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Checklist and distribution of the land and freshwater molluscs from north-western Italy (Piedmont, Valle d'Aosta and Liguria)

ABSTRACT

This checklist of terrestrial, freshwater and brackish-water molluscs of Piedmont, Valle d'Aosta and Liguria (NW Italy) is based on literature and museum data and on research by the authors and co-workers carried out until the end of 2020. The malacofauna consists of 394 taxa (280 land and 114 aquatic molluscs), 308 for Piedmont (225 land and 83 aquatic), 139 for Valle d'Aosta (120 land and 19 aquatic) and 274 for Liguria (193 land and 81 aquatic) and includes 24 undetermined or undescribed species and 44 endemics, 27 of which have a very narrow range. Three species are particularly localized: *Iglica pezzolii* Boeters, 1971, and *Chondrina feneriensis* Bodon, Nardi, Cianfanelli & Kokshoorn, 2015, limited to Monte Fenera (Novara and Vercelli provinces), and *Falkneria camerani* (Lessona, 1880), known from a few localities in the Pennine Alps. Seven taxa, recorded in the past, were no longer found: *Eupaludestrina stagnorum* (Gmelin, 1791), *Marstoniopsis insubrica* (Küster, 1853), *Orcula dolium dolium* (Draparnaud, 1801), *Leucostigma candidescens* (Rossmässler, 1835), *Zonites algirus* (Linnaeus, 1758), *Cochlicella conoidea* (Draparnaud, 1801) and *Pisidium moitessierianum* Paladilhe, 1866. Several species are of conservation interest according to the European Red List of non-marine molluscs and the IUCN Red List of terrestrial gastropods: one of these, *Renea bourguignatiana* Nevill, 1880, present in Italy in a few sites near Ventimiglia, is considered Critically Endangered; five others are reported as Endangered and 13 as Vulnerable. Among the threatened species, two have a very narrow range: *Alzoniella delmastroi* Bodon & Cianfanelli, 2004, limited to the Turin area and *Pezzolia radapalladis* Bodon & Giusti, 1986, known only in eastern Liguria from Recco to Rapallo (Genoa province). Finally 46 entities are aliens, including three recently reported in Italy: *Zonitoides arboreus* (Say, 1817), *Boettgerilla pallens* Simroth, 1912 and *Deroceras sturanyi* (Simroth, 1894).

Keywords: Non-marine Gastropoda and Bivalvia, north-western Italy, faunistics, biogeography, conservation

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INTRODUCTION

Knowledge of land and freshwater molluscs in north-western Italy (Piedmont, Valle d'Aosta and Liguria) is still patchy and not equally detailed and comprehensive everywhere. Decisive contributions to the study of malacofauna of Piedmont and Valle d'Aosta were made in the nineteenth century. Unfortunately, in the twentieth century this work did not continue: findings were not brought up to date, nor was distribution, taxonomy and nomenclature revised or historical data restudied. The malacology of most of Liguria aroused little interest until the last 20-30 years, when much field work occurred, but the abundant data acquired is still largely unpublished.

The first information on molluscs of Piedmont and Valle d'Aosta dates back to the first half of the nineteenth century and can be inferred from unpublished catalogues of the collections of the "Regio Museo Zoologico" at Turin University (Bonelli, 1824-30; Gené, 1834-47). With regard to Liguria, an early list of species appeared in Vérany (1846) as part of a survey on the fauna of the territory of Genoa, which then included Liguria and the much more extensively studied Département des Alpes-Maritimes. Strobel (1853) published the first comprehensive work on land and freshwater molluscs of eastern Piedmont from the Toce to the Trebbia rivers (now in the region of Emilia-Romagna), to which Stabile (1859) added some reports for north-eastern Piedmont. Mortillet (1862), Villa (1862) and Payot (1864) subsequently added more information for the provinces of Aosta, Turin and Cuneo, and then Stabile (1864) expanded the research by drafting the first checklist of land snails and slugs of Piedmont, that included species from Valle d'Aosta (Valle d'Aosta has often been included in naturalistic studies dealing with Piedmont). For Liguria, in the same period, Gentile & Sulliotti (undated) published a list of species for Imperia province, and Tapparone Canefri (1869) compiled a list of the molluscs of the province of La Spezia. Further malacological records for Piedmont were provided by Lessona (1873) and for Liguria by Strobel (1878) and Sulliotti (1889).

In the last decades of the nineteenth century, field research on molluscs of Piedmont and Valle d'Aosta became more frequent and produced many published results (Lessona, 1879, 1880, 1881; Nevill, 1880; Lessona & Pollonera, 1882; Boettger, 1883; Bourguignat, 1883; Pegorari, 1883; Pollonera, 1884, 1885a, 1887, 1890a; Simon & Boettger, 1884; Pini, 1885), whereas data on the molluscs of Liguria remained scarce and fragmentary (Issel, 1882; Pollonera, 1892, 1893; Wagner, 1897). Pollonera (1885b) updated the list of land snails and slugs in Piedmont, to which he added two short notes (Pollonera, 1886a, 1889a) and a list of fresh-water species found in this region (Pollonera, 1889b). Other studies concerned new taxa described from Piedmont and Valle d'Aosta and reports of new sites for species already listed from the area (Drouët, 1883; Pollonera, 1886b, 1888, 1889d, 1890b; Piolti, 1887; Calloni, 1890; Monti, 1903; Pavesi, 1904).

At the beginning of the twentieth century, research on the molluscs of Piedmont and Valle d'Aosta arrested temporarily after Pollonera's death (Colosi, 1923; Hesse, 1924; Pallary, 1924). Some surveys on land and freshwater molluscs were published from parts of the study area (Dellepiane, 1906, 1914; Simroth, 1910;

Bisacchi, 1928; Gambetta, 1928, 1932a, 1932b, 1933; Forcart, 1933, 1959, 1966a; Alzona & Alzona Bisacchi, 1938; Coen, 1945; Pfeiffer, 1951; Tortonese & Rossi, 1954; Mirolli, 1958; Nocentini, 1963, 1966; Martinotti, 1968; Girod, 1969). The catalogue of living Italian land and freshwater molluscs (Alzona, 1971) also contained abundant but relatively undetailed data for Piedmont, Valle d'Aosta and Liguria. Bishop (1976a) subsequently published the first summary on land snails and slugs in the former province of Novara, now split into the provinces of Verbano-Cusio-Ossola and Novara. The same author published a critical literature-based catalogue of land snails and slugs of Piedmont and Valle d'Aosta (Bishop, 1980) giving their distribution according to the former provinces of Alessandria, Aosta, Asti, Cuneo, Novara, Vercelli and Turin.

Despite the absence of an overall regional survey, a progressive increase in available information on molluscs of Piedmont and Valle d'Aosta has occurred more recently. Many reports were included in taxonomic, faunal or genetic studies (Boeters, 1971; Bishop, 1976b; Magnaghi *et al*., 1978; Badino & Celebrano, 1981; Kuiper, 1981; Badino, 1982; Bodon & Giusti, 1982; Riedel, 1983, 1998; Repetto, 1984, 1985a, 1985b, 1986, 1995; Badino *et al*., 1986; Pezzoli, 1987a, 1988; Nordsieck, 1989, 1990, 2003; Badino & Lodi, 1990; Battegazzore, 1990; Falkner, 1990; Battegazzore *et al*., 1992; Bonomi & Ruggiu, 1996; Castagnolo, 1996; Eikenboom, 1996; Manganelli & Giusti, 1998; Giusti & Manganelli, 1999; Santamaria, 2000; Nagel & Badino, 2001; Pezzoli & Lemme, 2003; Ricciardi *et al*., 2003; Binelli & Ricciardi, 2004; Forni & Sacchi, 2004; Evangelista & Vallinotto, 2008; Sindaco *et al*., 2009; Cianfanelli *et al*., 2010; Heim *et al*., 2010; Benke *et al*., 2011; Giusti *et al*., 2011; Formenti, 2012; Bodon & Delmastro, 2013; Guarneri, 2013; Kamburska *et al*., 2013; Brandstetter, 2014, 2015; Brandstetter & Kapp, 2014; Razkin *et al*., 2016b; Riccardi *et al*., 2016, 2019; Froufe *et al*., 2017; Korábek *et al*., 2018b; Marrone *et al*., 2019).

Biospeleological research also produced more data from the provinces of Biella, Cuneo, Novara, Turin, Vercelli and Verbano-Cusio-Ossola (Cella & Guanella, 1987; Pascutto, 1998, 2002, 2003; Casale *et al*., 1999; Lana, 2001; Pascutto & Ricci, 2004; Lana *et al*., 2014, 2016; Lana & Sella, 2016). At the same time, several species from sites in Piedmont, Valle d'Aosta and Liguria were depicted in the atlas of Italian land and freshwater molluscs by Cossignani & Cossignani (1995, 2020), while unionids from Piedmont in the Paulucci Collection of Sistema Museale di Ateneo, Sezione Zoologica de "La Specola", University of Florence, were reported in Castagnolo *et al.* (2002). A contribution to knowledge of the malacofauna of the provinces of Turin and Cuneo was given by recent studies in parts of these areas (Lauri, 2003; Evangelista, 2007; Gavetti *et al*., 2008). Finally, short contributions from recent research also concerned Valle d'Aosta (Facchini & Badino, 1998; Sindaco *et al*., 2005; Evangelista, 2009).

The studies carried out in Liguria in the second half of the twentieth century included in-depth surveys on the freshwater malacofauna of the region (Giusti & Pezzoli, 1977; Bodon, 1980; Pezzoli & Giusti, 1980a, 1980b; Giusti & Bodon, 1981, 1984; Bodon & Giusti, 1982; Pezzoli, 1987b, 1987c) and the molluscs of geographical areas, such as the Ligurian Alps (Boato *et al*., 1985; Bologna & Vigna

Taglianti, 1985), eastern Liguria (Bodon, 2007) and Palmaria Island (Repetto, 2012). The distribution of numerous taxa in Liguria was deduced from information obtained in field surveys or taxonomic work (Sanfilippo, 1950; Franciscolo, 1955; Giusti, 1971; Gittenberger, 1973; Cesari, 1980; Falkner, 1981; Bodon *et al*., 1982, 2001; Boato *et al*., 1983; Giusti *et al*., 1985, 1986; Pezzoli, 1985, 1988, 1990, 1996; Boato, 1986, 1988; Bodon & Giusti, 1986; Bodon & Boato, 1987; Manganelli & Giusti, 1988; Boeters *et al*., 1989; Manganelli *et al*., 1991; Bodon, 1994; Favilli *et al*., 1998; Mariotti *et al*., 2002; Birindelli, 2006; Margelli, 2012; Chueca *et al*., 2017; Costa *et al*., 2019). An important improvement in knowledge of the distribution of freshwater prosobranchs and bivalves in Piedmont, Valle d'Aosta and Liguria was provided by field work for the checklist of Italian malacological fauna (Bodon *et al*., 2005a, 2005b).

The checklist has also been integrated with data on the new taxa subsequently described, redescribed or introduced (Bodon & Cianfanelli, 2002, 2004, 2012; Bodon *et al*., 2004, 2015, 2020; Gargominy & Ripken, 2006; Nordsieck, 2006a; Cianfanelli *et al*., 2007; Nitz *et al*., 2009; Manganelli *et al*., 2010; Evangelista *et al*., 2013; Birindelli *et al*., 2015) and with records available on the web repository (ATBI, 2010; AnimalBase, 2013; ENEA, 2016; iNaturalist, 2020; Natura Mediterraneo, 2020).

Although recent publications are valuable references on the molluscs of north-western Italy, many doubts remain, data on certain taxa and areas is lacking and no synthesis for the whole area has yet been made. The regional checklists for Liguria and Piedmont compiled by Cossignani & Cossignani (1995) are not reliable, complete or accurate and the same is true of the list that can be assembled from the species maps of the Guide to the Identification of Species of European Non-Marine Molluscs by Welter-Schultes (2012a).

The present checklist of land and freshwater molluscs of Piedmont, Valle d'Aosta and Liguria comes about 40 years after Bishop (1980) and 35 years after Boato *et al*. (1985). It critically reviews the literature and includes much of the unpublished records held by the authors.

North-western Italy

The study area includes the administrative regions of Piedmont, Valle d'Aosta and Liguria, which extend for about 34,000 square kilometres in the north-western sector of Italy, and consists of 13 administrative districts: the provinces of Alessandria, Aosta, Asti, Biella, Cuneo, Genoa, Imperia, La Spezia, Novara, Turin, Savona, Verbano-Cusio-Ossola and Vercelli (Fig. 1 A). From a geographical point of view, it is bounded to the north and west by the Alpine Arc and to the south by the Ligurian Sea, while to the east there are no defined natural boundaries.

The area, characterised by sharp morphological variability, is 52% montane, 28% hilly and 20% flat. The mountainous part falls in the portion of the western Alps and of the Apennines between Liguria and Piedmont. According to the International Subdivision of the Alpine Orographic Unified System (SOIUSA) (Marazzi, 2005), the Italian western Alps include, from south-west to north-east: (1)

the Ligurian Alps, separated from the Maritime Alps by the Roia and Vermenagna valleys; (2) the Maritime Alps, separated from the Cottian Alps by Valle Stura di Demonte; (3) the Cottian Alps, separated from the Graian Alps by Moncenisio in Valle di Susa; (4) the Graian Alps, separated from the Pennine Alps by Valle Dora Baltea; (5) the Pennine Alps, separated from the Lepontine Alps by the Simplon Pass; (6) the Lepontine Alps. The hilly areas include on the left bank of Po river the morainic amphitheatres (Morainic Amphitheatre of Rivoli and Avigliana, at the mouths of the Valle di Susa; Morainic Amphitheatre of Ivrea at the mouth of the Valle d'Aosta) and on the right bank of Po river the so-called "internal hills" (from south to north and east to west: the Langhe and upper Monferrato, Monferrato and Roero, Turin) (De Biaggi *et al*., 1990). The lowland areas are summarily divided into "low plain" of Vercelli and Novara, "low plain" of Alessandria and "mid-upper-plain" of Cuneo and Turin (Fig. 1 B).

As far as geological aspects are concerned, in the western Alps crystalline rock prevails over limestones and dolomites. The largest areas of limestone occur in Valle di Susa and many valleys in Cuneo province (Po, Varaita, Maira, Stura di Demonte, Gesso, Vermenagna) and in the Ligurian Alps (Marguareis Massif and Valle Tanaro). Regarding the northern valleys of Piedmont, limited calcareous outcrops occur in Valle Devero, Val Formazza and Val Sesia at Monte Fenera. In Valle d'Aosta, limestone is limited to a few areas, including Piccolo San Bernardo, Courmayeur, Cogne and Aosta. The hilly inland areas of the southern sector are rich in loam, calcareous sandstone and gypsum. In Liguria, limestone is predominant in the western sector, along the French border and in Valle Tanaro. Inland from Imperia, flyschoid formations dominate, whereas in Savona province limestone formations are found inland of Albenga, mainly in Val Pennavaira, and inland of Loano and Finale Ligure, where there is an abundance of biogenic limestone. Between Genoa and Rapallo, a broad area of calcareous flysch crops out and extends into Valle Scrivia; other limestone appears around La Spezia, between the headlands of Portovenere and Montemarcello.

Orographically, the western Alps are characterized by increasing average altitudes from south to west, and then north. Passing from the Ligurian to the Maritime, Cottian and Graian Alps, altitude increases from 2000 m to 4000 m, culminating in Monte Bianco (4810 m), the highest mountain in Europe. The Pennine Alps also reach considerable altitudes at Monte Rosa (4634 m) and Cervino (4478 m), while the Lepontine Alps reach little over 3500 m. Finally, the Ligurian-Piedmontese Apennines have their highest peak at Monte Maggiorasca (1799 m).

Hydrologically, the area mostly falls in the upper Po catchment that drains all of northern and western Piedmont; the Tanaro sub-catchment drains southern Piedmont with the Maritime and Ligurian Alps and the western Ligurian-Piedmontese Apennines, while the eastern Ligurian-Piedmontese Apennines are drained by the Scrivia sub-catchment. On the Tyrrhenian side of Liguria, watercourses are short, except in the Magra-Vara basin, at the Tuscan border; the Magra is the only river with potamal characters and salt water in its final stretch. Lago Maggiore and Lago d'Orta are the largest subalpine waterbodies in northern Piedmont; smaller lakes are found in the morainic amphitheatres of Ivrea, Viverone

and Rivoli-Avigliana. Small alpine waterbodies are frequent throughout the Alps, especially at high altitudes, while in the Apennines they are limited to small areas formed by glaciers, such as the lakes of Agoraie, near Rezzoaglio (Genoa province). Finally, the study area abounds in reservoirs built for hydroelectric systems and town water supply.

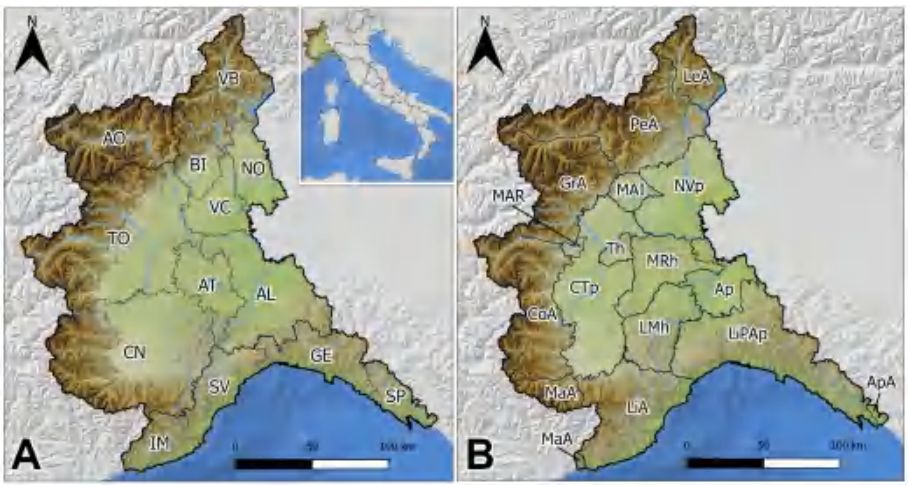

Fig. 1. Study area. **A**: Geographic subdivision (regions and provinces) of north-western Italy; **Piedmont Region**: NO (Novara), VB (Verbano-Cusio-Ossola), VC (Vercelli), BI (Biella), TO (Turin), CN (Cuneo), AT (Asti), AL (Alessandria); **Valle d'Aosta Region**: AO (Aosta); **Liguria Region**: SP (La Spezia), GE (Genoa), SV (Savona), IM (Imperia). **B**: Geographic subdivision of north-western Italy according to De Biaggi *et al*. (1990, modified) and Marazzi (2005, modified); ApA (Apuan Alps), CoA (Cottian Alps), GrA (Graian Alps), LeA (Lepontine Alps), LiA (Ligurian Alps), LiPAp (Ligurian-Piedmontese Apennines), MaA (Maritime Alps), PeA (Pennine Alps), LMh (Langhe and upper Monferrato hills), MRh (Monferrato and Roero hills), Th (Turin hills), MAI (Morainic Amphitheatre of Ivrea), MAR (Morainic Amphitheatre of Rivoli and Avigliana), Ap (Alessandria plain), CTp (Cuneo-Turin plain), NVp (Novara-Vercelli plain). Cartography from: ARPA Piemonte - Europe hillshade WM (Web Map Tile Service WMTS) and Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA) - Digital Terrain Model - 75 meters (DEM 75 - dataset); hydrography from The National Geoportal - hydrografic network and inland water bodies (Web Feature Services WFS).

Concerning climate, the northern sector has a continental rainfall pattern and the southern sector has Mediterranean influences (with more pronounced summer drought). The sectors with the highest rainfall (2000-2500 mm/year or more) are the mountains between Val d'Ossola, Val Sesia and Lago Maggiore (part of so-called Insubria) in Piedmont, and the mountainous relief behind the Riviera di Levante in Liguria.

A synthesis of the floristic and ecological-vegetational features of the regions covered by this study is provided by Blasi (2010) and Blasi & Biondi (2017). They divided NW Italy into "provinces" and "subprovinces" according to contributions published since Giacomini & Fenaroli (1958) up to Rivas-Martínez *et al*. (2004) and Blasi *et al.* (2010). In particular, Piedmont belongs to the Mediterranean Alpine and Western Alpine subprovinces (Alpine province) and to the Po subprovince (Apennine-Balkan province), Valle d'Aosta to the Western Alpine subprovince and Liguria to the Mediterranean Alpine and the Apennine subprovinces (Blasi & Biondi, 2017). However, this level of detail is beyond the aim of the present introduction, which is concerned with floristic-vegetational aspects of north-western Italy, and aims to outline the main environments hosting the malacological fauna. There are several hundred contributions on the flora and vegetation of different sectors of the regions in question (Barberis *et al*., 1979, 2005; Montacchini *et al*., 2000; Bouvet *et al.*, 2005; Bovio, 2005; Estivi *et al*., 2016), whereas the number of exhaustive syntheses is quite limited.

NW Italy has rich flora and significant diversity of vegetation (Montacchini, 1976; Mondino, 2007). The vascular flora of NW Italy consists of 4408 native species (3464 for Piedmont, 2289 for Valle d'Aosta and 3002 for Liguria) according to Bartolucci *et al*. (2018) and 753 alien species (526 for Piedmont, 149 for Valle d'Aosta and 456 for Liguria) according to Galasso *et al*. (2018). According to these contributions, Piedmont is the region of Italy with the highest plant diversity, understood as number of floristic units. The different phytoclimatic belts of this area host a great diversity of fungi, lichens and mosses (Blasi *et al*., 2005) which characterizes many micro-habitats favourable for the development of terrestrial malacofauna.

With 121 endemic vascular plants, NW Italy is an important area of endemism (Bartolucci *et al*., 2018). Moreover, these figures are underestimated because they do not include species with a narrow range present on both sides of the western alpine chain (see Aeschimann *et al*., 2004). Piedmont has 84 endemic entities (Bartolucci *et al*., 2018), some of which have a very narrow range: *Campanula elatines* occurs between Val Chiusella and Valle Maira (Pistarino & D'Andrea, 2015); *Primula cottia* is reported from Valle Po, Val Pellice, Val Germanasca, Val Sangone and Valle di Susa (Selvaggi *et al*., 2017); *Ranunculus abbaianus* is restricted to a small area in the province of Cuneo; *Ranunculus pedemontanus* is currently only known from a single locality in the province of Vercelli (Dunkel, 2010). Valle d'Aosta has 12 endemic taxa (Bartolucci *et al*., 2018), one of which, *Ranunculus bovioi*, was recently described from the upper Val d'Ayas (Bovio, 2014). Liguria has 12 endemic taxa (Bartolucci *et al*., 2018), many of which are exclusive to rocky environments: *Campanula isophylla* restricted to the Finale Ligure area and *Centaurea veneris* on the cliffs of the promontory of Portovenere and the islands opposite (Pignatti, 2018); *Leucanthemum ligusticum* in a few stations in the provinces of La Spezia and Genoa (Melai *et al*., 2012). *Campanula sabatia* and *Cerastium utriense* occur in parts of Liguria and Piedmont: the first is endemic to the area between Capo Noli (Savona province) and Ventimiglia (Imperia province) up to Colle San Bernardo (Cuneo province), the

second lives exclusively on ophiolitic cliffs and debris of the Voltri Group between Liguria and Piedmont (Barberis, 1988; Pistarino & D'Andrea, 2015). Other species, such as *Lilium pomponium*, *Fritillaria involucrata* and *Crocus ligusticus* are worth mentioning: their distributions include the French Maritime Alps and Ligurian Alps (De Maria & Meriana, 1978; Mariotti, 1988).

Piedmont is the region of Italy with the largest area of forest, 38% of its total; this area has almost doubled since World War 2, due to spontaneous denaturalisation of abandoned rural areas (Camerano *et al*., 2017). In low and mid-altitude dry valleys of the inner Piedmont Alps, up to altitudes of 1000-1200 m, forests of downy oak (*Quercus pubescens*) are dominant; in areas with sub-oceanic climate they are replaced by extensive stands of chestnut (*Castanea sativa*). The mesophilous woods of the montane belt are largely dominated by European beech (*Fagus sylvatica*) often associated with silver birch (*Betula pendula*). Pure formations of Swiss pine cover large areas in Valle Varaita, Bosco de l'Alevè and to a lesser extent Valle di Susa and Val Chisone. Pure forests of Norway spruce (*Picea abies*) are rare in the western Alps; the major ones are found on northern exposures of the Valle di Susa (Gran Bosco di Salbertrand) and the Valli dell'Ossola. Forests of Scots pine (*Pinus sylvestris*) occur on south-exposed slopes, especially in the upper Valle di Susa between 1000 and 1800 m. Extensive forests of European larch (*Larix decidua*), sometimes associated with Swiss pine (*Pinus cembra*), characterize the subalpine belt between 1500 and 2000 m. The creeping pine (*Pinus mugo* subsp. *uncinata*) is present in rocky areas and on slopes with stabilized detritus (Dotta & Motta, 2000; IPLA, 2002). Above the tree line, stable alpine vegetation includes creeping shrubs of alpenrose (*Rhododendron ferrugineum*), green alder (*Alnus viridis*) and sparse alpine juniper (*Juniperus communis* subsp. *nana*) (Mondino, 2007).

For historical reasons and due to lower demographic pressure than in other regions of northern Italy, Piedmont hosts the most extensive floodplain forests of the Po plain; this area is nevertheless less than that occupied by crops (Camerano *et al*., 2009). Among semi-natural biocoenoses, oak and hornbeam formations dominated by common oak (*Quercus robur*) or Cornish oak (*Quercus petraea*) and European hornbeam (*Carpinus betulus*) are the most widespread; white elm (*Ulmus laevis*), field elm (*Ulmus minor*), European ash (*Fraxinus excelsior*) and narrow-leaved ash (*Fraxinus angustifolia*) can be variably associated with the former species (Gottero *et al*., 2007). These woods are especially linked to ancient residences of the Royal Houses of Savoy, military properties or collective ownerships such as Bosco delle Sorti della Partecipanza di Trino. Forests of Cornish oak, downy oak and Turkey oak (*Quercus cerris*) are quite widespread; riparian woods of bitter willow (*Salix elaeagnos*), white willow (*Salix alba*), silver poplar (*Populus alba)* and common alder (*Alnus glutinosa*) are rarer. Stands of human origin are mainly dominated by black locust (*Robinia pseudoacacia*) and chestnut (Siniscalco & Bouvet, 2010).

The plains of Piedmont are highly anthropized: relict fragments of moorland, a plant community dominated by shrubs of heather (*Calluna vulgaris*) and tufts of purple moor grass (*Molinia caerulea*), only survive in the high plains of Vauda in the Canavese area and in those of Baraggia in the provinces of Vercelli

and Novara. The provinces of Turin and Cuneo are largely occupied by rotating horticultural and cereal crops and orchards, the province of Alessandria by wheat and pasture. The eastern low plains in the provinces of Novara and Vercelli have over 100,000 hectares of rice fields. In the last 50 years, poplar forestry has expanded into all the lowlands of Piedmont. The Po hill belt hosts forest stands and sparse cultivations, whereas Monferrato and the southern Langhe hills are largely occupied by orchards, vineyards and hazelnut groves. Tree stands of Alta Langa consist mainly of forests of downy oak, Turkey oak or oaks and hornbeams, associated with large extensions of chestnut and *Robinia pseudoacacia* (IPLA, 2002). Lakesides and swamp margins host riparian stands with common alder, while riversides show plant communities with white willow, black poplar (*Populus nigra*) and silver poplar. Riparian tree and shrub vegetation are sensitive to competition from invasive alien species such as *Buddleja davidii, Amorpha fruticosa, Reynoutria japonica* and *Sicyos angulatus*, now dominant along many rivers of Piedmont (Bouvet, 2013).

Despite its small area, Valle d'Aosta has high floral diversity due to large portions of relatively undisturbed habitats and a special combination of geographical, geological, lithological and climatic features (Bovio, 2014). Since rocky areas occupy a large proportion of the region and the mean altitude is rather high (about 2100 m), forests cover 30% of Valle d'Aosta, a percentage which is increasing as a consequence of declining agro-pastoral activities. Forest types are mainly conifer woods with a prevalence of European larch and Norway spruce, with rare localized stands of Swiss pine and creeping pine. Xero-thermophilous mountain woods in the most continental sectors of the region are characterized by forests of Scots pine. In lowland broadleaf woods, the most frequent species are chestnut and downy oak. Grasslands are extremely diversified and include a special regional plant community: continental arid pseudo-steppes characterized by xero-thermophilous species such as *Alyssum argenteum* and *Stipa pennata* aggr. (Camerano *et al*., 2007).

The western sector of Liguria, corresponding to the Ligurian Alps, is characterized by a remarkably high number of phytocoenoses due to its position between different eco-regions (Mediterranean, central-European and Alpine), resulting in exclusive communities especially in rocky areas (Martini, 1984). The Ligurian coastline has favourable climatic conditions for its latitude. Near sea level it includes a Mediterranean horizon dominated by holm oak forests (*Quercus ilex*) and a sub-Mediterranean horizon dominated by downy oak, Cornish oak or European hop-hornbeam (*Ostrya carpinifolia*), with some stands of Scots pine in the Alpine sector and Turkey oak in the Apennine sector (Gentile, 1984). The coastal strip has the most arid and xerothermic conditions in the Riviera di Ponente and on the promontories of Portofino and Portovenere, where Mediterranean thermo-xerophilous shrubland formations are widespread. These are characterized by tree spurge (*Euphorbia dendroides*), strawberry tree (*Arbutus unedo*) and rock-roses (*Cistus albidus*, *Cistus salvifolius*). Coastal pine forests dominated by Aleppo pine (*Pinus halepensis*) are also widespread and frequently associated with Mediterranean shrubland formations with Italian buckthorn (*Rhamnus alaternus*) and mastic (*Pistacia lentiscus*) (De Maria & Meriana, 1978; Gentile, 1984; Biondi *et*

al., 2006). Along the banks of some watercourses, such as the Roia and the Nervia, it is still possible to find relic stretches of vegetation with oleander (*Nerium oleander*) (Gentile, 1984). The banks of streams generally host pioneer riparian communities with shrubby willows (bitter willow and purple willow, *Salix purpurea*, in the riverbed, white willow and black poplar along the banks) or riparian stands of common alder (Biondi *et al*., 2006); alien and invasive species, such as *Arundo donax*, *Helianthus tuberosus* and *Paspalum distichum*, are not rare, favoured by repeated human intervention in the riverbed and alteration of the river banks. Between altitudes of 200 and 700 m, introduced chestnut forests are widespread (De Maria & Meriana, 1978). The montane level is dominated by vast beech forests and at higher elevations Norway spruce or European larch stands (Gentile, 1984). The montane area between Genoa and Savona is characterized by very poor harsh serpentine soils colonized by relic glacial species, such as *Caltha palustris*, *Daphne cneorum*, *Viola biflora*, *Aster alpinum* and *Eriophorum angustifolium*. The alpine level has creeping shrubs, alpenroses, common juniper (*Juniperus communis*), grass communities and at its highest altitudes, hypsophilous vegetation with cryo-nival and rupestral communities (De Maria & Meriana, 1978; Gentile, 1984).

The natural vegetation of the Ligurian coastline has suffered the impact of human activities and been replaced by maritime (*Pinus pinaster*) and Aleppo pine plantations, extensive olive groves on terraced slopes and some vineyards on the steep slopes of Cinque Terre in the province of La Spezia. Large areas in the Riviera di Ponente are occupied by cultivations, especially greenhouse crops; horticulture is abundant along the main valley floors and floriculture in coastal areas of the province of Imperia, where the climate is milder. Most of the shoreline of Liguria is rocky and very densely populated; and the few areas with sandy or pebbly shores are occupied by beach properties. Since beach habitats are intensely altered and modified by human activities, important native plants, such as *Pancratium maritimum*, have almost disappeared (De Maria & Meriana, 1978).

Large portions of NW Italy are formally protected by the Natura 2000 network (Sites of Community Importance, SCIs; Special Protection Areas for birdlife, SPAs; Special Areas of Conservation, SACs), national parks (Gran Paradiso, Val Grande and Cinque Terre), regional parks, natural reserves and other protected areas (Figs. 2-16).

Fig. 2. Monte Rosa seen from the Passo del Monte Moro (Macugnaga, VB); photo L. Leardi.

Fig. 3. Monte Bianco seen from the Colle di Champillon (Doues, AO); photo L. Leardi.

Fig. 4. Gran Paradiso (Valsavarenche, AO); photo L. Leardi.

Fig. 5. Middle-upper Val d’Ala (Balme, TO); photo L. Leardi.

Fig. 6. Piano del Valasco (Valdieri, CN); photo L. Leardi.

Fig. 7. Sources of the Maira stream (Acceglio, CN); photo M. Bodon.

Fig. 8. Monviso (Crissolo, TO); photo L. Leardi.

Fig. 9. Morainic Amphitheatre of Ivrea seen from Monte Cavallaria (Brosso, TO); photo L. Leardi.

Fig. 10. Lago Maggiore (Premeno, VB); photo M. Bodon.

Fig. 11. Cinque Terre (Vernazza, SP); photo L. Leardi.

Fig. 12. Punta Chiappa (Portofino, GE); photo M. Bodon.

Fig. 13. Lago di Rezzo (Rezzoaglio, GE); photo M. Bodon.

Fig. 14. Po river (Isola Sant'Antonio, AL); photo M. Bodon.

Fig. 15. Rice fields near Cascina Bosco (Casalbeltrame, NO); photo M. Bodon.

Fig. 16. Hills of Valle Belbo (Rocchetta Palafea, AT); photo L. Leardi.

MATERIAL AND METHODS

The checklist reports all the non-marine molluscs of NW Italy, including those living in brackish environments (aquatic entities such as the neritid *Smaragdia*, the hydrobiid *Hydrobia* and *Ecrobia*, the assimineids *Assiminea* and *Paludinella*, the truncatellid *Truncatella*, and amphibious entities such as the ellobiids *Leucophytia*, *Myosotella* and *Ovatella*), usually considered in continental lists (Tab. I).

The checklist is based on literature data (which was critically reviewed), museum records (mainly from the collections of the Museo Regionale di Scienze Naturali in Turin, the Museo Civico di Storia Naturale "Giacomo Doria" in Genoa, the Sistema Museale di Ateneo, Sezione Zoologica de "La Specola" in Florence, and the MUSE - Museo delle Scienze in Trent) and field work by the authors and some correspondents in recent decades.

The bibliographic documentation reported in the Introduction comes from a selection of all contributions containing malacological data from Piedmont, Valle d'Aosta and Liguria: lists of regional or provincial fauna, monographs on species groups, critical revisions and especially all papers that provided at least five reasonably accurate records from north-western Italy; in the case of recent literature, reference is also made to work that described new taxa.

The voucher specimens are currently housed largely in the malacological collections of the Museo Regionale di Scienze Naturali of Turin and the Dipartimento di Scienze della Vita e Biologia dei Sistemi, University of Turin, in the F. Giusti collection (Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente, University of Siena), in the collections of the Sistema Museale di Ateneo, Sezione Zoologica de "La Specola", University of Florence, and in the private collections of S. Birindelli (Turin), M. Bodon (Genoa) and S. Cianfanelli (Florence).

Taxonomy, nomenclature and sequence of taxa are according to the checklists by Bank & Neubert (2017) for gastropods and by Bank (2017) for bivalves, although most subspecific taxa reported in these checklists should be carefully revised to establish their effective status. When taxonomy, nomenclature and sequence differ from or concern taxa not included in the checklists by Bank (2017) and Bank & Neubert (2017), some explanatory remarks are given (Appendix). In some cases, different sources were used for family or genus/subgenus taxonomy: Wilke *et al*. (2001, 2013) for Hydrobiidae s.l., Razkin *et al*. (2015) and Neiber *et al*. (2017) for Hygromiidae s.l. and Nordsieck (2006a, 2007) for Clausiliidae.

Global distribution is usually expressed in terms of the chorological categories proposed by Vigna Taglianti *et al*. (1993, 1999). For alien taxa the native geographical distribution is reported.

Other information concerns endemism and xenodiversity in NW Italy (NW) and Italy (I) and range in NW Italy (R): E (endemic, taxon with range entirely within NW Italy/Italy), Q (quasi-endemic, taxon with range almost entirely within NW Italy/Italy), S (semi-endemic, taxon with narrow or very narrow range only partially

included in NW Italy/Italy), A (alien: introduced, non-native or crytpogenic taxon), W (taxon with wide range in NW Italy >5000 km^2), N (taxon with narrow range in NW Italy 1000-5000 km^2), V (taxon with very narrow range in NW Italy <1000 km^2) (Fig. 17).

Local distribution is expressed on a provincial basis; provinces in counter-clockwise order from NE to SE: NO (Novara), VB (Verbano-Cusio-Ossola), VC (Vercelli), BI (Biella), AO (Aosta), TO (Turin), CN (Cuneo), AT (Asti), AL (Alessandria), and from E to W for Liguria: SP (La Spezia), GE (Genoa), SV (Savona) and IM (Imperia). Presence (black symbols) is based on material historical, i.e collected before 1970 (H), or recent, i.e. collected since 1970 (R), both published (P) or unpublished (U): PH, published historical; UH, unpublished historical; PR, published recent; UR, unpublished recent; presence based on tentative identification is reported with light gray symbols.

Fig. 17. Examples of distribution of endemic, semi-endemic and quasi-endemic taxa in NW Italy or in Italy, with narrow or very narrow range in NW. **A**: yellow area, *Cochlodina comensis lucensis* (Italian endemic subspecies, with narrow range in NW, range entirely included in Italy; **-/IE**, **N**); red area, *Cochlostoma subalpinum* (NW and Italian quasi-endemic species, with very narrow range in Italy, almost entirely included in NW Italy; **NWQ/IQ**, **V**); orange area, *Mediterranea polygyra* (NW and Italian endemic species, with narrow range entirely included in NW Italy; **NWE/IE**, **N**), green area, *Alzoniella macrostoma* (NW semi-endemic and Italian endemic species, with very narrow range in NW, range only partially included in NW Italy; **NWS/IE**, **V**); **B**: dark grey area, *Acicula lineolata lineolata* (Italian quasi-endemic subspecies, with narrow range in NW, range almost entirely included in Italy; **-/IQ**, **N**); light blue area, *Delphinatia fontenillii alpina* (NW and Italian semi-endemic subspecies, with very narrow range in NW, range only partially included in Italy; **NWS/IS**, **V**); purple area, *Argna ligustica* (NW quasi-endemic and Italian endemic species, with narrow range, almost entirely included in NW Italy; **NWQ/IE**, **N**). Cartography from: ARPA Piemonte - Europe hillshade WM (Web Map Tile Service WMTS). French data of *D. fontenillii alpina* integrated from Inventaire National du Patrimoine Naturel (Gargominy, 2018).

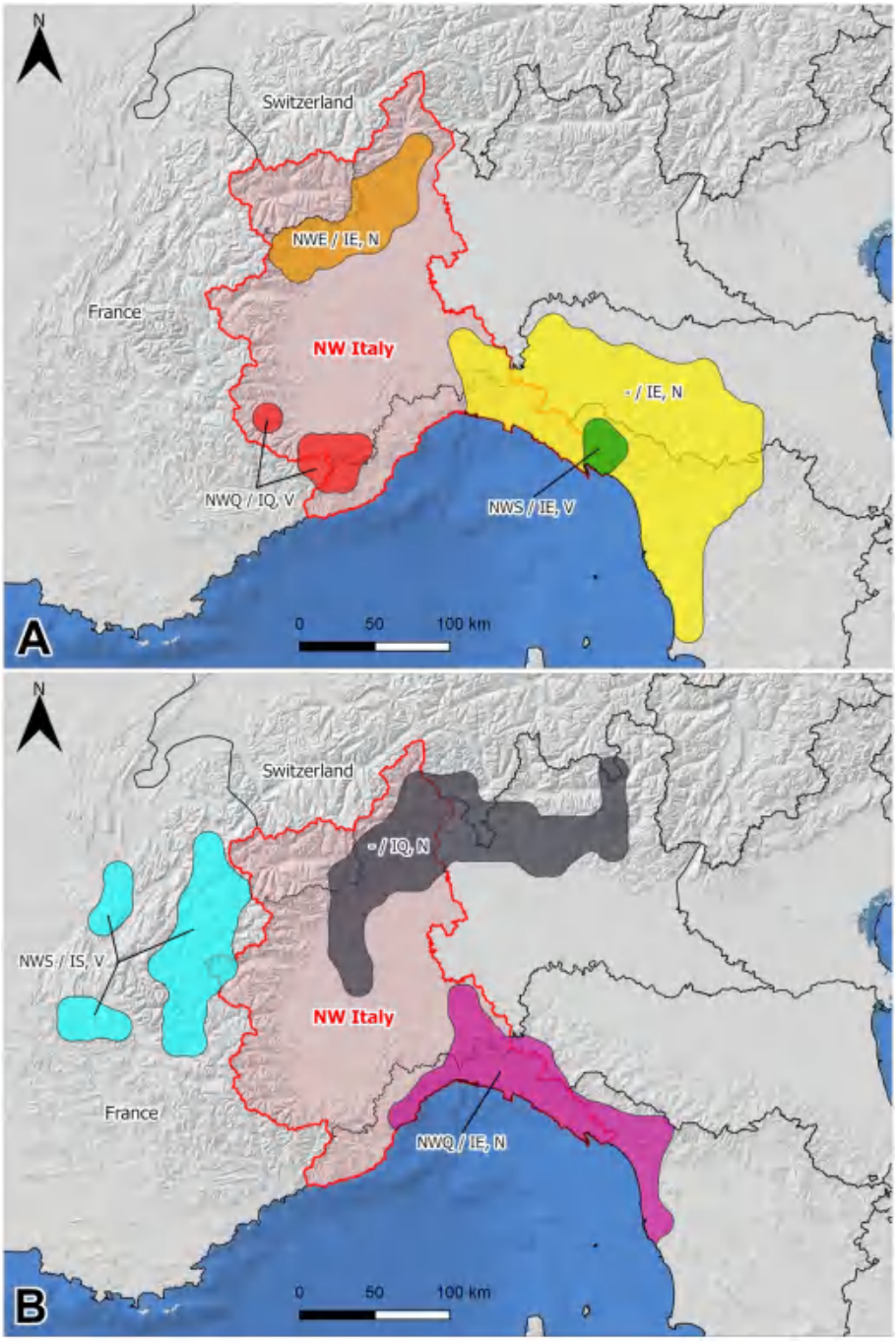
N
Switzerland
NWE / IE, N
France
NW Italy
- / IE, N
NWQ / IQ, V
NWS / IE, V
0
50
100 km
A
N
Switzerland
- / IQ, N
NWS / IS, V
NW Italy
France
NWQ / IE, N
0
50
100 km
B

TABLE I
Checklist and distribution of the land and
freshwater molluscs from north-western Italy

Species: an asterisk (*) before the name of the species/subspecies denotes a note with taxonomic, chorological or conservation remarks in the Appendix; **Chorotype**: AFA (African and SE Asian), ALAP (Alpine-Apennine), ALDI (Alpine-Dinaric), ALP (Alpine), ALPC (Central-S Alpine), ALPS (S Alpine), ALPW (W Alpine), ALSW (SW Alpine), ALWA (W Alpine-Apennine), ANAT (Anatolian), APDI (Apennine-Dinaric), APPC (Central-Apennine), APPE (Apennine), APPN (N Apennine), ASE (Asiatic-European), ASI (Asiatic), AUS (Australasian), AWNA (W Alpine-N Apennine), CEU (Central-European), COS (Cosmopolitan), CSA (Central-S American), EEU (E European), EUM (European-Mediterranean), EUR (European), ITAL (Italian), MED (Mediterranean), NAF (N African), NAM (N American), OLA (Holarctic), PAL (Palearctic), SEU (S European), SICI (Sicilian), SIE (Siberian-European), TEM (Turanian-European-Mediterranean), TUE (Turanian-European), TYRR (Tyrrhenian), WEU (W European), WME (W Mediterranean), WPA (W Palearctic). **Distribution** in NW Italy (NW) and Italy (I): E (endemic, taxon with range entirely within NW Italy/Italy), Q (quasi-endemic, taxon with range almost entirely within NW Italy/Italy), S (semi-endemic, taxon with narrow or very narrow range only partially included in NW Italy/Italy), A (alien: introduced, non-native or crytpogenic taxon). **Range** (R): W (taxon with wide range in NW Italy >5000 km^2), N (taxon with narrow range in NW Italy 1000-5000 km^2), V (taxon with very narrow range in NW Italy <1000 km^2). **Provinces**: NO (Novara), VB (Verbano-Cusio-Ossola), VC (Vercelli), BI (Biella), AO (Aosta), TO (Turin), CN (Cuneo), AT (Asti), AL (Alessandria), SP (La Spezia), GE (Genoa), SV (Savona), IM (Imperia). **Presence symbols** (PH, published historical; PR, published recent; UH, unpublished historical; UR, unpublished recent): ◴ (PH record), ◶ (PR record), ◔ (UH record), ◶ (UR record), ◐ (PH and PR records), ◓ (PH and UH records), ◑ (UH and UR records), ◒ (PR and UR records), ◕ (PH, PR and UR records), ◓ (PH, UH and PR records), ◓ (PH, UH and UR records), ◕ (UH, PR and UR records), ◓ (PH and UR records), ◓ (UH and PR records), ● (PH, UH, PR and UR records); doubtful presence indicated with light gray symbols.

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Neritidae Rafinesque, 1815																	
**Theodoxus fluviatilis fluviatilis* (Linnaeus, 1758)	WPA	-	-	W	◔		◔			●		◒	◒	◔	◒		
**Smaragdia viridis* (Linnaeus, 1758)	OLA	-	-	N										◔	◒	◒	◒
Megalomastomatidae Blanford, 1864																	
**Cochlostoma* (*Dalfreddia*) *subalpinum* (Pini, 1885)	ALSW	Q	Q	V							◔						◕
**Cochlostoma* (*Turritus*) *macei* (Bourguignat, 1869)	ALSW	-	-	V													◕
**Cochlostoma* (*Turritus*) *montanum montanum* (Issel, 1866)	APPN	-	E	V										◔			
**Toffolettia striolata* (Porro, 1840)	APPN	Q	E	N									◔	◕	●		◔
Aciculidae Gray, 1850																	
**Acicula lineata sublineata* (Andreae, 1883)	ALPS	-	Q	W		◒	◔			◒							
**Acicula lineolata banki* Boeters, Gittenberger & Subai, 1989	ALAP	-	-	W							◔				◒	◔	◒
**Acicula lineolata lineolata* (Pini, 1885)	ALPC	-	Q	N	◒	◔	◒	◔	◔	◔		◔					
**Acicula szigethyannae* Subai, 1977	APDI	-	-	V										◒			
**Acicula vezzanii* Bodon, 1994	APPN	E	E	N											◒		
**Acicula* sp. 1	ALSW	E	E	V													◔
**Platyla foliniana* (Nevill, 1879)	ALSW	S	S	V													◒
**Platyla gracilis* (Clessin, 1877)	SEU	-	-	V										◔	◔		
**Platyla microspira* (Pini, 1885)	SEU	-	-	V										◒			
**Platyla similis* (Reinhardt, 1880)	SEU	-	-	N										◔	◔		
**Platyla stussineri* (Boettger, 1884)	ALAP	-	-	V										◔			
**Renea bourguignatiana* Nevill, 1880	ALSW	S	S	V													◒
**Renea elegantissima* (Pini, 1886)	AWNA	-	Q	W		◒				◔	◒	◔	◔	◔	◕	◒	◔
**Renea gentilei* (Pollonera, 1889)	ALSW	E	E	V							◕						
**Renea paillona* Boeters, Gittenberger & Subai, 1989	ALSW	S	S	V													◒
**Renea veneta* (Pirona, 1865)	ALP	-	-	V												◒	◔
**Renea* sp. 1	ALPW	E	E	V							◔						
Viviparidae Gray, 1847																	
**Viviparus ater ater* (De Cristofori & Jan, 1832)	ALPS	-	-	W	●	●	◒	◕		●			◒				
**Viviparus contectus* (Millet, 1813)	EUR	-	-	W	◕	◕	◒	◒		●	◕		◕	◒			
Thiaridae Gill, 1871																	
**Melanoides tuberculata* (Müller, 1774)	AFA	A	A	-												◒	
Pomatiidae Newton, 1891																	
Pomatias (*Pomatias*) *elegans* (Müller, 1774)	EUR	-	-	W						◕	◕	◕	◕	◕	◕	◒	◕
Bithyniidae Gray, 1857																	
**Bithynia italica* (Paulucci, 1880)	ITAL	-	-	W	◔		◒	◒		◒	◒	◒	◒	●	◒	◒	
Bithynia tentaculata (Linnaeus, 1758)	PAL	-	-	W	◕	●	◕	◒		●	◒	◔	◒	●	●	◕	●
Moitessieriidae Bourguignat, 1863																	
**Moitessieria simoniana* (Saint-Simon, 1848)	SEU	-	-	N							◒					◒	◒
**Iglica pezzolii* Boeters, 1971	ALPC	E	E	V	◒		◒										
**Iglica* sp. 1	ALPC	E	E	V				◒									
Cochliopidae Tryon, 1866																	
**Eupaludestrina stagnorum* (Gmelin, 1791)	EUM	-	-	V											◔		

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Tateidae Thiele, 1925																	
**Potamopyrgus antipodarum* (Gray, 1843)	AUS	A	A	-	◒	◒	◒	◔	◒	◒	◒	◒	◒	◒	◒	◒	◔
Hydrobiidae Stimpson, 1865																	
**Hydrobia acuta acuta* (Draparnaud, 1805)	EUM	-	-	V										◒			
**Ecrobia ventrosa* (Montagu, 1803)	EUM	-	-	V										◒			
**Pseudamnicola lucensis* (Issel, 1866)	APPN	-	E	N										●	◕		
**Belgrandia thermalis* (Linnaeus, 1767)	APPE	-	E	V										◒			
**Graziana alpestris* (Frauenfeld, 1863)	ALPS	-	-	W						◕	◒		◒			●	●
**Pseudavenionia pedemontana* Bodon & Giusti, 1982	ALSW	E	E	W						◔	◒	◔	◒			◒	
**Alzoniella braccoensis* Bodon & Cianfanelli, 2004	APPN	E	E	V										◒	◒		
**Alzoniella delmastroi* Bodon & Cianfanelli, 2004	ALPW	E	E	V						◒							
**Alzoniella feneriensis* Giusti & Bodon, 1984	ALPC	E	E	V	◒		◒										
**Alzoniella finalina* Giusti & Bodon, 1984	AWNA	Q	E	N				◔					◔		◔	◒	
**Alzoniella ligustica* (Giusti & Bodon, 1981)	APPN	-	E	N									◒	◒	◒		
**Alzoniella lunensis* Bodon & Cianfanelli, 2002	APPN	S	E	V										◒			
**Alzoniella macrostoma* Bodon & Cianfanelli, 2002	APPN	S	E	V										◒			
**Alzoniella microstoma* Bodon & Cianfanelli, 2002	APPN	S	E	V										◒			
**Alzoniella parvula* (Giusti & Bodon, 1981)	APPN	E	E	N										◒	◒		
**Alzoniella sigestra* Giusti & Bodon, 1984	APPN	E	E	V									◔		◒		
**Alzoniella* sp. 1	APPN	E	E	V									◔		◒		
**Alzoniella* sp. 3	ALSW	E	E	V												◒	
**Alzoniella* sp. 4	APPN	-	E	V											◔		
**Alzoniella* sp. 5	ALPW	E	E	V						◔							
**Alzoniella* sp. 6	APPN	E	E	N									◔				
**Fissuria* sp. 1	APPN	S	E	N									◒		◒		
**Fissuria* sp. 2	APPN	S	E	N									◔				
**Fissuria* sp. 3	APPN	E	E	V									◔		◔		
**Pezzolia radapalladis* Bodon & Giusti, 1986	APPN	E	E	V											◒		
**Pezzolia* sp. 1	APPN	E	E	V											◒		
**Pezzolia* sp. 2	APPN	E	E	V											◒		
**Pezzolia* sp. 3	APPN	E	E	V									◔				
**Islamia pezzoliana* Bodon & Cianfanelli, 2012	APPE	-	E	-											◔		
**Islamia piristoma* Bodon & Cianfanelli, 2002	APPE	-	E	N									◒	◒	◒		
**Islamia* sp. 1	ALSW	E	E	V													◔
Amnicolidae Tryon, 1863																	
**Marstoniopsis insubrica* (Küster, 1853)	EUR	-	-	V		◕											
Bythinellidae Locard, 1893																	
**Bythinella ligurica* (Paladilhe, 1867)	ALPW	Q	Q	W	●	●	◒	◒	◕	●	●	◔	◒		◕	◕	●
**Bythinella opaca* (Gallenstein, 1848)	ALAP	-	-	N									◒	◒	◕		
Emmericiidae Brusina, 1870																	
**Emmericia patula* (Brumati, 1838)	ALDI	A	-	-			◔				◒						
Truncatellidae Gray, 1840																	
**Truncatella subcylindrica* (Linnaeus, 1767)	EUM	-	-	N										◕	◒	◔	◒

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Assimineidae Adams & Adams, 1856																	
**Assiminea* (*Assiminea*) *gittenbergeri* van Aartsen, 2008	MED	-	-	V													
**Solenomphala* sp. 1	ASI	A	A	-													
**Paludinella* (*Paludinella*) *globularis* (Hanley, 1844)	EUM	-	-	N													
**Paludinella* (*Paludinella*) *sicana* (Brugnone, 1876)	MED	-	-	N													
Valvatidae Gray, 1840																	
Valvata (*Valvata*) *cristata* Müller, 1774	ASE	-	-	W													
Valvata (*Cincinna*) *piscinalis* (Müller, 1774)	ASE	-	-	W													
Lymnaeidae Rafinesque, 1815																	
Galba (*Galba*) *truncatula* (Müller, 1774)	PAL	-	-	W													
**Stagnicola corvus* (Gmelin, 1791)	EUR	-	-	W													
**Stagnicola fuscus* (Pfeiffer, 1821)	PAL	-	-	W													
Radix auricularia (Linnaeus, 1758)	PAL	-	-	W													
**Radix balthica* (Linnaeus, 1758)	PAL	-	-	W													
**Radix labiata* (Rossmässler, 1835)	EUR	-	-	W													
Lymnaea stagnalis (Linnaeus, 1758)	OLA	-	-	W													
**Pseudosuccinea columella* (Say, 1817)	CSA	A	A	-													
Physidae Fitzinger, 1833																	
**Physa fontinalis* (Linnaeus, 1758)	OLA	-	-	W													
**Physella* (*Acutiana*) *acuta* (Draparnaud, 1805)	NAM	A	A	-													
**Aplexa hypnorum* (Linnaeus, 1758)	OLA	-	-	W													
Planorbidae Rafinesque, 1815																	
**Planorbis* (*Planorbis*) *carinatus* Müller, 1774	EUR	-	-	W													
**Planorbis* (*Planorbis*) *moquini* Requien, 1848	WME	-	-	N													
Planorbis (*Planorbis*) *planorbis* (Linnaeus, 1758)	WPA	-	-	W													
**Anisus* (*Anisus*) *leucostoma* (Millet, 1813)	PAL	-	-	N													
Anisus (*Anisus*) *spirorbis* (Linnaeus, 1758)	PAL	-	-	W													
Anisus (*Disculifer*) *vortex* (Linnaeus, 1758)	SIE	-	-	N													
**Anisus* (*Disculifer*) *vorticulus* (Troschel, 1834)	SIE	-	-	W													
Bathyomphalus contortus (Linnaeus, 1758)	PAL	-	-	W													
Gyraulus (*Gyraulus*) *albus* (Müller, 1774)	EUR	-	-	W													
**Gyraulus* (*Gyraulus*) *chinensis* (Dunker, 1848)	ASI	A	A	-													
Gyraulus (*Torquis*) *laevis* (Alder, 1838)	EUR	-	-	W													
Gyraulus (*Armiger*) *crista* (Linnaeus, 1758)	OLA	-	-	W													
**Planorbarius corneus* (Linnaeus, 1758)	SIE	-	-	N													
**Helisoma duryi* (Wetherby, 1879)	NAM	A	A	-													
Hippeutis complanatus (Linnaeus, 1758)	PAL	-	-	W													
**Segmentina nitida* (Müller, 1774)	ASE	-	-	W													
**Ancylus fluviatilis* s.l. Müller, 1774	WPA	-	-	W													
**Ferrissia californica* (Rowell, 1863)	NAM	A	A	-													
Acroloxidae Thiele, 1931																	
Acroloxus lacustris (Linnaeus, 1758)	SIE	-	-	W													

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Ellobiidae Pfeiffer, 1854																	
**Myosotella myosotis* (Draparnaud, 1801)	WPA	-	-	N													
**Ovatella firminii* (Payraudeau, 1826)	MED	-	-	V													
**Leucophytia bidentata* (Montagu, 1808)	WPA	-	-	N													
Carychiidae Jeffreys, 1830																	
**Carychium hellenicum* Bank & Gittenberger, 1985	APDI	A	-	-													
**Carychium minimum* Müller, 1774	PAL	-	-	W													
**Carychium tridentatum* (Risso, 1826)	EUM	-	-	W													
Ruminidae Wenz, 1923																	
**Rumina decollata* (Linnaeus, 1758)	MED	-	-	W													
Ferussaciidae Bourguignat, 1883																	
**Cecilioides* (*Cecilioides*) *acicula* (Müller, 1774)	TEM	-	-	W													
**Cecilioides* (*Cecilioides*) *janii* (De Betta & Martinati, 1855)	SEU	-	-	W													
**Cecilioides* (*Cecilioides*) *petitiana* (Benoit, 1862)	TEM	-	-	W													
**Cecilioides* sp. 1	ITAL	-	Q	N													
**Hohenwartiana hohenwarti* (Rossmässler, 1839)	SEU	-	-	V													
**Ferussacia* (*Ferussacia*) *folliculum* (Schröter, 1784)	MED	-	-	N													
Testacellidae Gray, 1840																	
**Testacella haliotidea* (Draparnaud, 1801)	WME	A	A	-													
**Testacella scutulum* Sowerby, 1821	EUR	-	-	W													
Succineidae Beck, 1837																	
**Succinea putris* (Linnaeus, 1758)	SIE	-	-	W													
**Succinea* cf. *tenella* Morelet, 1865	ASI	A	A	-													
Succinella oblonga (Draparnaud, 1801)	SIE	-	-	W													
**Oxyloma* (*Oxyloma*) *elegans* (Risso, 1826)	OLA	-	-	W													
**Quickella arenaria* (Potiez & Michaud, 1838)	EUR	-	-	W													
Cochlicopidae Pilsbry, 1900																	
**Cochlicopa lubrica* (Müller, 1774)	OLA	-	-	W													
Lauriidae Steenberg, 1925																	
Lauria (*Lauria*) *cylindracea* (da Costa, 1778)	TEM	-	-	W													
Lauria (*Lauria*) *sempronii* (Charpentier, 1837)	SEU	-	-	W													
Orculidae Pilsbry, 1918																	
**Orcula* (*Orcula*) *dolium dolium* (Draparnaud, 1801)	CEU	-	-	V													
**Sphyradium doliolum* (Bruguière, 1792)	TUE	-	-	W													
Pagodulinidae Pilsbry, 1924																	
**Pagodulina austeniana* (Nevill, 1880)	ALPS	-	-	W													
**Pagodulina subdola sanremoensis* Pilsbry, 1924	ALSW	S	S	N													
Argnidae Hudec, 1965																	
**Argna biplicata biplicata* (Michaud, 1831)	SEU	-	-	W													
**Argna bourguignatiana* (Nevill, 1880)	ALSW	-	Q	N													
**Argna ferrari ferrari* (Porro, 1838)	ALPS	-	Q	W													
**Argna ligustica* (Pollonera, 1887)	APPN	Q	E	N													

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Valloniidae Morse, 1864																	
Vallonia costata (Müller, 1774)	OLA	-	-	W													
Vallonia enniensis (Gredler, 1856)	EUM	-	-	W													
**Vallonia pulchella* (Müller, 1774)	OLA	-	-	W													
**Gittenbergia sororcula* (Benoit, 1859)	MED	-	-	N													
Acanthinula aculeata (Müller, 1774)	WPA	-	-	W													
Pupillidae Turton, 1831																	
Pupilla (*Pupilla*) *alpicola* (Charpentier, 1837)	SEU	-	-	W													
Pupilla (*Pupilla*) *muscorum* (Linnaeus, 1758)	OLA	-	-	W													
**Pupilla* (*Pupilla*) *sterrii* (Forster, 1840)	ASE	-	-	W													
Pupilla (*Pupilla*) *triplicata* (Studer, 1820)	EUM	-	-	W													
Pyramidulidae Kennard & Woodward, 1914																	
**Pyramidula jaenensis* (Clessin, 1882)	MED	-	-	W													
**Pyramidula umbilicata* (Montagu, 1803)	EUR	-	-	W													
Chondrinidae Steenberg, 1925																	
Granopupa granum (Draparnaud, 1801)	TEM	-	-	W													
**Granaria frumentum illyrica* (Rossmässler, 1835)	SEU	-	-	W													
**Granaria stabili stabili* (Martens, 1865)	ALPW	-	-	W													
**Granaria variabilis* (Draparnaud, 1801)	WEU	-	-	W													
**Solatopupa juliana* (Issel, 1866)	APPE	-	E	V													
**Solatopupa pallida* (Rossmässler, 1842)	APPN	E	E	N													
**Solatopupa psarolena* (Bourguignat, 1858)	ALSW	S	S	V													
**Solatopupa similis* (Bruguière, 1792)	SEU	-	-	W													
**Abida secale secale* (Draparnaud, 1801)	EUR	-	-	W													
**Chondrina avenacea avenacea* (Bruguière, 1792)	SEU	-	-	W													
**Chondrina caziotana* Pilsbry, 1918	ALSW	S	S	V													
**Chondrina feneriensis* Bodon, Nardi, Cianfanelli & Kokshoorn, 2015	ALPC	E	E	V													
Truncatellinidae Steenberg, 1925																	
**Columella columella* (Martens, 1830)	EUR	-	-	W													
Columella edentula (Draparnaud, 1805)	SIE	-	-	W													
Truncatellina callicratis (Scacchi, 1833)	EUM	-	-	W													
**Truncatellina claustralis* (Gredler, 1856)	EUR	-	-	W													
Truncatellina cylindrica (Férussac, 1807)	EUM	-	-	W													
Vertiginidae Fitzinger, 1833																	
**Vertigo* (*Vertigo*) *alpestris* Alder, 1838	EUR	-	-	W													
Vertigo (*Vertigo*) *antivertigo* (Draparnaud, 1801)	SIE	-	-	W													
**Vertigo* (*Vertigo*) *moulinsiana* (Dupuy, 1849)	EUM	-	-	W													
**Vertigo* (*Vertigo*) *pusilla* Müller, 1774	SIE	-	-	W													
Vertigo (*Vertigo*) *pygmaea* (Draparnaud, 1801)	PAL	-	-	W													
**Vertigo* (*Vertigo*) *substriata* (Jeffreys, 1833)	SIE	-	-	V													
**Vertigo* (*Vertilla*) *angustior* Jeffreys, 1830	SIE	-	-	W													

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Enidae Woodward, 1903																	
**Jaminia quadridens elongata* (Moquin-Tandon, 1856)	SEU	-	-	W													
**Jaminia quadridens quadridens* (Müller, 1774)	EUR	-	-	W													
**Ena montana* (Draparnaud, 1801)	EUR	-	-	N													
Merdigera obscura (Müller, 1774)	EUM	-	-	W													
**Zebrina detrita* (Müller, 1774)	SEU	-	-	N													
**Chondrula tridens tridens* (Müller, 1774)	EUM	-	-	W													
Clausiliidae Gray, 1855																	
**Leucostigma candidescens* (Rossmässler, 1835)	APPC	A	E	-													
**Cochlodina* (*Cochlodina*) *fimbriata fimbriata* (Rossmässler, 1835)	ALP	-	-	W													
**Cochlodina* (*Cochlodina*) *laminata laminata* (Montagu, 1803)	EUR	-	-	W													
**Cochlodina* (*Cochlodinastra*) *comensis lucensis* (Gentiluomo, 1868)	APPN	-	E	N													
**Cochlodina* (*Procochlodina*) *bidens* (Linnaeus, 1758)	APPE	-	E	N													
**Charpentieria dyodon alpina* (Stabile, 1859)	ALPW	E	E	V													
**Charpentieria dyodon dyodon* (Studer, 1820)	ALPW	S	S	V													
**Charpentieria dyodon paulucciana* (Pollonera, 1885)	ALPW	E	E	V													
**Charpentieria dyodon thomasiana* (Küster, 1850)	ALPW	Q	Q	W													
**Charpentieria itala albopustulata* (De Cristofori & Jan, 1832)	ALPC	A	-	-													
**Charpentieria itala punctata* (Michaud, 1831)	ALWA	-	Q	N													
**Siciliaria* (*Stigmatica*) *piceata* (Rossmässler, 1836)	APPC	A	E	-													
**Papillifera papillaris papillaris* (Müller, 1774)	SEU	A	-	-													
**Papillifera solida solida* (Draparnaud, 1805)	TYRR	-	-	V													
**Ruthenica filograna filograna* (Rossmässler, 1836)	EUR	-	-	V													
**Macrogastra* (*Macrogastra*) *ventricosa ventricosa* (Draparnaud, 1801)	EUR	-	-	V													
**Macrogastra* (*Pyrostoma*) *attenuata iriana* (Pollonera, 1885)	APPE	-	E	W													
**Macrogastra* (*Pyrostoma*) *attenuata lineolata* (Held, 1836)	CEU	-	-	W													
**Macrogastra* (*Pyrostoma*) *badia alpina* Nordsieck, 2006	ALP	-	-	N													
**Macrogastra* (*Pyrostoma*) *mellae leia* (Bourguignat, 1877)	ALPW	S	S	V													
**Macrogastra* (*Pyrostoma*) *mellae mellae* (Stabile, 1864)	ALPW	Q	Q	W													
**Macrogastra* (*Pyrostoma*) *plicatula apennina* (Gentiluomo, 1868)	ALWA	-	E	W													
**Macrogastra* (*Pyrostoma*) *plicatula plicatula* (Draparnaud, 1801)	EUR	-	-	W													
**Clausilia* (*Clausilia*) *bidentata crenulata* Risso, 1826	ALSW	S	S	N													
**Clausilia* (*Clausilia*) *cruciata bonellii* Martens, 1873	ALWA	-	Q	W													
**Clausilia* (*Clausilia*) *cruciata cruciata* (Studer, 1820)	EUR	-	-	N													

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Clausiliidae Gray, 1855																	
**Clausilia* (*Clausilia*) *cruciata pedemontana* Nordsieck, 1990	ALPW	E	E	W													
**Clausilia* (*Clausilia*) *dubia dubia* Draparnaud, 1805	EUR	-	-	W													
**Clausilia* (*Clausilia*) *rugosa parvula* (Férussac, 1807)	EUR	-	-	N													
**Clausilia* (*Clausilia*) *rugosa pinii* Westerlund, 1878	APPE	-	Q	N													
**Laciniaria plicata plicata* (Draparnaud, 1801)	EUR	-	-	-													
**Balea perversa* (Linnaeus, 1758)	EUR	-	-	W													
Punctidae Morse, 1864																	
Punctum (*Punctum*) *pygmaeum* (Draparnaud, 1801)	PAL	-	-	W													
**Paralaoma servilis* (Shuttleworth, 1852)	AUS	A	A	-													
Helicodiscidae Baker, 1927																	
**Lucilla scintilla* (Lowe, 1852)	NAM	A	A	-													
**Lucilla singleyana* (Pilsbry, 1889)	NAM	A	A	-													
Discidae Thiele, 1931																	
**Discus* (*Discus*) *ruderatus* (Hartmann, 1821)	SIE	-	-	W													
**Discus* (*Gonyodiscus*) *rotundatus rotundatus* (Müller, 1774)	EUM	-	-	W													
Pristilomatidae Cockerell, 1891																	
**Hawaiia minuscula* (Binney, 1841)	NAM	A	A	-													
**Vitrea contracta* (Westerlund, 1871)	EUM	-	-	N													
Vitrea etrusca (Paulucci, 1878)	APPE	-	Q	W													
**Vitrea narbonensis* (Clessin, 1877)	WEU	-	-	V													
**Vitrea pseudotrolli* Pintér, 1983	AWNA	Q	Q	W													
**Vitrea subrimata* (Reinhardt, 1871)	EUM	-	-	W													
**Vitrea* sp. 1	APPN	E	E	N													
**Vitrea* sp. 2	ALSW	E	E	V													
Gastrodontidae Tryon, 1866																	
**Zonitoides* (*Zonitoides*) *arboreus* (Say, 1817)	NAM	A	A	-													
Zonitoides (*Zonitoides*) *nitidus* (Müller, 1774)	OLA	-	-	W													
**Aegopinella minor* (Stabile, 1864)	EUR	-	-	W													
**Aegopinella pura* (Alder, 1830)	EUR	-	-	W													
**Retinella* (*Retinella*) *giustii* Riedel, 1998	ALPW	E	E	N													
**Retinella* (*Retinella*) *olivetorum olivetorum* (Gmelin, 1791)	APPE	-	Q	W													
**Retinella* (*Retinella*) *pseudoaegopinella* Giusti, Boato & Bodon, 1986	ALPS	-	Q	N													
**Retinella* (*Retinella*) *stabilei* (Pollonera, 1886)	ALPW	E	E	V													
Perpolita hammonis (Strøm, 1765)	ASE	-	-	W													
Perpolita petronella (Pfeiffer, 1853)	SIE	-	-	W													
Oxychilidae Hesse, 1927																	
**Daudebardia* (*Daudebardia*) *rufa* (Draparnaud, 1805)	EUM	-	-	V													
**Oxychilus* (*Oxychilus*) *draparnaudi* (Beck, 1837)	EUM	-	-	W													
**Oxychilus* (*Oxychilus*) *mortilleti mortilleti* (Pfeiffer, 1859)	ALP	-	-	W													

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Oxychilidae Hesse, 1927																	
Oxychilus (*Ortizius*) *clarus* (Held, 1838)	SEU	-	-	W	1		1	1	1	3	2	1	2	1	2	2	1
**Oxychilus* (*Ortizius*) *gardinii* Manganelli, Bodon & Giusti, 1991	APPN	E	E	N									1		2	2	
**Oxychilus* (*Ortizius*) *meridionalis* (Paulucci, 1881)	APPN	-	E	V										2			
**Morlina glabra glabra* (Rossmässler, 1835)	SEU	-	-	W	2	2	3	3	3	4	3						
**Mediterranea depressa* (Sterki, 1880)	SEU	-	-	N		1		2	2								
**Mediterranea hydatina hydatina* (Rossmässler, 1838)	MED	-	-	W						3	1	1	3		1	2	3
**Mediterranea polygyra* (Pollonera, 1885)	ALPW	E	E	N		1	2	3	2	2							
Milacidae Ellis, 1926																	
**Milax nigricans* (Philippi, 1836)	MED	-	-	N						1				1	1	1	2
**Tandonia budapestensis* (Hazay, 1880)	SEU	A	-	-				1		1					3		2
Tandonia rustica (Millet, 1843)	EUR	-	-	W	2	2	3	1	3	3	3	1	2	1	3	3	2
**Tandonia sowerbyi* (Férussac, 1823)	EUR	-	-	N										1	2		
Zonitidae Mörch, 1864																	
**Zonites algirus* (Linnaeus, 1758)	EEU	A	A	-													4
Vitrinidae Fitzinger, 1833																	
**Hessemilimax kotulae* (Westerlund, 1883)	CEU	-	-	V					3	1							
**Vitrinobrachium baccettii* Giusti & Mazzini, 1971	APPN	-	E	W							2		1	1	3	2	
**Vitrinobrachium breve* (Férussac, 1821)	EUR	-	-	W	1			1		1	1	1	1				
**Eucobresia diaphana* (Draparnaud, 1805)	CEU	-	-	W		3	3		3	3							
**Eucobresia glacialis* (Forbes, 1837)	ALP	-	-	W		3		2	3	2							
**Eucobresia nivalis* (Dumont & Mortillet, 1854)	CEU	-	-	W		3	3	1	4	3							
**Eucobresia pegorarii* (Pollonera, 1884)	ALPC	-	-	N					4	1							
Vitrina pellucida (Müller, 1774)	PAL	-	-	W		3	3	1	3	3	3	3	3		2	2	2
**Phenacolimax blanci* (Pollonera, 1884)	ALSW	E	E	V							3						2
**Phenacolimax locardi* (Pollonera, 1884)	ALPW	E	E	N	1	2	1	3	1	3							
**Phenacolimax stabilei* (Lessona, 1880)	ALPW	Q	Q	N						3	3						1
Oligolimax annularis (Studer, 1820)	TUE	-	-	W		3			3	3	3						
Boetgerillidae Wiktor & Likharev, 1979																	
**Boettgerilla pallens* Simroth, 1912	EEU	A	A	-					1	2							
Limacidae Lamarck, 1801																	
**Limax alpinus* Férussac, 1822	ALPC	Q	Q	W	2	3	3	3	3								
**Limax canapicianus* Pollonera, 1885	ALPW	E	E	N					1	3							
**Limax dacampi cruentus* Lessona, 1880	ALSW	E	E	N							3					2	
**Limax dacampi dacampi* Menegazzi, 1855	APPN	-	Q	W					3	3	1	3	2	2	4		
**Limax erythrus* Bourguignat, 1864	ALPW	Q	Q	W					3	3	3						
**Limax maximus* Linnaeus, 1758	EUR	-	-	W	2	3	3	3	3	3	3	2	3	2	3	2	2
**Limax millipunctatus* Pini, 1885	APPN	E	E	V									1		3	3	
**Limax polipunctatus* Pollonera, 1888	AWNA	Q	E	V						3					2	3	
**Limax subalpinus* Lessona, 1880	ALPW	E	E	W						3	3	1	1		2	1	
**Limax* sp. 1	APPN	E	E	N										1	2		
**Limax* sp. 2	APPN	-	E	N									1	3	2		

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Limacidae Lamarck, 1801																	
**Limacus flavus* (Linnaeus, 1758)	SEU	A	-	-	◔	◔			◔	◕		◔	◕	◔	◒	◔	◒
Malacolimax tenellus (Müller, 1774)	EUR	-	-	W		◕	◔	◕	◕	◕	◒						
**Lehmannia* cf. *marginata* (Müller, 1774)	EUR	-	-	V											◔		
**Lehmannia rupicola* Lessona & Pollonera, 1882	SEU	-	-	W	◒	◕	◕	◒	◕	◕	◕						◒
**Ambigolimax valentianus* (Férussac, 1821)	WME	A	A	-		◔		◔		◒				◔	◔	◔	◒
Agriolimacidae Wagner, 1935																	
**Deroceras agreste* (Linnaeus, 1758)	ASE	-	-	W		◔			◕	◕	◕				◒		
**Deroceras bisacchianum* Bodon, Boato & Giusti, 1982	ALSW	E	E	N							◔					◒	◒
**Deroceras invadens* Reise, Hutchinson, Schunack & Schlitt, 2011	?	A	A	-	◔	◔		◔		◕		◔	◔	◒	◒	◒	◒
Deroceras laeve (Müller, 1774)	PAL	-	-	W	◔	◔		◕	◕	◕	◕				◒		
**Deroceras panormitanum* (Lessona & Pollonera, 1882)	SICI	A	-	-													◒
Deroceras reticulatum (Müller, 1774)	EUR	-	-	W	◔	◒	◔	◔	◔	◕	◒	◒	◕	◔	◕	◒	◒
**Deroceras rodnae* Grossu & Lupu, 1965	SEU	-	-	V													◒
**Deroceras sturanyi* (Simroth, 1894)	EEU	A	A	-						◒							
**Deroceras* sp. 1	ALSW	Q	Q	N							◒					◔	◒
**Deroceras* sp. 2	ALPW	S	E	N	◔	◔		◔		◒							
Euconulidae Baker, 1928																	
**Euconulus* (*Euconulus*) *fulvus* s.l. (Müller, 1774)	OLA	-	-	W	◒	◒	◕	◕	◕	◕	◕	◔	◕	◔	◒	◒	◒
Arionidae Gray, 1840																	
**Arion* (*Arion*) *rufus* (Linnaeus, 1758)	CEU	A	A	-		◒											
**Arion* (*Arion*) *vulgaris* Moquin-Tandon, 1855	CEU	A	A	-	◒	◒	◒	◒	◒	◒	◒	◒	◒	◔	◒	◒	◔
**Arion* (*Mesarion*) *euthymeanus* Florence, 1886	ALPW	-	-	N						◒	◒					◒	◒
**Arion* (*Mesarion*) *fuscus* (Müller, 1774)	EUR	-	-	W	◒	◕	◕	◕	◕	◕	◕		◔		◒	◔	◒
**Arion* (*Carinarion*) *circumscriptus* Johnston, 1828	EUR	-	-	W	◒	◕	◔	◕	◕	◕	◕						
**Arion* (*Kobeltia*) *distinctus* Mabille, 1868	EUR	A	A	-					◔	◕							
**Arion* (*Kobeltia*) *intermedius* Normand, 1852	EUR	-	-	W		◕		◔		◕	◕	◔	◒	◒	◒	◒	◒
**Arion* (*Kobeltia*) *obesoductus* Reischütz, 1973	CEU	-	-	V				◕	◔								
**Arion* (n. sgen.) *franciscoloi* Boato, Bodon & Giusti, 1983	APPN	-	E	N									◔	◒	◒		
**Ariunculus speziae* Lessona, 1881	ALPW	Q	Q	V	◔	◕	◕	◕	◕	◔							
Sphincterochilidae Zilch, 1960																	
**Sphincterochila* (*Albea*) *candidissima* (Draparnaud, 1801)	NAF	A	A	N												◕	◕
Bradybaenidae Pilsbry, 1934																	
Fruticicola fruticum (Müller, 1774)	ASE	-	-	W	◔		◔	◔		◕	◕	◕	◕				
Helicodontidae Kobelt, 1904																	
**Falkneria camerani* (Lessona, 1880)	ALPC	E	E	V			◕	◕	◕								
**Helicodonta angigyra* (Rossmässler, 1834)	ALPC	A	Q	-						◕							
**Helicodonta obvoluta obvoluta* (Müller, 1774)	EUR	-	-	W	◕	◕	◕	◕	◕	◕	◕	◕	◒	◕	◒	◒	●
**Drepanostoma nautiliforme* Porro, 1836	ALPS	Q	Q	W	◒	◕	◕	◕	◒	◕							
Hygromiidae Tryon, 1866																	
Trochulus hispidus (Linnaeus, 1758)	EUR	-	-	W				◔	◕	●	◕	◕	◕		◔	◔	◕

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Hygromiidae Tryon, 1866																	
**Trochulus suberectus* (Clessin, 1878)	ALP	-	-	V													
**Edentiella* (*Edentiella*) *edentula edentula* (Draparnaud, 1805)	ALP	-	-	V													
**Monacha (Monacha*) *cantiana* (Montagu, 1803)	SEU	-	-	W													
Monacha (*Monacha*) *cartusiana* (Müller, 1774)	EUR	-	-	W													
**Monacha* (*Monacha*) *cemenelea* (Risso, 1826)	SEU	-	-	W													
**Monacha* (*Monacha*) cf. *martensiana* (Tiberi, 1869)	APPC	A	E	-													
**Monacha* (*Monacha*) *parumcincta* (Rossmässler, 1834)	SEU	A	-	-													
**Euomphalia strigella strigella* (Draparnaud, 1801)	EUR	-	-	W													
**Urticicola glabellus glabellus* (Draparnaud, 1801)	ALPW	-	-	N													
**Urticicola mounierensis mounierensis* (Caziot, 1909)	ALSW	S	S	V													
**Urticicola moutonii* (Dupuy, 1847)	ALSW	S	S	V													
Ciliella ciliata (Hartmann, 1821)	SEU	-	-	W													
Hygromia (*Hygromia*) *cinctella* (Draparnaud, 1801)	SEU	-	-	W													
**Pseudotrichia rubiginosa* (Rossmässler, 1838)	ASE	-	-	N													
**Monachoides incarnatus incarnatus* (Müller, 1774)	CEU	-	-	W													
Geomitridae Boettger, 1909																	
**Cochlicella* (*Cochlicella*) *acuta* (Müller, 1774)	MED	-	-	N													
**Cochlicella* (*Cochlicella*) *conoidea* (Draparnaud, 1801)	MED	-	-	V													
**Cochlicella* (*Prietocella*) *barbara* (Linnaeus, 1758)	MED	-	-	N													
**Xerotricha apicina* (Lamarck, 1822)	WME	-	-	V													
Xerotricha conspurcata (Draparnaud, 1801)	WME	-	-	W													
**Microxeromagna lowei* (Potiez & Michaud, 1838)	WME	A	A	-													
**Bacheljaia gigaxii* (Pfeiffer, 1847)	WEU	-	-	-													
**Cernuella* (*Cernuella*) *aginnica* (Locard, 1882)	WEU	-	-	N													
Cernuella (*Cernuella*) *cisalpina* (Rossmässler, 1837)	SEU	-	-	W													
**Cernuella* (*Cernuella*) *virgata* (da Costa, 1778)	EUM	-	-	W													
**Cernuella* (*Xerocincta*) *neglecta* (Draparnaud, 1805)	EUR	-	-	W													
**Xerosecta* (*Xeromagna*) *cespitum* (Draparnaud, 1801)	SEU	-	-	-													
**Candidula unifasciata unifasciata* (Poiret, 1801)	EUR	-	-	W													
**Candidula* sp. 1	APPN	E	E	V													
**Xerolenta obvia obvia* (Menke, 1828)	EUR	A	-	-													
**Trochoidea elegans* (Gmelin, 1791)	WME	-	-	N													
**Trochoidea pyramidata* (Draparnaud, 1805)	MED	-	-	N													
**Trochoidea trochoides* (Poiret, 1789)	MED	-	-	N													
**Xerocrassa* (*Amandana*) *geyeri* (Soós, 1926)	EUR	-	-	N													
Helicidae Rafinesque, 1815																	
**Arianta arbustorum arbustorum* (Linnaeus, 1758)	EUR	-	-	W													
**Arianta arbustorum repellini* (Reeve, 1852)	ALPW	S	S	V													

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Helicidae Rafinesque, 1815																	
**Arianta arbustorum vareliensis* Ripken & Falkner, 2000	ALSW	S	S	V													
**Chilostoma* (*Chilostoma*) *adelozona foetens* (Studer, 1820)	ALPW	S	S	V													
**Chilostoma* (*Chilostoma*) *frigidum liguricum* (Kobelt, 1876)	ALSW	Q	Q	V													
**Chilostoma* (*Chilostoma*) *millieri* (Bourguignat, 1880)	ALSW	S	S	V													
**Chilostoma* (*Chilostoma*) *tigrinum* (De Cristofori & Jan, 1832)	ALPS	-	E	V													
**Chilostoma* (*Chilostoma*) *zonatum* (Studer, 1820)	ALP	-	-	W													
**Chilostoma* (*Cingulifera*) *cingulatum bizona* (Rossmässler, 1842)	ALSW	Q	Q	N													
**Campylaea* (*Campylaea*) *planospira planospira* (Lamarck, 1822)	APPE	-	E	N													
**Campylaea* (*Oricampylaea*) *padana* (Stabile, 1864)	ALPS	E	E	N													
**Helicigona lapicida lapicida* (Linnaeus, 1758)	EUR	A	A	-													
**Causa holosericea* (Studer, 1820)	CEU	-	-	W													
**Delphinatia fontenillii alpina* (Michaud, 1831)	ALPW	S	S	V													
**Delphinatia glacialis* (Férussac, 1832)	ALPW	-	-	N													
**Murella muralis* (Müller, 1774)	SICI	A	E	-													
**Macularia niciensis niciensis* (Férussac, 1821)	ALSW	S	S	V													
**Macularia sylvatica* (Draparnaud, 1801)	ALPW	-	-	W													
**Theba pisana pisana* (Müller, 1774)	MED	-	-	N													
**Cepaea nemoralis* (Linnaeus, 1758)	EUR	-	-	W													
**Eobania vermiculata* (Müller, 1774)	MED	-	-	N													
**Cantareus apertus* (Born, 1778)	MED	-	-	N													
**Cornu aspersum* (Müller, 1774)	EUM	-	-	W													
**Helix* (*Helix*) *cincta* Müller, 1774	EEU	A	A	-													
**Helix* (*Helix*) *lucorum* Linnaeus, 1758	ANAT	A	A	-													
**Helix* (*Helix*) *pomatia* Linnaeus, 1758	EUR	-	-	W													
Unionidae Rafinesque, 1820																	
**Microcondylaea bonellii* (Férussac, 1827)	ALDI	-	-	N													
**Unio elongatulus* Pfeiffer, 1825	ALDI	-	-	W													
**Unio mancus turtonii* Payraudeau, 1826	TYRR	-	-	V													
**Anodonta anatina* (Linnaeus, 1758)	PAL	-	-	W													
**Anodonta cygnea* (Linnaeus, 1758)	EUR	-	-	W													
**Anodonta exulcerata* Porro, 1838	ALDI	-	-	W													
**Sinanodonta woodiana* (Lea, 1834)	ASI	A	A	-													
Cyrenidae Gray, 1840																	
**Corbicula fluminea* (Müller, 1774)	ASI	A	A	-													
**Corbicula leana* Prime, 1867	ASI	A	A	-													
Sphaeriidae Deshayes, 1855																	
**Sphaerium* (*Sphaerium*) *corneum* (Linnaeus, 1758)	ASE	-	-	N													
**Sphaerium* (*Sphaerium*) *nucleus* (Studer, 1820)	EUR	-	-	W													
**Sphaerium* (*Sphaerium*) *ovale* (Férussac, 1807)	SIE	-	-	V													

Family Species	Chorotype	NW	I	R	NO	VB	VC	BI	AO	TO	CN	AT	AL	SP	GE	SV	IM
Sphaeriidae Deshayes, 1855																	
Musculium (*Musculium*) *lacustre* (Müller, 1774)	OLA	-	-	W	3/4	3/4	3/4			3/4	2/4	1/4	2/4			1/4	
Pisidium (*Pisidium*) *amnicum* (Müller, 1774)	PAL	-	-	W	3/4	2/4	3/4	2/4		3/4	2/4		2/4	2/4			
Pisidium (*Euglesa*) *casertanum* (Poli, 1791)	COS	-	-	W	2/4	3/4	3/4	3/4	4/4	3/4	2/4	2/4	4/4	4/4	4/4	4/4	4/4
Pisidium (*Euglesa*) *personatum* Malm, 1855	WPA	-	-	W	2/4	3/4	1/4	4/4	2/4	2/4	4/4	2/4	2/4	2/4	4/4	3/4	4/4
**Pisidium* (*Euglesa*) *ponderosum* Stelfox, 1918	EUR	-	-	V			1/4		1/4			1/4	1/4				
Pisidium (*Cyclocalyx*) *obtusale* (Lamarck, 1818)	OLA	-	-	W	2/4	1/4	1/4		2/4	2/4	2/4						
Pisidium (*Tropidocyclas*) *henslowanum* (Sheppard, 1823)	PAL	-	-	W	2/4	3/4	1/4			3/4	2/4	1/4	2/4				
Pisidium (*Tropidocyclas*) *lilljeborgii* Esmark & Hoyer, 1886	OLA	-	-	W		3/4			1/4	2/4	2/4						
Pisidium (*Hiberneuglesa*) *hibernicum* Westerlund, 1894	PAL	-	-	W		1/4			3/4	4/4	2/4						
Pisidium (*Cingulipisidium*) *milium* Held, 1836	OLA	-	-	W	2/4	2/4	3/4		2/4	3/4	2/4					1/4	2/4
Pisidium (*Cingulipisidium*) *nitidum* Jenyns, 1832	OLA	-	-	W	2/4	3/4	1/4	2/4	2/4	2/4	2/4		2/4			1/4	
Pisidium (*Pseudeupera*) *subtruncatum* Malm, 1855	OLA	-	-	W	2/4	3/4	1/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4	2/4
**Pisidium* (*Neopisidium*) *conventus* Clessin, 1877	OLA	-	-	V		3/4											
**Pisidium* (*Odhneripisidium*) *moitessierianum* Paladilhe, 1866	EUR	-	-	V		1/4											
Pisidium (*Odhneripisidium*) *tenuilineatum* Stelfox, 1918	WPA	-	-	N		2/4	1/4			2/4							
Dreissenidae Gray, 1840																	
**Dreissena* (*Dreissena*) *polymorpha polymorpha* (Pallas, 1771)	TUE	A	A	-	2/4	2/4				1/4							

RESULTS AND DISCUSSION

Checklist and Biodiversity

The malacofauna of Piedmont, Valle d'Aosta and Liguria is very rich: based on critical analysis of literature, examination of museum collections and field work by the authors and co-workers, it includes about 40% of the taxa reported from Italy according to the compilations of European non-marine molluscs by Bank (2017) and Bank & Neubert (2017). It comprises 394 taxa (280 terrestrial and 114 aquatic, including some of brackish environments), of which 308 from Piedmont (225 terrestrial, 83 aquatic), 139 from Valle d'Aosta (120 terrestrial, 19 aquatic) and 274 from Liguria (193 terrestrial, 81 aquatic). The checklist includes 24 entities undetermined or not yet described, although most have already been reported (11 terrestrial: *Acicula* sp. 1, *Renea* sp. 1, *Cecilioides* sp. 1, *Vitrea* sp. 1, *Vitrea* sp. 2, *Limax* sp. 1, *Limax* sp. 2, *Deroceras* sp. 1, *Deroceras* sp. 2, *Candidula* sp. 1 and the alien *Solenomphala* sp. 1; 13 aquatic: *Iglica* sp. 1, *Alzoniella* sp. 1, *Alzoniella* sp. 3, *Alzoniella* sp. 4, *Alzoniella* sp. 5, *Alzoniella* sp. 6, *Fissuria* sp. 1, *Fissuria* sp. 2, *Fissuria* sp. 3, *Pezzolia* sp. 1, *Pezzolia* sp. 2, *Pezzolia* sp. 3 and *Islamia* sp. 1).

Piedmont hosts the highest richness (308 taxa), closely followed by Liguria (274 taxa) despite its smaller area (about 1/5 of Piedmont). Valle d'Aosta (139 taxa) is far from the figures of the other two regions. The low richness of Valle d'Aosta is partly due to its small area (just over 1/8 of Piedmont) and partly to its poverty of aquatic species due to absence of potamal environments, where most freshwater species occur, and of non-glacialized subterranean waters and springs suitable for hydrobiids.

At province level, Turin and Cuneo have the highest richness (222 and 205 taxa respectively), while Asti and Biella have the lowest (114 and 123 taxa respectively). However, when richness (i.e number of taxa, NT) is considered in relation to area (A), the provinces with the highest values are La Spezia (NT/A: 18.8) and Imperia (NT/A: 15.2), and those with lowest are Cuneo (NT/A: 3.0) and Turin (NT/A: 3.3). Endemics (NWE) per province range from 3 to 15 and the ratio endemics/richness from 1.8 to 8.2%. Genoa, Alessandria and Turin are the provinces with highest number of endemics (15, 12 and 11, respectively) and Asti has the lowest (only 2). Genoa, Vercelli and Alessandria are those with the highest endemics/richness ratio (8.2, 7.4 and 6.6%, respectively) and again Asti has the lowest (1.8%). Aliens (NWA) range from 11 to 26. Turin is the province with highest xenodiversity (26 taxa) and Vercelli those with the lowest (11 taxa); Turin and Biella are the provinces with highest aliens/richness ratio (11.7 and 11.4%, respectively) and Alessandria that with the lowest (7.7%) (Tab. II).

These patterns are correlated with different aspects of single provinces such as area, morphology, hydrography, geology, habitats, vegetation, anthropization and so forth. For example, the lesser richness recorded in Asti province may depend on its small area, rather uniform geomorphology and scarcity of calcareous outcrops. Conversely, the large number of aliens found in Turin province may be related to the

presence of large urban settlements that progressively deplete natural environments and at the same time facilitate the spread of synanthropic entities (Fig. 18).

Ecology

Due to the variety of available habitats, the malacofauna of NW Italy includes entities with very different ecological requirements. Brackish and marine environments in Liguria host some rather rare and localized taxa such as *Smaragdia viridis*, *Hydrobia acuta acuta*, *Ecrobia ventrosa*, *Truncatella subcylindrica*, *Assiminea gittenbergeri*, *Paludinella globularis*, *P. sicana*, *Myosotella myosotis*, *Ovatella firminii* and *Leucophytia bidentata*. Their rarity is mainly due to the absence or reduction of transition environments along the Ligurian coastlines, with the exception of the mouth of Magra river in La Spezia province.

Lentic or slow-flowing aquatic environments, especially those rich in aquatic vegetation, host pulmonate gastropods belonging to the families Lymnaeidae, Physidae, Planorbidae and Acroloxidae, and bivalves belonging to the Unionidae and Sphaeriidae. In the cleanest and most oxygen-rich freshwater habitats it is also possible to find prosobranch gastropods belonging to the families Neritidae, Viviparidae, Bithyniidae and Valvatidae. All are quite widespread in Piedmont, mainly in the lowlands, while they are localized or absent in Liguria and Valle d'Aosta, due to a lack of potamal environments. Other species, such as the gastropod *Ancylus fluviatilis* s.l., usually inhabit lotic or fast-flowing aquatic environments and are widespread in almost the entire study area. Some entities, such as *Galba truncatula*, *Radix labiata* and *Pisidum personatum*, are frequent in many aquatic environments, including springs, creeks and rivers, and are also found in the Alpine lakes of Piedmont and Valle d'Aosta. Other species, such as *Pisidium lilljeborgii* and *P. hibernicum*, are also widespread but only in the alpine or sub-alpine lakes.

A high percentage of endemites belonging to the families Moitessieriidae and Hydrobiidae occur among species living in springs, subterranean waters and karstic aquifers. These species are mainly found in areas without Quaternary glacial influence, at the foot of Alpine ranges (such as Monte Fenera), or the Ligurian Apennine (on the Tyrrhenian and Po sides). Other species, such as members of the genera *Alzoniella* and *Fissuria*, are linked to alluvial groundwater of watercourses; these molluscs can be found in several sites in the basins of the Scrivia (between Liguria and Piedmont) and Magra rivers (between the province of La Spezia and Tuscany).

Most terrestrial species depend on a limestone substrate; this is especially true for rock-dwelling entities (*Pyramidula* species, many chondrinids and some clausiliids) and entities linked to open grassy or bushy environments with a rocky superficial substrate.

Rock debris of high alpine environments is inhabited by widespread species such as *Pyramidula umbilicata*, *Eucobresia nivalis*, *Vitrina pellucida*, *Oligolimax annularis*, *Euconulus fulvus* s.l. and more localized entities, such as *Eucobresia pegorarii*, *Phenacolimax locardi*, *P. stabilei*, *Arianta arbustorum repellini* and *A. arbustorum vareliensis*.

Province	A (km^2)	NT	NT/A (%)	E	E/NT (%)	X	X/NT (%)
Novara (NO)	1340.3	129	9.6	6	4.7	14	10.9
Verbano-Cusio-Ossola (VB)	2260.9	150	6.6	3	2.0	14	9.3
Vercelli (VC)	2081.6	135	6.5	10	7.4	11	8.1
Biella (BI)	913.3	123	13.5	6	4.9	14	11.4
Aosta (AO)	3260.9	139	4.3	5	3.6	14	10.1
Turin (TO)	6827.0	222	3.3	11	5.0	26	11.7
Cuneo (CN)	6894.9	205	3.0	10	4.9	14	6.8
Asti (AT)	1510.2	114	7.5	2	1.8	12	10.5
Alessandria (AL)	3558.8	182	5.1	12	6.6	14	7.7
La Spezia (SP)	881.4	166	18.8	5	3.0	18	10.8
Genoa (GE)	1833.8	182	9.9	15	8.2	18	9.9
Savona (SV)	1546.3	173	11.2	8	4.6	18	10.4
Imperia (IM)	1154.8	175	15.2	5	2.9	18	10.3

Tab. II. Administrative attributes and recorded species for each province in the study area, with indication of endemic taxa, alien taxa and richness ratio; **A** (area), **NT** (number of taxa), **E** (NW endemic taxa), **X** (NW alien taxa).

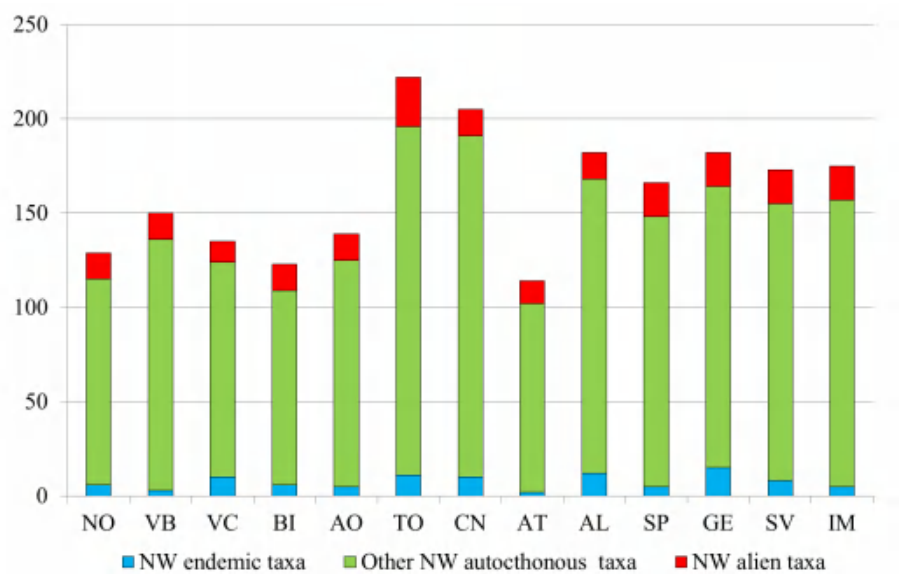

Fig. 18. Number of species of endemic, other autochthonous and alien taxa per province (NW Italy).

Some species, like *Eucobresia glacialis* and *Delphinatia glacialis*, reach altitudes exceeding 2500 or even 3000 m in Piedmont and Valle d'Aosta. Other species, strongly localized in Cuneo province, are found under rocky debris, or in high altitude rock rubble: *Urticicola mounierensis mounierensis* (found between 2200 and 2800 m), *Chilostoma frigidum liguricum* (1750-2300 m) and *C. millieri* (2200-2430 m).

Forest habitats at intermediate and low altitudes host several clausiliids and a few helicodontids, as well as small litter species such as *Acanthinula aculeata* and *Punctum pygmaeum*.

Subterranean species are present in all three regions, especially Liguria. These live at different depths in the soil; some are very widespread (e.g. members of the genus *Cecilioides*), while others are more localized (e.g. *Argna ligustica*) or rare (certain aciculids, such as *Acicula vezzanii*).

The coastal dunes of Liguria host an unusual malacofauna, which is localized and threatened by extreme urbanization and tourism development; for example *Cochlicella conoidea*, formerly reported from central and western Liguria, is now extinct. Finally, a good number of anthropic species occur in the study area, mainly in Mediterranean environments and ruderal areas, and can be easily translated or introduced as a result of various human activities; examples include geomitrid and helicid snails of the genera *Xerotricha*, *Cernuella*, *Trochoidea*, *Eobania*, and slugs such as *Limacus*, *Ambigolimax* and *Deroceras*.

Biogeography

NW Italian malacofauna includes 44 endemics (NWE) and 40 sub-endemics (17 quasi-endemic, NWQ, and 23 semi-endemic, NWS). Twenty-seven of the 44 NW endemics have a very restricted distribution, in some cases limited to a few square kilometers. This group includes 16 small groundwater gastropods (*Iglica pezzolii*, *Iglica* sp. 1, *Alzoniella braccoensis*, *A. delmastroi*, *A. feneriensis*, *A. sigestra*, *Alzoniella* sp. 1, *Alzoniella* sp. 3, *Alzoniella* sp. 5, *Alzoniella* sp. 6, *Fissuria* sp. 3, *Pezzolia radapalladis*, *Pezzolia* sp. 1, *Pezzolia* sp. 2, *Pezzolia* sp. 3 and *Islamia* sp. 1) and 12 lands gastropods (*Acicula* sp. 1, *Renea gentilei*, *Renea* sp. 1, *Chondrina feneriensis*, *Charpentieria dyodon alpina*, *C. dyodon paulucciana*, *Vitrea* sp. 2, *Retinella stabilei*, *Phenacolimax blanci*, *Limax millipunctatus*, *Falkneria camerani* and *Candidula* sp. 1.

Ten of the 40 sub-endemics have a range that extends into other Italian regions and they are therefore also Italian endemics. They include four quasi-endemic species (*Toffolettia striolata*, *Alzoniella finalina*, *Argna ligustica* and *Limax polipunctatus*) and six semi-endemic species (*Alzoniella lunensis*, *A. macrostoma*, *A. microstoma*, *Fissuria* sp. 1, *Fissuria* sp. 2 and *Deroceras* sp. 2). The other 30 sub-endemics have ranges that extend beyond national borders, mainly into small sectors of the French Alps. Hence, they are not Italian endemics but Italian quasi-endemic or semi-endemic taxa. They comprises 13 quasi-endemics: a freshwater gastropod associated with springs (*Bythinella ligurica*) and 12 land gastropods (*Cochlostoma subalpinum*, *Charpentieria dyodon thomasiana*, *Macrogastra mellae mellae*, *Vitrea*

pseudotrolli, *Phenacolimax stabilei*, *Limax alpinus*, *L. erythrus*, *Deroceras* sp. 1, *Ariunculus speziae*, *Drepanostoma nautiliforme*, *Chilostoma frigidum liguricum* and *C. cingulatum bizona*), and 17 semi-endemic land gastropods (*Platyla foliniana*, *Renea bourguignatiana*, *R. paillona*, *Pagodulina subdola sanremoensis*, *Solatopupa psarolena*, *Chondrina caziotana*, *Charpentieria dyodon dyodon*, *Macrogastra mellae leia*, *Clausilia bidentata crenulata*, *Urticicola mounierensis mounierensis*, *U. moutonii*, *Arianta arbustorum repellini*, *A. arbustorum vareliensis*, *Chilostoma adelozona foetens*, *C. millieri*, *Delphinatia fontenillii alpina*, and *Macularia niciensis niciensis*). Notably, no surface-water species is endemic to NW Italy. Indeed, most of these aquatic taxa show a wide global distribution. Their high dispersal capacity depends on a number of natural vectors that enable them to colonize any suitable environment.

Many species are frequent and widespread over the entire area. Some are present in all the provinces: 5 freshwater gastropods (*Galba truncatula*, *Radix auricularia*, *R. labiata*, *Gyraulus laevis* and *Ancylus fluviatilis* s.l.), 27 terrestrial gastropods (*Carychium minimum*, *C. tridentatum*, *Cecilioides acicula*, *Oxyloma elegans*, *Cochlicopa lubrica*, *Vallonia costata*, *V. pulchella*, *Acanthinula aculeata*, *Columella edentula*, *Truncatellina cylindrica*, *Vertigo pygmaea*, *Merdigera obscura*, *Punctum pygmaeum*, *Discus rotundatus rotundatus*, *Vitrea subrimata*, *Zonitoides nitidus*, *Oxychilus draparnaudi*, *Tandonia rustica*, *Limax maximus*, *Deroceras reticulatum*, *Euconulus fulvus* s.l., *Helicodonta obvoluta obvoluta*, *Ciliella ciliata*, *Hygromia cinctella*, *Cepaea nemoralis*, *Cornu aspersum* and *Helix pomatia*) and 3 bivalves (*Pisidium casertanum*, *P. personatum* and *P. subtruncatum*).

Some widespread and catholic species seem absent in certain provinces (e.g. *Gyraulus albus*, *Oxychilus clarus*, *Vitrina pellucida*, *Arion intermedius*, *Monacha cartusiana* and *Candidula unifasciata unifasciata*): this may be due to unsatisfactory sampling or to true absence for lack of suitable habitats. Furthermore, the distribution of species with mostly nocturnal habit (e.g. most slugs, such as *Limax dacampi dacampi*) is probably underestimated.

Analysis of the geographical ranges of native entities (348 taxa) showed a prevalence of taxa with European or Alpine distribution. This is due to the particular geographical location of the study area, bounded by the western Alps to the north and west, by the Po plain to the east and by the south-western Alps, northern Apennine and the Ligurian Sea to the south. Specifically, 75 taxa (about 22% of the total) show a wide distribution (chorotypes: Asiatic-European, Cosmopolitan, Holarctic, Palearctic, Siberian-European, Turanian-European-Mediterranean, Turanian-European and W Palearctic), 84 taxa (24%) a European distribution (chorotypes: Central-European, European-Mediterranean, European and W European), 50 taxa (14%) a Mediterranean distribution (chorotypes: Italian, Mediterranean, S European, Tyrrhenian and W Mediterranean), 84 taxa (24%) an Alpine distribution (chorotypes: Alpine-Dinaric, Alpine, Central-S Alpine, S Alpine, W Alpine and SW Alpine), 45 taxa (13%) an Apennine distribution (chorotypes: Apennine-Dinaric, Apennine and N Apennine), and the remaining 10 taxa (3%) an Alpine-Apennine distribution (chorotypes: Alpine-Apennine, W Alpine-Apennine and W Alpine-N Apennine) (Fig. 19).

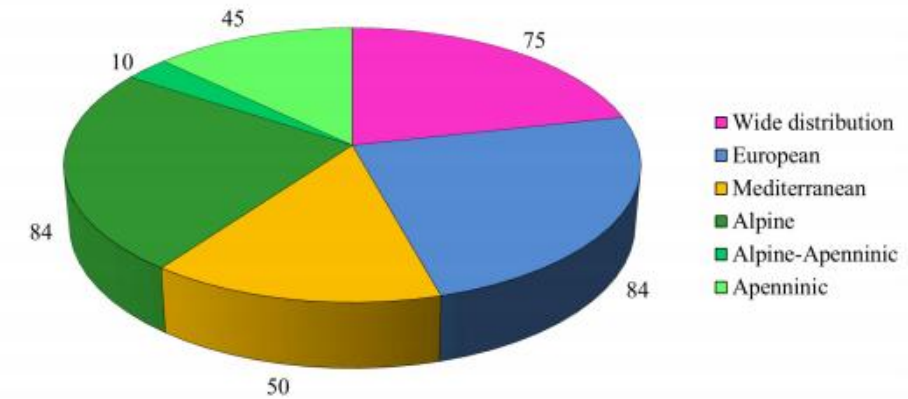

Fig. 19. Number and distribution of native taxa in NW Italy, grouped by higher order chorological categories.

When examining the breakdown of chorotypes by province, sharp variations emerge in relation to their geographic position. The percentage of taxa having wide or prevalent European distribution is substantial in all areas, but decreases in southern sectors, particularly in Liguria, where taxa with Mediterranean distribution increase. Taxa characterized by Alpine distribution are well represented over all the Alpine provinces of Piedmont and Valle d'Aosta, while their presence is lower (but not negligible) in southern districts (Asti and Alessandria provinces). In Liguria they progressively decrease along a west-to-east geographical gradient: well represented in Imperia and Savona provinces, they decrease significantly in Genoa province, and almost completely disappear in La Spezia province. Conversely, the number of Apennine taxa, well represented in La Spezia and Genoa provinces, is scarce in Savona province, and almost insignificant in Imperia province. In Piedmont Apennine taxa are common in Alessandria province, bordering Apennine Liguria, scarce in the southern provinces of Asti and Cuneo, negligible or absent in the remaining northern and western provinces (Fig. 20).

Xenodiversity

NW Italy has been significantly affected by the introduction and spread of non-native species, favored by human land use. Aquatic environments are the habitats most subject to colonization by alien species. These encounter favorable conditions, especially in degraded areas, due to lack of natural competitors.

In NW Italy, 46 non-native species are currently present, 14 of which, mainly terrestrial, come from other Italian regions (NWA/-, NWA/IE and NWA/IQ). Other species are only native to some districts, but have certainly been translocated to others; for example, some xerophilous helicoideans are indigenous to the western Ligurian coast, but are not native to other areas of Liguria and Piedmont.

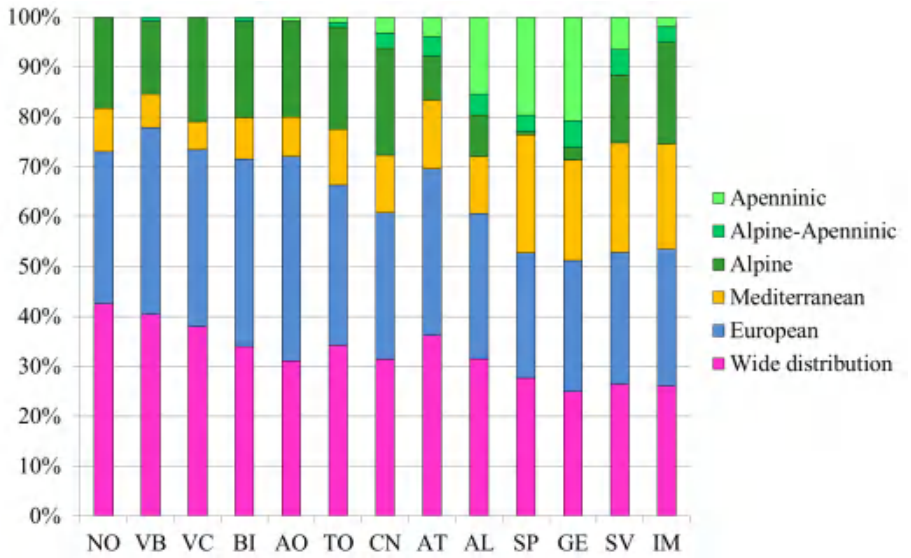

Fig. 20. Percentage breakdown of native taxa in the provinces of NW Italy, grouped by higher order chorological categories.

Most terrestrial non-native species were unintentionally introduced (through the transport of wood, fruit, vegetables and other goods, or via plant nurseries and greenhouse crops), probably in ancient times. Examples are *Testacella haliotidea* and *Leucostigma candidescens*, the latter probably extinct in the study area (Pollonera, 1888; Bisacchi, 1928; Boato *et al*., 1985); others such as *Boettgerilla pallens*, *Zonitoides arboreus* and *Deroceras sturanyi* arrived recently (Gavetti *et al*., 2008; Evangelista *et al*., 2013; Birindelli *et al*., 2015). Others were probably introduced intentionally for food: examples include *Zonites algirus*, introduced to western Liguria in prehistoric times and no longer present, and *Helix lucorum*, whose distribution has increased in recent times due to snail farming.

Some non-native species are still relatively sparse (unless understimated), and are found almost exclusively in anthropogenic environments: *Carychium hellenicum*, *Succinea* cf. *tenella*, *Charpentieria itala albopustulata*, *Siciliaria piceata*, *Papillifera papillaris papillaris*, *Zonitoides arboreus*, *Tandonia budapestensis*, *Boettgerilla pallens*, *Limacus flavus*, *Ambigolimax valentianus*, *Deroceras panormitanum*, *D. sturanyi*, *Arion distinctus*, *Helicodonta angigyra*, *Monacha parumcincta*, *Microxeromagna lowei*, *Murella muralis* and *Helix cincta*. Conversely, other species (*Paralaoma servilis*, *Lucilla scintilla*, *L. singleyana*, *Deroceras invadens*, *Arion vulgaris*, *Xerolenta obvia obvia* and *Helicigona lapicida lapicida*) have invaded natural habitats, the first four being the most widespread in the study area.

The dispersal of some species, native but regularly or occasionally synanthropic, can also be (more or less accidentally) facilitated by human activities,

such as trade in fruits, vegetables and ornamental plants (*Oxyloma elegans*, *Vallonia costata*, *V. pulchella*, *Discus rotundatus rotundatus*, *Oxychilus draparnaudi*, *Limax maximus* and *Deroceras reticulatum*) or by snail farming for food (*Cornu aspersum* and *Helix pomatia*).

As far as freshwater molluscs are concerned, the presence of non-native species is mainly due to accidental introductions, possibly reiterated over time, resulting from floriculture, rice growing, aquariums (*Melanoides tuberculata*, *Pseudosuccinea columella*, *Physella acuta*, *Gyraulus chinensis*, *Helisoma duryi* and *Ferrissia californica*), fish restocking (*Potamopyrgus antipodarum*, *Emmericia patula*, *Sinanodonta woodiana* and *Corbicula fluminea*) and nautical activities (*Dreissena polymorpha polymorpha*). The latter species, known as zebra mussel, is one of the 100 most invasive alien species in the world (GISD, 2017) and readily colonizes new water bodies transported by boats (Cianfanelli *et al*., 2007; Ng *et al*., 2016). The subsequent diffusion is further favored by natural factors (floods, river currents, dispersal by birds and fish), human activities involving transport of contaminated equipment (environmental monitoring of watercourses, river maintenance, river works, frequentation by bathers and fishers, etc.) (Costa *et al*., 2017, 2019). The most widespread alien freshwater species in the study area are: *Potamopyrgus antipodarum*, *Physella acuta*, *Gyraulus chinensis* and *Ferrissia californica*. In addition, *Sinanodonta woodiana* and *Corbicula fluminea* are rapidly expanding westward in major river catchments and lakes.

Conservation

Like other components of the flora and fauna, the malacofauna of NW Italy has suffered a high human pressure due to urbanization, industry, agriculture and tourism. Some species, recorded from NW Italy in the past, were not found recently, although sometimes they may have escaped field research due to their rarity or very restricted distribution. This is the case of *Orcula dolium dolium* in Valle d'Aosta, *Pisidium moitessierianum* in the Insubria lakes and *Marstoniopsis insubrica* in Lago Maggiore. Cases of certain disappearance may be due to natural causes like that of alien *Leucostigma candidescens* and *Zonites algirus* or to human activities like that of *Eupaludestrina stagnorum* and *Cochlicella conoidea*, related to artificialization of the Ligurian coast. Many species, still present and sometimes widespread, have disappeared in some areas, for example *Viviparus contectus*, *Physa fontinalis*, *Planorbis carinatus* and *Pisidium amnicum* near La Spezia, due to destruction of lentic habitats, and *Succinella oblonga*, *Vertigo moulinsiana* and *Pseudotrichia rubiginosa* near Aosta, due to destruction of wet habitats.

According to the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019), some species are of conservation concern due to their limited distribution and other risk factors that threaten their habitat: one species is Critically Endangered (the land terrestrial gastropod *Renea bourguignatiana*), 13 species are Vulnerable (2 freshwater gastropods: *Alzoniella feneriensis* and *A. lunensis*; 10 terrestrial gastropods: *Platyla foliniana*, *Renea gentilei*, *R. paillona*, *Argna bourguignatiana*,

Solatopupa psarolena, *Vertigo moulinsiana*, *V. angustior*, *Phenacolimax blanci*, *Falkneria camerani* and the non-native *Zonites algirus*; 1 freshwater bivalve: *Microcondylaea bonellii*) and 5 species are Endangered (4 freshwater gastropods: *Pseudamnicola lucensis*, *Alzoniella delmastroi*, *A. finalina* and *Pezzolia radapalladis*; 1 terrestrial gastropod: *Eucobresia pegorarii*).

Some taxa are included in Annexes II (*Anisus vorticulus*, *Vertigo moulinsiana* and *V. angustior*), IV (*A. vorticulus*) or V (*Helix pomatia*, *Microcondylaea bonellii* and *Unio elongatulus*) of the Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) and in Appendix III of the Bern Convention on the Conservation of European Wildlife and Natural Habitats (*H. pomatia*, *M. bonellii* and *U. elongatulus*) (Cuttelod *et al*., 2011; Genovesi *et al*., 2014). However, some of these taxa are in need of reassessment of their real conservation status. For example, *Vertigo angustior*, though quite rare and localized in NW Italy, is widespread in much of Italy and therefore could not be threatened in Italy. Conversely, other species, like many unionids, are seriously threatened: despite their good tolerance of organic pollution, they cannot withstand fluvial alterations, water abstraction and introduction of non-native competitors, such as *Sinanodonta woodiana*.

Risk factors (other than restricted ranges) are mainly habitat loss or alteration. Rock-dwelling species with a restricted range, such as *Toffolettia striolata*, may be harmed by alteration and/or destruction of dry stone walls, where they find refuge and food in the absence of natural rocky outcrops. Species living in open environments with sparse grass or shrub cover, such as certain xerophilous helicoideans, may be harmed by fires and gradual reforestation of open habitats.

Future prospects are alarming if global warming is not halted. The effects of climate change are already evident: higher temperatures, summer droughts of increasing in intensity and duration and extremely violent winter rains are undermining the survival of many molluscs, especially mesophiles like the *Monacha* species and ipsophiles like *Chilostoma frigidum liguricum*.

Many areas of NW Italy are formally protected by inclusion in the Natura 2000 network, national parks, regional parks and other reserves. Unfortunately, this is not enough to ensure the conservation of molluscs, because although they are protected, habitat destruction also continues in these areas, sometimes with devastating measures (artificialization of river banks, alteration of hydrographic networks, indiscriminate water uptake, over-exploitation of land for agriculture and grazing, forest felling and so forth). If this this persists, then it could cause a sharp decrease or even disappearance of populations of certain native molluscs, leading unavoidably to biodiversity loss and making malacocoenoses less diverse through an increasing component of synanthropic or non-native species.

APPENDIX
Explanatory remarks on some species

Family **Neritidae** Rafinesque, 1815

Theodoxus fluviatilis (Linnaeus, 1758). Polytypic species with five European subspecies; NW Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). Subspecies validity in *T. fluvialitis* was questioned by Alba *et al.* (2011) and Welter-Schultes *et al.* (2011) and no subspecies division was adopted by Glöer (2019). According to Glöer (2019) the genus *Theodoxus* includes 22 species in the western Palaearctic. Bayesian phylogeny of mtDNA and nDNA of almost all western Palaearctic *Theodoxus* recovered 18 MOTUs, each corresponding to one or more morphospecies (Sands *et al*., 2019).

Smaragdia viridis (Linnaeus, 1758). Occasionally in brackish waters, but reported only from coastal marine habitats in NW Italy (ENEA, 2016).

Family **Megalomastomatidae** Blanford, 1864

Cochlostoma subalpinum (Pini, 1885) (Fig. 21). Quasi-endemic species with narrow range limited to the Ligurian Alps and the Cottian Alps (Val Grana, Cuneo province), and outside the study area, to Vallée de la Roja (Alpes-Maritimes department) (Boato *et al*., 1985; Gargominy & Ripken, 2006; unpublished personal data). Specimens from Val Grana and Val Corsaglia, near Bossea (Ligurian Alps) are slightly different from the others (Boato *et al.*, 1985; unpublished personal data). This species is genetically related to *C. porroi* (Strobel, 1850) from the central Alps (subgenus *Dalfreddia* Zallot, Groenenberg, De Mattia Fehér & Gittenberger, 2015; Zallot *et al.*, 2015).

Cochlostoma macei (Bourguignat, 1869). Species occurring in SE France (from Vaucluse to Alpes-Maritimes departments) and NW Italy (Val Roia and Val Nervia). In NW Italy it is only present along the French-Italian border, on the ridge between Monte Pietravecchia and Monte Grammondo (Imperia province) (Boato *et al.*, 1985; unpublished personal data). Formerly reported as *C. patulum simrothi* (Caziot, 1908) by Boato *et al.* (1985) and Bodon *et al.* (1995), but according to Falkner *et al.* (2002), *C. simrothi* is a different species from *C. patulum* (Draparnaud, 1801). *C. simrothi* and *C. macei* are considered to be distinct species by Gargominy & Ripken (1999), Falkner *et al.* (2002), Gargominy *et al.* (2011) and Welter-Schultes *et al.* (2011), but we failed to find conchological or anatomical characters that distinguish them.

Fig. 21. *Cochlostoma subalpinum*, a quasi-endemic species (NWQ) with very narrow range (V) in NW Italy. Frabosa Soprana (CN); photo E. Lana.

Cochlostoma montanum (Issel, 1866). Polytypic species with two subspecies (Giusti, 1973; Nordsieck, 2011b). Northern populations living in the Apuan Alps are assigned to the nominotypical subspecies (Giusti, 1973; Nordsieck, 2011b). In NW Italy, it has only been collected in Magra river debris (La Spezia province) (unpublished personal data) but the specimens probably originate from outside the study area (probably from the Apuan Alps, Tuscany). Central and southern populations, assigned to *C. montanum cassiniacum* (Paulucci, 1878), are widespread along the Apennines from southern Latium to Calabria (Giusti, 1973; Nordsieck, 2011b; Welter-Schultes, 2012a; unpublished personal data). Tapparone Canefri (1869) reported *C. patulum* (Draparnaud, 1801) from the mountain reliefs bordering the eastern side of La Spezia gulf. This species occurs in southern France and the Iberian Peninsula and is absent in Italy (Manganelli *et al.*, 1995; Falkner *et al.*, 2002). Tapparone's report probably concerns *C. montanum* but the absence of voucher specimens or new materials from the area, despite extensive field work, makes it impossible to establish which species was actually involved.

Toffolettia striolata (Porro, 1840) (Fig. 22). Endemic species occurring in eastern Liguria and nearby SE Piedmont, and outside NW Italy, at the western tip of Emilia-Romagna (Alzona, 1971; Giusti, 1971; unpublished personal

data). Introduced to western Liguria where it only occurs around Imperia (Boato *et al.*, 1985). Reports from France (Alpes-Maritimes) not confirmed (Falkner *et al.*, 2002). *Toffolettia* Giusti, 1971, is here used instead of *Striolata* Wagner, 1897, as suggested Zallot *et al.* (2015).

Fig. 22. *Toffolettia striolata*, a quasi-endemic species (NWQ) with narrow range (N) in NW Italy. Genova (GE); photo M. Bodon.

Family **Aciculidae** Gray, 1850

Acicula lineata (Draparnaud, 1801). Polytypic species with two subspecies (Boeters *et al.*, 1989). Italian populations are assigned to *A. lineata sublineata* (Andreae, 1883), a subspecies which in the study area occurs in northern Piedmont, from Lago Maggiore (Verbano-Cusio-Ossola province) to Valle di Susa (Turin province). Reports from Imperia province based on collection material (Boeters *et al.*, 1989) doubtful, because unsupported by recent field surveys.

Acicula lineolata (Pini, 1885). Polytypic species with two subspecies (Boeters *et al.*, 1989). NW Italian populations are assigned to the nominotypical subspecies and to *A. lineolata banki* Boeters, Gittenberger & Subai, 1989. The former occurs in northern and central Piedmont, and outside the study area, in other regions of northern Italy and in Canton Ticino, Switzerland (Boeters

et al., 1989; Turner *et al.*, 1998). The latter occurs in southern Piedmont and Liguria; outside NW Italy, it is widespread in other parts of Italy (NE regions, northern and southern Apennines), southern Germany, Austria, Slovenia, Croatia (Boeters *et al.*, 1989; Bank & Neubert, 2017; MolluscaBase, 2020; personal unpublished data).

Acicula szigethyannae Subai, 1977. In NW Italy, it has only been collected in Magra river debris (La Spezia province) (Bodon, 1994) but the specimens may have originated from outside the study area. The species is widespread along the Apennines (Apuan Alps, Tuscan and central Apennines, Gargano) and in Montenegro (Boeters *et al.*, 1989; unpublished personal data).

Acicula vezzanii Bodon, 1994. Endemic species with narrow range limited to the Ligurian Apennines (Genoa province) (Bodon, 1994).

Acicula sp. 1. Undescribed endemic species with very narrow range limited to western Liguria (Imperia province). Similar to *A. lineolata* but characterized by larger size.

Platyla foliniana (Nevill, 1879). Semi-endemic species with very narrow range including the Mentone area in France and only a few sites near the French-Italian border in Italy (Bodon & Boato, 1987; Boeters *et al.*, 1989). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019).

Platyla gracilis (Clessin, 1877). In NW Italy it only occurs in Genoa (Valle Scrivia) and La Spezia provinces (unpublished personal data).

Platyla microspira (Pini, 1885). In NW Italy it only occurs at the eastern tip of Liguria (La Spezia province) (Cianfanelli *et al.*, 2000).

Platyla similis (Reinhardt, 1880). Formerly reported without details from the Ligurian Apennines (Boato *et al.*, 1985, as *Acicula delpretei* Paulucci, 1881), in NW Italy it only occurs in Genoa (Val Scrivia) and La Spezia provinces (unpublished personal data).

Platyla stussineri (Boettger, 1884). Formerly reported without details from the Ligurian Apennines (Boato *et al.*, 1985), in NW Italy it only occurs in La Spezia province (unpublished personal data).

Renea bourguignatiana Nevill, 1880. Semi-endemic species with very narrow range including the Menton area near the French-Italian border (Alpes-Maritimes department) in France and a few sites near Ventimiglia (Imperia province) in Italy (Boeters *et al.*, 1989; Gargominy & Ripken, 1999; Manganelli *et*

al., 2000; Falkner *et al.*, 2002). Described on fossil shells and subsequently discovered alive by Falkner *et al.* (2002). Listed as Critically Endangered by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al.*, 2019).

Renea elegantissima (Pini, 1886) (Fig. 23). Species with range limited to the Alpes-Maritimes department of France and to NW regions, Emilia-Romagna and northern Tuscany in Italy (Boeters *et al.*, 1989; Lori & Cianfanelli, 2005; Cianfanelli, 2009; unpublished personal data).

Fig. 23. *Renea elegantissima*, a quasi-endemic species (IQ) in Italy. San Germano Chisone (TO); photo S. Cianfanelli.

Renea gentilei (Pollonera, 1889). Endemic species with very narrow range limited to the Ligurian Alps (Val Corsaglia and Val Casotto, Cuneo province) (Bishop, 1976b; Boeters *et al.*, 1989; unpublished personal data). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al.*, 2019).

Renea paillona Boeters, Gittenberger & Subai, 1989. Semi-endemic species with very narrow range limited to the Alpes-Maritimes department and the western tip of Liguria (Bodon & Boato, 1987, erroneously as *R.*

bourguignatiana; Boeters *et al.*, 1989). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019).

Renea veneta (Pirona, 1865). Species with a mainly eastern Alpine distribution (Boeters *et al.*, 1989), present in NW Italy at a few isolated sites in Val Pennavaira (Savona and Imperia provinces) (Boato *et al.*, 1985; unpublished personal data).

Renea sp. 1. Undescribed endemic species with very narrow range limited to high Valle Po (Cottian Alps, Cuneo province) (Boato *et al.*, 1985, as *Renea* (*Pleuracme*) sp.). Similar to *R. elegantissima* but characterized by a shell with a larger aperture.

Family **Viviparidae** Gray, 1847

Viviparus ater (De Cristofori & Jan, 1832). Polytypic species with three or four subspecies (Zilch, 1955; Bank & Neubert, 2017; MolluscaBase, 2020), but one of these, *V. ater hellenicus* (Clessin, 1879), was ranked as a distinct species by Glöer & Georgiev (2014) and Glöer (2019). Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020), but specimens from Lago di Doberdò (Gorizia province, Friuli-Venezia Giulia, NE Italy) belong to another subspecies, *V. ater gallensteini* Kobelt, 1892 (Zilch, 1955) (Fig. 24).

Viviparus contectus (Millet, 1813). Formerly also reported from Liguria (ponds of La Spezia, La Spezia province; Tapparone Canefri, 1869) (specimens collected from La Spezia are in Museo Civico di Storia Naturale “Giacomo Doria” of Genoa). Now it has disappeared due to wetland destruction.

Family **Thiaridae** Gill, 1871

Melanoides tuberculata (Müller, 1774). Alien species, recently found in Liguria (Costa *et al.*, 2017, 2019) in a thermal spring at Toirano (Savona province).

Family **Bithyniidae** Gray, 1857

Bithynia italica (Paulucci, 1880). According to Falkner *et al.* (2002) and Glöer (2019) Italian bithynids, usually assigned to *B. leachii* (Sheppard, 1823), belong to two species: *B. italica* and *B. boissieri* (Küster, 1852). However, in the absence of a sound revision, the status of these taxa is controversial. Specimens from NW Italy seem to match *B. italica* at least on the basis of

some anatomical characters (tubular penial gland longer than in *B. leachii* on average).

Family **Moitessieriidae** Bourguignat, 1863

Moitessieria simoniana (Saint-Simon, 1848). Species with a mainly SW French distribution (Bertrand, 2004), present in Italy only in a few isolated sites in southern Piedmont (Cuneo province), western Liguria (Imperia and Savona provinces) and western Emilia-Romagna (Piacenza province) (Bodon *et al.*, 2005b).

Iglica pezzolii Boeters, 1971. Endemic species with very narrow range limited to Monte Fenera (Novara and Vercelli provinces), where it lives in subterranean waters (Bodon *et al.*, 2005b).

Iglica sp. 1. Undescribed endemic species with very narrow range limited to Biella province and tentatively assigned to the genus *Iglica* Wagner, 1927 (Pascutto, 1998). Similar to *I. pezzoli* but characterized by a conical-elongate shell.

Fig. 24. Lago Maggiore (VB), a subalpine lake hosting *Viviparus ater ater* with *Bithynia tentaculata*, *Valvata piscinalis*, *Radix auricularia*, *R. balthica*, *Physella acuta*, *Unio elongatulus*, *Anodonta exulcerata* and *Dreissena polymorpha*; photo M. Bodon.

Family **Cochliopidae** Tryon, 1866

Eupaludestrina stagnorum (Gmelin, 1791). Species of coastal oligohaline or slightly brackish waters. Formerly reported from central Liguria (specimens collected in Genoa in late 19th century are in Museo di Storia Naturale dell'Università di Firenze), but now extinct from NW Italy. This species was previously included in the genus *Heleobia* Stimpson, 1865, but the great molecular distance between the Neotropical and western Palaearctic species assigned to this genus supports inclusion of the latter in a different genus: *Eupaludestrina* Mabille, 1877 (senior synonym of *Semisalsa* Radoman, 1974) (Kadolsky, 2012; Kroll *et al.*, 2012).

Family **Tateidae** Thiele, 1925

Potamopyrgus antipodarum (Gray, 1843). Alien invasive species native to New Zealand (Ponder, 1988). First European reports date back to late 19th century and first Italian reports to 1961 (Roia river, Imperia province) (Berner, 1963). Now the species can be found in all Italian regions (Favilli *et al.*, 1998; Bodon *et al.*, 2005b; Cianfanelli *et al.*, 2007; personal unpublished data) (Fig. 25). Reported also in brackish waters but in Italy it is only found in inland waters.

Family **Hydrobiidae** Stimpson, 1865

Hydrobia acuta (Draparnaud, 1805). Euryhaline species usually living in brackish, oligohaline or waters with highly variable salinity, and sometimes even along sea coasts. Polytypic species with two subspecies (Wilke *et al.*, 2002); Italian populations are assigned to the nominotypical subspecies (Wilke *et al.*, 2002). *H. acuta* occurs at the mouth of the Magra river (La Spezia province) (Bodon & Cianfanelli, 2002). Reported also along the coasts of La Spezia province (ENEA, 2016), subject to verification.

Ecrobia ventrosa (Montagu, 1803). Glöer (2019) assigned the western Mediterranean populations to *Ecrobia vitrea* (Risso, 1826), regarding it as a distinct species from Atlantic *E. ventrosa*. However, phylogenies based on mtDNA do not support distinction of the two species (Wilke & Davis, 2000). Euryhaline species usually living in brackish waters. In NW Italy it only occurs at the mouth of the Magra river (La Spezia province) (Bodon & Cianfanelli, 2002).

Pseudamnicola lucensis (Issel, 1866). In NW Italy, it only occurs in coastal areas of eastern Liguria. However, the taxonomic setting of these populations is still not definitive. They are genetically closer to those of *P. lucensis* from the

northern Tuscany than those assigned to *P. moussonii* (Calcara, 1841) from southern Tuscany (T. Wilke, pers. comm., 18.12.2001). Current taxonomy of the Italian *Pseudamnicola*, based on anatomical characters, recognizes three species: *P. lucensis* (Issel, 1866) (eastern Liguria, northern Tuscany), *P. moussoni* (Tyrrhenian area, inclusive of Corsica, Sardinia and Sicily) and *P. orsinii* (Küster, 1852) (senior synonym of *P. conovula* (Frauenfeld, 1863); Adriatic area, southern Italy and eastern Sicily) (Bodon *et al.*, 2005b). However, the picture is certainly more complex, due to the existence of other species only discernible on a molecular basis (Delicado *et al.*, 2015). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the IUCN Red List of threatened species (IUCN, 2017) but its conservation status needs a revision, since it has a wider distribution than was previously thought.

Fig. 25. Fosso Crosio (Biandrate, NO), irrigation ditch hosting the aliens *Potamopyrgus antipodarum, Gyraulus chinensis* and *Corbicula fluminea*; photo M. Bodon.

Belgrandia thermalis (Linnaeus, 1767). In NW Italy it only occurs in Val Magra (La Spezia province) (Bodon & Cianfanelli, 2002); Val Magra is the westermost limit of its range (Bodon *et al.*, 1995).

Graziana alpestris (Frauenfeld, 1863). Species with a southern Alpine distribution, occurring in two separate areas: the central Alps and SW Alps (Bodon *et al.*, 2005b) (Fig. 26).

Pseudavenionia pedemontana Bodon & Giusti, 1982. Endemic species occurring in southern Piedmont and western Liguria (Savona province), from the Centa to the Varatello basin (Bodon *et al.*, 2005b).

Alzoniella braccoensis Bodon & Cianfanelli, 2004. Endemic species with very narrow range limited to eastern Liguria (Bodon & Cianfanelli, 2004). Formerly reported as *Alzoniella* sp. 1 by Bodon *et al.* (1995).

Alzoniella delmastroi Bodon & Cianfanelli, 2004. Endemic species with very narrow range limited to the Turin area (Bodon & Cianfanelli, 2004). Listed as Endangered by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the IUCN Red List of threatened species (IUCN, 2017).

Fig. 26. Tetti Bandito (CN), a limestone spring inhabited by *Graziana alpestris* in association with *Bythinella ligurica* and *Radix labiata*; photo M. Bodon.

Alzoniella feneriensis Giusti & Bodon, 1984. Endemic species with very narrow range limited to Monte Fenera (Novara and Vercelli provinces), where it is only known from two sites (Bodon *et al.*, 2005b), and to the Sesia basin

near Cravagliana (Vercelli province; unpublished personal data) (Fig. 27). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the IUCN Red List of threatened species (IUCN, 2017).

Alzoniella finalina Giusti & Bodon, 1984. Quasi-endemic species described from Finalese (Savona province) (Bodon *et al.*, 2005b). However, many other populations, discovered in southern Piedmont and western Liguria, and maybe in Biella province, may be conspecific. Listed as Endangered by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the IUCN Red List of threatened species (IUCN, 2017) but its conservation status needs revision, since it may have a wider distribution than previously thought.

Fig. 27. Cravagliana (VC), alluvial springs on the right hand side of the base of the dam inhabited by *Alzoniella feneriensis*, an endemic species (NWE) with very narrow range (V) in NW Italy; photo M. Bodon.

Alzoniella ligustica (Giusti & Bodon, 1981). In NW Italy it occurs in southern Piedmont and eastern Liguria; outside the study area, it occurs in northern Tuscany and southern Emilia-Romagna (Bodon *et al.*, 2005b). Italian species usually assigned to *Avenionia* Nicolas, 1882, constitute a distinct group, close or conspecific to *Alzoniella* Giusti & Bodon, 1984, the

definitive systematic setting of which needs further investigation (Bodon *et al.*, 2000; Cianfanelli & Bodon, 2017).

Alzoniella lunensis Bodon & Cianfanelli, 2002. Semi-endemic species with very narrow range limited to Val Magra (La Spezia and Massa-Carrara provinces) (Bodon & Cianfanelli, 2002). It has been tentatively assigned to the genus *Alzoniella* Giusti & Bodon, 1984. Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the IUCN Red List of threatened species (IUCN, 2017).

Alzoniella macrostoma Bodon & Cianfanelli, 2002. Semi-endemic species with very narrow range limited to Val Magra (La Spezia and Massa-Carrara provinces) (Bodon & Cianfanelli, 2002). It has been tentatively assigned to the genus *Alzoniella* Giusti & Bodon, 1984.

Alzoniella microstoma Bodon & Cianfanelli, 2002. Semi-endemic species with very narrow range limited to Val Magra (La Spezia and Massa-Carrara provinces) (Bodon & Cianfanelli, 2002). It has been tentatively assigned to the genus *Alzoniella* Giusti & Bodon, 1984.

Alzoniella parvula (Giusti & Bodon, 1981). Endemic species with narrow range limited to eastern Liguria (Bodon *et al.*, 2005b, as *Avenionia parvula*; Cianfanelli & Bodon, 2017) (Fig. 28).

Alzoniella sigestra Giusti & Bodon, 1984. Endemic species with very narrow range limited to western neighbourhood of Genoa, where it is only known from a few sites (Giusti & Bodon, 1984), and perhaps from southern Piedmont (Alessandria province), where some populations tentatively assigned to this species are present (personal unpublished data).

Alzoniella sp. 1. Undescribed endemic species with narrow range limited to central Liguria (Bodon *et al.*, 2005b, as *Avenionia* sp. 1; Cianfanelli & Bodon, 2017). Similar to *A. ligustica* but characterized by a shell with deeper sutures and more convex whorls.

Alzoniella sp. 3. Undescribed endemic species with narrow range limited to the Ligurian Alps and Langhe (Val Bormida di Pallare and Val Bormida di Spigno, Savona province) (Bodon *et al.*, 2005b, as *Avenionia* sp. 2; Cianfanelli & Bodon, 2017). This species is characterized by a penis without lobes.

Alzoniella sp. 4. Undescribed semi-endemic species with very narrow range limited to eastern Liguria and western Emilia-Romagna (Parma province) (Cianfanelli & Bodon, 2017). Similar to *A. ligustica* but characterized by a penis with three lobes instead of two.

Fig. 28. Sorgente Bocche Nuove (Maissana, SP), karstic spring inhabited by *Alzoniella parvula* with *Bythinella opaca*, *Ancylus fluviatilis* s.l. and *Pisidium personatum*; photo M. Bodon.

Alzoniella sp. 5. Undescribed endemic species with very narrow range limited to low Valle Stura di Lanzo (Turin province). Similar to *A. finalina* but with three lobes on penis onstead of two.

Alzoniella sp. 6. Undescribed endemic species with narrow range limited to the Scrivia basin (Alessandria province) (Fig. 29). Similar to *Alzoniella* sp. 1 but with bursa copulatrix in the female genital tract.

Fissuria sp. 1. Undescribed species occurring in the Scrivia basin (Alessandria and Genoa provinces), and outside the study area, in some basins of western Emilia-Romagna (Pezzoli, 1988; Bodon *et al.*, 2005b). Characterized by a globose shell.

Fissuria sp. 2. Undescribed semi-endemic species with narrow range limited to the Scrivia basin (Alessandria province), and outside the study area, to the Nure, Arda and Stirone basins (Piacenza and Parma provinces). Characterized by a depressed shell with an external varix near the peristome.

Fissuria sp. 3. Undescribed endemic species with very narrow range limited to Valle Stura (Genoa province). Putative conspecific specimens also collected in Val Visone (Alessandria province). Characterized by a sub-globose shell.

Fig. 29. Cantalupo Ligure (AL), alluvial spring colonized by *Alzoniella* sp. 6, an endemic species (NWE) with narrow range (N) in NW Italy; photo M. Bodon.

Pezzolia radapalladis Bodon & Giusti, 1986. Endemic species with narrow range limited to eastern Liguria from Recco to Rapallo (Genoa province) (Bodon *et al.*, 2005b). Listed as Endangered by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the IUCN Red List of threatened species (IUCN, 2017).

Pezzolia sp. 1. Undescribed endemic species with narrow range limited to the eastern neighbourhood of Genoa (from Valle del Rio Bagnara to Valle del Torrente Sori) (Bodon *et al.*, 2005b) (Fig. 30). Characterized by one or two glandular lobes near the apex of the penis.

Pezzolia sp. 2. Undescribed endemic species with narrow range limited to the neighbourhood of Genoa (Val Bisagno and Valle Sturla) (Bodon *et al.*, 2005b). Although anatomically different from *Pezzolia* sp. 1 for the position of the glandular lobes in the penis (Bodon *et al.*, 2001), the two species are not genetically distinct (T. Wilke, pers. comm., 04.09.2000).

Fig. 30. Valle Nervi (GE), karstic spring inhabited by *Pezzolia* sp. 1, an endemic species (NWE) with very narrow range (V) in NW Italy; photo M. Bodon.

Pezzolia sp. 3. Undescribed endemic species localized in a single site in Val Borbera (Alessandria province) (unpublished personal data). Characterized by a penis with a slender apex and only one glandular lobe.

Islamia cf. *pezzoliana* Bodon & Cianfanelli, 2012. In NW Italy it only occurs near Rapallo (Genoa province). Taxonomic setting uncertain: it may be conspecific with the Apennine *I. pezzoliana* widespread in central Italy (southern Tuscany, Latium, Umbria and Marche) (Bodon & Cianfanelli, 2012; unpublished personal data).

Islamia piristoma Bodon & Cianfanelli, 2002. Species occurring in SE Piedmont and eastern Liguria, and outside the study area, in southern Lombardy, Emilia-Romagna and Tuscany (Bodon *et al.*, 2005b; Bodon & Cianfanelli, 2012) (Fig. 31). Formerly reported as *Islamia* sp. 4 by Bodon *et al.* (1995).

Islamia sp. 1. Undescribed endemic species with narrow range limited to the Cervo basin (Imperia province) (unpublished personal data). Similar to *I. piristoma* due to an appendix on the penial lobe, but without filament on penial apex.

Fig. 31. Lerici (SP), karstic spring inhabited by *Islamia piristoma*, an Italian endemic species (IE) with narrow range (N) in NW Italy; photo M. Bodon.

Family **Amnicolidae** Tryon, 1863

Marstoniopsis insubrica (Küster, 1853). In NW Italy it only occurs in Lago Maggiore (Verbano-Cusio-Ossola province) (Gaschott, 1931; Nocentini, 1963), but has not been found in recent surveys. Falniowski & Wilke (2001) regarded it as a senior synonym of the widespread *M. scholtzi* (Schmidt, 1856) on the basis of molecular evidence.

Family **Bythinellidae** Locard, 1893

Bythinella ligurica (Paladilhe, 1867). Probably a quasi-endemic species occurring in the western Alps from the Ligurian and Maritime Alps (westward up to the Alpes-Maritimes department in France), to Lago Maggiore (eastward up to Varese province in Lombardy), in the western Ligurian Apennines and, maybe, in Corse (Falkner *et al*., 2002). Molecular research on *Bythinella* from northern Italy recovered at least two groups (clades 25 and 28; Benke *et al.*, 2011) one of which (clade 28) includes most of the Piedmontese and Ligurian populations. The earliest available name for this clade is *B. ligurica* (Bodon & Delmastro, 2013). Molecular research is underway on

other populations of uncertain relationship (Bodon & Delmastro, 2013; T. Wilke, pers. comm., 03.04.2013).

Bythinella opaca (Gallenstein, 1848). This species corresponds to clade 25 by Benke *et al.* (2011) and includes populations from SE Piedmont, eastern Liguria, Austria and Slovenia. In the past, Italian *Bythinella* were assigned to a single species: *B. schmidtii* (Küster, 1852) (Giusti & Pezzoli, 1977). *B. schmidtii* has been regarded as a junior synonym of *B. opaca* (Boeters, 1993; Falkner *et al.*, 2001; Glöer, 2002) or as a species genetically close to *B. opaca* (Benke *et al.*, 2011). *B. schmidtii*, *B. opaca* and allied species form a clade which mainly occurs in the eastern Alps with spurs extending to the northern Apennines.

Family **Emmericiidae** Brusina, 1870

Emmericia patula (Brumati, 1838). Alien (translocated) species native to NE Italy, Slovenia and Croatia (Radoman, 1967), recently introduced into Piedmont (Vercelli and Cuneo provinces) (Bodon *et al.*, 2005b; G.B. Delmastro coll., 1994; G. Rossi coll., 2009), and other Italian regions and European countries (Boeters & Heuss, 1985; Mouthon, 1986; Cianfanelli *et al.*, 1991; Bodon *et al.*, 2005b; Petraccioli *et al.*, 2011; unpublished personal data).

Family **Truncatellidae** Gray, 1840

Truncatella subcylindrica (Linnaeus, 1767). Euryhaline species usually living in coastal marine and brackish waters. In NW Italy it only occurs in Liguria, sometimes also inhabiting estuaries.

Family **Assimineidae** Adams & Adams, 1856

Assiminea gittenbergeri van Aartsen, 2008. Euryhaline species living in coastal marine and brackish waters. In NW Italy it has only been collected on the beach of San Terenzo and at the mouth of the Magra river (La Spezia province) (unpublished personal data) (Fig. 32). This species, recently described, includes the Mediterranean *Assiminea* formerly assigned to *A. grayana* Fleming, 1828.

Solenomphala sp. 1. An alien species of uncertain origin (Benocci *et al.*, 2014). It has been collected near plant nurseries at the mouth of the Rio Carenda near Albenga (Savona province) (unpublished personal data). It matches the species reported from Elba Island (Tuscan Archipelago) by Benocci *et al.* (2014).

Fig. 32. Magra river mouth (Ameglia, SP), inhabited by *Assiminea gittenbergeri* with *Truncatella subcylindrica*, *Hydrobia acuta*, *Ecrobia ventrosa*, *Myosotella myosotis* and *Leucophytia bidentata*; photo M. Bodon.

Paludinella globularis (Hanley in Thorpe, 1844). Euryhaline species usually living in coastal marine and brackish waters. It has been collected in a few localities along the coast of Liguria (unpublished personal data). A species of *Paludinella* was also reported from Mortola (ENEA, 2016, as *P. littorina*) and from La Spezia province by Tapparone Canefri (1869 as *P. littorina*) but the identity of these reports is uncertain due to possible confusion with *P. sicana*. Kadolsky (2012) demonstrates that the name *P. littorina* (Della Chiaie, 1828), used to denote this species, was probably based on a juvenile of *Melarhaphe neritoides* (Linnaeus, 1758) and that the earliest available name to conserve this taxon in its accustomed sense is *P. globularis*. Moreover, until recently, two very similar species have been confused under the name "*P. littorina*": one with a paucispiral protoconch (the "true" *P. littorina*) and one with a multispiral protoconch (*Paludinella sicana* (Brugnone, 1876)) (van Aartsen, 2008).

Paludinella sicana (Brugnone, 1876). Euryhaline species usually living in coastal marine and brackish waters; it has been collected in a few sites along the coast of Liguria (unpublished personal data). Recently distinguished from the congeneric *P. globularis* by virtue of its multispiral protoconch (van Aartsen, 2008).

Family **Lymnaeidae** Rafinesque, 1815

Stagnicola corvus (Gmelin, 1791). In NW Italy it occurs in Lago Maggiore (Novara, Verbano-Cusio-Ossola and Varese provinces) and in a few other sites of Piedmont (Mirolli, 1958, as *Lymnaea palustris* (Müller, 1774); Gavetti *et al.*, 2008; M. Paulucci coll., 1863, 1882, 1898; unpublished personal data).

Stagnicola fuscus (Pfeiffer, 1821). Most of Italian reports of *S. palustris* (Müller, 1774), a species that has never been found in Italy, concern this species.

Radix balthica (Linnaeus, 1758). This species was long known as *Radix ovata* (Draparnaud, 1805) but according to Falkner *et al.* (2002) this name is a junior synonym of *Helix balthica* Linnaeus, 1758. Molecular evidence suggests that European *Radix* lymnaeids belong to some distinct clades/MOTUs that may constitute different species (Pfenninger *et al.*, 2006), belonging to different genera (Aksenova *et al.*, 2018). However, their possible morphological separation is very controversial (Pfenninger *et al.*, 2006; Schniebs *et al.*, 2011, 2013; Aksenova *et al.*, 2018). The best morphological character to identify these species is apparently the position of the bursa and the bursa duct (Schniebs *et al.*, 2013). Aksenova *et al.* (2018) assigned this species to the genus *Ampullaceana* Servain, 1881.

Radix labiata (Rossmässler, 1835). This species was long known as *Radix peregra* (Müller, 1774). According to Falkner *et al.* (2002) the identity of Müller's species is uncertain: the type material no longer exists and the species has disappeared from the type locality. The authors therefore proposed to use *Lymnaea pereger* var. *labiatus* Rossmässler, 1835, to denote this species. Although accepted by most, Vinarski (2017) advocated that *R. peregra* be conserved to ensure stability and continuity of nomenclature and that *R. labiata* not replace Müller's name, since its type material belongs to a different species. Following Vinarski's statements (2017), Aksenova *et al.* (2018) and Holyoak *et al.* (2019) reinstated Müller's name for this species. Concerning its morphological identification, see Schniebs *et al.* (2013). Aksenova *et al.* (2018) assigned it to the genus *Peregriana* Servain, 1881 (Fig. 33).

Pseudosuccinea columella (Say, 1817). Alien species native to eastern North America (Burch, 1989), recently found in the Hambury Botanical Gardens near Ventimiglia (Imperia province) (Cianfanelli *et al.*, 2007).

Fig. 33. Carpignano Sesia (NO), an alluvial fountain inhabited by *Radix labiata*, a species widespread (W) in NW Italy, with *Pisidium personatum* and *P. milium*; photo M. Bodon.

Family **Physidae** Fitzinger, 1833

Physa fontinalis (Linnaeus, 1758). Threatened species in Italy. Many populations, such as those reported from La Spezia province (Tapparone Canefri, 1869; Santamaria, 2000; specimens from La Spezia in Museo di Storia Naturale dell'Università di Firenze), disappeared probably due to competition with alien *Physella acuta* (Draparnaud, 1805) (Cianfanelli *et al.*, 2007). Taylor (2003) assigned populations studied by Mirolli (1958) from Lago Maggiore (Novara, Verbano-Cusio-Ossola and Varese provinces) and Lago di Mergozzo (Verbano-Cusio-Ossola province) to the new species *P. mirollii* Taylor, 2003. Unfortunately, he did not perform a new examination of these populations, but based his description on the anatomical report of Mirolli (1958). If *P. mirollii* were a valid species, *P. stabilei* Lessona, 1880 (type locality: Lago d'Azeglio, where it has disappeared) might be its senior synonym; alternatively, *P. mirollii* might be a junior synonym of *P. fontinalis*.

Physella acuta (Draparnaud, 1805). Alien invasive species native to North America introduced into Europe and Africa (Brown, 1994; Dillon *et al.*, 2002; Anderson, 2003; Taylor, 2003; Wethington, 2003). First Italian reports date back to mid 19th century; now the species is widespread in all regions

(Cianfanelli *et al.*, 2007). Usually included in *Physella* Haldeman, 1843, the latter considered a distinct genus or a subgenus of *Physa*. Taylor (2003) proposed a new genus classification of the family based on anatomical characters, moving this species to *Haitia* Clench & Aguayo, 1932. Wethington & Lydeard (2007) investigated the molecular phylogeny of 28 physid taxa uncovering six major clades. *P. acuta* belongs to the *Physa* type c penial complex group, for which Kadolsky (2012) proposed the name *Physella* (*Acutiana*).

Aplexa hypnorum (Linnaeus, 1758). Threatened species in Italy (Manganelli *et al.*, 1995, 2000) and uncommon in NW Italy where it only occurs in some sites in Piedmont. Taylor (2003) assigned Italian specimens to *Paraplexa cornea* (Massot, 1845) based on a poor anatomical study by Cesari & Orlandini (1984). The validity of *P. cornea* is controversial: its distinctive anatomical characters are uncertain and doubtful.

Family **Planorbidae** Rafinesque, 1815

Planorbis carinatus Müller, 1774. Formerly also reported from Liguria (Gentile & Sulliotti, undated; Tapparone Canefri, 1869), where it has disappeared, probably due to lentic habitat alteration and destruction.

Planorbis moquini Requien, 1848. In NW Italy it only occurs in Liguria, where it reaches the northernmost limit of its range (Girod *et al.*, 1980; personal unpublished data based on anatomical identifications available for Savona and Genoa provinces and on shell identifications for La Spezia province). Glöer & Zettler (2009) regarded *P. moquini* as endemic to Corsica and claimed that Italian specimens belong to other species.

Anisus leucostoma (Millet, 1813). Uncommon species in NW Italy, only occurring in lowland Piedmont (Novara, Turin and Alessandria provinces; G.B. Delmastro coll., 1989, 1990; unpublished personal data).

Anisus vorticulus (Troschel, 1834). Uncommon species in NW Italy, occurring mostly in lowland Piedmont (Evangelista, 2007; unpublished personal data). Threatened species (Manganelli *et al.*, 1995; species included in Annex II/IV of the Habitats Directive).

Gyraulus chinensis (Dunker, 1848). Alien species native to SE Asia and first reported from Italy in rice fields of the Po plain (Meier-Brook, 1983; Falkner, 1990). Now the species occurs in many Italian rivers and lakes, especially in the northern regions (Cianfanelli *et al.*, 2007).

Planorbarius corneus (Linnaeus, 1758). Polytypic species with three subspecies according to Bank & Neubert (2017) and MolluscaBase (2020). These subspecies are treated as distinct species by Glöer (2019).

Helisoma duryi (Wetherby, 1879). Alien species native to Florida (Burch, 1989). First Italian reports of *Helisoma* Swainson, 1840, from Latium and Sicily date back to the 1980s (Manganelli *et al.*, 1995; Mastrantuono *et al.*, 2011); according to Glöer (2019) these reports involve two or three different species. In NW Italy, *H. duryi* was found in the Hambury Botanical Gardens near Ventimiglia (Imperia province) (Cianfanelli *et al.*, 2007). Some authors (e.g. Bank & Neubert, 2017; MolluscaBase, 2020) include this species in *Planorbella* Haldeman, 1843, mainly based on shell characters (see Giusti *et al.*, 1995). Molecular data (Morgan *et al.*, 2002) suggests that *H. duryi* and *H. anceps* (Menke, 1830) (= *Planorbis bicarinatus* Say, 1819, the type species of *Helisoma*) belong to the same clade.

Segmentina nitida (Müller, 1774). Threatened species in Italy due to habitat alteration and destruction (Manganelli *et al.*, 1995, 2000); uncommon in NW Italy where it only occurs in some sites in Piedmont (Coen, 1945; Lauri, 2003; Gavetti *et al.*, 2008; G.B. Delmastro coll., 1980; R. Sindaco coll., 1985, 1996; unpublished personal data).

Ancylus fluviatilis s.l. Müller, 1774. Based on molecular study, Pfenninger *et al.* (2003) and Albrecht *et al.* (2006) found that *A. fluviatilis* constitutes a complex of species. Italian *Ancylus* does not belong to *A. fluviatilis* s.str. but to two clades (clades 3 and 4 according to Pfenninger *et al.*, 2003; *Ancylus* sp. B and C according to Albrecht *et al.*, 2006) for which Glöer (2019) proposed the names *A. recurvus* Martens, 1873 and *A. striatus* Quoy & Gaimard, 1834. Both clades occur in northern Italy but are difficult to recognise without molecular data (Pfenninger *et al.*, 2003).

Ferrissia californica (Rowell, 1863). Alien species native to North America (Walther *et al.*, 2006a, 2006b; Marrone *et al.*, 2011; Christensen, 2016). The first Italian reports were from Lago di Mergozzo and Lago Maggiore (Verbano-Cusio-Ossola province) in the 1950s (Mirolli, 1960) (Fig. 34); now it is widespread in many Italian regions (Cianfanelli *et al.*, 2007). Formerly known as *F. wautieri* (Mirolli, 1960), *F. clessiniana* (Jickeli, 1882) or *F. fragilis* (Tyon, 1863) (Walther *et al.*, 2006a, 2006b; Marrone *et al.*, 2011).

Family **Ellobiidae** Pfeiffer, 1854

Myosotella myosotis (Draparnaud, 1801). Coastal marine species living in the supralittoral zone, rather frequent in Liguria.

Fig. 34. Lago di Mergozzo (VB), a subalpine lake hosting *Ferrissia californica* with *Valvata piscinalis*, *Physella acuta*, *Radix balthica*, *Gyraulus laevis*, *Anodonta exulcerata*, *Unio elongatulus*, *Corbicula fluminea*, *Pisidium henslovanum*, *P. nitidum*, *P. subtruncatum*, *P. milium* and *P. conventus*; photo M. Bodon.

Ovatella firminii (Payraudeau, 1826). Coastal marine species living in the supralittoral zone, very rare in Liguria, collected only at Riva Trigoso (Genoa province, M. Sosso leg., 1986) and San Terenzo (La Spezia province, unpublished personal data).

Leucophytia bidentata (Montagu, 1808). Coastal marine species living in the supralittoral zone, not frequent in Liguria except in La Spezia gulf and at the mouth of the Magra river (La Spezia province) (Tapparone Canefri, 1869; unpublished personal data).

Family **Carychiidae** Jeffreys, 1830

Carychium hellenicum Bank & Gittenberger, 1985. Alien (translocated) species native to Greece and the centre and south of Italy (Bank & Gittenberger, 1985; Ferreri *et al.*, 2005; Manganelli *et al.*, 2017), recently introduced into Piedmont (Biella province) (Birindelli *et al.*, 2015).

Carychium minimum Müller, 1774. Many specimens from Liguria and Piedmont are similar to *Carychium mariae* Paulucci, 1878, due to their columellar lamella structure. However, based on DNA barcoding, *C. mariae* is regarded as a junior synonym of *C. minimum* by Weigand *et al.* (2012a). Based on COI sequences, Weigand *et al.* (2012b) found that *C. minimum* (including *C. mariae*) constitutes a complex of several lineages in Europe (five molecular taxonomic units), most of which occur in northern Italy.

Carychium tridentatum (Risso, 1826). Based on molecular study (COI sequences), Weigand *et al.* (2012b) found that this species constitutes a complex of several lineages (eight molecular taxonomic units), three of which are present in northern Italy.

Family **Ruminidae** Wenz, 1923

Rumina decollata (Linnaeus, 1758) (Fig. 35). In NW Italy it occurs in western Liguria and sporadically in eastern Liguria and in Piedmont, where it was probably introduced (Boato *et al.*, 1985; unpublished personal data). Based on molecular study, Prévot *et al.* (2013) found that *R. decollata* constitutes a complex of six species. They did not examine NW Italian *Rumina*; the closest populations belong to two different clades: those from southern France to Clade A and those from mainland Italy to Clade F.

Family **Ferussaciidae** Bourguignat, 1883

Cecilioides acicula (Müller, 1774). This species belongs to a group of subterranean microsnails. Their taxonomy is based solely on shell characters, leading to recognition of about ten species in Europe (Falkner, 1990; Beckmann & Falkner, 2008; Welter-Schultes, 2012a; Bank & Neubert, 2017; MolluscaBase, 2020). Unfortunately, while identification of extreme forms, such as *C. acicula* and *C. janii* in their typical aspect, is easy, recognition of others is problematical due to intermediate forms.

Cecilioides janii (De Betta & Martinati, 1855). Known in the 2000s as *C. veneta* (Strobel, 1855) based on alleged priority of this name over that of De Betta & Martinati (1855) (Bank *et al.*, 2000; Falkner *et al.*, 2002). However, as stated by Welter-Schultes (2010), *Achatina veneta* Strobel, 1855, is a nomen nudum and as such is not available.

Cecilioides petitiana (Benoit, 1862). Species of uncertain validity, common in NW Italy outside the Alpine areas (Pollonera, 1885b, as *Caecilianella pedemontana*; unpublished personal data). According to Bank & Neubert (2017) it is a junior synomym of *C. tumulorum* (Bourguignat, 1856), while

it is of uncertain status according to MolluscaBase (2020). However, topotypical material of *C. tumulorum* from Greece (see Neubert *et al.*, 2015, fig. 82), corresponding to that depicted by Bourguignat (1856, pl. 18, figs. 15-17), is different from that of *C. petitiana* reported by Beckmann & Falkner from Sicily (2003, pl. 8, figs. 12-14).

Fig. 35. *Rumina decollata*, a species with wide range (W) in NW Italy. Vallecrosia (IM); photo M. Bodon.

Cecilioides sp. 1. Probably an undescribed species occurring in eastern Liguria and in other regions in central and southern Italy, mostly on the Tyrrhenian coast (unpublished personal data). Similar to *C. acicula* but characterized by a shell with a larger protoconch.

Hohenwartiana hohenwarti (Rossmässler, 1839). In NW Italy it only occurs in the SE Piedmont between the lower Valle Scrivia and Valle Staffora (Alessandria province) (Pollonera, 1885b; unpublished personal data).

Ferussacia folliculum (Schröter, 1784) (Fig. 36). In NW Italy it occurs in western Liguria (Boato *et al.*, 1985). Localized occurrences in central and eastern Liguria (specimens collected in the surroundings of Genoa and Portofino in the late 19th century are in Museo di Storia Naturale dell'Università di Firenze; recent records from Genoa and Portovenere, unpublished personal

data) are probably due to introduction. In the rest of Italy, it can only be found in southern regions, Sardinia and Sicily (Alzona, 1971; Eikenboom, 1996; Ferreri *et al.*, 2005; Petraccioli *et al.*, 2005).

Fig. 36. *Ferussacia folliculum*, a species with narrow range (N) in NW Italy. Finale Ligure (SV); photo M. Bodon.

Family **Testacellidae** Gray, 1840

Testacella haliotidea (Draparnaud, 1801) (Fig. 37). Alien species, probably native to western Europe (Nardi & Bodon, 2011), only occurring on Collina di Torino, where it was first reported by Pollonera (1888) (Manganelli *et al.*, 1995; De Mattia, 2006).

Testacella scutulum Sowerby, 1821 (Fig. 38). In NW Italy it only occurs in Liguria, southern Piedmont (Asti and Alessandria provinces) and a few sites in Turin and Biella provinces (Boato *et al.*, 1985; unpublished personal data).

Fig. 37. *Testacella haliotidea*, an alien species (IA) in Italy. Torino (TO); photo S. Birindelli.

Fig. 38. *Testacella scutulum*, a widespread species (W) in Piedmont and Liguria. Torino (TO); photo S. Birindelli.

Family **Succineidae** Beck, 1837

Succinea putris (Linnaeus, 1758) (Fig. 39). Uncommon species in NW Italy, found only in Piedmont. Formerly also reported from far western Liguria (Val Roia, Imperia province), but has now disappeared (Boato *et al.*, 1985).

Fig. 39. *Succinea putris*, a species with wide range (W) in NW Italy. Brusasco (TO); photo M. Bodon.

Succinea cf. *tenella* Morelet, 1865. An alien species of uncertain origin (Benocci *et al.*, 2014, as *Succinea* sp.), collected in plant nurseries near Albenga (Savona province) (unpublished personal data). Already reported on Elba Island (Tuscan Archipelago) by Benocci *et al.* (2014), it has often been reported worldwide as *Succinea tenella*, although its true identity is uncertain (G. Barker, pers. comm., 08.11.2011; Benocci *et al.*, 2014).

Quickella arenaria (Potiez & Michaud, 1838). Uncommon species in NW Italy, found only in internal areas of the Alps of Piedmont (Gavetti *et al.*, 2008; unpublished personal data). Most literature reports are probably based on misidentifications of the similar shelled and more widespread *Succinella oblonga*. Identifications based on anatomical characters are only available from one site in the Cottian Alps.

Family **Cochlicopidae** Pilsbry, 1900

Cochlicopa lubrica (Müller, 1774) (Fig. 40). Classic species delimitation and recognition in *Cochlicopa* is controversial, especially for *C. lubricella* (Porro, 1838) (Giusti & Manganelli, 1992; Manganelli *et al.*, 1995). Armbruster & Bernhard (2000) analyzed *Cochlicopa* relationships, examining ITS-1 ribosomial RNA sequences in 10 populations from central and northern Europe. They found that specimens identified as *C. lubricella* are arranged paraphyletically: part of them cluster with *C. lubrica* and part in an independent clade. No molecular data is available for Italian populations.

Fig. 40. *Cochlicopa lubrica*, a species with wide range (W) in NW Italy. Sauze d'Oulx (TO); photo S. Birindelli.

Family **Orculidae** Pilsbry, 1918

Orcula dolium (Draparnaud, 1801). Polytypic species with nine subspecies (Bank & Neubert, 2017; MolluscaBase, 2020), but there could be others because some taxa are awaiting revision (Harl *et al.*, 2011). Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). In the study area, it was reported from two sites in

Valle d'Aosta (Payot, 1864; Pavesi, 1904) and since then has never again been found.

Sphyradium doliolum (Bruguière, 1792). In NW Italy it only occurs in southern Piedmont and Liguria (Lessona, 1880; Boato *et al.*, 1985; Repetto, 1985a; Bodon, 2007; Cossignani & Cossignani, 2020); reported also from a site in Valle d'Aosta (Payot, 1864) and since then has never again been found.

Family **Pagodulinidae** Pilsbry, 1924

Pagodulina austeniana (Nevill, 1880). According to Bank & Neubert (2017) and MolluscaBase (2020), this is a polytypic species but the distinctive characters of single subspecies appear to vary greatly, making it problematical to distinguish them. In NW Italy it is widespread in southern Piedmont and western Liguria (Boato *et al.*, 1985; unpublished personal data), and uncommon and localized in northern Piedmont, where it is only found in Valle di Susa and Valli di Lanzo (Turin province) (Gavetti *et al.*, 2008). Reports of *P. pagodula* (Des Moulins, 1830) from Piedmont (Bishop, 1980) concern this species.

Pagodulina subdola (Gredler, 1856) (Fig. 41). Polytypic species with six or seven subspecies (Hausdorf, 1996; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations are assigned to *P. subdola sanremoensis* Pilsbry, 1924, which occurs in southern Piedmont (Val Grana and Val Tanaro, Cuneo province), western Liguria (Imperia province) (Pilsbry, 1924; Boato *et al.*, 1985, as *P. subdola*; unpublished personal data), and outside the study area, in the Alpes-de-Haute-Provence and Hautes-Alpes departments, France (Gargominy *et al.*, 2008).

Family **Argnidae** Hudec, 1965

Argna biplicata (Michaud, 1831). Polytypic species with three subspecies (Gittenberger, 1985). NW Italian populations, occurring in southern Piedmont and Liguria, are assigned to the nominotypical subspecies (Boato *et al.*, 1985).

Argna bourguignatiana (Nevill, 1880). Species with narrow range, described on fossil shells and subsequently discovered alive (Gargominy & Ripken, 1999). It occurs in SE France and western Liguria (Boato *et al.*, 1985, partly as *A. ligustica* (Pollonera, 1887); Falkner *et al.*, 2002; unpublished personal data). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019).

Fig. 41. *Pagodulina subdola sanremoensis*, a semi-endemic subspecies (NWS) with narrow range (N) in NW Italy. Rezzo (IM); photo M. Bodon.

Argna ferrari (Porro, 1838) (Fig. 42). Polytypic species with two subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). The nominotypical subspecies occurs along the Alps from Piedmont to Veneto (Belluno province), and outside Italy, in Canton Ticino (Switzerland) (Boato *et al.*, 1989; Turner *et al.*, 1998; Dalfreddo *et al.*, 2000; Boschi, 2011). The other subspecies, *A. ferrari blanci* (Bourguignat, 1874), only occurs outside Italy in the Alpes-Maritimes department (France) and perhaps in Catalonia (Spain) (Falkner *et al.*, 2002; Alba *et al.*, 2011; Gargominy *et al.*, 2011). *A. ferrari blanci* was reported in Ligurian Alps of southern Piedmont (Manganelli *et al.*, 1995; Gavetti *et al.*, 2008), but re-examination of new material does not confirm its presence in NW Italy.

Argna ligustica (Pollonera, 1887). Quasi-endemic species occuring mainly in eastern Liguria and SE Piedmont (Valle Scrivia, Alessandria province), and outside the study area, in the neighbouring Emilia-Romagna (Val Trebbia, Piacenza province) and NW Tuscany (Boato *et al.*, 1985; personal unpublished data) (Fig. 43).

Fig. 42. *Argna ferrari ferrari*, a quasi-endemic taxon (IQ) in Italy. San Germano Chisone (TO); photo S. Cianfanelli.

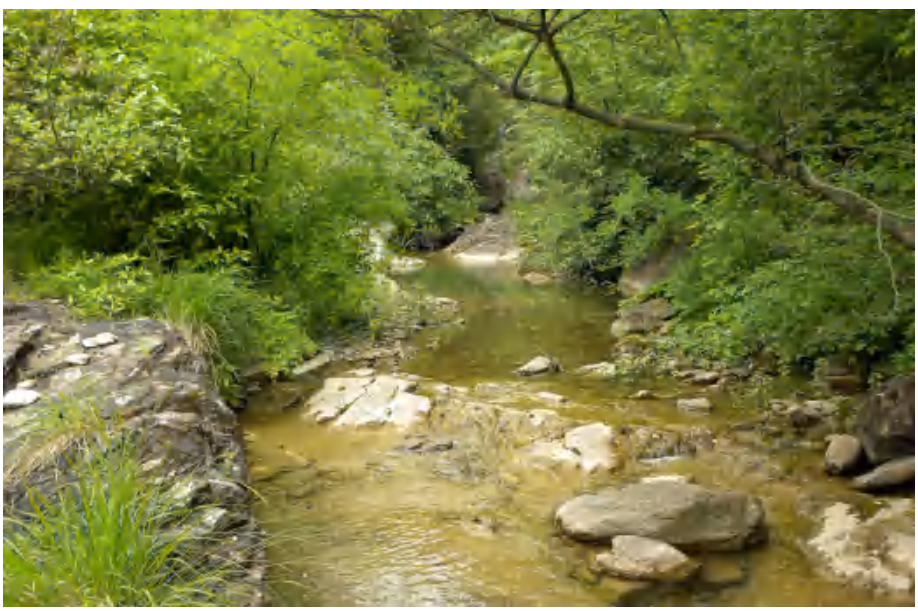

Fig. 43. Valle Nervi (GE), a riparian habitat along a stream where *Argna ligustica*, a quasi-endemic species (NWQ) with narrow range (N) in NW Italy, can be found with *Punctum pygmaeum*, *Vitrea subrimata*, *Retinella olivetorum* and *Oxychilus clarus*; photo M. Bodon.

Family **Valloniidae** Morse, 1864

Vallonia pulchella (Müller, 1774) (Fig. 44). *V. excentrica* Sterki, 1892, is regarded as a distinct species from *V. pulchella* (Gerber, 1996; Falkner *et al.*, 2002; Welter-Schultes, 2012a), although many scholars have questioned its taxonomic validity (e.g. Hubendick, 1950; Varga, 1972; Giusti & Manganelli, 1992; Pakiet, 1994; Giusti *et al.*, 1995). Korte & Armbruster (2003) analyzed its status by ITS-1 ribosomal RNA sequences in four populations of *V. pulchella* from Germany and Italy and seven populations of *V. excentrica* (three of which were sympatric with *V. pulchella*) from Germany, one population of *V. enniensis* (Gredler, 1856) from Hungary and five populations of *V. costata* (Müller, 1774) from Germany, Great Britain and Austria, using *Acanthinula aculeata* as outgroup. They recovered two clades, one formed by *V. costata* and another by all the other species. *V. excentrica* consisted of a paraphyletic array (*V. excentrica* type 1, *V. excentrica* type 2, *V. enniensis* + *V. pulchella*). Unfortunately, sampling was much too limited to establish a stable taxonomic setting of European *Vallonia*, and no molecular data is available for Italian populations with *excentrica* features.

Fig. 44. *Vallonia pulchella*, a widespread species (W) in NW Italy. Pont-Saint-Martin (AO); photo S. Birindelli.

Gittenbergia sororcula (Benoit, 1859). In NW Italy, it occurs only in the Maritime and Ligurian Alps and a few sites in the Ligurian and Piedmontese Apennines (Boato *et al.*, 1985; Cossignani & Cossignani, 1995; Bodon, 2007; unpublished personal data).

Family **Pupillidae** Turton, 1831

Pupilla sterrii (Forster, 1840). In NW Italy it only occurs in a few Alpine areas: Valle di Susa (Turin province) (Gavetti *et al.*, 2008), Ligurian Alps and Valle d'Aosta (unpublished personal data).

Family **Pyramidulidae** Kennard & Woodward, 1914

Pyramidula jaenensis (Clessin, 1882). Gittenberger & Bank (1996) revised the taxonomy of *Pyramidula*, validating six distinct species, two of which were considered to occur in Italy: *P. pusilla* Gittenberger & Bank, 1996 and *P. rupestris* (Draparnaud, 1801). However, molecular studies by Kirchner *et al.* (2016) and Razkin *et al.* (2016a, 2016b) excluded the presence of *P. rupestris* in Italy and only found *P. jaenensis* and *P. pusilla* in NW Italy. The latter was subsequently regarded as a junior synonym of *P. umbilicata* (Montagu, 1803) by Holyoak *et al.* (2019).

Pyramidula umbilicata (Montagu, 1803). Most Italian reports of *P. rupestris* may concern the widespread *P. umbilicata*; this species has been reported in NW Italy by Razkin *et al.* (2016a, 2016b) based on molecular data (Fig. 45).

Family **Chondrinidae** Steenberg, 1925

Granaria frumentum (Draparnaud, 1801). Polytypic species with six subspecies (Fehér *et al.*, 2010; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations have been assigned to *G. frumentum illyrica* (Rossmässler, 1835) (Manganelli *et al.*, 1995), but their taxonomic status needs to be revised (Fehér *et al.*, 2010; Nardi & Niero, 2013).

Granaria stabili (von Martens, 1865). Polytypic species with two subspecies occurring in the western Alps and SE France (Gittenberger, 1973; Falkner *et al.*, 2002; Gavetti *et al.*, 2008). Italian populations are assigned to the nominotypical subspecies (Falkner *et al.*, 2002; Kokshoorn & Gittenberger, 2010).

Granaria variabilis (Draparnaud, 1801). In NW Italy it occurs in the western Alps from the Ligurian to the Cottian Alps (Gittenberger, 1973; Boato *et al.*,

1985; Gavetti *et al.*, 2008); it is also present in some isolated sites in the northern Apennines, between Liguria and Piedmont and in Emilia-Romagna (Alzona, 1971; unpublished personal data).

Solatopupa juliana (Issel, 1866). In NW Italy it only occurs in eastern Liguria (La Spezia province), and outside this area, in Tuscany and Latium (Boato, 1991). It was separated from the very similar *S. similis* (Bruguière, 1792) on the basis of allozymes and DNA sequences (Boato, 1991; Ketmaier *et al.*, 2006).

Fig. 45. Limone Piemonte (CN), rocky walls inhabited by *Pyramidula umbilicata* and *Granaria stabili stabili*; photo M. Bodon.

Solatopupa pallida (Rossmässler, 1842). Endemic species occurring in eastern Liguria (La Spezia and Genoa provinces) and SE Piedmont (Alessandria province), but with a disjunct site in western Liguria (Savona province) (Boato *et al.*, 1985; unpublished personal data). Alleged French reports not confirmed (Falkner *et al.*, 2002).

Solatopupa psarolena (Bourguignat, 1858) (Fig. 46). Semi-endemic species with narrow range limited to the Ligurian Alps (Cuneo and Imperia provinces), where it only occurs in a few sites (Boato *et al.*, 1985), and outside the study area, to Vallée de la Roja (Alpes-Maritimes department), where it

was recently found (Falkner *et al.*, 2002). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019).

Fig. 46. *Solatopupa psarolena*, a semi-endemic species (NWS) with very narrow range (V) in NW Italy. Pigna (IM); photo M. Bodon.

Solatopupa similis (Bruguière, 1792) (Fig. 47). In NW Italy it is widespread in central and western Liguria and localized in Piedmont, where it only occurs in Valle di Susa (Turin province) and in a few valleys in Cuneo province near the Ligurian border (Boato *et al.*, 1985; Gavetti *et al.*, 2008; Margelli, 2012).

Abida secale (Draparnaud, 1801). Polytypic species with 19 subspecies (Kokshoorn & Gittenberger, 2010). NW Italian populations are assigned to the nominotypical subspecies (Kokshoorn & Gittenberger, 2010) (Fig. 48).

Chondrina avenacea (Bruguière, 1792) (Fig. 49). Polytypic species with six subspecies (Kokshoorn & Gittenberger, 2010; Bank & Neubert, 2017). NW Italian populations are assigned to the nominotypical subspecies (Boato *et al.*, 1985; Gavetti *et al*., 2008).

Fig. 47. *Solatopupa similis*, a species widespread (W) mainly in central and western Liguria. Genova (GE); photo M. Bodon.

Fig. 48. Gola delle Fascette (CN-IM), a rocky gorge hosting *Abida secale secale* with *Pyramidula umbilicata*, *Granaria variabilis*, *Chondrina avenacea avenacea*, *Charpentieria itala punctata* and *Chilostoma cingulatum bizona*; photo M. Bodon.

Fig. 49. *Chondrina avenacea avenacea*, a taxon with wide range (W) in NW Italy. Fenestrelle (TO); photo S. Cianfanelli.

Chondrina caziotana Pilsbry, 1918. A semi-endemic species occurring in the Ligurian Alps on Monte Pietravecchia (Imperia province) near the French border (Manganelli *et al.*, 1995), and outside the study area, in the Basses-Alpes and Alpes-Maritimes departments (Gittenberger, 1973). Formerly regarded as a subspecies of *C. megacheilos* (De Cristofori & Jan, 1832) (Gittenberger, 1973; Nardi, 2009), molecular data excludes relationships with the other subspecies of *C. megacheilos* (Bodon *et al.*, 2015).

Chondrina feneriensis Bodon, Nardi, Cianfanelli & Kokshoorn, 2015. Endemic taxon with a very narrow range limited to Monte Fenera in Piedmont (Novara and Vercelli provinces) (Bodon *et al.*, 2015). It is related to *Chondrina generosensis* Nordsieck, 1962, a species only known from western Lombardy and south Switzerland (Nordsieck, 1962; Turner *et al.*, 1998; Boschi, 2011).

Family **Truncatellinidae** Steenberg, 1925

Columella columella (von Martens, 1830). Usually an alpine species (Pegorari, 1883; Boato *et al.*, 1985; Gavetti *et al.*, 2008), it is also found in a few sites in the Ligurian Apennines (Genoa province) (unpublished personal data).

Truncatellina claustralis (Gredler, 1856). In Italy it is an uncommon and localized species outside the central-to-eastern Alpine regions. In NW Italy it occurs near Arona (Novara province) (unpublished personal data), in Valle di Susa (Turin province) (Gavetti *et al.*, 2008), Valle Maira and upper Val Tanaro (Cuneo province), Valle Arroscia and Valle Centa (Imperia and Savona provinces) (unpublished personal data).

Family **Vertiginidae** Fitzinger, 1833

Vertigo alpestris Alder, 1838. Uncommon species in NW Italy where occurring in the northern Alps of Piedmont, between Turin and Vercelli provinces, in Valle d'Aosta and in the Ligurian Alps (Imperia province) (Pollonera, 1885b; unpublished personal data).

Vertigo moulinsiana (Dupuy, 1849). In NW Italy, it occurs in some sites in Piedmont and Valle d'Aosta, but in the latter region it may have disappeared (Pegorari, 1883; Pollonera, 1885b; Bishop, 1976a; Manganelli *et al.*, 2000, 2001; Bodon *et al.*, 2005b; Evangelista, 2007; Gavetti *et al.*, 2008; Sindaco *et al.*, 2009). Species included in Annex II of the Habitats Directive, listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019), and uncommon in Italy (Manganelli *et al.*, 2000, 2001). Nekola *et al*. (2018) assigned this species to the subgenus *Isthmia* Gray, 1821.

Vertigo pusilla Müller, 1774. In NW Italy it only occurs in Valle d'Aosta and northern Piedmont (Stabile, 1864; Pegorari, 1883; Bishop, 1976a; Sindaco *et al.*, 2005; Evangelista, 2009); reported in Liguria from Val Roia (Boato *et al.*, 1985) but never found again.

Vertigo substriata (Jeffreys, 1833). Uncommon species in NW Italy only occurring in the NE Alps of Piedmont, between Lago d'Orta and Lago Maggiore (Novara and Verbano-Cusio-Ossola provinces) (Bishop, 1976a; unpublished personal data).

Vertigo angustior Jeffreys, 1830. Species included in Annex II of the Habitats Directive and listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and Near Threatened by the European Red List of terrestrial gastropods (Neubert *et al*., 2019). Although still widespread and common in Italy (Manganelli *et al*., 2000), it is scattered and localized in NW Italy (mainly in the plains of the rivers Po, Stura di Demonte and Tanaro in Piedmont, Magra and Parmignola in eastern Liguria).

Family **Enidae** Woodward, 1903

Jaminia quadridens (Müller, 1774). Polytypic species with two subspecies. Italian populations are assigned in part to the nominotypical subspecies and in part to *J. quadridens elongata* (Moquin-Tandon, 1856) (Bank & Neubert, 2017; MolluscaBase, 2020). However, molecular study by Modica *et al.* (2016) indicated that Italian *J. quadridens* is a complex of species. NW Italian *Jaminia* were not examined by Modica *et al.* (2016); the closest populations are those from southern France that belong to MOTU A (occurring in Provence and Sardinia). Most Italian populations belong to MOTU E (occuring in central Italy), which includes sinistral and dextral morphs. The shell characters of the western Ligurian populations match those of *J. quadridens elongata*, while those from other parts of NW Italy match the nominotypical subspecies.

Ena montana (Draparnaud, 1801). In NW Italy it only occurs in internal areas of the Alps from Valle di Susa (Turin province) to Val Formazza (Verbano-Cusio-Ossola province) (Bishop, 1976a; Gavetti *et al.*, 2008). Reports from the Langhe (Cuneo province) (Repetto, 1985a) were not confirmed by recent field work.

Zebrina detrita (Müller, 1774) (Fig. 50). In NW Italy it occurs in calcareous areas of Valle d'Aosta, Valle di Susa (Turin province), Valle Maira, Valle Stura di Demonte and Langhe (Cuneo province) (Lessona, 1880; Pegorari, 1883; Pollonera, 1885b; Stabile, 1864; Gavetti *et al.*, 2008; Evangelista, 2009).

Chondrula tridens (Müller, 1774). Polytypic species with three subspecies; Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020).

Family **Clausiliidae** Gray, 1855

Leucostigma candidescens (Rossmässler, 1835). Alien (translocated) species, native to central and southern Apennines (Alzona, 1971; Nordsieck, 2011a). It was reported from Monterosso al Mare (La Spezia province) by Bisacchi (1928) where it has not been found again, despite extensive field work. Polytypic species with nine subspecies (Nordsieck, 2011a). Unfortunately, it has not been possible to examine any historical material from Liguria.

Cochlodina fimbriata (Rossmässler, 1835). Polytypic species with two subspecies (Nordsieck, 2007, 2015). Italian populations are assigned to the nominotypical subspecies, which in the study area occurs in Valdossola (Verbano-Cusio-Ossola province) (Bishop, 1976a), the Maritime and Ligurian Alps (Cuneo, Imperia and Savona provinces) (Boato *et al.*, 1985;

unpublished personal data) and Ligurian-Piedmontese Apennines from Valle Scrivia (Alessandria and Genoa provinces) to Val d'Aveto (Genoa province) (Bisacchi, 1928; Bodon, 2007; unpublished personal data) (Fig. 51).

Fig. 50. *Zebrina detrita*, a species with narrow range (N) in NW Italy. Bardonecchia (TO); photo S. Birindelli.

Cochlodina laminata (Montagu, 1803). Polytypic species with two or more subspecies (Nordsieck, 2007, 2013a, 2015; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020).

Cochlodina comensis (Pfeiffer, 1850). Polytypic species with three subspecies (Nordsieck, 2007, 2015). NW Italian populations are assigned to *C. comensis lucensis* (Gentiluomo, 1868), which occurs in SE Piedmont (Valle Scrivia and Val Borbera, Alessandria province) and in eastern Liguria (Genoa and La Spezia provinces), and outside the study area, in the Tuscan-Emilian Apennines and Apuan Alps (Alzona, 1971; Giusti & Mazzini, 1971; Lori & Cianfanelli, 2005; Bodon, 2007; Cianfanelli, 2009; Cossignani & Cossignani, 2020), Monte Pisano, Monti Livornesi and Colline Metallifere in northern and south-western Tuscany (Meluzzi, 1980; unpublished personal data). The report of the nominotypical subspecies

from western Liguria (Boato *et al.* 1985) was based on misidentification of *C. fimbriata*.

Cochlodina bidens (Linnaeus, 1758). In NW Italy it only occurs in central and eastern Liguria (Bisacchi, 1928; Nordsieck, 1969; unpublished personal data). Bisacchi's (1928) report from Porto Maurizio (Imperia province) has not received any subsequent support (Boato *et al.*, 1985). Formerly reported as *C. incisa* (Küster, 1876), but see note to *Papillifera papillaris* (Müller, 1774).

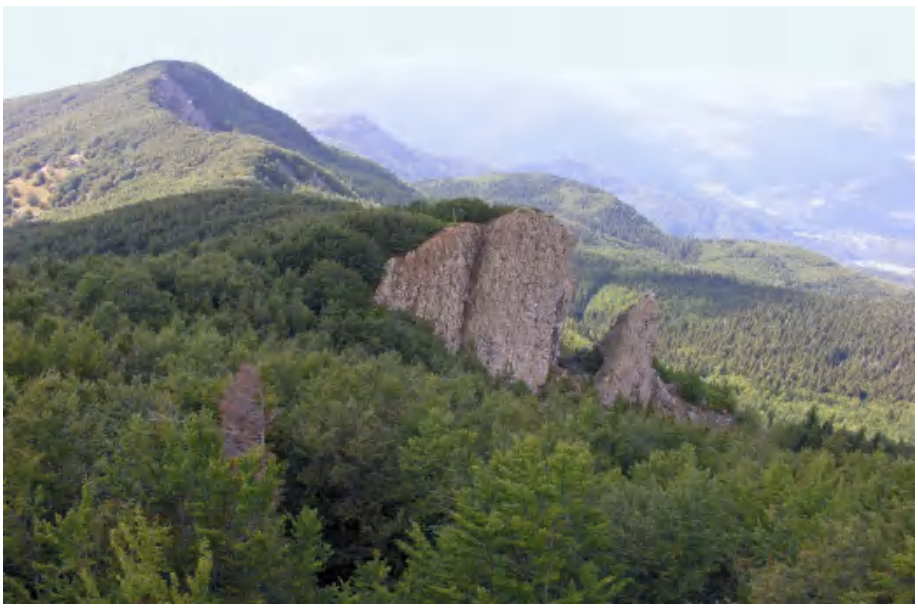

Fig. 51. Beech forest of Monte degli Abeti (GE), habitat of *Cochlodina fimbriata fimbriata*, a taxon widespread (W) mainly in the mountains of Piedmont and Liguria; photo M. Bodon.

Charpentieria dyodon (Studer, 1820) (Fig. 52). Semi-endemic species occurring in the Piedmontese Alps, from Graian to the Lepontine Alps (Gavetti *et al.*, 2008), and outside NW Italy, in a few sites in the Hautes-Alpes department (France), where however it has not been found again in recent years (Falkner *et al.*, 2002), in Sempione and Canton Ticino (Switzerland) (Turner *et al.*, 1998; Boschi, 2011). According to Nordsieck (2002, 2006b, 2007) it is a polytypic species with three or four subspecies, two endemic (*C. dyodon alpina* (Stabile, 1859) and *C. dyodon paulucciana* (Pollonera, 1885), although the status of the latter is doubtful), one quasi-endemic (*C. dyodon thomasiana* (Küster, 1850)) and one semi-endemic (the

nominotypical subspecies). *C. dyodon thomasiana* was formerly regarded a distinct species; it was downgraded by Nordsieck (2002) on the grounds that *C. dyodon paulucciana* has transitional characters between *C. dyodon thomasiana* and *C. dyodon dyodon*.

Fig. 52. *Charpentieria dyodon thomasiana*, a quasi-endemic subspecies (NWQ) in NW Italy. Issime (AO); photo S. Birindelli.

Charpentieria itala (von Martens, 1824) (Figs. 53-54). Polytypic species with many subspecies (Nordsieck, 2007, 2015). NW Italian populations are assigned to *C. itala punctata* (Michaud, 1831) and *C. itala albopustulata* (De Cristofori & Jan, 1832) (subspecific identifications revised by H. Nordsieck, pers. comm., 21.09.2010 and 23.03.2011). In the study area, the former occurs in southern Piedmont and Liguria; the latter, probably introduced (translocated), is only found in lower Valle d'Aosta, in two sites near Ivrea (Turin province) and near Verbania (Verbano-Cusio-Ossola province) (Evangelista, 2009; G. Nardi coll., 2010; unpublished personal data).

Siciliaria piceata (Rossmässler, 1836) (Fig. 55). Alien (translocated) species native to central Italy (Alzona, 1971). In NW Italy it was recently found along the Tanaro and Po rivers (Cuneo, Asti and Alessandria provinces), on the banks of the Magra and at the mouth of the Parmignola rivers (La Spezia province), where it was certainly introduced (unpublished personal data).

Fig. 53. *Charpentieria itala punctata*, an Italian quasi-endemic subspecies (IQ) with narrow range (N) in NW Italy. Varese Ligure (SP); photo M. Bodon.

Fig. 54. *Charpentieria itala albopustulata*, an alien subspecies (NWA) in NW Italy. Pont-Saint-Martin (AO); photo S. Birindelli.

Papillifera papillaris (Müller, 1774) (Fig. 56). Polytypic species with five subspecies (Nordsieck, 2007, 2013b, 2015, as *Papillifera bidens*). NW Italian populations are assigned to the nominotypical subspecies, occurring in Liguria and in southern Piedmont, where they were probably introduced (translocated), because they are only found in anthropized areas (Bisacchi, 1928; Boato *et al.*, 1985, Nordsieck, 2013b; personal unpublished data). This species has been the subject of a long taxonomic-nomenclatural controversy since the 2000s. Falkner *et al.* (2002) resurrected an old and uncertain binomen, *Turbo bidens* Linneaus, 1758, and designating a neotype for it, made the name available as senior synonym of *Helix papillaris* Müller, 1774. Giusti & Manganelli (2005) opposed this action, applying to ICZN to conserve Müller's name for the *Papillifera* species through suppression of the Linnean name (Case 3319), but ICZN rejected the application (Opinion 2176, ICZN, 2007). Kadolsky (2009) subsequently demonstrated that the neotype designation of *Turbo bidens* by Falkner *et al.* (2002) was invalid and proposed a new neotype based on a different new interpretation of the Linnean nominal taxon. This made the name available as senior synomym of *Clausilia incisa* Küster, 1876. Welter-Schultes (2012b) applied to ICZN to conserve the name as senior synonym of *Helix papillaris*, setting aside the neotype designation by Kadolsky (2009) (Case 3581), but ICZN rejected his application (Opinion 2355).

Papillifera solida (Draparnaud, 1805). Polytypic species with four or five subspecies (Nordsieck, 2013b, 2015; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations, assigned to nominotypical subspecies (Nordsieck, 2013b), occur only in westernmost (Imperia province) and easternmost (La Spezia province) Liguria (Tapparone Canefri, 1869; Bisacchi, 1928; Boato *et al.*, 1985). However, in eastern Liguria the species has not been found in recent times.

Ruthenica filograna (Rossmässler, 1836). Polytypic species with five subspecies (Nordsieck, 2019). Italian populations, assigned to nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020), only occur in western Liguria (Imperia province) (Boato *et al.*, 1985), eastern Alps, Karst and a few sites in central Italy (Alzona, 1971; Maassen, 1987; Boato *et al.*, 1989; Manganelli *et al.*, 1995; De Mattia, 2003, 2004).

Macrogastra ventricosa (Draparnaud, 1801). Polytypic species with three subspecies (Nordsieck, 2006a, 2007, 2015). NW Italian populations are assigned to the nominotypical subspecies (Nordsieck, 2006a), which only occurs in Valle del Bouthier, Valle d'Aosta (Pegorari, 1883; Pollonera, 1885b).

Macrogastra attenuata (Rossmässler, 1835). Polytypic species with six subspecies (Nordsieck, 2006a, 2007, 2015). NW Italian populations are assigned to

two subspecies: *M. attenuata lineolata* (Held, 1836) and *M. attenuata iriana* (Pollonera, 1885); the former occurs in northern Piedmont and the latter in southern Piedmont and Liguria (Nordsieck, 2006a).

Macrogastra badia (Pfeiffer, 1828). Polytypic species with five subspecies (Nordsieck, 2006a, 2007, 2015). NW Italian populations are assigned to *M. badia alpina* Nordsieck, 2006, which only occurs in western Piedmont (Valle di Susa, Turin province) and Valle d'Aosta (Nordsieck, 2003, 2006a; Gavetti *et al.*, 2008).

Macrogastra mellae (Stabile, 1864) (Fig. 57). Polytypic species with three subspecies, recently separated from *M. attenuata* (Rossmässler, 1835) (Nordsieck, 2003, 2007, 2015). Italian populations are assigned to the quasi-endemic nominotypical subspecies which occurs in western Liguria and central-western Piedmont (Nordsieck, 2003, 2006a; Gavetti *et al.*, 2008). The other two subspecies occur in the Alpes-Maritimes department (France) (Nordsieck, 2003; Gargominy & Ripken, 2006), but *M. mellae leia* (Bourguignat, 1877), has also been found in debris of the Roia river (Imperia province), near the French border (unpublished personal data).

Macrogastra plicatula (Draparnaud, 1801). Polytypic species with seven subspecies (Nordsieck, 2006a, 2007, 2015). NW Italian populations are assigned to the nominotypical subspecies and *M. plicatula apennina* (Gentiluomo, 1868). The former occurs in NW Italy and the latter in southern Piedmont and Liguria (Cuneo, Alessandria, Genoa and Savona provinces), partially overlapping with the former (Bisacchi, 1928; Bishop, 1976a; Boato *et al.*, 1985; Nordsieck, 2006a; Gavetti *et al.*, 2008).

Clausilia bidentata (Strøm, 1765) (Fig. 58). Polytypic species with four subspecies (Nordsieck, 1990, 2007, 2015). Italian populations are assigned to *C. bidentata crenulata* Risso 1826, a semi-endemic subspecies which only occurs in two distinct areas in western Liguria (one between the Italian-French border and Imperia and the other between Savona and Genoa, and northward to Molare in Piedmont) (Bisacchi, 1928; Boato *et al.*, 1985; Nordsieck, 1990; unpublished personal data), and outside the study area, in SE Provence (Nordsieck, 1990).

Clausilia cruciata (Studer, 1820) (Fig. 59). Polytypic species with four to six subspecies (Nordsieck, 2007, 2015; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations are assigned to three subspecies: the nominotypical, *C. cruciata bonellii* von Martens, 1873, and the endemic *C. cruciata pedemontana* Nordsieck, 1990. In NW Italy, *C. cruciata bonellii* occurs in southern Piedmont and Liguria (Boato *et al.*, 1985; unpublished personal data), while *C. cruciata cruciata* is found in NE Piedmont

(Bishop, 1976a). The endemic *C. cruciata pedemontana* is only present in the western Alps (Nordsieck, 1990).

Clausilia dubia Draparnaud, 1805 (Fig. 60). Polytypic species with many subspecies of uncertain taxonomic status (Bank & Gittenberger, 2000; Nordsieck, 2007, 2015; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations are assigned to the nominotypical subspecies (Bank & Gittenberger, 2000), present in the Alps of Piedmont and in the upper Val Tanaro (Imperia province) (Pegorari, 1883; Pollonera, 1885b; Bishop, 1976a; Boato *et al.*, 1985; Gavetti *et al.*, 2008; unpublished personal data).

Fig. 55. *Siciliaria piceata*, an alien species (NWA) in NW Italy. Sarzana (SP); photo M. Bodon.

Clausilia rugosa (Draparnaud, 1801). Polytypic species with ten subspecies (Nordsieck, 2007, 2015; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations are assigned to two subspecies: *C. rugosa parvula* (Férussac, 1807) and *C. rugosa pinii* Westerlund, 1878. The former occurs in the Cottian (Cuneo province) and Graian (Valle d'Aosta) Alps, and outside the study area, in France (Pollonera, 1885b; Nordsieck, 1990; unpublished personal data) and possibly in other parts of central and southern Europe (Bank & Neubert, 2017; MolluscaBase, 2020). The latter ranges from southern Piedmont and Liguria to Abruzzo, and outside Italy,

is found in a site in the Alpes-Maritimes department (Nordsieck, 1990; Gargominy & Ripken, 2006).

Laciniaria plicata (Draparnaud, 1801). Polytypic species with five to eight subspecies (Nordsieck, 1990, 2007, 2008, 2015; Bank & Neubert, 2017; MolluscaBase, 2020). Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020), which occurs in the central Alps from Val Cervo (Biella province) to Lago Maggiore (Novara and Verbano-Cusio-Ossola province) (Pollonera, 1885b; Alzona, 1971; Bishop, 1976a; unpublished personal data), and outside NW Italy, in western Lombardy (Stabile, 1864). Alleged reports from central Lombardy and Trentino-Alto Adige (Ehrmann, 1956) need confirmation.

Balea perversa (Linnaeus, 1758). Uncommon species of conservation concern in Italy (Manganelli *et al.*, 1995, 2000) still quite widespread in northern Piedmont and Valle d'Aosta (Eikenboom, 1996; Sindaco *et al.*, 2005; Gavetti *et al.*, 2008; Evangelista, 2009), whereas the Ligurian and Apennine populations have declined, vanishing from some areas (Boato *et al.*, 1985).

Fig. 56. *Papillifera papillaris papillaris*, an alien taxon (NWA) in NW Italy. Sestri Levante (GE); photo M. Bodon.

Fig. 57. *Macrogastra mellae mellae*, a quasi-endemic taxon (NWQ) in NW Italy. Torino (TO); photo S. Birindelli.

Fig. 58. *Clausilia bidentata crenulata*, a semi-endemic subspecies (NWS) with narrow range (N) in NW Italy. Dolcedo (IM); photo M. Bodon.

Fig. 59. *Clausilia cruciata bonellii*, a quasi-endemic subspecies (IQ) in Italy. Varese Ligure (SP); photo M. Bodon.

Fig. 60. *Clausilia dubia dubia*, a taxon with wide range (W) in NW Italy. Courmayeur (AO); photo S. Birindelli.

Family **Punctidae** Morse, 1864

Paralaoma servilis (Shuttleworth, 1852). Alien species of uncertain origin (Falkner *et al.*, 2002; Halgass & Vannozzi, 2010), collected in Italy since the 19th century (Pfeiffer, 1846) and now widespread in most of Italy (Lori *et al.*, 2005) (Fig. 61). Due to its controversial taxonomic setting, this species has changed its name many times: *Punctum pusillum* (Lowe, 1831), *Toltecia pusilla* (Lowe, 1831), *Pleuropunctum micropleum* (Paget, 1854) and *Paralaoma caputspinulae* (Reeve, 1852) (Manganelli *et al.*, 1995; Falkner *et al.*, 2002).

Fig. 61. Glacial erratic "Pietra Grossa" (Caselette, TO), a suburban garden where four alien species were found: *Paralaoma servilis*, *Boettgerilla pallens*, *Ambigolimax valentianus* and *Deroceras invadens*; photo S. Birindelli.

Family **Helicodiscidae** Baker, 1927

Lucilla scintilla (Lowe, 1852). This species was first discovered in Italy on Montecristo Island (Tuscan Archipelago) and was regarded as a new species endemic to Montecristo (*Helicodiscus riparbellii* Giusti, 1976). When it was subsequently found in many other Italian, European and west Mediterranean sites, it was suspected to be an alien species (Manganelli *et al.*, 1995). According to Falkner *et al.* (2002) it matches a species,

described from Madeira by Lowe (1852), which is presumably native to the west Palaearctic, but was probably introduced into Macaronesia. On the contrary, according to Horsák *et al*. (2009) it is native to North America. Italian specimens from Piedmont match those first found on Montecristo anatomically (unpublished personal data). Available data maintain that, at least in Italy, it is a recently-introduced alien species.

Lucilla singleyana (Pilsbry, 1889). Alien species native to North America (Manganelli *et al.*, 1995; Halgass & Vannozzi, 2010), first reported from Italy in 1971 (Pezzoli, 1985). Now it occurs in all regions, living in subterranean habitats along rivers in plain and hill areas (Bodon *et al.*, 2004). According to Falkner *et al.* (2002), European populations constitute a native species different from that of North America. Be this as it may, in Italy it is a recently-introduced alien species.

Family **Discidae** Thiele, 1931

Discus ruderatus (Hartmann, 1821) (Fig. 62). In NW Italy it only occurs along the Alps from Valle di Susa (Turin province) to Val Formazza (Verbano-Cusio-Ossola province) (Bishop, 1976a; Gavetti *et al.*, 2008).

Discus rotundatus (Müller, 1774). Polytypic species with two subspecies (Falkner *et al.*, 2002), but Alba *et al*. (2011) have questioned the validity of *D. rotundatus omalisma* (Fagot, 1879). Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020).

Family **Pristilomatidae** Cockerell, 1891

Hawaiia minuscula (Binney, 1841). Alien species of Neartic origin, only recently reported in Italy (Bodon *et al.*, 2004). In NW Italy it occurs in scattered localities, along the Ligurian coast, near Viverone and in the Scrivia and Po plains in Piedmont (Birindelli *et al.*, 2015; unpublished personal data).

Vitrea contracta (Westerlund, 1871). Uncommon species in NW Italy, found in Valle d'Aosta where it occurs mainly along the Dora Baltea, and in Piedmont where it occurs in Valle di Susa (Turin province) and in Biella province (Gavetti *et al.*, 2008; Evangelista, 2009; unpublished personal data).

Vitrea narbonensis (Clessin, 1877). Some populations of *Vitrea* from the high Valle del Po (Cuneo province) show anatomical characters (sarcobellum) matching those of *V. narbonensis* (see Riedel, 1980). This species, widespread in NE Spain and southern France (Welter-Schultes, 2012a), has

also been found in scattered sites in the Ain and Hautes-Pyrénées departments (France) (unpublished personal data).

Vitrea pseudotrolli Pintér, 1983. Quasi-endemic species occurring in Liguria and southern Piedmont (Boato *et al.*, 1985; Cossignani & Cossignani, 1995, 2020; unpublished personal data), and outside NW Italy, in the Alpes-Maritimes department (France) (Gargominy & Ripken, 1999).

Fig. 62. *Discus ruderatus*, a species with wide range (W) in NW Italy. Courmayeur (AO); photo S. Birindelli.

Vitrea subrimata (Reinhardt, 1871). Probably a group of species in need of revision (Manganelli *et al.*, 1995; Ferreri *et al.*, 2005). As currently conceived, *V. subrimata* is common and widespread in Italy.

Vitrea sp. 1. Probably an undescribed endemic species of the *V. subrimata* group, with troglophile habitus and narrow range (it only occurs in eastern Liguria and nearby SE Piedmont). With respect to the sympatric *V. subrimata*, it has a shell with rather slowly expanding whorls and unpigmented ocular tentacles (unpublished personal data).

Vitrea sp. 2. Another undescribed endemic species of *Vitrea*, very rare and probably endogean. It is similar to *V. subrimata* but characterized by rather large size

and a rather wider umbilicus. It has only been found in the karst area of Bossea, Ligurian Alps (Cuneo province) (unpublished personal data).

Family **Gastrodontidae** Tryon, 1866

Zonitoides arboreus (Say, 1817) (Fig. 63). Alien species native to northern and central America (Pilsbry, 1946; Riedel, 1980; Seddon, 2008), recently found in Piedmont (Turin and Biella provinces), Valle d'Aosta and Liguria (Genoa and Savona provinces) (Evangelista *et al.*, 2013; Birindelli *et al.*, 2015; unpublished personal data).

Fig. 63. *Zonitoides arboreus*, an alien species (IA) in Italy. Chiaverano (TO); photo S. Birindelli.

Aegopinella minor (Stabile, 1864). The only medium-sized *Aegopinella* species occurring in NW Italy (Piedmont and Valle d'Aosta; Forcart, 1959; Bishop, 1976a; Riedel, 1983; Sindaco *et al.*, 2005; Gavetti *et al.*, 2008; Evangelista, 2009; unpublished personal data). Formerly reported as *Hyalinia dutaillyana* Mabille, 1878, *Hyalinia nitens* Michaud, 1831, or *Hyalinia nitidula* Draparnaud, 1805 (Strobel, 1853; Mortillet, 1862; Pini, 1885; Pollonera, 1885b, 1886a; Piolti, 1887; Eikenboom, 1996).

Aegopinella pura (Alder, 1830). Past reports based on shell identifications need to be confirmed. Indeed, only anatomical characters make it possible to distinguish this species with certainty from similarly shelled *Retinella pseudoaegopinella* Giusti, Boato & Bodon, 1986 (see Giusti *et al.*, 1986).

Retinella giustii Riedel, 1998. Endemic species occurring in NE Piedmont (Biella, Vercelli, Novara and Verbano-Cusio-Ossola provinces; Riedel, 1998; unpublished personal data). Reports of *Retinella hiulca* (Albers, 1850) from Piedmont (Pollonera, 1886a; Bishop, 1976a; Pascutto, 1998) are based on misidentified specimens of *R. giustii*.

Retinella olivetorum (Gmelin, 1791) (Fig. 64). Polytypic species with two subspecies (Riedel, 1980). NW Italian populations are assigned to the nominotypical subspecies (Riedel, 1980) which, in NW Italy, occurs in southern Piedmont and Liguria, and outside Italy, only in Bouches-du-Rhône department, France (Magnin *et al.*, 2012).

Fig. 64. *Retinella olivetorum olivetorum*, a quasi-endemic taxon (IQ) in Italy. Varese Ligure (SP); photo M. Bodon.

Retinella pseudoaegopinella Giusti, Boato & Bodon, 1986. In NW Italy it occurs in the Ligurian, Maritime and Cottian Alps (Savona, Imperia and Cuneo provinces) and in the Pennine Alps (Novara and Vercelli provinces) (Giusti

et al., 1986; unpublished personal data); outside the study area it is only present in the Alpes-Maritimes department (France) (Falkner *et al.*, 2002). Reports from northern Lombardy (Eikenboom, 1996) need to be confirmed by anatomical study.

Retinella stabilei (Pollonera, 1886) (Fig. 65). Endemic species with narrow range limited to Colle San Giovanni and Valli di Lanzo (Turin province) (Giusti *et al.*, 1986; Manganelli *et al.*, 2000; Gavetti *et al.*, 2008). Reports from Valle d'Aosta (Pollonera, 1886a) not confirmed by recent field work.

Fig. 65. *Retinella stabilei*, an endemic species (NWE) with very narrow range (V) in NW Italy. Viù (TO); photo M. Bodon.

Family **Oxychilidae** Hesse, 1927

Daudebardia rufa (Draparnaud, 1805). In NW Italy it occurs only in SE Piedmont where it was probably introduced (unpublished personal data).

Oxychilus draparnaudi (Beck, 1837) (Fig. 66). Most Italian reports of *O. cellarius* (Müller, 1774), a central northern European species never found in Italy, concern this species (Giusti & Manganelli, 1997).

Oxychilus mortilleti (Pfeiffer, 1859) (Fig. 67). Polytypic species with two subspecies; Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). A frequently misidentified species only occurring in Alpine and pre-Alpine area, from the Pennine to the Julian Alps and in the Karst (Manganelli & Giusti, 1998; Dalfreddo *et al.*, 2000; De Mattia, 2003; Dalfreddo, 2005). In NW Italy it only occurs east of the Dora Riparia river (Bishop, 1976a; Eikenboom, 1996; Manganelli & Giusti, 1998; Pascutto, 1998; Lana *et al.*, 2016; Lana & Sella, 2016) and in southern Piedmont (only in Val Pesio, Cuneo province; unpublished personal data). Reports from Finalese (Boato *et al.*, 1985, as *O.* cfr. *mortilleti*) based on misidentified specimens of *O. draparnaudi*.

Fig. 66. *Oxychilus draparnaudi*, a species with wide range (W) in NW Italy. Lavagna (GE); photo M. Bodon.

Oxychilus gardinii Manganelli, Bodon & Giusti, 1991. Endemic species with narrow range limited to western Ligurian Apennines (Savona province) (Manganelli *et al.*, 1991) and southern Piedmont (Alessandria province) (unpublished personal data).

Oxychilus meridionalis (Paulucci, 1881). Uncommon species in NW Italy only occurring in eastern Liguria (from Levanto to eastern sector of La Spezia

province; unpublished personal data); outside the study area, it only occurs in Tuscany (Manganelli & Giusti, 2001).

Morlina glabra (Rossmässler, 1835). Polytypic species with five subspecies (Riedel, 1980; Bank & Neubert, 2017; MolluscaBase, 2020). Northern Italian populations are assigned to the nominotypical subspecies (Boato *et al.*, 1985; Gavetti *et al.*, 2008); they occur along the Alps from Piedmont to Trentino-Alto Adige.

Fig. 67. *Oxychilus mortilleti mortilleti*, a taxon with wide range (W) in NW Italy. Grignasco (NO); photo S. Birindelli.

Mediterranea depressa (Sterki, 1880). Uncommon species, known in Italy only from a few Alpine localities in the Graian Alps, Pennine Alps, eastern Dolomites, Carnic Alps and Prealps (Alzona, 1971; Decet & Fossa, 2001; Cianfanelli *et al.*, 2005); in Piedmont only known from four sites in Aosta, Biella and Verbano-Cusio-Ossola provinces (Pascutto, 2002; Cianfanelli *et al.*, 2005; unpublished personal data).

Mediterranea hydatina (Rossmässler, 1838). Polytypic species with two subspecies; Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020).

Mediterranea polygyra (Pollonera, 1885) (Fig. 68). Endemic species occurring in the Graian Alps, Pennine Alps and around Verbania (Valle d'Aosta and northern Piedmont; Giusti & Manganelli, 1999; Sindaco *et al.*, 2005).

Fig. 68. *Mediterranea polygyra*, an endemic species (NWE) with narrow range (N) in NW Italy. Noasca (TO); photo M. Bodon.

Family **Milacidae** Ellis, 1926

Milax nigricans (Philippi, 1836) (Fig. 69). In NW Italy it occurs sporadically in Liguria, only in coastal areas; also found in Turin, where it was introduced (Boato *et al.*, 1985; unpublished personal data).

Tandonia budapestensis (Hazay, 1880) (Fig. 70). Probably introduced (translocated) into NW Italy, where it occurs sporadically in Liguria (Genoa and Imperia provinces; Simroth, 1910; Boato *et al*., 1985) and in Piedmont (Biella and Turin provinces; unpublished personal data).

Tandonia sowerbyi (Férussac, 1823). In NW Italy it only occurs in central-eastern Liguria, mainly in coastal areas (Boato *et al.*, 1985; unpublished personal data).

Fig. 69. *Milax nigricans*, a species with narrow range (N) in NW Italy. Torino (TO); photo S. Birindelli.

Family **Zonitidae** Mörch, 1864

Zonites algirus (Linnaeus, 1758). Alien species native to south Balkan Peninsula (Riedel, 1992). In the NW Mediterranean it occurs only in southern France (Falkner *et al.*, 2002); in the past it was also reported from a few sites in western Liguria where it is now probably extinct (Boato *et al.*, 1985).

Family **Vitrinidae** Fitzinger, 1833

Hessemilimax kotulae (Westerlund, 1883). In NW Italy it has only been reported from Valle d'Aosta (Pollonera, 1884, 1885b; Cossignani & Cossignani, 2020) and is also found in Valle Orco (Turin province) (unpublished personal data).

Vitrinobrachium baccettii Giusti & Mazzini, 1971 (Fig. 71). Species occurring in the eastern Liguran Alps, northern Apennine, and outside the study area, in the Apuan Alps and the Tuscan Apennine (Giusti & Mazzini, 1971; Boato *et al.*, 1985; Lori & Cianfanelli, 2005). The report of *Vitrina brevis* Férussac, 1821, from Busalla (Genoa province) (Pollonera, 1889b) concerns this species (unpublished personal data).

Vitrinobrachium breve (Férussac, 1821). In NW Italy it has only been found near Vignole Borbera (Alessandria province) (identification based on anatomical characters). Reports based on shell identifications from the Piedmontese and Ligurian Apennines need to be confirmed. Other old records, such as that from Lago della Vecchia in Valle Cervo (Biella province) (Pollonera, 1884, 1885b) may belong to a different species because *V. breve* does not live at high altitudes. *V. breve* is probably a complex of species in need of revision (Giusti *et al.*, 2011).

Fig. 70. *Tandonia budapestensis*, an alien species (NWA) in NW Italy. Caselette (TO); photo S. Birindelli.

Eucobresia diaphana (Draparnaud, 1805). In NW Italy it only occurs in the Alps of Piedmont and Valle d'Aosta, from Valli di Viù (Turin province) to Val Formazza (Verbano-Cusio-Ossola province) (Stabile, 1864; Lessona, 1880; Pollonera, 1885b, 1886a; Gambetta, 1932b; Bishop, 1976a).

Eucobresia glacialis (Forbes, 1837). In NW Italy it only occurs in the Alps of Piedmont and Valle d'Aosta, from Valle di Susa (Turin province) to Val Formazza (Verbano-Cusio-Ossola province), mostly at high altitudes up to 3400 m (Pollonera, 1885b; Bishop, 1976a; Pascutto, 1998; Gavetti *et al.*, 2008; Giusti *et al.*, 2011).

Eucobresia nivalis (Dumont & Mortillet, 1854). In NW Italy it only occurs in the Alps of Piedmont and Valle d'Aosta, from Valli di Lanzo (Turin province) to Val Formazza (Verbano-Cusio-Ossola province), mostly at high altitudes up to 2950 m (Stabile, 1864; Pegorari, 1883; Pollonera, 1884, 1885b; Bishop, 1976a; Eikenboom, 1996; Giusti *et al.*, 2011; unpublished personal data).

Fig. 71. *Vitrinobrachium baccettii*, an endemic species (IE) in Italy. Sesta Godano (SP); photo M. Bodon.

Eucobresia pegorarii (Pollonera, 1884). Rare species in NW Italy; it has only been reported from Valle d'Aosta (Pollonera, 1884, 1885b; Sindaco *et al.*, 2005) and is also found in Valle Orco (province of Turin) (unpublished personal data). Listed as Endangered by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019).

Phenacolimax blanci (Pollonera, 1884). Endemic species with very narrow range limited to the Ligurian and Maritime Alps (Liguria and Piedmont) (Boato *et al.*, 1985; unpublished personal data). NW Italian reports of *P. major* (Férussac, 1807) (cf. Alzona, 1971; Bishop, 1976a; Boato *et al.*, 1985), a species never found in Italy, concern *P. blanci*, *P. locardi* (Pollonera, 1884) or *P. stabilei* (Lessona, 1880). Listed as Vulnerable by the European Red

List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al*., 2019).

Phenacolimax locardi (Pollonera, 1884) (Fig. 72). Endemic species occurring in Valle di Susa (Turin province), in Biella province, in Val Sesia (Vercelli province) and along Lago Maggiore (Novara and Verbano-Cusio-Ossola provinces) (Bishop, 1976, as *P. major*; Gavetti *et al.*, 2008). Anatomical characters of *Phenacolimax* from the NW Piedmontese Alps support the distinction of two species, the endemic *P. locardi* living at low or middle altitudes (400-1900 m) and the quasi-endemic *P. stabilei* living at high altitudes (1800-2820 m) (Gavetti *et al.*, 2008).

Fig. 72. *Phenacolimax locardi*, an endemic species (NWE) with narrow range (N) in NW Italy. Fontainemore (AO); photo S. Birindelli.

Phenacolimax stabilei (Lessona, 1880). Quasi-endemic species occurring in the western Alps, from Val Nervia (Imperia province) to Valle di Susa (Turin province) (Gavetti *et al.*, 2008), and outside the study area, to the Hautes-Alpes department (De Winter, 1990).

Family **Boetgerillidae** Wiktor & Likharev, 1979

Boettgerilla pallens Simroth, 1912 (Fig. 73). Alien species native to the Caucasus (Wiktor, 1989), recently found in Valle di Susa, Val Pellice, Monte Castello near Givoletto, Collina di Torino (Turin province) and Valle d'Aosta (Gavetti *et al.*, 2008; unpublished personal data).

Fig. 73. *Boettgerilla pallens*, an alien species (IA) in Italy. Torre Pellice (TO); photo S. Birindelli.

Family **Limacidae** Lamarck, 1801

Limax alpinus Férussac, 1822 (Fig. 74). Quasi-endemic species occurring in northern Piedmont, from Biella to Verbano-Cusio-Ossola provinces, in Valle d'Aosta, and outside the study area, in NW Lombardy, Switzerland, and maybe in France (Nitz *et al.*, 2009, as *L. sarnensis* Heim & Nitz in Nitz *et al.*, 2009; Heim *et al.*, 2010, as *L. sarnensis*; Brandstetter & Kapp, 2014; unpublished personal data). Nitz *et al.* (2009) designated a neotype from near Ebensee (Niederösterreich, Austria) that was conspecific with *L. cinereoniger* Wolf, 1803. Consequently Welter-Schultes (2012a) and Bank & Neubert (2017) regarded *L. alpinus* as a junior synonym of Wolf's species. However the validity of the neotype designation by Nitz *et al.* (2009) was disputed by Brandstetter (2011) who argued that it does not

meet the conditions of Art. 75.3.6, because the neotype did not come as nearly as practicable from the type locality (Switzerland).

Limax canapicianus Pollonera, 1885 (Fig. 75). Endemic species only occurring in the Graian and Pennine Alps (Turin and Aosta provinces) (Alzona, 1971; Brandstetter, 2015; unpublished personal data).

Fig. 74. *Limax alpinus*, a quasi-endemic species (NWQ) in NW Italy. Champorcher (AO); photo S. Birindelli.

Limax dacampi Menegazzi, 1855 (Figs. 76-77). Polytypic species with two subspecies (Manganelli *et al.*, 1995). NW Italian populations are assigned to the nominotypical subspecies and to the endemic *L. dacampi cruentus* Lessona, 1880. The former occurs in Valle d'Aosta, Piedmont and central-eastern Liguria and has frequently been reported as *L. cinereoniger* Wolf, 1803, a species absent in NW Italy (Bodon *et al.*, 2019). The latter only occurs in southern Piedmont and western Liguria (Ligurian Alps and western Ligurian Apennines; Cuneo and Savona provinces); sometimes specimens from the western Ligurian Apennines have a chromatic habitus similar to that of the nominotypical subspecies (Boato *et al.*, 1985). Reports from Switzerland and Great Britain (Turner *et al.*, 1998; Boschi, 2011; Rowson *et al.*, 2014a, 2014b) need to be re-examined.

Limax erythrus Bourguignat, 1864 (Fig. 78). Quasi-endemic species occurring in the Maritime, Cottian and Graian Alps, in Piedmont and Valle d'Aosta (Simroth, 1910, as *L. maximus* Linnaeus, 1758, partim; Boato *et al.*, 1985, as *Limax* sp. A; Gavetti *et al.*, 2008; unpublished personal data), and outside NW Italy, in the Hautes-Alpes department (France) (De Winter, 1990). Frequently reported as *L. albipes* Dumont & Mortillet, 1853, a species probably absent in Italy (Gavetti *et al.*, 2008).

Limax maximus Linnaeus, 1758. Species living in plains and hilly areas, mainly in anthropogenic habitats. In mountain sites of the Ligurian Alps, some populations have specimens that are black or have few or small dark spots (Boato *et al.*, 1985). Some have been assigned to other species (Brandstetter, 2014: *L. millipunctatus* Pini, 1885), although their anatomical characters are similar to those of *L. maximus* (unpublished personal data).

Limax millipunctatus Pini, 1885 (Fig. 79). Probably an endemic species with narrow range, limited to the Ligurian-Piedmontese Apennines west of Genoa (Pini, 1885; Pollonera, 1888; Alzona, 1971; Brandstetter, 2014; Cossignani & Cossignani, 2020; unpublished personal data). Falkner *et al.* (2002) also listed it from France, based on material from the Alpes-Maritimes department, identified by C. Pollonera and published by Caziot (1910). However, Pollonera did not study internal penial structure which provides the only characters for certain identification in this group of *Limax* species. Occurrence of the species in France is therefore uncertain. Reports from Lombardy (Pini, 1885; Manganelli *et al.*, 1995) also require confirmation.

Limax polipunctatus Pollonera, 1888 (Fig. 80). Quasi-endemic species occurring in the Graian Alps, near Givoletto (Turin province) and in the western Ligurian Apennines between Genoa and Savona (Pollonera, 1886a, 1888; Manganelli *et al.*, 1995; Brandstetter, 2014), and outside the study area, possibly in western Lombardy (Varese province) (unpublished personal data).

Limax subalpinus Lessona, 1880 (Fig. 81). Endemic species occurring in the SW Alps (Boato *et al.*, 1985; Gavetti *et al.*, 2008; Brandstetter, 2015). It is replaced by *L. alpinus* in NE Piedmont and Valle d'Aosta. Reports from Switzerland and Bulgaria (Wiktor, 1983; Turner *et al.*, 1998) require confirmation.

Fig. 75. *Limax canapicianus*, an endemic species (NWE) with narrow range (N) in NW Italy. Cogne (AO); photo M. Bodon.

Fig. 76. *Limax dacampi dacampi*, a quasi-endemic taxon (IQ) in Italy. Montanaro (TO); photo C. Rossato.

Fig. 77. *Limax dacampi cruentus*, an endemic subspecies (NWE) with narrow range (N) in NW Italy. Chiusa Pesio (CN); photo L. Leardi.

Fig. 78. *Limax erythrus*, a quasi-endemic species (NWQ) in NW Italy. Entracque (CN); photo S. Birindelli.

Fig. 79. *Limax millipunctatus*, an endemic species (NWE) with very narrow range (V) in NW Italy. Mornese (AL); photo M. Bodon.

Fig. 80. *Limax polipunctatus*, a quasi-endemic species (NWQ) with very narrow range (V) in NW Italy. Givoletto (TO); photo S. Birindelli.

Limax sp. 1 (Fig. 82). Undescribed endemic species with narrow range limited to eastern Liguria (Boato *et al.*, 1985, as *Limax* sp. B). Similar to *L. corsicus* Moquin-Tandon, 1855 in external appearance but with male distal genitalia as in *L. polipunctatus.*

Limax sp. 2 (Fig. 83). Undescribed species occurring in SE Piedmont, eastern Liguria, Emilia-Romagna and Tuscany (Giusti & Mazzini, 1971, as *L. callichrous* Bourguignat, 1862; Boato *et al.*, 1985, as *Limax* sp. C; unpublished personal data).

Limacus flavus (Linnaeus, 1758) (Fig. 84). In NW Italy, it occurs in Liguria and Piedmont where it was probably (Liguria) or certainly (Piedmont) introduced (translocated), only being found in urban habitats (Colosi, 1920; Boato *et al.*, 1985; Gavetti *et al.*, 2008; iNaturalist, 2020; Natura Mediterraneo, 2020; unpublished personal data).

Lehmannia cf. *marginata* (Müller, 1774) (Fig. 85). In NW Italy it only occurs in a few isolate sites in eastern Liguria (Monte Aiona and Monte Zatta; unpublished personal data). The taxonomic setting of these populations (and of others south of Tuscany) is uncertain: they may be conspecific with *L. marginata*, a mainly northern and eastern Alpine species (Forcart, 1966a), although reported from other European non-alpine countries as well (Bank & Neubert, 2017; MolluscaBase, 2020).

Lehmannia rupicola Lessona & Pollonera, 1882. *Lehmannia* sp. from Valle di Susa and Val Soana (Graian Alps, Turin province) (Gavetti *et al.*, 2008) corresponds to this species (unpublished personal data).

Ambigolimax valentianus (Férussac, 1821) (Fig. 86). Alien species native to the Iberian Peninsula (Waldén, 1961). In NW Italy it has been reported from Liguria (all provinces; Falkner, 1981; unpublished personal data) and Piedmont (Verbano-Cusio-Ossola, Biella and Turin provinces; Bodon *et al*., 2004; Birindelli *et al*., 2015; Cossignani & Cossignani, 2020; unpublished personal data). Assigned to the genus *Ambigolimax* by Rowson *et al.* (2014a) on molecular evidence.

Family **Agriolimacidae** Wagner, 1935

Deroceras agreste (Linnaeus, 1758). Most past reports of *D. agreste* concern other species, mainly *D. reticulatum*. Indeed, *D. agreste* is a mountain species, generally restricted to Alpine meadows (Bishop, 1976a; Gavetti *et al.*, 2008).

Fig. 81. *Limax subalpinus*, a species endemic to NW Italy (NWE). Nomaglio (TO); photo S. Birindelli.

Fig. 82. *Limax* sp. 1, an endemic species (NWE) with narrow range (N) in NW Italy. Borzonasca (GE); photo M. Bodon.

Fig. 83. *Limax* sp. 2, a species endemic to Italy (IE) with narrow range (N) in NW Italy. Lerici (SP); photo M. Bodon.

Fig. 84. *Limacus flavus*, an alien species (NWA) in NW Italy. Torino (TO); photo S. Birindelli.

Fig. 85. *Lehmannia* cf. *marginata*, a species with very narrow range (V) in NW Italy. Borzonasca (CN); photo M. Bodon.

Fig. 86. *Ambigolimax valentianus*, an alien species (IA) in Italy. Finale Ligure (SV); photo S. Birindelli.

Deroceras bisacchianum Bodon, Boato & Giusti, 1982 (Fig. 87). Endemic species with narrow range limited to western Liguria (Bodon *et al.*, 1982) and upper Valle Tanaro (Cuneo province) (unpublished personal data).

Deroceras invadens Reise, Hutchinson, Schunack & Schlitt, 2011 (Fig. 88). Alien species of uncertain origin, widespread throughout Italy, recently separated from *D. panormitanum* (Lessona & Pollonera, 1882), the latter regarded as limited to Sicily and the Maltese Islands (Reise *et al.*, 2011). In NW Italy it occurs in Liguria (all provinces; Bodon *et al.*, 1982; Bodon, 2007; Gavetti *et al.*, 2008; Repetto, 2012) and in Piedmont (Novara, Verbano-Cusio-Ossola, Biella, Turin, Asti and Alessandria provinces; Simroth, 1910; Bishop, 1976a, 1980; Bodon *et al*., 1982; Gavetti *et al*., 2008; unpublished personal data). Putative earlier names for this species are: *D. queenslandicus* (Hedley, 1888), *D. cecconii* (Pollonera, 1896), *D. ilvaticus* (Pollonera, 1905), *D. scharffi* (Simroth, 1910) and *D. dubius* (Hoffmann, 1941). Their status should be re-examined to ascertain their availibility to denote this species.

Deroceras panormitanum (Lessona & Pollonera, 1882). According to Reise *et al.* (2011), a species apparently restricted to Sicily and the Maltese Islands. However, it has recently been reported from outside Sicily (Great Britain, Portugal, Balearic Islands, Malta; Bank & Neubert, 2017; Castillejo & Iglesias, 2017; Holyoak *et al*., 2019; MolluscaBase, 2020). In NW Italy, the only known report is from Bordighera, western Liguria, based on specimens that were probably introduced, identified on anatomical characters (Hutchinson *et al.*, 2014).

Deroceras rodnae Grossu & Lupu, 1965 (Fig. 89). Species with a mainly central-eastern European distribution, known in Italy from a few isolated sites in western Liguria (Bodon *et al.*, 1982).

Deroceras sturanyi (Simroth, 1894) (Fig. 90). Alien species recently found in Italy on the shores of Lago di Viverone (Turin province) (Birindelli *et al.*, 2015).

Deroceras sp. 1. Undescribed quasi-endemic species with narrow range limited to the Ligurian Alps (Bodon *et al.*, 1982), and outside the study area, to the Alpes-Maritimes department (France) (Falkner *et al.*, 2002, as *D.* sp. 3 [“prope *bisacchiunum*”]).

Deroceras sp. 2. Undescribed endemic species occurring in Piedmont, from the Cottian to the Pennine Alps (Gavetti *et al.*, 2008).

Fig. 87. *Deroceras bisacchianum*, an endemic species (NWE) with narrow range (N) in NW Italy. Finale Ligure (SV); photo M. Bodon.

Fig. 88. *Deroceras invadens*, an alien species (IA) in Italy. Caselette (TO); photo S. Birindelli.

Fig. 89. *Deroceras rodnae*, a species with very narrow range (V) in NW Italy. Ventimiglia (IM); photo M. Bodon.

Fig. 90. *Deroceras sturanyi*, an alien species (IA) in Italy. Piverone (TO); photo S. Birindelli.

Family **Euconulidae** Baker, 1928

Euconulus fulvus s.l. (Müller, 1774) (Fig. 91). European euconulids have been traditionally assigned to two species: *E. fulvus* and *E. alderi* (Gray, 1840) (e.g. Kerney *et al.*, 1983). Based on a revision in progress, Falkner *et al.* (2002) recognized two additional species in western Europe (see also Gargominy & Ripken, 2011). Falkner and coworkers' revision is not yet available and some of their nomenclatural issues have been questioned by Welther-Schultes *et al.* (2011, 2012a) and Holyoak *et al.* (2019). Recently, Horsakova *et al.* (2020) confirmed the validity, in Europe, on molecular data (mitochondrial 16S+COII) and nuclear ITS1+ITS2), of only two species: *E. fulvus* and *E. alderi*. The Italian material of *E. fulvus* s.l. will need to be re-examined.

Fig. 91. *Euconulus fulvus* s.l., a species with wide range (W) in NW Italy. Courmayeur (AO); photo S. Birindelli.

Family **Arionidae** Gray, 1840

Arion rufus (Linnaeus, 1758) (Fig. 92). Alien species native to central Europe (Falkner *et al.*, 2002), uncommon in Italy (Lori *et al.*, 2005). In NW Italy it has only been reported from Gignese (Verbano-Cusio-Ossola province)

(Bishop, 1976a) where it was recently confirmed (unpublished personal data).

Arion vulgaris Moquin-Tandon, 1855 (Fig. 93). Alien invasive species of uncertain origin, probably from the central Europe (Falkner *et al.*, 2002; Pfenninger *et al.*, 2014; Zając *et al.*, 2017), found in Italy since 1965 (Altena, 1971; Cesari, 1978; Magnaghi *et al.*, 1978). The species is widespread in western Europe and in expansion; it occurs in many sites in northern Italy, both in anthropogenic and natural habitats. It was formerly reported as *A. lusitanicus* Mabille, 1868, but Castillejo (1997) first showed that *A. lusitanicus* was a slug endemic to Portugal, different from the species invading central Europe, for the which the name *A. vulgaris* was available. Since Kerney (1999), the taxonomic independence of the two taxa has been widely accepted. Colomba *et al*. (2007) added further genetic evidence in support of the existence of two separate species, and Pfenninger *et al.* (2014) showed that *A. vulgaris* had central European origin. Zając *et al.* (2017) reviewed its biology, nomenclature, distribution, characteristics, control methods and status. According to Backeljau & De Bruyn (1990) and Backeljau & De Winter (1987), *A. vulgaris* belongs to the subgenus *Mesarion* Hesse, 1926, whereas according to Rowson *et al.* (2014a) it belongs to the nominotypical subgenus.

Fig. 92. *Arion rufus*, an alien species (IA) in Italy. Gignese (VB); photo M. Bodon.

Arion euthymeanus Florence, 1886 (Fig. 94). In Italy it only occurs in western Liguria and in two valleys in Piedmont: Valle di Susa (Turin province) and Valle Tanaro (Cuneo province) (Boato *et al.*, 1985; Gavetti *et al.*, 2008); it is also present in SE France (Falkner *et al.*, 2002). Formerly erroneously reported from western Liguria as *A.* cf. *atripunctatus* Dumont & Mortillet, 1857 (Boato *et al.*, 1985).

Arion fuscus (Müller, 1774) (Fig. 95). Formerly known as *A. subfuscus* (Draparnaud, 1805). Forcart (1966b) argued that two distinct taxa were reported under this name: one widespread in central-northern Europe, for which he proposed the name *A. fuscus* (Müller, 1774), and another from Montagne Noire (France), for which the name *A. subfuscus* was available. Based on morphology and molecular data (allozyme and mitochondrial 16S rDNA), Pinceel *et al.* (2004) supported distinction of the two species, reporting them from several European countries. Italian specimens, identified on the basis of anatomical characters evidenced by Pinceel *et al.* (2004), correspond to *A. fuscus.*

Arion circumscriptus Johnston, 1828. Species of subgenus *Carinarion* Hesse, 1926, *A. circumscriptus*, *A. fasciatus* (Nilsson, 1823) and *A. silvaticus* Lohmander, 1937 are genetic strains (Backeljau *et al.*, 1987, 1997; Jordaens *et al.*, 1998). Each strain may be regarded as a distinct species (Jordaens *et al.*, 2001, 2002) or all strains may be included in a single species (Geenen *et al.*, 2006). Based on new molecular data (mitochondrial COI and 16S; nuclear ITS), Rowson *et al.* (2014a) suggested regarding *A. circumscriptus* and *A. silvaticus* as conspecific (but perhaps distinct as subspecies on the basis of habitat separation) and *A. fasciatus* as a different species.

Arion distinctus Mabille, 1868 (Fig. 96). Alien species native to central-northern Europe (Welter-Schultes, 2012a). *A. cottianus* Pollonera, 1889 (type locality: Bardonecchia, Turin province) is a junior synonym of *A. distinctus* based on the original description and figures (see Pollonera, 1889c, fig. 23; Gavetti *et al.*, 2008; Manganelli *et al.*, 2010) and re-examination of topotypes (unpublished personal data). It has only been found at Bardonecchia (near the cemetery) and at Courmayeur, in Valle d'Aosta (unpublished personal data).

Arion intermedius Normand, 1852. Includes *Arion alpinus* Pollonera, 1887 (Manganelli *et al.*, 2010).

Arion obesoductus Reischütz, 1973 (Fig. 97). In NW Italy it occurs at Santuario di Oropa (Biella province) (Falkner, 1990; Falkner *et al.*, 2002; G. Nardi, pers. comm., 17.03.2011) and in Valle d'Aosta (unpublished personal data). Italian specimens reported as *A. hortensis* Férussac, 1819, partly correspond to this species which has sometimes been quoted as *A. alpinus* (e.g.

Reischütz, 1980; Falkner, 1990; Falkner *et al.*, 2002; Dvořák *et al.*, 2006). The latter, recently revised by Manganelli *et al.* (2010), is a junior synonym of *A. intermedius*.

Arion franciscoloi Boato, Bodon & Giusti, 1983 (Fig. 98). Species occurring in central-eastern Liguria, in southern Piedmont (near Voltaggio, Alessandria province), and outside the study area, in the Apuan Alps and the Tuscan-Emilian Apennines (Boato *et al.*, 1983; Cianfanelli, 2009; unpublished personal data). Tentatively assigned to the subgenus *Arion* s.s. by Bank & Neubert (2017), but its systematic setting needs reconsideration. Indeed, it has distinctive anatomical characters (Boato *et al.*, 1983; Backeljau & De Bruyn, 1990) and molecular (mitochondrial DNA (COI and 16S) and nuclear DNA (ITS) sequences; Rowson *et al.*, 2014a), which support a genus/subgenus taxon of its own.

Ariunculus speziae Lessona, 1881. Quasi-endemic species occurring in the Graian and Pennine Alps (Piedmont and Valle d'Aosta), and outside the study area, in Canton Ticino (Switzerland) (Gambetta, 1928; Lessona, 1880, 1881; Bishop, 1976a; Sindaco *et al.*, 2005; Boschi, 2011). Bishop (1976a) regarded *Ariunculus* as a distinct genus. However, the status of this taxon should be re-analysed in a thorough revision of supraspecific taxonomy of arionids.

Fig. 93. *Arion vulgaris*, an alien species (IA) in Italy. Valchiusella (TO); photo S. Birindelli.

Fig. 94. *Arion euthymeanus*, a species with narrow range (N) in NW Italy. Claviere (TO); photo S. Birindelli.

Fig. 95. *Arion fuscus*, a species with wide range (W) in NW Italy. Bionaz (AO); photo S. Birindelli.

Fig. 96. *Arion distinctus*, an alien species (IA) in Italy. Bardonecchia (TO); photo S. Birindelli.

Fig. 97. *Arion obesoductus*, a species with very narrow range (V) in NW Italy. Champdepraz (AO); photo S. Birindelli.

Fig. 98. *Arion franciscoloi*, a species endemic to Italy (IE) with narrow range (N) in NW Italy. Camogli (GE); photo M. Bodon.

Family **Sphincterochilidae** Zilch, 1960

Sphincterochila candidissima (Draparnaud, 1801). According to Hallgass & Vannozzi (2010), it is an alien species in Italy; in NW it only occurs in western Liguria (Imperia and Savona provinces), mainly in coastal areas (Boato *et al.*, 1985).

Family **Helicodontidae** Kobelt, 1904

Falkneria camerani (Lessona, 1880) (Fig. 99). Endemic species with very narrow range limited to the Pennine Alps, where it is known from very few localities (Alzona, 1971; Welter-Schultes, 2012a; Manganelli *et al.*, 2000; Cossignani & Cossignani, 2020). Species of special conservation concern due to its narrow distribution and rarity (Manganelli *et al.*, 2000). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the European Red List of terrestrial gastropods (Neubert *et al.*, 2019).

Helicodonta angigyra (Rossmässler, 1834). Alien (translocated) species native to central Alps (Lombardy and Trentino-Alto Adige in Italy; Canton Ticino in

Switzerland) (Girod, 1968; Gavetti *et al.*, 2008; Boschi, 2011). In NW Italy it only occurs in Valle di Susa (Turin province) where it was introduced (Gavetti *et al.*, 2008). Also introduced in the Savoie Alps (Savoie and Haute-Savoie departments, France) (Falkner *et al.*, 2002).

Fig. 99. *Falkneria camerani*, an endemic species (NWE) with very narrow range (V) in NW Italy. Tavigliano (BI); photo G. Nardi.

Helicodonta obvoluta (Müller, 1774) (Fig. 100). Polytypic species with five subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations may be assigned to the nominotypical subspecies by virtue of their reduced peristomal tooth; the other alpine subspecies, *H. obvoluta dentata* (Westerlund, 1876), occurring in central and eastern alpine areas, is characterized by a well developed peristomal tooth.

Drepanostoma nautiliforme Porro, 1836 (Fig. 101). Quasi-endemic species occurring in the central Alps from the Graian Alps to the western Lombard Prealps and Canton Ticino in Switzerland (Girod, 1968; Turner *et al.*, 1998; Gavetti *et al.*, 2008; Boschi, 2011).

Fig. 100. *Helicodonta obvoluta obvoluta*, a taxon with wide range (W) in NW Italy. Grignasco (NO); photo S. Birindelli.

Fig. 101. *Drepanostoma nautiliforme*, a quasi-endemic species (NWQ) in NW Italy. Grignasco (NO); photo S. Birindelli.

Family **Hygromiidae** Tryon, 1866

Trochulus suberectus (Clessin, 1878). Species of uncertain validity (Welter-Schultes, 2012a). In NW Italy only reported from two site in Valle d'Aosta (Piccolo San Bernardo; Forcart, 1965; Servaz, Valtournenche; Cossignani & Cossignani, 2020); recently it was also collected in a few other localities (La Thuile, Val Veny and Courmayeur; unpublished personal data).

Edentiella edentula (Draparnaud, 1805). Polytypic species with five subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations are assigned to the nominotypical subspecies (Gavetti *et al.*, 2008). In NW Italy it is an uncommon species, only known from two localities, one in Valle di Susa (Turin province) (Gavetti *et al.*, 2008) and the other in Valle d'Aosta (F. Giusti coll., 1992).

Monacha cantiana (Montagu, 1803) (Fig. 102). The separation between this species and *M. cemenelea* (Risso, 1826) (see Falkner *et al.*, 2002) was recently confirmed by molecular data (Pieńkowska *et al.*, 2018). However, it is still unclear whether they can be distinguished morphologically (*M. cantiana* has a less evident calotte-shaped swelling at the base of the vaginal appendix than *M. cemenelea*; Pieńkowska *et al.*, 2018). *Monacha* populations from the foothills of the Alps bordering the Po plain seems to match topotypical populations of *M. cantiana* from the United Kingdom due to less evident calotte-shaped swelling at the base of the vaginal appendix (unpublished personal data).

Monacha cemenelea (Risso, 1826) (Fig. 103). This species, first described from southern France and frequently reported from Italy (Alzona, 1971), was regarded as a junior synonym of *M. cantiana* until the early 2000s, when Falkner *et al.* (2002) separated it again from Montagu's species. Although their distinction was recently confirmed by molecular data, it is still unclear whether it is morphologically distinct from *M. cantiana* (alleged more evident calotte-shaped swelling at the base of the vaginal appendix than in *M. cantiana*) (Pieńkowska *et al.*, 2018).

Monacha cf. *martensiana* (Tiberi, 1869). Probably an alien (translocated) species native to central Italy (Manganelli *et al*., 1995). It has only been found in Valle Maira (Cuneo province), where it was certainly introduced (unpublished personal data). This species has also been reported from the Alpes-Maritimes department by Gargominy & Ripken (2006).

Monacha parumcincta (Rossmässler, 1834) (Fig. 104). Alien (translocated) species native to central and southern Italy and the Adriatic and southern Balkan Peninsula (Falkner, 1990; Ferreri *et al.*, 2005; Bank & Neubert, 2017). In NW Italy it was recently found in Liguria near Carasco, Lavagna and Sestri

Levante (Genoa province), where it was certainly introduced (unpublished personal data). According to Welter-Schultes (2012a) the identity of this species is problematic; here it is considered in its usual sense (cf. Pieńkowska *et al.*, 2018). A contribution to its taxonomic and nomeclatural setting is in preparation by F. Giusti and colleagues.

Fig. 102. *Monacha cantiana*, a species widespread (W) in the plains of Piedmont, recently introduced into Liguria. Ronco Scrivia (GE); photo M. Bodon.

Euomphalia strigella (Draparnaud, 1801) (Fig. 105). Polytypic species with three subspecies (Falkner *et al.*, 2002; Bank & Neubert, 2017; MolluscaBase, 2020). Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020).

Urticicola glabellus (Draparnaud, 1801). Polytypic species with two subspecies (Falkner *et al.*, 2002; Bank & Neubert, 2017; MolluscaBase, 2020). Italian populations are assigned to the nominotypical subspecies (Gavetti *et al.*, 2008). In Italy, the species only occurs in the western Alps, from the Ligurian to the Graian Alps in Valle d'Aosta (Pollonera, 1885b, as *Helix* (*Trichia*) spp.; Boato *et al.*, 1985; Gavetti *et al.*, 2008; unpublished personal data).

Fig. 103. *Monacha cemenelea*, a species formerly widespread (W) in Liguria but now rare. Villanova d'Albenga (SV); photo S. Birindelli.

Urticicola mounierensis (Caziot, 1909) (Fig. 106). Polytypic species with two subspecies (Falkner *et al.*, 2002; Bank & Neubert, 2017; MolluscaBase, 2020). Italian populations are assigned to the nominotypical semi-endemic subspecies (unpublished personal data). This species only occurs in scattered localities of the western Alps, at high altitudes (Boato *et al.*, 1985, as *Perforatella* (*Monachoides*) cfr. *ventouxiana* Forcart, 1946; Manganelli *et al.*, 1995, as *U. ventouxiana*; Gargominy & Ripken, 2006, as *U. mounierensis*/*U.* sp.) (Fig. 107). Beyond the Italian border, it is only present in Mercantour (Alpes-Maritimes department) (Falkner *et al.*, 2002; Gargominy & Ripken, 2006).

Urticicola moutonii (Dupuy, 1847) (Fig. 108). Semi-endemic species occurring in the Ligurian Alps near the Italian-French border (Boato *et al.*, 1985, as *Perforatella* (*Monachoides*) sp.; Manganelli *et al.*, 1995, as *U. telonensis* (Mittre, 1848); Cossignani & Cossignani, 2020), and outside the study area, in SE France (Falkner *et al.*, 2002). This taxon was regarded as conspecific with *U. telonensis*, but Falkner *et al.* (2002) separated the two species.

Pseudotrichia rubiginosa (Rossmässler, 1838). Re-examination of the historical material and study of new specimens show that reports of *Trochulus plebeius* (Draparnaud, 1805) from Piedmont (Stabile, 1864; Lessona, 1879,

1880; Pegorari, 1883; Pollonera, 1885b; Gavetti *et al.*, 2008) must be assigned to *P. rubiginosa*. In Piedmont it was only found in the Turin plain in recent surveys (Gavetti *et al.*, 2008; unpublished personal data).

Fig. 104. *Monacha parumcincta*, an alien species (NWA) in NW Italy. Carasco (GE); photo M. Bodon.

Pseudotrichia rubiginosa (Rossmässler, 1838). Re-examination of the historical material and study of new specimens show that reports of *Trochulus plebeius* (Draparnaud, 1805) from Piedmont (Stabile, 1864; Lessona, 1879, 1880; Pegorari, 1883; Pollonera, 1885b; Gavetti *et al.*, 2008) must be assigned to *P. rubiginosa*. In Piedmont it was only found in the Turin plain in recent surveys (Gavetti *et al.*, 2008; unpublished personal data).

Monachoides incarnatus (Müller, 1774) (Fig. 109). Polytypic species with three subspecies (Bank & Neubert, 2017; MolluscaBase, 2020) but one of them, *M. incarnatus armatus* Stabile (1859) is questioned by Turner *et al.* (1998). NW Italian populations are therefore assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). In Italy it only occurs along the Alps (Alzona, 1971); in NW Italy it is present in northern Piedmont and in lower Valle d'Aosta (southern border of its range: lower Valli di Lanzo and Po river) (Bishop, 1976a; Eikenboom, 1996; Pascutto, 1998; Sindaco *et al.*, 2005; unpublished personal data).

Fig. 105. *Euomphalia strigella strigella*, a taxon with wide range (W) in NW Italy. Sauze d'Oulx (TO); photo S. Birindelli.

Fig. 106. *Urticicola mounierensis mounierensis*, a semi-endemic taxon (NWS) with very narrow range (V) in NW Italy. Argentera (CN); photo M. Bodon.

Fig. 107. Argentera (CN), rock rubble where *Urticicola mounierensis mounierensis* can be found with *Phenacolimax stabilei* and *Arianta arbustorum vareliensis*; photo M. Bodon.

Fig. 108. *Urticicola moutonii*, a semi-endemic species (NWS) with very narrow range (V) in NW Italy. Pigna (IM); photo M. Bodon.

Fig. 109. *Monachoides incarnatus incarnatus*, a taxon with wide range (W) in NW Italy. Valchiusella (TO); photo S. Birindelli.

Family **Geomitridae** Boettger, 1909

Cochlicella acuta (Müller, 1774) (Fig. 110). In NW Italy it mainly occurs in western Liguria, limited to coastal areas (Boato *et al.*, 1985).

Cochlicella conoidea (Draparnaud, 1801). In NW Italy it only occurred in western Liguria, where it lived in dune habitats; it is now extinct due habitat destruction (Boato *et al.*, 1985).

Cochlicella barbara (Linnaeus, 1758) (Fig. 111). In NW Italy it occurs only in Liguria, mainly in coastal areas (Boato *et al.*, 1985; Repetto, 2012).

Xerotricha apicina (Lamarck, 1822). In NW Italy it only occurs in westernmost (Imperia and Savona provinces) and easternmost (La Spezia province) Liguria, limited to coastal areas (Tapparone Canefri, 1869; Boato *et al.*, 1985; unpublished personal data).

Microxeromagna lowei (Potiez & Michaud, 1838). Alien species probably of west Mediterranean origin (Halgass & Vannozzi, 2010), occurring in very few Italian localities (Giusti & Manganelli, 1989; Manganelli *et al.*, 1995, 2014). In NW Italy it is only present in westernmost Liguria (Falkner,

1981). Formerly known as *M. vestita* (Rambur, 1868) or *M. armillata* (Lowe, 1852).

Backeljaia gigaxii (Pfeiffer, 1847). In Italy it only occurs in western Liguria (Alzona, 1971; Boato *et al.*, 1985). Formerly included in the genus *Candidula* Kobelt, 1871, but since Chueca *et al.* (2017) demonstrated the polyphyly of this genus based on molecular data, the species was included in the new genus *Backeljaia* Cuenca, Gómez-Moliner, Madeira & Pfenninger, 2017.

Cernuella aginnica (Locard, 1882). In Italy it mainly occurs in western Liguria, where it inhabits coastal areas (Boato *et al.*, 1985). Reports of "*Xerophila neglecta*" from Porto Maurizio (Imperia province) and Noli (Savona province) (Pollonera, 1892) concern this species because *C. neglecta* does not occur in coastal areas in Liguria.

Cernuella virgata (da Costa, 1778). In NW Italy it occurs in Liguria, where it sporadically inhabits coastal areas, and in Piedmont (Verbano-Cusio-Ossola, Asti and Alessandria provinces), where it was introduced (translocated) (Tapparone Canefri, 1869; Boato *et al.*, 1985; Repetto, 2012; unpublished personal data).

Fig. 110. *Cochlicella acuta*, a species with narrow range (N) in NW Italy. Imperia (IM); photo M. Bodon.

Fig. 111. *Cochlicella barbara*, a species with narrow range (N) in NW Italy. Villanova d'Albenga (SV); photo S. Birindelli.

Cernuella neglecta (Draparnaud, 1805). In NW Italy it occurs in the Piedmont plain, Langhe, lower Valle Scrivia, Monferrato and Piedmontese Apennines (Turin, Cuneo, Asti, Alessandria, Savona and Genoa provinces) (Strobel, 1853; Stabile, 1864; Lessona, 1880; unpublished personal data).

Xerosecta cespitum (Draparnaud, 1801) (Fig. 112). The taxonomy of *Xerosecta* is still uncertain and the status of several taxa is therefore still uncertain. Italian populations, usually reported as *X. cespitum* (cf. Manganelli *et al.*, 1995), were assigned to a distinct endemic species, *X. introducta* (Villa & Villa, 1841), by Falkner *et al.* (2002), Gargominy & Ripken (2011), Gargominy *et al.* (2011) and Bank & Neubert (2017). The latter was regarded as a junior synonym of *X. cespitum* by Manganelli *et al.* (1995) and Welter-Schultes *et al.* (2011). Some *Xerosecta* species have been examined in the framework of helicoidean phylogenetic studies but their relationships remain uncertain and unsupported (cf. Manganelli *et al.*, 2005; Razkin *et al.*, 2015). In NW Italy it occurs in Valle di Susa (Gavetti *et al.*, 2008) and in southern Piedmont and Liguria (Lessona, 1880; Pollonera, 1893; Aparicio, 1985; Boato *et al.*, 1985; Repetto, 2012).

Candidula unifasciata (Poiret, 1801). Polytypic species with subspecies, some of which have controversial status whereas others may be distinct species

(Giusti & Mazzini, 1971; Pfenninger & Magnin, 2001; Falkner *et al.*, 2002; Bank & Neubert, 2017; Chueca *et al.*, 2017; MolluscaBase, 2020). NW Italian populations are assigned to the nominotypical subspecies (Giusti & Mazzini, 1971).

Fig. 112. *Xerosecta cespitum*, a species widespread (W) mainly in southern Piedmont and Liguria. Villanova d'Albenga (SV); photo S. Birindelli.

Candidula unifasciata (Poiret, 1801). Polytypic species with subspecies, some of which have controversial status whereas others may be distinct species (Giusti & Mazzini, 1971; Pfenninger & Magnin, 2001; Falkner *et al.*, 2002; Bank & Neubert, 2017; Chueca *et al.*, 2017; MolluscaBase, 2020). NW Italian populations are assigned to the nominotypical subspecies (Giusti & Mazzini, 1971).

Candidula sp. 1. An undescribed endemic species with a very narrow range limited to the Ligurian-Piedmontese Apennines (Fig. 113). It has a keeled shell similar to that of some species from the central Apennines, but its anatomy matches that of *C. unifasciata* (unpublished personal data).

Xerolenta obvia (Menke, 1828) (Fig. 114). Alien (translocated) species native to central and eastern Europe (Falkner *et al.*, 2002), recently found in some localities of Valle di Susa (Turin province), Valle d'Aosta and near Turin

(Gavetti *et al.*, 2008; Busato, 2009, 2012; Evangelista, 2009; unpublished personal data). Polytypic species with two subspecies; Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020).

Fig. 113. Crocefieschi (GE), rocky walls where *Candidula* sp. 1 can be found with *Solatopupa pallida*, *Granaria variabilis* and *Jaminia quadridens*; photo M. Bodon.

Trochoidea elegans (Gmelin, 1791). In NW Italy it only occurs in Liguria (western Liguria and near La Spezia) where it inhabits coastal areas (Alzona, 1971; Boato *et al.*, 1985; Cossignani & Cossignani, 1995; Welter-Schultes, 2012a).

Trochoidea pyramidata (Draparnaud, 1805). In NW Italy it only occurs in westernmost (Imperia province) and easternmost Liguria (La Spezia province), where it inhabits coastal or plain areas (Gentile & Sulliotti, undated; Tapparone Canefri, 1869; unpublished personal data).

Trochoidea trochoides (Poiret, 1789) (Fig. 115). In NW Italy it only occurs in central and western Liguria, in coastal areas (Imperia, Savona and Genoa provinces) (Boato *et al.*, 1985; Falkner, 1990; Cossignani & Cossignani, 1995).

Fig. 114. *Xerolenta obvia obvia*, an alien taxon (NWA) in NW Italy. Oulx (TO); photo S. Birindelli.

Fig. 115. *Trochoidea trochoides*, a species with narrow range (N) in NW Italy. Villanova d'Albenga (SV); photo S. Birindelli.

Xerocrassa geyeri (Soós, 1926) (Fig. 116). In Italy it occurs in very few localities of western and northern Piedmont, at high altitudes, where it was only recently found (Valle Maira and Valle Varaita, Cuneo province; Valle di Susa and Val Chisone, Turin province; Val Formazza, Verbano-Cusio-Ossola province) (Gavetti *et al.*, 2008; De Mattia & Páll-Gergely, 2014; unpublished personal data).

Fig. 116. *Xerocrassa geyeri*, a species with narrow range (N) in NW Italy. Oulx (TO); photo S. Birindelli.

Family **Helicidae** Rafinesque, 1815

Arianta arbustorum (Linnaeus, 1758) (Fig. 117). Polytypic species with some subspecies (Falkner *et al.*, 2002; Gittenberger *et al.*, 2004; Bank & Neubert, 2017; MolluscaBase, 2020), occurring in Italy only in the Alps. The NW Italian populations are assigned to four subspecies: the nominotypical subspecies, *A. arbustorum alpicola* (Férussac, 1821), the semi-endemic *A. arbustorum repellini* (Reeve, 1852) and *A. arbustorum vareliensis* Ripken & Falkner, 2000 (Falkner *et al.*, 2002; Gavetti *et al.*, 2008). *A. arbustorum alpicola* is regarded by Gittenberger *et al.* (2004) as an ecotype of *A. arbustorum arbustorum* based on molecular data, although the two forms can be recognized and live in different areas at least in the western Alps (Gavetti *et al.*, 2008). In NW Italy, the nominotypical subspecies (including

A. arbustorum alpicola) occurs in the Alpine sector of Piedmont and Valle d'Aosta from the Cottian Alps to Val Formazza (Verbano-Cusio-Ossola province); *A. arbustorum repellini* is present in the upper Valle Po (Cuneo province), and outside the study area, in the Hautes-Alpes department (Gittenberger, 1991; unpublished personal data); *A. arbustorum vareliensis* inhabits the upper Valle Stura di Demonte and the upper Valle Maira in the Cottian Alps (Cuneo province), and outside the study area, the Mercantour massif in the Alpes-Maritimes department (Gargominy & Ripken, 2006; unpublished personal data). In a revision of the ariantine helicids combining morphological and molecular data, Groenenberg *et al.* (2016) found that *A. arbustorum repellini* and *A. arbustorum vareliensis* form a clade distinct from that including the nominotypical subspecies.

Chilostoma adelozona (Strobel, 1857). Polytypic species with three subspecies, two living in Italy: *C. adelozona adelozona* and the semi-endemic *C. adelozona foetens* (Studer, 1820) (Bank & Neubert, 2017; MolluscaBase, 2020; unpublished personal data). The nominotypical subspecies occurs in Brescia and the Bergamasque Prealps, and outside Italy, in Canton Ticino, Switzerland (Manganelli *et al.*, 1995; Turner *et al.*, 1998, as *C. achates adelozona*; Boschi, 2011). The other subspecies is present in Valle d'Aosta and nearby areas of Switzerland and possibly France (Stabile, 1864, as *Helix foetens* var. *cisalpina* partim; Forcart, 1933, as *Helicogona zonata foetens*; Manganelli *et al.*, 1995, as *C. zonata foetens*; Turner *et al.*, 1998, as *C. zonatum* partim; Falkner *et al.*, 2002, as *C. zonatum foetens*; Formenti, 2012, as *Chilostoma zonatum foetens* partim; Sindaco *et al.*, 2005, as *Chilostoma zonatum* (Studer, 1820) partim). The latter, formerly a subspecies of *C. zonatum* (Manganelli *et al.*, 1995; Bank & Neubert, 2017; MolluscaBase, 2020), has been assigned to *C. adelozona* based on personal unpublished anatomical research.

Chilostoma frigidum (De Cristofori & Jan, 1832). Gargominy & Ripken (2006) regarded *C. frigidum* (De Cristofori & Jan, 1832) as a species distinct from *C. cingulatum* (Studer, 1820), including the nominotypical subspecies and two other subordinate taxa living in high altitude habitats, formerly regarded as subspecies of *C. cingulatum*: *C. frigidum liguricum* (Kobelt, 1876) and *C. frigidum hermesianum* (Pini, 1874). Based on molecular data, Groenenberg *et al.* (2016) confirmed the distinction between *C. frigidum* and *C. cingulatum* and assigned *C. frigidum* to *Chilostoma* (*Chilostoma*). NW Italian populations are assigned to the quasi-endemic *C. frigidum liguricum* which occurs in the Ligurian Alps, at high altitudes (Pollonera, 1890b; Alzona & Alzona Bisacchi, 1938; Pfeiffer, 1951; Boato *et al.*, 1985), and outside the study area, in Marguareis, Alpes-Maritimes department (Gargominy & Ripken, 2006). Some populations are reduced or have disappeared, probably in relation to climate change (unpublished personal data).

Fig. 117. *Arianta arbustorum vareliensis*, a semi-endemic subspecies (NWS) with very narrow range (V) in NW Italy. Argentera (CN); photo M. Bodon.

Chilostoma millieri (Bourguignat, 1880) (Fig. 118). Semi-endemic species with very narrow distribution limited to a small area of the Maritime Alps between Italy and France (Falkner *et al.*, 2002; unpublished personal data). Species in need of revision: it is very close to *C. adelozona*, from which it is only distinguished by some weak anatomical features. Specimens from the Ligurian Alps, reported by Boato *et al.* (1985) as *Helicigona zonata* cf. *millieri*, belong to *C. zonatum*.

Chilostoma tigrinum (De Cristofori & Jan, 1832). Species with disjunct distribution, consisting of a larger eastern sector (Lombardy Prealps, from Lago di Como to Lago d'Iseo; Pfeiffer, 1951) and a smaller western sector (Cottian Alps: Valle Grana and Valle Maira, Cuneo province) (iNaturalist, 2020; unpublished personal data). In the Cottian Alps it lives in natural habitats, which suggests that its occurrence here, far and isolated from the main area inhabited by the species, is natural. This taxon is listed as a distinct species by virtue of some shell and anatomical characters (unpublished personal data) and molecular data (Groenenberg *et al.*, 2016), which distinguish it from *C. cingulatum*.

Chilostoma zonatum (Studer, 1820) (Fig. 119). Species occurring in the western and central Alps, in NW Italy from the Ligurian (Boato *et al.*, 1985) to the

Lepontine Alps (Bishop, 1976a). Taxonomy of populations from the SW Alps is controversial. They were assigned to *C. zonatum flavovirens* (Dumont & Mortillet, 1852) by Falkner *et al.* (2002), but their characters are variable and do not discriminate them from the nominotypical subspecies occurring in the central Alps (Gavetti *et al.*, 2008). Only specimens from the type locality (Moncenisio, Haute-Savoie department) are distinct by virtue of shell colour, but this seems insufficient to include them in a distinct subspecies.

Fig. 118. *Chilostoma millieri*, a semi-endemic species (NWS) with very narrow range (V) in NW Italy. Valdieri (CN); photo M. Bodon.

Chilostoma cingulatum (Studer, 1820) (Fig. 120). *C. cingulatum* group includes many taxa, usually regarded as subspecies, although some have at times been considered distinct species. In the absence of modern revisions, the taxonomy of this group of land snails remains controversial (Manganelli *et al.*, 1995). In a revision of the ariantine helicids combining morphological and molecular data, Groenenberg *et al.* (2016) examined some taxa of the *C. cingulatum* group, finding that they grouped into two clades: most belong to *C. cingulatum*, a species assigned to the subgenus *Cingulifera* Held, 1838; the others belong to two distinct species (*C. frigidum* and *C. tigrinum*) that clustered with species of the nominotypical subgenus. NW Italian populations of *C. cingulatum* belong to a quasi-endemic subspecies

of *C. cingulatum* (i.e. *C. cingulatum bizona* (Rossmässler, 1842)), which occurs in the Ligurian Alps (Boato *et al.*, 1985, as *Helicigona* (*Chilostoma*) *cingulata* cfr. subsp. *cingulata*; Cossignani & Cossignani, 2020), and outside the study area, in Vallée de la Roja, Alpes-Maritimes department (Pfeiffer, 1951, as *C. cingulata cingulata*; Falkner *et al.*, 2002 and Gargominy *et al.*, 2011, as *C. cingulatum cingulatum*).

Fig. 119. *Chilostoma zonatum*, a species widespread (W) in the mountains of Piedmont and Valle d'Aosta. Roccaforte Mondovì (CN); photo M. Bodon.

Campylaea planospira (Lamarck, 1822). Polytypic species with some subspecies (Manganelli *et al.*, 1995) of uncertain value and rank (some may be local ecomorphs, others distinct species). NW Italian populations are assigned to the nominotypical subspecies (Manganelli *et al.*, 1995) which occurs in a sector of the Ligurian-Piedmontese Apennines, between Alessandria, Savona and Genoa provinces, widely separated from the main range (central Italy) (unpublished personal data). It was also reported from La Spezia province by Tapparone Canefri (1869) where it has not been found again, despite extensive field work. Usually assigned to the genus *Chilostoma*, but moved to *Campylaea* Beck, 1837, in the nominotypical subgenus, based on molecular data (Groenenberg *et al.*, 2016).

Campylaea padana (Stabile, 1864) (Fig. 121). Endemic species occurring in the Cottian Alps, from Valle Grana to Val Chisone (Cuneo and Turin provinces) and on Monte Fenera (Novara and Vercelli provinces) (Alzona & Alzona Bisacchi, 1938; Alzona, 1971; Pascutto, 1998; unpublished personal data). Species in need of revision: it is very similar to *Campylaea illyrica* (Stabile, 1864). The latter, usually assigned to the genus *Chilostoma*, has been moved to *Campylaea* in the subgenus *Oricampylaea* Groenenberg, Subai & Gittenberger, 2016, based on molecular data (Groenenberg *et al.*, 2016).

Fig. 120. *Chilostoma cingulatum bizona*, a quasi-endemic subspecies (NWQ) with narrow range (N) in NW Italy. Alto (CN); photo M. Bodon.

Helicigona lapicida (Linnaeus, 1758) (Fig. 122). Polytypic species with two subspecies (Bank & Neubert, 2017; MolluscaBase, 2020); NW Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020). In Italy it only occurs in Val Dora Riparia and Val Dora Baltea (Piedmont and Valle d'Aosta), where it was probably introduced from France (Pegorari, 1883; Pollonera, 1885b; Alzona, 1971; Eikenboom, 1996; Gavetti *et al.*, 2008; Evangelista, 2009).

Causa holosericea (Studer, 1820) (Fig. 123). In Italy it only occurs along the Alps (Alzona, 1971); in NW Italy it is present from the Ligurian (Cuneo

province) to the Pennine (Verbano-Cusio-Ossola province) Alps (Pegorari, 1883; Pollonera, 1885b; Bishop, 1976a; Eikenboom, 1996; Sindaco *et al.*, 2005; Gavetti *et al.*, 2008; Evangelista, 2009; unpublished personal data).

Delphinatia fontenillii (Michaud, 1829). Polytypic species with two subspecies (Falkner *et al.*, 2002). Italian populations assigned to the semi-endemic *D. fontenillii alpina* (Michaud, 1831), occurring in upper Valle di Susa (Turin province) and in nearby areas in France (Falkner *et al.*, 2002; Gavetti *et al.*, 2008). Usually assigned to the genus *Chilostoma* Fitzinger, 1833, it was moved to *Delphinatia* Hesse, 1931, based on molecular data (Groenenberg *et al.*, 2016).

Fig. 121. *Campylaea padana*, an endemic species (NWE) with narrow range (N) in NW Italy. Torre Pellice (TO); photo S. Birindelli.

Delphinatia glacialis (Férussac, 1832) (Fig. 124). Species occurring at high altitudes in the western Alps of Italy and France (Falkner *et al.*, 2002; Gavetti *et al.*, 2008). In Italy it is present from Valle Varaita (Cuneo province) to Valli di Lanzo (Strobel, 1853; Stabile, 1864; Lessona, 1880; Pollonera, 1885b; Gavetti *et al.*, 2008; Cossignani & Cossignani, 2020; unpublished personal data), in an isolated site near Pila, Valle d'Aosta (unpublished personal data) and in a site in Biella province according to a historical sample in the malacological collection of the Dipartimento di Scienze della Vita e

Biologia dei Sistemi, University of Turin. Other historical records from the Swiss Alps are uncertain and may be due to exchange of specimens or labels (Turner *et al.*, 1998); indeed Boschi (2011) does not list the species from Switzerland. Usually assigned to the genus *Chilostoma*, it was moved to *Delphinatia* Hesse, 1931, based on molecular data (Groenenberg *et al.*, 2016).

Fig. 122. *Helicigona lapicida lapicida*, an alien taxon (IA) in Italy. Courmayeur (AO); photo M. Bodon.

Murella muralis (Müller, 1774). Alien (translocated) species native to Sicily (Fiorentino *et al.*, 2010), introduced into many towns in the Tyrrhenian area. In NW Italy it occurs in two sites in eastern Liguria, Levanto and Riomaggiore (Manganelli *et al.*, 1995; unpublished personal data). It was also reported from Genoa by Issel (1867), where it has not been found again, despite extensive field work. This highly variable species has many named forms, usually regarded as subspecies (e.g. Alzona, 1971; Bank & Neubert, 2017; MolluscaBase, 2020), but needs revision (Fiorentino *et al.*, 2010, 2012).

Macularia niciensis (Férussac, 1821). Polytypic species with four subspecies (Falkner *et al.*, 2002; Bank & Neubert, 2017; MolluscaBase, 2020). The Italian population was assigned to *M. niciensis faudensis* (Sulliotti, 1883)

by Bank & Neubert (2017) and MolluscaBase (2020), a subspecies that cannot be distinguished from *M. niciensis niciensis* (unpublished personal data). The semi-endemic nominotypical subspecies only occurs in westernmost Liguria (Imperia province), from the Italian-French border to Monte Faudo (Alzona & Alzona Bisacchi, 1941; Boato *et al.*, 1985) and outside the study area, in Var, Alpes-Maritimes and Alpes-de-Haute-Provence departments (Falkner *et al.*, 2002) (Fig. 125). Species of conservation concern in Italy (Manganelli *et al.*, 1995).

Fig. 123. *Causa holosericea*, a species widespread (W) in the mountains of Piedmont and Valle d'Aosta. Courmayeur (AO); photo S. Birindelli.

Macularia sylvatica (Draparnaud, 1801). Moved from genus *Cepaea* Held, 1838, to *Macularia* Albers, 1850, based on molecular data (Neiber & Hausdorf, 2015). It occurs on the French and Italian sides of the western Alps (Cesari, 1980; Falkner *et al.*, 2002); in Italy it is present in alpine areas from the Ligurian Alps to the Pennine Alps of Valle d'Aosta (Cesari, 1980; Boato *et al.*, 1985; Gavetti *et al.*, 2008).

Theba pisana (Müller, 1774) (Fig. 126). Polytypic species with four subspecies (Gittenberger & Ripken, 1987). The Italian populations are assigned to the nominotypical subspecies (Bank & Neubert, 2017; MolluscaBase, 2020), which in NW Italy only occurs in western Liguria and La Spezia province,

close to the Tuscan border, where it inhabits coastal areas (Boato *et al.*, 1985; Tapparone Canefri, 1869; unpublished personal data).

Cepaea nemoralis (Linnaeus, 1758) (Fig. 127). Polytypic species with two subspecies (Alzona, 1971; Cesari, 1980; Bank & Neubert, 2017; MolluscaBase, 2020). NW Italian populations are mainly assigned to the nominotypical subspecies (Cesari, 1980). The status of the other subspecies, *C. nemoralis etrusca* (Rossmässler, 1835) occurring in Liguria and in central and southern Italy (Cesari, 1980), requires re-examination (Manganelli *et al.*, 1995).

Fig. 124. *Delphinatia glacialis*, a species with narrow range (N) in NW Italy. Usseglio (TO); photo L. Leardi.

Eobania vermiculata (Müller, 1774) (Fig. 128). In NW Italy it only occurs in Liguria, mainly in coastal areas, and in Piedmont where it was introduced in some sites (Tapparone Canefri, 1869; Boato *et al.*, 1985; Repetto, 2012; Natura Mediterraneo, 2020; unpublished personal data). Bouaziz-Yahiatene *et al.* (2017) proposed that *Eobania* Hesse, 1913, is a junior synonym of *Massylaea* Möllendorff, 1898, but according to Holyoak *et al.* (2019), their result is based on misidentification of relevant material.

Fig. 125. Monte Grammondo (IM), dry stone walls inhabited by *Macularia niciensis niciensis* and *Solatopupa similis*; photo M. Bodon.

Fig. 126. *Theba pisana pisana*, a taxon with narrow range (N) in NW Italy. Sanremo (IM); photo S. Birindelli.

Fig. 127. *Cepaea nemoralis*, a species with wide range (W) in NW Italy. Sauze d'Oulx (TO); photo S. Birindelli.

Fig. 128. *Eobania vermiculata*, a species with narrow range (N) in NW Italy. Villanova d'Albenga (SV); photo S. Birindelli.

Cantareus apertus (Born, 1778) (Fig. 129). In NW Italy it only occurs in Liguria, mainly in coastal areas (Tapparone Canefri, 1869; Boato *et al.*, 1985; Bodon, 2007).

Cornu aspersum (Müller, 1774) (Fig. 130). The molecular phylogenetic relationships and history of the species have been extensively investigated (Guiller *et al.*, 1994, 2001; Guiller & Madec, 2010; Gaitán-Espitia *et al.*, 2013). This research found a very distinct farmed stock of unknown origin (usually labelled *Helix aspersa maxima* Taylor, 1883, or *Helix maxima*) which is sister group to all the other wild populations examined. The latter consist of two major geographically structured clades: one mainly Europaean and the other mainly North African.

Helix cincta Müller, 1774 (Fig. 131). Alien (translocated) species probably native to NE Italy and the Balkan Peninsula (Alzona, 1971; Cesari, 1978; Falkner, 1990; Giusti *et al.*, 2015; Fiorentino *et al.*, 2016), recently found in Valle d'Aosta (unpublished personal data).

Helix lucorum Linnaeus, 1758. Molecular data confirms the distinction between *H. lucorum* and *H. straminea* Briganti, 1825 (Korábek *et al.*, 2014, 2015, 2018a; Fiorentino *et al.*, 2016). However, although they belong to two different groups with distinct ancestral ranges, their morphological distinction is problematical. In Italy, as far as is known, *H. lucorum* is widespread in northern regions, where it was probably introduced from the Balkans or Anatolia, while *H. straminea* is found mainly in central and southern regions (Korábek *et al.*, 2014, 2018a; Fiorentino *et al.*, 2016; Bassi & Palmieri, 2017). In NW Italy *H. lucorum* occurs in eastern Liguria (Ligurian Apennines, La Spezia province) (Tapparone Canefri, 1869; Issel, 1882; Bodon, 2007), and locally in western Liguria and Piedmont (Coen, 1945; Gavetti *et al.*, 2008; iNaturalist, 2020; unpublished personal data).

Helix pomatia Linnaeus, 1758 (Fig. 132). Threatened species (Manganelli *et al.*, 2000), included in Annex V of the Habitats Directive and in Appendix III of the Bern Convention. It is uncommon in Liguria (Boato *et al.*, 1985; Birindelli, 2006) but widespread in Piedmont and Valle d'Aosta, especially in the Alpine area (Bishop, 1976a; Gavetti *et al.*, 2008).

Fig. 129. *Cantareus apertus*, a species with narrow range (N) in NW Italy. Genova (GE); photo M. Bodon.

Fig. 130. *Cornu aspersum*, a synanthropic species with wide range (W) in NW Italy. Genova (GE); photo M. Bodon.

Fig. 131. *Helix cincta*, an alien species (IA) in Italy. Quart (AO); photo S. Birindelli.

Fig. 132. *Helix pomatia*, a threatened species with wide range (W) in NW Italy. Sauze d'Oulx (TO); photo S. Birindelli.

Family **Unionidae** Rafinesque, 1820

Microcondylaea bonellii (Férussac, 1827) (Fig. 133). In Italy it only occurs in the Po and Veneto plains, where it has declined in some areas (Manganelli *et al.*, 2000; Bodon *et al.*, 2005a; Froufe *et al.*, 2017). In Piedmont, there are localized populations in the Po and the plain north of the river (Bodon *et al.*, 2005a; Froufe *et al.*, 2017), very rare south of it (Lessona, 1880; Repetto, 1995). Formerly known as *M. compressa* (Menke, 1830). Listed as Vulnerable by the European Red List of non-marine molluscs (Cuttelod *et al.*, 2011) and the IUCN Red List of threatened species (IUCN, 2017). Species included in Annex V of the Habitats Directive and in Appendix III of the Bern Convention.

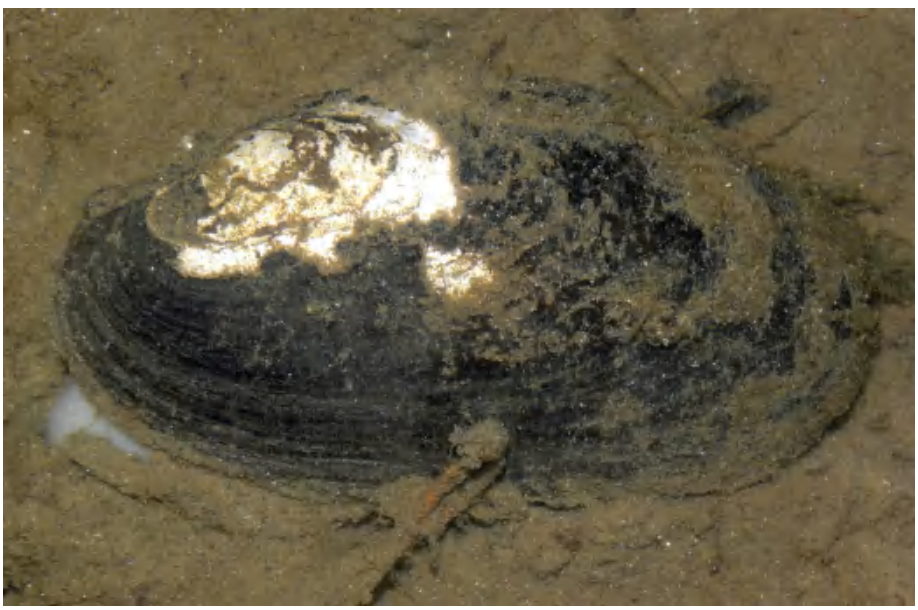

Fig. 133. *Microcondylaea bonellii*, a threatened species with narrow range (N) in NW Italy. Motta de' Conti (VC); photo M. Bodon.

Unio elongatulus Pfeiffer, 1825. Extensive allozyme study on Italian *Unio* since 1980s suggests that these bivalves, usually reported as to *U. elongatulus* and/or *U. mancus* Lamarck, 1819, could be close to or conspecific with *U. pictorum* (Linnaeus, 1758) (Badino & Celebrano, 1981; Badino, 1980, 1982; Badino *et al.*, 1991; Nagel *et al.*, 1998; Nagel, 2000; Nagel & Badino, 2001; Castagnolo *et al.*, 2002). In the 2000s, DNA studies have been the starting point for a new unionid systematics. Study of western

European *Unio* has revealed many more species than hitherto supposed (Araujo *et al.*, 2005, 2009a, 2009b; Prié *et al.*, 2012; Reis *et al.* 2013; Prié & Puillandre, 2014). These studies confirmed the distinction between the western European *U. mancus* and the mainly central European *U. pictorum* (Prié *et al.*, 2012; Reis *et al.* 2013; Prié & Puillandre, 2014). The north Italian *Unio* investigated (many specimens from Lago Maggiore and other sites in Piedmont and other regions) belongs to a single distinct species, for which the name *U. elongatulus* has been proposed (Riccardi *et al.*, 2016; Froufe *et al.*, 2017; Marrone *et al.*, 2019). Species of conservation concern in Italy (Manganelli *et al.*, 2000; Lopes-Lima *et al.*, 2017b), listed in Annex V of the Habitats Directive and in Appendix III of the Bern Convention.

Unio mancus Lamarck, 1819 (Fig. 134). Recently resurrected as polytypic species with three subspecies occurring in western Europe; populations from the Tyrrhenian sector assigned to *U. mancus turtonii* Payraudeau, 1826 (Prié, 2012; Prié *et al.*, 2012; Araujo *et al.*, 2017; Froufe *et al.*, 2017; Lopes-Lima *et al.*, 2017a). In NW Italy it is only reported from the Magra basin (La Spezia province) (Marrone *et al.*, 2019).

Fig. 134. *Unio mancus turtonii*, a subspecies with very narrow range (V) in NW Italy. Sarzana (SP); photo M. Bodon.

Anodonta anatina (Linnaeus, 1758) (Fig. 135). According to early allozyme investigations, Italian *Anodonta* seemed to include two endemic taxa closer to *A. anatina* than to *A. cygnea* (Linnaeus, 1758) (Nagel *et al*., 1998; Nagel & Badino, 2001). Subsequent mitochondrial COI studies found that European *A. anatina* is split into two or four clades: Italian populations cluster with those of the Mediterranean (Froufe *et al.*, 2014, 2017; Lopes-Lima *et al.*, 2015; Riccardi *et al*., 2019). *A. anatina* is hard to distinguish morphologically (shell and anatomy) from *A. exulcerata* Porro, 1838, one of the three other Italian *Anodonta* (Lopes-Lima *et al.*, 2017b; Riccardi *et al*., 2019). In Italy it does not seem to be widespread and in NW Italy it has only been reported, based on molecular identification, from Lago Maggiore in Verbano-Cusio-Ossola province (Froufe *et al.*, 2017; Riccardi *et al*., 2019).

Fig. 135. *Anodonta anatina*, a species with wide range (W) in NW Italy. Cengio (SV); photo M. Bodon.

Anodonta cygnea (Linnaeus, 1758). Mitochondrial COI studies by Froufe *et al.* (2017) confirmed the presence of this species in Italy, where it seems rather uncommon. According to Killeen *et al.* (2004), *A. cygnea* can be distinguished morphologically from *A. anatina*, but with difficulty from *A. exulcerata* Porro, 1838 (Riccardi *et al*., 2019). In NW Italy, molecular data only confirms its presence in Lago Maggiore in Verbano-Cusio-Ossola

province (Froufe *et al.*, 2017; Riccardi *et al*., 2019). If identifications based on morphological characters are correct, it also occurs in some sites in Piedmont and Liguria (Fig. 136).

Fig. 136. Lago della Busalletta (AL-GE), an artificial lake inhabited by *Anodonta cygnea*, a species widespread (W) in the lowland areas of Piedmont and Liguria; photo M. Bodon.

Anodonta exulcerata Porro, 1838. Mitochondrial COI studies by Froufe *et al.* (2017) and Riccardi *et al*. (2019) distinguished this species, which seems rather widespread in Italy and Dalmatia. It is hard to distinguish morphologically (shell and anatomy) from *A. anatina* (Lopes-Lima *et al.*, 2017b; Riccardi *et al*., 2019). In NW Italy it has been reported from Lago di Candia (Turin province), Lago di Viverone (Biella province) and Lago Maggiore (Verbano-Cusio-Ossola province) (Froufe *et al.* 2017; Riccardi *et al*., 2019) based on molecular identification, but it is certainly more widespread.

Sinanodonta woodiana (Lea, 1834) (Fig. 137). Alien species native to the eastern Palaearctic (Haas, 1969), first reported from Italy in Emilia-Romagna and Latium (Manganelli *et al*., 1998) and now widespread in Italy. In NW Italy it occurs in the Piedmontese plain, where it is common in rivers, canals and artificial lakes (Fabbri & Landi, 1999; Niero, 2003; Bodon *et al.*, 2005a; Solustri & Nardi, 2006; Cianfanelli *et al.*, 2007, 2010; De Vico *et al.*, 2007; Niero & Bodon, 2011; Colomba *et al.*, 2013; Guarneri *et al.*, 2014) and in

Liguria where it was recently found in the plain of the Magra river (Costa *et al.*, 2019). As happened in other countries, introduction was probably due to release of *Ctenopharyngodon idellus*, *Cyprinus carpius* or other glochidia-infested fish (Watters, 1997).

Family **Cyrenidae** Gray, 1840

Corbicula fluminea (Müller, 1774) (Fig. 138). Alien species native to SE Asia (Cianfanelli *et al.*, 2007), first reported from Italy in the Po basin (Fabbri & Landi, 1999; Malavasi *et al.*, 1999). Now the species occurs in parts of northern Italy, Tuscany and Latium (Nardi & Braccia, 2004; Bodon *et al.*, 2005a; Genoni *et al.*, 2008; Cianfanelli *et al.*, 2007, 2010; Ercolini & Cenni, 2015; Grano & Di Giuseppe, 2020). In NW Italy it is present in the Po, Lago di Mergozzo, Lago Maggiore, the Ticino and Sesia basins and Lago di Viverone (Verbano-Cusio-Ossola, Novara, Vercelli, Biella, Turin and Alessandria provinces) (Bodon *et al.*, 2005a, 2020; iNaturalist, 2020; Natura Mediterraneo, 2020). The identity of Italian *Corbicula* needs re-examination, because many similar species have been reported in Europe (Quiñonero Salgado & López Soriano, 2016a, 2016b, 2017a, 2017b; López Soriano *et al*., 2017).

Corbicula leana Prime, 1867. Alien species native to SE Asia, recently reported from Italy in Lago di Garda (López Soriano *et al*., 2017). This species can be found in the plains of northern Italy; in Piedmont only in the Ticino river (Bodon *et al*., 2020).

Family **Sphaeriidae** Deshayes, 1855

Sphaerium corneum (Linnaeus, 1758). In NW Italy it is uncommon in the plains of Piedmont (unpublished personal data). Many past reports of *S. corneum* may concern *S. nucleus* (Studer, 1820), which is more widespread in Piedmont. Korniushin (2001) and Bank (2017) assigned *Sphaerium* species to different subgenera, mainly based on anatomical characters. The validity of these subgeneric divisions seems uncertain because they do not match phylogenies based on molecular data (Cooley & Ó Foighil, 2000; Lee & Ó Foighil, 2003; Stunžėnas *et al*., 2011).

Sphaerium nucleus (Studer, 1820). In NW Italy it is rather frequent in the plains of Piedmont (unpublished personal data). Formerly regarded as a variety of *S. corneum*, it is now accepted as a distinct species (Korniushin, 2001; Bank, 2017).

Fig. 137. *Sinanodonta woodiana*, an alien species (IA) in Italy. Sarzana (SP); photo M. Bodon.

Sphaerium ovale (Férussac, 1807). In NW Italy it was recently found in the Po (Turin province) and Ticino (Novara province) rivers, and a canal near Mirabello Monferrato (Alessandria province) (unpublished personal data). Formerly considered a valid species (Lessona, 1880; Pegorari, 1883; Pollonera, 1889b) but subsequently dismissed (e.g. Giusti & Castagnolo, 1980), it is now again accepted as a distinct species (Korniushin, 2001; Bank, 2017).

Pisidium ponderosum Stelfox, 1918. Uncommon in NW Italy, it is found in scattered localities in the provinces of Aosta, Asti and Alessandria (unpublished personal data). Formerly regarded as a variety of *P. casertanum* (Poli, 1791), it is now accepted as a distinct species (Glöer & Zettler, 2005; Zettler & Glöer, 2006; Nesemann, 2014).

Pisidium conventus Clessin, 1877. Uncommon species in NW Italy, reported from Lago Maggiore (Lenz, 1954, 1955), Lago di Mergozzo (Nocentini, 1966; Bonacina *et al.*, 1992; Bonomi & Ruggiu, 1996) (Fig. 139) and Lago Devero in Val Formazza (Verbano-Cusio-Ossola province) (unpublished personal data). Korniushin (1998, 1999) and Bank (2017) assigned *Pisidium* species to different genera and subgenera, based mainly on anatomical characters. However, the validity of these generic/subgeneric divisions seems uncertain because it does not entirely match phylogenies based on molecular data (Lee & Ó Foighil, 2003; Azevedo, 2013).

Fig. 138. *Corbicula fluminea*, an alien species (IA) in Italy. Mergozzo (VB); photo M. Bodon.

Fig. 139. Lago di Mergozzo (VB), a subalpine lake where *Pisidium conventus*, a species with very narrow range (V) in NW Italy, can be found together with *Valvata piscinalis*, *Radix balthica*, *Physella acuta*, *Gyraulus laevis*, *Ferrissia californica*, *Anodonta exulcerata*, *Unio elongatulus*, *Corbicula fluminea*, *Pisidium henslovanum*, *P. nitidum*, *P. subtruncatum* and *P. milium*; photo M. Bodon.

Pisidium moitessierianum Paladilhe, 1866. Only reported from Lago di Mergozzo (Verbano-Cusio-Ossola province) in NW Italy (Nocentini, 1966), where it has not subsequently been found (personal unpublished data).

Family **Dreissenidae** Gray, 1840

Dreissena polymorpha (Pallas, 1771). Alien species native to eastern Europe (van der Velde *et al.*, 2010) and first reported from Italy in Lago di Garda (Giusti & Oppi, 1973). Now it occurs in many Italian lakes and rivers, especially in northern regions (Bodon *et al.*, 2005a; Cianfanelli *et al.*, 2010). Polytypic species with three subspecies (van der Velde *et al.*, 2010). Italian populations are assigned to the nominotypical subspecies, which in the study area occur in a lake near Moncalieri, in Lago Maggiore and the Ticino basin (Turin, Novara and Verbano-Cusio-Ossola provinces) (Bodon *et al.*, 2005a; Cianfanelli *et al.*, 2010; iNaturalist, 2020).

SPECIES EXCLUDED

Family **Aciculidae** Gray, 1850

Renea moutonii (Dupuy, 1849). Reported from western Liguria by Sulliotti (1889) and Pollonera (1889d). *R. moutonii* occurs in Alpes-Maritimes and Var departments (France) and it has never been found in Italy; it is probable that these historical records concern *R. elegantissima* (Boato *et al.*, 1985; Boeters *et al.*, 1989; Bodon *et al.*, 1995b).

Family **Chondrinidae** Steenberg, 1925

Abida polyodon (Draparnaud, 1801). Reported from western Liguria by Boato *et al.* (1985) based on some historical specimens from Porto Maurizio (Imperia province). The fact that the species has not recorded in literature and has not been found again despite extensive field work suggests its absence in Italy.

Family **Pristilomatidae** Cockerell, 1891

Vitrea crystallina (Müller, 1774). Frequently reported in the past from the Italian peninsula and Tyrrhenian islands, but apart from a few records the others are based on misidentifications, so that Manganelli *et al.* (1995) excluded the presence of this species in Italy. Some unpublished historical Ligurian specimens from Bordighera (Imperia province), mentioned by Boato *et al.* (1985), may have been due to a mix up of collection material or of labels, or may have concerned an introduced population that failed to acclimatize. An intoduction may also explain the specimens reported from Gargnano (Lago di Garda) by Welter-Schultes (2012a).

Family **Limacidae** Lamarck, 1801

Limax albipes Dumont & Mortillet, 1852. Italian reports of this slug (Stabile, 1864; Brandstetter & Kapp, 2014), probably based on specimens identified only by virtue of colour, need to be checked. Indeed, the species occurs in the Alps of France and Switzerland and it is probably absent in Italy (Gavetti *et al.*, 2008).

Family **Arionidae** Gray, 1840

Arion hortensis Férussac, 1819. Reported from Valsavaranche (Valle d'Aosta) by Gambetta (1928). It has not been possible to establish which arionid species was involved in this report because Gambetta's material was not recovered and new specimens from Valsavaranche were not available.

Family **Unionidae** Rafinesque, 1820

Unio tumidus Philipsson, 1788 (Fig. 140). Reported from Piedmont by Lessona (1880), Droüet (1883) and Pollonera (1889d), but an historical sample labelled as "*Unio tumidus*", preserved in the malacological collection of the Dipartimento di Scienze della Vita e Biologia dei Sistemi, University of Turin, belongs to *U. elongatulus*. *U. tumidus* occurs in central and eastern Europe and has not been found in Italy (Gavetti *et al.*, 2008; Marrone *et al.*, 2019).

Fig. 140. *Unio elongatulus*, Lago di Avigliana (TO). Historical specimen assigned to *Unio tumidus* kept in the malacological collection of the Dipartimento di Scienze della Vita e Biologia dei Sistemi, University of Turin; photo L. Ghiraldi.

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RIASSUNTO

Checklist e distribuzione dei molluschi terrestri e d'acqua dolce dell'Italia nord-occidentale (Piemonte, Valle d'Aosta e Liguria)

Questo contributo presenta la lista dei molluschi terrestri, d'acqua dolce e salmastri dell'Italia nord-occidentale (Piemonte, Valle d'Aosta e Liguria), sulla base sia di dati bibliografici e museali, sia di ricerche condotte dagli autori e collaboratori sino alla fine del 2020. La malacofauna è costituita da 394 taxa (280 molluschi terrestri e 114 acquatici), 308 per il Piemonte (225 molluschi terrestri e 83 acquatici), 139 per la Valle d'Aosta (120 molluschi terrestri e 19 acquatici) e 274 per la Liguria (193 molluschi terrestri e 81 acquatici) e annovera 24 specie indeterminate o non descritte e 44 taxa endemici, di cui 27 caratterizzati da una distribuzione molto ristretta. Tre specie sono particolarmente localizzate: *Iglica pezzolii* Boeters, 1971 e *Chondrina feneriensis* Bodon, Nardi, Cianfanelli & Kokshoorn, 2015, limitate al Monte Fenera (province di Novara e di Vercelli) e *Falkneria camerani* (Lessona, 1880), presente in pochissime stazioni delle Alpi Pennine. Sette entità segnalate storicamente non sono state ritrovate: *Eupaludestrina stagnorum* (Gmelin, 1791), *Marstoniopsis insubrica* (Küster, 1853), *Orcula dolium dolium* (Draparnaud, 1801), *Leucostigma candidescens* (Rossmässler, 1835), *Zonites algirus* (Linnaeus, 1758), *Cochlicella conoidea* (Draparnaud, 1801) e *Pisidium moitessierianum* Paladilhe, 1866. Diverse specie sono di interesse conservazionistico secondo la "European Red List of non-marine molluscs" e la "IUCN Red List of threatened species": una di queste, *Renea bourguignatiana* Nevill, 1880, limitata in Italia ad alcuni siti vicino a Ventimiglia, è considerata "In Pericolo Critico", 5 sono ritenute "In Pericolo" e 13 "Vulnerabili". Fra le entità in pericolo molto localizzate si segnalano *Alzoniella delmastroi* Bodon & Cianfanelli,

2004, limitata all'area torinese e *Pezzolia radapalladis* Bodon & Giusti, 1986, nota unicamente per la Liguria orientale da Recco a Rapallo (provincia di Genova). Infine 46 entità sono aliene, incluse tre segnalate solo recentemente per l'Italia: *Zonitoides arboreus* (Say, 1817), *Boettgerilla pallens* Simroth, 1912 e *Deroceras sturanyi* (Simroth, 1894).

Parole chiave: Gasteropodi e bivalvi non marini, Italia nord-occidentale, faunistica, biogeografia, conservazione

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