cydnid is particularly common in the peninsular and insular regions including Sicily and many of the small islets surrounding it, namely Lampedusa, Linosa, Pantelleria, Marettimo, Favignana, Ustica, Filicudi, Salina, Lipari, Vulcano, Stromboli (Servadei 1967; Tamanini 1981; Carapezza 1977, 1981, 1995).

Fig. 1. *Macroscytus brunneus*, adult female, Linosa island, A. Carapezza coll. (photo A. Carapezza).

With regard to Linosa, its occurrence was firstly reported in 1982 (Carapezza 1995).

In general, the interest for *M. brunneus* in literature has been until now limited to morphological, faunistic and distribution studies and very little is known about its biology. Among the few relevant available data in literature, Stichel (1961) reports as the main host plant *Glaucium corniculatum* L. (Rudolph) (Blackspot horny poppy or Red horned poppy). This Mediterranean plant is widely present in cultivated areas of Linosa (La Mantia et al. 2011).

Observations

An exceptional outbreak of *Macroscytus brunneus* occurred during summer 2017 at Linosa (Pelagian Islands, Sicily).

Linosa is a small island of volcanic origin located at a distance of 163 km S of Sicily and 165 km E of Tunisia. It is circular shaped (its diameter being 3.5 Km), formed by a series of craters of which Monte Vulcano, 195 metres high, is the most relevant.

The original plant association (*Periploco-Euphorbietum dendroidis*) is of maquis kind, but mainly consisting of degraded garrigue and steppe formations. Its small size, modest altitude and the presence of a poor maquis, frequently monospecific (dominated by *Pistacia lentiscus* L.), contribute to making it unsuitable for many species of both vertebrates and invertebrates. Reafforestation with *Pinus halepensis* Mill., attempted in the last forty years together with the formation of large expanses of prickly pears (*Opuntia ficus-indica* (L.) Mill.) have improved the edaphic conditions of some windswept areas. Fishing, tourism and a poor agriculture are its main economic resources. The island has a resident population of less than 450 people.

From July to September 2017, in the evening, thousands of adults were observed flying around every light in the urban area of the island (see: Supplementary material). The presence of the insects was particularly troublesome for local population and tourists, in houses, restaurants and all public places where light attracted them. In some restaurants, the lights were covered with red paper or cloth in order to reduce their attractiveness towards the insects. In order to mitigate the disturbance, people on the island used to spray the walls where the bugs alighted; the day after, in the morning, hundreds of dead specimens were found at the base of every sprayed wall. Sometimes their number was so high that whole buckets were filled with their bodies (Fig. 2).

For almost three months the bugs appeared every day at dusk and disappeared altogether the morning after; not a single specimen could be seen around in daylight, when they presumably sheltered deep in the ground. The local population reported that a similar outbreak had already occurred in 2013.

Fig. 2. *Macroscytus brunneus* dead during night and found in a terrace on Linosa in August 2017 (tile size is 30 x 30 cm).

The only previous record of the presence of high numbers of *M. brunneus* feeding on pepper (*Capsicum* spp) and carnation plants (*Dianthus* spp) was documented in Izmir, Central Turkey, during the summer months of the years 1987-1988 (Karsavuran 1988).

An interesting precedent, concerning another species of cydnid, *Aethus pseudindicus* Lis, 1993[(1)], presents some points of similarities with the Linosa event. Presumably attracted by the light large numbers of the bug started to invade the houses of a town on Okinoerabu Island (Amami Islands, Japan) at about 8 pm on July 18, 1974. The invasion lasted for four nights and occurred again in August for five nights. The inhabitants were afflicted by the offensive smell emitted by the bugs and suffered from the contamination of food and drink with their stink fluid. The bugs were so intrusive that several of them entered the ears of people; more than one hundred people were seriously injured and had to be treated in hospital. Similar outbreak of cydnid bug and injuries to the ears were recorded simultaneously from the two adjacent islands of Tokunoshima and Yoron (Takai et al. 1975). The ecology of the bug was investigated on Okinoerabu island. As a result, the bug was collected only at the areas flourishing with foxtailgrass, *Setaria viridis* (L.) and fingergrass, *Digitaria sanguinalis* (L.) Scop., but not at other areas. The population density of the adults was as high as 500 per square metre at the suitable habitats (Ikemoto et al. 1976).

[(1)] In the relevant literature published at the time of the outbreak the species was indicated as *Aethus indicus* (Westwood, 1837); Lis (1993) demonstrated that previous records of *A. indicus* had to be referred to three different species, recognizable only by the different male genitalia. Among them *A. pseudindicus* is the only species occurring in Japan (Lis 1993, 1994).

Discussion

Insect population outbreaks and their causes, among them climate, food resources, spatial structure of vegetation, activity of predators and parasitoids, etc., were investigated mainly in forest defoliating species (Dwyer et al. 2004; Haynes et al. 2014; Hughes et al. 2015; Hartl-Meier et al. 2017).

Among climatic factors involved in insect outbreaks, temperature is considered the dominant abiotic factor affecting herbivorous insects (Bale et al. 2002), as it directly influences development, winter or summer survival rate, range and abundance. Moreover, drought seems to have an important role in outbreaks of plant-eating insects, as it heavily influences physiological aspects of the food plants and reduces the control by natural enemies (Mattson & Haack 1987; Hart et al. 2014).

In many species, the causes of outbreaks are often difficult to identify, particularly if their biology is almost unknown and outbreaks occur on isolated islands where entomological and ecological surveys are only occasionally conducted.

In general, the occurrence of cydnid outbreaks is considered unusual. In the Western hemisphere, at Cuba, the cydnid *Scaptocoris divergens* Froeschner, 1960 was observed, during the first hours of the evening, to come in great numbers attracted to the lights of the School of Agriculture; interestingly, when the insect is abundant, it becomes the favourite food of a toad, *Rhinella marina* (Linnaeus, 1758) [=*Bufo marinus*], that does not seem to mind the repugnant smell of the bug (Froeschner 1960). Tissot (1939), quoted by Froeschner (1960), reports that a Neartic species, *Pangaeus (Homaloporus) bilineatus* (Say, 1825) may be injurious to cotton and vegetables when the bugs congregate in great numbers.

In an attempt to forecast the outbreaks of a species of Cydnidae, *Aethus indicus* Westwood, and its incidence on cereals in Northern India, Goel (1980) studied the response to certain climatic parameters involved in controlling the flight activity of the cydnid, studying the correlation between the number of specimens attracted to light traps and different parameters relative such as humidity, rainfall and phases of the moon over a period of three years (August 1973 - July 1976). He concluded that the highest number of individuals trapped occurred with high temperature, high relative humidity, low or absent rainfall and waning moon.

The unusual abundance of *M. brunneus* on Linosa, reported in 2013 and 2017, might be due to climatic conditions in the island of Linosa. In both years, high summer temperatures were recorded, with maximum temperature of 30°C and 36°C in August 2013 and 2017, respectively. With regard to rainfall, in both cases very low rainfall (on the whole less than 100 mm) occurred in the first six months of the two years, whereas in the last 4 months of the previous years rainfall was relatively abundant (higher than 250 mm and 150 mm, respectively) compared with usual autumn rainfall of the island. Further observations could confirm the relationship between climatic conditions and the probability of *M. brunneus* outbreaks.

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Supplementary material: A video showing a huge swarm of *Macroscytus brunneus* flying around a lamp street of Linosa village in August 2017.