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2011

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Müller, Günter; Hogsette, Jerome; Kravchenko, Vasiliy; Revay, Edit; and Schlein, Yosef, "New records and ecological remarks regarding the tribe Stomoxyini (Diptera: Muscidae) from Israel" (2011). *Publications from USDA-ARS / UNL Faculty*. 1023.

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## Scientific Note

### New records and ecological remarks regarding the tribe Stomoxyini (Diptera: Muscidae) from Israel

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The Stomoxyini is a small tribe with only ten genera and 49 known species worldwide (Zumpt 1973) belonging to the Muscidae, one of the largest dipteran. Apart from feeding occasionally on nectar (Müller et al. 2011a), the adult flies of this tribe are obligate blood feeders and can easily be recognized by their conspicuous proboscis adapted for biting and sucking blood (Zumpt 1973). Several members of the tribe, especially *Stomoxys* and *Haematobia* species, are major pests of domestic livestock. Two species, *Stomoxys calcitrans* (Linnaeus 1758) and *Haematobia irritans* (Linnaeus 1758), cause billions of USD in damages annually in the cattle industry (Byford et al. 1992, Hogsette et al. 1991, Taylor and Berkebile 2006). *Haematobia irritans* is known to be a vector of nematodes like *Stephanofilaria stilesi* Chitwood (Hibler 1966), and several *Staphylococcus* spp. bacteria that cause mastitis or infection of the teats (Owens et al. 1998). *Stomoxys calcitrans* is a vector of the nematode, *Habronema microstoma* (Zumpt 1973), and has been shown to transmit many pathogens, mostly under laboratory conditions (Greenberg 1971, Mihok et al. 1995, Sumba et al. 1998). Nevertheless, it is the painful, often multiple bites of the Stomoxyini which cause decreased weight gain and reduction in milk production in livestock because of defensive behavior (Foil and Hogsette 1994). Though Stomoxyini are zoophilic, some species will also bite humans, especially in the absence of livestock (Zumpt 1973).

In two recent outbreaks of lumpy skin disease during 1989 and 2006 in several dairy farms in Israel, *S. calcitrans* was suspected as a possible vector (Yeruham et al. 1995, Brenner et al. 2006). At that time, little was known about the distribution and phenology of this species in Israel. This initiated a two-year survey in 2006 to collect biting flies (mainly Stomoxyini and Tabanidae), active diurnally, from 38 Israeli and 11 Palestinian farms. The flies were collected at each selected site for one or two years, with six Alsynite traps (Hogsette and Ruff 1990) per site. During the same time, flies at seven Israeli and four Palestinian farms were collected monthly with Malaise traps and sweep nets. Additionally, from 2006 to 2010 we collected biting flies with sweep nets from grazing animals, including cattle, horse, donkey, camel, sheep and goat, throughout Israel. Malaise

and Nzi traps were operated regularly during the five-year period in natural habitats in the major phyto-geographical zones of Israel. Stomoxyini flies were also collected from flowers and fruits in natural habitats and from plant-baited traps. During the survey, six species, *Stomoxys calcitrans*, *Stomoxys sitens* Rondani 1873, *H. irritans*, *Haematobia minuta* (Bezzi, 1892), *Stygeromyia maculosa* Austen, 1907, and *Haematobosca stimulans* (Meigen, 1824), were collected.

The stable fly, *S. calcitrans*, is cosmopolitan in distribution. In Israel, it is by far the most common and widespread *Stomoxys* species, and was found in every farm and pasture. In the lower parts of the country, especially the Coastal Plain and the Rift Valley, it was observed year-round. Above 700 m in the Mediterranean hills, the Golan Heights, and Mt. Hermon, it was absent or scarce from late November to early March. *Stomoxys calcitrans* was most abundant in dairy farms, farms raising calves, and horse stables. On some dairy farms they were more common than house flies, *Musca domestica* L. In Israel, *S. calcitrans* rarely bites humans in the vicinity of favored hosts, but in autumn, especially in small oases in arid southern Israel, it occasionally attacks humans for short periods (unpublished data of the authors). Also in the aforementioned locations, often tens of km from farms and suitable breeding sites, this species was frequently found feeding in large numbers on flowering bushes, especially *Ochradenus baccatus* Delile, Resedaceae, *Prosopis farcta* (Banks & Sol.), Mimosaceae, and the local *Tamarix* species.

*Stomoxys sitens*, also a serious pest of cattle, is widespread in the Oriental and Ethiopian regions. In the Palearctic it was previously only known from Egypt where it is common in the Nile Delta (Zumpt 1973) with only a few records from the Sinai Peninsula (A. Freidberg personal communication). Though we examined more than 10,000 *Stomoxys* from all of Israel during the survey, we identified only four *S. sitens*, three in the Rift Valley and one near Kibbutz Tze'elim close to Egypt and Gaza. The latter specimen and the one near Kibbutz Yotvata (40 km north of Eilat) were caught on alsynite traps several hundred m from the farm facilities in the outer perimeter of the villages. The other two specimens were caught in NeotHakikar oasis at the southern end of the Dead Sea, one on an alsynite trap in

the vicinity of camels, and the other on a sticky trap baited with *O. bacchatus* (Müller et al. 2011b). All four specimens were females and the ones caught near Yotvata and Tze'elim were also blood-fed.

*H. irritans*, the horn fly, is cosmopolitan in distribution and, as an obligate parasite of cattle, rarely leaves its host (Zumpt 1973). In Israel, it is common but less widespread than *S. calcitrans* on dairies and is associated mainly with pastured beef cattle. This species is widely spread in bush and grassland in the temperate north and center of Israel, but in the arid south it is locally distributed and less common. *Haematobia irritans* is more temperature dependent than *S. calcitrans* (Zumpt 1973) and is rarely found during the winter months, even in the hottest areas of Israel, in the Rift Valley below sea level. Apart from cattle, we also observed this species feeding on horses, donkeys, and dogs, but never on camel, sheep, or goats. While sampling, we were occasionally attacked by this fly in pastures and in oases but never inside farms. We observed only once a single male *H. irritans* in mid-summer feeding on a flowering tamarisk in the Hula Valley in the vicinity of cattle.

According to Zumpt (1973), *H. minuta* is an Afro-tropical species penetrating the Arab peninsula, suggesting that records from Israel, Iraq, and Iran (Henning 1964) probably refer to the Palearctic species, *Haematobia thiraxi titillans* (Bezzi, 1907). We collected only five *H. minuta* in NeotHakikar oasis feeding together with numerous *H. irritans* on donkeys. The identity of the two males was verified by genitalia preparation, but we were not able to examine the specimens referred to by Henning (1964). Some of the larger oases in the Israeli-Jordanian Rift valley, especially in the depression of the Dead Sea, are known refugia of Ethiopian flora and fauna (Danin 1988, Furth 1975). This inconspicuous species might be more widely distributed around these oases. It is worthwhile noting that in NeotHakikar, one specimen was collected in early March, one in late May, two in late July, and one in mid-November, all in the dry season. Kangwagyea (1974) observed the same species in Uganda, but only during the second annual rainy season from September to November. He suggested that the uni-modal peak in population dynamics might be related to soil conditions favorable for breeding. In NeotHakikar, there is only occasional rain in winter and the annual precipitation rarely exceeds 50 mm (Orni and Efrat 1980). Regardless, several fresh water springs maintain year-round natural ponds, streamlets, and marshland, and conditions might be favorable for *H. minuta* to breed throughout the year.

*Stygeromyia maculosa* is widely distributed over the western Oriental and the eastern, central, and southern parts of the Ethiopian region. In the Palearctic, it has been found previously only in Iran (Zumpt 1973). We collected two specimens near Jericho in June, 2009 in CDC UV traps while trapping sand flies, and in the same month, another two specimens on a donkey just after sunset. Zumpt (1973) stated that this species has only rarely been collected because of its crepuscular behavior. One year later we attempted to collect additional specimens on donkeys and cattle in the

same vicinity. During subsequent years, we screened CDC light trap catches from other projects in the same area (Junnilla et al. 2011, Kline et al. 2011) but we did not recover more *S. maculosa*. Therefore, it is not clear if this species was caught accidentally in UV- or CO<sub>2</sub>-baited CDC traps or if it is just rare.

*Haematobosca stimulans* is a Holarctic species distributed from North America to Europe and Central Asia (Zumpt 1973). Two specimens were collected on cattle grazing in scattered woodland on Mt. Hermon 1600 m a.s.l. (mid-May, 2008) and 1800 m a.s.l. (late May, 2008). The identity of one male was verified by genitalia preparation. In Europe and Russia this species is known to be closely associated with cattle, rarely feeding on horses and never biting humans. In the northern U.S., the same species is associated with elk and occasionally bites humans (Zumpt 1973). This is the most southern record of *H. stimulans* in the Palearctic, and its ecology and dependence on low temperatures (Thomsen 1935, Thomsen and Thomsen 1937) make it unlikely that this species will be found further to the south or at lower altitudes in Israel and the Levant.

Previously, only two species of Stomoxyini, *S. calcitrans* and *H. irritans*, were known from Israel and the occurrence of *H. minuta* was regarded as doubtful (Kugler 1969, A. Freidberg, personal communication). Despite the importance of the Stomoxyini, little attention has been given to this group in Israel, its neighboring countries, or territories.

It is therefore not clear if our new records indicate expanding ranges, or if these species were simply overlooked in the past. *S. sitiens*, found previously only in northern Egypt, might disperse through the Rift valley and along the coast from Egypt into Israel. It is worthwhile mentioning that though Israeli farmers are among the best-educated farmers world-wide, <20% of them (11/ 58) were aware of blood-feeding Muscidae in 2006. Even fewer considered that the same flies may carry diseases or may cause economic damage. Additional research is needed in Israel and the entire region to address the distribution and the ecology of this important group of flies.

#### Acknowledgments

The authors thank Mr. Schacht, Zoologische Staatssammlung Muenchen, Germany, for encouraging us in this study and for his help in identifying part of the material. Dr. Amnon Freidberg, Department of Zoology, Tel Aviv University, shared his knowledge on the stomoxine biting flies previously known from Israel. This study was funded in part by the United States Department of the Army, Space and Missile Defense Command, Deployed War Fighters Protection Project (DWFP) grant W81R6000325007.

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