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***Mieniplotia scabra* (Müller, 1774), another gastropod invasive species in Europe and the status of freshwater allochthonous molluscs in Greece and Europe**

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Abstract

Mieniplotia scabra (Müller, 1774), a freshwater gastropod originating from the Indo-Pacific area, has proved to be a successful invader spreading to other parts of East Asia, Middle East, the Pacific Islands, North America and West Indies. This paper reports the first record of *M. scabra* from Europe, where it has become naturalized in Kos Island in Greece. This new trans-continental introduction brings the number of alien freshwater mollusc species to nine in Greece and to 30 in Europe. This paper provides an updated snapshot of the presence of the numerous non-native freshwater species in Europe (divided by nation) - an account that is currently lacking in literature and in the specific databases.

Keywords: *Mieniplotia scabra*, Europe, Greece, Kos Island, aquatic alien molluscs, distribution, Greek and European alien-list.

Introduction

Mieniplotia scabra (Müller, 1774) is a freshwater gastropod belonging to the Thiaridae Troschel, 1857, a family that in Europe includes another alien invasive species: *Melanoides tuberculata* (Müller, 1774). The original distribution includes a large area of the Indo-Pacific coasts and adjacent islands, from central-east Africa to south Asia and north-east Australia (Davis & Yamaguchi, 1969; Pace, 1973; Brandt, 1974; Starmühlner, 1976, 1979; Brown, 1980; Burch, 1980; Starmühlner, 1982, 1983, 1984; Subba Rao, 1989; Nesemann *et al.*, 2007; Glaubrecht *et al.*, 2009; Dunga *et al.*, 2010; Nesemann *et al.*, 2011; Budha, 2012; Glöer & Pešić, 2012; GBIF, 2014). In Africa, the species lives in eastern South Africa, Kenya, Tanzania (Wami and Kingani rivers, Zanzibar, Pemba Island), Madagascar, Comore Islands, Seychelles Islands, Reunion, Mauritius (Rodriguez Island included). In Asia, the species has been recorded from Afghanistan, India, Sri Lanka, Nepal (Indo-Gangetic Plane), Bangladesh, Myanmar, Andaman Islands, Thailand, Malaysia, Laos, Vietnam, south China, Japan (Ryukyu Islands), Taiwan, Philippines, Indonesia (Borneo, Sulawesi, Sumatra, Java, Moluccas), East Timor. In addition, the species has been recorded from north and north-east Australia (Northern Territory and Queensland).

However, given its high propensity to invasiveness (Nasarat *et al.*, 2014), it is difficult to be certain if this species is actually native throughout these regions. Nev-

ertheless, for the Asian region, *M. scabra* has likely been introduced in the United Arab Emirates, in Oman and Yemen (including Socotra Island) in south-eastern Arabia (Brown & Gallagher, 1985; Al-Safadi, 1990; Neubert, 1998; Feulner & Green, 1999; Glaubrecht *et al.*, 2009; Budha, 2012).

In the Pacific area, the species has now spread in many west Pacific Islands; Starmühlner (1983) considered the species native to this area, even if he affirmed that it was one of the commonest species in west Pacific Islands and hypothesized a possible human introduction with rice and aquatic plants. More recent papers tend to consider the species in this area as cryptogenic (Cowie, 2000, 2002; Glaubrecht *et al.*, 2009) or invasive (Bogan, 2012; Budha, 2012). In particular, it has been recorded from Guam Island, Palau, Federated States of Micronesia (Kosrae, Pohnpei, Truk, Yap Islands), Papua New Guinea including Bismarck Archipelago (Manus, New Ireland, New Britain, Long Island), Solomon Islands (Guadalcanal, Malaita), Vanuatu (Espiritu Santo Island and Éfate Island), New Caledonia, Fiji Islands (Viti Levu and Vanua Levu) and Samoa (Pace, 1973; Brandt, 1974; Starmühlner, 1976, 1983; Haynes, 1984; Starmühlner, 1984; Haynes, 1985, 1990, 1993; Cowie, 2000; Haynes, 2000; Cowie, 2002; Glaubrecht *et al.*, 2009; Glaubrecht & Podlaka, 2010; Prasad, 2010; Budha, 2012; GBIF, 2014).

Recently *M. scabra* has also been introduced into North America, in Florida and in the West Indies, such

as Antilles, Jamaica and Montserrat (Thompson *et al.*, 2009; GBIF, 2014).

It has also been introduced in the Mediterranean area recently: in Israel (Mienis, 2008; Mienis & Mienis, 2008a, 2008b; Roll *et al.*, 2009; Mienis, 2011; Heller *et al.*, 2014) and Jordan (Nasarat *et al.*, 2014).

M. scabra is considered one of the most successful invasive species in many parts of the world (Thompson *et al.*, 2009) and its recent and very rapid diffusion in some Middle East countries (Israel and Jordan) confirms the high level of invasiveness (Mienis & Mienis, 2008a, 2008b; Nasarat *et al.*, 2014).

To date, no record exists from Europe, and the discovery of a population in the Kos Island, Greece, is the first data from this continent.

Materials and Methods

Specimens were collected by hand. The collection data are listed as follows: locality, altitude, UTM coordinates, collectors and dates; number of specimens, collection and, if present, number of collections in parentheses. Names of the localities and UTM coordinates were taken from Google Earth and converted in ED 50. The examined material is preserved in the following collections: Museo di Storia Naturale dell'Università di Firenze, sezione di Zoologia "La Specola", Via Romana 17, Florence, Italy (MZUFC); Marco Bodon, Via delle Eliche 100/8, Genoa, Italy (MBC); Simone Cianfanelli, Via Monferato 3, Florence, Italy (SCC); Enrico Talenti, Piazza Parri 4, Incisa, Florence, Italy (ETC).

Sampling was performed at five sites in Greece, South Aegean, Dodekanisos, Kos Island, municipality of Kos (Table 1); *M. scabra* was found in sites 1 and 2.

1. Lake Pyli, small lake fed by springs, 1.2 km SSE of Marmari, 22 m ca. a.s.l., 35S 05143 40800, E. Talenti leg. 01/07/2013 (1 spec., 1 juv. spec., MZUFC GC/44740; 1 spec., MBC; 1 spec., SCC 44740/18955; 2 spec., 7 juv. spec., ETC).

2. Small canal fed by springs, along the main road, 900 m S-SE of Marmari, 15 m ca. a.s.l., 35S 05141 40803, E. Talenti leg. 01/07/2013 (2 juv. spec., ETC).

3. Tributary canal of the Lake Alik, west shore, 0 m a.s.l., 35S 05146 40819, E. Talenti leg. 04/07/2013.

4. Lake Alik, west shore, debris, 0 m a.s.l., 35S 05146 40820, E. Talenti leg. 04/07/2013.

5. Lake Alik, southern shore, debris, 0 m a.s.l., 35S 05152 40818, E. Talenti leg. 10/07/2013.

The updated distribution of alien species in Europe (Table 2) and the data processing (Figs. 2-4) are the result of a meticulous research utilizing books, texts and scientific journals, including journals of regional relevance, from national checklists (Gittenberger *et al.*, 1998; Angelov, 2000; Falkner *et al.*, 2002; Korniushev *et al.*, 2002; Reischütz, 2002; Albuquerque de Matos & Kolouch, 2003; 2004; Killeen *et al.*, 2004; Anderson, 2005; Glöer

& Zettler, 2005; Zettler *et al.*, 2005; Gloer & Sirbu, 2006; Gollasch & Nehring, 2006; Cejka *et al.*, 2007; Hubenov, 2007; Jungbluth & Knorre, 2008; Byrne *et al.*, 2009; Fehér & Eross, 2009; Fontaine *et al.*, 2010; Kantor *et al.*, 2009; De Oliveira *et al.*, 2010a, 2010b; Horsák *et al.*, 2010; Koralewska-Batura *et al.* 2010; Munjiu & Shubernetski, 2010; Sirbu *et al.*, 2010; Sokolka & Preda, 2010; Boschi, 2011; Gargominy *et al.*, 2011; Proschwitz, 2011; Welter-Schultes *et al.*, 2011; Zettler, 2014) to records or monographs on alien species (especially recent works, i.e. Reischütz, 2002; Anderson, 2003, 2004; Horsák *et al.*, 2004; Nienhuis, 2004; Vimpère, 2004; Beran & Gloer, 2006; Zettler *et al.*, 2006; Majoros *et al.*, 2008; López Soriano *et al.*, 2009; Son, 2008; van der Velde *et al.*, 2010; Verween *et al.*, 2010; Marrone *et al.*, 2011; Soes *et al.*, 2011; Butkus *et al.*, 2014; Marrone *et al.*, 2014; Quiñoneiro-Salgado & López-Soriano, 2014); furthermore, various online databases were checked, such as Fauna Europea (Araujo, 2013; Bank, 2014), GBIF (2014), GISP (2014), IUCN (2014) and AnimalBase (2015).

Results

Identification and taxonomy

M. scabra is a medium size operculate gastropod, with a dextral shell (Fig. 1 A-F). The shell is ovoid-conical, 10-32 mm in height, with a rather short spire (less than last whorl in height), consisting of 7-9 whorls (even if usually early juvenile whorls are worn away) with fine spiral ridges and more strong axial ribs with rising, in the upper part of the whorls, as nodules and spines. Sometimes the spines may be very developed, extending the suture of the whorl (*Melania spinulosa* Lamark, 1822, taxa of uncertain taxonomic status, considered synonym by some authors as Brandt, 1974). The ground colour is tawny with vertical, rust-coloured flames and blotches alternating with the nodules and spines (Bentham-Jutting, 1956; Brandt, 1974; Starmühlner, 1976; Muley, 1978b; Glaubrecht *et al.*, 2009; Nasarat *et al.*, 2014). *M. scabra* has a horny, paucispiral operculum smaller than aperture, with eccentric nucleus (Pace, 1973; Starmühlner, 1976, 1983; Gomez *et al.*, 2011).

In the case of the Thiaridae family, the anatomy of the genital tract is quite uniform and anatomical details are irrelevant for the recognition of the species (Riech, 1937; Abbot, 1948; Pace, 1973; Brandt, 1974; Starmühlner, 1974, 1976; Muley, 1977, 1978a).

M. scabra may be confused for the apparent morphological similarity of the shell with some untypical forms of *Melanoides tuberculata*, which usually is easily distinguishable for the more elongated and conical shape, the on average bigger size, the absence, in the upper part of the whorls, of the more or less developed nodules or stout spines.

M. scabra is variable and includes many synonyms or infraspecific taxa of uncertain validity (Bentham-Jutting, 1956; Brandt, 1974; Starmühlner, 1976, 1983, 1984).

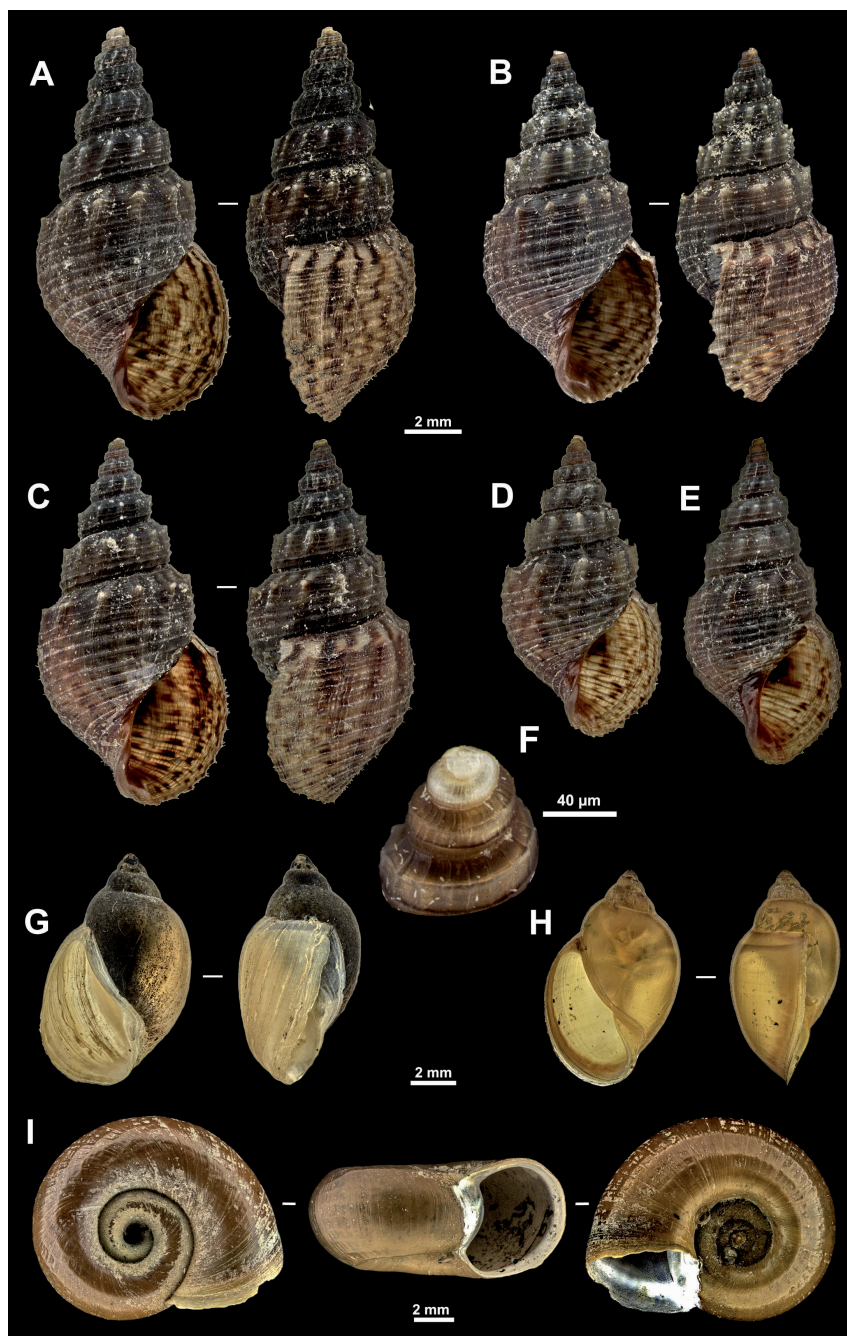


Fig. 1: Non-native Gastropods from Kos Island. A-F) *Mieniploia scabra* (Müller, 1774), frontal view, lateral view and magnification of the protoconch in subapical view; Lake Pyli, 1.2 km SSE of Marmari, E. Talenti leg. 01/07/2013 (A, F: MZUFC GC/44740; B: SCC; C: MBC; D-E: ETC). G-H) *Physella acuta* (Draparnaud, 1805), frontal view and lateral view; tributary canal of the Lake Alik, west shore, E. Talenti leg. 04/07/2013 (MZUFC GC/44741). I) *Helisoma duryi* (Wetherby, 1879), upper view, frontal and lower view; tributary canal of the Lake Alik, west shore, E. Talenti leg. 04/07/2013 (MZUFC GC/44738).

Even the systematic recognition at genus level is controversial; the species is often attributed to *Thiara* Röding, 1798, and, even recently, some authors are continuing to consider valid the attribution to this genus (Roll *et al.*, 2009; GBIF, 2014); other authors (Mienis, 2012; Mienis & Rittner, 2013; Nasarat *et al.*, 2014) place the species in the genus *Pseudoplotia* Forcart, 1950; while Glaubrecht *et al.* (2009), Glaubrecht & Podlaka (2010), Budha (2012) and Bogan (2012) place the species in the genus *Plotia* Röding, 1798. The generic attribution has been

recently reviewed by Low & Tan (2014) that have established the new monospecific genus *Mieniploia*, already adopted by Bouchet (2015). Considering that the genetic analysis confirms *M. scabra* as rather distant from all other Thiariidae (Glaubrecht *et al.*, 2009), its inclusion in a monospecific genus is acceptable.

Distribution on Kos Island

At sites 1 and 2 (Table 1), the populations of *Mieniploia scabra*, sampled in 2013, were abundant and with

Table 1. List of the freshwater (F) and brackish water (B) molluscs of Kos Island, based on the literature and the collections of the authors; the asterisk (*) highlights the alien species.

Family	Species	Habitat	Literature	Collecting sites				
				1	2	3	4	5
Neritidae	<i>Theodoxus anatolicus</i> (Récluz, 1844)	F	Gambetta 1929; Schütt 1986; Bank and Neuteboom 1988; Bank 2006		X			
Thiaridae	<i>Mieniplotia scabra</i> (Müller, 1774)*	F		X	X			
Melanopsidae	<i>Melanopsis buccinoidea</i> (Olivier, 1801)	F	Gambetta 1929; Fuchs and Käufel 1936; Bank and Neuteboom 1988; Bank 2006	X	X	X		X
Bithyniidae	<i>Pseudobythinia gittenbergeri</i> Glöer & Maassen, 2009	F				X	X	X
Hydrobiidae	<i>Pseudamnicola</i> sp.	F	Bank and Neuteboom 1988					
Hydrobiidae	<i>Radomaniola</i> sp.	F	Schütt 1980 (<i>Belgrandiella seminula</i>); Bank and Neuteboom 1988 (<i>Belgrandiella</i> n. sp.); Bank 2006 (<i>Belgrandiella seminula</i>); Georgiev 2013 (<i>Radomaniola seminula</i>)					
Cochliopidae	<i>Eupaludestrina</i> sp.	F/B						X
Bythinellidae	<i>Bythinella kosensis</i> Schütt, 1980	F	Schütt 1980; Bank and Neuteboom 1988; Bank 2006					
Truncatellidae	<i>Truncatella subcylindrica</i> (Linnaeus, 1767)	B						X
Valvatidae	<i>Valvata saulcyi</i> Bourguignat, 1853	F						X
Physidae	<i>Physella acuta</i> (Draparnaud, 1805)*	F	Bank and Neuteboom 1988; Bank 2006	X	X	X		X
Lymnaeidae	<i>Galba truncatula</i> (Müller, 1774)	F	Bank and Neuteboom 1988; Bank 2006					X
Planorbidae	<i>Planorbis intermixtus</i> (Mousson, 1874)	F				X		X
Planorbidae	<i>Helisoma duryi</i> (Wetherby, 1879)*	F				X		
Ancylidae	<i>Ancylus fluviatilis</i> Müller, 1774	F	Gambetta 1929; Bank and Neuteboom 1988; Bank 2006					
Sphaeriidae	<i>Pisidium casertanum</i> (Poli, 1791)	F	? Bank and Neuteboom 1988 (<i>Pisidium</i> sp.)					X

specimens of all sizes, demonstrating that naturalization of this alien species occurred in Kos Island. At all sites, except 4, also other alien species were found.

Discussion

At present, there are no reliable data on the date and causes of the introduction of *M. scabra* in Kos Island; the findings are recent but there have not been any reports in the previous years from the same locality. Only Bank & Neuteboom (1988) sampled the area near Pyli, in 1978, 1979 and 1987 and *Melanopsis buccinoidea* (Olivier, 1801) was collected, but no *M. scabra*. One reliable hypothesis can be the natural introduction through avian carriers, given the recent invasion of *M. scabra* in Israel, observed since 2006 (Mienis, 2008; Mienis & Mienis, 2008a, 2008b; Mienis & Rittner, 2013); the Kos Island is, in effect, near one of the major bird migration routes that transit from Europe to the Middle East (BLI, 2015; WID, 2015). However, an involuntary introduction for anthropogenic causes, by means of the transport and trade of aquatic ornamental plants or by means of aquariophily, as has been suggested

by Roll *et al.* (2009) for the aquatic species introduced in Israel or by Nasarat *et al.* (2014) for the introduction of *M. scabra* in Jordan, cannot be excluded.

Kos Island has not been the subject of recent research on freshwater and brackish water species and only nine have been cited in literature (Gambetta, 1929; Schütt, 1980, 1986; Bank & Neuteboom, 1988; Georgiev, 2013; see Table 1). From the summarily research carried out in 2013, with the sampling of 5 sites, 12 aquatic species were identified, some of which are new for the island: 11 gastropod and 1 bivalve species. The preliminary list of the malacological fauna from Kos has therefore been updated to 16 species (Table 1). Nevertheless, this checklist is certainly incomplete, as few aquatic habitats have been sampled in Kos. Besides *M. scabra*, two other alien freshwater species were identified: *Physella acuta* (Draparnaud, 1805) (Fig. 1 G-H) (already reported in Bank & Neuteboom, 1988 and in Bank, 2006) and *Helisoma duryi* (Wetherby, 1879), a new record for the island (Fig. 1 I).

With *M. scabra*, the number of allochthonous freshwater molluscs found in Greece rises to 9 (Economou *et al.*, 1991; Petridis & Sinis, 1993; Conides *et al.*, 1995; Bank,

Table 2. Checklist of alien freshwater molluscs in Europe, with the continent of origin and distribution for each country. X: allochthonous in the indicated country; *: native in the indicated country (species whose area of origin is practically non-European or very invasive species with marginal native range).

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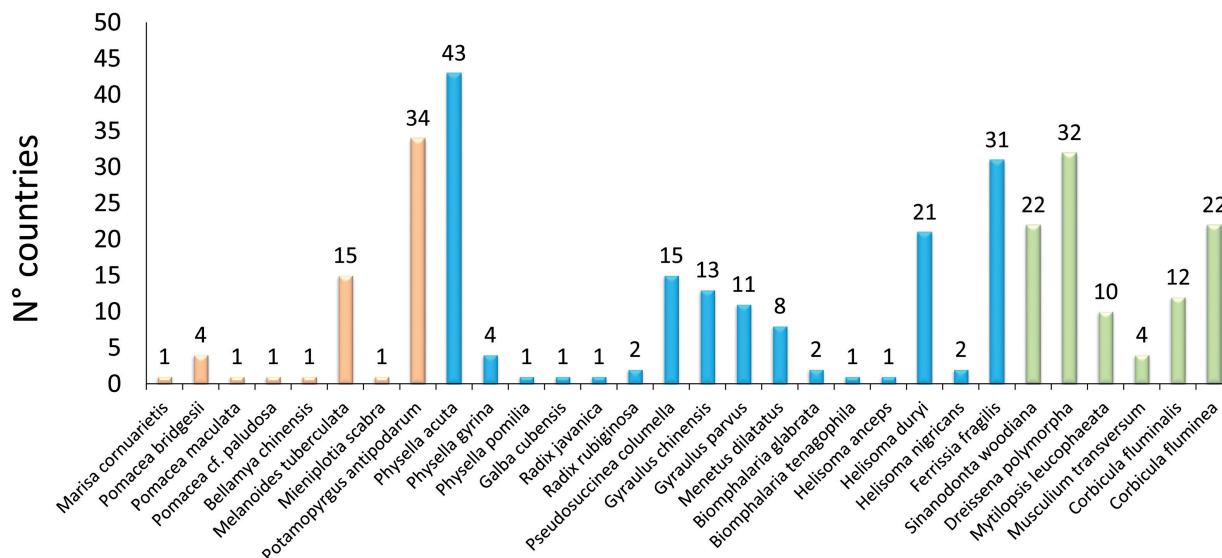


Fig. 2: Number of European countries where the presence of species of allochthonous freshwater molluscs has been reported: many species are particularly invasive, being now present in many countries, while others may be dormant or not invasive, being present in only a few European states and only in artificial environments.

2006; Radea *et al.*, 2008; Zenetos *et al.*, 2009; Bank, 2011, 2013); *Helisoma anceps* (Menke, 1830), recorded by Eröss *et al.*, 2005 from Prespa Lake, is here referred to *Helisoma duryi*, according to Bank, 2011, 2013, while the doubtful records of *Dreissena polymorpha* from Greece (Zenetos *et al.*, 2009) have not been confirmed by genetic data (Wilke *et al.*, 2010).

Molluscs are, at the European level, a taxon with many allochthonous species representing about 10 % of the total amount of introduced freshwater alien species (Gherardi *et al.*, 2008; DAISIE, 2009). Currently the freshwater molluscs of extra-European origin, present in European countries, amount to 30 species (Table 2). In the list of introduced species, taxa of extra-European origin or present, in origin, only marginally in the continent (taking the eastern geographic borders proposed in UNSC, 2014 and in INSTAT, 2014, thereby excluding Turkey to the south of the Bosphorus and the Georgia) have been considered. A very invasive species, which has its original origin in Eastern Europe at the turn with the Asian continent: *Dreissena polymorpha* (Pallas, 1771) was also included, while *Dreissena rostriformis bugensis* (Andrusov, 1897) being native to Ukraine has been regarded as of European origin (van der Velde *et al.*, 2010) and therefore not included. Finally, two other taxa have been considered as non-European, with the exception of a single European nation, where the species are considered autochthonous (*Melanoides tuberculata* in Malta and *Gyraulus parvus* (Say, 1817) in Iceland). Allochthonous species include both species acclimated in nature and those known from the literature as species present in artificial environments such as pools, greenhouses, intensive crops, nurseries, gardens and botanical gardens, sometimes not naturalized. It is in fact known that some species, spread by means of aquariophily, such as *Mela-*

noides tuberculata or *Helisoma duryi*, species distributed in tropical areas, remain confined to artificial and semi-natural environments or hot and thermal waters in colder countries in central Europe (Glöer, 2002), while, in the Mediterranean countries, these species spread more easily in natural environments and become invasive.

In Europe, among the major invasive continental molluscs there are several aquatic species that have found a quick and easy route of spreading along the drainage systems, also thanks to anthropical interventions (Ricciardi, 2001; Gherardi *et al.*, 2008). Among the 30 alien freshwater species of molluscs, these are the most alarming invaders, such as *Physella acuta* (Draparnaud, 1805), present in all the 43 European countries, *Potamopyrgus antipodarum* (Gray, 1843) present in 34 countries, *Dreissena polymorpha*, present in 32 countries, *Ferrissia fragilis* (Tryon, 1863), present in 31 countries, *Corbicula fluminea* (Müller, 1774) and *Sinandodonta woodiana* (Lea, 1834), present in 22 countries (Table 2; Fig. 2). However the data reported in Table 2 are still provisional, since the phenomenon of biological introductions is extremely dynamic, and the number of species is exponentially growing; also the level of knowledge is very different from one country to another, and many of the small alien entities are not easily detected except through specific research, which sometimes is not carried out in depth in all the European countries.

In Europe, the wide range of habitats and climatic diversity facilitate the acclimatization of alien species from different continents, and these are mainly found in the central and Mediterranean areas (Fig. 3). The allochthonous species come from Oceania (*Potamopyrgus antipodarum*), Africa and Asia (*Melanoides tuberculata*, *Mieniplotia scabra*), Central and South America (*Pseu-*

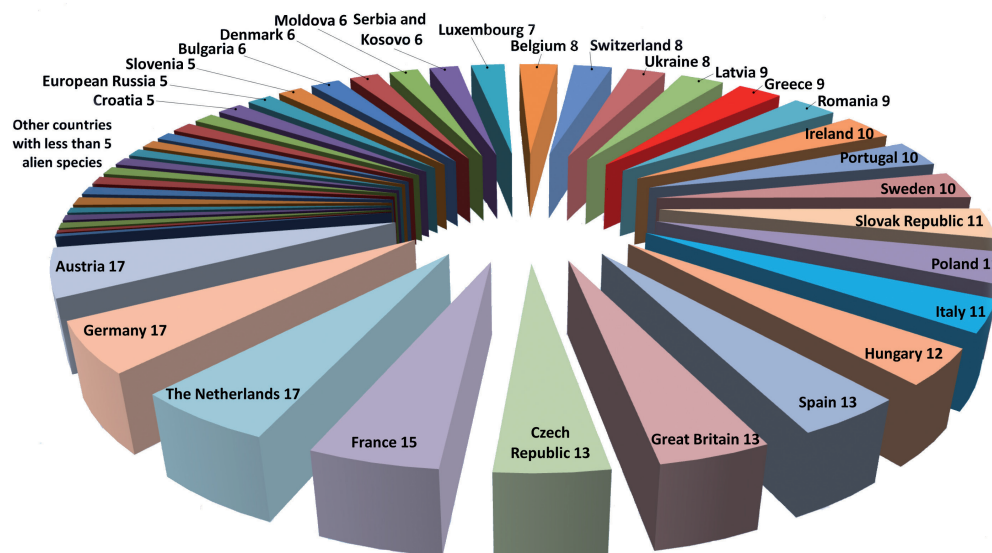


Fig. 3: Number of alien freshwater molluscs by country: central European nations have the largest number of introduced species (17 in Austria, in The Netherlands and in Germany: 15 in France, etc.), but the numbers are also high in the Mediterranean areas, such as in Spain (13), in Italy (11) and in Greece (9).

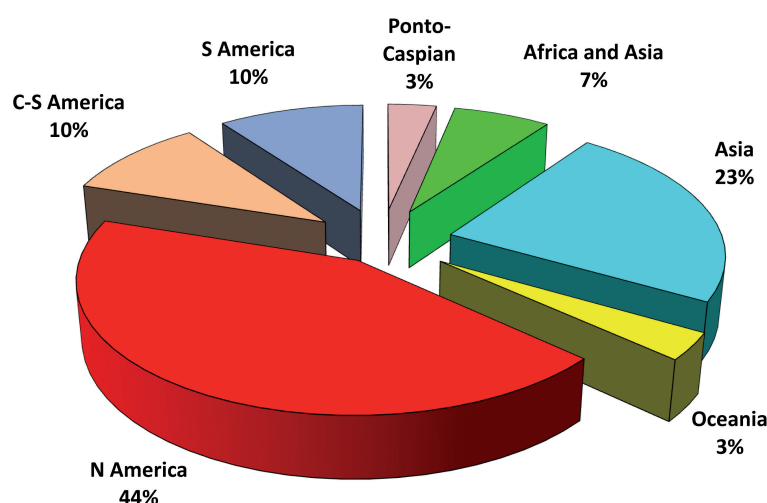


Fig. 4: Percentage of allochthonous freshwater molluscs introduced in Europe according to the continent of origin.

dosuccinea columella Say, 1817) and species of the genus *Helisoma* Swainson, 1840), Asia (with *Corbicula fluminalis* and particularly invasive species such as *Sinandonta woodiana* and *Corbicula fluminea* (Müller, 1774)), but the largest number of alien species (13 species, 44 %, Fig. 4) is native to North America, with *Physella acuta*, the more prevalent alien in Europe and other species such as *Ferrissia fragilis* at present very frequent, while species such as *Menetus dilatatus* (Gould, 1841) and *Gyraulus parvus* are less widespread.

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References

- Abbot, R.T., 1948. Handbook of medically important mollusks of the orient and the western Pacific. *Bulletin Museum of Comparative Zoology*, 100 (3), 285-299.
- Albuquerque-de-Matos, R.M., 2004. Non-marine testaceous Gastropoda of continental Portugal and Berlengas Islands. I. Catalogue and bibliography. *Arquivos do Museu Bocage*, Nova Série, 4 (1), 1-158.

- Al-Safadi, M.M., 1990. Freshwater molluscs of Yemen Arab Republic. *Hydrobiologia*, 208 (3), 245-251.
- Anderson, R., 2003. *Physella (Costatella) acuta* Draparnaud in Britain and Ireland – Its taxonomy, origins and relationship to other introduced Physidae. *Journal of Conchology*, 38 (1), 7-19.
- Anderson, R., 2004. *Pseudosuccinea columella* (Say) and other additions to the fauna of Menorca. *Journal of Conchology*, 38 (3), 323.
- Anderson, R., 2005. An annotated list of the non-marine Mollusca of Britain and Ireland. *Journal of Conchology*, 38 (6), 607-637.
- Angelov, A.M., 2000. *Catalogus Faunae Bulgaricae 4. Mollusca (Gastropoda et Bivalvia) aquae dulcis*. Academia Scientiarum Bulgarica Institutum Zoologicum, Backhuys Publ., Sofia, Leiden, xiv + 57 pp.
- Araujo, R., 2013. *Mollusca Bivalvia*. Fauna Europaea version 2.6.2. Last update 29 August 2013. <http://www.faunaeur.org> (Accessed January 2015)
- Bank, R.A., Neuteboom, W.H., 1988. Zur Molluskenfauna der Dodekanes-Inseln Kos, Kalymnos, Pserimos und Nisiros (Griechenland). *De Kreukel Jubileumnummer*, 45-62.
- Bank, R.A., 2006. Towards a catalogue and bibliography of the freshwater Mollusca of Greece. *Heldia*, 6 (1-2), 51-86.
- Bank, R.A., 2011. *Checklist of the land and freshwater Gastropoda of Greece*. Fauna Europaea Project. http://www.nmbe.ch/sites/default/files/uploads/pubinv/fauna_europaea_-_gastropoda_of_greece.pdf (Accessed November 2014)
- Bank, R.A., 2013. *Mollusca Gastropoda*. Fauna Europaea version 2.6.2. Last update 29 August 2013. <http://www.fau-naeur.org> (Accessed January 2015)
- Benthem-Jutting, W.S.S. van, 1956. Critical revision of the Javanese freshwater gastropods. *Treubia*, 23 (2), 259-477.
- Beran, L., Glöer P., 2006. *Gyraulus chinensis* (Dunker, 1848) - a new greenhouse species for the Czech Republic (Gastropoda: Planorbidae). *Malacologica Bohemoslovaca*, 5, 25-28.
- BLI, 2015. *Mediterranean/Black Sea Flyway*. Bird Life International. http://www.birdlife.org/datazone/userfiles/file/sowb/flyways/5_Mediterranean_Black_Sea_Factsheet.pdf (Accessed January 2015)
- Bogan, A.E., 2012. Review of the invasion and taxonomy of the Pagoda Tiara, *Plotia scabra* (Müller, 1774) (Gastropoda: Thiariidae). *Ellipsaria*, 14 (1), 11-12.
- Boschi, C., 2011. *Die Schneckenfauna der Schweiz. Ein umfassendes Bild- und Bestimmungsbuch*. Haupt Verlag, Bern, 624 pp.
- Bouchet, P., 2015. *Mieniplotia scabra* (O.F. Müller, 1774). In: *Molluscabase*, 2015. Accessed through: World Register of Marine Species at <http://www.marinespecies.org/aphia.php?p=taxdetails&id=828967> on 2015-06-03
- Brandt, R.A.M., 1974. The non-marine aquatic Mollusca of Thailand. *Archiv für Molluskenkunde*, 105 (1-4), 1-423.
- Brown, D.S., 1980. *Freshwater snails of Africa and their medical importance*. Taylor & Francis, London, 487 pp.
- Brown, D.S., Gallagher, M.D., 1985. Freshwater snails of Oman, South Eastern Arabia. *Hydrobiologia*, 127 (2), 125-149.
- Brown, D.S., Wright, C.A., 1980. Freshwater Molluscs. p. 341-358. In: *Fauna of Saudi Arabia 2*. Wittner W., Buttiker W. (Eds). Natural History Museum, Basel.
- Budha, P.B., 2012. *Plotia scabra*. The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org (Accessed November 2014)
- Burch, J.B., 1980. A guide to the freshwater snails of the Philippines. *Malacological review*, 13 (1-2), 121-143.
- Butkus R., Šidagytė E., Rakauskas V., Arbačiauskas K., 2014. Distribution and current status of non-indigenous mollusc species in Lithuanian inland waters. *Aquatic Invasions*, 9 (1), 95-103.
- Byrne, A., Moorkens E.A., Anderson, R., Killeen I.J., Regan, E.C., 2009. Ireland Red List No. 2 Non-Marine Molluscs. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland, 1-49. <http://www.npws.ie/sites/default/files/publications/pdf/RL2.pdf>
- Čejka, T., Dvořák L., Horsák M., Šteffek J., 2007. Checklist of the Molluscs (Mollusca) of the Slovak Republic. *Folia Malacologica*, 15 (2), 49-58.
- Conides, A., Koussouris, T., Gritzalis, K., Bertahas, I., 1995. Zebra mussel, *Dreissena polymorpha*: population dynamics and notes on control strategies in a reservoir in Western Greece. *Lake and Reservoir Management*, 11, 329-336.
- Cowie, R.H., 2000. Non-indigenous land and freshwater molluscs in the islands of the Pacific: conservation impacts and threats. p. 143-166. In: *Invasive species in the Pacific: a technical review and draft regional strategy*. Sherley G. (Ed). http://www.issg.org/database/species/.%5Cspecies%5Creference_files%5CSPREP.pdf#page=150 (Accessed November 2014)
- Cowie, R.H., 2002. Invertebrate invasions on Pacific Islands and the replacement of unique native faunas: a synthesis of the land and freshwater snails. *Biological Invasions*, 3, 119-136.
- DAISIE Consortium (Eds.), 2009. *DAISIE, Handbook of Alien Species in Europe*. Springer, Dordrecht, 399 pp.
- Davis, G.M., Yamaguchi, S., 1969. The freshwater Gastropoda of Okinawa. *Venus*, 28 (3), 137-152.
- De Oliveira, Á., Altonaga, K., 2010a. Materiais para o estudo da malacofauna não-marinha de Portugal. 10. *Oxychilus (Orizius) alliaris* (Miller, 1822) e *Oxychilus (Oxychilus) cellarius* (Müller O. F., 1774) Pulmonata, Oxychilidae). *Noticiario de la Sociedad Española de Malacología*, 54, 46-47.
- De Oliveira, Á., Holyoak, G. A., Holyoak, D. T., 2010b. Additional records of alien freshwater Mollusca in Portugal (Materiais para o estudo da malacofauna não-marinha de Portugal. 9). *Noticiario de la Sociedad Española de Malacología*, 54, 41-45.
- Dung, B.T., Madsen, H., The, D.T., 2010. Distribution of freshwater snails in family-based VAC ponds and associated waterbodies with special reference to intermediate hosts of fish-borne zoonotic trematodes in Nam Dinh Province, Vietnam. *Acta Tropica*, 116 (1), 15-23.
- Economou, A.N., Daoulas, Ch., Economidis, P., 1991. Observations on the biology of *Leuciscus 'svallize'* in the Kremasta reservoir (Greece). *Hydrobiologia*, 213 (2), 99-111.
- Eröss, Z.P., Fehér, Z., Hunyadi, A., 2005. Invasion of a North American Alien, *Planorbella anceps* (Menke, 1830) (Mollusca: Gastropoda: Planorbidae), in the ancient Lake Prespa. *Tentacle*, 13, 6-7.
- Falkner, G., Ripken, T.E.J., Falkner, M., 2002. *Mollusques continentaux de la France. Liste de référence annotées et bibliographie*. Patrimoines Naturels, Paris, 52, 1-350.

- Fehér, Z., Eröss, Z.P., 2009b. Checklist of the Albanian molluscs fauna. *Schriften zur Malakozoologie* 25, 22-38.
- Feulner, G.R., Green, S.A., 1999. Freshwater snails of the UAE. *Tribulus*, 9 (1), 5-9.
- Fontaine, B., Bichain, J.M., Cucherat X., Gargominy, O., Prié, V., 2010. Les noms scientifiques français des mollusques continentaux de France: processus d'établissement d'une liste de référence. *Revue d'écologie. La Terre et la Vie*, 65, 293-317.
- Fuchs, A., Käufel, F., 1936. Anatomische und systematische Untersuchungen an Land- und Süßwasserschnecken aus Griechenland und von den Inseln des Ägäischen Meeres. *Archiv für Naturgeschichte. Abteilung B., Neue Folge*, 5 (4), 541-662.
- Gargominy, O., Prie, V., Bichain, J.M., Cucherat, X., Fontaine, B., 2011. Liste de reference annotée des mollusques continentaux de France. Annotated checklist of the continental mollusc from France. *MalaCo*, 7, 307-382.
- Gambetta, L., 1929. Molluschi. Ricerche faunistiche nelle isole italiane dell'Egeo compiute da Alessandro Chigi, Raffaele Issel, Alessandro Brian, Renato Santucci, Vittorio Citterio, Federico Alzani per incarico del Governo delle Isole Egee nell'Agosto del 1926. *Archivio Zoologico Italiano*, 13 (1-2), 45-117.
- GBIF, 2014. Global Biodiversity Information Facility Free and Open Access to Biodiversity Data. <http://www.gbif.org/> (Accessed November 2014)
- Georgiev, D., 2013. A new species of *Radomaniola* Szarowska, 2006 (Gastropoda: Hydrobiidae) from Peloponnese, Greece. *Acta Zoologica Bulgarica*, 65 (3), 293-295.
- Gherardi, F., Bertolino, S., Bodon, M., Casellato, S., Cianfanelli, S., Ferraguti, M., Lori, E., Mura, G., Nocita, A., Riccardi, N., Rossetti, G., Rota, E., Scalera, R., Zerunian, S., Tricarico, E., 2008. Animal xenodiversity in Italian inland waters: distribution, modes of arrival, and pathways. *Biological Invasions*, 10 (4), 435-454.
- GISP, 2014. Global Invasive Species Database <http://www.issg.org/database> (Accessed December 2014)
- Gittenberger, E., Janssen, A.W., Kuijper, W.J., Kuiper, J.G.J., Meijer, T., van-der-Velde, G., de Vries, J.N., 1998. *De Nederlandse zoetwatermollusken. Recente en fossiele weekdieren uit zoet en brak water*. Nederlandse Fauna 2. Nationaal Natuurhistorisch Museum Naturalis, KNNV Uitgeverij & EIS-Nederland, Leiden, 288 pp.
- Glaubrecht, M., Brinkmann, N., Pöppe, J., 2009. Diversity and disparity "down under": systematics, biogeography and reproductive modes of the "marsupial" freshwater Thiaridae (Caenogastropoda, Cerithioidea) in Australia. *Zoosystematics and Evolution*, 85 (2), 199-275.
- Glaubrecht, M., Podlaka, K., 2010. Freshwater gastropods from early voyages into the Indo-West Pacific: the "melaniids" (Cerithioidea, Thiaridae) from the French "La Coquille" circumnavigation, 1822-1825. *Zoosystematics and Evolution*, 86 (2), 185-211.
- Glöer, P., 2002. *Mollusca I. Süßwassergastropoden Nord- und Mitteleuropas. Bestimmungsschlüssel, Lebensweise, Verbreitung*. 2. ConchBooks, Hackenheim, 327 pp.
- Glöer, P., Sirbu, I., 2005. New freshwater molluscs species found in the Romanian fauna. *Heldia*, 6 (5-6), 229-238.
- Glöer, P., Zettler, M.L., 2005. Kommentierte Artenliste der Süßwassermollusken Deutschlands. *Malakologische Abhandlungen*, Dresden, 23, 3-26.
- Glöer, P., Pešić, V., 2012. The freshwater snails (Gastropoda) of Iran, with descriptions of two new genera and eight new species. *ZooKeys*, 219, 11-61.
- Gollasch, S., Nehring S., 2006. National checklist for aquatic alien species in Germany. *Aquatic Invasions*, 1 (4), 245-269.
- Gomez, M.I., Strong, E.E., Glaubrecht, M., 2011. Redescription and anatomy of the viviparous freshwater gastropod *Hemisinus lineolatus* (W. Wood, 1828) from Jamaica (Cerithioidea, Thiaridae). *Malacologia*, 53 (2), 229-250.
- Haynes, A., 1984. *Guide to the brackish and fresh water gastropods of Fiji*. University of the South Pacific, Institute of Natural Resources. Ed. Suva Institute of Natural Resources, 37 pp.
- Haynes, A., 1985. The ecology and local distributions of non-marine aquatic gastropods in Viti Levu, Fiji. *Veliger*, 28 (2), 204-210.
- Haynes, A., 1990. The numbers of freshwater gastropods on Pacific islands and the theory of island biogeography. *Malacologia*, 31 (2), 237-248.
- Haynes, A., 1993. The gastropods in the streams and rivers of four islands (Guadalcanal, Makira, Malaita, and New Georgia) in the Solomon Islands. *Veliger*, 36 (3), 285-290.
- Haynes, A., 2000. The distribution of freshwater gastropods on four Vanuatu islands: Espiritu Santo, Pentecost, Éfate and Tanna (South Pacific). *Annals Limnology*, 36 (2), 101-111.
- Heller, J., Dolev, A., Zohary, T., Gal, G., 2014. Invasion dynamics of the snail *Pseudoplotia scabra* in Lake Kinneret. *Biological Invasions*, 16 (1), 7-12.
- Horsák, M., Dvořák L., Juříčková, L., 2004. Greenhouse gastropods of the Czech Republic: current stage of research. *Malakologické Tájékoztató. Malacological Newsletter*, 22, 141-147.
- Horsák, M., Juříčková, L., Beran L., Čejka, T., Dvořák, L., 2010. Komentovaný seznam měkkýšů zjištěných ve volné přírodě České a Slovenské republiky. Annotated list of mollusc species recorded outdoors in the Czech and Slovak Republics. *Malacologica Bohemoslovaca*, Suppl., 1, 1-37.
- Hubenov, Z., 2007. *Fauna and Zoogeography of Marine, Freshwater, and Terrestrial Mollusks (Mollusca) in Bulgaria*. In: V. Fet and A. Popov (Eds.), Biogeography and Ecology of Bulgaria, Springer, 141-198.
- ISTAT, 2014. Classificazione degli Stati esteri. Elenco degli Stati esteri, delle aree e dei continenti al 31 dicembre 2013. <http://www.istat.it/it/archivio/6747> (Accessed January 2015)
- IUCN, 2014. The IUCN Red List of Threatened Species. Version 2014.3. www.iucnredlist.org. (Accessed and downloaded on December 2014)
- Jungbluth, J.H., von-Knorre D., 2008. Trivialnamen der Land- und Süßwassermollusken Deutschlands (Gastropoda et Bivalvia). *Mollusca*, 26 (1), 105-156.
- Kantor, Y.I., Schileyko, A.A., Vinarski, M.V., Sysoev, A.V., 2009. *Catalogue of the continental mollusks of Russia and adjacent territories*. 295 pp. http://www.ruthenica.com/documents/Continental_Russian_molluscs_ver2-3-1.pdf
- Kolouch, L.R., 2003. Terrestrial, freshwater, and brackish mollusca of Malta islands. *Malacologica Bohemoslovaca*, 2, 43-50.
- Killeen, I., Aldridge, D., Oliver, G., 2004. Freshwater bivalves of Britain and Ireland. FSC/National Museum of Wales, *Occasional Publications*, 82, 1-114.

- Koralewska-Batura, E.K., Goldyn, B., Szybiak, K., Błoszyk, J., 2010. Materials to the knowledge of molluscs of wielkopolska. II. Checklist. *Folia Malacologica*, 18 (1), 29–41.
- Korniushin, A.V., Janovich, N.L., Melnichenko, K.M., 2002. Arten der Süßwassermuscheln der Ukraine. Mit Bemerkungen über taxonomischen Status, Verbreitung und Gefährdungskategorien einiger Arten und Formen. In Falkner et al., *Collectanea Malacologica*, 463–478.
- López-Soriano, J., Quiñonero-Salgado, S., Tarruella, A., 2009. Presencia masiva de *Pomacea* cf. *canaliculata* (Lamarck, 1822) (Gastropoda: Ampullariidae) en el Delta del Ebro (Cataluña, España). *Spira*, 3 (1-2), 117–121.
- Low, M.E.Y., Tan S.K., 2014. *Mieniplotia* gen. nov. for *Buccinum scabrum* O.F. Müller, 1774, with comments on the nomenclature of *Pseudoplotia* Forcart, 1950, and *Tiaropsis* Brot, 1870 (Gastropoda: Caenogastropoda: Cerithioidea: Thiaridae). *Occasional Molluscan Papers*, 3, 15–17.
- Majoros, G., Fehér Z., Deli T., Földvári G., 2008. Establishment of *Biomphalaria tenagophila* snails in Europe. *Emerging Infectious Diseases*, 14 (11), 1812–1814.
- Marrone, F., Lo-Brutto, S., Arculeo, M., 2011. Cryptic invasion in Southern Europe: the case of *Ferrissia fragilis* (Pulmonata: Ancyliidae) Mediterranean populations. *Biologia*, 66 (3), 484–490.
- Marrone, F., Naser, M.D., Yasser, A.G., Sacco, F., Arculeo, M., 2014. First record of the North American cryptic invader *Ferrissia fragilis* (Tryon, 1863) (Mollusca: Gastropoda: Planorbidae) in the Middle East. *Zoology in the Middle East*, 60 (1), 39–45.
- Mienis, K., 2012. What is the correct generic name of the invasive tropical thiarid species occurring in Israel and elsewhere that was described originally as *Buccinum scabrum* Müller, 1774? *Ellipsaria*, 14 (2), 14–16.
- Mienis, H.K., 2008. Additional localities of the freshwater snail *Tarebia granifera* from Israel with a note on the presence of another tropical invasive gastropod *Thiara scabra*. *Ellipsaria*, 10 (1), 12–13.
- Mienis, H.K., 2010. Exotic land and freshwater mollusks of Israel. *Haasiana*, 5, 68–69.
- Mienis, H.K., 2011. A further note on the conquest of Israel by the invasive tropical gastropod *Thiara scabra*. *Ellipsaria*, 13 (2), 29.
- Mienis, H.K., Mienis D., 2008a. *Thiara scabra*, a tropical snail, has invaded the Sea of Galilee, Israel. *Triton*, 18, 35–36.
- Mienis, H.K., Mienis, D., 2008b. More information concerning the invasion of the Sea of Galilee, Israel, by the tropical freshwater gastropod *Thiara scabra* (Gastropoda, Thiaridae). *Ellipsaria*, 10 (2), 8.
- Mienis, H.K., Rittner, O., 2013. Have invasive freshwater gastropods conquered the lower part of the Tanninim river in Israel? *Tentacle*, 21, 37–38.
- Muley, E.V., 1977. Studies on the breeding habits and development of the brood-pouch of a viviparous prosobranch, *Melania scabra*. *Hydrobiologia*, 54 (2), 181–185.
- Muley, E.V., 1978a. Embryology and development of a freshwater prosobranch, *Melania scabra*. *Hydrobiologia*, 58 (1), 89–92.
- Muley, E.V., 1978b. Studies on growth indices of the fresh water prosobranch, *Melania scabra*. *Hydrobiologia*, 58 (2), 137–143.
- Munjiu, O., Shubernetski, I., 2010. First record of Asian clam *Corbicula fluminea* (Müller, 1774) in the Republic of Moldova. *Aquatic Invasions*, 5, Suppl. 1, 67–70.
- Nasarat, H., Amr, Z., Neubert, E., 2014. Two invasive freshwater snails new to Jordan (Mollusca: Gastropoda). *Zoology in the Middle East*, 60 (1), 46–49.
- Nesemann, H., Sharma, G., Sinha, R.K., 2011. Benthic macroinvertebrate fauna and “marine elements” sensu Annandale (1922) highlight the valuable dolphin habitat of river Ganga in Bihar - India. *Taprobanica*, 3 (1), 18–30.
- Nesemann, H., Sharma, S., Sharma, G., Khanal, S.N., Pradhan, B., Shah, D.N., Tachamo, R.D., 2007. *Aquatic Invertebrates of the Ganga River System. 1 - Mollusca, Annelida, Crustacea (in part)*. Chandi Press, Kathmandu, 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.
- Nienhuis, J.A.J.H., 2004. *Musculium transversum* (Say, 1829) (Bivalvia, Sphaeriidae) in Nederland opniuw levend aangetroffen. *Basteria*, 67 (4-6), 147–148.
- Pace, G.L., 1973. The freshwater snails of Taiwan (Formosa). *Malacological Review, Supplement 1*, 1–118.
- Petridis, D., Sinis, A., 1993. Benthic macrofauna of Tavropos reservoir (central Greece). *Hydrobiologia*, 262, 1–12.
- Prasad, B.C., 2010. Freshwater resources inventory of the Fiji Islands. *Natural resource inventory report of the Fiji Islands*, 1, 1–35. http://repository.usp.ac.fj/4857/1/Vol_2_Marine_Resour_Inventory_Report.pdf (Accessed November 2014)
- Proschwitz, T. von, 2011. En uppdaterad checklista Med Vetenskapliga och Svenska Namn. Naturhistoriska Musset, Göteborg, 1–12. <http://www.nrm.se/download/18.4e32c81078a8d9249800016704/1367705030810/sotvmoll.pdf>
- Quiñonero-Salgado, S., López-Soriano, J., 2014. Observaciones sobre las puestas de *Pomacea maculata* Perry, 1810 (Gastropoda: Ampullariidae) en el Delta del Ebro. *Spira*, 5 (3), 143–145.
- Radea, C., Louvrou, I., Economou-Amilli, A., 2008. First record of the New Zealand mud snail *Potamopyrgus antipodarum* JE Gray 1843 (Mollusca: Hydrobiidae) in Greece - Notes on its population structure and associated microalgae. *Aquatic Invasions*, 3 (3), 341–344.
- Reischütz, P.L., 2002. Weichtiere (Mollusca). In Essl F. & Rabitsch W.: *Neobiota in Österreich. Umweltbundesamt, Federal Environment Agency*, Wie, 239–250.
- Ricciardi, A., 2001. Facilitative interactions among aquatic invaders: is an “invasional meltdown” occurring in the Great Lakes? *Canadian Journal of Fisheries and Aquatic Sciences*, 58, 2513–2525.
- Riech, E., 1937. Systematische, anatomische, ökologische und tiergeographische Untersuchungen über die Süßwassermollusken Papuasians und Melanesians. *Archiv für Naturgeschichte Abteilung A, Neue Folge*, 6 (1), 37–153.
- Roll, U., Dayan, T., Simberloff, D., Mienis, H.K., 2009. Non-indigenous land and freshwater gastropods in Israel. *Biological Invasions*, 11, 1963–1972.
- Schütt, H., 1980. Zur Kenntnis griechischer Hydrobiiden. *Archiv für Molluskenkunde*, 110 (4/6), 115–149.
- Schütt, H., 1986. The dissemination of *Theodoxus* species in Greece including the islands (Moll. Prosobranch.). *Biologia Gallo-hellenica*, 12, 283–290.
- Sîrbu, I., Sîrbu M., Benedek A.M., 2010. The freshwater mollusca fauna from Banat (Romania). *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»*, 53, 21–43.

- Skolka, M., Preda, C., 2010. Alien invasive species at the Romanian black seacoast – present and perspectives. *Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa»*, 53, 443-467.
- Soes, D.M., Majoor, G. D., Keulen, S.M.A., 2011. *Bellamya chinensis* (Gray, 1834) (Gastropoda: Viviparidae), a new alien snail species for the European fauna. *Aquatic Invasions*, 6 (1), 97–102.
- Son, M.O., 2008. Rapid expansion of the New Zealand mud snail *Potamopyrgus antipodarum* (Gray, 1843) in the Azov-Black Sea Region. *Aquatic Invasions*, 3 (3), 335-340.
- Starmühlner, F., 1974. The freshwater Gastropods of Ceylon. *Bulletin of the Fisheries Research Station, Sri Lanka*, 25 (1/2), 97-181.
- Starmühlner, F., 1976. Beiträge zur Kenntnis der Süßwasser-Gastropoden pazifischer Inseln. Ergebnisse der Österreichischen Indopazifik-Expedition des 1. Zoologischen Institutes der Universität Wien. *Annalen des Naturhistorischen Museums in Wien*, 80, 473-656.
- Starmühlner, F., 1979. Results of the Austrian Hydrobiological Mission, 1974, to the Seychelles, Comores and Mascarene Archipelagos. Part I. Preliminary Report: introduction, methods, general situation of the islands with descriptions of the stations and general comments on the distribution of the fauna in the running waters of the islands. *Annalen des Naturhistorischen Museums in Wien*, 82, 621-742.
- Starmühlner, F., 1982. Occurrence, distribution and geographical range of the freshwater-Gastropods of the Andaman Islands. *Malacologia*, 22 (1-2), 455.
- Starmühlner, F., 1983. Results of the Hydrobiological Mission 1974 of the Zoological Institute of the University of Vienna. Part VIII. Contributions to the knowledge of the freshwater-Gastropoda of the Indian Ocean Islands (Seychelles, Comores, Mascarene-Archipelagos). *Annalen des Naturhistorischen Museums in Wien*, 84 B, 127-249.
- Starmühlner, F., 1984. Results of the Austrian-Indian Hydrobiological Mission 1976 to the Andaman-Islands. Part IV. The freshwater Gastropods of the Andaman Islands. *Annalen des Naturhistorischen Museums in Wien*, 86 B, 145-204.
- Subba-Rao, N.V., 1989. *Freshwater molluscs of India*. Zoological Survey of India, Calcutta, 289 pp.
- Thompson, F.G., Heyn, M.W., Campbell, D.N., 2009. *Thiara scabra* (O. F. Muller, 1774): the introduction of another Asian freshwater snail into the United States. *Nautilus*, 123 (1), 21-22.
- UNSC, 2014. United Nations Statistical Commission Composition of macro geographical (continental) regions, geographical sub-regions, and selected economic and other groupings. <http://millenniumindicators.un.org/unsd/methods/m49/m49regin.htm> (Accessed November 2014)
- Van-der-Velde, G., Rajagopal, S., bij-de-Vaate, A., 2010. 1. From zebra mussels to quagga mussels: an introduction to the Dreissenidae. p. 1-10. In: *The Zebra Mussel in Europe*. van der Velde G., Rajagopal S., bij de Vaate A. (Eds). Backhuys Publishers, Leiden/Margraf Publishers, Weikersheim.
- Verween, A., Vincx, M., Degraer, S., 2010. 3. *Mytilopsis leucophaea*: The brackish water equivalent of *Dreissena polymorpha*? A review. In: van der Velde G., Rajagopal S. & bij de Vaate A. (eds). *The Zebra Mussel in Europe*. Backhuys Publishers, Leiden/Margraf Publishers, Weikersheim, 29-43.
- Vimpère, J., 2004. Introduction en France continentale d'un gastéropode d'eau douce originaire de Floride: *Planorbella duryi* (Wetherby, 1879), (Mollusca; Gastropoda; Pulmonata). *Le Naturaliste Vendeen*, 4, 127-130.
- Welter-Schultes, F., Audibert, C., Bertrand, A. 2011. Liste des mollusques terrestres et dulcicoles de France continentale (excl. hydrobioides). *Folia Conchylologica*, 12, 4-44.
- Welter-Schultes, F., 2015. AnimalBase Project Group, 2005-2015. AnimalBase. Early zoological literature online. World wide web electronic publication www.animalbase.uni-goettingen.de (Accessed January 2015)
- WID, 2015. Birds without boundaries. Migratory, nomadic & other wandering birds. WysInfo Dpcuwebs http://www.wysinfo.com/Migratory_Birds/Migratory_Birds_Without_Boundaries.htm (Accessed January 2015)
- Zenetos, A., Pancucci-Papadopoulou, M.A., Zogaris, S., Papastergiadou, E., Vardakas, L., Aligizaki, K., Economou, A.N., 2009. Aquatic alien species in Greece (2009): tracking sources, patterns and effects on the ecosystem. *Journal of Biological Research-Thessaloniki*, 12, 135-172.
- Wilke, T., Schultheiß, R., Albrecht, C., Bornmann, N., Trajanovski, S., Kevrekidis, T., 2010. Native *Dreissena* freshwater mussels in the Balkans: in and out of ancient lakes. *Biogeosciences*, 7, 3051 -3065.
- Zettler, M. L., Jueg, U., Menzel-Harloff, H., Göllnitz, U., Petrick, S., Weber, E., Seemann, R. 2006. *Die Land- und Süßwassermollusken Mecklenburg-Vorpommerns*. Schwerin (Obotritendruck), 1-318.
- Zettler, M.L., 2014. Süßwassermollusken Litauens, eine Ergänzung. *Mitteilungen der Deutschen Malakozoologischen Gesellschaft*, 91, 33-42.
- Zettler, M.L., Zettler, A., Daunys, D., 2005. Bemerkenswerte Süßwassermollusken aus Litauen. Aufsammlungen vom September 2004. *Malakologische Abhandlungen*, 23, 27-40.