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INSECTS FROM THE MIDDLE OF THE ADRIATIC SEA

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The sampling of insects (Insecta) during pitch-dark nights in the middle of the Adriatic Sea during 2009 resulted in the recording of 12 species from the Diptera order and 2 species from the Lepidoptera order. The determined species were classified into the following families: Syrphidae, Drosophilidae, Muscidae, Calliphoridae and Scatophagidae (Diptera), Nymphalidae and Sphingidae (Lepidoptera).

Insecta, Adriatic Sea, Croatia

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Uzorkovanje kukaca (Insecta) tijekom 2009. godine na sredini Jadranskog mora obavljeno je tijekom mrkle noći, čije je rezultat zabilješka 12 vrsta iz reda dvokrilaca (Diptera) i dvije vrste leptira iz reda (Lepidoptera). Utvrđene vrste svrstane su u sljedeće porodice: Syrphidae, Drosophilidae, Muscidae, Calliphoridae i Scatophagidae (Diptera), Nymphalidae i Sphingidae (Lepidoptera).

Kukci, Jadransko more, Hrvatska

Introduction

Insects account for about 80 percent of all the animals on this earth and are thus without doubt the largest class in the animal kingdom (Zahradník, 1990). Practically all parts of the world are inhabited by insects. They are to be found in the tropics, subtropics and the temperate zone and even beyond the Arctic and Antarctic Circles (Zahradník, 1990). Insects are most abundant in the tropics (Zahradník, 1990). However, the ongoing globalization of economies and trade greatly facilitates the spreading non-indigenous species, which cross oceans and colonize formerly remote regions of the world (Olden et al., 2008). Sometimes, a fraction of non-indigenous species become invasive (Jeschke & Strayer, 2006) and represent a serious threat to national economies and human health and can cause the extinction of native species (Vitousek et al. 1996; Mack et al. 2000; Pimentel et al. 2000). Many species of insects are known as vectors of disease agents. In the history of humanity, the most famous example is the mosquito, vector of *Plasmodium* that causes malaria (Mihaljević et al. 1986). Insect migration is a topic of great importance to continental countries as well as islands because it has implications for human health and agrarian economics as well as for conservation (Sparks et al. 2007). Migratory species may be among the most adaptable of species, because they may represent a competitive threat to resident species, which typically have lower mobility and are more specialised in their habitat requirements (Cannon, 1998; Sparks et al. 2007). Most studies on insects deal with their biology and distribution. However, little has been published to date on the consequences of climate change on the migration of insects (Sparks et al. 2007). In this short paper we describe the invasion of insects pursuant to an investigation carried out on the research-ship „Naše more“ (Our sea) in the middle of Adriatic Sea.

Material and Methods

In the oceanographic research ship „Naše more“ (Our sea) from the University of Dubrovnik the „Meduza“ expedition of 25 May 2009 took place about 40 nautical miles from the Croatian coast and about 70 nautical miles from Italy (N 42 13 20 and E 17 32 22). The ship is 31 meters long and 7 meters wide. The ship was exposed to the invasion of many insects during the windless night, whereas

very few insects occurred during the day on the ship. Samples of insects were collected by Adam Benović., DSc. Identification and nomenclature for Diptera followed Zahradník (1990) and Stubbs & Falk (1983), and for Lepidoptera Tolman & Lewington (1997) and Skinner (1986).

Results and Discussion

Altogether 45 specimens were identified, representing 12 species of Diptera classified in 5 families: Syrphidae, Drosophilidae, Muscidae, Calliphoridae and Scatophagidae. The majority of species, 5, belonged to the family Syrphidae, followed by the family Drosophilidae, Muscidae, Calliphoridae with two species each and finally the family Scatophagidae with only one species. The order Lepidoptera is represented by 2 species classified in 2 families: Nymphalidae and Sphingidae. Below, the determined species with the main biological characteristics are listed.

Biology of recorded two-winged flies – Diptera from the Adriatic Sea

Order: Diptera

Family: Syrphidae

Eristalis tenax (Linnaeus, 1758)

Eristalis tenax is a European hoverfly, also known as the drone fly. Slightly resembles a bee Altogether 9 specimens were collected (Table 1). On the wing from April to October, settles on flowers. Larvae live in dung heaps and foul water and are regular inhabitants of country privies (Zahradník, 1990). The larva of *Eristalis tenax* is a rat–tailed maggot. It lives in drainage ditches, pools around manure piles, sewage, and similar places containing water badly polluted with organic matter (Aguilera et al. 1999). The larva likely feeds on the abundant bacteria living in these places. However, the larvae of *E. tenax* are also known to cause Myiasis among humans (Aguilera et al., 1999; Whish-Wilson, 2000). This occurs when the maggots eat faeces, causing discomfort, pain or itching (Aguilera et al., 1999; Whish-Wilson, 2000). The adults are common

visitors to flowers, especially in late summer and autumn, and the adults are beneficial pollinators. Distribution: cosmopolitan (Zahradník, 1990).

Eristalis arbustorum (Linnaeus, 1758)

E. arbustorum are found throughout the world (Europe, Africa, Asia and North America) especially in open terrain. Only one specimen was collected (Table 1). Their preferred food source is nectar and the pollen of plants from the sunflower family (Asteraceae) and the carrot family (umbellifers). Apears from March to October (Stubbs & Falk, 1983).

Episyrphus balteatus (De Geer, 1776)

A very common European species often occurring in large swarms in coastal areas, possibly migrating. Flies in forest rides, in parks and in gardens. During this sampling one specimen was collected (Table 1). Like most other hoverflies it mimics a much more dangerous insect, the solitary wasp, though it is a quite harmless species. They often form dense migratory swarms, which may cause panic among people for the resemblance to wasps (Zahradník, 1990). Distribution: Europe, Asia, north Africa, Australia (Zahradník, 1990).

Syrphus ribesii (Linnaeus, 1758)

Two specimens were collected (Table 1). *S. ribesii* is oligovoltine in England, with either two or three generations per year, and overwinters as a cold-tolerant larva (Sadeghi & Gilbert, 2000a). However, it has also been reported to migrate in large numbers to the Mediterranean to overwinter (http://en.wikipedia.org). It is a common and voracious predator, and can have a significant effect on the natural regulation of aphid populations. Much work has been done on the oviposition preference of the females of this species, with females showing a strong preference to oviposit near sycamore aphids, rose aphids, and pea aphids (Sadeghi & Gilbert, 2000b). Larvae are aphidophagous and polyphagous and feed on a wide range of aphid species. Many parasitoids of *S. ribesii* are also known, including members of the Braconidae, Chalcididae, Proctotrupidae, Encyrtidae and Ichneumonidae. Distribution: Widespread throughout Canada, and from Alaska down to Mexico and Central America. It is also found in much of Europe, as well as Asia (http://www.entomology.ualberta.ca).

Scaeva pyrastri (Linnaeus, 1758)

Five specimens were collected (Table 1). It is a common visitor to flowers in gardens, meadows and waste ground in summer. It does not usually survive the winters

in western Europe (though this may change with global warming) and very often arrives as a migrant and then breeds here every summer, so numbers vary from year to year (http://www.bioimages.org). On the wing from May to October. Settles on flowering Umbelliferae. Found high up in the mountains. Distribution: Europe, northern and western Asia, north Africa, North America (Zahradník, 1990).

Family: Drosophilidae

Drosophila melanogaster Meigen, 1830

The species is commonly known as the common fruit fly or vinegar fly. Only one specimen was collected (Table 1). This species is one of the most commonly used model organisms in biology, including studies in genetics, physiology, microbial pathogenesis and life history evolution because they are easy to take care of, breed quickly, and lay many eggs. Distribution: cosmopolitan (Zahradník, 1990).

Drosophila funebris (Fabricius, 1787)

This is practically a worldwide species. Just one specimen of this species too was collected (Table 1). The adults are found in or around buildings more often than they are in fields or woods (Dyson-Hudson, 1954). However, it cannot be classified exclusively as an indoor species because it has also been found in gardens and orchards, in woodland of various kinds, and in more open habitats. *D. funebris* can be caught at a wider variety of bait than any other species: it finds decaying material just as attractive as fermenting substances. Gordon (1942) records it from elm sap in late summer.

Family: Calliphoridae

Calliphora vomitoria (Linnaeus, 1758)

The blue bottle fly or bottlebee (*Calliphora vomitoria*) is a common blow-fly found in most areas of the world and is the type species for the genus *Calliphora*. Three specimens were collected (Table 1). A female lays her eggs where she feeds, usually in decaying meat, garbage, or faeces. Pale whitish larvae, commonly called maggots, soon hatch from the eggs and immediately begin feeding on the decomposing matter where they were hatched. After a few days of feeding, they are fully grown. At that time they will crawl away to a dry place where they can burrow into soil or similar matter to pupate into tough brown cocoons. After two or three weeks, the adults emerge to mate,

beginning the cycle again. The adults are pollinators of some flowers with a strong odour such as skunk cabbage and goldenrod (http://en.wikipedia.org).

Calliphora vicina Robineau-Desvoidy, 1830

C. vicina are found throughout the world in urban areas and are most abundant where the temperatures are around 13 – 24 C. Only one specimen was collected (Table 1). The species predominates in Europe and the New World, but has found its way into other countries via harbours and airports ((http://en.wikipedia.org).

C. vicina goes through five generations in a year at a threshold temperature of 27 C. A female *C. vicina* can lay up to 300 eggs on fresh carrion or on open wounds (http://en.wikipedia.org). Under favourable conditions, the larvae feed for about three to four days. When the larvae complete their development, they disperse to find an adequate place to pupate. The pupa stage last about 11 days. At 27 C, *C. vicina's* life cycle lasts approximately 18 days (Gomes et al., 2006). In warmer weather the life cycle can last a little less and in cooler temperatures the life cycle takes a little longer (Gomes et al., 2006). Distribution: most zoogeographic regions (Zahradník 1990).

Family: Scatophagidae

Scatophaga stercoraria Linnaeus, 1758

The yellow dung-fly is widespread up to mountain elevations (3,000 meters in the Alps). It flies around excrement, dung heaps and refuse from early spring, hunting small insects found there (Zahradník, 1990). During this sampling only one specimen was collected (Table 1). During the mating season both sexes of *Scatophaga* are common around fresh cow droppings or pats. Females use the pats as oviposition sites, and males move to these sites to capture mates (Borgia, 1981). Distribution: the Palearctic and Nearctic (Zahradník, 1990).

Family: Muscidae

Musca autumnalis De Geer, 1776

M. autumnalis, the face fly or autumn house fly, is a pest of cattle and horses. Seven specimens were collected (Table 1). Adult flies will emerge from winter hibernation around March to early April. In the daytime they feed on manure juices and plant sugars. On cattle and horses they feed on secretions of the facial orifices, around the eyes, mouth and nostrils. The adult flies will also feed on host blood through wounds such as horse-fly bites. A larger proportion of face flies on the host will be females, as they have a higher need for the protein provided by animal hosts. Night time both sexes will rest on

vegetation. Females deposit eggs on fresh cow manure, and these hatch within hours post deposition. The yellowish white maggots feed on the microbial flora and fauna of the manure and pass though three larval stages, growing to about 12 mm long. Then develop into pupae, emerging as adults approximately 10 to 20 days after egg deposit, dependent on temperature. *M. autumnalis* is considered a pest species, as it transmits the eyeworm *Thelazia rhodesi* to cattle and horses and pinkeye (infectious bovine keratoconjunctivitis) in cattle (Gregor et al., 2002; Pont et al., 2005). The *M. autumnalis* is similar to the closely related house fly *Musca domestica* L. Distribution: *M. autumnalis* is widespread throughout most of Europe, central Asia, north India, Pakistan, China and some parts of north Africa (http://en.wikipedia.org).

Stomoxys calcitrans (Linnaeus, 1758)

Several generations occur in a year; in the south one follows immediately after another. This species was the most abundant species during the sampling (Table 1). Occurs primarily in the country, less common in cities. Feeds on the blood of various mammals, including man. It bites severely. Stable flies have been identified as a major pest of animals grazing in pastures. Weight losses due to stable flies may be as high as 0.5 lb per head per day based on studies in Neberaska (Broce et al., 2005) Eggs are laid in excrement. Distribution: cosmopolitan (Zahradník, 1990).

Order: Lepidoptera

Family: Nymphalidae

Vanessa cardui (Linnaeus, 1758)

Painted lady was found in several specimens during the sampling. Painted lady is a migrant butterfly in whole Europe. *Vanessa cardui* is a permanent resident in North Africa, Canary Islands, Madeira and some parts of Mediterranean area (Tolman & Lewington 1997). The species comes in European mountain areas like a migrant as well (3,000 meters). Painted lady is a polyvoltine with no stage of diapauses (Tolman & Lewington 1997; Lafranchis, 2004). It inhabits different habitat types including gardens and parks. Larval host-plants are different species of plants from families Asteraceae, Boraginaceae, Brassicaceae, Cucurbitaceae, Fabaceae, Malvaceae, Vitaceae. A female lays ova usually on the uppersides of the leaves (Tolman & Lewington, 1997). Painted lady is very common in all parts of Croatia.

Family: Sphingidae

Macroglossum stellatarum (Linnaeus, 1758).

During the sampling period four specimens of the humming-bird hawk-moth were collected. *Macroglossum stellatarum* is a migrant species, usually seen in day-time flying and visiting different species of plants including garden plants. Humming-bird hawk-moth inhabits different habitat types including parks and gardens with different species from genera *Buddleia*, *Echium*, *Jasminium*, *Nicotiana*, *Primula*, *Viola*. Larval host-plants are hedge bedstraw (*Galium molugo*), lady's bedstraw (*Galium verum*) and wild madder (*Rubia peregina*) (Skinner, 1986). The eggs are spherical pale green. The second instar of larvae is green. The pupae are pale brownish with a prominent proboscis and two spines at the end. The wingspan of adults is 50–58 millimetres (Skinner, 1986). Humming-bird Hawk-moth overwinters as an adult. It is distributed throughout the Palaearctic region from Portugal to Japan, and resident only in warmer climates (North Africa, and points east). *Macroglossum stellatarum* is very common moth in all parts of Croatia.

Table 1. Systematic list of determined species from the Diptera order.

Tablica1. Sistematski popis determiniranih vrsta iz reda Diptera.

Family	Species	Specimens	Sex
Syrphidae	*Eristalis tenax* (Linnaeus, 1758)	9	♀
	Eristalis arbustorum (Linnaeus, 1758)	1	♀
	Episyrphus balteatus (De Geer, 1776)	1	♀
	Syrphus ribesii (Linnaeus, 1758)	2	♀
	Scaeva pyrastri (Linnaeus, 1758)	5	♀
Drosophilidae	*Drosophila melanogaster* Meigen, 1830	1	♀
	Drosophila funebris (Fabricius, 1787)	1	♀
Calliphoridae	*Calliphora vomitoria* (Linnaeus, 1758)	3	♀
	Calliphora vicina Robineau-Desvoidy, 1830	1	♀
Scatophagidae	*Scatophaga stercoraria* Linnaeus, 1758	1	♀
Muscidae	*Musca autumnalis* De Geer, 1776	7	♀
	Stomoxys calcitrans (Linnaeus, 1758)	13	♀
Σ 5	12	45	1

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