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EDITORIAL

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Amendment of Articles 8, 9, 10, 21 and 78 of the *International Code of Zoological Nomenclature* to expand and refine methods of publication

International Commission on Zoological Nomenclature[1]

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Abstract

The International Commission on Zoological Nomenclature has voted in favour of a revised version of the amendment to the *International Code of Zoological Nomenclature* that was proposed in 2008. The purpose of the amendment is to expand and refine the methods of publication allowed by the Code, particularly in relation to electronic publication. The amendment establishes an *Official Register of Zoological Nomenclature* (with ZooBank as its online version), allows electronic publication after 2011 under certain conditions, and disallows publication on optical discs after 2012. The requirements for electronic publications are that the work be registered in ZooBank before it is published, that the work itself state the date of publication and contain evidence that registration has occurred, and that the ZooBank registration state both the name of an electronic archive intended to preserve the work and the ISSN or ISBN associated with the work. Registration of new scientific names and nomenclatural acts is not required. The Commission has confirmed that ZooBank is ready to handle the requirements of the amendment.

Keywords

Amendment, archiving, electronic publication, International Code of Zoological Nomenclature, Official Register of Zoological Nomenclature, ZooBank

In 2008, the International Commission on Zoological Nomenclature (ICZN) published a proposed amendment to the *International Code of Zoological Nomenclature*, 4th edition (ICZN 1999), the primary aim of which was to define a mechanism by which electronic publication of new scientific names and nomenclatural acts could be permitted under the Code (ICZN 2008—BZN **65**: 265-275). The key principles approved

by the Commission for drafting the document were: 1) Electronic-only publications should be allowed, if mechanisms can be found that give reasonable assurance of the long-term accessibility of the information they contain; 2) Some method of registration should be part of the mechanism of allowing electronic publication of names and nomenclatural acts; 3) Physical works that are not paper-based (e.g. CD-ROMs, DVDs) should be disallowed (ICZN 2008—BZN **65**: 266). The core principles of the amendment were approved by the International Union of Biological Sciences (IUBS, the governing body for ICZN) in their 2009 general meeting in Cape Town in agreement with Article 78.3 of the Code. Thereafter the details were extensively debated within the Commission, in online forums (especially Taxacom and the ICZN listservers), in the pages of the *Bulletin* (BZN volumes **66-67**, all contributed comments available here: http://iczn.org/content/availability-electronic-publication), at numerous taxonomic meetings and at an open meeting held in London on 29 October 2011 (summary published in ICZN 2011—BZN **68**: 246-247).

A number of incremental votes were held within the ICZN Council and the Commission to develop consensus wording that satisfied many of the concerns raised during the discussion period. The main decisions reached in these votes were as follows:

1) The changes concerning electronic publication should be effective from the beginning of 2012.
2) The requirement for registration in ZooBank of new scientific names in electronic works was changed to a requirement for registration of the work itself.
3) The requirement that an electronic work be archived was changed to a requirement of intent to archive, with this requirement being satisfied by statement of the intended archive in ZooBank.
4) A requirement that an ISSN or ISBN (International Standard Serial Number or International Standard Book Number) be included in the ZooBank registration was added.
5) The period during which optical discs such as CD-ROM were acceptable media was changed from "after 2000 and before 2010" to "after 1985 and before 2013".

In a three-month vote from 9 February to 9 May 2012 the Commissioners voted in favour of the revised amendment, pending a separate vote on the readiness of ZooBank. In a one-month vote from 1 August to 1 September 2012, Commissioners certified that ZooBank was fit for the purpose of handling the requirements of the amendment, thus clearing the last obstacle to allowing electronic publication under the *International Code of Zoological Nomenclature*. The ZooBank development team has established a robust architecture and work flow for registration. During extensive beta testing of ZooBank 3.0 over the last several months, they have demonstrated the ability to respond to problems reported and suggestions made by users. The Commission anticipates that ZooBank will continue to evolve in response to input from the broader community and encourages suggestions for its ongoing development. The text of the revised amendment is published here, with bracketed comments describing the changes from the fourth edition of the Code.

Amendment

[Under Article 8 (what constitutes published work), Article 8.1.3 is modified to accommodate electronic publishing and an example is added. Former Article 8.4 is reformulated as the new 9.2, former Articles 8.5 and 8.6 are simplified and merged under the new Article 8.4, and new Articles 8.5 and 8.6 are introduced. The associated recommendations are revised.]

8.1. **Criteria to be met.** A work must satisfy the following criteria:

8.1.1. it must be issued for the purpose of providing a public and permanent scientific record,

8.1.2. it must be obtainable, when first issued, free of charge or by purchase, and

8.1.3. it must have been produced in an edition containing simultaneously obtainable copies by a method that assures

8.1.3.1. numerous identical and durable copies (see Article 8.4), or

8.1.3.2. widely accessible electronic copies with fixed content and layout.

Example: PDF/A (Portable Document Format Archive), described by ISO Standard 19005-1:2005, is a file format that allows content and layout to be preserved unchanged.

[Articles 8.2 and 8.3 are unchanged.]

8.4. **Works issued as physical copies.** Printing on paper and optical disc are the only recognized formats for works issued as physical copies. In addition to fulfilling the requirements of Article 8.1 while not being excluded by Article 9, works issued as physical copies are subject to the following criteria:

8.4.1. Works printed on paper. Before 1986 and after 2012, the only acceptable means of producing physical copies is by printing on paper using ink or toner**.**

8.4.2. Works on optical disc. To be considered published, a work on optical disc must be issued, in read-only memory form, after 1985 and before 2013, and

8.4.2.1. if issued before 2000, must contain a statement that any new name or nomenclatural act within it is intended for public and permanent scientific record and that the work is produced in an edition containing simultaneously obtainable copies, or

8.4.2.2. if issued after 1999, must contain a statement naming at least five major publicly accessible libraries in which copies of the optical disc were to have been deposited.

8.5. **Works issued and distributed electronically.** To be considered published, a work issued and distributed electronically must

8.5.1. have been issued after 2011,

8.5.2. state the date of publication in the work itself, and

8.5.3. be registered in the *Official Register of Zoological Nomenclature* (ZooBank) (see Article 78.2.4) and contain evidence in the work itself that such registration has occurred.

Examples. Evidence of registration is given by stating information that would be known only if the registration has occurred, such as the exact date of registration or the registration number assigned to the work or to a new name or nomenclatural act introduced in the work. A work issued as a PDF may contain the registration number as an embedded hyperlink. Even if the registration number is not visible in the normal viewing mode of the file or when the work is printed from the file, it is deemed to be cited in the work itself because the text of the hyperlink can easily be revealed using standard software for viewing PDFs.

8.5.3.1. The entry in the *Official Register of Zoological Nomenclature* must give the name and Internet address of an organization other than the publisher that is intended to permanently archive the work in a manner that preserves the content and layout, and is capable of doing so. This information is not required to appear in the work itself.

8.5.3.2. The entry in the *Official Register of Zoological Nomenclature* must give an ISBN for the work or an ISSN for the journal containing the work. The number is not required to appear in the work itself.

8.5.3.3. An error in stating the evidence of registration does not make a work unavailable, provided that the work can be unambiguously associated with a record created in the *Official Register of Zoological Nomenclature* before the work was published.

Examples. The following are examples of admissible errors: In preparing a manuscript an author accidentally deletes the final digit of the registration number. An author states the wrong date of registration forgetting that ZooBank uses Coordinated Universal Time rather than local time. An author registers two works that are in review for publication and accidentally uses the same ZooBank number in both published versions.

The following are examples of inadmissible errors: An author, in preparing a manuscript for publication, states that day's date for the registration date, intending to register it later that day but forgetting to do so. The author discovers the omission after the work is published and immediately registers it; because registration occurred after publication, the work is not available. A publisher discovers errors in a work and reissues it to correct those errors, but instead of registering the new edition, uses the original ZooBank number; the revised edition is not available because it was not separately registered.

8.6. **New methods of publication and archiving.** The Commission may issue Declarations to clarify whether new or unconventional methods of production, distribution, formatting or archiving can produce works that are published in the meaning of the Code.

[Article 8.7 is unchanged. Recommendation 8A is modified, and new Recommendations 8B, 8C, 8D and 8H are added. The former 8B is deleted, the former 8C is modified and renumbered as 8E and the former 8D and 8E becomes the new 8F and 8G but are otherwise unchanged.]

Recommendation 8A. Wide dissemination. Authors have a responsibility to ensure that new scientific names, nomenclatural acts, and information likely to affect nomenclature are made widely known. Authors can accomplish this by publishing in appropriate scientific journals or well-known monographic series, by entering new names and nomenclatural acts into the *Official Register of Zoological Nomenclature* (ZooBank), and by sending copies of their works to the *Zoological Record*.

Recommendation 8B. Minimum edition of printed works. A work on paper should be issued in a minimum edition of 25 copies, printed before any is distributed.

Recommendation 8C. Electronic works. Electronic works should be structured to allow automated indexing and data extraction and should include actionable links to external resources (such as embedded hyperlinks to records in the *Official Register of Zoological Nomenclature*), where appropriate.

Recommendation 8D. Content immutable. The content of a work is immutable once it is published. Corrections should be made through notices of errata or other separate publications. Second or other additional printings of a work should be clearly labeled as such, with date of publication stated in the work, even if no changes have been introduced.

Recommendation 8E. Public accessibility of published works. Copies of published works that contain new scientific names or nomenclatural acts, or information likely to affect nomenclature, should be permanently conserved in or by libraries that make their holdings publicly accessible.

Recommendation 8H. Archiving encouraged. Authors are encouraged to ensure that their electronic works are archived with more than one archiving organization. Archiving organizations utilized for registered works should have permanent or irrevocable license to make a work accessible should the publisher no longer do so.

[Under Article 9, new Articles 9.2, 9.3 and 9.9 are added. Former Articles 9.2 through 9.6 are renumbered as 9.4 to 9.8. The former 9.7, 9.8 and 9.8 are reformulated as the new 9.12, 9.11 and 9.10, respectively. An example is added for 9.12 and Recommendation 9A is rephrased.]

Article 9. What does not constitute published work. Notwithstanding the provisions of Article 8, none of the following constitutes published work within the meaning of the Code:

9.1. after 1930, handwriting reproduced in facsimile by any process;

9.2. after 1985, works produced by hectographing or mimeographing;

9.3. before 1986 and after 2012, works issued on optical discs;

9.4. photographs as such;

9.5. proof sheets;

9.6. microfilms;

9.7. acoustic records made by any method;

9.8. labels of specimens;

9.9. preliminary versions of works accessible electronically in advance of publication (see Article 21.8.3);

9.10. materials issued primarily to participants at meetings (e.g. symposia, colloquia, congresses, or workshops), including abstracts and texts of presentations or posters;

9.11. text or illustrations distributed by means of electronic signals (e.g. via the Internet), except those fulfilling the requirements of Articles 8.1 and 8.5.

9.12. facsimiles or reproductions obtained on demand of an unpublished work [Art. 8], even if previously deposited in a library or other archive.

Example: A Ph.D. thesis that was distributed only to members of the student's thesis committee is listed for sale in the catalogue of a print-on-demand publisher. The print-on-demand work is a reproduction of the thesis. Because the thesis was an unpublished work in its original form, it remains unpublished. If an editorial process was evident in converting the work to print-on-demand form (e.g., change to single spacing, repagination, addition of running headers), it might be considered published.

Recommendation 9A. Avoidance of new names and acts in meeting abstracts. Authors should not include new names and nomenclatural acts in abstracts of papers or posters to be presented at meetings. This avoids the appearance that they are published and prevents inadvertent publication if the abstracts are widely distributed. (For disclaimer of abstracts volumes, see Recommendation 8G.)

[Changes to Article 10 (Criteria of Availability) proposed in the original draft of the Amendment have been removed, except that Recommendation 10B is modified and placed after Article 10.7.]

Recommendation 10B. Registration of names encouraged. Authors are encouraged to include registration numbers from the *Official Register of Zoological Nomenclature* for new names and nomenclatural acts introduced in their publications, and to register names and acts that have been previously published.

[Under Article 21 (determination of date), Articles 21.7 and 21.8 are modified and Article 21.9 is added.]

21.7. **Date not specified.** If the date of publication is not specified in a work the earliest day on which the work, or a part of it, is demonstrated to be in existence as a published work is to be adopted as the date of publication of the work or of that part.

21.7.1. In the absence of evidence as to day, the provisions of Article 21.3 apply.

21.7.2. Works issued as electronic copies are required to state a date of publication (Article 8.5.2), even if incompletely specified (Article 21.3).

21.8. **Advance distribution of separates and preprints.** Advance distribution of separates or preprints affects date of publication as specified by the following criteria:

21.8.1. Before 2000, an author who distributed separates in advance of the specified date of publication of the work in which the material was published thereby advanced the date of publication.

21.8.2. The advance issue of separates after 1999 does not advance the date of publication, whereas preprints on paper, unambiguously imprinted with their own date of publication, are published works from the date of their issue, if they fulfil the criteria for publication in Article 8 and are not excluded by Article 9 (see Glossary: "separate", "preprint").

21.8.3. Some works are accessible online in preliminary versions before the publication date of the final version. Such advance electronic access does not advance the date of publication of a work, as preliminary versions are not published (Article 9.9).

21.9. **Works issued on paper and electronically.** A name or nomenclatural act published in a work issued in both print and electronic editions takes its date of publication from the edition that first fulfilled the criteria of publication of Article 8 and is not excluded by Article 9.

[Under Article 78 (powers and duties of the Commission), Article 78.2.4 is added to allow establishment of the *Official Register*.]

78.2.4. The Commission may establish and maintain an *Official Register of Zoological Nomenclature* (ZooBank), to record essential information about works, names and nomenclatural acts. The *Official Register of Zoological Nomenclature* may be maintained in electronic or paper form. The *Official Lists* and *Official Indexes* may be maintained in the *Official Register*.

[The following terms are added to the Glossary.]

archive, n. A depository for works (q.v.); v. to place a work in an archive with the intent that it be permanently preserved there.

Official Register, n. An abbreviated title for the *Official Register of Zoological Nomenclature* [Article 78.2.4], maintained by the Commission to record information about works, names and nomenclatural acts (see ZooBank).

optical disc, n. a laser-readable data storage medium. Compact disc read-only memory (CD-ROM) and digital video disc read-only memory (DVD-ROM) are optical disc formats that could be used to produce available works after 1985 and before 2013 (Article 8.4.2).

publication, electronic, n. A publication issued and distributed by means of electronic signals.

register, v. To enter into the *Official Register* information about a work, name, author, nomenclatural act, or other item tracked for purposes of zoological nomenclature.

registration number, n. A unique identifying number or alpha-numeric code assigned in the *Official Register* to a particular item.

ZooBank, n. The online version of the *Official Register of Zoological Nomenclature*.

Discussion

The reasoning behind the five main changes to the amendment summarized in the Introduction is detailed here. Further information about ZooBank in its role as the *Official Register of Zoological Nomenclature* will be published in subsequent issues of the *Bulletin of Zoological Nomenclature*.

Retroactivity. Although the Amendment is retroactive to 1 January 2012, there are no works that fulfilled the requirements of the amendment as of that date. The live version of ZooBank did not support the fields for statement of intended archive and ISSN or ISBN until later in the year (September 2012), because the requirements had not been established by vote of the Commission. Some Commissioners therefore felt that it was better to have a start date of 1 January 2013. That, however, raised a different problem, that ZooBank would have to support the required fields in advance of that date in order to allow pre-registration. Either way, electronic journal articles might appear that contained ZooBank registration numbers that were nonetheless not published under the Code. The majority of Commissioners deemed it better to allow electronic publication sooner than later.

Registration of works. The shift to registration of works instead of registration of names addressed a problem caused by requiring registration of names but not of acts (as originally proposed): a work could have names that were not available because they were not registered, but nomenclatural acts in the same work would be available, which would be confusing. The alternative approach, to also require registration of acts in electronic works, was problematic, as it would be easy for authors to forget to register acts such as first reviser's choices in situations where the Code does not currently require a statement that an act has occurred. The shift to registering works lets registration of names and acts proceed on a voluntary basis, which gives more time to fully develop those functions in ZooBank, and allows more informed decision-making if such registrations are proposed to be mandatory in the future.

Intent to archive. The original proposal asked for archiving within one year, which created a "limbo period" during which it would not be known if the archiving requirement had been fulfilled. The change to requiring "intent to archive", analogous to intent to deposit a holotype (Article 16.4.2), eliminates this uncertainty. ZooBank provides a list of accepted archives and stores archive information for journals where such is known. If a user leaves the archive field blank, ZooBank warns that a statement of the intended archive is required for electronic publication. Users can suggest archives to be added to the accepted list in ZooBank.

ISSN/ISBN. A majority of Commissioners thought it desirable to add a requirement that an electronic work have an ISSN or ISBN to be registered in ZooBank. Reasons in favour included consistency with the new botanical rule for electronic publications and likelihood that works with ISSN and ISBN would be deposited in national archives, as deposition is required in some countries. Reasons against included that ISSN and ISBN give no assurance of quality while increasing costs and that some outlets for taxonomic monographs have not traditionally used ISBN. The new Article 8.5.3.2 does not require that the ISSN or ISBN appear in the work.

Status of optical discs. The Commission changed the date ranges when optical discs could be used as a medium of publication under certain conditions to avoid retroactively disallowing works that formerly had published status. The discussion of the proposed amendment in BZN **65**: 275 noted that the Commission was not aware of works on CD-ROM issued before 2000 in compliance with the requirements of the former Article 8.5. A few such works have now been brought to the Commission's attention, so the "after 1985" time frame has been restored. Similarly, some works on optical disc have been produced during 2012 in compliance with the former Article 8.6. Rather than have all parts of the amendment come into effective on 1 January 2012, the Commission has allowed publication on CD-ROM to continue through 2012 under the conditions specified in Article 8.4.2.

The Vote

The Commission voted as follows on the final version of the amendment as reproduced above:

For: 23
Against: 3
Abstain: 1

and as follows on the proposition that ZooBank, as available in August 2012, is fit for the purpose of handling the requirements of the amendment:

For: 23
Against: 4

References

ICZN (1999) International Code of Zoological Nomenclature, 4th edition. xxix, 306 pp. The International Trust for Zoological Nomenclature, London.

ICZN (2008) Proposed Amendment of Articles 8, 9, 10, 21 and 78 of the International Code of Zoological Nomenclature to expand and refine methods of publication. Bulletin of Zoological Nomenclature, 65: 265–275.

ICZN (2011) ICZN meeting on electronic publication. Bulletin of Zoological Nomenclature, 68: 246–247.

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RESEARCH ARTICLE

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The freshwater snails (Gastropoda) of Iran, with descriptions of two new genera and eight new species

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Abstract

Using published records and original data from recent field work and revision of Iranian material of certain species deposited in the collections of the Natural History Museum Basel, the Zoological Museum Berlin, and Natural History Museum Vienna, a checklist of the freshwater gastropod fauna of Iran was compiled. This checklist contains 73 species from 34 genera and 14 families of freshwater snails; 27 of these species (37%) are endemic to Iran. Two new genera, *Kaskakia* and *Sarkhia*, and eight species, i.e., *Bithynia forcarti, B. starmuehlneri, B. mazandaranensis, Pseudamnicola georgievi*, *Kaskakia khorrasanensis*, *Sarkhia sarabensis*, *Valvata nowsharensis* and *Acroloxus pseudolacustris* are described as new to science; *Ecrobia grimmi* (Clessin & Dybowski, 1888), *Heleobia dalmatica* (Radoman, 1974) and *Hippeutis complanatus* (Linnaeus, 1758) are reported for the first time from Iran. Additional field work is highly desirable for a more appropriate evaluation of the extant freshwater snail biodiversity in Iran.

Keywords

Freshwater snails, checklist, new species, Iran

Introduction

Considering the geographical position of Iran, a rich fauna of freshwater snails could be expected. A high level of endemism and a diverse mixture of Palaearctic and Paleotropical elements are characteristic of the Iranian freshwater fauna (Pešić and Saboori 2007).

Research of molluscs biodiversity in Iran has a relatively long tradition. In 1862, a group of Italian scientists undertook the first systematic expedition to Persia, which revealed a large number of molluscan samples. The results of this expedition have been published by Issel (1863). Two decades later, the mollusc fauna of the Caspian Sea was studied by Dybowski (1888). The first study on the molluscs diversity of inland water was done at the beginning of the XXth Century by the Indian malacologists Annandale and his coauthors (Annandale and Prashad 1919, Annandale 1921, Annandale and Rao 1925) who studied the molluscan fauna of Seistan and Baluchistan Province. Biggs (1936, 1937, 1971) studied the malacofauna of the Central Plateau of Iran. In 1936 he noted: "Little has been written on the Mollusca of the Iranian Plateau. This was perhaps due to the inaccessibility of the interior in the past when the only method of travelling was by caravan". Forcart (1935) studied molluscs from the Mazandaran Province. Starmühlner and Edlauer (1957) published the results of the Austrian Iran expedition of 1949/50 and 1956. Later on, Starmühlner (1961, 1965) studied molluscs from Northern and Eastern Iran collected by the Austrian A. Ruttner. More recently, Mansoorian (1986, 1994, 1998, 2000) published on the molluscan fauna of Iran.

However, our knowledge of freshwater snails of Iran remains scanty. Despite a growing number of data over the last years, resulting from the expeditions of the junior author in 2005, 2007, and 2011, literature records of freshwater snails in Iran have remained scattered and unreviewed, hampering ecological and biogeographical analysis. To what extent is the area of Iran unique and important for freshwater snail biodiversity? This paper attempts to answer such questions by compiling data on water molluscs and their current geographic distribution in Iran.

Material and methods

The checklist of the freshwater snail fauna of Iran was compiled using published records and original data. The data from all publications were brought to the presently accepted state of taxonomy following Subba Rao (1989) (for Asian Fauna), Brown (1994) (for African Fauna) and Glöer (2002) (for the European Fauna), and papers published thereafter. Species referred to in postgraduate theses and scientific meetings are no formal publications and are consequently not considered herein.

During the field work, freshwater snails were collected by hand netting, sorted on the spot and preserved in 75 % alcohol. The data and locations of the sampling sites, where the junior author collected in 2005, 2007 and 2011 are listed in Appendix 1. In the section 'New records' collecting site abbreviations derive from the geographical database Pešić. The type material will be deposited in the Zoological Museum Ham-

burg (ZMH), Germany. Further, we had the opportunity to revise material of some Iranian freshwater snails deposited in the collections of the Natural History Museum Basel (NMB – Forcart's collection), Zoological Museum Berlin (ZMB) and Natural History Museum Vienna (NHMW – Edlauer's collection).

Not all species could be identified due to the sparsity of specimens and the non-characteristic shells, especially of small hydrobioid snails. Furthermore, the Caspian Sea fauna is not considered in the present paper. The order of families follows Bouchet and Rocroi (2005).

Results

Systematics

Family Neritidae Rafinesque, 1815
http://species-id.net/wiki/Neritidae

Remarks. *Theodoxus* and *Neritina* are distinguished from each other by their ontogeny (Bandel 2001). While the *Theodoxus* species hatch from the spawn as miniature adult, *Neritina* species leave their spawn as planktotrophic larva that will float in the sea for a more or less extended period before its metamorphosis to a crawling young. However, at the adult stage the taxonomic separation of species of the genera *Theodoxus* and *Neritina* is not always easy. As most of the *Neritina* spp. are marine species and usually have a denticulate border of the columella and two apophysis of the operculum, most species of the genus *Theodoxus* are limnic and have a smooth border of the columella and one apophysis (the "rib"); some also have a small apophysis, the peg, on the operculum (Glöer 2002). Further, in *Neritina* the peg is thick and strong, while in *Theodoxus* it is, if exists at all, small and weak. A revision of this family, particularly its subdivion in clearly defined genera is needed.

Genus *Neritina* Rafinesque, 1815

Type species. *Nerita pulligera* Linnaeus, 1758

***Neritina mesopotamica* Martens, 1874**
http://species-id.net/wiki/Neritina_mesopotamica
Figs 2a–c

Records from Iran. Khuzestan Province (Mansoorian 2001).

Material examined. Zoological Museum Berlin (ZMB), "*Neritina* (*Neritaea*) *anatolica* var. *mesopotamica*, Ras el Ain, Mesopot. Hausknecht".

Remarks. The height of the largest shell of the examined syntypes from Zoological Museum Berlin was 7 mm. Mansoorian (1994) in his identification key described shell

Figure 1. Map of Iran with dots showing the collection localities (corresponding to the sampling site numbers in Appendix). The total number of freshwater mollusc species collected from each province are as follows (in parentheses): Bushehr (1), Fars (15), Gilan (12), Hormozgan (13), Isfahan (10), Kerman (15), Hermanshah (4), Khorasan (5), Khuzestan (14), Lorestan (6), Markazi (5), Mazandaran (21), Qom (1), Seistan and Baluchestan (16), Semnan (1), Teheran (5), West Azarbayjan (1), Yazd (6), Zanjan (1).

of this species as being 14 mm high. Considering his photos (Mansoorian 1994), he probably confused it with *Neritina schlaeflii* Mousson, 1874 (Figs 2f–g).

Distribution. Iraq, Iran (Khuzestan).

***Neritina cinctellus* (Martens, 1874)**
http://species-id.net/wiki/Neritina_cinctellus

Syn.: *Theodoxus cinctellus* Martens, 1874

Records from Iran. Khuzestan Province (Chu et al. 1968, Massoud and Hedayeti-Far 1979).

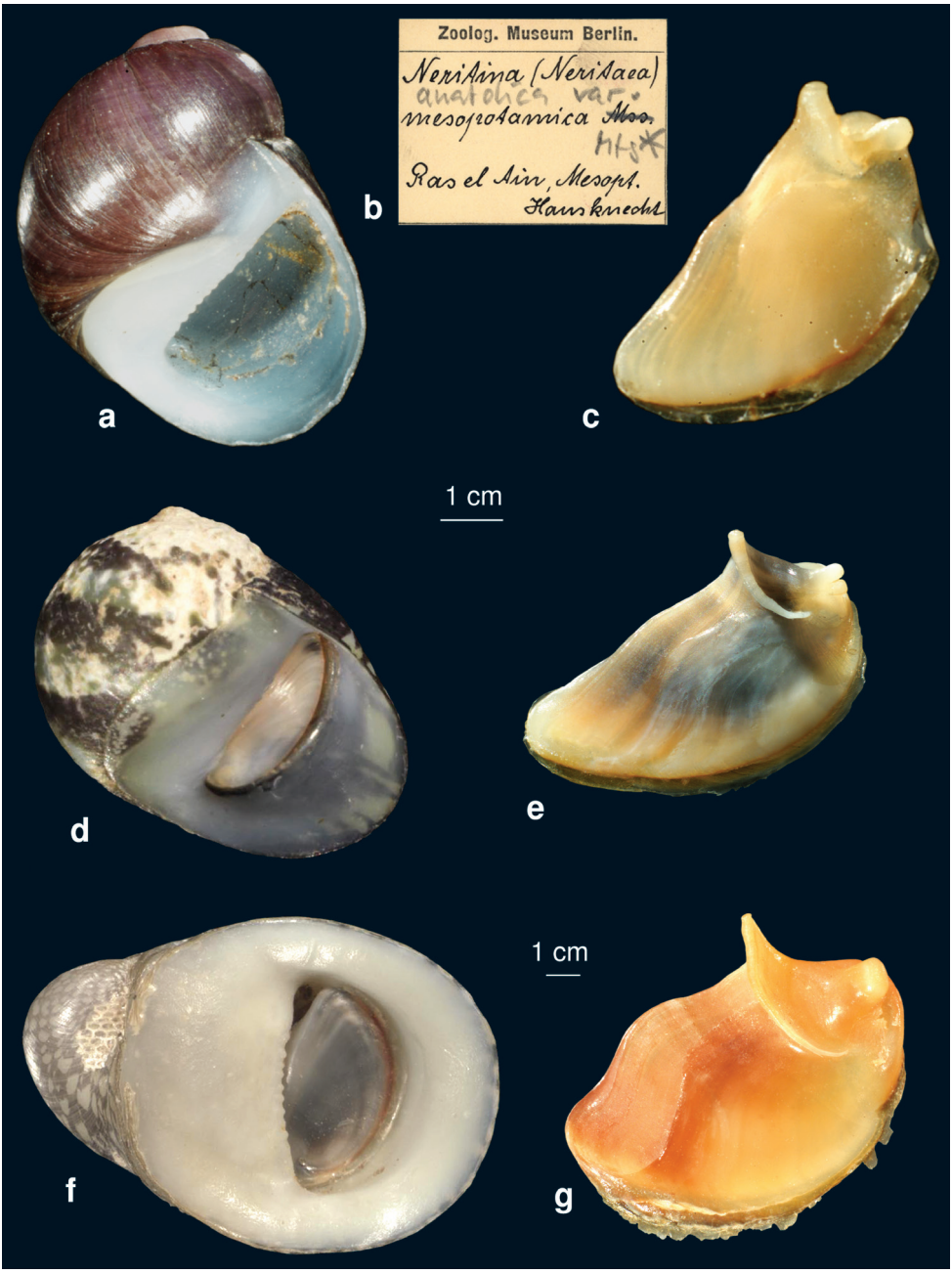

Figure 2. a–c *Neritina mesopotamica* **d–e** *N. euphratica* **f–g** *N. schlaeflii* **a** shell (syntype) **b** lable **c** operculum **d** shell (syntype, ZMZ 528916, Irak, Samava, photo: Eike Neubert) **e** operculum of *N. euphratica* from Euphrates **f** shell (syntype, ZMZ 529679, Persian Gulf, Island Ghaes, photo: Eike Neubert) **g** operculum of *N. schlaeflii* from Shatt Al-Arab-Fao region.

Remark. According to the original description (Martens 1874) this species is characterized by the presence of denticulated border of the columella, and should be ascertained to the genus *Neritina*.

Distribution. Iraq, Iran.

Neritina euphratica Mousson, 1874

http://species-id.net/wiki/Neritina_euphratica
Figs 2d–e

Records from Iran. Khuzestan Province (Massoud and Hedayeti-Far 1979, Mansoorian 2001).

Remark. This species is characterized by a small shell with 6 mm in height and a small spire. The boder of the columella is straight and not denticulated. The operculum has a rib which is attenuated at its basis, the peg is thick and strong and split in two parts (fig. 2e).

Distribution. Iraq, Iran.

Genus *Theodoxus* Montfort, 1810

Type species. *Nerita fluviatilis* Linnaeus, 1758

Theodoxus fluviatilis (Linnaeus, 1758)

http://species-id.net/wiki/Theodoxus_fluviatilis
Figs 3c, 11a

Theodoxus doriae Issel, 1865 (synonymy)

Records from Iran. (all mentioned as *Th. doriae* Issel): Kerman (Issel 1863, Martens 1874, Biggs 1937); Gilan, Mazandaran and Lorestan Province (Mansoorian 2000).

New records. Fars Province: IR13-07 [3 ex.]; IR14-07 [2 ex.]; Khorrasan Province: IR76-05 [1 ex]; IR 64-05 [1 ex.]; IR78a-05 [2 ex.]; IR79-05 [1 ex.]; Hormozgan Province: IR 17-11 [5 ex.]

Associated species. *Melanopsis* sp., *Radix* sp., *Planorbis intermixtus, Farsithyra farsensis, Physella acuta.*

Remarks. Martens (1879) synonymised *Theodoxus doriae*, the species reported by Issel (1863) from S Iran, with *Th. fluviatilis*. Later on, Mansoorian (2000) described the operculum of *Th. doriae*, which has only a rib, no peg. However, the shell illustrated by Mansoorian (1994) agrees well with *Th. fluviatilis*. Thus we follow Martens' (1879) synonymisation of *Theodoxus doriae* with *Th. fluviatilis*. Our samples revealed only the presence of *Th. fluviatilis*.

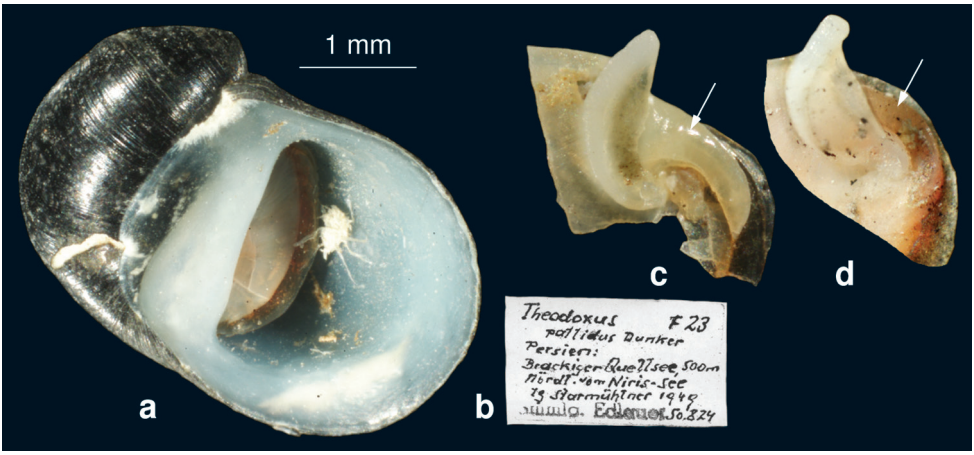

Figure 3. a–c *Theodoxus pallida* (from Edlauer's collection, NHMW 75000/E/50824) **a** Shell with corroded apex **b** label of Edlauer's collection **c** apophysis of *Th. pallida* **d** apophysis of *Th. fuiviatilis* (from IR79).

Distribution. W- to Central-Palaearctic. *Theodoxus fluviatilis* has been considered by many authors to be an exclusively European species (see e.g. Zhadin 1952, Glöer 2002). But Bourguignat (1864), Brown (1994) and van Damme (1984) mentioned it from NW Africa (Morocco, Algeria). Records of this species in Turkey (Yıldırım 1994), and in Iran, confirm its wide distribution. However, it does not occur in Siberia (Vinarski, pers. comm.).

Theodoxus lituratus Eichwald, 1838

http://species-id.net/wiki/Theodoxus_lituratus

Records from Iran. Kerman Province (Biggs 1971); Mazandaran Province (Eichwald 1838, Eliazian et al. 1979).

Remarks. This species has been described from the Caspian Sea. According to the original description (Eichwald 1838) this species is very distinct from the other *Theodoxus* spp. mentioned here.

Distribution. Iran.

Theodoxus pallida Dunker, 1861

http://species-id.net/wiki/Theodoxus_pallida
Figs 3a–b

Records from Iran. Isfahan and Fars Province (Starmühlner and Edlauer 1957).

Material examined. NHMW 75000/E/50824, "*Theodoxus pallidus* Dunker" Persien, Brackiger Quellsee, 500 m, nördl. vom Niris-see, leg. Starmühlner 1949.

Remarks. Starmühlner and Edlauer (1957) provide a detailed description of the anatomy of this species but did not consider the operculum, the most important diagnostic feature. On the other hand, as figured in Starmühlner and Edlauer (1957), the receptaculum seminis and the bursa copulatrix differ in length (while being of equal length in *Th. fluviatilis)*.

The re-examination of the specimens of *Theodoxus pallida* (Dunker, 1862) from Edlauer's collection in NHMW clearly shows that this species is distinct from *Theodoxus fluviatilis* due to the shape of shell and the operculum (Fig. 3). As already mentioned by Dunker (1862) the spire in *Th. pallida* is higher than in *Th. fluviatilis*, and furthermore the apophysis of the operculum is broader and not attenuated at its basis (Fig. 3c). In addition the callus at border of the operculum in *Th. pallida* is much stronger (Fig. 3c arrow).

Distribution. Iran.

Family Viviparidae J.E. Gray, 1847

Genus *Bellamya* Jousseaume, 1886

Type species. *Paludina bellamya* Jousseaume, 1886

***Bellamya bengalensis* (Lamarck, 1822)**
http://species-id.net/wiki/Bellamya_bengalensis

Records from Iran. Khuzestan Province (Chu et al. 1968, Massoud and Hedayeti-Far 1979, Mansoorian 1994, 2001), Mazandaran Province (Mansoorian 2000).

Distribution. According to Ramakrishna and Dey (2007) this species is widely distributed on the Indian subcontinent.

***Bellamya hilmandensis* (Kobelt, 1909)**
http://species-id.net/wiki/Bellamya_hilmandensis

Records from Iran. Seistan and Baluchestan Province (Annandale et al. 1919).

Distribution. Iran.

Family Melanopsidae H. & A. Adams, 1854

Genus *Melanopsis* Férussac, 1807
http://species-id.net/wiki/Melanopsis

Type species. *Buccinum praemorsum* Linnaeus, 1758

Remark. *Melanopsis praerosa* L. is a misspelling of *M. praemorsa* L.

***Melanopsis costata* (Olivier, 1804)**
http://species-id.net/wiki/Melanopsis_costata
Fig. 11e

Records from Iran. Kerman Province (Martens 1874); Khuzestan Province (Prashad 1921, Chu et al. 1968, as *M. nodos*a: Massoud and Hedayeti-Far 1979, Mansoorian 2001).

New records. Fars Province: IR13-07 [23 ad., 25 juv.].

Associated species. *Farsithyra farsensis.*

Distribution. Asia Minor, Syria, Palestine, Iraq, Iran.

***Melanopsis doriae* Issel, 1865**
http://species-id.net/wiki/Melanopsis_doriae
Fig. 4

Records from Iran. Kerman Province (Issel 1863, Martens 1874, Biggs 1936, 1937, Starmühlner and Edlauer 1957, 1961, 1965); Fars Province (Starmühlner and Edlauer 1957); Yazd Province (Starmühlner and Edlauer 1957); Khuzestan Province (Mansoorian 1994, 2001); Mazandaran Province (Starmühlner and Edlauer 1957, Mansoorian 2000); Gilan Province (Starmühlner and Edlauer 1957); Bushehr Province (Starmühlner and Edlauer 1957).

New records. Hormozgan Province: IR17-11 [2 ex.]; IR19-11 [1 ex.].

Material examined. NHMW "*Melanopsis doriae* Issel" Persien, Kerman, aus teilweise eingestürztem Kanal, leg. Starmühlner 1949/50.

Associated species. *Melanoides tuberculatus, Thiara scabra, Farsithyra farsensis.*

Figure 4. *Melanopsis doriae* (from Edlauer's collection, NHMW 750000/E/50801a): shell.

Remarks. Starmühlner and Edlauer (1957) studied the anatomy of *Melanopsis doriae* and *M. kotschyi* showing differences in the nervous system. Furthermore they found differences in some features of the opercula between these species, and showed a strong morphological plasticity of the shells (see: Starmühlner and Edlauer 1957, plate 1: Figs g', g'', g''' and h', h''). Re-examintion of *Melanopsis doriae* from Edlauer's collection in NHMW shows that the shell (Fig. 4) is slimmer than the shell of *Melanopsis* sp.

Distribution. Iran.

***Melanopsis kotschyi* Philippi, 1847**
http://species-id.net/wiki/Melanopsis_kotschyi

Records from Iran. Fars Province (Starmühlner and Edlauer 1957).

Remarks. See remarks under previous species.

Distribution. Iran.

***Melanopsis* sp.**
Fig. 11d

Records from Iran. Kerman Province (as *Melanopsis variabilis*: Martens 1874); Seistan and Baluchistan Province (as *M. deserticola*: Annandale and Prashad 1919); Isfahan and Yazd provinces (Biggs 1937); Fars province (as *M. buccinoidea variabilis*: Starmühlner and Edlauer 1957, as *M. praerosa*: Starmühlner 1961); Khuzestan Province (Chu et al. 1968, as *M. praerosa*: Massoud and Hedayeti-Far 1979, Manssorian 2001).

New records. Mazandaran Province: IR02-05 [11 ad., 48 juv.]; Khorrasan Province: IR64-05 [12 ad., 39 juv.]; IR79-05 [3 ad., 4 juv.]; IR78a-05 [8 ad., 15 juv.]; IR78c-05 [2 ex.]; Fars Province: IR17-07 [2 ex]; Hormozgan Province: IR19-11 [21 ex.].

Associated species. *Galba truncatula, Theodoxus fluviatilis, Planorbis intermixtus, Grossuana* sp., *Farsithyra farsensis.*

Remark. The species of this genus have a high morphological plasticity and many species have been described. Glaubrecht (1993) tried to solve the complicated taxonomy by proposing to consider all circum-Mediterranean *Melanopsis* spp. as being part of one 'superspecies', *M. praemorsa*. However, we follow Neubert (1998) who believes that this approach does not solve the problem. In recent literature the 'superspecies' notion tends to be abandoned and the former species names are being reinstituted (see: Heller et al. 2005; van Damme et al. 2010. This means that the smooth unsculptured species *M. praemorsa* sensu stricto (terra typica: Spain) is actually a western Mediterranean species and that unsculptured morphs from the Levant belong to other species, such as *M. buccinoidea, ammonis,*

dircaena, khabourensis and *meiostoma* (Heller et al. 2005). Those from Mesopotamia have been described under *M. variabilis, deserticola, buccinoidea* and *praemorsa.* Further study is necessary to establish under which name or names the Iranian populations should be placed.

Family Potamididae H. & A. Adams, 1854

Genus *Cerithidea* Swainson, 1840

Type species. *Cerithium obtusum* Lamarck, 1822

***Cerithidea cingulata* (Gmelin, 1790)**
http://species-id.net/wiki/Cerithidea_cingulata
Fig. 8c

Records from Iran. Hormozgan Province (Ghasemi et al. 2011).
New records. Hormozgan Province: IR14-11 [21 ad., 6 juv.]; IR-20-11 [10 ex.].
Associated species. *Ecrobia grimmi*, *Pseudamnicola* sp.
Distribution. Indo-Pacific coast.

Family Thiaridae Gill, 1871

Genus *Thiara* Roeding, 1798

Type species. *Helix amarula* Linnaeus, 1758

***Thiara scabra* (O.F. Müller, 1774)**
http://species-id.net/wiki/Thiara_scabra
Fig. 12c

Records from Iran. Seistan and Baluchestan Province (as *Melanoides scabra* var. *elegans*: Annandale and Prashad 1919); Isfahan Province (as *M. scabra*: Biggs (1937); Hormozgan Province (Starmühlner and Edlauer 1957).
New records. Hormozgan Province: IR08-11 [13 ex.]; IR17-11 [2 ex.].
Associated species. *Farsithyra farsensis, Melanoides tuberculatus, Physella acuta*, *Melanopsis doriae.*
Distribution. Indo-Pacific coasts.

Genus *Melanoides* Olivier, 1804

Type species. *Melanoides fasciolata* Olivier, 1804 = *Nerita tuberculata* O.F. Müller, 1774.

***Melanoides tuberculatus* (O.F. Müller, 1774)**
http://species-id.net/wiki/Melanoides_tuberculatus
Fig. 12b

New records. Seistan and Baluchestan Province: IR8a-11 [5 juv.], IR8-11 [18 ex.]. Hormozgan Province: IR10-11 [3 ex.], IR17-11 [10 ad., 9 juv.], IR18-11 [1 ad., 8 juv.], IR19-11 [2 ex.].

Associated species. *Melanopsis doriae*, *Thiara scabra*, *Farsithyra farsensis.*

Records from Iran. Kerman Province (as *Melania tuberculata*: Issel 1863), Martens 1874, Biggs 1936, 1937, Starmühlner and Edlauer 1957); Seistan and Baluchestan Province (as *M. pyramis, M. tigrina*: Annandale and Prashad 1919, Biggs 1937); Hormozgan Province (Biggs 1937, Starmühlner and Edlauer 1957), (as *Melania tuberculata*: Starmühlner (1961); Isfahan Province (Biggs 1937); Yazd Province (Starmühlner and Edlauer 1957, as *Melania tuberculata*: Starmühlner 1965); Khuzestan Province (Chu et al. 1968, Mansoorian 2001); South Iran (Manssorian 1994); Fars Province (Starmühlner and Edlauer 1957): Mazandran Province (Starmühlner and Edlauer 1957, Mansoorian 2001).

Remarks. The species *Melanoides pyramis* and *M. tigrina*, which have been mentioned by Annandale and Prashad (1911) from Seistan and Baluchistan, have been listed by Westerlund (1886) as subspecies. However, due to the high morphological plasticity of *M. tuberculatus* and in absence of any geographical seperation of these taxa, we list all *Melanoides* taxa under *M. tuberculatus*.

Distribution. S Asia, Arabia, Near East, Africa.

Family Bithyniidae J.E. Gray, 1847

Genus *Bithynia* Leach, 1818

Type species. *Helix tentaculata* Linnaeus, 1758

***Bithynia* (*Bithynia*) *tentaculata* (Linnaeus, 1758)**
http://species-id.net/wiki/Bithynia_tentaculata

Records from Iran. Mazandaran Province (Mansoorian 2000); Gilan and Lorestan Province (Mansoorian 2000).

Rejected records. Mazandaran Province (Forcart 1935).

Remarks. The Euro-Siberian species *Bithynia tentaculata* (Linnaeus 1758) has often been mentioned from Iran, Turkey and Greece. However, this species could not be found in Greece (Glöer et al. 2010) and probably does not occur in Turkey. The southern distribution border of this species lies possibly in N Bulgaria (Georgiev pers. comm.). An analysis of the specimens from NMB published by Forcart (1935) as *Bithynia tentaculata* shows that these specimens represent *B. forcarti* sp. n. (see below). Thus, *B. tentaculata* most probably does not occur in Iran and has been confused with *B. forcarti* sp. n. or possibly with *Bithynia mazandaranensis* sp. n. (see below).

Distribution. Euro-Siberian.

***Bithynia* (*Bithynia*) *forcarti* sp. n.**
urn:lsid:zoobank.org:act:8A83711B-797D-4D86-99D5-72F217B14A89
http://species-id.net/wiki/Bithynia_forcarti
Figs 5a–b

Type locality. Mazandaran Province, Tschalekuti.

Holotype (NMB 11517a): shell height 7.5 mm, width 5.6 mm.

Paratypes. Mazandaran Province, Tschalekuti (NMB 11517a, 26 ex.), Geniste d. Babul (NMB 11517b, 1 ex., NMB 11571c, 10 ex.)

Etymology. Named after Lothar Forcart in appreciation on his studies of Iranian freshwater snails.

Description. The whitish shell is conical with 5.5 whorls, which are convex with a deep suture and a small and acute apex. The convex whorls are flattened at the suture. The umbilicus is open. The aperture is ovate, angled at the top. The margin of the aperture is, from lateral view, slightly sinuated. The surface is smooth with fine growth lines. Shell height 5.5 – 7.5 mm, width 5.0 – 5.6 mm.

Differentiating features. Due to the shape of the aperture (angled at the top), *Bithynia forcarti* sp. n. resembles *B. mazandaranensis* sp. n. (see below). However, from the latter species it can be easily distinguished by the stepped whorls.

Remarks. Formerly (Forcart 1935) this species has been confused with *B. tentaculata*.

***Bithynia* (*Bithynia*) *starmuehlneri* sp. n.**
urn:lsid:zoobank.org:act:5A63D216-B630-4808-8B2D-0F77E3EAE287
http://species-id.net/wiki/Bithynia_starmuehlneri
Figs 6a–c

Bulimus (*Bithynia*) *leachi troschelii*: Starmühlner and Edlauer 1957, non *troschelii* Paasch, 1842 (synonymy)

Type locality. Border of Lake Urmia, W Azarbayian, 1949 leg. Starmühlner.

Holotype. NHMW (50940): shell height 10.3 mm, width 5.6 mm.

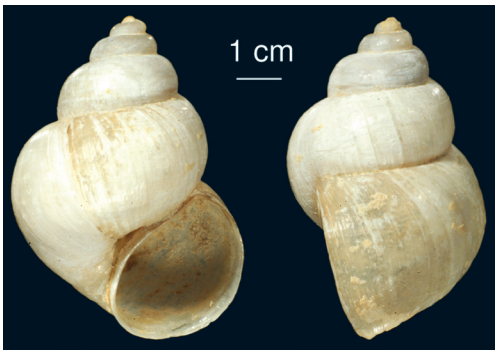

Figure 5. *Bithynia forcarti* sp. n. **a** shell, frontal view **b** shell, lateral view.

Paratypes. 9 ex. from the type locality.

Etymology. Named after Ferdinand Starmühlner, who collected this species in 1949.

Description. The whitish shell is elongated conical with 6.5 whorls, which are convex with a deep suture and a small and acute apex. The umbilicus is open. The aperture is ovate. The margin of the aperture is, from lateral view, straight. The surface is smooth with fine growth lines. Shell height 8.2 – 10.3 mm, width 4.6 – 6.4 mm.

Differentiating features. This slim species is the largest *Bithynia* sp. known in Iran. It can be easily distinguished from the other *Bithynia* spp. by the larger dimensions of elongated shell with the stepped whorls and the not angled aperture.

Remarks. This species has been misidentified by Starmühlner and Edlauer (1957) with *B. troschelii*.

***Bithynia* (*Bithynia*) *mazandaranensis* sp. n.**
urn:lsid:zoobank.org:act:22D0892E-8670-4131-9149-0F77C007BB94
http://species-id.net/wiki/Bithynia_mazandaranensis
Figs 7a–d

Type locality. Mazandaran Province, Nowshahr city, pond near Caspian Sea, 51°31'E, 36°38'N, 18 June 2005.

Holotype (ZMH 79369): Shell height 8.0 mm, width 5.0 mm.

Etymology. Named after the region where the species was collected.

Description. The horn-coloured shell is conical with 5.5 whorls, which are slightly convex with a clear suture and an acute apex. The umbilicus is closed. The aperture is ovate, angled at the top. The margin of the aperture is, from lateral view, sinuated. The surface bears a lattice structure. Shell height 8.0 mm, width 5.0 mm, aperture height 3.6 mm.

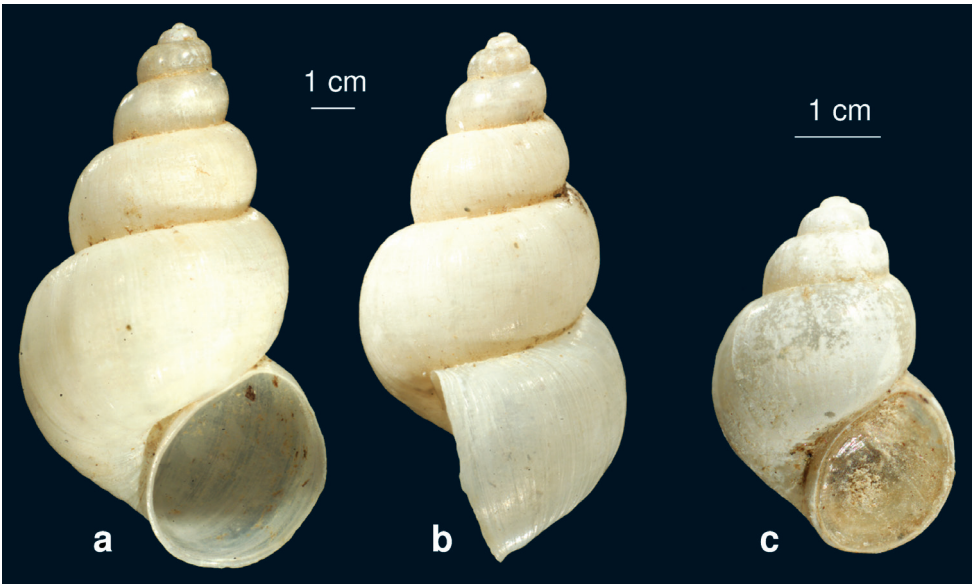

Figure 6. Shell of *Bithynia starmuehlneri* sp. n. **a** frontal view **b** lateral view **c** juvenile shell with operculum.

Differentiating features. The new species resembles *B. tentaculata* but differs from it by the following features: (i) the operculum is more angled (Fig. 7c), (ii) the whorls are more convex (Fig. 7a–b), and (iii) the surface has longitudinal and transverse striae (Fig. 7d).

Associated species. *Planorbis carinatus, Anisus* sp., *Valvata cristata, Valvata nowshahrensis* sp. n., *Hippeutis complanatus.*

Remarks. Probably this species formerly (e.g., Mansoorian 2000) was confused with *B. tentaculata*. Because we had only an empty shell of this species, we do not know if it belongs to the genus *Bithynia* or *Pseudobithynia*, so our generic assignment is tentative. To address this question, anatomical studies of more specimens are necessary.

Bithynia (*Bithynia*) cf. *ejecta* Mousson, 1874

Records from Iran. Isfahan Province – (as *Amnicola ejecta*: Biggs 1937).

Remarks. Probably due to the small size of this species, Biggs (1937) assigned this species belongs to the genus *Amnicola*, although Mousson (1874) described it as a *Bythynia*, and pointed out that the operculum is characteristic for *Bythinia* and different from *Amnicola* (syn. to *Pseudamnicola*). Furthermore, Biggs (1937) found his species in the mountains, while the original description of *Bithynia ejecta* comes from the lowland, indicating the Biggs's species is not conspecific with *Bithynia ejecta* and probably represents an undescribed species.

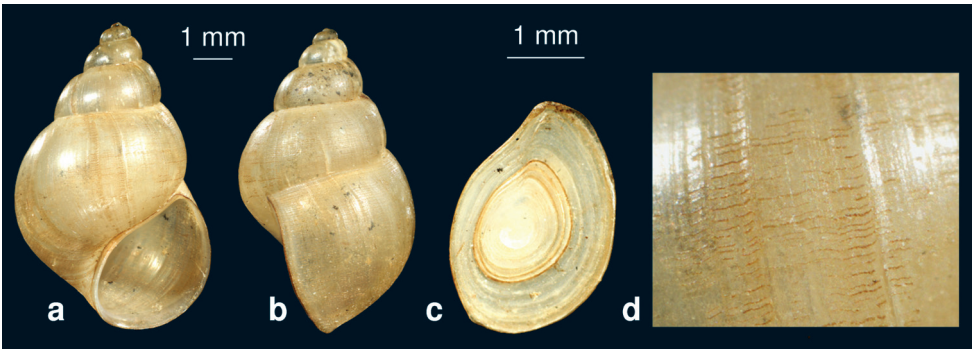

Figure 7. *Bithynia mazandaranensis* sp. n. **a, b** shell **c** operculum **d** detail of the shell surface.

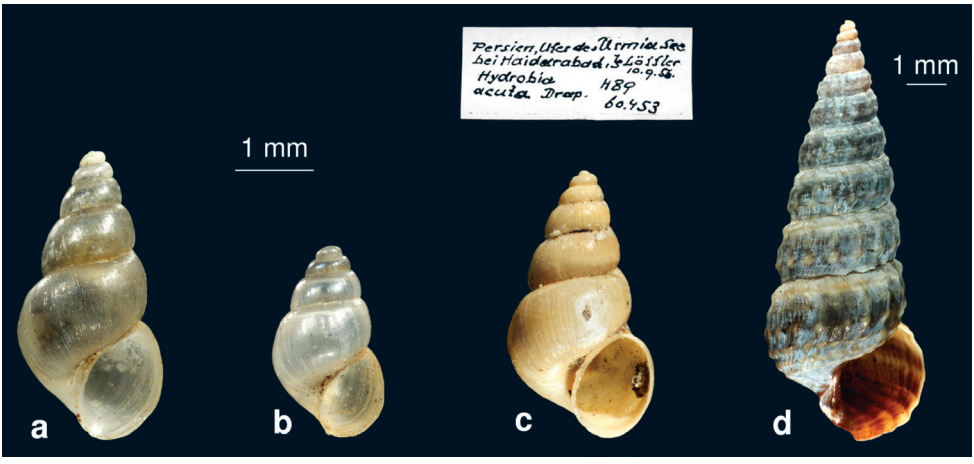

Figure 8. The molluscs of brackish waters. **a** *Ecrobia grimmi* **b** *Heleobia dalmatica* **c** *Ecrobia grimmi* from Edlauer's collection (NHMW, "*Hydrobia acuta*" 75000/E/60453) **d** *Cerithidea cingulata*.

***Bithynia* (*Bithynia*) *rubens* (Menke, 1830)**
http://species-id.net/wiki/Bithynia_rubens

Records from Iran. North Iran (Caspian Sea) – Eliazian et al. (1979).

Remarks. This species could not be found in any of the neighbouring countries of Iran. Eliazian et al. (1979) don't mention the source that led to their identification. The record and taxonomic status of this species is questionable and needs new confirmation.

Subgenus *Gabbia* Tryon, 1865

Type species. *Gabbia australis* Tryon, 1865

Remarks. Some authors (e.g Subba Rao 1989, Nesemann et al. 2007) mention *Gabbia* as a genus. However, it seems not possible to distinguish the genera of the Bithyniidae by the shape of opercula (Mandahl-Barth 1968) and/or by shell forms, because these characters are found to be variable. On the other hand, the examined material of the family of Bithyniidae can be easily separated by the characteristics of penis morphology (having a penial appendix: *Bithynia* Leach 1818; or lacking a penial appendix: *Pseudobithynia* Glöer & Pešić 2006). In our study, we tentatively use the name *Gabbia* as a subgenus for small *Bithynia* species with a globular shell, originating from India.

***Bithynia* (*Gabbia*) *sistanica* (Annandale & Prashad, 1919)**
http://species-id.net/wiki/Bithynia_sistanica

Records from Iran. Seistan and Baluchestan Province (as *Amnicola sistanica*: Annandale and Prashad 1919).

Remark. Annadale and Prashad (1919) described this species as *Amnicola* (*Alocinma*) *sistanica* and depicted the penis morphology. Due to the presence of a penial appendix this species is ascertained to the genus *Bithynia*. The members of the genus *Pseudamnicola* (formerly *Amnicola*) have no penial appendix.

Distribution. Iran; only known from N Seistan.

Genus *Pseudobithynia* Glöer & Pešić, 2006

Type species. *Pseudobithynia irana* Glöer & Pešić, 2006

***Pseudobithynia irana* Glöer & Pešić, 2006**
http://species-id.net/wiki/Pseudobithynia_irana
Fig. 12k

Records from Iran. Markazi and Lorestan Provinces (Glöer and Pešić 2006).

New records. Lorestan Province: IR26-07 [10 ex.].

Associated species. *Planorbis intermixtus*, *Radix* sp.

Distribution. Iran; Markazi and Lorestan Provinces.

***Pseudobithynia zagrosia* Glöer & Pešić, 2009**
http://species-id.net/wiki/Pseudobithynia_zagrosia
Fig. 12l

Records from Iran. Fars Province (Glöer and Pešić 2009).

Distribution. Iran; known only from the locus typicus (Dasht Arzhan village, Shiraz to Kazerum road).

Family Cochliopidae Tryon, 1866

Genus *Heleobia* Stimpson, 1865

Type species. *Heleobia stagnorum* (Gmelin, 1791)

***Heleobia dalmatica* (Radoman, 1974)**
http://species-id.net/wiki/Heleobia_dalmatica
Fig. 8b

New records. Hormozgan Province: IR14-11 [12 ad., 20 juv.].

Associated species. *Cerithidea cingulata, Ecrobia grimmi, Pseudamnicola sp.*

Remarks. New for Iran.

Distribution. Previously only known from the brackish part of rivers along the coast of Croatia (Radoman 1983).

Family Hydrobiidae Stimpson, 1865

Genus *Hydrobia* Hartmann, 1821

Type species. *Cyclostoma acutum* Draparnaud, 1805

***Hydrobia acuta* (Draparnaud, 1805)**
http://species-id.net/wiki/Hydrobia_acuta

Records from Iran. Isfahan Province (Biggs 1971).

Rejected records. Fars Province (Starmühlner and Edlauer 1957).

Remark. Probably this species has been confused with one of the following species (*Ecrobia grimmi*, *Heleobia dalmatica*), so all former records of this species in Iran are questionable. The record for this species is kept until the original material of Biggs could be studied.

Genus *Ecrobia* Stimpson, 1865

Type species. *Turbo ventrosus* Montagu, 1803

***Ecrobia grimmi* (Clessin & Dybowski, 1888)**
http://species-id.net/wiki/Ecrobia_grimmi
Figs 8a, c

New records. Hormozgan Province: IR14-11 [12 ad., 20 juv.].

Associated species. *Cerithidea cingulata, Heleobia dalmatica, Pseudamnicola* sp.

Remarks. On the base of molecular results, Haase et al. (2010) concluded that *Ecrobia grimmi* from the mixomesohaline Lake Sawa (Iraq) was possibly transported by migrating birds from the Caspian Sea. The identification of our material of *Ecrobia grimmi* as well of *Heleobia dalmatica* was confirmed by using molecular techniques (Martin Haase pers. communication). An analysis of the specimens from NHMW published by Starmühlner and Edlauer (1957) as *Hydrobia acuta* shows that these specimens probably belong to *Ecrobia grimmi* (see Fig. 8c).

Distribution. Caspian Sea; Iraq, Iran.

Genus *Pseudamnicola* Paulucci, 1878

Type species. *Bithynia lucensis* Issel, 1866

***Pseudamnicola kotschyi* v. Frauenfeld, 1863**
http://species-id.net/wiki/Pseudamnicola_kotschyi

Records from Iran. Isfahan Province (Starmühlner 1961, 1965).

Distribution. Iran: Isfahan Province; endemic.

***Pseudamnicola saboori* Glöer & Pešić, 2009**
http://species-id.net/wiki/Pseudamnicola_saboori
Fig. 12h

Records from Iran. Khorasan and Markazi Provinces (Glöer and Pešić 2009).

Distribution. Iran: Khorasan and Markazi Provinces.

***Pseudamnicola zagrosensis* Glöer & Pešić, 2009**
http://species-id.net/wiki/Pseudamnicola_zagrosensis
Fig. 12i

Records from Iran. Kermanshah Province – Glöer and Pešić (2009).

Distribution. Iran: Kermanshah Province.

***Pseudamnicola raddei* Boettger, 1889**
http://species-id.net/wiki/Pseudamnicola_raddei

Records from Iran. Mazandaran Province – Forcart (1935).

Distribution. Transcaspian region (Zhadin 1952).

Remarks. In Russia it is listed as *Turkmenamnicola raddei* (Kantor et al. 2009).

***Pseudamnicola georgievi* sp. n.**
urn:lsid:zoobank.org:act:D2E680D0-AAC4-45DF-954A-28D553EC957F
http://species-id.net/wiki/Pseudamnicola_georgievi
Fig. 9

Type locality. Markazi Province, Ashtian to Arak road (ca. 5 km after Ashtian city, Ashtian county), 50°01'E, 34°34'N, ca. 1800 m asl., 21 June 2005.

Holotype (ZMH 79370): Shell height 2.6 mm, width 1.9 mm.

Paratypes (ZMH 79371): 6 ex. from type locality.

Etymology. Named after Dr. Dilian Georgiev in appreciation of his studies on Bulgarian hydrobiids.

Description. The whitish shell is conical with 4.5 whorls, which are separated by a clear suture. The surface is glossy and finely striated. The apex is blunt, the umbilicus is closed, the aperture is ovate and pointed at the top. Shell height 2.4–2.6 mm, width 1.9 mm.

Differentiating features. The conical shell with its pointed aperture (Fig. 9) clearly distinguished the new species from other Iranian members of the genus *Pseudamnicola*.

Remark. We had only shells with dried tissue at our disposal. Since the penis morphology could not be examined, the assignment to the genus *Pseudamnicola* is provisional.

Distribution. Iran; only known from the type locality.

Genus *Kaskakia* gen. n.
urn:lsid:zoobank.org:act:31BFCB62-BE86-43CE-A888-B0562CC2740E
http://species-id.net/wiki/Kaskakia

Diagnosis. Shell conical. Penis broad at the basis, distal part with a bulbous and acute penis tip.

Type species. *Kaskakia khorrasanensis* sp. n.

Etymology. Named after the region where the species was collected.

Figure 9. *Pseudamnicola georgievi* sp. n.: shell.

Differential diagnosis. The new genus appears to be close to *Pseudamnicola*, but can easily be distinguished by the unique morphology of the penis with bulbous and acute apex (vs. a broad elongated triangular penis in *Pseudamnicola*).

***Kaskakia khorrasanensis* sp. n.**
urn:lsid:zoobank.org:act:8EDD45AD-46F2-4BC8-A7BE-73B44BBCDF6D
http://species-id.net/wiki/Kaskakia_khorrasanensis
Figs 10a–d

Type locality. Khorrasan Province, Kaskak stream in Kaskak village, 59°10'E, 35°25'N, ca. 1800 m asl., 11 June 2005.

Holotype (ZMH 79372): Shell height 2.5 mm, width 1.9 mm.

Paratypes (ZMH 79373): 21 ex. from type locality.

Etymology. Named for its occurrence in Khorrasan Province.

Description. The yellowish shell is conical to globular with 5.5 whorls, which are slightly convex and separated by a clear suture (Fig. 10a). The whorls increase rapidly with a prominent body whorl. The surface is glossy and finely striated. The apex is acute, the aperture is ovate and angled at the top, the umbilicus is closed. Shell height 2.3–2.5 mm, width 1.8–1.9 mm.

Animal. The mantle and head are black. The penis is broad at the basis and tapered at the distal end (Figs 10b–d).

Differentiating features. As for the genus.

Distribution. Iran: Khorrasan Province; known only from type locality.

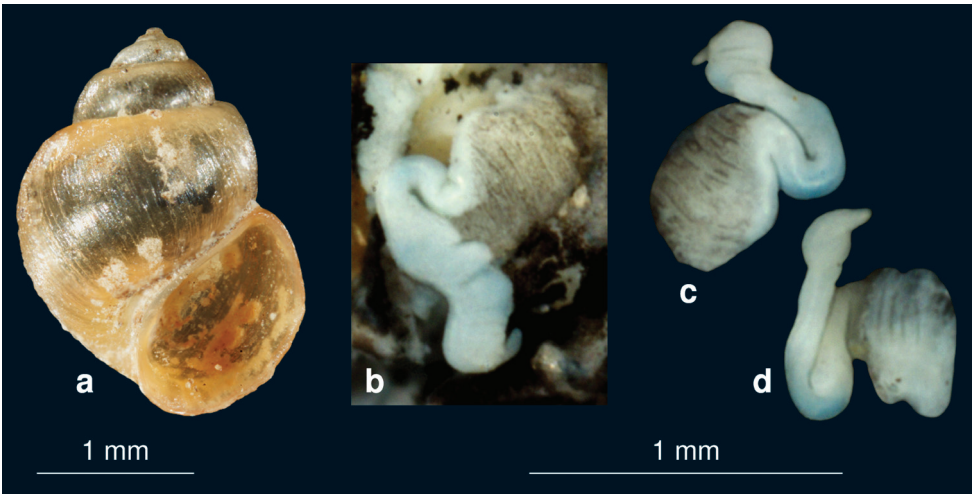

Figure 10. *Kaskakia khorrasanensis* sp. n. **a** shell **b** penis in situ **c–d** penis (c: dorsal view, d: ventral view).

Genus *Sarkhia* gen. n.
urn:lsid:zoobank.org:act:4AC287DC-4E88-4043-BA17-880E84883276
http://species-id.net/wiki/Sarkhia

Diagnosis. Shell elongated conical. Penis simple, broad at the basis and tapered at the distal end, with a black pigmentation mark. The tentacles are cylindrical.

Type species. *Sarkia sarabensis* sp. n.

Etymology. Named after the region where the species was collected.

Differential diagnosis. The genus seems to be closely related to *Pseudamnicola* (in the following, in parentheses), but the unique morphology of the penis, broad at the basis and tapered at the distal end (Figs 10b–c), with a black pigmentation mark (vs. broad and elongated triangular penis), and the presence of broad cylindrical tentacles (slim cylindrical tentacles) will separate the new genus from *Pseudamnicola***.**

***Sarkhia sarabensis* sp. n.**
urn:lsid:zoobank.org:act:F7FBD536-0970-4B9B-A0AC-EAF9E7C91C72
http://species-id.net/wiki/Sarkhia_sarabensis
Fig. 11a–c

Type locality. Kermanshah Province, Sarabe–Sahne (= Sarabe – bede – Sarkh) city, stream, 27 June 2005.

Holotype (ZMH 79374): Shell height 5.9 mm, width 2.3 mm.

Paratypes (ZMH 79375): 1 specimen dissected.

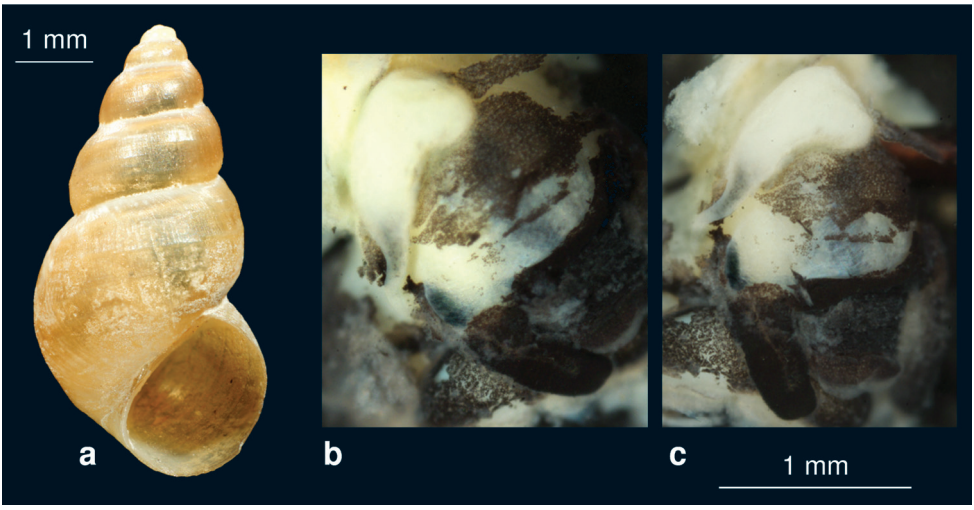

Figure 11. *Sarkhia sarabensis* nov. sp. **a** shell **b, c** penis in situ.

Etymology. Named after the region where the species was collected.

Description. The yellowish shell is elongated conical with 6.5 whorls, which are slightly convex and separated by a deep suture. The aperture is oval with a sharp periostome, the umbilicus is closed. The surface is dull. Shell height 5.9 mm, width 2.3 mm.

Differentiating features. The slim elongated conical shell with more than 5 whorls (Fig. 11a) is characteristic and separates this species from *Sarkhia kermanshahensis* (see below).

Distribution. Iran, Kermanshah Province; only known from type locality.

***Sarkhia kermanshahensis* (Glöer & Pešić, 2009), comb. n.**
http://species-id.net/wiki/Sarkhia_kermanshahensis
Fig. 12g

Pseudamnicola kermanshahensis Glöer & Pešić, 2009 (synonymy)

New records. Markazi Province: IR51 [2 ex.].

Records from Iran. Kermanshah Province (as *Pseudamnicola kermanshahensis* Glöer and Pešić 2009).

Remarks. This species has originally been placed in the genus *Pseudamnicola*. However, due to the characteristic shape of the penis and the tentacles it is transfered to *Sarkhia* gen. n.

Distribution. Iran; Kermanshah and Markazi Provinces.

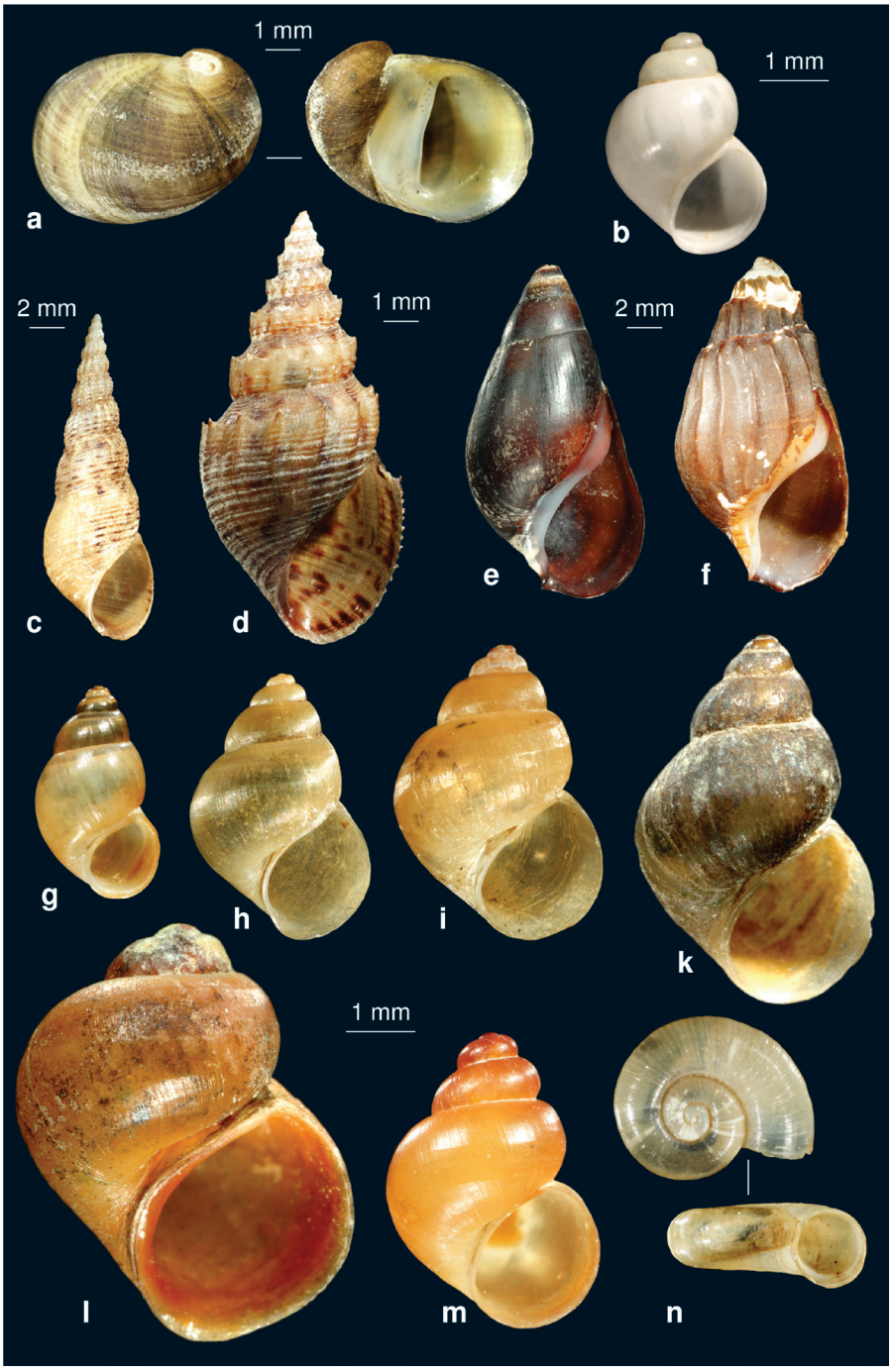

Figure 12. The prosobranch molluscs of Iran. **a** *Theodoxus fluviatilis* (operculum see Fig. 3d) **b** *Bithynia* (*Bithynia*) *ejecta* (syntype ZMZ 524006, Iraq, Samava, ex coll. Mousson, photo: E. Neubert) **c** *Melanoides tuberculatus* **d** *Thiara scabra* **e** *Melanopsis* sp. **f** *Melanopsis costata* **g** *Farsithyra farsensis* **h** *Sarkhia kermanshahensis*, **i:** *Pseudamnicola saboori* **k** *P. zagrosensis* **l** *Pseudobithynia irana* **m** *P. zagrosia* **n** *Valvata cristata*.

Genus *Belgrandiella* Wagner, 1927

Type species. *Belgrandia kusceri* Wagner, 1914

***Belgrandiella elburensis* (Starmühlner & Edlauer, 1957), comb. n.**
http://species-id.net/wiki/Belgrandiella_elburensis

Records from Iran. Tehran Province – "*Frauenfeldia elburensis*" Starmühlner and Edlauer (1957).

Remarks. Starmühlner and Edlauer (1957) originally described this species as *Frauenfeldia elburensis*. However, the genus name *Frauenfeldia* is preoccupied, and thus, the species of this genus have been re-assigned to *Belgrandiella*, *Boleana*, *Graziana* and *Sarajana* (Radoman 1983). Due to the shape of the aperture in original description (see Starmühlner and Edlauer 1957) we affiliate this species to the genus *Belgrandiella*.

Distribution. Iran, only known from the locus typicus (Gelandoah, 60 km NE of Tehran).

Genus *Hauffenia* (Pollonera, 1898)

Type species. *Valvata erythropomatia* Hauffen, 1856

***Hauffenia erythropomatia* (Hauffen, 1856)**
http://species-id.net/wiki/Hauffenia_erythropomatia

Records from Iran. Sistan and Baluchestan Province (Source lake Gomun) – "*Erythropomatiana erythropomatia*" Starmühlner and Edlauer (1957).

Remarks. Most probably, Starmühlner and Edlauer (1957) misidentified this subterranean species, known only from its type locality in Slovenia, far away from Iran. The comparison with the description of *H. erythropomatia* by Radoman (1983) shows that these species are not conspecific as the umbilicus seems to be broader in later species compared with the species depicted by Starmühlner and Edlauer (1957). Unfortunately this species could not be found in Edlauer's collection in NHMW (Anita Eschner, pers. comm.). The record for this species is kept until specimens from the original locality could be studied.

Family Stenothyridae Tryon, 1866

Genus *Stenothyra* Benson, 1854

Type species. *Nematura deltae* Benson, 1836

***Stenothyra arabica* Neubert, 1998**
http://species-id.net/wiki/Stenothyra_arabica

Records from Iran. Hormozgan Province (Ghasemi et al. 2011).

Distribution. Saudi-Arabia, Iran.

Genus *Gangetia* Ancey, 1890

Type species. *Hydrobia* (*Belgrandia*) *miliacea* Nevill, 1880

***Gangetia* (*Iranothyra*) *uzielliana* (Issel, 1866)**
http://species-id.net/wiki/Gangetia_uzielliana

Records from Iran. Kerman province (as *Bythinia uzielliana*: Issel 1866, Martens 1874), as *Hydrobia uzielliana*: Biggs (1936, 1937), (as *Pseudamnicola uzelliana*: Starmühlner and Edlauer (1957), (as *Pseudamnicola uzelliana*: Starmühlner (1961, 1965); Fars province (as *Pseudamnicola uzelliana*: Starmühlner and Edlauer (1957), (as *Pseudamnicola uzelliana*: Starmühlner and Edlauer (1961, 1965).

Rejected records. Yazd Province (as *Pseudamnicola uzelliana*: Starmühlner and Edlauer 1957).

Remarks. Schütt (1973) classified this species in the genus *Gangetia* and introduced the new subgenus *Iranothyra* Schütt, 1973. Mansoorian (1994) reported *Gangetia uzielliana* with some doubts. However, his species clearly differs from the topotype of *Gangetia uzielliana* illustrated by Schütt (1973). Most probably, the species recorded by Mansoorian (1994) under this name represents an undescribed new species (Glöer and Pešić 2009).

Distribution. Iran.

Genus *Farsithyra* Glöer & Pešić, 2009

Type species. *Farsithyra farsensis* Glöer & Pešić, 2009

***Farsithyra farsensis* Glöer & Pešić, 2009**
http://species-id.net/wiki/Farsithyra_farsensis
Fig. 12f, 13a–b

Bulimus badiella: Starmühlner and Edlauer 1957, non *badiella* Küster, 1852 (synonymy)

Records from Iran. Fars Province (Glöer and Pešić 2009).

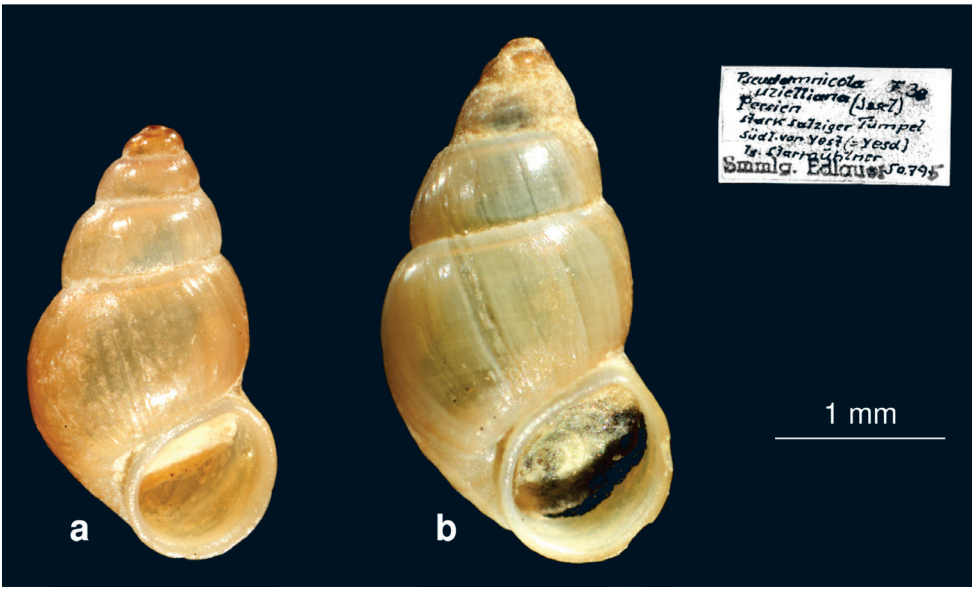

Figure 13. *Farsithyra farsensis* (from Edlauer's collection, NHMW "*Pseudamnicola uzielliana*" 75000/E/50795): **a–b** shell.

New records. Hormozgan Province: IR17-11 [1 ex.].

Material examined. NHMW "*Pseudamnicola uzelliana* Issel", Persien, stark salziger Tümpel, südl.von Yest (=Yesd), leg. Starmühlner. NHMW 60.459 "*Bulimus badiella*", Lake Taschk, 07.07.1956 leg. Löffler.

Associated species. *Melanoides tuberculatus*, *Melanopsis* sp., *Melanopsis doriae*, *Thiara scabra.*

Remarks. Starmühlner and Edlauer (1957) mentioned *Gangetia uzielliana* from many sampling sites in Yazd Province. An analysis of one lot from the Edlauer collection (NHMW) with the specimens from Yazd Province shows that these specimens (Fig. 13a–b) belong to *Farsithyra farsensis*. Further, re-examination of the specimens from Lake Taschk in Fars Province identified by Starmühlner and Edlauer (1957) as *Bulimus badiella* (syn. to *Bithynia badiella*) shows that it is also conspecific with *Farsithyra farsensis*.

Distribution. Iran: Fars, Yazd and Hormozgan Provinces.

Family Valvatidae J.E. Gray, 1840

Genus *Valvata* O.F. Müller, 1773

Type species. *Valvata cristata* O.F. Müller, 1774

***Valvata cristata* O.F. Müller, 1774**
http://species-id.net/wiki/Valvata_cristata
Fig. 12m

New records. Mazandaran Province: IR01-05 [6 ex.]. Tehran Province: IR48-05 [2 ex.].

Associated species. *Bithynia mazandaranensis* sp. n., *Planorbis carinatus, Anisus* sp., *Valvata nowshahrensis* sp. n., *Hippeutis complanatus.*

Records from Iran. Mansoorian (1994).

Remarks. Considering the photo provided by Mansoorian (1994), he probably confused this species with *Valvata nowshahrensis* sp. n. (see below).

Distribution. Palaearctic.

***Valvata piscinalis* O.F. Müller, 1774**
http://species-id.net/wiki/Valvata_piscinalis

Records from Iran. Gilan, Mazandaran and Lorestan Province – Mansoorian (2000).

Distribution. Palaearctic.

***Valvata nowshahrensis* sp. n.**
urn:lsid:zoobank.org:act:944E6EE3-B23C-43FB-A305-882A4D4CF3D9
http://species-id.net/wiki/Valvata_nowshahrensis
Fig. 14a–c

Type locality. Mazandaran Province, Nowshahr city, pond near the Caspian See, 51°31'E, 36°38'N, 18 June 2005.

Holotype (ZMH 79376): Shell diameter 3.3 mm, height 2.3 mm.

Paratypes (ZMH 79377): 2 specimens from type locality; [2 ex.], Kermanshah Province: IR105-05.

Etymology. Named after the region, where the species was collected.

Description. The yellowish shell is translucent with 3 circular whorls. The umbilicus is wide, and the first whorl is visible through the umbilicus. The surface is glossy with very fine ribs. Shell diameter 3.2–3.3 mm, height 2.3 mm.

Differentiating features. The new species can be distinguished from *Valvata piscinalis* by its larger umbilicus and from *V. cristata* by its higher spire.

Remarks. This species has possibly been depicted by Mansoorian (1994) and confused with *Valvata cristata*.

Associated species. *Pseudobithynia mazandaranensis* sp. n., *Planorbis carinatus, Anisus* sp., *Valvata cristata, Hippeutis complanatus*

Distribution. Iran: Mazandaran and Kermanshah Provinces.

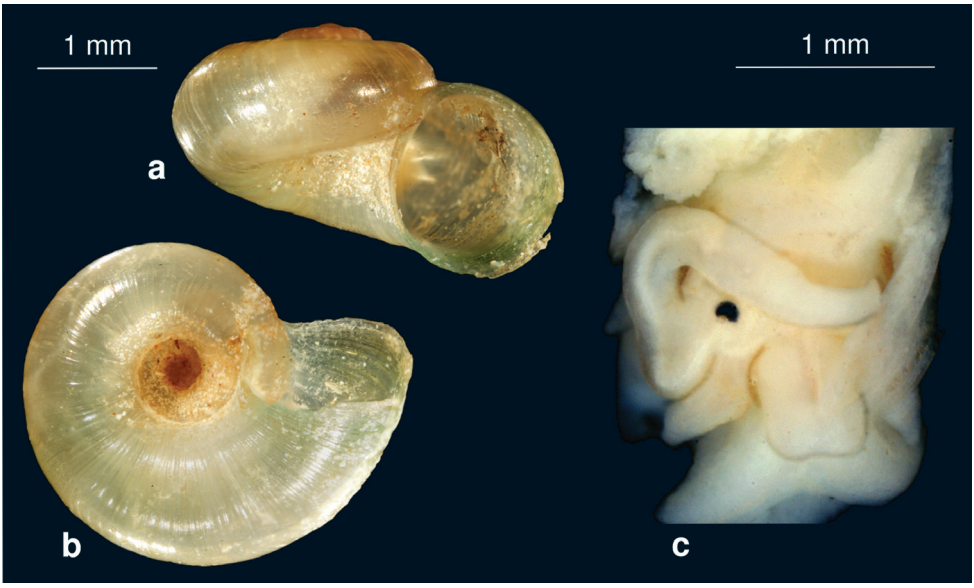

Figure 14. *Valvata nowshahrensis* sp. n. **a** shell **b** ventral view on the umbilicus **c** head with penis in situ.

Pulmonata

Family Acroloxidae Thiele, 1931

Genus *Acroloxus* H. Beck, 1838

Type species. *Patella lacustris* Linnaeus, 1758

***Acroloxus lacustris* (Linnaeus, 1758)**
http://species-id.net/wiki/Acroloxus_lacustris

Rejected Records from Iran. Mazandaran Province – Forcart (1935).

Remarks. See remarks under *Acroloxus pseudolacustris* sp. n.

***Acroloxus pseudolacustris* sp. n.**
urn:lsid:zoobank.org:act:83575F59-E417-44D3-8F6D-A5DB45EA2B21
http://species-id.net/wiki/Acroloxus_pseudolacustris
Fig. 15a–b

Type locality. Gilan Province, IR82-05, Bandar Anzali Lagoon, 49°27'E, 37°26'N, 16 June 2008.

Holotype (ZMH 79378): Shell length 4.0 mm, width 2.0 mm, height 0.9 mm.

Paratypes. 2 ex., NMB 11516a "*Acroloxus lacustris*" zwischen Nika und Aschref, 10 m ü. M., Drs. A. Erni & R. Buxtorf leg. 22.X.1931.

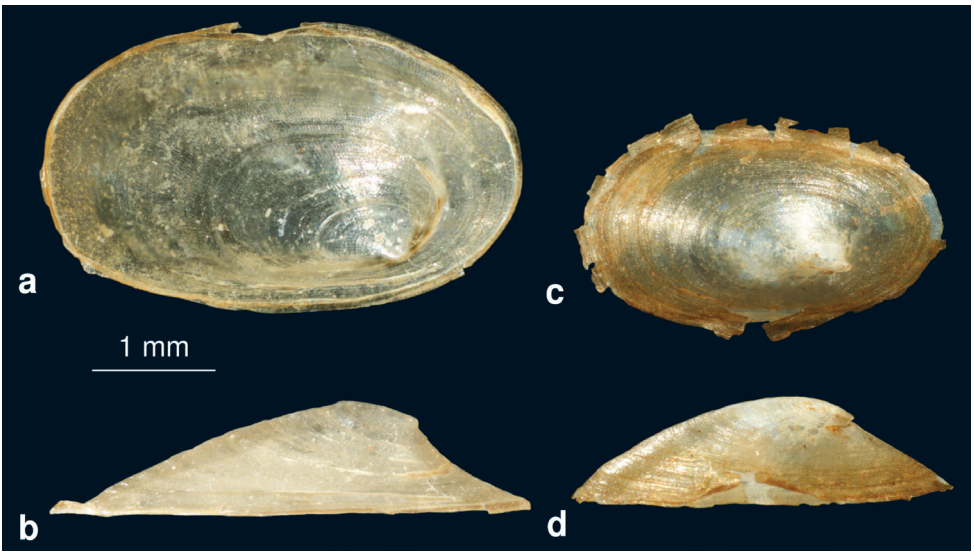

Figure 15. a–b *Acroloxus pseudolacustris* sp. n.: shell **c–d** *Acroloxus lacustris* (from Hamburg, Germany): shell.

Etymology. Named for its resemblance with *Acroloxus lacustris*.

Description. The oval limpet shell is transparent. The apex is blunt and bent to the left side (Figs 15a–b).

Differentiating features. The new species resembles *A. lacustris*, which can be easily distinguished by the shape of apex, which is always acute and not blunt (Figs 15c–d) like in the new species. From Russia, no *Acroloxus* sp. with a blunt apex is known (Vinarski, pers. comm.).

Remark. An analysis of the two specimens from Forcart's collection (NMB 11516a) identified as *Acroloxus lacustris* from Mazandaran Province shows that these specimens belong to *A. pseudolacustris* sp. n.

Associated species. *Haitia acuta.*

Distribution. Iran: Gilan and Mazandaran Provinces.

Family Lymnaeidae Rafinesque, 1815

Genus *Radix* Montfort, 1810

http://species-id.net/wiki/Radix

Type species. *Helix auricularia* Linnaeus, 1758

Remarks. Hubendick (1951) grouped most *Radix* spp. from the Near East (i.e. *R. tenera*, *R. euphratica* – «Mesopotamia», *R. bactriana* - Afghanistan, *R. gedrosiana* - Iran, *R. rectilabrum* - Seistan and Baluchistan, *R. persica* - Iran and *R. acuminata* - (Bengal, India) under the palaearctic *R. auricularia*, but from Europe he lumped all *Radix* spp.

together in three species. Today, five *Radix* species are known from Europe, confirmed by molecular (Pfenninger et al. 2006, Schniebs et al. 2011) and anatomical studies (Glöer 2002). Only a few species can be distinguished by the shells alone (e.g. *Radix ampla*, *R. auricularia*). Most species show a large morphological plasticity in the shape of the shell, so this character cannot be used for distinguishing species. Ananndale and Prashad (1919) and Annandale and Rao (1923) provided anatomical data of *Radix* spp., but these drawings are not suitable enough to identify the *Radix* spp. found by us in Iran. The diagnostic features and taxonomic relationship of the Iranian *Radix* species require further revision and particularly the application of molecular techniques with topotypes of the species. The following list of *Radix* species contains the hitherto recorded nominal species, their taxonomic status remains to be explored.

***Radix persica* (Issel, 1865)**
http://species-id.net/wiki/Radix_persica
Fig. 16a

Records from Iran. Kerman Province – "*Limnaea auricularia* var. *persica"* Issel (1865), "*Limnaea auricularia* var. *persica"* Martens (1874); Seistan and Baluchestan Province (as *Limnaea auricularia* var. *persica:* Annandale and Prashad 1919); Isfahan Province (as *Lymnaea persica*: Biggs 1937).

New records. Markazi Province: IR27-07 [7 ex.]

Distribution. South Iran.

***Radix auricularia* (Linnaeus, 1758)**
http://species-id.net/wiki/Radix_auricularia

Records from Iran. Khuzestan Province (Mansoorian 2001); Mazandaran, Gilan and Lorestan Provinces (Starmühlner and Edlauer 1957), Isfahan Province (Starmühlner 1965).

Distribution. Palaearctic.

***Radix bactriana* (Annandale & Prashad, 1919)**
http://species-id.net/wiki/Radix_bactriana
Figs 16b–d

Records from Iran. Seistan and Baluchestan Province (Annandale and Prashad 1919); Kerman Province (Starmühlner and Edlauer 1957).

New records. Markazi Province: IR03-05 [1 ex], IR87-05 [9 ex.], IR88-05 [3 ex.], IR89-05 [2 ex], IR91-05 [3 ex.]; Khorasan Province: IR67-05 [1 ex.], IR79-05 [1 ex.].

Distribution. Iran: Seistan and Baluchestan and Kerman Provinces.

***Radix iranica* (Annandale & Prashad, 1919)**
http://species-id.net/wiki/Radix_iranica
Fig. 16g

Records from Iran. Seistan and Baluchestan Province (Annandale and Prashad 1919).
New records. Markazi Province: IR89-05 [5 ex].
Distribution. Iran: Seistan and Baluchestan Province.

***Radix gedrosiana gedrosiana* (Annandale & Prashad, 1919)**
http://species-id.net/wiki/Radix_gedrosiana_gedrosiana

Records from Iran. Seistan and Baluchistan Province (Annandale and Prashad 1919), Azarbayjan Province (Starmühlner and Edlauer 1957), Khuzestan Province (Chu et al. 1968, Massoud and Hedayeti-Far 1979, as *Lymnaea auricularia gedrosiana*: Mansoorian 2001), N Iran (Annandale 2000).
Distribution. Iran, Pakistan.

***Radix gedrosiana rectilabrum* (Annandale & Prashad, 1919)**
http://species-id.net/wiki/Radix_gedrosiana_rectilabrum

Records from Iran. Seistan and Baluchestan Province (Annandale and Prashad 1919); Isfahan Province (Starmühlner and Edlauer 1957).
Distribution. Iran; endemic.

***Radix hordeum* (Mousson, 1874)**
http://species-id.net/wiki/Radix_hordeum

Records from Iran. Seistan and Baluchestan Province (Annandale and Prashad 1919)
Distribution. Iraq (Euphrates, as *Limnaea hordea*: Mousson 1874); Iran: Seistan and Baluchestan Province.

***Radix lagotis* (Schrank, 1803)**
http://species-id.net/wiki/Radix_lagotis

Records from Iran. Qom, Tehran and Gilan Provinces (Martens 1874); Kerman Province (Biggs 1937).
Remarks. This species has been described from the Danube (Germany) and most probably does not occur in Iran. According to Subba Rao (1989) *R. lagotis* is a synonym of *R. peregra* (syn. to *R. labiata*). However, recently Schniebs et al. (2011) clearly showed that *R. lagotis* and *R. labiata* are distinct species.
Distribution. Europe.

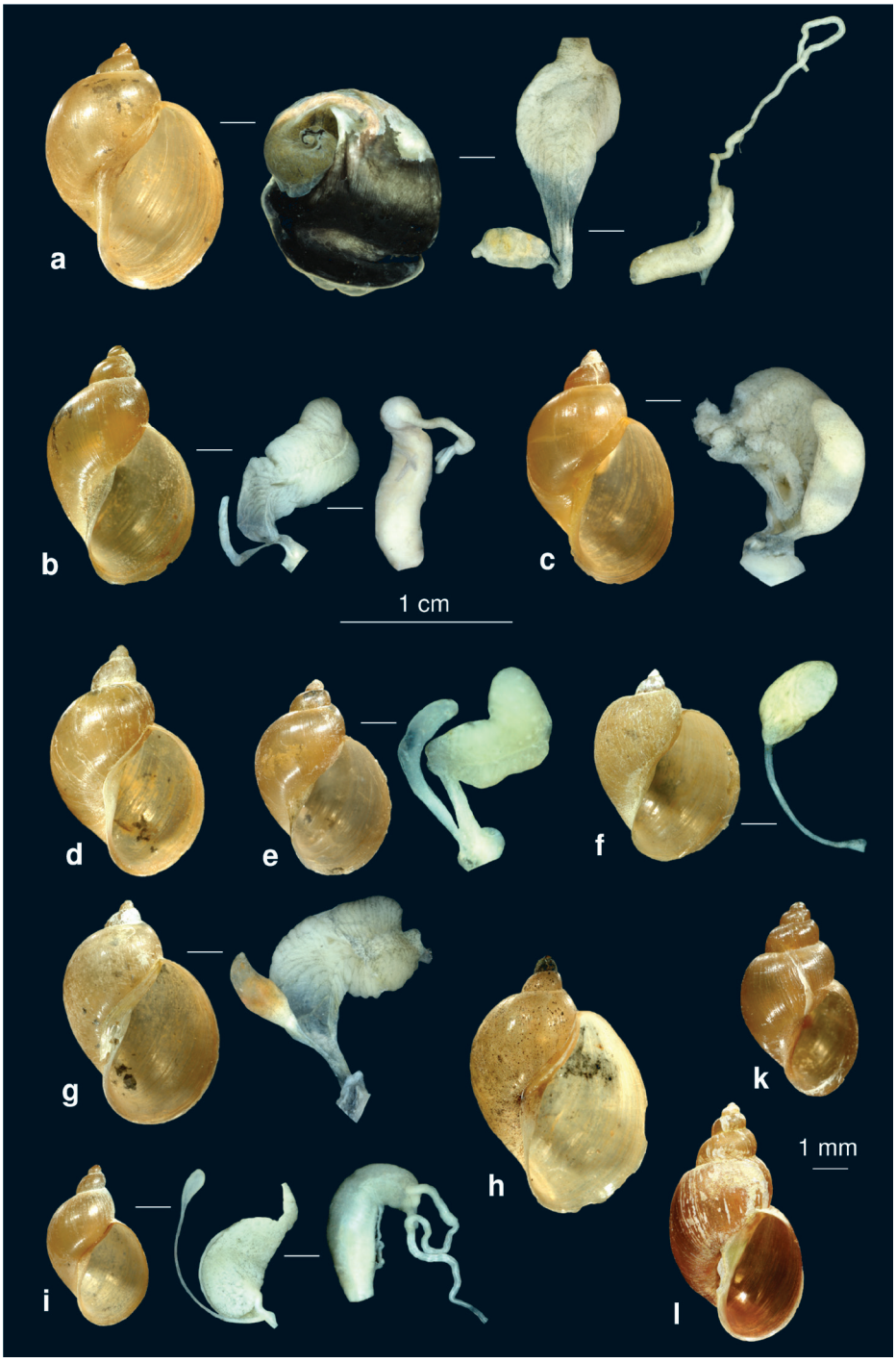

Figure 16. The Lymnaeidae of Iran. **a** *Radix persica* (IR27-07) **b–d** *Radix bactriana* (**b** IR03-05 **c** IR87-05 **d** IR88-05 **e** IR91-05) **f** *Radix persica* (IR107-05) **g** *Radix iranica* (IR89-05) **h** *Radix* sp. **i** *Radix* sp. **k** *Galba truncatula* (IR62-05) **l** *Galba schirazensis*.

***Radix labiata* (Rossmaessler, 1835)**
http://species-id.net/wiki/Radix_labiata

Records from Iran. (mentioned as *R. peregra* f. *canalifera*): N Iran (Caspian Sea) (Eliazian et al. 1979); Kerman Province (Starmühlner and Edlauer (1957); Fars Province (Starmühlner and Edlauer 1957); Yazd Province (Starmühlner and Edlauer 1957); Kermanshah Province (Starmühlner and Edlauer 1957), Starmühlner (1965).

Remarks. *R. labiata* is a species which prefers springs and is distributed in M – and S Europe and the Balkans (Glöer 2002).

Distribution. Europe.

Genus *Galba* Schrank, 1803

Type species. *Galba truncatula* O.F. Müller, 1774

***Galba truncatula* (O.F. Müller, 1774)**
http://species-id.net/wiki/Galba_truncatula
Fig. 16k

Records from Iran. Seistan and Baluchestan Province (as *Limnaea truncatula*: Annandale and Prashad 1919); North Iran (Caspian Sea) (as *Lymnaea truncatula*: Eliazian et al. 1979); Manzandaran Province (Forcart 1935); Gilan, Mazandaran and Lorestan Province (Mansoorian 2000); Kerman Province (Starmühlner and Edlauer 1957, Biggs 1937); Tehran Province (Starmühlner and Edlauer 1957); Khuzestan Province (Mansoorian 2001, Chu et al. 1968, Massoud and Hedayeti-Far 1979); Isfahan Province (Biggs 1937); Semnan Province (Starmühlner 1961); Hormozgan Province (Starmühlner 1965).

New records. Khorasan Province: IR63-05 [22 ex.]; IR66a-05 [1 ex.]; IR77-05 [1 ex.].

Associated species. *Radix sp., Planorbis intermixtus, Physella acuta.*

Distribution. Worldwide.

***Galba schirazensis* Küster, 1862**
http://species-id.net/wiki/Galba_schirazensis
Fig. 16l

Records from Iran. Fars Province (Küster 1862); Gilan Province (Bargues et al. 2010).

Distribution. Iran, Mediterranean, Central America (Bargues et al. 2011).

Genus *Stagnicola* Jeffreys, 1830

Type species. *Buccinum palustre* O.F. Müller, 1774

***Stagnicola palustris* (O.F. Müller, 1774)**
http://species-id.net/wiki/Stagnicola_palustris

Records from Iran. Kerman Province (Martens 1874); Isfahan Province (Martens 1874); Qazvin and E Azarbayjan Provinces (Starmühlner and Edlauer 1957); Gilan, Mazandaran and Lorestan Provinces (Eliazian et al. 1979); N Iran (Mansoorian 2000).

Rejected Records from Iran. Mazandaran Province (Forcart 1935).

Remark. The recent insights on the distribution of *Stagnicola palustris* show that it is a Northern European/Siberian species. Most probably, the species reported from Iran as *S. palustris* represents an undescribed species (see below).

***Stagnicola* sp.**
Fig. 17

Records from Iran. Mazandaran Province (Forcart 1935).

Material examined: 35 ex., NMB 11518b "*Stagnicola palustris*" Zw. Nika und Aschref, Dr. Erni & Buxtorf 1934; 3 ex., NMB 11518a "Iran, Prov. Mazandaran. Meschhediser, Geniste am rechten Ufer des Babul ca. 300 m S der Mündung, -26 m Meereshöhe. Leg. 23.8.1931 & don. 1935 Drs. A. Erni & R. Buxtorf".

Remark. An examination of the specimens from NMB identified by Forcart (1935) as *Stagnicola palustris* shows that these specimens are not conspecific with *S. palustris*. Namely, Forcart's specimens clearly differ in the aperture, which is broader at the basis (Fig. 17) than in *S. palustris*. However, due to the fact that the shells of *Stagnicola* spp. are very variable, it is not possible to identify or eventually describe this specis as new to science without anatomical studies.

Genus *Lymnaea* Lamarck, 1799

Type species. *Lymnaea stagnalis* (Linnaeus, 1758)

***Lymnaea stagnalis* (Linnaeus, 1758)**
http://species-id.net/wiki/Lymnaea_stagnalis

Records from Iran. Khuzestan Province (Mansoorian 1998, 2001).

Distribution. Palaearctic.

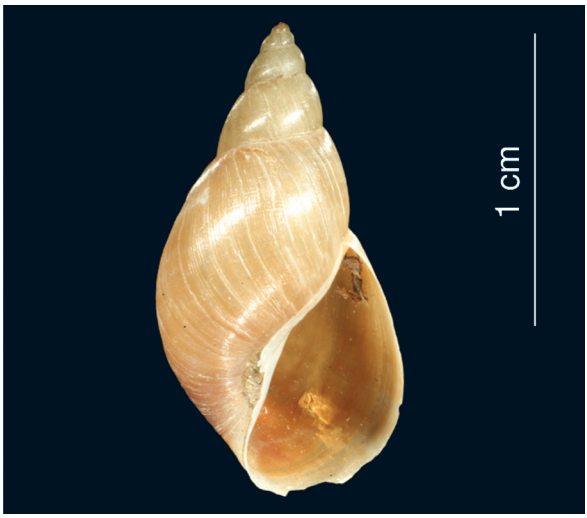

Figure 17. *Stagnicola* sp. (from Forcart's collection, NMB 11518b "*Stagnicola palustris*"): shell.

Family Planorbidae Rafinesque, 1815

Genus *Bulinus* O.F. Müller, 1781

Type species. *Physa truncata* Audouin, 1827

***Bulinus truncatus* (Audouin, 1827)**
http://species-id.net/wiki/Bulinus_truncatus

Records from Iran. Khuzestan Province (Chu et al. 1968, Massoud and Hedayeti-Far 1979, Mansoorian 1994, 2001); Gilan Province (Mansoorian 2000).

Distribution. Tropical Africa, Arabian Peninsula, Iran.

Genus *Planorbis* O.F. Müller, 1774

Type species. *Helix planorbis* Linnaeus, 1758

***Planorbis intermixtus* Mousson, 1874**
http://species-id.net/wiki/Planorbis_intermixtus
Fig. 18b

Planorbis subangulatus Philippi, 1844; *Planorbis persicus* Ancey, 1900 (synonymy)

Records from Iran. Northern Iran (as *P. planorbis*: Mansoorian 2000); Mazandaran Province (as *P. planorbis*: Eliazian et al. 1979, Mansoorian 2000); Fars Province (as

P. planorbis: Forcart 1935, Starmühlner and Edlauer 1957); Isfahan Province (Glöer and Pešić 2010); Yazd Province (as *P. persicus*, *P. subangulatus*: Biggs 1937, 1971, Starmühlner and Edlauer 1957); Gilan Province (as *Anisus* (*Gyraulus*) *intermixtus*: Starmühlner and Edlauer 1957); Khuzestan Province (as *P. planorbis, P. planorbis submarginatus*: Starmühlner and Edlauer 1957, as *P. planorbis*: Biggs 1971); Markazi Province (Chu et al. 1968, Massoud and Hedayeti-Far 1979, Mansoorian 2001, Glöer and Pešić 2010).

New records. Mazandaran Province: IR01-05 [11 ex.]; Markazi Province: IR51-05 [11 ex.]; IR87-05 [3 ex.]; IR88-05 [7 ex.]; IR91-05 [5 ex.]; IR93-05 [1 ex.]; Khorasan Province: IR66-05 [10 ex.]; IR67-05 [2 ex.]; IR68-05 [5 ex.]; IR78a-05 [2 ex.]; IR78b-05 [7 ex.]; Fars Province: IR02-07 [2 ex.]; IR07-07 [2 ex.]; IR26-07 [9 ex.]; IR27-07 [3 ex.].

Associated species. *Physella acuta, Pseudobithynia zagrosia, Radix* sp.

Remarks. The species *Planorbis planorbis* and *P. intermixtus* can only be distinguished by the number of prostate diverticula (Glöer and Pešić 2010). All *Planorbis* spp. collected in Iran have been anatomically studied and no *P. planorbis* could be found. Thus we list the old records from Iran under *P. intermixtus*.

In addition, *Planorbis subangulatus* Philippi, 1844 and *Planorbis persicus* Ancey, 1900 have been mentioned from Iran (Ancey 1900, Biggs 1937). Both species have been described on the basis of the shells, the morphology of which falls within variability of *P. intermixtus*. Thus we list these species under *P. intermixtus*.

Distribution. Turkey, Iran, N India.

***Planorbis carinatus* O.F. Müller, 1774**
http://species-id.net/wiki/Planorbis_carinatus
Fig. 18a

Records from Iran. Northern Iran (Mansoorian 1994).

New records. Mazandaran Province: IR01-05 [5 ex., anat. det.].

Associated species. *Valvata cristata, Anisus* sp., *Valvata nowshahrensis* sp. n., *Pseudobithynia mazandaranensis* sp. n., *Hippeutis complanatus.*

Distribution. Palaearctic.

Genus *Anisus* S. Studer, 1820
http://species-id.net/wiki/Anisus

Type species. *Helix spirorbis* Linnaeus, 1758

Remarks. The identification of the species of this genus is based on the anatomical features (Glöer and Meier-Brook 2008), so all former records of this genus are questionable and need new confirmation.

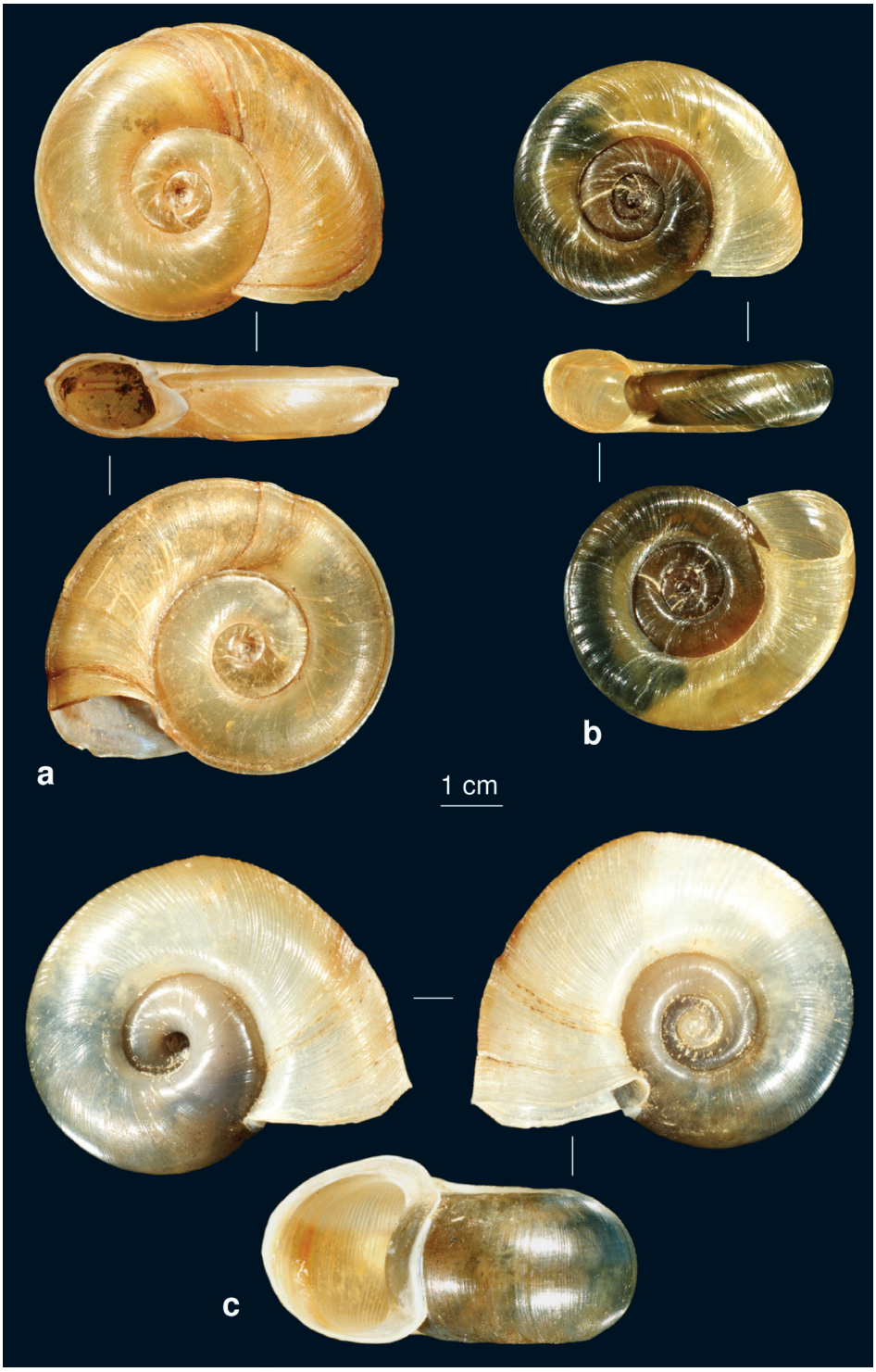

Figure 18. The *Planorbis* spp. of Iran. **a** *Planorbis carinatus* **b** *Planorbis intermixtus* **c** *Indoplanorbis exustus.*

***Anisus leucostoma* (Millet, 1813)**
http://species-id.net/wiki/Anisus_leucostoma

Records from Iran. Gilan Province – Mansoorian (1994, 2000).
Distribution. Palaearctic.

***Anisus spirorbis* (Linnaeus, 1758)**
http://species-id.net/wiki/Anisus_spirorbis

Records from Iran. Azarbayjan Province (Starmühlner and Edlauer 1957)
Distribution. Palaearctic.

***Anisus* sp.**
Fig. 19

New records. Mazandaran Province: IR01-05 [1 empty shell].
Associated species. *Planorbis carinatus, Anisus* sp., *Valvata nowshahrensis* sp. n., *Pseudobithynia mazandaranensis* sp. n., *Hippeutis complanatus*.
Remarks. The shells (Fig. 19) of this species are similar to the rare species *Anisus vorticulus*, which is distributed in Central and E Europe. Additional material is necessary to resolve the taxonomy of this taxon.

***Anisus vortex* (Linnaeus, 1758)**
http://species-id.net/wiki/Anisus_vortex

Records from Iran. Fars Province – Mansoorian (1994).
Distribution. Euro-Siberian.

Figure 19. *Anisus* sp.: shell.

Genus *Gyraulus* Charpentier, 1837

Type species. *Planorbis albus* O.F. Müller 1774

***Gyraulus piscinarum* (Bourguignat, 1852)**
http://species-id.net/wiki/Gyraulus_piscinarum
Fig. 20b

Records from Iran. Tehran Province (as *Anisus* (*Gyraulus*) *piscinarum*: Starmühlner and Edlauer 1957).

New records. Mazandaran Province: IR02-05 [6 ex.]; Fars Province: IR07-07 [13 ex.]; Seistan and Baluchestan Province: IR08-11 [10 ex.], IR09-11 [14 ex.].

Distribution. Lebanon, Syria, Turkey (Black Sea coast), Iran.

Remark. The examined specimens have been identified by its anatomy and are in a good agreement with Glöer and Bößneck (2007) as well as the anatomical studies carried out by Meier-Brook (1983).

***Gyraulus euphraticus* (Mousson, 1874)**
http://species-id.net/wiki/Gyraulus_euphraticus

Records from Iran. Seistan and Baluchestan Province (Annandale and Prashad 1919); Fars Province (Starmühlner and Edlauer 1957); Khuzestan Province (Massoud and Hedayeti-Far 1979, Mansoorian 2001).

Remarks. *Gyraulus euphraticus* can be confused with *Anisus* spp. (Glöer and Bössneck 2007).

Distribution. Irak, Iran.

***Gyraulus convexiusculus* (Hutton, 1849)**
http://species-id.net/wiki/Gyraulus_convexiusculus
Fig. 20a

New records. Seistan and Baluchestan Province: IR08-05 [2 ex.]; IR09-11 [4 ex.].

Records from Iran. Seistan and Baluchestan Province (Annandale and Prashad 1919); Yazd Province (Starmühlner and Edlauer 1957).

Distribution. Afghanistan to Thailand, Iran.

***Gyraulus laevis* (Alder, 1838)**
http://species-id.net/wiki/Gyraulus_laevis

Records from Iran. Mazandaran Province (Forcart 1935, Starmühlner and Edlauer 1957).

Distribution. Central Europe.

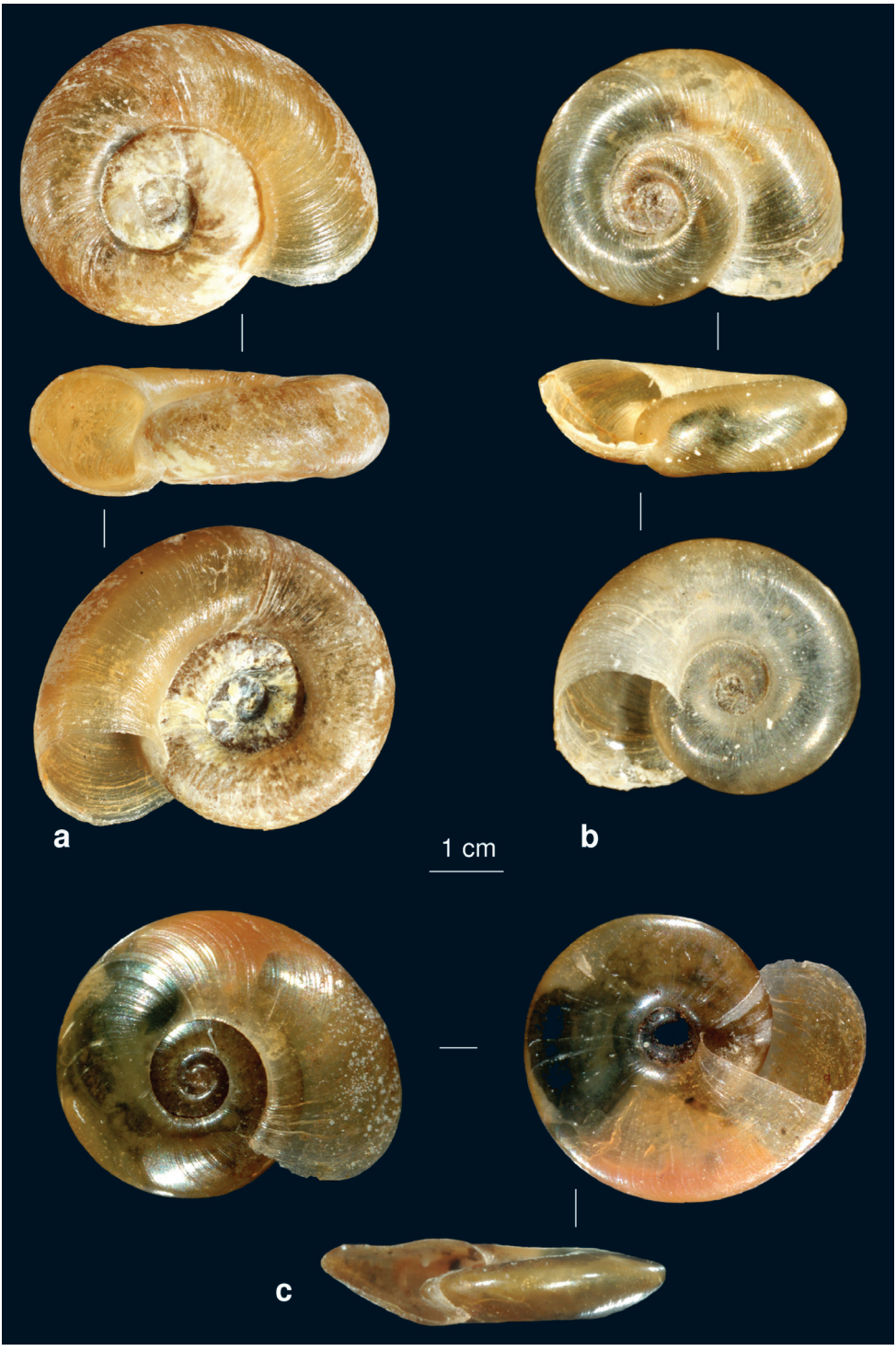

Figure 20. a *Gyraulus convexiusculus* **b** *G. piscinarum* **c** *Hippeutis complanatus*.

Genus *Indoplanorbis* Annandale and Prashad, 1920

Type species. *Planorbis exustus* Deshayes, 1834

***Indoplanorbis exustus* (Deshayes, 1834)**
http://species-id.net/wiki/Indoplanorbis_exustus
Fig. 18c

Records from Iran. Seistan and Baluchestan Province (Mansoorian 1994).
New records. Hormozgan Province: IR15-11 [5 ex.].
Distribution. Iran, Oman, Yemen, India, Nepal, SE Asia.

Genus *Hippeutis* Charpentier, 1837

Type species. *Helix complanata* Linnaeus, 1758

***Hippeutis complanatus* (Linnaeus, 1758)**
http://species-id.net/wiki/Hippeutis_complanatus
Fig. 20c

New records. Mazandaran Province: IR01-05 [3 ex., anat. det.].
Remarks. New for Iran.
Distribution. Europe to W Asia.

Genus *Segmentina* Fleming, 1818

Type species. *Planorbis nitidus* O.F. Müller, 1774

***Segmentina calatha* (Benson, 1850)**
http://species-id.net/wiki/Segmentina_calatha

Records from Iran. Seistan and Baluchestan Province (Annandale and Prashad 1919).
Distribution. India, Iran.

Genus *Ferrissia* Walker, 1903

Type species. *Ferrissia rivularis* (Say, 1817)

***Ferrissia isseli* (Bourguignat, 1866)**
http://species-id.net/wiki/Ferrissia_isseli

Records from Iran. Gilan Province (as *Protancylus* (*Ferrissia*) *isseli*: Starmühlner and Edlauer 1957).

Distribution. Africa, Iran.

Family Physidae Fitzinger, 1833

Genus *Haitia* Clench & Aguayo, 1932

Type species. *Physa globosa* Haldeman, 1841

***Haitia acuta* (Draparnaud, 1805)**
http://species-id.net/wiki/Haitia_acuta

Records from Iran. all mentioned as *Physa acuta*: Gilan, Mazandaran and Lorestan Provinces (Mansoorian 2000); Khuzestan Province (Mansoorian 2001, Massoud and Hedayeti-Far 1979, Elazian et al. 1979).

New records. Mazandaran Province: IR02-05 [2 ex.]; IR03-05 [3 ex.]; IR04-05 [3 ex.]; IR05-05 [3 ex.]; Markazi Province: IR51-05 [2 ex.], IR91-05 [6 ex.]; IR93-05 [1 ex.]; Khorasan Province: IR70-05 [1 ex.]; IR77-05 [1 ex.]; Gilan Province: IR82-05 [1 ex.]; Lorestan Province; IR95-05 [39 ex.]; Fars Province: IR07-07 [22 ex.]; IR14-07[13 ex.]; IR26-07 [3 ex]; Seistan and Baluchestan Province: IR08-11 [12 ex.]; Hormozgan Province. IR17-11 [1 ex.].

Associated species. *Melanoides tuberculatus, Thiara scabra, Grossuana* sp., *Galba truncatula, Acroloxus pseudolacustris, Planorbis intermixtus, Pseudobithynia zagrosia.*

Distribution. Europe, Mediterranean, Iraq, Iran.

Discussion

The checklist of Iranian freshwater snails presented here shows a total of 73 species in 34 genera and 14 families. The records and taxonomic status of six species i.e. *Neritina mesopotamica* Martens, 1874, *Bithynia* cf. *ejecta* Mousson, 1874, *B. rubens* (Menke, 1830), *Hydrobia acuta* (Draparnaud, 1805), *Hauffenia erythropomatia* (Hauffen, 1856) and *Stagnicola palustris* (O.F. Müller, 1774) are questionable and needs new confirmation. Further, the genus *Melanopsis* needs revision as several species have been reported from Iran (i.e., *Melanopsis variabilis, deserticola, buccinoidea* and *praemorsa*), but without further study and additional materials it is not possible to establish under which name or names the Iranian populations should

be placed. The genus *Radix* is richest in the number of the species. However, our list of *Radix* species from Iran contains the hitherto recorded nominal species, their taxonomic status remains to be explored. For the two species i.e. *Stagnicola* sp. and *Anisus* sp. further study and additional specimens are necessary to resolve the taxonomy of these taxa. The identification of the species of the genus *Anisus* is based on the anatomical features (Glöer and Meier-Brook 2008), so all former records of this genus are questionable and need new confirmation. Three species, *Bithynia badiella* (Küster, 1852), *B. troschelii* (Pasch, 1842) and *Acroloxus lacustris* (Linnaeus, 1758), are excluded from the list of Iranian freshwater snails, while *Bithynia tentaculata* most probably does not occur in Iran.

Of the 73 species reported in this paper, 12 species have a wide distribution (known from two or more bieogeographical regions), 9 species are Palaearctic, 4 species are W-Palaearctic and 8 species are "Middle East" (Iran, Iraq, Tadjikistan, Uzbekistan, Turkey, Syria, Israel) in their distribution. Insufficient knowledge hampers the determination of the biogeographic status of the rest of the species. Moreover, another 27 (37%) of these species have been indicated as being endemic to Iran.

If we take generic diversity into consideration, we can see that only three genera i.e. *Farsithyra* Glöer & Pešić 2009, *Kaskakia* gen. n. and *Sarkhia* gen. n. are endemic to Iran.

The species-richness of freshwater gastropods in our study was rather low one with an average of 2.12 species and a maximum of 6 spp. per sampling site. Only some common species occur in high abundances [> 20 ind./sampling site], abundances of most species being < 10 ind./sampling site. Most sampling sites in our study were intermittent streams, with perennial surface water only present in the head water section near their source in the mountains. Further downstream, riverbeds are usually seasonally dry with occasionally some standing pools in their middle course (Pešić et al. 2012).

As expected, our current knowledge of the diversity of the freshwater snail fauna is far from being complete. For most Iranian provinces, all available data come from a few surveys with as objective the study of snails as vectors of digenetic trematodes of medical or veterinary importance (e.g., Mansoorian 1994, 1998, 2001). However, large portions of Iran remain unexplored and many important hydrological basins have never been sampled. The number of known species may hence only represent but a part of the total freshwater snail species number in Iran. For example, for Central Europe, an estimated total species number of about 150 appears appropriate (Glöer 2002).

However, the present study is exhaustive and constitutes the most complete list of freshwater snails in Iran, including a complete bibliography of research on the subject. Further studies should focus at a serious improvement of our knowledge on Iranian freshwater snails by intensive collecting activities in little known areas in order to close the large gaps in our knowledge on their diversity. Particularly some specific habitats such as springs and underground habitats are more or less unexplored but may prove to be a major source for freshwater biodiversity.

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References

Ancey CMF (1900) Description of New Species of Asiatic shells. The Nautilus 14 (7): 83–84.

Annandale N (1921) The aquatic fauna of Seistan. Records of the Indian Museum 18: 235–253.

Annandale N, Prashad B (1919) The Mollusca Fauna of the Inland Waters of Baluchistan and of Seistan. Records of the Indian Museum 18: 18–62.

Annandale N, Rao HS (1925) Materials for a revision of the recent Indian Lymnaeidae (Mollusca Pulmonata). Records of the Indian Museum 27: 137–189.

Bandel K (2001) The history of *Theodoxus* and *Neritina* connected with description and systematic evaluation of related Neritimorpha (Gastropoda). Mitteilungen aus dem Geologisch-Paläontologischen Institut der Universität Hamburg. 85: 65–164.

Bargues MD, Vigo M, Horak P, Dvorak J, Patzner RA, Pointier JP, Jackiewicz M, Meier-Brook C, Mas-Coma S (2001) European Lymnaeidae (Mollusca: Gastropoda), intermediate hosts of trematodiases, based on nuclear ribosomal DNA ITS-2 sequences. Infection, Genetics and Evolution 1 (2): 85–107. doi: 10.1016/S1567-1348(01)00019-3

Biggs HEJ (1936) Collecting Mollusca on the Iranian Plateau. The Nautilus 50: 8–13.

Biggs HEJ (1937) Mollusca of the Iranian Plateau. Journal of Conchology 20: 342–350.

Biggs HEJ (1971) Mollusca of the Iranian Plateau-III. Journal of Conchology 27: 211–220.

Bouchet Ph, Rocroi JP (2005) Classification and Nomenclator of Gastropod Families. Malacologia 47(1–2): 1–397.

Bourguignat JR (1864) Malacologie de l'Algérie. Histoire naturelle des animaux mollusques terrestres et fluviatiles. Vol. II. Paris (Chalamelle Ainé), 380 pp.

Brown DS (1994) Freshwater Snails of Africa and their Medical Importance. 2nd ed. Taylor & Francis, London, 608 pp.

Chu KY, Massoud J, Arfaa F (1968) Distribution and Ecology of *Bulinus truncatus* in Khuzestan, Iran. Bulletin of the World Health Organization 39: 607–637.

Dybowski W (1888) Die Gastropoden-Fauna des Kaspischen Meeres. Malakozoologische Blätter NF 10: 1–79.

van Damme D (1984) The Freshwater Mollusca of Northern Africa. Dr. W. Junk Publishers, Dordrecht, 164 pp.

van Damme D, Ghamizi M, Soliman G, McIvor A, Seddon M (2010) The status and distribution of freshwater molluscs. In: Garcia N, Cuttelod A, Abdul Malak D (Eds) The status and distribution of freshwater biodiversity in Northern Africa. Gland, Switzerland, Cambridge, UK and Malaga, Spain, IUCN, Occasional Paper of the IUCN Species Survival Commission (ISBN: 978–2-8317–1271–0), Chapter 4: 30–49.

Eichwald E (1841) Fauna caspio-caucasia nonnullis observationibus novis. Petropoli. IV + 233 pp. + 2 pp. Corrigenda, 40 Taf.

Eliazian M, Tamiji Y, Akbarzadeh M, Hagh-Nazari J (1979) Snails from the northern parts of Iran (Caspian Sea). Archives of Razi Institute 31: 29–36.

Forcart L (1935) Die Mollusken der nordpersischen Provinz Masenderan und ihre tiergeographische Bedeutung. Archiv für Naturgeschichte, N.F. 4 (3): 404–447.

Ghasemi S, Zakaria M, Mola Hoveizeh N (2011) Abundance of Molluscs (Gastropods) at Mangrove Forests of Iran. Journal of American Science 7 (1): 660–669.

Glaubrecht M (1993) Mapping the diversity: Geographical distribution of the freshwater snail *Melanopsis* (Gastropoda: Cerithioidea: Melanopsidae) with focus on its systematics in Mediterranean basin. Miutteilungen aus dem Hamburgischen Museum und Institut 90: 41–97.

Glöer P (2002) Die Süßwassergastropoden Nord- und Mitteleuropas. Bestimmungsschlüssel, Lebensweise, Verbreitung. Die Tierwelt Deutschlands, 73, 327 pp.

Glöer P, Bössneck U (2007) Zur Identität von *Gyraulus piscinarum* Bourguignat 1852 mit der Beschreibung von *G. bekaensis* n. sp. (Gastropoda: Planorbidae). Mollusca 25 (2): 139–146

Glöer P, Meier-Brook C (2008) Redescription of *Anisus septemgyratus* (Rossmässler, 1835) and *Anisus leucostoma* (Millet, 1813) (Gastropoda: Planorbidae). Mollusca 26: 89–94.

Glöer P, Pešić V (2006) On the identity of *Bithynia graeca* gen. n. (Westerlund, 1879) with the description of three new *Pseudobithynia irana* n. gen species from Iran and Greece (Gastropoda: Bithyniidae). Malakologische Abhandlungen 24: 29–36.

Glöer P, Pešić V (2009) New freshwater gastropod species of the Iran (Gastropoda: Stenothyridae, Bithyniidae, Hydrobiidae). Mollusca 27 (1): 33–39.

Glöer P, Pešić V (2010) The *Planorbis* species of the Balkans with the description of *Planorbis vitojensis* sp. n. (Gastropoda: Planorbidae). Journal of Conchology 40: 249–257.

Götting K-J (2008) Meeres-Gehäuseschnecken Deutschlands, Bestimmungsschlüssel, Lebensweise, Verbreitung. Die Tierwelt Deutschlands 80: 1–179.

Haase M, Naser MD, Wilke T (2010) *Ecrobia grimmi* in brackish Lake Sawa, Iraq: indirect evidence for long-distance dispersal of hydrobiid gastropods (Caenogastropoda: Rissooidea) by birds. Journal of Molluscan studies 76: 101–105. doi: 10.1093/mollus/eyp051

Heller J, Mordan P, Ben-Ami F, Sivan N (2005) Conchometrics, systematics and distribution of *Melanopsis* (Mollusca: Gastropoda) in the Levant. Zoological Journal of the Linnean Society 144 (2): 229–260. doi: 10.1111/j.1096-3642.2005.00172.x

Hubendick B (1951) Recent Lymnaeidae. Their variation, morphology, taxonomy, nomenclature and distribution. Kungliga Svenska Vetenskapsakademiens Handlingar. Fjärde Serien 3 (1): 1–223.

Issel A (1865) Catalogo dei Molluschi raccolti dalla Missione Italiana in Persia, aggiuntavi la descrizione delle specie nuove o poco note. Memorie della Reale Accademia delle Scienze di Torino, (Ser. II) 23 [1866]: 387–439, 3 tavv. Torino. [Separatum: pp. 1–55, 3 tavv. Stamperia Reale, Torino 1865.]

Kantor YI, Vinarski MV, Schileyko AA, Sysoev AV (2009) Catalogue of the Continental Mollusks of Russia and adjacent territories. Version 2.3 (published online on December 22, 2009: http://www.ruthenica.com/documents/Continental_Russian_molluscs_ver2–3.pdf)

Mandahl-Barth G (1968) Revision of the African Bithyniidae (Gastropoda Prosobranchia). Revue de zoologie et de botanique africaines 78 (1–2): 129–159.

Martens E von (1874) Ueber vorderasiatische Conchylien nach den Sammlungen des Prof. Hausknecht. Novitates conchologicae. Supplement V.: 63–82 (Gastropoda).

Martens E von (1879) Die Gattung *Neritina*. Systematisches Conchylien Cabinet, II. 10, 303 pp.

Mansoorian A (1986) A practical guide to the identification of the freshwater snails of Iran. Iranian Journal Public Health 15 (1–2): 41–53. [In persian]

Mansoorian A (1998) Some freshwater snails from Iran. In: R Bieler R, Mikkelsen PM (Eds) Abstracts of World Congress of Malacology, July 1998, Washington DC, 206.

Mansoorian A (1994) Freshwater snails of Iran. Scientific publication of School of Public Health & Institute of Public Health Research, Technical series 2145: 1374.

Mansoorian A (2000) Some freshwater snails from Northern Iran. Iranian Journal Public Health 29 (1–4): 77–82.

Mansoorian A (2001) Freshwater Gastropod of Khuzestan Province, South-West Iran**.** Iranian International Journal of Science 2 (2): 1–9.

Massoud J, Hedayeti-Far M (1979) Freshwater mollusk fauna of the Khuzestan and Khorram-Bad areas in Southwestern Iran. Malacological Review 12: 96.

Meier-Brook C (1983) Taxonomic studies on *Gyraulus* (Gastropoda: Planorbidae). Malacologia 24 (1–2): 1–113.

Mousson MA (1874) Coquilles terrestres et fluviatiles recueillies par M. le Dr Alexandre Schlaefli en Orient. Journal de Conchyliologie (5th series), 22: 1–60.

Nesemann H, Sharma S, Sharma G, Khanal SN, Pradhan B, Shah DN, Tachamo RD (2007) Aquatic invertebrates of the Ganga River System. Mollusca, Annelida, Crustacea (in part), 1, 263 pp.

Neubert E (1998) Annotated checklist of the terrestrial and freshwater molluscs of the Arabian Peninsula with description of new species. Fauna of Arabia 17: 333–461.

Pešić V, Saboori A (2007) A checklist of the water mites (Acari: Hydrachnidia) of Iran. Zootaxa 1473: 45–68.

Pešić V, Smit H, Saboori A (2012) Water mites delineating the Oriental and Palaearctic regions - the unique fauna of southern Iran, with description of one new genus, one new subgenus and 14 new species. Zootaxa 3330: 1–67.

Pfenninger M, Cordellier M, Streit B (2006) Comparing the efficacy of morphologic and DNA-based taxonomy in the freshwater gastropod genus *Radix* (Basommatophora, Pulmonata). BiomedCentral Evolutionary Biology 14 pp. BMC Evolutionary Biology 2006, 6:100 doi: 10.1186/1471-2148-6-100

Prashad B (1921) Report on the freshwater gastropod molluscs of lower Mesopotamia. Part III. The families Neritidae, Hydrobiidae and Melaniidae, Records of Indian Museum, 18: 215–26.

Radoman P (1983) Hydrobioidea a superfamily of Prosobranchia (Gastropoda). I. Systematics. Monographs 547, Serbian Academy of Sciences and Arts, 256 pp.

Ramakrishna, Dey A (2007) Handbook on Indian Freshwater Molluscs. Zoological Survey of India, 399 pp.

Schniebs K, Glöer P, Vinarski MV, Hundsdoerfer AK (2011) Intraspecific morphological and genetic variability in *Radix balthica* (Linnaeus 1758) (Gastropoda: Basommatophora: Lymnaeidae) with morphological comparison to other European *Radix* species. Journal of Conchology 40 (6): 657–678.

Schütt H (1973) Einige Süsswassermollusken der zentralen Hochtäler Westasiens. Basteria 37: 31–38.

Starmühlner F (1961) Eine kleine Molluskenausbeute aus Nord- und Ostiran. Sitzungsberichte der österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse, Abteilung I, 170 (3–4): 89–99.

Starmühlner F (1965) Eine weiterer Beitrag zur Wassermolluskenfauna des Iran. Sitzungsberichte der österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse, Abteilung I, 174 (5–6): 171–183.

Starmühlner F, Edlauer A (1957) Ergebnisse der Österreichischen Iran-Expedition 1949/50 (Mit Berücksichtigung der Ausbeute der Österreichischen Iran-Expedition 1956): Beiträge zur Kenntnis der Molluskenfauna des Iran. Sitzungsberichte der österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftliche Klasse, Abteilung I, 166 (9/10): 435–494.

Subba Rao NV (1989) Handbook Freshwater Molluscs of India. Zoological Survey of India, Calcutta, 289 pp.

Yılıdırım MZ (1994) Türkiye Prosobranchia (Gastropoda: Mollusca) Türleri ve Zoocoğrafik Yayıhşları. Turkish Journal of Zoology 23: 877–900.

Westerlund CA (1886) Fauna der in der paläarctischen Region lebenden Binnenconchylien. 6: Fam. Ampullaridae, Paludinidae, Rissoidae, Assiminidae, Valvatidae, Melanidae & Neritidae. Lund (Ohlsson), 156+13 pp.

Zhadin VI (1952) Mollusks of Fresh and Brackish Waters of the U.S.S.R. Academie of Sciences of the Union of Soviet Socialist Republics (translated by the Israel Program of Scientific Translations, Jerusalem 1965), xvi + 368 pp.

Appendix

List of sampling sites.

	code	sampling site	GPS-coordinates [m asl.]	habitat	date
1	IR01-05	Mazandaran province, Nowshahr city (near Caspian Sea)	51°31'E, 36°38'N [- 28]	pond	18.06.2005
2	IR02-05	Mazandaran province, road to Kandelous	no coordinates	spring	18.06.2005
3	IR03-05	Markazi province, road to Khomeyn	no coordinates	stream	27.06.2005
4	IR05-05	Lorestan province, Khorramabad area.	no coordinates	stream	24.06.2005
5	IR04-05	Khorasan province, 25 km to Bojnurd River	no coordinates	stream	07.07.2005
6	IR51-05	Markazi Province, Bolagh stream 10 km after Shahzand city (in Shahzand to Pole Doab Road),	no coordinates	stream	04.06.2005
7	IR61-05	Khorrasan Province, Akhlamad	58°57'E, 36°40'N [ca. 2000]	waterfall	04.06.2005
8	IR62-05	Khorrasan Province, Golmakan, Cheshmeh Sebz	59°15'E, 36°15'N [ca. 2000]	spring	04.06.2005
9	IR63-05	Khorrasan Province, Gojki road to Kalat (ca. 94 km to Kalat)	59°45'E, 36°35'N [ca. 1400]	rheohelocrenic spring	05.06.2005
10	IR64-05	Khorrasan Province, Gojki road to Kalat (ca. 94 km to Kalat)	59°45'E, 36°35'N [ca. 1400]	stream	05.06.2005
11	IR66a-05	Khorrasan Province, spring at Masshad-Kalat road (35 km to Kalat)	no coordinates	spring	05.06.2005
12	IR67-05	Khorrasan Province, river near Kalat city	59°45'E, 36°58'N [ca. 1900]	river	05.06.2005
13	IR68-05	Khorrasan Province, Mach stream (in Moghan road), 16 km to Moghan	59°31'E, 35°10'N [ca. 2000]	stream	06.06.2005
14	IR70-05	Khorrasan Province, Kaskak stream in Kaskak village	59°10'E, 35°25'N [ca. 1800]	stream	07.06.2005
15	IR76-05	Khorrasan Province, Kharv stream in Kharv city (25 km to Neishabour)	59°5'E, 36°12'N [ca. 2200]	stream	10.06.2005
16	IR77-05	Khorrasan Province, Koh Sorkh stream (in Koh Sorkh city, ca. 35 km to Kashmar city)	59°25'E, 36°25'N [ca. 2200]	stream	10.06.2005
17	IR78-05	Khorrasan Province, Zou Eram spring in Zou Eram village (near Shirvan city)	57°40'E, 37°20'N [ca. 1600]	spring	11.06.2005
18	IR78a-05	Khorrasan Province, spring 1 near Zou Eram spring in Zou Eram village (near Shirvan city)	no coordinates [ca. 1600]	spring	11.06.2005
19	IR78b-05	Khorrasan Province, spring 2 near to Zou Eram spring in Zou Eram village (near Shirvan city)	no ccordiantes [ca. 1600]	spring	11.06.2005

	code	sampling site	GPS-coordinates [m asl.]	habitat	date
20	IR79-05	Khorrasan Province, Baba Aman Park spring (ca. 5 km to Bojnurd city)	57°24'E, 37°25'N [ca. 1300]	spring	11.06.2005
21	IR82-05	Gilan Province, Bandar Anzali Lagoon	49°27'E, 37°26'N	wetland	16.06.2005
22	IR87-05	Markazi Province, Ashtian to Arak road (ca. 5 km after Ashtian)	50°01'E, 34°34'N [ca. 1800]	pool	21.06.2005
23	IR88-05	Markazi Province Aman Abad spring in Anjedan road before Aman Abad village (ca. 5 km to Aman Abad village)	49°48'E, 33°55'N [ca. 1700]	spring	22.06.2005
24	IR89-05	Markazi Province, Cheshmeh Shater in Arak to Khomein road (8 km after Arak)	49°45'E, 34°08'N [ca. 1700]	pool	22.06.2005
25	IR90-05	Markazi Province, stream 2 km after Hassan Abad (in Arak to Khomein road)	49°52'E, 33°50'N [ca. 1700]	stream	22.06.2005
26	IR91-05	Markazi Province, Varcheh spring in Emamzadeh Varcheh village (in Arak to Khomein road, ca. 20 km to Khomein)	49°55'E, 33°49'N [ca. 1700]	spring	22.06.2005
27	IR93-05	Markazi Province, stream near Astaneh city (Azna Aligudarz cross way)	49°24'E, 33°55'N [ca. 2400]	stream	23.06.2005
28	IR94-05	Lorestan Province, Darband stream in Darband village (Azna to Dorood road, ca. 16 km to Azna)	49°17'E, 33°25'N [ca. 1800]	stream	23.06.2005
29	IR95-05	Lorestan Province, Dareh Takht stream in Dareh Takht village (13 km to Azna city)	33°22'N, 49°22'E [ca. 2800]	stream	23.06.2005
30	IR105-05	Kermanshah Province, Firoozan stream in Firoozan village	34°25'N, 48°11'E	stream	27.06.2005
31	IR106-05	Kermanshah Province, Sar Pol Kangarar stream in Sar Pol Kangarar village	34°30'N, 47°55'E	stream	27.06.2005
32	IR107-05	Kermanshah Province, spring near Sarabe – Sarkh city	no coordinates	spring	27.06.2005
33	IR108-05	Kermanshah Province, stream Gamasiab in village Gamasiab	34°27'N 47°45'E	stream	27.06.2005
34	IR07-07	Fars Province, Dasht Arzhan village (in Shiraz to Kazerum road)	29°39'N, 51°59'E [ca. 2300]	stream	04.08.2007
35	IR13-07	Fars Province, AtashKadeh spring, Ardeshir palace in Firooz Abad	28°54'N, 52°32'E [1683]	limnocrenic spring	05.08.2007
36	IR14-07	Fars Province, Firooz Abad city, Kay Zarrin village	28°53'N, 52°32'E [1711]	stream	05.08.2007
37	IR17-07	Fars Province, Shiraz to Firooz Abad road, Ebrahim Abad village, Ebrahim Abad stream	29°00'N, 52°34'E	stream	06.08.2007

	code	sampling site	GPS-coordinates [m asl.]	habitat	date
38	IR21-07	Lorestan Province, Mode Abad village	33°35''N, 48°37'E [1723]	stream	10.08.2007
39	IR26-07	Lorestan Province, road from Boroujerd to Khorram Abad city	33°30'N, 48°44'E [1660]	limnocrenic spring	10.08.2007
40	IR27-07	Markazi Province, Aman Abad (near Arak city)	33°59'N, 49°52'E [1775]	pool	11.08.2007
41	IR08-11	Seistan Province, Chabahar, Sharak village, Qanat 1	26°02'N, 61°04'E [264]	qanat (spring)	13.07.2011
42	IR08a-11	Seistan va Baluchestan Province, Chabahar, Sharak village, Qanat 2 (ca. 100 m from Qanat 1)	no coordinates	qanat (spring)	13.07.2011
43	IR09-11	Seistan va Baluchestan Province, Chabahar, Shirgovaz – Machkor stream, 45 m asl.	25°47'N, 61°28'E	stream	14.07.2011
44	IR10-11	Seistan va Baluchestan Province, Chabahar, Hootgat Bala river	25°48'N, 61°31'E [57]	river	14.07.2011
45	IR14-11	Hormozgan Province, Bandar Abass, Khorgoo village before hot water spring	27°29'N, 56°28'E [125]	saline stream	14.07.2011
46	IR15-11	Hormozgan Province, Bandar Abass, Khorgoo village before hot water spring, small pool near 14-11	27°29'N, 56°28'E [113]	pool (saline water)	16.07.2011
47	IR17-11	Hormozgan Province, Bandar Abass, Siahoo Qanat in Siahoo village	27°46'N, 56°20'E [630]	qanat (spring)	18.07.2011
48	IR18-11	Hormozgan Province, Bandar Abass, Taleguerdoo village, Poshtekeno spring, upper part of stream	27°49'N, 56°24'E [836]	stream	18.07.2011
49	IR19-11	Hormozgan Province, Bandar Abass, Banglayan village	27°46'N, 56°32'E [577]	stream	18.07.2011
50	IR20-11	Hormozgan Province, Bandar Abass, Bandar Kamir to Bandar Lenhueh road, ca 80 km to Bandar Abass, saline stream near Dezhgan	26°53'N, 55°16'E [20]	saline stream	20.07.2011
51	IR48-05	Tehran Province, Elbrus Mt., Shahrestanak River		river	18.08.2003

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A new species of *Euscorpius* Thorell, 1876 (Scorpiones, Euscorpiidae) from Turkey

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Abstract

A new species of the genus *Euscorpius* Thorell, 1876 is described based on specimens collected from Dilek Peninsula (Davutlar, Aydın) in Turkey. It is characterized by an oligotrichous trichobothrial pattern (*Pv*= 7, *et*= 5/6, *eb*= 4) and small size. *Euscorpius* (*Euscorpius*) *avcii* **sp. n.** is the first named species of the subgenus *Euscorpius* from Turkey.

Keywords

Scorpion, *Euscorpius*, new species, Turkey

Introduction

The genus *Euscorpius* Thorell, 1876 is one of the most studied taxa of scorpions. According to the present taxonomy, it includes 18 species grouped in four subgenera (*Alpiscorpius* Gantenbein et al. 1999; *Euscorpius* Thorell, 1876; *Polytrichobothrius* Birula, 1917; *Tetratrichobothrius* Birula, 1917) (Fet et al. 2004; Vignoli and Salomone 2008; Tropea 2012). However, its taxonomy is still not totally clear, especially in the Balkans and Turkey but also in Western Europe. The *Euscorpius* populations of Turkey have been poorly studied up to now, and only two valid species are recognized; *E.* (*Polytrichobothrius*) *italicus* (Herbst, 1800) and *E.* (*Alpiscorpius*) *mingrelicus* (Kessler, 1874). The latter is a species complex with six subspecies in Turkey (*E. m. mingrelicus* (Kessler, 1874), *E. m. ciliciensis* Birula, 1898, *E. m. phrygius* Bonacina, 1980, *E. m. ollivieri* Lacroix, 1995, *E. m. legrandi* Lacroix, 1995, and *E. m. uludagensis* Lacroix, 1995) that need clarification. Presence of the *"carpathicus* complex" have been reported by several authors; Hadži (1930) reported it from İstanbul; Schenkel (1947) from Havza (Samsun); Vachon (1951) from Acıpayam and Honaz Mountain (Denizli), Eğridir (Isparta), Korikos (Mersin) and İstanbul; Tolunay (1959) from Sinop; Kinzelbach (1975, 1982) from Amasya, the Middle Taurus, Borçka (Artvin), Çanakkale, Trakya and Efes (Izmir); Karatas (2006) from Marmara area, Sinop, Ada vicinity, Alanya, Avsallar, Fethiye and Kelebekler Valley; Koç and Yağmur (2007) from Dilek peninsula.

Kinzelbach (1975) divided *E. carpathicus* into two species, *E. carpathicus* and *E. mesotrichus* Hadži, 1929. According to Kinzelbach (1975), *E. tergestinus* is a synonym of *E. mesotrichus*, but the latter name is not available because it is a junior homonym of *E. italicus mesotrichus* Hadži, 1929 (Di Caporiacco 1950; Fet 1997b; Fet and Braunwalder 2000). *E. mesotrichus* was synonymized with *E. tergestinus* by Caporiacco (1950) and according to Fet and Braunwalder (2000) the correct name for this species should be *E. tergestinus*, but further studies (Gantenbein et al. 2001; Fet et al. 2003) reported that "*E. mesotrichus*" of Kinzelbach also refers to other species such as *E. balearicus* and *E. sicanus,* besides *E. tergestinus* and other forms waiting for clarification. "*E. mesotrichus*" was recorded in Turkey from Şile (İstanbul) and Prinkipos Island (Büyükada Island) in the Marmara Sea by Kinzelbach (1975).

Koç and Yağmur (2007) reported a population from Dilek Peninsula in Western Turkey as *Euscorpius sp.* ("*carpathicus* complex"). A Dilek specimen was also listed by Vignoli and Salomone (2008) as *E.* cf. *tergestinus* (AMNH, Söke, Davutlar, 44 m a.s.l., 28.IV.2005, H. Koç). This population is described in this study as a new species, *Euscorpius avcii* sp. n. According to our preliminary studies on Turkish *Euscorpius* populations, more species and forms ranging from polytrichous to oligotrichous are present and of these, the latter exhibits diagnostic characters that appear intermediate between the subgenus *Euscorpius* and *Alpiscorpius*. The new species, *Euscorpius avcii* sp. n. is oligotrichous and differs from other forms of the genus *Euscorpius* enough to justify its description as the first species of the subgenus *Euscorpius* to be registered in Turkey.

Materials and methods

A number of 79 specimens collected at Dilek Peninsula, in Turkey, were examined. Furthermore, 56 specimens from MZUF (*Euscorpius tergestinus* (C.L. Koch, 1837): 132/5856, 84/5847, 5848, 5861, 5862, 5863, 131/5838, 5839, 5840, 5841, 5842, 5843, 132/5854, 5856, 5857, 5860, 135/5699, 161/5850, 5851, 162/5864, 5865, 5866, 5867, 163/5987, 5988, 5889, 5990, 5991, 5992, 5993, 5994, 5995, 5996, 5997, 5998, 180/5852, 1417/5999, 6000, 6001, 6002, 6003, 6004, 6005, 6006, 6007, 6008, 6009, 6010, 6011, 6012, 165/6226, 73/6032, 1149/6238; *Euscorpius oglasae* Caporiacco, 1950 lectotype 122/5974, paralectotypes 123/5975) and 13 specimens of the private collection of Gioele Tropea (10 *Euscorpius tergestinus* (C.L. Koch, 1837) from Italy (Abruzzo, Latium and Umbria) and 3 *Euscorpius carpathicus* sensu stricto (Linnaeus, 1767) from Romania) were included in this study as comparison material.

Abbreviations: *V*: trichobothria on ventral pedipalp chela manus; *Pv*: trichobothria on patella ventral surface; *Pe*: trichobothria on the pedipalp patella external surface; *et*: external terminal; *est*: external sub-terminal; *em*: external medium; *esb*: external suprabasal; *eba*: external basal *a*; *eb*: external basal; DPS: dorsal patellar spur; DD: distal denticle; MD: median dentition; OD: outer dentition; ID: inner dentition; IAD: inner accessory denticles; AMNH: American Museum of Natural History, New York, USA; MZUF: Museo Zoologico 'La Specola' dell'Università di Firenze, Florence, Italy; GTC: private collection of Gioele Tropea; MTAS: Museum of the Turkish Arachnological Society; ZMSU: Zoology Museum of Sinop University; KUAM: Arachnological Museum of Kırıkkale University; ARC: private collection of Andrea Rossi.

The trichobothrial notations follow Vachon (1974). The morphological measurements are given in millimeters (mm) following Stahnke (1970). The morphological nomenclature follows Stahnke (1970), Hjelle (1990) and Sissom (1990); the chela carinae and denticle configuration follows Soleglad and Sissom (2001) and sternum terminology follows Soleglad and Fet (2003); description of hemispermatophore and terminology follows Soleglad and Sissom (2001) and Fet and Soleglad (2002).

Taxonomy

Family Euscorpiidae Laurie, 1896
Genus *Euscorpius* Thorell, 1876
Subgenus *Euscorpius* Thorell, 1876

***Euscorpius avcii* Tropea, Yağmur, Koç, Yeşilyurt & Rossi, sp. n.**
urn:lsid:zoobank.org:act:B6799900-DF03-488A-B675-F0195AEB9825
http://species-id.net/wiki/Euscorpius_avcii

Type material. Holotype: 1 ♂, Dilek Peninsula National Park, Canyon, Dilek Peninsula, near Davutlar Town, Kuşadası, Aydın, Turkey, 07.10.2005, leg. H. Koç (MTAS).

Paratypes: 1. 2 ♀♀, 3 ♂♂, Dilek Peninsula National Park, Canyon, Dilek Peninsula, near Davutlar Town, Kuşadası District, Aydın Province, Turkey, 06.11.2004, leg. H. Koç (ZMSU); 2 ♀♀, 1 sub♂, 3 sub♀, Dilek Peninsula National Park, Canyon, Dilek Peninsula, near Davutlar Town, Kuşadası District, Aydın Province, Turkey, 07.10.2005, leg. H. Koç (MZUF); same data but 1 ♂, 2 ♀ (GTC); 4 ♂♂, 3 ♀♀, Dilek Peninsula National Park, Canyon, Kuşadası District, Aydın Province, Turkey, 04.05.2011. 37°41'37"N, 27°09'37"E, 82 m, leg. E.A. Yağmur, A. Avcı and F. Yeşilyurt (MTAS); 5 ♂♂, 10 ♀♀, Dilek Peninsula National Park, Canyon, Dilek Peninsula, near Davutlar Town, Kuşadası District, Aydın Province, Turkey, 07.10.2005, leg. H. Koç (ZMSU); 3 ♀♀, Dilek Peninsula National Park, Canyon, Dilek Peninsula, near Davutlar Town, Kuşadası District, Aydın Province, Turkey, 18.06.2005, leg. H. Koç (ZMSU).

2. 3 ♂♂, 6 ♀♀, 5 km south of Güzelçamlı Village, Davutlar Town, Kuşadası District, Aydın Province, Turkey, 07.06.2011, 37°41'22"N, 27°13'31"E, 311 m, leg. F. Yeşilyurt and E.A. Yağmur (KUAM). Same data but 1 ♂, 1 ♀ (ARC). 3 ♂♂, 8 ♀♀. 5 km south of Güzelçamlı Village, Davutlar Town, Kuşadası District, Aydın Province, Turkey, 13.07.2010, 37°41'25"N, 27°13'53"E, 428 m, leg. F. Yeşilyurt and T. Danışman (KUAM).

3. 1 ♂, 8 ♀♀, Dilek Peninsula, 2 km south of Davutlar Town, pine forest, Kuşadası District, Aydın Province, Turkey, 02.07.2011, leg. E.A. Yağmur and A. Avcı (MTAS).

4. 6 ♂♂, 2 ♀♀, Dilek Peninsula National Park, picnic area, laurel forest, Kuşadası District, Aydın Province, Turkey, 13.08.2009, leg. E.A. Yağmur, N. Tezcan and V. Ülgezer (MTAS).

Etymology. The specific epithet refers to Dr. Aziz Avcı who is a Turkish herpetologist and the new species is named after him for his kind contributions to collecting scorpion species and his friendship.

Diagnosis. A small *Euscorpius* species, total length 24–28 mm. Color of adults is light brown to brown-reddish with the carapace and pedipalps darker brown-reddish, legs and telson lighter, yellowish colored. *E. avcii* sp. n. is oligotrichous; the number of trichobothria on the pedipalp manus ventral surface is 4 (3 *V* + *Et* 1); the number of trichobothria on the pedipalp patella ventral surface is 7 (of 78.5% of examined specimens and of 88% of pedipalps). The number of trichobothria on pedipalp patella external surface is: *eb* = 4, *eba* = 4, *esb* = 2, *em* = 4, *est* = 4, *et* = 5/6 (generally 5). The pectinal teeth count is: 7-9 (generally 8) in males, 6-7 (generally 7) in females. The telson vesicle in males is more swollen than in females, but only slightly more swollen if compared to other species of the subgenus *Euscorpius*. The pedipalps are stocky with a notch on fixed finger and scalloping of the movable finger well developed in adult males, obsolete in females. The dorsal patellar spur is weakly developed. Carinae on the metasomal segments are strongly reduced, almost smooth. Average value of the length from center median eyes to anterior margin of the carapace is equivalent to 39.20±2.0% of the carapace length. Average value of the length from center median eyes to posterior margin of the carapace is equivalent to 60.80±2.0% of the carapace length.

Description of the holotype male. Coloration: Light brownish with carapace and pedipalps darker, brownish-reddish, legs, telson and chelicerae are lighter,

yellowish-orange. Carapace slightly marbled. The coxal region is distinctly brownish-orange colored. The sternites, pectines and genital operculum are very light brownish-white (Fig. 3, 4 and 5).

Carapace: Length 3.70 mm; posterior width 3.75. Very slightly and finely granulated in laterally. All the furrows are shallow, only the posterior lateral furrows are slightly more marked. Distance from the center of the median eyes to the anterior margin of the carapace is equivalent to 39.62% of the prosoma; the length from the center of the median eyes to the posterior margin of the carapace is equivalent to 60.38% of the prosoma (Fig. 1A).

Mesosoma: Tergites very slightly and finely granulated, almost smooth; sternites smooth. The area of overlap between the sternites is lighter in color. Pectinal teeth count is 8-9. The spiracles are very small, oval shaped and it is inclined to about 45° downwards towards outside.

Metasoma: Medium to small size with respect to body length. Dorsal carinae from segment I–IV are almost smooth, exhibit a few distanced fine granules, obsolete or almost obsolete on the segment V; ventromedian carinae from segment I–IV absent; ventromedian carinae on segment V are formed by very fine granules. Ventrolateral carinae from segment I–IV are obsolete; on segment V they are formed by a few spaced granules (Fig. 2E,F).

Telson: Vesicle weakly swollen (Fig. 2A); smooth, with ventral setae of different sizes; telson height 1.37, telson length 3.65, vesicle length 2.65, vesicle width 1.40.

Pectines: Pectinal teeth count 8-9; middle lamellae count 5-4.

Genital operculum: Partially divided with genital papillae protruding; a few microsetae present.

Sternum: Pentagonal shape, type 2. Length similar to width, deep posterior emargination.

Pedipalp: Coxa and trochanter with strong granulation. Femur: dorsal internal carinae tuberculate; dorsal external carinae formed by low spaced tubercles, their size increases from distal to proximal. Intercarinal spaces bears scattered small granules, larger in the posterior proximal area. Ventral external carina is granulated in the proximal half. External median carinae serrulate, anterior median crenulate and tuberculate distally. Patella length 3.25; patella width 1.20; dorsal internal carinae crenulate. Dorsal external carinae from rough to smooth and are crenulate proximally. Ventral external carinae from smooth to rough. Ventral internal carinae serrulate. Intercarinal tegument smooth or rough. Dorsal patellar spur weakly developed (Fig. 1E).

Chelal carina D_1 is distinctly strong, dark and from smooth to rough; D_4 is formed from scattered granules; V_1 is distinctly strong, crenulate and dark; V_3 is formed from granules on 2/3 of length. External carina with granules on distal half. Intercarinal tegument rough or smooth except between carinae *D4* and *V3*. Movable finger dentition: MD like a straight line formed from very small denticles closely spaced and an DD on the distal tip; OD formed from 7 denticles on movable finger and 6 denticles on fixed finger, immediately outside of MD, their size increases progressively but the terminal denticle is not very pronounced; ID formed from 7

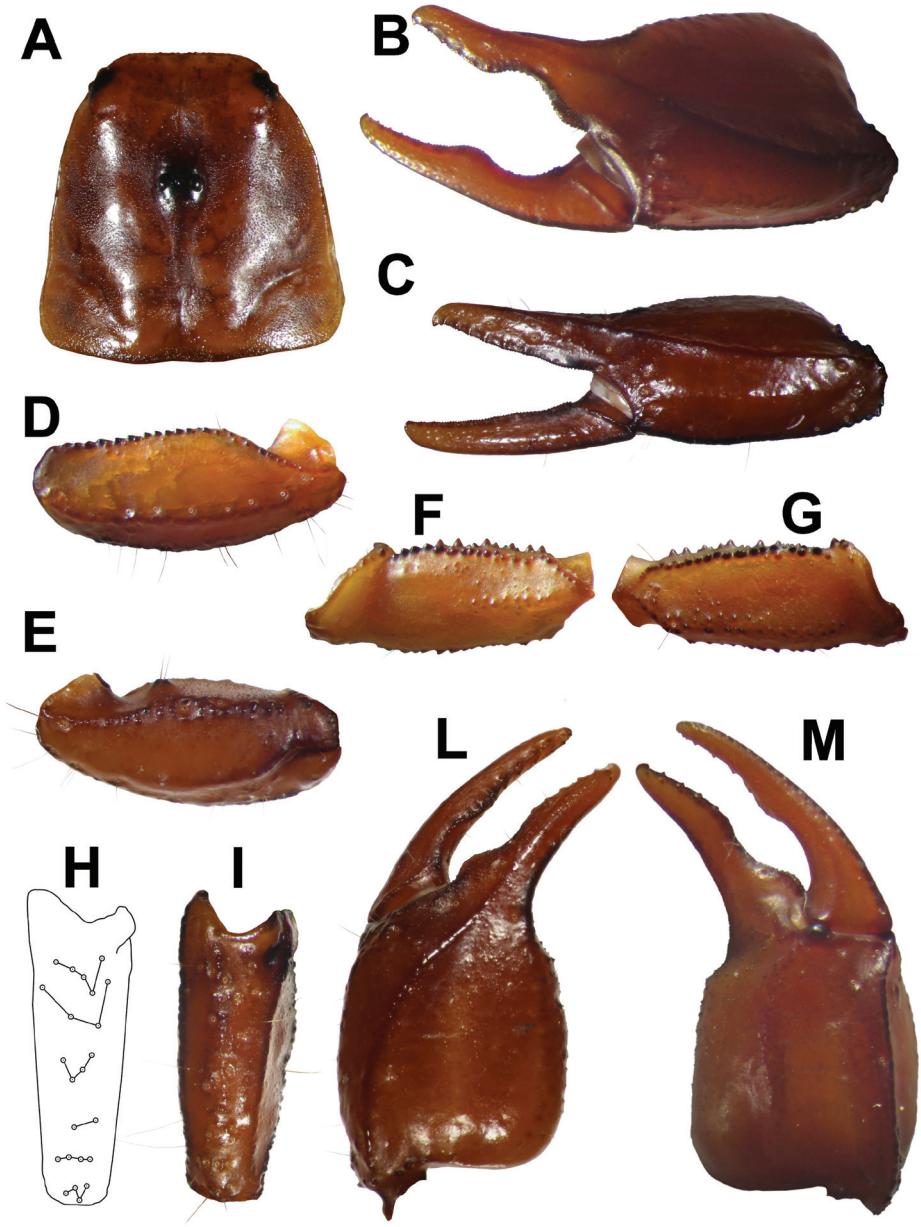

Figure 1. A carapace **B** external view of chela of the adult male **C** external view oh chela of the adult female **D** ventral view of pedipalp patella **E** dorsal view of pedipalp patella **F** ventral view of pedipalp femur **G** dorsal view of pedipalp femur **H** schematic view of trichobothrial pattern on external surface of pedipalp patella **I** view of external surface of pedipalp patella **L** dorsal view of chela **M** ventral view of chela.

denticles on movable finger and 6 denticles on fixed finger, spaced from MD, their size increases progressively but the terminal denticle is not very pronounced; IAD on both movable and fixed finger formed from 4 small denticles.

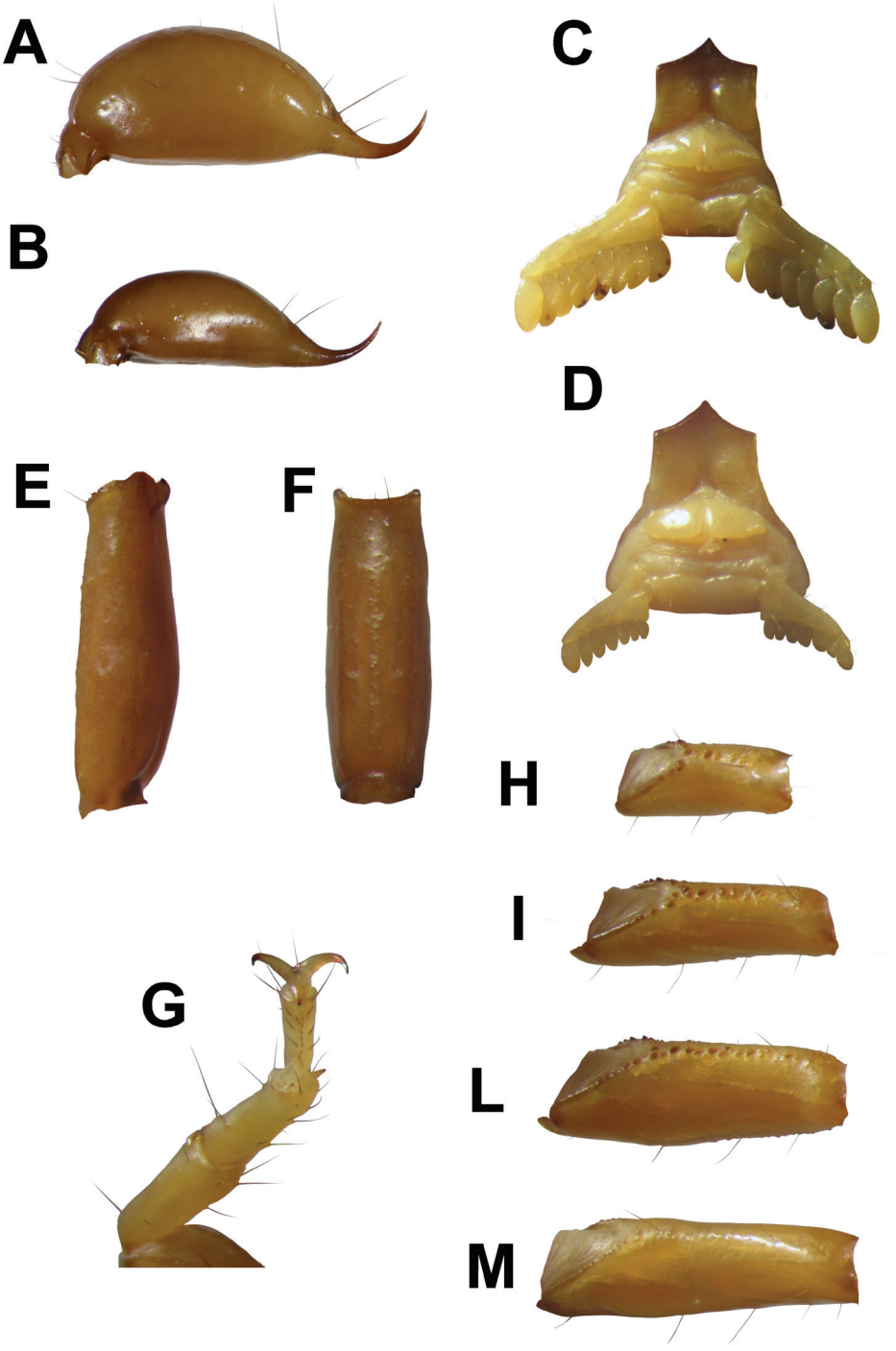

Figure 2. A telson of adult male **B** telson of adult female **C** sternopectinal area of adult male **D** sternopectinal area of adult female **E** latero-dorsal view of the metasomal segment V **F** ventral view of the metasomal segment V **G** tarsus and basitarsus **H** leg femur I **I** leg femur II **L** leg femur III **M** leg femur IV.

Figure 3. Dorsal and ventral views of *Euscorpius avcii* sp. n. male.

Trichobothria: Chela trichobothria series *V* standard: *V* = 4-4 (3 *V*+ *Et*1); patella ventral (*P*v): 8-7; Patella external (*P*e): *et* = 5-5, *est* = 4-4, *em* = 4-4, *esb* = 2-2, *eba* = 4-4, *eb* = 4-4.

Legs: legs with two pedal spurs. Tarsal ventral row with 10-12 stout spinules; 3 tarsal setae flanked pairs adjacent to the ventral spinules row. Basitarsus with 6 prolateral stout spinules on leg pair I; 7 prolateral stout spinules on leg pair II; 1 prolateral stout spinules on leg pair III; absent on leg pair IV. Granulation on the leg femora II and III is more marked both dorsally and ventrally, and only ventrally on leg I. Granulation is formed from dark granules; while the granulation on the dorsal surface of the femur of leg I and on the femur of leg IV both dorsally and ventrally is weakly marked and of lighter colored granules.

Chelicerae: movable finger: The dorsal distal tooth is smaller than the ventral distal tooth; Ventral edge is smooth with brush-like setae on the inner part; dorsal edge has five teeth: one distal, two small subdistal, one big median and a small basal; fixed finger has four teeth: one distal, one subdistal, one median and one basal. The median and the basal are in a fork arrangement. The internal edge has brush-like setae.

Variation: The variation observed in 79 studied specimens (29 males, 50 females) is the follows: pectinal teeth in males: 7-7 (1/29), 8-8 (23/29), 8-9 (4/29), 9-9 (1/29);

Figure 4. Dorsal and ventral views of *Euscorpius avcii* sp. n. female.

Figure 5. *Euscorpius avcii* sp. n. in its natural habitat.

females: 6-6 (5/50), 6-7 (11/50), 7-7 (34/50); pedipalp patella trichobothria *Pv*: 8-8 (2/79), 8-7 (9/79), 7-7 (62/79), 6-7 (6/79); pedipalp patella trichobothria *Pe*: *et* = 5-5 (41/79), 5-6 (19/79), 6-6 (19/79); *est* = 4-4 (79/79), *em* = 4-4 (79/79), *esb*= 2-2 (79/79), *eba* = 4-4 (79/79), eb = 4-4 (79/79). The variation in the trichobothrial pattern is within the standard values of variability and shows the stability of diagnostic characters.

Hemispermatophore. Well developed lamina with well visible basal constriction, tapered distally; truncal flexure present and well developed; capsular lobe complex well developed, with acuminate process; ental channel spinose distally, exhibiting six delicate variable sized spines (Fig. 6).

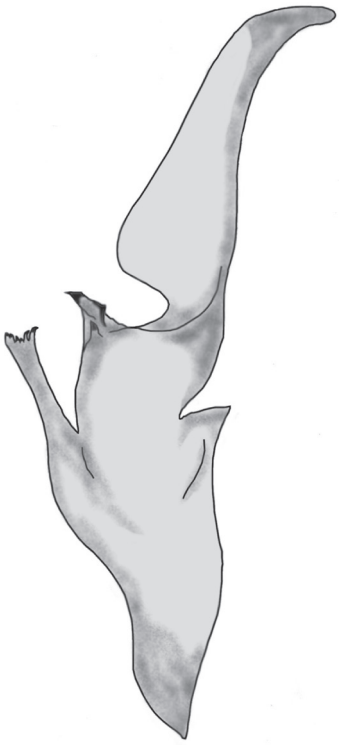

Figure 6. Left hemispermatophore of *Euscorpius avcii* sp. n.

Discussion

Euscorpius avcii sp. n. is an oligotrichous form with *Pv* = 7 and *Pe-et* = 5/6. Most of the species belonging to the subgenus *Euscorpius* have generally higher trichobothrial numbers, with some exceptions e.g. *Euscorpius oglasae* Di Caporiacco, 1950 (*Pv* = 7, *Pe-et* = 5) (Vignoli et al. 2007) and an unnamed form from the island of Samos in Greece (*Pv* = 5, *Pe-et* = 5) (Vignoli and Salomone 2008). Kinzelbach (1975) mentions *E. carpathicus* (Linnaeus, 1767) and *Euscorpius mesotrichus* from some localities in Turkey, according to the author the specimens with *Pv* 7/8 are *E. carpathicus*,

Table 1. Measurements (in mm) of male holotype and female and male paratype of *Euscorpius avcii* sp. n.

		Holotype	Paratype female	Paratype male
Total	Length	26.18	23.65	27.70
Carapace	Length	3.70	3.60	3.90
	Posterior width	3.75	3.70	3.80
Metasoma	Length	9.78	8.20	10.10
Segment I	Length	1.25	1.10	1.30
	Width	1.40	1.30	1.40
Segment II	Length	1.50	1.35	1.60
	Width	1.20	1.10	1.20
Segment III	Length	1.75	1.45	1.80
	Width	1.15	1.05	1.10
Segment IV	Length	2.05	1.70	2.20
	Width	1.07	1.00	1.05
Segment V	Length	3.23	2.60	3.20
	Width	1.10	1.00	1.10
Telson	Length	3.65	2.85	3.70
Vesicle	Length	2.65	2.10	2.80
	Width	1.40	0.75	1.40
	Height	1.37	0.95	1.40
Aculeus	Length	1.00	0.75	0.90
Femur	Length	3.20	3.10	3.10
	Width	1.25	1.20	1.20
Patella	Length	3.25	3.20	3.45
	Width	1.20	1.25	1.30
Chela	Length	6.70	6.35	7.05
	Width	3.00	2.70	3.05
Movable finger	Length	3.85	3.10	4.00
Pectines teeth		8–9	7–7	8–8

with *Pv* 10/14 are *E. mesotrichus*. According Kinzelbach (1975) *E. tergestinus* is a synonym of *E. mesotrichus*, but the latter name is not available because it is a junior homonym of *E. italicus mesotrichus* Hadži, 1929 (Di Caporiacco 1950; Fet 1997b; Fet and Braunwalder 2000). *E. mesotrichus* was synonymized with *E. tergestinus* by Caporiacco, (1950) and according to Fet and Braunwalder (2000) the correct name for this species should be *E. tergestinus*. Further studies (Gantenbein et al. 2001; Fet et al. 2003) reported that "*E. mesotricus*" of Kinzelbach also refers to other species such as *E. balearicus* and *E. sicanus* besides *E. tergestinus* and other forms that need clarification. *E. carpathicus* s. str. is now restricted to the populations of the type locality in Romania (Fet and Soleglad 2002). Among the specimens studied by Vignoli and Salomone (2008), there is one from Turkey of the AMNH collection labeled as *Euscorpius* cf. *tergestinus* (1 juvenile, Aydın Davutlar, Söke 44 m a.s.l., 28.IV.2005, H. Koç coll.) from the same population as presented in this study as a new species. The specimens of our study certainly do not fall within the range of *E. mesotrichus*

"of Kinzelbach" nor in *E. carpathicus* s. str. and *E. tergestinus* s. str., as we shall see from morphological and trichobothrial data below.

Euscorpius oglasae has a trichobothrial pattern that is almost identical to *Euscorpius avcii* sp. n., but the morphology and geographic distribution (*E. oglasae* is endemic to the island of Montecristo in the Tyrrhenian Sea in Tuscany, Italy) make easy to separate these two species. *E. oglasae* is larger than *Euscorpius avcii* sp. n. (up to 43 mm) (Vignoli et al. 2007), the lobe of the movable finger is weak in males and obsolete in females, the chela is slender, whereas *Euscorpius avcii* sp. n. has a very pronounced lobe on movable finger and the notch on fixed finger and the chela is stocky. The DPS is more developed in *E. oglasae* as well as the granulation and metasomal carinae. *E. oglasae* has a lower pectinal teeth count, 7–7 in males and 6–6 females, whereas *Euscorpius avcii* sp. n. has 8–8 in males and 7–7 in females.

Samos is a Greek island inhabited by an unnamed oligotrichous form, similar to *Euscorpius avcii* sp. n. The Samos population is characterized by small size, stocky pedipalps and trichobothrial pattern *Pv* = 5 and *et* = 5 (Vignoli and Salomone 2008). This form therefore seems to have a lower *Pv* count and *et* constant (*Euscorpius avcii* sp. n. has *Pv* = 7 and *et* = 5/6). Samos Island is very close to the Dilek Peninsula (in some places less than two kilometers), therefore a relationship could be possible between these two populations, but because of the lack of information about the Samos form, we cannot discuss its taxonomical relationship to *Euscorpius avcii* sp. n.

E. tergestinus s. str. is easily distinguished from *Euscorpius avcii* sp. n., even if the color and the trichobothrial pattern *eb* = 4, *eba* = 4, *em* = 4 may suggest that *Euscorpius avcii* sp. n. is a species belonging to the *"tergestinus* complex", but these are the only similar characters, in fact the morphology and the chaetotaxy reveal the great differences between these two species. *E. tergestinus* is larger in size (30-40 mm), it has a slender habitus with elongated pedipalps and DPS strongly developed, among the largest in the entire genus *Euscorpius*.

Its telson is very swollen, above average in both male and female. The metasomal carinae are much more pronounced, granulated and *Euscorpius avcii* sp. n. has a less swollen telson and the metasomal carinae almost smooth. The pedipalpal chela of *E. tergestinus* is slender and long, especially the fingers. In this species, trichobothrium *db* on the fixed finger is much more distal than in *Euscorpius avcii* sp. n. that has it in proximal position.

E. tergestinus has a more granulated carapace, and body, and developed furrows on the carapace whereas *Euscorpius avcii* sp. n. has almost smooth carapace, and body, with weak furrows, causing the appearance of a fairly flat carapace. The trichobothrial pattern of the pedipalp patella of *E. tergestinus* is reported as *Pv* = 7/11 (9), *Pe-et* = 5/8 (6 +) in Fet and Soleglad (2002). Based on this data, *Euscorpius avcii* sp. n. would fall within its range, but it actually does not. Fet and Soleglad (2002) synonymized *E. carpathicus oglasae*, with its low trichobothrial values, with *E. tergestinus*, but Vignoli et al. (2007) raised *E. oglasae* to the rank of species, therefore the range of *E. tergestinus* is *Pv* = 8/11 (9), *Pe-et* = 6/8 (6 +) (Tropea 2012). In fact, this species presents lowest values (*Pv* = 8, *Pe-et* = 6) in populations in central Italy (*E. carpathicus picenus, E. c. apuanus*,

Table 2. Trichobothrial counts of *Euscorpius* species discussed in this paper.

Species	*vP*	*tPe - e*	*tPe - es*	*mPe - e*	*bPe - es*	*aPe - eb*	*bPe - e*
E. avcii sp. n.	7	5–6	4	4	2	4	4
E. oglasae	7	5	4	4	2	4	4
E. koschewnikowi	8	5–6	4	4	2	4	4
E. sp. from *"Samos"*	5	5	4	4	2	4	4
E. c. aegaeus	7–8(8)	5/6(6)	4	4	2	4	4
E. c. ossae	6–8(7/8)	5	4	4	2	4	4
E. c. scaber	7–10(8/9)	6	4	4	2	4	4
E. c. candiota	9–10	6–7	4	4	2	4	4
E. tergestinus	8–11(9)	6–8(6)	4	4	2	4	4
E. carpathicus s.str.	7–9 (8)	5–7 (7)	4	3	2	4	4

of Di Caporiacco, (1950)), however normally its trichobothrial numbers are *Pv* = 9 and *Pe-et* = 6. These values increase toward the northeast of Italy and in the Balkans (Tropea 2012), but they are never less, therefore *Euscorpius avcii* sp. n. does not share the trichobothrial range of *E. tergestinus* s. str.

Other species and subspecies of subgenus *Euscorpius* s.str. that are relatively geographically close, from the Aegean area: *Euscorpius sicanus* (C. L. Koch, 1837)*, E. koshewnikowi* Birula, 1900, *E. carpathicus candiota* Birula, 1903*, E. c. ossae* Di Caporiacco, 1950*, E. c. aegaeus* Di Caporiacco, 1950 and *E. c. scaber* Birula, 1900. *E. sicanus* has never been reported in Turkey; furthermore, it is easy to separate because of its particular trichobothrial pattern; *Pe*: *eb*=5 and *eba* = 4/5 (Fet et al. 2003; Vignoli and Salomone 2008, Tropea 2012). *E. koschewnikowi* has been well redescribed by Fet and Soleglad (2002) as a species quite large in size and medium to dark brown colored, exceptionally smooth, with all segments of the metasoma longer than wide, and DPS highly developed. The description of this species contrasts completely with *Euscorpius avcii* sp. n. because the latter is a small species, colored clear reddish brown, squat, with DPS very weakly developed, and not all metasomal segments are longer than wide. *E. c. candiota,* among other differing characters, has a higher trichobothrial pattern as well as *E. c. aegaeus* (Fet 1985; Di Caporiacco 1950), whereas *E. c. ossae* is overall blackish with legs and telson slightly lighter and larger size (up to 37 mm) (Di Caporiacco 1950).

E. c. scaber is a scorpion from the northern Aegean area, has a dark coloration with a high number of pectinal teeth, a higher trichobothrial pattern, and in addition, its whole body is covered with granules of various size, as also the name suggests, whereas *Euscorpius avcii* sp. n. has a light coloration, and its granulation is very little accentuated, almost smooth.

In our opinion, *Euscorpius avcii* sp. n. is well divided from all described *Euscorpius* forms including those that await taxonomic clarification. At present there are no described species or subspecies that corresponds to the morphology and to the tricho-

bothrial pattern of this new species. We are confident that these data are enough to describe this form as a new species of the genus *Euscorpius*, and the first described species of the subgenus *Euscorpius* in Turkey.

Ecology

Specimens of *Euscorpius avcii* sp. n. were collected from the northern side of Dilek Peninsula (Fig. 7). Vegetation in this area is composed of both deciduous forest (*Quercus cerris*, *Tilia rubra* subsp. *caucasica*, *T. argentea* and *Castanea sativa*) and evergreen forest (which are *Pinus brutia* and *Laurus nobilis*). Coastal areas include scrub vegetation. Furthermore, northern side of Dilek Peninsula has a humid climate and in both summer and winter, flowing streams and wetlands exist. Specimens of *Euscorpius avcii* sp. n. were collected during the day under bark of decomposed wood, under stones and in rock crevices and at night with UV light from rocky places, roadsides and under pine forests (Fig. 8 and 9). *Euscorpius avcii* sp. n. specimens are sympatric with *Mesobuthus gibbosus* Brullé, 1832 and *Iurus kinzelbachi* Kovarik, Fet, Soleglad, Yagmur, 2010. We report an example of intraguild predation, we witnessed *Mesobuthus gibbosus* feeding on *Euscorpius avcii* sp. n. during one of our night trips (Fig. 10).

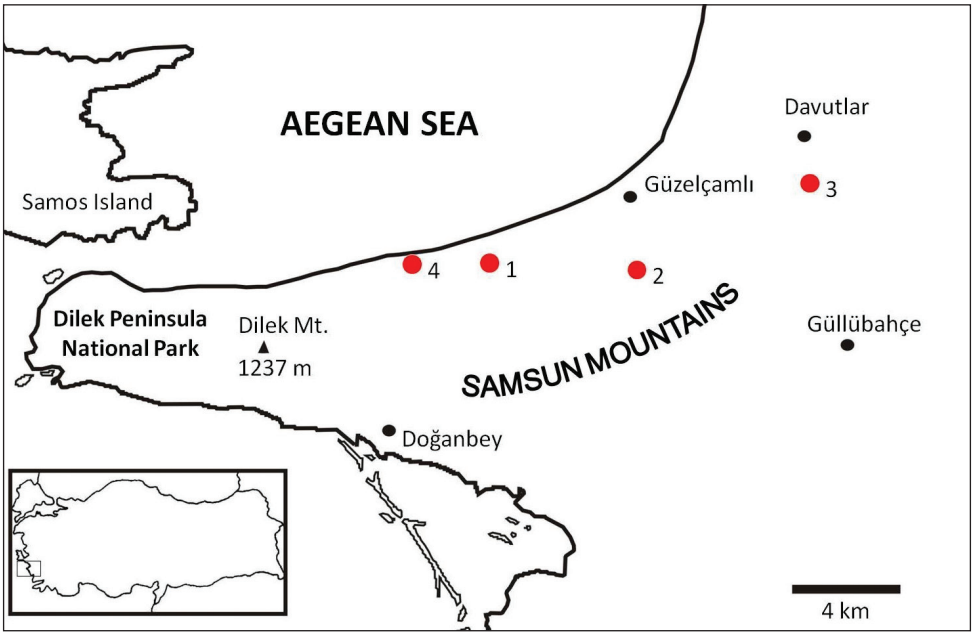

Figure 7. Map of Dilek Peninsula National Park

Figure 8. The habitat in Canyon in Dilek Peninsula National Park

Figure 9. The habitat in North of Güzelçamlı in Dilek Peninsula.

Figure 10. A *Mesobuthus gibbosus* which feeds on *Euscorpius avcii* sp. n.

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References

Di Caporiacco L (1950) Le specie e sottospecie del genere "*Euscorpius*" viventi in Italia ed in alcune zone confinanti. Memorie/Atti della Accademia Nazionale dei Lincei, serie VIII, volume II, sezione III, fascicolo 4: 159–230.

Fet V (1985) Notes on some *Euscorpius* (Scorpiones: Chactidae) from Greece and Turkey. Rivista del Museo Civico di Scienze Naturali "Enrico Caffi" (Bergamo) 9: 3–11.

Fet V (1997b): Notes on the taxonomy of some Old World scorpions (Scorpiones: Buthidae, Chactidae, Ischnuridae, (Scorpionidae). The Journal of Arachnology 25(3): 245–250.

Fet V, Braunwalder ME (2000) The scorpions (Arachnida: Scorpiones) of the Aegean area: current problems in taxonomy and biogeography. Belgian Journal Of Zoology 130(supplement 1): 15–20.

Fet V, Soleglad ME (2002) Morphology analysis supports presence of more than one species in the '*Euscorpius carpathicus*' complex (Scorpiones: Euscorpiidae). Euscorpius 3: 1–51.

Fet V, Soleglad ME, Gantenbein B (2004) The Euroscorpion: taxonomy and systematics of the genus *Euscorpius* Thorell, 1876 (Scorpiones: Euscorpiidae). Euscorpius 17: 47–60.

Fet V, Soleglad ME, Gantenbein B, Vignoli V, Salomone N, Fet EV, Schembri PJ (2003) New molecular and morphological data on the *Euscorpius carpathicus* species complex (Scorpiones: Euscorpiidae) from Italy, Malta, and Greece justify the elevation of *E. c. sicanus* (C.L. Koch, 1837) to the species level. Revues Suisse the Zoologie 110(2): 355–379.

Gantenbein B, Fet V, Largiadèr CR, Scholl A (1999) First DNA phylogeny of *Euscorpius* Thorell, 1876 (Scorpiones: Euscorpiidae) and its bearing on taxonomy and biogeography of this genus. Biogeographica (Paris) 75(2): 49–65.

Hadži J (1930) Die europäischen Skorpione des Polnischen Zoologischen Staatsmuseums in Warszawa. Annales Musei Zoologici Polonici 9(4): 29–38.

Hjelle JT (1990) Anatomy and morphology. In: Polis GA (Ed) Biology of Scorpions. Stanford University Press, Stanford, CA, 1990, 9–63.

Karatas A (2006) Distribution of the "*Euscorpius carpathicus*" complex (Scorpiones: Euscorpiidae) in Turkey. Serket 10(1): 1–8.

Kinzelbach VR (1975) Die Skorpione der Ägäis. Beiträge zur Systematik, Phylogenie und Biogeographie. Zoologische Jahrbücher, Abteilung für Systematik 102: 12–50.

Kinzelbach R (1982) Die Skorpionssammlung des Naturhistorischen Museums der Stadt Mainz. Teil I: Europa und Anatolien. Mainzer Naturwissenschaftliches Archiv 20: 49–66.

Koç H, Yağmur EA (2007) Dilek Yarımadasi Milli Parkı (Söke-Kuşadası, Aydın) akrep faunası. Ekoloji Dergisi 65: 52–59.

Koch CL (1837a) Die Arachniden. Nürnberg: C. H. Zeh'sche Buchhandlung 3(6): 105–115.

Lacroix J-B (1995) *Euscorpius* (*E.*) *mingrelicus* Kessler, 1876 en Turquie anatolienne (Arachnida: Scorpionida). Arachnides 26: 4–6.

Laurie M (1896) Further notes on the anatomy of some scorpions, and its bearing on the classification of the order. Annals and Magazine of Natural History 18 (6): 121–133. doi: 10.1080/00222939608680422

Schenkel E (1947) Einige Mitteilungen über Spinnentiere. Revue suisse de zoologie 54 (1): 13–16.

Sissom WD (1990) Systematics, biogeography and paleontology. In: Polis GA (Ed) The Biology of Scorpions. Stanford University Press, 1990, 64–160.

Soleglad ME, Fet V (2003) The scorpion sternum: structure and phylogeny (Scorpiones: Orthosterni). Euscorpius 5: 1–33.

Soleglad ME, Sissom WD (2001) Phylogeny of the family Euscorpiidae Laurie, 1896: a major revision. In: Fet V, Selden PA (Eds) Scorpions. British Arachnological Society, Burnham Beeches, Bucks, 25–112.

Stahnke HL (1970) Scorpion nomenclature and mensuration. Entomological News 81: 297–316.

Thorell T (1876) On the classification of scorpions. Annals and Magazine of Natural History 4(17): 1–15. doi: 10.1080/00222937608681889

Tolunay A (1959) Zur Verbreitung der Skorpione in der Türkei. Zeitschrift für angewandte Entomologie 43: 366–370.

Tropea G (2012) A new species of *Euscorpius* Thorell, 1876 (Scorpiones, Euscorpiidae) from Italy. Bulletin of the British Arachnological Society 15(8): 253–259

Vachon M (1951) A propres de quelques scorpions de Turquie collectés par M. le Professeur Dr. Curt Kosswig. İstanbul Üniversitesi Fen Fakültesi Mecmuası 16: 341–344.

Vachon M (1974) Étude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en Arachnologie, Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. Bulletin du Muséum National d'Histoire Naturelle (Paris) 140: 857–958.

Vignoli V, Salomone N (2008) A review of and additions to the current knowledge of the scorpion genus Euscorpius Thorell, 1876 (Scorpiones, Euscorpiidae). Fragmenta entomological 40(2): 189–228.

Vignoli V, Salomone N, Cicconardi F, Bernini F (2007) The scorpion of Montecristo, *Euscorpius oglasae* Di Caporiacco, 950, stat. nov. (Scorpiones, Euscorpiidae): a paleo-endemism of the Tuscan Archipelago (northern Tyrrhenian, Italy). Comptes Rendus Biologies 330: 113–125. doi: 10.1016/j.crvi.2006.11.003

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RESEARCH ARTICLE

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A new *Mylabris* species from south-eastern Iran and a key to the Iranian species of the nominate subgenus (Coleoptera, Meloidae)

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Abstract

A new species of *Mylabris* of the nominate subgenus is described and figured. This species is apparently endemic to the south-eastern Iranian province of Kerman and seems to be phenetically very distinct from all other species of this subgenus, primarily because of the unique elytral pattern. A key to the species of the nominate subgenus distributed in Iran is also presented.

Keywords

Iran, taxonomy, new species, key to the species

Introduction

The Meloidae of the Middle East remain poorly studied even though this area is one of the most interesting of the Palaearctic region from biogeographic and taxonomic points of view. Within the Middle East, the family is most speciose in Iran which har-

bours a fauna with several endemics together with many species in common with Central Asia, Anatolia and Levant, as well as some Saharo-Sindian and Arabic components in the southern provinces. The descriptions of species and faunistic records concerning the blister beetles of this area are few and highly scattered in the literature. The only synthetic works on the Iranian Meloidae were published in the last century by Kaszab (1957; 1968) and Mirzayans (1970). Bologna (2008), in the Palaearctic catalogue of Meloidae, listed 194 species for this country.

The Hayk Mirzayans Insect Museum (HMIM) of the Iranian Research Institute of Plant Protection and the M. Bologna collection at the University Roma Tre (CB) house several new species of Iranian Meloidae of the subfamilies Nemognathinae and Meloinae. Unresolved taxonomic problems prevent all from being described at this time. However, we are taking this opportunity to describe one very distinct new *Mylabris* Fabricius, 1775 belonging to the nominate subgenus. It is endemic to a narrow area of Iran and represents the southeasternmost species of the nominate subgenus except for *M. quadripunctata* (Linnaeus, 1767) and *M. variabilis* (Pallas, 1781), which are broadly distributed from the Iberian peninsula to western China.

The meloine genus *Mylabris* is easily distinguished using a key published by Bologna and Pinto (2002), and the nominate subgenus was well defined by Kuzin (1954) and Pardo Alcaide (1950). The most recent comprehensive key to the species of *Mylabris* remains that published by Sumakov (1915). In order to help with the identification of the Iranian species of the subgenus *Mylabris*, we provide a key to its species recorded in Iran.

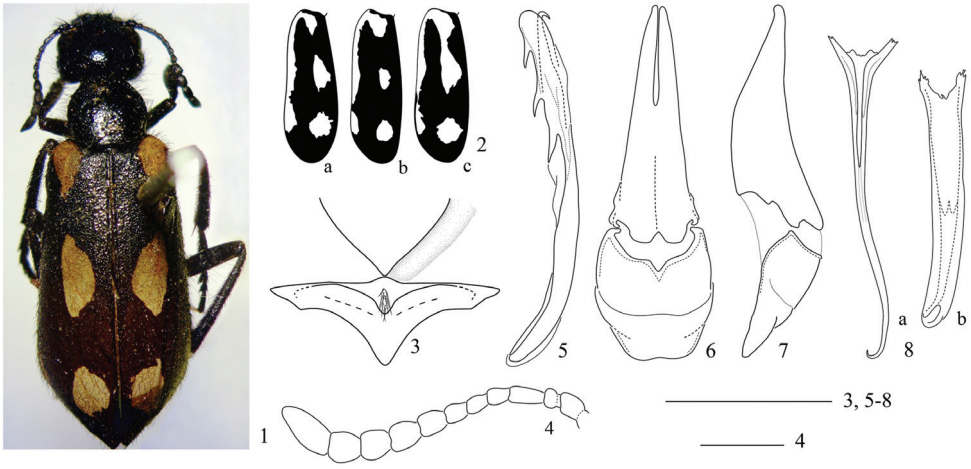
Results

***Mylabris* (*Mylabris*) *barezensis* sp. n.**
urn:lsid:zoobank.org:act:0141DDB7-3BC1-49EC-A502-776A5004B625
http://species-id.net/wiki/Mylabris_barezensis
Figure 1

Type specimens. Holotype male (HMIM), and 2 males (CB) and 1 male and 2 female paratypes (HMIM), labelled " Dehbakri, 6.5.1969, Paz.& Hasch.".

Type locality. IRAN, Dehbakri (29.0539°N, 57.9131°E); an Iranian town in the Kerman province, about 55 km southwest of Bam, east of Jebal Barez mountain, at 2027 m a.s.l. This mountainous area was characterized by forest until before the second World War (Planhol 1969) but now secondary steppe habitats are widely spread.

Diagnosis. A *Mylabris* species belonging to the nominate subgenus as defined by Pardo Alcaide (1950), Kuzin (1954) and Bologna (1991). Immediately distinguishable from other species of the subgenus by the unique elytral pattern characterized by reduced brown-orange surface and the large extension of black colouration everywhere as Figs 1 & 2. Male gonoforceps in lateral view (Fig. 7) slender. The mesosternum (Fig. 3) is narrowed posteriorly and the setae on its anteriorly modified section are longer than usual.



Figures 1–8. *Mylabris barezensis* sp. n. **1** Habitus **2a–c** variation of elytral pattern **3** mesosternum and mesepisterna **4** male left antenna **5** aedeagus, lateral view **6** tegmen, ventral view **7** tegmen, lateral view **8a–b** variation of *spiculum gastrale*. Bar scales: 1 mm**.**

Description. Body uniformly black, except elytra which have the following pattern: black colouration largely extended everywhere, except brown-orange as follows: at base (along the scutellum excluded), along the external margin except at apex (Figs 1, 2a) (in one specimen the posterior section of the external margin is fragmented in one spot as in Fig. 2b) and with two sub-oval spots, one in the middle, and another on the posterior third; in one specimen, the middle spot is fused to the brown-orange base (Fig. 2c). Setation uniformly black, but ventral side of male foretibiae and foretarsi with golden setae, forming a small pad under the pro- and mesotarsomeres; setation evidently longer on venter than dorsally; setae denser on head and pronotum, sparser on elytra. Body length: 10–15 mm.

Head slightly longer than wide at temples level (excluding mandibles), wider at temples than at eyes; punctures relatively deep, large and irregular, surface among punctures shagreened, shiny on vertex, wrinkled on frons; head capsule subquadrate, temples broadly curved posteriorly and subequal in length to the longitudinal length of eye; frons flat, in the middle with one red spot more or less divided posteriorly; clypeus transverse, convex, with slightly rounded anterior and lateral margins, anteriorly depressed, fronto-clypeal suture clearly visible; labrum only slightly shorter and narrower than clypeus, anterior margin sinuate, longitudinally depressed in the middle; mandibles robust, curved, in lateral view longer than clypeus and labrum together; maxillary palpomere II with very long setae on the posterior side, last maxillary palpomere apically thickened and truncate at apex; antennae (Fig. 4) extending almost to posterior margin of pronotum in male, scapus more than twice as long as pedicellus, pedicellus semi-globular; antennomere III elongate and about 1.2 times as long as IV–V together, IV and V similar in length, VI similar in length to IV and V but slightly widened apically, VIII – X progressively more elongate and apically widened, X subcylindrical, last antennomere elongate and narrowed in the last third, particularly in male.

Pronotum slightly wider than long, narrowed anteriad, convex, without evident depressions or with a superficial rounded depression in the middle of each side, maximum width posterior to middle; punctures almost confluent on anterior and posterior third; elytral pattern as in Fig. 1 and Fig. 2 (a, b, c), elytral setation shorter and sparser than that on head and pronotum, erect on the anterior third, recumbent and shorter on the remaining surface; mesosternum longitudinally elevated in the middle, with a clearly modified anterior section ("scutum"), with a slightly depressed oval area with dense and very long setae (Fig. 3); mesepisterna depressed along the anterior margin, which consequently appears to be raised. Legs black, pro- and mesotibial spurs both similar in shape and pointed, the inner metatibial spur stick-like and the external one pointed; femora with mixed short and long setae, setae robust and more elongate on tibiae and tarsi; male foretibiae ventrally with mixed golden and black short and dense setae, in female with short dense black pubescence and also elongate black setae on external side; male pro- and mesotarsomeres with ventral golden setae forming tarsal pads, those of mesotarsomeres smaller.

Sternite VIII deeply emarginate at middle of posterior margin in male, rounded in female. Male genitalia as in Figs 5–8: in lateral view (Fig. 7) the basal part of gonoforceps slender, apical lobe of gonoforceps relatively short, slightly less than half the length of total gonoforceps; in ventral view, gonoforceps as in Fig. 6; aedeagus (Fig. 5) with two distinct subequal hooks, both positioned far from apex and with the same inclination, the proximal one slightly longer; endophallic hook slender and curved (Fig. 5). The apodeme of the s*piculum gastrale* is variable: most males have this sclerite slender in the middle and clearly narrowed and elongate in the last portion (Fig. 8a) but in a single male it is very wide medially (Fig. 8b).

Etymology. This new species is named after the Jebal Barez mountain range in Kerman Province, in the north west of which the new species was collected.

Taxonomic remarks. The taxonomic revision of the nominate subgenus of *Mylabris* as well as its phylogenetic study remain in preparation (Pan et al. unpublished). The nominate subgenus at present contains 19 species (Bologna 2008), but at least another four undescribed species are recognized and will be described in a systematic study that includes both morphological and molecular data (Pan et al. unpublished).

For this reason we are unable to discuss in detail the phylogenetic relationships of *M. barezensis*. This species is clearly distinct from all others of the nominate subgenus by the unique elytral pattern, as well as by the mesosternal "scutum" with dense and very long setae.

Phenetically, *M. barezensis* is similar to two species of the subgenus *Micrabris* from Afghanistan, namely *afghanica* Kaszab, 1953 and *marakensis badakhaskanica* Kaszab, 1958 (both figured in Kaszab 1958). Similarity is due to the extended black elytral pattern. From both species it can be easily distinguished by setose area on the mesosternum, the wider pronotum, and the shape and position of aedeagal hooks (see Kaszab 1958 for comparison).

The type specimens were previously identified by Zoltán Kaszab, the late Hungarian specialist of Meloidae, as "*Mylabris biguttata* Gebler", a species which actually belongs to the mylabrine genus *Hycleus*, but has a similar elytral pattern.

Key to the Iranian species of *Mylabris* (*Mylabris*)

1 Elytral apex with a very wide black fascia, more or less sinuate anteriorly and extended to cover ca. 1/6 of the entire surface.....**2**

– Elytral apex uniformly reddish-brown or with a narrow black colouration which sometimes extends on the sutural inner margin **6**

2 Elytral pattern characterized by reduced orange-brown areas and a large extension of black colouration everywhere.....***barezensis* sp. n.**

– Elytral pattern reduced to distinct spots or fasciae, never fused or coalescing to form an extended black network, which leaves isolated orange-brown areas.....**3**

3 Pronotum with a shallow anterior transverse depression. Frons without red macula (exceptions are very rare). Elytra usually with two series of spots, one anterior and one on the middle, and an apical fascia widely emarginate just before the suture (in some populations middle spots fused to form a wide fascia). Aedeagal distal hook long and curved, the proximal one very long and curved forward, longer than distal, positioned far from apex; gonostyli broadly cylindrical, suddenly narrowed apically in two long and slightly curved lobes ..... ***quadripunctata* (Linnaeus, 1767)**

– Pronotum without an anterior transverse depression. Frons with red macula. Elytral pattern not as above. Aedeagal distal hook short, the proximal one clearly longer than distal, both positioned close to apex and more rectilinear; gonostyli uniformly slender, cylindrical **4**

4 Elytral pattern with two anterior oblique spots, one middle transverse incomplete and sinuate fascia, neither reaching the external margin nor the suture, and an apical small fascia sinuate on fore margin, not widely extended anteriorly. Aedeagal distal hook only slightly shorter than proximal, both hooks slightly inclined .....***parumpicta* (Heyden, 1883)**

– Elytral pattern usually with three fasciae (anterior, middle and apical), the middle one reaching both external margin and suture, the apical one widely extended anteriorly, with fore margin slightly emarginated lateral to the suture (in some populations the anterior fascia is reduced to two spots). Aedeagal distal hook clearly shorter than proximal hook, both clearly inclined.....
.....***variabilis* (Pallas, 1781)**

6 Antennomeres III-XI (particularly VII-XI) reddish, XI almost brownish. Black apical fascia of elytra very narrow,extended along the suture and reaching the internal margin of subapical transverse fascia ***olivieri* Billberg, 1813**

– Antennomeres uniformly black. Elytral pattern not as above **7**

7 Elytra uniformly reddish-brown with an extremely narrow black fascia on the apex ..... ***apicenigra* Soumakov, 1915**

– Elytra uniformly reddish-ochre .....***concolor* Marseul, 1870**

References

Bologna MA (1991) Coleoptera Meloidae, Fauna d'Italia. XXVIII. Calderini, Bologna, 541 pp.

Bologna MA (2008) New nomenclatorial and taxonomic acts, and comments, Meloidae; family Meloidae Gyllenhal, 1810. In: Löbl I, Smetana A (Eds) Catalogue of Palaearctic Coleoptera 5. Apollo Books, Stenstrup, 45–49, 370–412.

Bologna MA, Pinto JD (2002) The Old World genera of Meloidae (Coleoptera): a key and synopsis. Journal of Natural History 36: 2013–2102. doi: 10.1080/00222930110062318

Kaszab Z (1957) Neue Meloiden aus Iran (1954) (Coleopt.). Jahreshefte des Vereins für Vaterländische Naturkunde in Württemberg 112: 50–59.

Kaszab Z (1958) Die Meloiden Afghanistans (Coleoptera). Acta Zoologica Academiae Scientiarum Hungaricae 3: 245–312.

Kaszab Z (1968) Contribution à la faune de l'Iran, 8. Coléoptères Meloidae. Annales de la Société Entomologique de France (NS) 4: 749–776.

Kuzin VS (1954) K posnanyju systemy narybnikov (Coleoptera, Meloidae, Mylabrini). Trudly Usesojnogo Entomologizesko Obzestva 44: 336–379. [In Russian]

Mirzayans H (1970) Contribution à la connaissance de la faune des Clerides er Méloides de l'Iran. Entomologie et Phytopathologie Appliquées 29: 25–38.

Pardo Alcaide A (1950) Estudios sobre Meloidae. II. Los Mylabrini de la peninsula Iberica, Boletin de Patólogia vegetal y de Entomologia Agricola 17: 61–82.

Planhol X (1969) Le déboisement de l'Iran. Annales de Géographie 78: 625–635. doi: 10.3406/geo.1969.15948

Soumacov GG (1915) Les espèces paléarctiques du genre *Mylabris* Fabr. (Coleoptera, Meloidae). Horae Societatis Entomologicae Rossicae 42: 1–71.

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First record of *Zombrus bicolor* (Enderlein) (Hymenoptera, Braconidae, Doryctinae) in Western Europe

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Abstract

The finding of *Zombrus bicolor* (Enderlein) (Hymenoptera: Braconidae: Doryctinae) in a Tuscan vineyard of the Siena province (Italy) represents the first record of this species in western Europe. A female was captured in summer 2009 with a malaise trap located in an organic vineyard. Until this finding, the species was recorded only in the Oriental regions of continental China, Taiwan, Korea and Japan and, very recently, in the eastern and southern parts of the Palaearctic region.

Keywords

Vineyard, new finding, wood borer parasitoid, exotic species, Anoplophora chinensis

Introduction

A single female of *Zombrus bicolor* (Enderlein) (Hymenoptera: Braconidae: Doryctinae) was collected in June 2009 in a malaise trap located in a vineyard (cv Sangiovese) of an organic farm in the Montalcino district (Siena-Tuscany-Italy, 43°05.21N, 11°28.51E). The trap was installed at ca 180 m above sea level in a typical rural Tuscan landscape, with vineyards included in rolling, gentle hills surrounded by cultivated grassland areas,

woods and strips of shrubs, and wild bushes of deciduous trees. Until the current finding, *Z. bicolor* had only been reported as an Eastern Palaearctic and Oriental species, based on the description of specimens collected in Taiwan, China, Mongolia, Japan, Korea and, very recently, in Kyrgyzstan and in the European part of Russia (Astrakhan province) (Enderlein 1912; Fahringer 1929; Fischer 1980; Chou 1981; Papp 2003, Belokobylskij and Maetô 2009; Belokobylskij and Samartsev 2011).

The type specimens of *Z. bicolor* are two males stored in the collection of the Museum of the Zoology Institute in Warsaw (Poland). These males were collected by H. Sauter in 1907 in Takao (Formosa), the old name of the current city of Kaohsiung in south-western Taiwan, and subsequently described by Enderlein (1912).

Z. bicolor (Fig. 1A) belongs to the subtribe Odontobraconina of the tribe Holcobraconini, a monophyletic group including six genera and currently divided in the three subtribes Holcobraconina, Odontobraconina and Ivondroviina, (Belokobylskij 1992). The morphological features that characterize the tribe, the genus *Zombrus* and the species *Z. bicolor* are well described in Belokobylskij and Samartsev (2011).

According to these authors, the typical morphological features of *Z. bicolor*, which distinguish this species from the other Palaearctic species of *Zombrus*, are the completely dark fore wings (Fig. 1B), the body covered with long and dense setae (Fig. 1 D, Fig 2 A, B, D) and the presence of the occipital carina dorsally and, partly, laterally (Fig. 2A).

All the features of the specimen we collected in Italy match well with those reported by Belokobylskij and Samartsev (2011), with exception of the notauli which are not complete but reduced posteriorly on the mesoscutum (Fig. 2A).

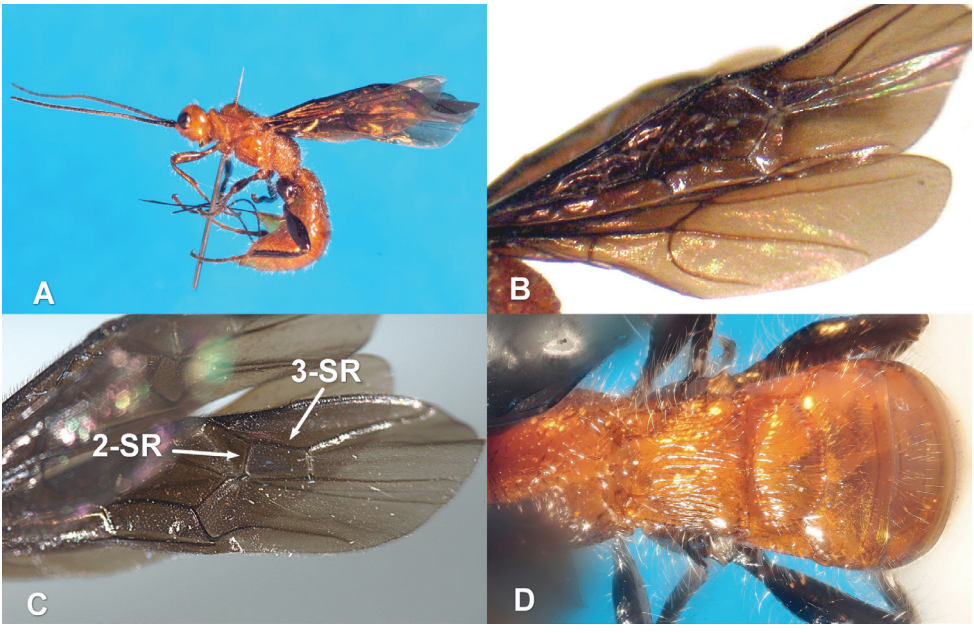

Figure 1. *Zombrus bicolor* female*:* **A** body lateral view **B** fore and hind wings **C** detail on the fore wing **D** abdominal terga 1-3 dorsal view.

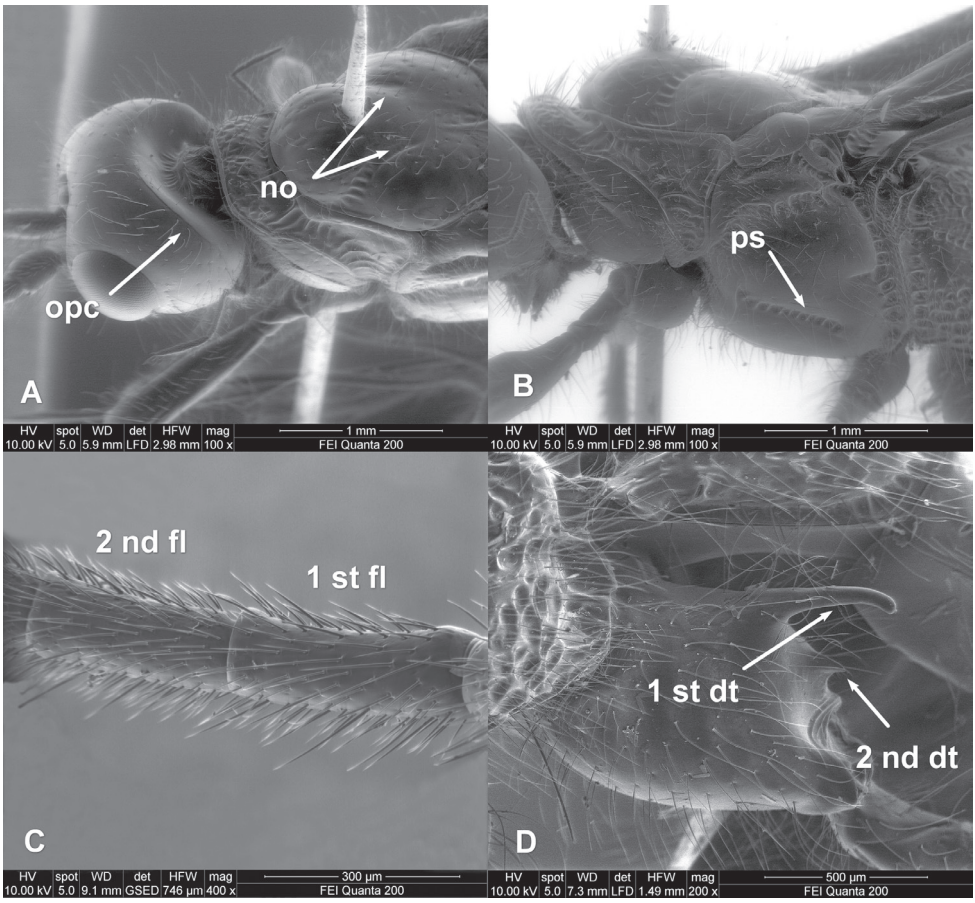

Figure 2. *Zombrus bicolor* female, SEM micrographs details on: **A** head and mesoscutum **B** mesopleuron **C** first and second flagellomeres **D** hind coxa. Abbreviations: **2-SR** and **3-SR** sectio radii veins of fore wing **opc** = occipital carina **no** = notauli **ps** = precoxal sulcus **1**st and **2**nd **fl** = first and second flagellomeres **1**st and **2**nd **dt** = first and second dorsal teeth of hind coxa. Morphological terminology is used according to van Achterberg (1993).

Our finding could represent one of the many cases of accidental introduction of exotic insects that have occurred in Italy in the last decades. At European level as well, the accidental introduction of new insect species from their original areas has become more and more frequent and alarming. Intensification of plant trade with geographically distant commercial partners and global warming, that allows aliens to establish successfully in new ecosystems, are considered the main causes of the occurrence of invasive species.

As an important crossroad in the Mediterranean basin, Italy seems particularly suitable to the introduction and settlement of alien species, also because its landmass extends over a wide range of latitudes climatically suitable to harbour subtropical species in the South and insects coming from temperate and continental zones in the northern and central regions of the peninsula.

It has been estimated that about 200 exotic species have been introduced and established in Italy since 1970 (Longo 2009), the vast majority of whom are insect pests.

Importantly, our finding concerns not a pest but a parasitoid, which in this case could have followed his victim/s in the transfer from one continent to another. This is permissible every time that the natural enemy is a cryptic species, such as an endoparasitoid, or an ectoparasitoid living in concealed galleries excavated by larvae of wood boring insects.

Z. bicolor is known as a solitary, larval parasitoid of many wood boring beetles (Yu et al. 2010; Belokobylskij and Samartsev 2011), including *Anoplophora chinensis* (Forster) (Coleoptera: Cerambycidae) (Smith et al. 2007). This wood borer was first detected in 2000 in northern Italy, in the surroundings of Milan and rapidly became a serious threat to deciduous trees in urban areas and natural forests throughout northern and central Italy. *A. glabribennis* was also found in the same area in 2007 (Maspero et al. 2007).These species are major pests of many deciduous trees and fruit plants in their native Asian countries (Hu et al. 2009), are considered quarantine pests for the European Union according to the Directive 2000/29/EC and are subjected to monitoring and eradication programs (Herard et al. 2009).

Though data are not available at the moment on the presence of *A. chinensis* in the areas where we collected *Z. bicolor*, we cannot exclude that the braconid, in its movement to West Europe, had been carried by these or other specific hidden hosts.

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References

Achterberg C van (1993) Illustrated key to the subfamilies of the Braconidae (Hymenoptera: Ichneumonoidea). Zoologische verhandelingen 283: 1–189.

Belokobylskij SA (1992) On the classification and phylogeny of the braconide wasps of subfamilies Doryctinae and Exothecinae (Hymenoptera, Braconidae). Part I. On the classification, 1. Entomologicheskoye Obozreniye 71 (4): 900–928.

Belokobylskij SA, Maetô K (2009) Doryctinae (Hymenoptera, Braconidae) of Japan. (Fauna mundi. Vol 1) Warszawa: Warshawska Drukarnia Naukova. 806 p.

Belokobylskij SA and Samartsev KG (2011) First record of the tribe Holcobraconini and the genus *Zombrus* Marshall, 1897 (Hymenoptera: Braconidae: Doryctinae) in Europe. Zoosystematica Rossica 20(2): 310–318.

Chou L (1981) A preliminary list of Braconidae (Hymenoptera) of Taiwan. Journal agricultural Research China 30(1): 71–88.

Enderlein G (1912) Zur Kenntnis der Spathiinen und einiger verwandter Gruppen. Archiv für Naturgeschichte (A), 78(2): 1–37.

Fahringer J (1929) Beiträge zur Kenntnis der Braconiden-Fauna Chinas. Entomologisk Tidskrift 50: 82–88.

Fischer M (1980) Taxonomische Untersuchungen über Doryctinae aus der Odontobracon-Verwandtschaft (Hymenoptera, Braconidae). Annales Naturhistorische Museum Wien 83: 547–572.

Herard F, Maspero M, Ramualde N, Jucker C, Colombo M, Ciampitti M, Cavagna B (2009) *Anoplophora glabripennis* infestation (col.: cerambycidae) in Italy. Bullettin OEPP/EPPO 39: 146–152.

Hu J, Angeli S, Schuetz S, Luo Y, Hajek AE (2009) Ecology and management of exotic and endemic Asian longhorned beetle *Anoplophora glabripennis*. Agricultural and Forest Entomology 11(4): 359–375. doi: 10.1111/j.1461-9563.2009.00443.x

Longo S (2009) Fitofagi esotici e invasioni biologiche negli ecosistemi forestali. Atti Accademia Nazionale Italiana di Entomologia, Anno LVII: 69–77.

Maspero M, Jucker C, Colombo M (2007) First record of *Anoplophora glabripennis* (Motschulsky) (Coleoptera Cerambycidae Lamiinae Lamiini) in Italy. Bollettino di Zoologia agraria e di Bachicoltura Ser II, 39(2): 161–164.

Papp J (2003) Braconidae (Hymenoptera) from Korea, XXI. Species of fifteen Subfamilies. Acta Zoologica Academiae Scientiarum Hungaricae 49(2): 115–152.

Smith MT, Fuester RW, Tropp JM, Aparicio EM, Tatman D, Wildonger JA (2007) Native natural enemies of native woodborers potential as biological control agents for the Asian longhorned beetle. USDA Interagency Research Forum - GTR-NRS-P- 28: 66–70.

Yu D, Barak AV, Jiao Y, Chen Z, Zhang G, Chen Z, Kang L, Yang W (2010) Sulfuryl Fluoride as a Quarantine Treatment for *Chlorophorus annularis* (Coleoptera: Cerambycidae) in Chinese Bamboo Poles. Journal of Economic Entomology 103(2): 277–283. doi: 10.1603/EC09292