

A review of the giant water bugs (Hemiptera: Heteroptera: Nepomorpha: Belostomatidae) of Israel

TANYA NOVOSELSKY¹, PING-PING CHEN² & NICO NIESER²

¹*The Steinhardt Museum of Natural History, Israel National Center for Biodiversity Studies, Tel Aviv University, Tel Aviv 69978, Israel. E-mail: tania@tauex.tau.ac.il*

²*Naturalis Biodiversity Centre, P.O. Box 9517, 2300 RA Leiden, The Netherlands. E-mail: p.chen@nvwa.nl, nieser.nico@gmail.com*

ABSTRACT

An updated and annotated check-list of Israeli giant water bugs (Belostomatidae) is provided. The recorded species belong in the subfamilies Belostomatinae and Lethocerinae. The following six species occur in the country: *Appasus urinator*, *Limnogeton fieberi*, *Lethocerus patruelis*, *Lethocerus cordofanus* (new record), *Hydrocyrius colombiae colombiae* (new record) and *Belostoma bifoveolatum* (new record). *Belostoma bifoveolatum* was previously known only from South America, so it is recorded in the Old World for the first time. An illustrated identification key is compiled for the Israeli Belostomatidae species. A list of exotic Belostomatidae material accumulated in the collection of the Steinhardt Museum of Natural History is provided.

KEYWORDS: Hemiptera, Heteroptera, Nepomorpha, Belostomatidae, aquatic insects, giant water bugs, identification key, male genitalia, Middle East, taxonomy.

INTRODUCTION

The Belostomatidae is a family of aquatic heteropterans of almost world-wide distribution, although its greatest diversity is observed in the tropics (Merritt & Cummins 1996; Schuh & Slater 1995). The family includes the largest—up to 120 mm long—representatives of Heteroptera, which are known as the giant water bugs or electric-light bugs, because they are attracted to light sources at night (Ribeiro *et al.* 2014).

Water bugs play an important role as bioindicators, predators and biocontrol agents of mosquito larvae and snails (Das & Gupta 2010; Tara & Kour 2014; Benelli *et al.* 2016; Younes *et al.* 2016). They are also an important food source for many organisms, including fish, amphibians, waterfowl, young crocodiles (Corbet 1960), and other animals. Most species of giant water bugs are generalist predators that ambush, often by night, a wide variety of prey, including turtles (Ohba 2011; Ribeiro *et al.* 2018) and even birds (Matheson 1907). Some species, notably members of the genus *Limnogeton*, are known to be obligatory predators of snails; *Belostoma* species also have snails as a component of their diet (Kessler & Munns 1989; Pereira *et al.* 1992a, b).

The Belostomatinae are famous for their males brooding the eggs, whereas in the Lethocerinae the eggs are attached to the vegetation above the water, which is known as egg attendance (Smiseth 2014). In the latter case the males guard them and, probably more importantly, keep them wet (Smith 1997).

The modern classification of the family was established by Lauck and Menke (1961). They divided the family into three supposedly monophyletic subfamilies, viz. the apparently monotypic Horvathiniinae Lauck & Menke, 1961, restricted to South Brazil and North Argentina, and the Belostomatinae and Lethocerinae, both being essentially tropicopolitan with a few species penetrating into temperate regions. This classification was followed by subsequent authors (e.g. De Carlo 1966; Nieser 1975; Mahner 1993; Schuh & Slater 1995; Schnack & Estévez 2005; Perez Goodwyn 2006; Estévez & Ribeiro 2011; Moreira *et al.* 2011). Ribeiro *et al.* (2018) in an extensive analysis of both morphological and molecular data came to the conclusion that *Horvathinia* Montandon, 1911 forms a clade together with *Hydrocyrius* Spinola, 1850 and *Limnogeton* Mayr, 1853 within the Belostomatinae, and abolished the subfamily Horvathiniinae.

The Lethocerinae were revised by Perez Goodwyn (2006), who reinstalled the genera *Benacus* Stål, 1861 and *Kirkaldyia* Montandon, 1909 that had been synonymized with *Lethocerus* by Lauck and Menke (1961). The only emendation of the classification of Belostomatinae by Lauck and Menke (1961) was done by Polhemus (1995b), who rescued the genus *Appasus* Amyot & Serville, 1843 from synonymy under *Diplonychus* Laporte, 1833. At present, there are 11 extant genera recognized in the family Belostomatidae.

In the Israeli fauna, there are two subfamilies of Belostomatidae, i.e. Belostomatinae and Lethocerinae. The first one is represented by four genera. *Belostoma* is the most speciose genus, with the greatest diversity recorded in South America (Lauck & Menke 1961; Moreira *et al.* 2011). *Appasus* is distributed throughout Africa, India, South-East Asia, and Australia. *Hydrocyrius* occurs in Algeria, Egypt, Saudi Arabia, tropical Africa, Madagascar, and little is known about the biology of its representatives. *Limnogeton* is essentially restricted to north-eastern Africa but extending into Asia Minor, and is apparently a strict predator of snails (Schuh & Slater 1995). *Limnogeton* species have smooth profemora, lacking sulci, and are thought to be the only representatives of the Belostomatidae that do not have middle and hind legs modified for swimming (Ribeiro *et al.* 2014, 2018).

The Lethocerinae is a cosmopolitan subfamily distributed in tropical, subtropical, and temperate areas, with its highest diversity in the Neotropical and Nearctic regions (Perez Goodwyn 2006). In Israel, the Lethocerinae are represented only by the genus *Lethocerus*.

In the present contribution, we provide three rediscoveries of the Belostomatidae and three new species records for the Israeli fauna. Exotic Belostomatidae material accumulated so far in the collection of the Steinhardt Museum of Natural History is listed in the Appendix (p. 141).

MATERIALS AND METHODS

The study is based on 122 belostomatid specimens accumulated in the Collection National of Insects, Tel Aviv University (SMNHTAU) over some 80 years from 1934–2017. The material is preserved in 70% ethanol or pinned.

Identification of the Belostomatidae species requires examination of the male genitalia. The techniques for preparation of male and female genitalia were adapted from those of Ribeiro (2007). The parameres are mostly on the outside of the genital capsule, which is concealed and needs to be examined after dissection. The genitalia were extracted by opening the posterior abdominal sternites after soaking dry specimens in hot water, boiled in a 10% aqueous solution of KOH, placed after examination in plastic tubes filled with glycerine and pinned next to the specimen on the same pin.

The total length has been measured in millimetres from the apex of the head to the tip apex of the abdomen.

In general, photographs were taken with a Canon PowerShot G9 camera, mounted on a Zeiss SteREO Discovery V20 dissecting microscope and processed using the CombineZP software, and a Leica DFC295 digital camera mounted on a Leica M205C dissecting microscope, combining image stacks with Helicon Focus 5.3, and editing the final images when necessary with Adobe Photoshop CS5. Photographs of the Belostomatidae habitus were captured with a Canon EOS 350D digital camera, combining image stacks with Helicon Focus 5.3 and editing the final images when necessary with Adobe Photoshop CS5.

All locality data were entered into the SMNHTAU database.

Species identifications were done using the following sources: for *Belostoma*, Lauck (1962, 1963, 1964) and Ribeiro (2007); for *Lethocerus*, Perez Goodwyn (2006); for *Appasus*, *Hydrocyrius* and *Limnogeton*, Poisson (1949, 1954), Lee (1991) and Ribeiro *et al.* (2014, 2018). Terminology of wing parts in the key follows Gorb & Perez Goodwyn (2003).

The map of geographic regions of Israel (Fig. 48) is after Ionescu and Eyer (2016), who modified it from Theodor (1975). Where names of localities have changed, the most recent transliterated Hebrew names are given together with alternative names cited in brackets, e.g. Mizpe Golani [Tel Faher].

TAXONOMY

Family Belostomatidae Leach

Subfamily Belostomatinae Leach

Genus *Appasus* Amyot & Servile (*A. urinator urinator* Dufour)

Genus *Belostoma* Latreille (*B. bifoveolatum* (Spinola))

Genus *Hydrocyrius* Spinola (*H. colombiae colombiae* Spinola)

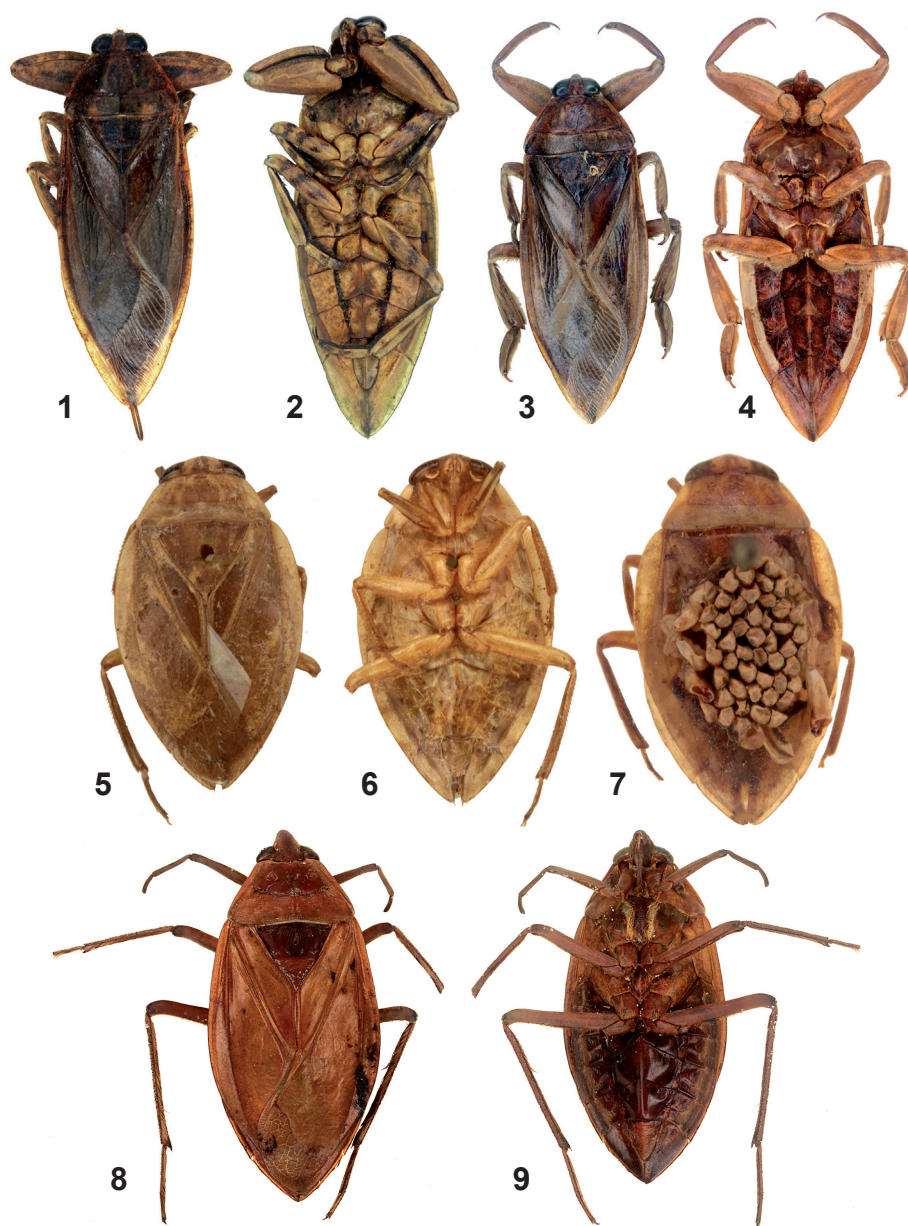
Genus *Limnogeton* Mayr (*L. fieberi* Mayr)

Subfamily Lethocerinae Lauck & Menke

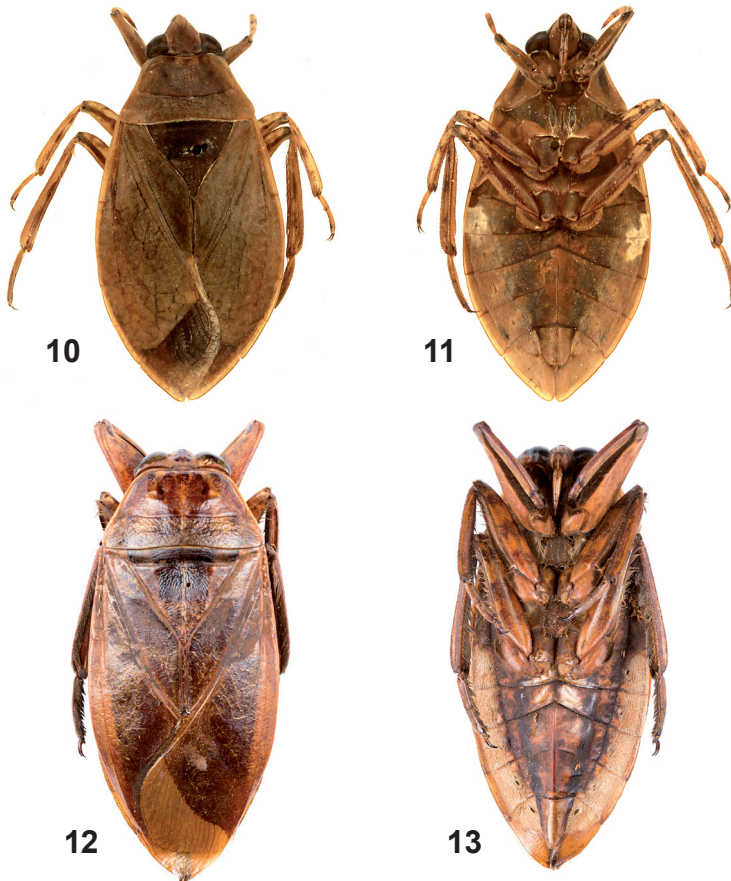
Genus *Lethocerus* Mayr (*L. cordofanus* Mayr, *L. patruelis* (Stål))

Identification key to the Belostomatidae species from Israel

- 1 Segment 1 of rostrum short, thicker than long and shorter than segment 2 (Figs 2, 4, 14). Abdominal sternites 5 and 6 clearly divided laterally (Figs 2, 4, 18). Spiracles located on or adjacent to mesal margins of ventral laterotergites (Fig. 18) (subfamily Lethocerinae). Foretarsus 3-segmented, with 1 large and strong and 1 reduced claw (Figs 29, 30). Genital operculum of females with spines and acutely rounded at apex (*Lethocerus*) 2
- Segment 1 of rostrum longer than thick, subequal in length to segment 2 (Figs 6, 9, 11, 13, 15–17). Abdominal sternites not clearly divided laterally (Figs 6, 9, 11, 13, 19–22). Spiracles located near centre of ventral laterotergites (Figs 19–22) (subfamily Belostomatinae) 3
- 2 Prosternum medially with keel-bearing beak-like apical attenuation (Fig. 24). Male genital capsule as in Figs 34, 35. Paramere with bent/curved keel (Figs 38, 39). Diverticulum flanged/cap-like (Figs 42–44). Body length, ♀ 65.2–68.1, ♂ 73.0–75.1 mm *Lethocerus cordofanus*
- Prosternum with ulu-shaped keel (Fig. 23). Male genital capsule as in Figs 36, 37. Keel on paramere not bent (Figs 40, 41). Diverticulum not flanged (Figs 45–47). Body length, ♀ 78.1–83.4, ♂ 63.2–70.1 mm *Lethocerus patruelis*
- 4 Foretarsus 2-segmented with one claw. Foretibiae and foretarsi laterally flattened (Figs 28, 31) (*Belostoma* or *Appasus*) 5
- Foretarsus 3-segmented with two claws (Figs 32, 33). Foretibiae and foretarsi laterally flattened or cylindrical (*Hydrocyrius* or *Limnogeton*) 6
- 5 Prosternum medially with rounded-triangular projection (Fig. 25). Membrane of hemelytron developed (Fig. 10). Forefemur with groove, widest at mid-length, ratio 1:5. Abdominal pilosity as in Figs 11, 19. Female genital operculum bare. Body length, ♀ 25.5±3.2, ♂ 21.1±3.4 mm *Belostoma bifeoveolatum*
- Prosternum medially with broadly triangular projection (Fig. 26). Membrane of hemelytron reduced (Figs 5–7). Forefemur with projection. Abdominal pilosity of ventral laterotergites 4 not attaining external margin (Figs 6, 20). Female genital operculum with 2 tufts of setae on apex. Body length, ♀ 17.3±1.5, ♂ 16.3±1.7 mm *Appasus urinator urinator*
- 6 Fore tibiae and tarsi laterally flattened, with 2 large unequal claws (Fig. 32). Forefemur with 2 grooves. Prosternum medially with ulu-shaped keel. Abdominal pilosity as in Figs 13, 21. Female genital operculum with 1 apical tuft of setae. Body, length, ♀ 67.2 mm *Hydrocyrius colombiae colombiae*
- Foretibiae and foretarsi laterally cylindrical, with 2 short equal claws (Fig. 33). Forefemur with 1 wide flat groove. Prosternum medially with spine-like projection (Fig. 27). Abdominal pilosity of ventral laterotergites 4 attaining external margin along its entire length (Figs 9, 22). Genital operculum of female fringed with hairs. Body length, ♀ 50.0±3.7, ♂ 43.1±3.5 mm *Limnogeton fieberi*



Figs 1–9: Belostomatidae, general habituses: (1, 2) *Lethocerus cordofanus*, dorsal and ventral views; (3, 4) *Lethocerus patruelis*, dorsal and ventral views; (5–7) *Appasus urinator urinator*, male, dorsal (5) and ventral (6) views, (7) eggs on back; (8, 9) *Limnogeton fieberi*, dorsal and ventral views.



Figs 10–13: Belostomatidae, general habituses: (10, 11) *Belostoma bifoveolatum*, dorsal and ventral views; (12, 13) *Hydrocyrius colombiae colombiae*, dorsal and ventral views.

Family Belostomatidae Leach, 1815
Genus *Appasus* Amyot & Servile, 1843

Species of this genus exhibit male parental care. Eggs are laid on the male's back (Fig. 7), and the male carries them until they hatch (Smith 1997).

Appasus urinator urinator Dufour, 1863
(Figs 5–7, 16, 20, 26, 31, 49)

Appasus urinator Dufour, 1863: 393; Polhemus 1995a: 20 (synonymy).

Material examined: Israel: *Central Coastal Plain:* 2♂ Nehar Yarden, 32°41'53.0"N 35°33'57.4"E, 21.v.2018, T. Eshcoly; 2♂ Tel Aviv, Tel Aviv University, 13.vii.2011, A. Shlagman. *Golan Heights:* 1♂ Mizpe Golani [Tel Faher], 22.viii.1981, J. Margalit. *Hula and Korazim Block:* 1♂ 'Enot 'Enan, 13.vii.2011, L. Friedman; 23♂ 4♀ HaHula Nature Reserve [33°04'N 35°36'E], 5–6.vii.1934 (1♂

1♀), 1.iii.1956 (11♂), 8.vi.1958, L. Fishelsohn (2♂ 1♀), 16.x.1961, A. Ar & L. Fishelsohn (1♂ 1♀), 25.xii.1963, J. Margalit & S. Blondheim (2♂), 5.viii.1964, J. Margalit (2♂ 1♀), 6.vii.1977, A. Freidberg (1♂), 21.ix.1999 (1♂), 3.v.2005, A. Gazit (1♂, reared in Tel Aviv by A. Shlagman), 24.v.2010, G. Wizen (1♂); 2♂ Sede Nehemya, 17.viii.1957, 1.vi.1972, Y. Palmoni. *Jordan Valley*: 2♂ Deganya A, 14.vi.1955, 19.iv.1964, Y. Palmoni. *Lower Galilee*: 1♂ Huqqoq, 9.viii.1986 R. Ortal. *Upper Galilee Hills*: 7♂ 2♀ Dan, 9.vii.1979, E. Zchori-Fein, on cotton (7♂), 9–15.vii.1979, E. Zchori (2♀); 1♂ 'En Gome, 24.v.2017, L. Goren.

Previous records from Israel: Bodenheimer (1937: 209) reports the species from “Palestine” as *Nepoides urinator* (Duf.), Linnavuori (1960: 51) as *Sphaerodema urinator* (Df.), and Polhemus (1995a: 20) as *Appasus urinator urinator*.



Figs 14–17: Rostra, lateral view: (14) *Lethocerus cordofanus*, (15) *Belostoma bifoveolatum*, (16) *Appasus urinator urinator*, (17) *Limnogeton fieberi*.

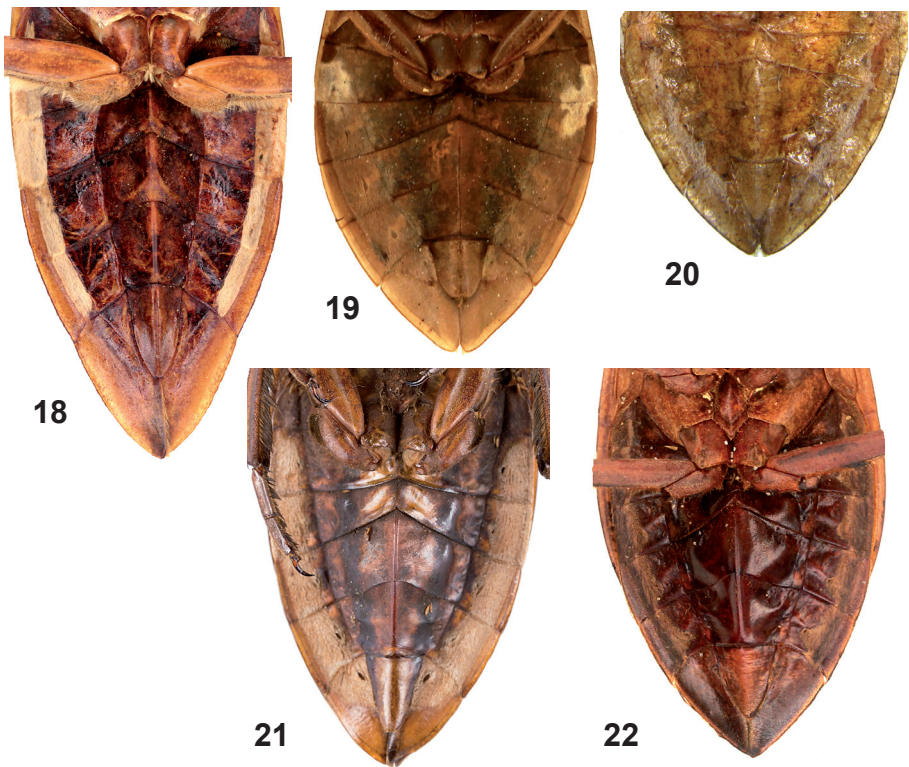
Distribution: Egypt, Iraq, Israel (Fig. 49), tropical Africa (Linnavuori 1960; Tawfik *et al.* 1978; Polhemus 1995a; Estévez & Ribeiro 2011).

Phenology in Israel: Larvae of this species were collected in March, July, August and October, adults were collected in April–June, August–September and December.

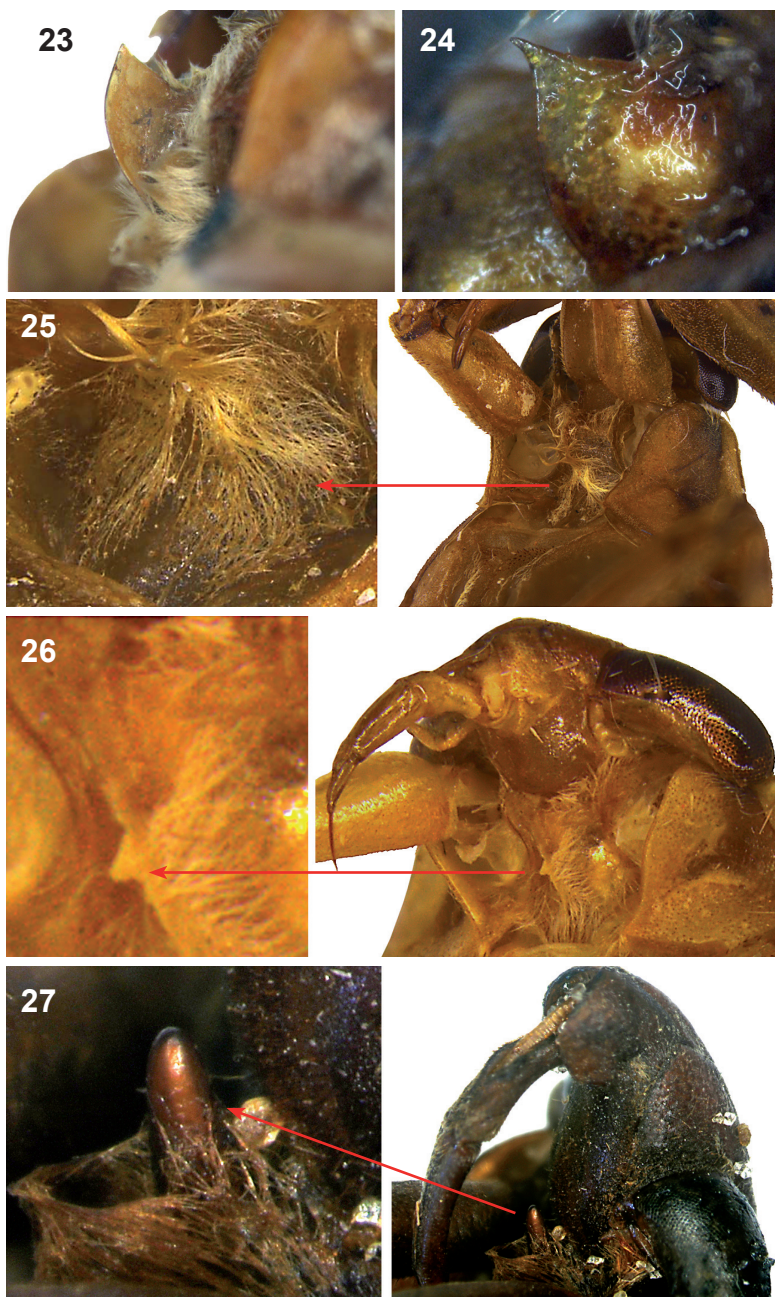
Biology: *Appasus urinator* dwells in lakes, ponds, marshes and rice fields, and preys on a wide range of other aquatic organisms, such as insects, mosquito larvae and pupae, snails and other soft-bodied animals. The bug larvae apparently have a preference for mosquito larvae and pupae. In Egypt the species has two to three generations per year (Tawfik *et al.* 1978).

Genus *Belostoma* Latreille, 1807

The genus *Belostoma* can be distinguished from other members of the Belostomatinae by having the large membrane of the hemelytra, the phallobase bifurcated



Figs 18–22: Abdomen with ventral leterotergites with spiracles, abdominal pilosity: (18) *Lethocerus cordofanus*, (19) *Belostoma bifoveolatum*, (20) *Appasus urinator urinator*, (21) *Hydrocyrius colombiae colombiae*, (22) *Limnogeton fieberi*.



Figs 23–27: Prosterna medially: (23) *Lethocerus patruelis*, (24) *Lethocerus cordofanus*, (25) *Belostoma bifoveolatum*, (26) *Appasus urinator urinator*, (27) *Limnogeton fieberi*.

dorsally, and the dorsal arms of the phallosome extending nearly to the apex of the ventral diverticulum. The membrane of the hemelytron is well developed, with its greatest width more than that of the clavus, most of its cells equal in length, in the form of long, narrow rectangles (De Carlo 1966; Nieser 1975; Estévez & Ribeiro 2011).

According to Nieser (1975) and Lanzer de Souza (1980), *Belostoma* accommodates about 70 described species. The genus is considered endemic to the New World, and is most speciose in tropical South America. No species have previously been reported outside the Americas, so this is the first record of the genus *Belostoma* in the Old World.

Belostoma bifoveolatum (Spinola, 1852)

(Figs 10, 11, 15, 19, 25, 28, 50)

Belostoma bifoveolatum Spinola, 1852: 227; Lauck 1964: 130.

Zaitha bifoveolata: Dufour 1863: 389.

Material examined: **Israel:** *Hula and Korazim Block*: 4♂ 1♀ HaHula Nature Reserve [33°04'N 35°36'E], 3.v.2005, A. Gazit. *Note:* Three specimens were reared in the laboratory by Mr. A. Shlagman from material originating from the Hula area.

Distribution: Argentina, Chile (Nieser 1975; Faúndez & Carvajal 2017; Stefanello *et al.* 2018; Jara & Perotti 2018), Israel (new record, Fig. 50).

Phenology in Israel: Adults were collected in May.

Biology: Hydroperiodicity and temperature may regulate voltinism and development in *B. bifoveolatum*, thus defining the population structure of this giant water bug. In northern Patagonia, *B. bifoveolatum* populations may produce one or two generations per year (Kight *et al.* 2011; Jara & Perotti 2018). As the season progresses, nymphs become more abundant, and adults disappear from water bodies, presumably because they die after reproduction or migrate to other habitats (Jara & Perotti 2018). The warm season in Israel provides an excellent potential for their development. As the observed males were carrying eggs the species seemed to reproduce well.

Comments: *Belostoma bifoveolatum* belongs to the *bifoveolatum* group, which also incorporates *B. angustum* Lauck and *B. elegans* (Mayr). These are cryptic species, being quite similar in terms of their body shape, dimensions and male genital morphology (Stefanello *et al.* 2018). The species occur from the southern part of South America along the Andes up to Peru. *Belostoma bifoveolatum* is one of the very few Nepomorpha occurring both in Argentina and Chile (Coscarón 2017; Stefanello *et al.* 2018). As *Belostoma* does not occur naturally outside the Americas its record in Israel clearly represents an introduction, albeit through a yet unknown route. This striking, medium sized species can quite easily adapt to different ecological conditions (Jara & Perotti 2018). Therefore it is advisable to monitor its Israeli population and make an attempt to eradicate it, if it shows signs of becoming invasive.



Figs 28–33: Foretarsi: (28) *Belostoma bifoveolatum*, (29) *Lethocerus patruelis*, (30) *Lethocerus cordofanus*, (31) *Appasus urinator urinator*, (32) *Hydrocyrius colombiae colombiae*, (33) *Limnogeton fieberi*.

Genus *Hydrocyrius* Spinola, 1850

Hydrocyrius colombiae colombiae Spinola, 1850

(Figs 12, 13, 21, 32, 51)

Hydrocyrius colombiae Spinola, 1850: 107; Polhemus 1995a: 21 (synonymy).

Material examined: **Israel:** *Hula and Korazim Block:* 1 ♀ HaHula Nature Reserve [33°04'N 35°36'E], 5.iv.1943, R. Ortal. *Northern Coastal Plain:* 1 ♀, nymph iv, Ma'agan Mikha'el [32°33'N 34°55'E], 1.i.1957, R. Ortal.

Distribution: Algeria, Egypt, Saudi Arabia, tropical Africa, Israel (new record, Fig. 51).

Phenology in Israel: The adults were collected in April and January, the nymph in January.

Genus *Limnogeton* Mayr, 1853

The genus *Limnogeton* contains the only apparently obligate freshwater snail predators and comprises four extant species (Poisson 1949; Voelker 1966, 1968).

The genus has recently been revised by Ribeiro *et al.* (2014), who also keyed the known species.

Limnogeton fieberi Mayr, 1853

(Figs 8, 9, 17, 22, 27, 33, 52)

Limnogeton fieberi Mayr, 1853: 17; Polhemus 1995a: 21 (synonymy).

Material examined: **Israel:** *Central Coastal Plain:* 1♂ 1♀ Beit Yanai, 1.ii.1976 (1♀), 1.viii.1984 (1♂), W. Ferguson; 1♂ Herzliyya, vii.1985, A. Cohen. *Northern Coastal Plain:* 1♀ 'Atlit, 5.x.1986, I. Livne; 1♀ Na'aman Nature Reserve, 3.iv.1937, Y. Palmoni. *Southern Coastal Plain:* 1♀ Palmahim, 1.viii.1984, H.K. Mienis. *Upper Galilee:* 3♀ Hulata, 10.v.19[?], H. Bytinski-Salz.

Distribution: Egypt, Iraq, Israel (Fig. 52), tropical Africa (Montandon 1896; Linnavuori 1960, 1971; Voelker 1966, 1968; Tawfik *et al.* 1978; Polhemus 1995a).

Previous records from Israel: Linnavuori (1960: 51) reported this species from the HaHula Nature Reserve.

Phenology in Israel: Adults were collected in February, April, May, July, August and October.

Subfamily Lethocerinae Lauck & Menke, 1961

The subfamily Lethocerinae is represented in the Israeli fauna by the genus *Lethocerus*. All species of Lethocerinae are emergent brooders, their eggs being deposited on near-water vegetation and tended to by the males (Lauck & Menke 1961).

The Lethocerinae include the largest Heteroptera, reaching 120 mm length and being among the largest living insects. They differ from the rest of the Belostomatidae in having the widened mid and hind tibiae, the short and stout beak, slender respiratory appendages, a “suture-like” fold on the parasternites, the aedeagus completely separated from the ventral diverticulum, fore legs of larvae with two equal claws, and their reproductive trait that involves oviposition on a substrate outside the water and guarding behaviour of the male (Ichikawa 1988; Smith & Larsen 1993). Identification is often difficult because many species are very similar in their general appearance.

Genus *Lethocerus* Mayr, 1853

These are the largest bugs in Israel. Whereas *Lethocerus patruelis* is rather common, *L. cordofanus* has only been collected several times in the region. *Lethocerus* bugs are eaten in south-east Asia, where they are sold fresh or canned (De Foliart & Gene 2002; Hanboonsong *et al.* 2013). Perez Goodwyn (2006) provides an illustrated key to species of the genus *Lethocerus*.

Lethocerus cordofanus Mayr, 1853

(Figs 1, 2, 14, 18, 24, 30, 34, 35, 38, 39, 42–44, 53)

Belostoma fakir Gistel, 1848: 191.

Lethocerus cordofanus Mayr, 1853: 18; Perez Goodwyn 2006: 55.

Belostoma niloticum Stål, 1854: 240.

Belostoma bispinulosum Dufour, 1863: 381.

Belostoma lutescens Dufour, 1863: 384.

Lethocerus niloticus Cummings, 1933: 199.

Material examined: **Egypt:** 1♂ Sinai, Bardawil [31°08'N 33°07'E], x.1976. **Israel:** *Central Coastal Plain:* 2♀ Tel Aviv, 1.i.1980, A. Shlagman. *Central Negev:* 1♂ Sde Boqer [30°52'N 34°47'E], 7.ii.1979, Y. Kha'ani. *Hula and Korazim Block:* 1♀ HaHula Nature Reserve [33°04'N 35°36'E], 10.viii.1945, H. Bytinski-Salz.

Distribution: The species is present all over central tropical Africa south of the Sahara desert from the Gulf of Guinea to Somalia. The southernmost locality where it has been recorded is Pretoria (South Africa). In the north, the species reaches the Mediterranean through the Nile River basin (Perez Goodwyn 2006). Israel (new record, Fig. 53).

Phenology in Israel: Adults were collected in January, February and August.

Biology: Eggs are laid on emergent vegetation (Lauck & Menke 1961). Tawfik (1969) studied its life history in detail.

Comments. The name *Belostoma fakir* Gistel, 1848 has been out of use for more than 150 years. Perez Goodwyn (2006) argues that the description by Gistel can also refer to *Hydrocyrius colombiae* Spinola, 1850, and, as there is no type material of *Belostoma fakir*, it is treated as a *species inquirenda*. Thus, the first description and valid name referring with certainty to this species is *Lethocerus cordofanus*.



Figs 34–37: Male genitalia, genital capsule: (34, 35) *Lethocerus cordofanus*, ventral (34) and dorsal (35); (36, 37) *Lethocerus patruelis*, genital capsule, ventrally (36) and dorsally (37). Scale bar = 1 mm.



Figs 38–41: Parameres of *Lethocerus* spp.: (38, 39) *L. cordofanus*, lateral (38) and ventral (39) views; (40, 41) *Lethocerus patruelis*, lateral (40) and ventral (41) views.

Lethocerus patruelis (Stål, 1854)

(Figs 3, 4, 23, 29, 36, 37, 40, 41, 45–47, 53)

Belostoma patrule Stål, 1854: 241.

Belostoma niloticum Mayr, 1868: 185 (nec Stål).

Belostoma niloticum var. *persicum* Montandon, 1898: 431.

Lethocerus persicus Menke, 1963: 258.

Lethocerus patruelis: Kanyukova & Kerzhner 1980: 598; Perez Goodwyn 2006: 61.

Material examined: Israel: *Arava Valley:* 1♀ Ne'ot HaKikkar, 23.vi.1952 J. Wahrman. *Central Coastal Plain:* 1♂ 1♀ Tel Aviv, xii.1941, Y. Palmoni (1♀), iii.1959, P. Berkovitch (1♂). *Central Negev:* 1♀ Mizpe Ramon, 18.x.1977, D. Simon. *Golan Heights:* 1♀ Yarmouk River, 10.viii.1953, Y. Palmoni. *Hula and Korazim Block:* 7♂ HaHula Nature Reserve, 5.iv.1943, R. Ortal (1♂), 3.iii.1957, Z. Shoham (1♂), 27.vii.1954 (1♂), 1960, D. Rawe (4♂). *Jordan Valley:* 2♂ Deganya A, 31.v.1957, Y. Palmoni; Massada, 18.ix.1952, Y. Palmoni. *Karmel (Carmel) Ridge:* 1♂ Haifa, Akhusa, 20.ix.1955, J. Wahrman; 1♂ Haifa, 10.v.19[?], H. Bytinski-Salz. *Northern Coastal Plain:* 1♂ 1♀ Beit Yanai, 1.ii.1976 (1♀), 26.xii.1986 (1♂), W. Ferguson; 1♂ HaBonim, vi.1977, B. Feldman; 1♂ Herzliyya, 23.iv.1976, S. Lev-Yadun; 3♀ Ma'agan Mikha'el [32°33'N 34°55'E], iv.1956, 13.ii.1988, Dov A. Ben, 20.i.1984, A. Valdenberg; 1♀ Ma'ayan Tzvi, 1957, S. Angres; 1♀ Nahal Taninim, 16.vii.1975, D. Berkovitch. *Sea of Galilee area:* 4♂ Moshava Kinneret, 20.v.1943, Y. Palmoni. *Southern Coastal Plain:* 2♀ Bet Dagan, iv.1963, H. Mendelson; 1♂ Gan Yavne, x.1956; 1♂ 2♀ Palmahim, 31.v.2014, D. Nagar (1♂ 1♀), iv.1984, H.K. Mienis (1♀); 2♂ Ramat Gan, 19.v.1936; 1♂ Rehovot, 19.viii.1936, Hecht. *Upper Galilee:* 1♂ Tel Dan Nature Reserve, 5.xi.1952. *Jezreel Valley:* 1♂ Mizra', 17.vi.1961.



Figs 42–47: Male genitalia of *Lethocerus* spp., aedeagi: (42–44) *L. cordofanus*, ventral (42), dorsal (43) and lateral (44) views; (45–47) *L. patruelis*, ventral (45), dorsal (46) and lateral (47) views. Scale bar = 1 mm.

Distribution: Hungary, Romania, Italy, Albania, Bulgaria, Croatia, Macedonia, Montenegro, Greece, Turkey, Israel (Fig. 54), Syria, Iraq, Iran, Saudi Arabia, Kuwait, United Arab Emirates, Yemen, Afghanistan, Nepal, Pakistan, India, Burma (Zimmermann 1982; Linnavuori 1986; Polhemus 1995a; Perez Goodwyn 2006; Cianferoni & Nardi 2013).

Previous records from Israel: Bodenheimer (1937: 209) recorded this species from “Palestine” as *Belostoma niloticum*, and Linnavuori (1960: 51) as *B. cordofanum*.

Phenology in Israel: Adults were collected throughout the year.

Biology: Eggs are laid on emergent vegetation (Lauck & Menke 1961).

Comments: The species is extremely similar to *L. cordofanus*. Besides the male genitalia, the paler overall colour with lighter and fewer dark patches as well as stripes of the pronotum, which are wider than those of *L. cordofanus*, are useful characters to separate the two species.

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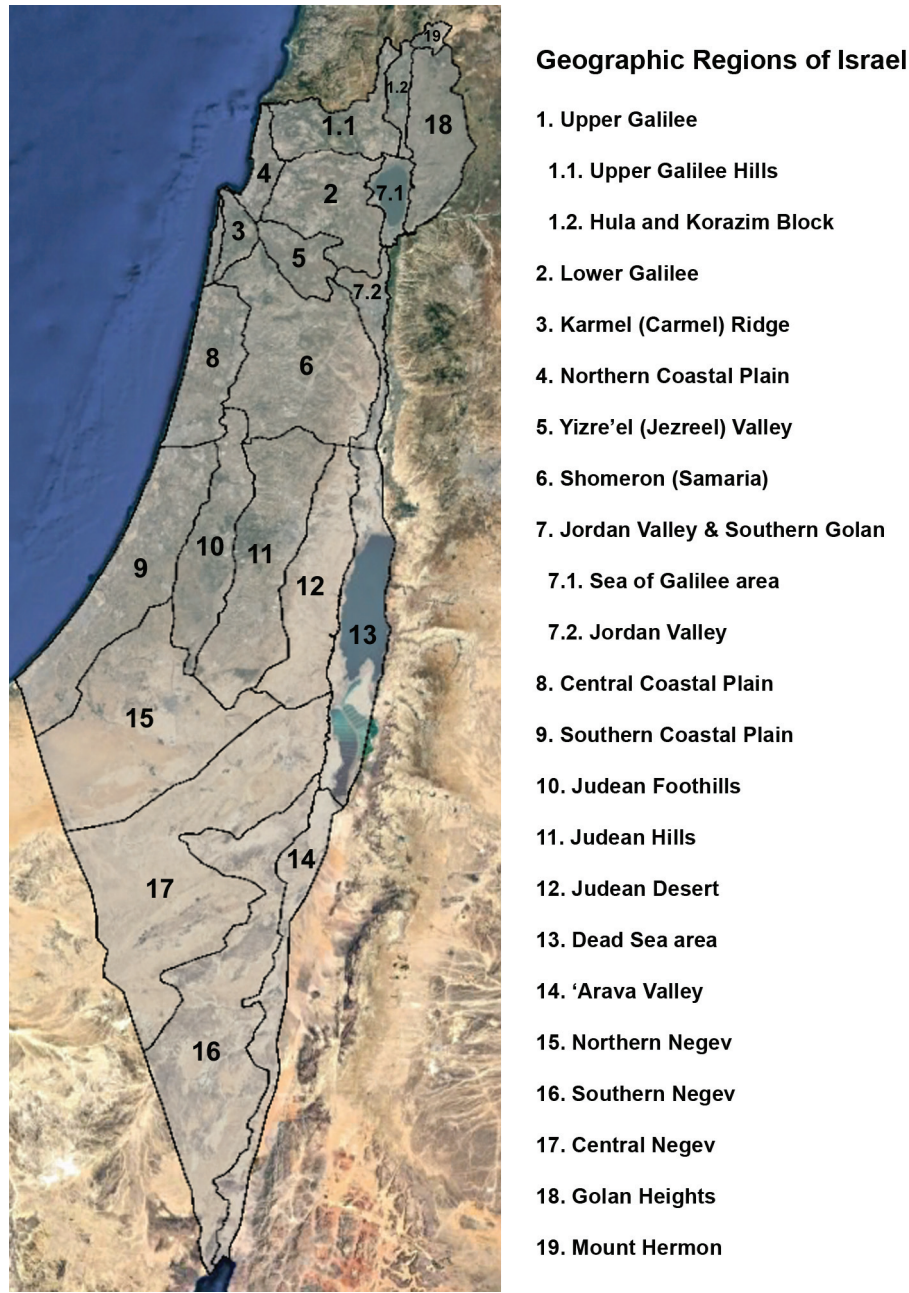
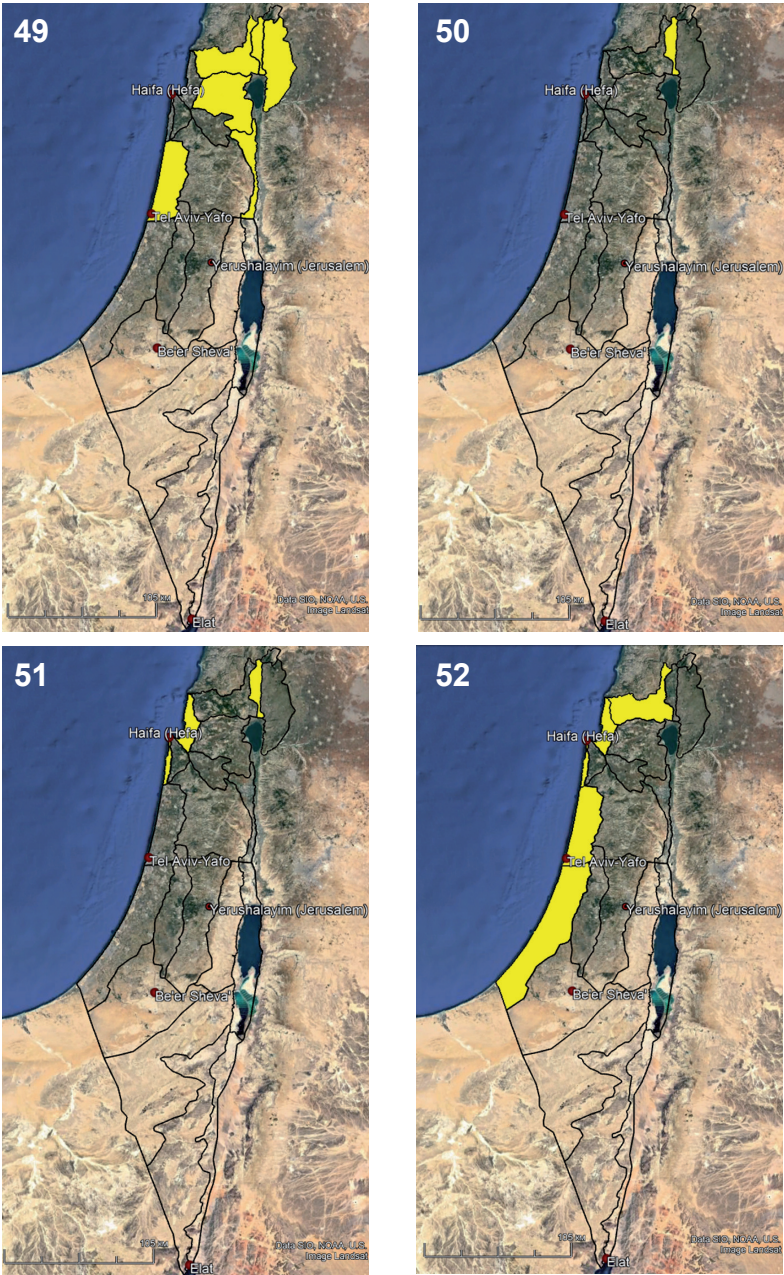
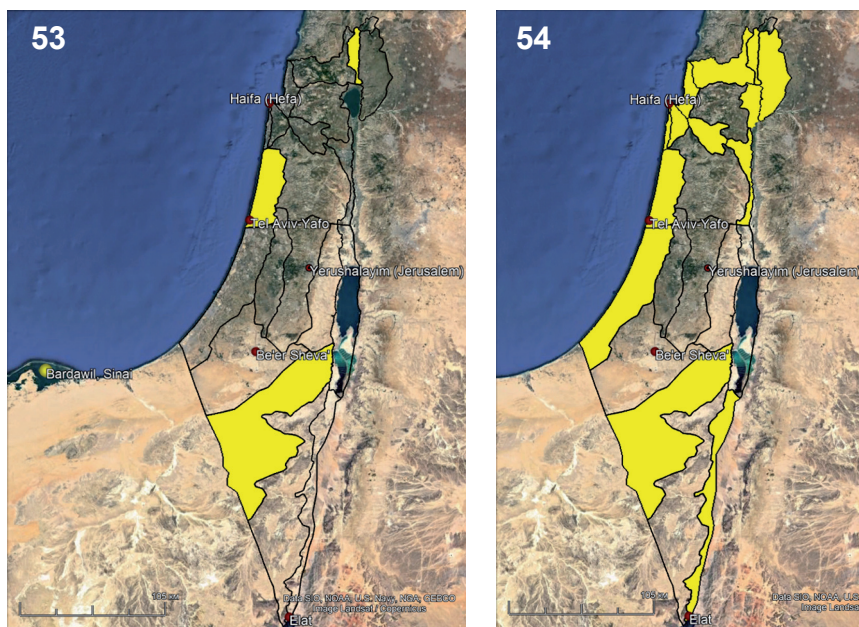


Fig. 48: Biogeographic subdivisions of Israel (after Ionescu & Eyer (2016)).



Figs 49–52: General distribution of Belostomatidae in Israel (yellow areas): (49) *Appasus urinator*, (50) *Belostoma bifoveolatum*, (51) *Hydrocyrius colombiae colombiae*, (52) *Limnogeton fieberi*.



Figs 53, 54: General distribution of Belostomatidae in Israel and on Sinai, Egypt (yellow areas): (53) *Lethocerus cordofanus*, (54) *Lethocerus patruelis*.

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Appendix. The following exotic material of giant water bug species (Belostomatidae) is present in the SMNHTAU collection, in addition to that mentioned in the main text.

Abedus indentatus (Haldeman, 1854)

Material examined: USA: 1♂ California, Idillwild, San Jacinto Mts., 6.xii.1940.

Appasus nepoides (Fabricius, 1803)

Material examined: Ethiopia: 1♂ Awash Nature Reserve, 8°58'60"N 40°10'00"E, 875 m, 12.xi.2007, A. Freidberg.

Appasus sp.

Material examined: Kenya: Tsavo West, Kilaguni Lodge, 14.i.1983, A. Valdenberg. **South Africa:** Malhangasi, 18.iii.1969, D. Gerling.

Belostoma elegans (Mayr, 1871)

Material examined: Argentina: 1♀ Buenos Aires [Cap. Federal], 1.xii.1952.

Hydrocyrius colombiae colombiae Spinola, 1850

Material examined: Mali: 73♂ 154♀ Dogon, Bandiagara, 1.i.2009, G. Muller (23♂ 71♀), 13.x.2011, V. Kravchenko (50♂ 83♀); 27♂ 10♀ Mopti Region, Sévaré, bank of Niger River, 14°32'N 4°06'W, V. Kravchenko.

Hydrocyrius nanus (Montandon, 1907)

Material examined: Mali: 1♂ Mopti Region, Sévaré, bank of lagoon of Niger River, 14°32'N 4°06'W, xii.2010, V. Kravchenko.

Lethocerus (Lethocerus) cordofanus Mayr, 1853

Material examined: Mali: 23♂ 40♀ Dogon, Bandiagara, 1.i.2009, G. Muller (7♂ 12♀), 13.x.2011, V. Kravchenko (16♂ 28♀). **Uganda:** 1♂ Kampala, vi.1977, J. Ngirumwe.

Limnogeton fieberi Mayr, 1853

Material examined: Mali: 1♂ Mopti Region, Sévaré, bank of Niger River, 14°32'N 4°06'W, xi.2010, V. Kravchenko & Z. Efremova. **Uganda:** 1♂ Lake Edward (Nyanza).

Limnogeton scutellatum Mayr, 1863

Material examined: Guinea: Ziela, Nimba Scientific Station, 7°42'57.64"N 8°21'25.69"W, 545 m, viii–xi.2016, V. Kravchenko & G. Muller. **Mali:** 3♂ Mopti Region, Sévaré, bank of Niger River, 14°32'N 4°06'W, xi.2010, V. Kravchenko & Z. Efremova (2♂), xii.2010, V. Kravchenko (1♂).

