

Notes on the current and past freshwater snail fauna of Jordan

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ABSTRACT

Past and current distribution of the freshwater snails of Jordan is given. The freshwater snail fauna of Jordan belongs to two subclasses of the class Gastropoda (Prosobranchia and Pulmonata). Prosobranchians includes seven families (Bithyniidae, Cochliopidae, Neritidae, Hydrobiidae, Melanopsidae, Neritidae, Thiaridae and Valvatidae) with ten genera (*Bithynia*, *Globuliana*, *Heleobia*, *Melanoides*, *Melanopsis*, *Plotia*, *Pseudamnicola*, *Pyrgophorus*, *Theodoxus* and *Valvata*) representing 16 species. Pulmonates are represented by three families (Lymnaeidae, Physidae and Planorbidae) within six genera (*Bulinus*, *Haitia*, *Galba*, *Gyraulus*, *Lymnaea* and *Planorbis*) and six species.

Keywords: Prosobranchia , Pulmonata, Jordan, Invasive species.

INTRODUCTION

In spite of the limited range and size of freshwater habitats in Jordan, at least 19 species of snail have been recorded across the country (Burch et al., 1989). Particular attention has been given to those species, which are known to be the intermediate hosts of human parasitic diseases such as, schistosomiasis and fasciolosis (Abdel-Azim & Gismann, 1956, Saliba et al., 1976, Lutfy et al., 1978, Saliba & Othman, 1980, Arbaji et al., 1998). In 1950 and 1951 a study was commissioned by the World Health Organization (WHO) to search for *Bulinus truncatus*, the intermediate host for

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schistosomiasis, across south-western Asia including Jordan (Azim and Gismann, 1956). This study also provided records of *Melanopsis* sp. of various forms from the Jordan and Zarqa rivers. Additional information on the freshwater snails of Jordan can be found in Scates (1968) and Schütt (1983a & b). Outside Jordan, Tristram (1865) provides various records of the freshwater and land snails of Palestine, Jordan, Lebanon and Syria. He also found *Melanopsis ammonis* from “the streams of Heshbon and Ammon”.

Within Jordan, the freshwater snails of the Azraq Oasis have received a considerable attention, especially in the 1960s. During an International Jordan Expedition, freshwater snails from Azraq were collected by M. Goerge and J. Rzoska and stored at the British Museum of Natural History, London. Some details from this collection were published by Brown and Wright (1980). Scates (1968) listed five definitely identified species of snail (*Melanooides tuberculatus*, *Melanopsis praemorsa*, *Theodoxus macrii*, *Planorbis planorbis philippii*, and *Limnea auricularia* [Sic]). She expressed some confusion about *Hydrobia* sp. and stated that this genus is represented by three forms, one of which is similar to that of *Hydrobia ventrosa*, although the other two forms were not clearly identified. Nelson (1973) listed six species of freshwater snails from Druze and Shishan ponds in Azraq. Perhaps he quoted Scates (1968), and included *Hydrobia ventrosae* [Sic] (= *Hydrobia ventrosa* (Montagu, 1803)) in addition to other common species known from Azraq.

More recently, the collections made by Prof. Ragner Kinzelbach and his students between 1975 and 1980 from the Middle East were re-examined by Schütt (1983a). Although the surveys were confined to only a relatively few sites, seven species of snail were recorded then. Schütt (1983b) also examined the collection obtained by the German geologist Dr. Klaus Bandel made in 1978 while stationed in Jordan. He recorded 14 species of freshwater snails from several locations.

Between 1981-1983, the first comprehensive study on the freshwater snails of Jordan was carried out through efforts on Prof. Elias Saliba (University of Jordan) and the Ministry of Health in partnership with Prof. John Burch (University of Michigan, Ann Arbor, USA)

and Prof. John Bruce (University of Lowell, USA). Two hundred and thirty nine freshwater sites were surveyed across the country. The results of this survey were published initially by Burch & Bruce (1985), and then by Burch et al. (1989). They listed a total of 17 freshwater snail species. Collected specimens are now held at the museum of Zoology, at the University of Michigan, Ann Arbor.

Previous studies on the freshwater snails of the Middle East, particularly on Syria and Lebanon were published by Germain (1921-1922) and Pallary (1929, 1939). More detailed studies on the freshwater snails of neighboring countries are given in Schütt (1983a and b) and Kinzelbach (1980) for Syria; Alouf (1998), Glöer & Bößneck (1997 a & b) and Bößneck (2011) for Lebanon, and Neubert (1998) for the Arabian Peninsula. Thus, the main aim of the current study was to re-examine the freshwater snails of Jordan through direct field surveys and where necessary to update the current taxonomic status of individual species.

MATERIALS AND METHODS

Eighty five freshwater sites representing several aquatic habitats (springs, dams, water collecting pools, swamps, rivers and streams, ponds and irrigation canals) were surveyed for the presence of freshwater snails between 2010 and 2013. Samples were collected by hand or by means of a 2 mm pore size sieve for small-sized and mud-dwelling species. Specimens were then preserved in plastic containers containing 70% ethanol. For each site, a standard snail survey form was completed including description of the site body is main features and surrounding landscape.

RESULTS

The freshwater snail fauna belongs to two subclasses of the class Gastropoda (Caenogastropoda and Pulmonata). Prosobranchians includes seven families (Bithyniidae, Cochliopidae, Neritidae, Hydrobiidae, Melanopsidae, Neritidae, Thiariidae and Valvatidae) with nine genera (*Bithynia*, *Heleobia*, *Melanooides*, *Melanopsis*, *Plotia*, *Pseudamnicola*, *Pyrgophorus*, *Theodoxus*, *Valvata*) representing 16 species. Pulmonates are represented by three families (Lymnaeidae, Physidae and Planorbidae) within six genera and species.

Prosobranchia

Family Neritidae Rafinesque, 1815

Theodoxus jordani (Sowerby 1844)

Description: Shell medium in size, up to 15 mm in length, with about 4 whorls, 'zebrated' (generally), or with white spots on a dark background, or uniform black or dark purple to yellow in color. Zebrated shells have red or brown to deep purple or black zig-zag stripes on a white or yellow background. The shell is imperforate, and has a wide, flat, white parietal callus. The spire is very short, body whorl large, elongate, and usually has a broad, shallow constriction. The aperture is D-shaped, and is tightly closed by an operculum of the same shape (Fig. 1 A).



Fig. 1: A. Shell morphology of *Theodoxus jordani*. B. Shell morphology of *Theodoxus macrii*.

Range of distribution: Distributed in the Near East, except the Arabian Peninsula.

Distribution in Jordan: Present study: along the East Ghore Canal, Aqraba spring, Al-Ghazal spring (Yarmouk Reserve), Ghnyah and Khraisan springs in Zarqa. Previous records: Wadi Zaraq Ma'in (Near the Dead Sea), Azraq (Schütt, 1983a); Azraq, Rumeimin springs, Seel Hisban, Wadi Essir, Dhibin stream, Wadi Hidan, Elquneiya spring, Hemma, Yarmouk river, Wadi Azraq (Schütt, 1983b). Tawaheen Al Sokar, Dair Alla, East Ghore Canal, Yarmouk River, Abu Sedo, Shai-kh Hussain Bridge, King Hussain Bridge, Ein Rahoub, Al Mogarin, Kufri Lahi spring, Abdou spring (Burch et al., 1989).

Habitat: This is one of the most ornamented freshwater snail species in Jordan. Within the same population, different patterns of striations as well as coloration were observed. *Theodoxus jordani* is confined to some localities in the Jordan Valley and along the Jordan and Yarmouk rivers. It prefers clear and fast running water. Snails are usually submerged and attached to stones located within turbulent parts of the water body. It was collected from the East Ghore Canal as well as from the secondary and tertiary irrigation canals. An isolated population in Azraq oasis was also recorded (Burch et al., 1989).

Remarks: The *jordani* complex consists of three isolated subpopulations; *Theodoxus niloticus* (Reeve, 1856) in the Nile River, *Theodoxus jordani* (Sowerby, 1844) in the Levant rift valley and *euphraticus* (Mousson 1874) in Mesopotamia (Roth, 1987). Furthermore, Roth (1984) showed that the characteristics of the operculum provide an effective characteristic for the systematics of this species. Schütt et al. (1983) discussed the relationships between the plio-pleistocene snails of the Jordan and the Orontes valleys. They stated that this species is very adaptive and variable, to the point that shells of the living forms cannot be grouped into geographical subspecies. Further studies discussed the biogeographic relationship of this species in the Middle East (Alouf, 1998).

Theodoxus macrii (Sowerby 1844)

Description: Shell with the same general characteristics as *Theodoxus jordani*, but somewhat smaller, uniformly black or dark purple in color, and without a constriction in the body whorl. The shell is ovate in 'apertural' or top view, and hemi-spherical in side view. Operculum as in *Theodoxus jordani* (Fig. 1 B).

Range of distribution: Jordan, Syria, Iraq, Palestine.

Distribution in Jordan: Present study Ajloun, Al-Zoughdyah, Bossat El Eraq, Ennab fish ponds (Kofranga), Al-Baida spring (North Shoonah), Al-Rmaimeen spring. **Previous records:** Swaimeh spring, Othaymat, Quasmiya, Barakat spring, Halaweh spring, Quanyah, Al-Diat, Azraq Druze, Damyah Bridge, Al-Deak Spring, Bayda spring, Tal Arbaeen spring, Wadi Ziglab, Shaikh Hussein spring, Jorf Wadi, Lakna spring, Tul Arbueen Outlet, Yarmouk River North, Salem Yousef spring, Amayrah Spring, Bast Al-Halabi, Al-Rasam spring, Abu-Azbi spring, Ganam southern spring, Sharhabeel Basa, Slikhat, Mageda spring, Al-Yabis Agricultural Station spring, Shouna Spring, Gholah spring, Zour Ambeerh, Al-Jarm Wadi, Sofsafo Spring, Abu Hajeer spring, Ben Hammadn spring, Sekeen spring, La'aban spring, Om Shrar Irbid, Eoon Om Ershid Al-Rafeed, Iraq Al-Ameer, Khillet Al-Ein Saham-Irbid, Ein Eish Al-Rumman Saham-Irbid, Ein Al-monqat Samar, Ein Al-Fatouha Kufr Soum, Aqraba spring, Doflah spring, Sa'ud spring, Hajala spring, Sofla spring, Wadi Al-Rmemin, Sultan spring, Wadi Alal-Irbid, Al-Ghadir springs-Kufr soum, Sheeha spring (Burch et al., 1989).

Habitat: This species inhabits clear springs and fast running water. It is most common in the springs and streams in the Mediterranean ecozone and the Jordan Valley.

Remarks: Burch et al. (1989) recognized *Th. macrii* as a separate species from *Th. jordani* since the two nominal species are clearly distinguishable among the examined Jordanian specimens. On the other hand, Degan (1971) considered *Th. jordani* and *Th. macrii* as the same species. His conclusion was based on the opercular apophyses and the shape of the central teeth of the *radula*. *Theodoxus macrii* is

smaller than *Th. jordani*, with uniformly black or dark purple colour and without a constriction of the body whorl (Burch & Amr 1990). Further studies are required to clarify its systematic status.

Family Valvatidae Gray, 1840

Valvata saulcyi Bourguignat 1853

Description: The adult shell is about 4 mm in diameter, has 3 1/2 to 4 whorls, is depressed helicoid, rather widely umbilicate, translucent, pale to tannish-horn, with well-developed transverse striae and faint spiral striae. The sutures are moderately deep. The round aperture is closed by a round, thin, corneous, multi-spiral operculum (Fig. 2 A).

Range of Distribution: Jordan, Syria, Palestine, Lebanon, Turkey, Egypt and Italy (Sicily).

Distribution in Jordan: Previous records: Azraq south pool, Jerash Roman Pools, Wadi Essir, Wadi Rum spring (Schütt, 1983b); Al-Hashra swamps (Burch et al., 1989).

Habitat: This species occurs in different types of standing water and springs, preferably with aquatic vegetation.

Family Bithyniidae Gray, 1857

Bithynia philalensis (Conrad 1852)

Description: The shell is horn or tannish-horn in color, moderately glossy, rather solid, translucent, smooth except for sculpture of fine growth lines, imperforate, perforate or rimately perforate, with impressed sutures and up to 5 whorls. Shells of the largest specimens reach nearly 10 mm in length. The spire height varies from being less than the height of the shell aperture to being noticeably greater than that of the aperture. The aperture is entire and is ovate in shape. The calcareous, concentric operculum has a small spiral nucleus, 1/6 to 1/5 the width of the operculum. The operculum barely fits the shell aperture (Fig. 2 B).

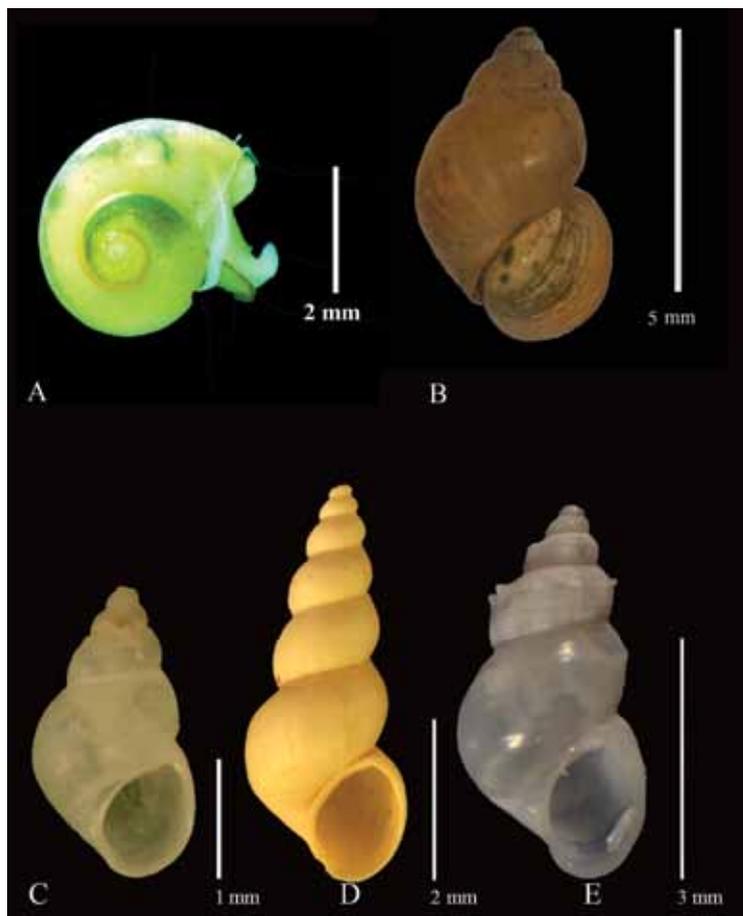


Fig. 2: A. Shell morphology of *Valvata saulcyi*. B. Shell morphology of *Bithymia philalensis*. C. Shell morphology of *Heleobia contempta*. D. Shell morphology of *Heleobia longiscata*. E. Shell morphology of *Pyrgophorus coronatus*.

Range of Distribution: Jordan, Palestine, Lebanon and Syria.

Distribution in Jordan: Previous records: Shaik Hussain spring,

Azraq southern, Jordan River Shaikh Hussain Bridge, Wadi Khaled Irbid, Al-Tarfeh Swamps Yarmouk River, Al-Hashra Swamps (Burch et al., 1989).

Habitat: This species inhabits swamps, in small groups around springs and small ponds. It was collected along swamps formed near the Yarmouk and Jordan rivers.

Remarks: Further studies on the penial morphology are required to distinguish species from the *Pseudobithynia* species known from Middle East, and clarify its generic affiliation (Glöer & Bössneck 2007; Glöer et al. 2012).

Family Hydrobiidae Stimpson, 1865

Globuliana gaillardotii (Bourguignat, 1856)

Description: Shell small, 2.5–3.5 mm in length, subovately to subglobose conic, with about 4 1/2 to 5 1/2 whorls. The shell is narrowly umbilicate to perforate, glassy and transparent to translucent horn. The aperture is entire. Although the length of the spire is variable, its length is generally about the same as or a little more than that of the aperture.

Range of Distribution: Jordan, Lebanon, Syria and Palestine.

Distribution in Jordan: Previous records: Al Ma'alaka spring (Ruwaiha), Ein Om Ershid, Basat Al Faras (Ghore Kabed), Ain Al Amyreh (Saham), Wadi Al Kafer, Wadi Al Khood, Wadi Al Mokaran, Barakat spring, Zarat spring, Beer Al Azraq (Burch et al., 1989).

Habitat: It was found in various freshwater habitats including spring, mineral springs and swamps along the Jordan Valley (Burch et al., 1989).

Remarks: This species was listed as *Globuliana gaillardoti* (Germain, 1911) by Mienis (2010). Burch et al. (1989) listed this species as *Pseudamnicola gaillardoti* for Jordan.

Pseudamnicola solitaria Tchernov, 1971

Description: Shell small, 1–1.5 mm in length, with four whorls, globose, glossy, near transparent, narrowly umblicate with entire aperture.

Range of distribution: Jordan and Palestine.

Distribution in Jordan: Previous records: Dead Sea springs, Zarqa Ma'in cool and hot waters, Tal spring (Schütt, 1983b), Wadi Al Kafer, Beer Al Azraq (Burch et al., 1989).

Habitat: This is another halophylic hydrobiid inhabiting swamps and streams around the Dead Sea area (Schütt 1983b, Burch et al., 1989). *Pseudamnicola solitaria* is an **endemic** species to Jordan and Palestine.

Remarks: This species was originally described from a few springs along the Dead Sea (Tchernov, 1971). It is considered Endangered according to the IUCN Red List of Endangered Species.

Pseudamnicola sp.

Description: Subovately to ovately conic shells, perforate and small (3-5 mm) length, 5 whorls and sculpture of fine growth lines, tannish horn color.

Distribution in Jordan: Present study: North Shunah. **Previous records:** Azraq Druze, Ein Om Ershid, Zour Al-Nees, Zour Al-Breej Yarouk River, Wadi Khalid Irbid (Burch et al., 1989).

Habitat: Located in brackish water, and occurs on sandy-muddy substrates. The shell morphology of this species is close to *Bithynia phialensis* but smaller in size. Further examination for live specimens for this form should be undertaken to reveal its identity.

Family Cochliopidae Tryon, 1866

Heleobia contempta (Dautzenberg 1894)

Description: Shell small, 2-3.5 mm in length, narrowly to elongately

conic imperforate shell that consists of 5 to 5.5 whorls, light white-yellowish color and translucent, sutures separating the whorls are mildly impressed (Fig. 2 C).

Range of distribution: Jordan, Palestine, Syria and Lebanon.

Distribution in Jordan: Present study: Al-Karamah dam. **Previous records:** Dead sea, Sail Hisban, Jerash Roman Ponds, Wadi Essir, Dhibin stream, Zarqa Ma'in cool and warm waters, Wadi Hidan, Elquneiya spring, Hemma, Yarmouk River, Wadi Na'ur spring, Kherbat Suweirat (Schütt, 1983b); Beer Al-Azraq, Rahib spring, Al-Maleh spring, Okla Wadi, Wadi Mokran spring, Al-Karn spring, Bast Al-Feleh Mashareh, Al-Kafer wadi, Debaa Spring, Rehab spring, Saham Irbid, Aqraba area, Ein Frouj Irbid, E'oun Al-Alka Saham, Ein Al-Habees Saham, Faroje Spring, Ein Om Ershid (Burch et al., 1989).

Habitat: It was found to inhabit springs, swamps and dams. Specimens were usually found attached to roots of aquatic vegetation.

Remarks: In previous reports, this species was placed as *Semisalsa contempta*. Molecular data suggests that species of the genus *Semisalsa* should be reassigned under the genus *Heleobia* (Wilke et al., 2001).

Heleobia longiscata (Bourguignat, 1856)

Description: Another brackish water living species, shell is 4-6 mm length only, shell is narrowly elongated conic with up to 6 1/2 whorls, torsion is right-handed, light of tan white-yellowish color with transverse bands on the body whorl impressed sutures separating the whorls and the shell is perforated (Fig. 2 D).

Range of distribution: The distribution range extends from Turkey to Jordan.

Range: Jordan, Syria, Libya, Israel and Turkey.

Distribution in Jordan: Present study: Azraq Oasis. **Previous records:** Asad spring (=Lion Spring Azraq), Dashah-Azraq (Burch et al., 1989).

Habitat: This small snail is only known from the swamps of Azraq oasis. It was reported from brackish waters of the Syrian coastal area (Schütt, 1983a).

Remarks: Schütt (1991) considered this species to be in the genus *Semisalsa* rather than *Heleobia*. The record of Schütt (1983b) of *Semisalsa musaensis* (= *Hydrobia musaensis*) from Azraq may probably erroneous and could be *Heleobia longiscata*. Also, the record of *Hydrobia lactea* from the Lion spring in Azraq by Brown & Wright (1980) and Scates (1968) for *Hydrobia ventrosa* could be also *H. longiscata*.

Pyrgophorus coronatus (L. Pfeiffer, 1840)

Description: shells very small, right coiling, ca.1.2-3.5 mm length; shell perforated with a slit-like umbilicus; teleoconch whorls strongly shouldered, shoulder often with conical or triangular spines; lower part of the whorls with fine spiral ridges; usually, penultimate whorl only slightly shouldered marked by a fine keel or step-like margin; shell light greyish to white-yellowish in color (Fig. 5 E).

Range of distribution: Coastal areas of the southern states of North America, both sides of Central America and the northern countries of South America. Introduced to Hawaii, Jordan and Palestine.

Distribution in Jordan: Present study: Al-Karamah Dam, Ayoon Al Tilal (Al Masharea'h), Northern Jordan Valley.

Habitat: Shells and living specimens were collected from four sites in the Jordan Valley, including a dam, irrigation ponds and a spring. This is an invasive species that was not collected during 1981-1983 survey. Recently *Pyrgophorus* sp. was reported in the Tanininim River basin, Israel (Mienis et al., 2011).

Remarks: Hershler & Thompson (1992) reviewed the systematics of the genus. There is no current revision of the genus *Pyrgophorus*, as this genus is widely distributed in the American tropics with more than 20 described species proposed.

Family Thiaridae Gill, 1871

Melanooides tuberculata (Müller, 1774)

Description: Shells vary in size, the larger ones reaching nearly 50 mm in length and containing up to 15 whorls. The shell is imperforate, and has moderately rounded whorls, which are separated by moderately impressed sutures. The shell surface is sculptured with transverse ribs and spiral ridges and grooves (although in some regions of the species' distribution populations occur which contain shells that are almost or completely smooth). The shell is light horn or somewhat darker in color, with reddish-brown color patches. The anterior shell aperture is evenly curved. The posterior aperture is not narrowly constricted, as it is in *Melanopsis praemorsa* (Fig. 3 A).

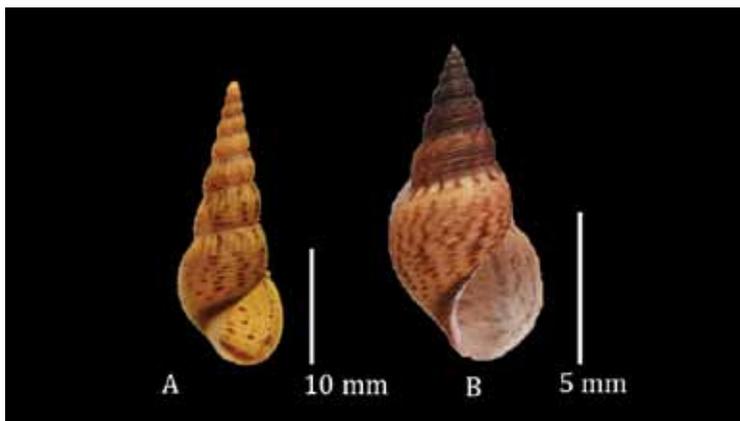


Fig. 3: A. Shell morphology of *Melanooides tuberculata*. B. Shell morphology of *Plotia scabra*.

Range of distribution: worldwide in distribution throughout much of Africa into Asia and Australia.

Distribution in Jordan: Present study: water collecting pools in South Shoonah, Ghore Al-Safi, Ghore Fifa, Al-Karamah Dam, Ennab

fish ponds in Kofranga, streams near Dead Sea, Irrigation canals in Swaimeh, Khraisan and Ghnayah springs in Al-Hashemyah (Zarqa). **Previous records:** Dead sea springs, Azraq Shishan and south pool, Zerqa ma'in cool water, El Quneiya spring (Al Hashimiyah), Hemma, Yarmouk River, Hammam spring, el Sokhneh, Deir Alla, Wadi Azraq (Schütt, 1983). Swaimeh spring, Hamdi Al-Anees spring, Othaymat, Quasmiya, Mahateet spring, Wadi Dokhanya, Nakhlah spring, Barakat spring, Mahafeet spring, Draybeh, Halaweh spring, Kafreen Dam, Moasher farm, Quanyah, Jedyaab Wells, Al-Birkteen, Al-Waleh Wadi, Al-Deak Spring, Ma'an, Abu Zyad spring Halaka Spring, Aleyah spring, kofer Assad spring, Tal Arbaeen spring, Al-Maleh spring, Northern Maleh spring, Wadi Ziglab, Kasim spring, Abu Besseh spring, Tal Zarah, Jorf Wadi, East Jordan canal, Dokan spring, Lakna spring, Shater spring, Tul Arbueen Outlet, Bayda Spring, Wadi Zahar, Al-Maleh Southern spring, Al-Maleh med Spring, Yarmouk River North, Nakheel Wadi, Wadi Al-Ghore, Salem Yousef spring, Amayrah spring, Basat Al-Halabi, Al-Rasam spring, Bata spring, Abu Azbi spring, Ganam southern spring, Al-Khesa spring, Awad Hamod spring, Narjas spring, Sharhabeel Basa, Bast Rayahni, Abu Hani spring, Slikhat, Mageda spring, Al-Yabis Agricultural station spring, Shouna spring, Ghanam spring, Sa'ada spring, Tal Salman spring, Masbeerah spring, Zour Al-hamam, Gholah spring, Marazal Spring, Amayrah spring, Zour Ambeerh, Mnawer spring, Al-Jarm Wadi, Sof-safa spring, Abu Hajeer spring, Yatook spring, Arabeya spring, Ben Hammadn spring, Sekeen spring, La'aban spring, Azraq-southern, Jordan River King Hussain bridge, Om Sharar, Salleh spring, Sahab-Irbid, Ein Haroub Irbid, E'oun Al-Alka Saham-Irbid, Wadi Khaled Irbid, Qanat Al-Aqlat Saham, Ein Al-Amayreh Saham, Ein Al-Dellan Al-Mansoorah Irbid, Ein Deeb Saham, Ein Al-Sahn Al-Mansoorah, Eraq Al-Amir, Khiller Al-Ein Saham, Ein Al-magaren Kufr Soum, Ein Eish Al-Rumman Saham, Ein Al-Monqat Samar, Ein Al-Fatouha Kufr Soum, Ein Al-Tayyah Irbid, Ein Al-Habees Saham, Ein Issa Saham, Sheha and Sokar spring, Mokhibeh Yarmouk River, Hemma spring, Aqraba spring, Doflah spring, Sa'ud spring, Sab'ee spring, Hajala spring, Yobla spring Irbid, Kufr Lahi spring, Sofla spring, Wadi Al-Rmemin, Wadi Al-Wala Madaba, Ein Al-Safayneh Saham, Sultan spring, Sahal spring, Wadi Alal Irbid, Al-Ghadeer spring Kufr Soum, Abdou spring (Burch et al., 1989).

Habitat: One of the most common species in the Jordan Valley. This thiarid snail is associated with saline freshwater bodies, including springs, streams and swamps. This is a common species in the Jordan Valley and around the Dead Sea basin. It was also collected from Azraq oasis (Burch et al., 1989). This species is active mostly at night, hiding beneath decaying plants and stones or burying itself in the mud during the day (Livshits & Fishelson, 1983).

Plotia scabra (Müller, 1774)

Description: shell conical, turreted, with a maximum length of 23 mm; shell consisting of 8-12 whorls; usually, upper whorls shouldered, ribbed, often with upwards pointing spines at the shoulder, or with thickened knob-like ribs on the shoulder; teleoconch whorls with spiral threads; shell colour varying from reddish-yellowish to olive-green with an irregular pattern of red-brown spots or zig-zag like axial flames (Fig. 3 B).

Range of distribution: South and Southeast Asia, the Indo-Australian Archipelago extending westwards to the western Pacific Islands. This species has been introduced to many countries in the Arabian Peninsula, Jordan and Palestine.

Distribution in Jordan: Present study: North Shunah, near Al Adasyeha area, The East Ghore Canal.

Habitat: Considered as invasive tropical species, closely related in morphology and habitat to *M. tuberculata*. In the Middle East, it became a dominant species in Lake Tiberius, reaching as much as 95% of the total freshwater snail fauna, causing almost eradication of four native species (Heller et al., 2013). It was also found in other adjacent water bodies (Roll et al., 2009; Mienis et al., 2011) and became established in many countries in the Arabian Peninsula (Brown & Wright 1980, Brown & Gallagher 1985, Neubert, 1998; Feulner & Green, 1999).

Remarks: Glaubrecht et al. (2009) moved *Thiara scabra* to the genus *Plotia* Röding, 1798 and suggested *Plotia scabra* for this species. Further clarification of the systematics of this species is given by Mienis (2012).

Family Melanopsidae Adams & Adams, 1854

Systematics: Olivier (1801 and 1804) considered two species of the genus *Melanopsis* in the Levant; *M. buccinoidea* and *M. costata*. Forty three species of *Melanopsis* have been described earlier, but later reduced to six species by Germain (1921) including *M. praemorsa*, *M. jordanicensis*, *M. bullio*, *M. saulcyi*, *M. bovieri* and *M. costata*. Some investigators suggested that all *Melanopsis* shell variations reflects ecotypes and all belong to a single species; *Melanopsis praemorsum* (Tchernov, 1975). Two species of *M. praemorsa* (smooth) and *M. costata* (rough) were considered by Bilgin (1983). Five species of *Melanopsis* were represented by Mienis & Ortal (1994) as *M. p. buccinoidea*, *M. p. eremita*, *M. p. jordanica*, *M. saulcyi* and *M. certhiopsis*. Schütt & Sesen (1989a) considered all *Melanopsis* of the Levant as *M. praemorsa* and *M. p. bandeli* from Jordan in addition to five subspecies derived from *M. praemorsa* from Syria. Burch et al. (1989) assigned *Melanopsis* in Jordan by two species; *M. p. buccinoidea* and *M. p. costata*. Glaubercht (1996, 1999) suggested that the two subspecies arise from the superspecies *M. praemorsa*, and have minor anatomical differences including radula and shell sculpture and they hybridized widely to produce polymorphic individuals. Heller & Sivan (2000) suggested, based on comparative studies of sperms, radula and allozymes, that four species occurred in the Jordan valley (*M. buccinoidea*, *M. costata*, *M. saulcyi* and *M. meiotoma*) and seven species in the Levant; all those of the Jordan Valley and another three species *M. doraie*, *M. sharhabili* and *M. ammonis* (Bandel, 2000).

Five smooth-shelled *Melanopsis* species were described; *M. buccinoidea*, *M. ammonis*, *M. dircaena*, *M. khabourensis* and *M. meiotoma* (Heller et al., 2005). *M. ammonis* is considered as a subspecies from the buccinoidae and significantly differs from *M. meiotoma* (Heller et al., 2005). Another five species with ribbed shells; four subspecies derived from *M. costata* found in north Orontes, upper Jordan, Sea of Galilee and south of Levant (Heller et al., 2005). According to fossil evidence, the *M. saulcyi* has released due to hybridization between *M. costata* and *M. buccinoidae* during the last 1.5 Million years. Therefore in morphology, *M. saulcyi* specimens have narrower shell and shorter, bumpier ribs compared with *M. costata*. Other ribbed shell snails in the Levant, including *M. germaini* have numerous ribs com-

pared with *M. costata*. *M. pachya* with shorter ribs. *M. infracincta* is characterized by its bumpy shells with each rib has huge tubercles with pronounced ridge flanking the columella.

***Melanopsis ammonis* Tristram, 1865**

Description: Elongated and narrow shell, black or reddish brown in colour, apex acutely pointed. Shell body smooth with 7-9 high whorls, gradually increasing, separated by very shallow sutures, ribs or striae indistinct, simple and acute while callus around the shell mouth (Fig. 4).



Fig. 4: Shell morphology of *Melanopsis ammonis*.

Range of distribution: Endemic to the Jordan Valley, Palestine and Jordan.

Distribution in Jordan: Present study: Rumeimin waterfalls, Rumeimin spring. Previous records: Heshbon (=Hisban) and Ammon (=Amman) streams (Tristram, 1865); Rabat Ammon (=Amman), Wadi Al Walla, Hamam Yarmouk, Rumeimin (Heller et al., 2005).

Habitat: Found in clear running water around springs and waterfalls around Rumeimin.

Remarks: *M. ammonis* was considered as a subspecies from the buccinodae and significantly differs from *M. meiotoma* (Heller et al., 2005). *Melanopsis ammonis* differs from *M. buccinoidea* of the Jordan valley in its higher penultimate whorl, as expressed in its higher values of the ratio $f/\text{mouth height}$.

***Melanopsis buccinoidea* (Olivier, 1801)**

Description: Two forms were; the Levant form (elongated) and the Jordan Valley form. Compared to the Levant forms, the Jordan Valley form is 'stouter'. So the shell diameter compared to shell height (SD/SH) is relatively large in the Jordan Valley form with a larger mouth height relative to shell height (MH/SH) and lower (F/MH) ratio. For clearer discrimination between the two forms, cluster analyses have been made to study the relationship of the two ratios ($f/\text{Mouth Height}$) relative to ($\text{Mouth Height}/\text{Shell Height}$) with two clusters found as the Jordan Valley form has high a ratio of (MH/SH) and lower ratio of (f/MH) and vice versa for the elongated form (Fig. 5).



Fig. 5: Shell morphology of *Melanopsis buccinoidea*.

Melanopsis saulcyi (Bourguignat, 1853)

Description: Has more ribs than *M. costata*, the shell is elongated and the mouth height is small in relation to the shell height (MH/SH). The ribs are 'bumpier' and descend from the suture to about the middle of the lowest whorl; the rib usually consists of an upper tubercle, fused to the lower ridge. The color varies from pale brown to dark brown or black, each rib, on the penultimate whorls, has a waist (Fig. 6).



Fig. 6: Shell morphology of *Melanopsis saulcyi*.

Range of distribution: Jordan, Palestine and Syria.

Distribution in Jordan: Present study: Ghnayah and khraisan springs, Ennab fish ponds (Kofranga), Al-Baidah spring, Al-Rmai-meen spring, Um El-Ebr spring. Previous records: perhaps it was confused with *M. costata*.

Habitat: This species was found in slow running water courses and occurred close to aquatic vegetation.

Melanopsis costata jordanica (Roth, 1839)

Description: Shell is significantly 'stout', compared to the *M. saulcyi*.

The ribs are mildly pronounced, with rounded shoulders, the mouth is relatively large. Shell color varies, some shells are black but many are banded; the dark bands are broad and black. The last whorl of each banded shell has three dark bands and two pale ones (Fig. 7).



Fig. 7: Shell morphology of *Melanopsis costata jordania*

Range of distribution: the Levant and Iran.

Distribution in Jordan: Present study: Yarmouk River.

Habitat: Like *M. saulcyi*, *M. c. jordania* is found attached to rocks or concrete on both sides of the water canals. This species is a habitat generalist. It was found along irrigation canals, streams, swamps and ditches.

Melanopsis costata obliqua (Bourguignat, 1884)

Description: Ribs of the last whorl extend along the entire length of the whorl, the shell is conic to elongate in shape. Each rib has a very prominent tubercle fused to straight prominent lower ridge. The upper three whorls are smooth, while the lower whorls are ribbed; tubercle and the ridge are sometimes separated by a depression. The shell color is grayish yellow to almost black (Fig. 8).



Fig. 8: Shell morphology of *Melanopsis costata obliqua*.

Range of distribution: the Levant and Iran.

Distribution in Jordan: Present study: Jordan River, the East Ghore Canal.

Habitat: Inhabiting springs and swamps often found submerged in the mud. This species was known from the lower Jordan valley and the coastal plain of the southern Levant.

Melanopsis costata lampra Bourguignat, 1884

Description: Shell conical, ribs are mildly pronounced and their shoulders are rounded. *M. c. lampra* further differs from *M. c. costata* in that it has a larger mouth (higher mouth-height/shell-height), higher number of ribs, and these are closer together (Fig. 9).

Range of distribution: Known from the Hula valley, upper Jordan River, coastal plain of northern Palestine, and in the Azraq Oasis in Jordan.

Distribution in Jordan: Present study: Azraq marshes.



Fig. 9: Shell morphology of *Melanopsis costata lampra*.

Habitat: This species inhabits still water with dense vegetation of *Typha*.

Family Lymnaeidae Rafinesque, 1815

Galba truncatula (O.F. Müller, 1774)

Description: Shell dextral, small in size (10 mm or less), 'rimately' perforated, sutures deeply impressed, white-brownish or tan color and glossy. The spire is broader and less acutely pointed than *Radix auricularia*, and is about the same height as the shell aperture (Fig. 10 A).

Range of distribution: Widespread throughout the world.

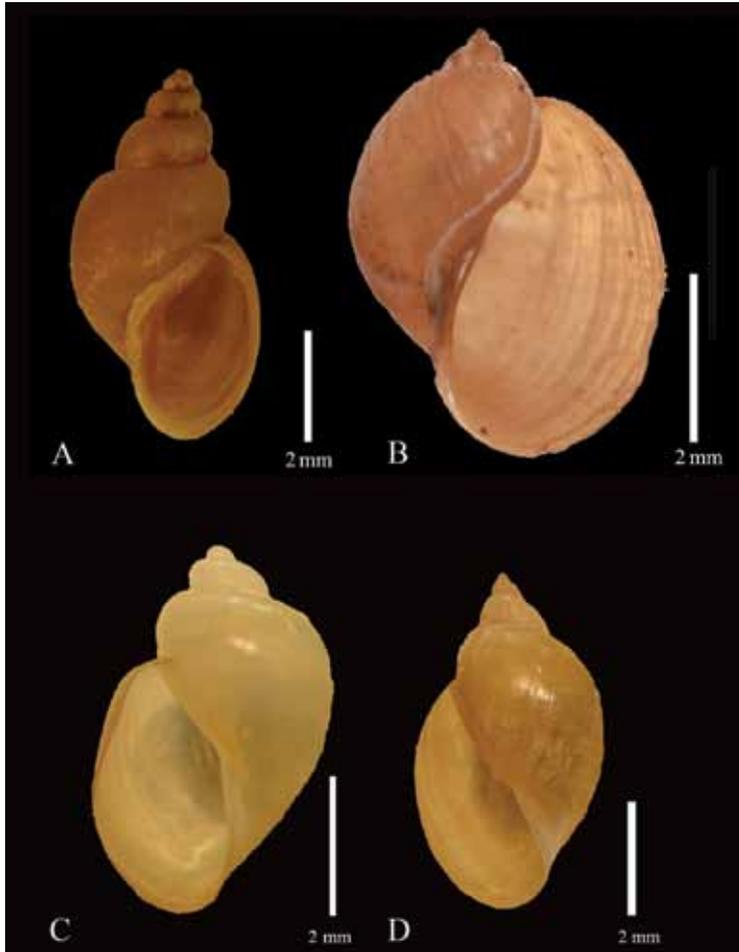


Fig. 10: A. Shell of *Galba truncatula*. B. Shell of *Lymnaea natalensis*. C. Shell of *Bulinus truncatus* D. Shell of *Haitia acuta*.

Distribution in Jordan: Present study: Ail spring (Ma'an), Um Al-Ebr spring (Ajloun), Jinin and Danah springs (Al-Tafilah). **Previous records:** Kherbat es Suweirat (Schütt, 1983b). Kafreen Dam, Mohr-

been spring, Abu Azbi spring, Hamed spring, Mageda spring, Debaa spring, Aymeh spring, La'aban spring, Lahtha spring, Ma'an spring, Aeil spring, Wadi Al-Sigin Hartha-Irbid, Saham Irbid, Na'our, E'oun Al-Alka Saham, Wadi Khaled Irbid, Mureihat kated Al-Karama, Ein Al-Lataifeh Saham, Zizon spring, Mokhibeh Yarmouk River, Om Green spring, Quaibeh spring (Burch et al., 1989).

Habitat: This species inhabits stagnant and slow running waters, irrigation canals and swamps. It was found along the muddy edges of rivers and springs.

Remarks: Species of this genus have undergone various radical revisions. Previously, species of *Galba* in the Middle East were placed under the genus *Lymnaea*. *Bargues* et al. (2001) stated that the taxonomic status of this family remains unclear.

Lymnaea natalensis Krauss, 1848

Description: The shell is medium in size, 12 to 15 mm in length, thin (but not especially fragile), has a relatively large body whorl and a small and pointed spire, is tannish-brown in color, translucent, perforate, without spiral sculpture, lacks a columellar plait (or has only a slight trace of one), and has a thin and sharp 'apertural' lip. The shell surface is moderately glossy, with distinct (but not prominent) growth lines (Fig. 10 B).

Range of distribution: Tropical Africa, Yemen, Oman and Saudi Arabia.

Distribution in Jordan: Previous records Berjes/ Azraq, Azraq Southern, Om Khlal Irbid, Zour Al-Breej Yarmouk River, Al-Braig Irbid, Zour Abo Al-Ghosh Aqraba, Wadi Zeizon Irbid, Wadi Amrawa Irbid, Al-Hashra Bridge Swamps Irbid, Ein Om Ershid Irbid (Burch et al., 1989).

Habitat: This snail prefers swamps with dense vegetation on the margins. Recently, we found a small population in Al Shawmari Wildlife Reserve, living around animal watering area with limited vegetation. It used to be common in swamps in the Jordan valley,

but now it is known from very few locations.

Remarks: Previous records for this species from Jordan are referred to as *Lymnaea auricularia* (Lutfy et al. 1978; Saliba & Othman 1980), and *Lymnaea (Radix) auricularia* (Burch et al., 1989). Neubert (1998) pointed out the urgent need for a revision of the species within the family Lymnaeidae. *Radix natalensis* and *Radix auricularia* have both been found across the Arabian Peninsula.

Family Physidae Fitzinger, 1833

Haitia acuta (Draparnaud, 1805)

Description: Shell sinistral and ovate, small to medium size shell (8-15 mm), imperforated and forming 5 1/2 whorls. Pale white-yellowish in color and translucent, smooth and moderately glossy. Shell with fine growth lines and faint spiral sculpture. Aperture is more than half the total shell length. The outer lip of the aperture is sharp and their shell has a sharply pointed apex (Fig. 10 C).

Range of distribution: widespread in northern America, Europe, Eurasia, and Africa.

Distribution in Jordan: Present study: Zarqa River, Wadi Shaib Dam, Al-Sader spring (Wadi Mussa), Khraisan and Ghnayah springs in Zarqa, Al-Ghazalat spring. **Previous records:** Deir Alla (Schütt, 1983), Kafreen Dam, Tawahen Al-Sokar, Arda Triangle, Kabed Lake, Ghour kabed canal, South shounah Dam, Al-Karamah wells, Moasher farm, Swalha, Al-Fazah, Dair Alla, Masri Triagle, Swalha, Tal Al-Dahab, Al-Diat, Fanosh Spring, University Farm Station, Shoeabe Dam, Damyah Bridge, Issa spring, Sokhnah spring, Aid spring, Nabaa spring, East Jordan Canal, Yarmouk River North, Said Shameeli spring, Al-Kafer spring, Shaheen spring, Bast Al-Halabi, Ahmed spring, Abadee spring, Hamed spring, Abdel Hadi spring Bast Hamdan, Tal Sliman Shamalih, Al-Karn spring, Sharhabeel Basa, Bajawi spring, Barghasha spring, Bast Rayahni, Bast Al-Feleh Mashareh, Abu Akeel spring, Al-Yabis Agricultural station spring, Abu Sedo, Zour Al-Hamam, Gholah spring, Shahadat Wadi, Tahtamoni Spring, Salem spring, Jordan River Shaikh Hussain Bridge, Zour Al-Nusayrah

Irbid, Zour Al-Breej Yarmouk River, Al-Braig Irbid, Wadi Khaled Irbid, Mureihat Kated Al-Karama, Zour Abu Al-Ghosh Aqraba, Zour Al-Nees, Al-Tarfeh Swamps Yarmouk River, Wadi Zeizon Irbid, Ein Al-Sarayah, Zizon Spring, Wadi Amrawa Irbid, Al-Hashra Bridge Swamps Irbid, Ein Om Ershid (Burch et al., 1989).

Habitat: This is one of the most common species inhabiting water bodies in the Jordan valley. *Haitia acuta* does not occur in mountain range or the eastern desert of Jordan. In the Jordan valley, it inhabits sewage contaminated streams (i.e. Zarqa River and Wadi Sha'ib), irrigation ponds, swamps, slow running water along springs and streams.

Remarks: Taylor (2003) has assigned *Physella acuta* to the genus *Haitia* Clench & Aguayo, 1932. The taxonomic status of populations within the Middle Eastern remains poorly understood.

Family Planorbidae Rafinesque, 1815

Bulinus truncatus (Audouin, 1827)

Description: Sinistral, small shell reaching about 10 mm in length, perforated and translucent light white-yellowish in color, moderately glossy with depressed sutures. Similar to *Haitia acuta* but less pointed, more 'shouldered' and perforated rather than imperforated (Fig. 10 D).

Range of distribution: Africa, southwest Asia and Portugal, Sardinia and Corsica.

Distribution in Jordan: Present study: Ghore Fifa, Al-Tanoor Dam. **Previous records:** Jerash Roman pools (Schütt, 1983b); Al-Birkteen, Shaik Hussain spring, Ahmed spring, Tal Sliman Shamalih, Zour Al-Hamam (Burch et al., 1989); Ghadir Abu-Zeid, Zur Al-Khbeinah, Zur Al-Nasaireh, Tallat Khalid ben Al-Walid, Mahatat Khalid, Zur Al-Klea, Ar Ramtha, Jarash - The Roman pools, Jarash, Ghawr Kabid, El-Karamah, Ash Shunah, Wadi Batus, Al-Kufren Dam, Al-Kufren, Wadi Rama, Zur Shasha'a, Ghore As-Safi, Hammamat Burbaytah, Wadi Abo Dubana, Ad-Disah (Arbaji et al., 1998)

Habitat: *Bulinus truncatus* was found to inhabit all types of ecozones of Jordan. Since 1975 and until the present, a total of 60 sites were found in four Governorates with this snail species. Most of the known populations were concentrated along the Jordan valley and the Yarmouk River (Balqa and Irbid Governorates), other major sites includes Zarqa River, King Talal Dam and Jarash Roman Pools (Zarqa and Jarash Governorates). An additional site in the southeastern Wadi Rum desert was found with this snail (Arbaji et al. 1998).

It prefers still water as in dams, reservoirs, ponds, slow water running ditch canals and pools. Snails were found from underneath rocks, floating vegetation, submerged objects (plastic sheets and containers) or around the edges the areas sampled.

Gyraulus piscinarium (Bourguignat, 1852)

Description: Discoidal small shell (5mm with 4 whorls as adult), well developed growth lines but have no spiral striation and has a shallow depressed spire, umbilicate side is slightly curved (Fig. 11).

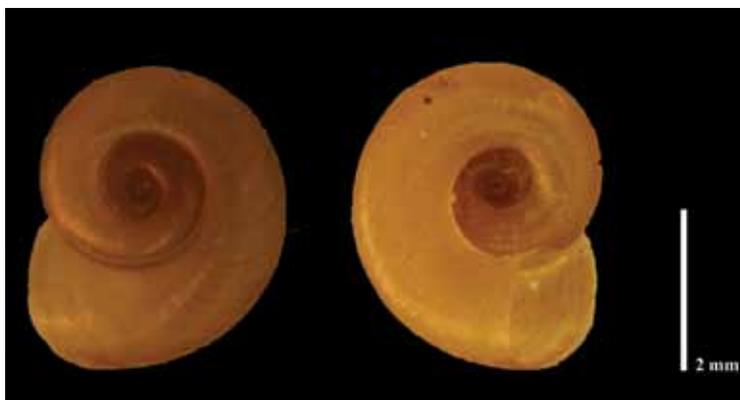


Fig. 11: Dorsal and ventral views for *Gyraulus piscinarium* collected from Ail spring.

Range of distribution: Bulgaria, Iran, Palestine, Lebanon, Syria and Turkey.

Distribution in Jordan: Present study: Ail spring, Lawrence spring

(Wadi Rum). Previous records: Wadi Rum (Schütt, 1983b); Ma'an spring, Wadi Al-Sigin, Eyoon Om Ershid, Wadi Khaled, Zour Al-Nees, Quaibeh spring, Hartha (Burch et al., 1989).

Habitat: Live specimens were recorded from small pools around springs and swamps.

Planorbis planorbis (L. 1758)

Description: Shell discoidal, up to 8 mm in major diameter, with about 4 1/2 slowly increasing whorls, pale horn in colour, with growth (transverse) lines, but without spiral striae. The inverted spire is flat, hardly depressed; the umbilical (upper-most) side is nearly flat. The whorls have a keel or sharp angulation at the periphery and this feature differentiates *P. planorbis* from *Gyraulus piscinarium*.

Range of distribution: This species is widely distributed across the Palearctic region, upper Egypt, Morocco and Algeria.

Distribution in Jordan: Previous records: Azraq (Brown & Wright, 1980); Al-Azraq (Burch et al., 1989)

Habitat: In Jordan, the distribution of this snail is known from the marshes of Azraq Oasis in the eastern desert of Jordan. It lives in shallow standing water densely vegetated by *Typha*. Its presence in Azraq may represent a relict of a formerly more widespread distribution.

Remarks: Glöer and Pešić (2010) gave a description of *Planorbis planorbis* along with the other species of this genus from the Balkans.

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