

# Country reports

## Alien Species in Romania

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### Abstract

We have compiled a list of 982 alien species reported in Romania from public databases, scientific literature and our own data. The most abundant group are plants with 490 species, followed by terrestrial animals with 390 species (of which 90% are invertebrates), and aquatic organisms with 102 species (44 freshwater and 58 marine). Most alien species originate from North America and Southeast Asia and were introduced accidentally. A series of management measures are considered at national level aimed at the prevention, early detection and response, and management of naturalised species.

### Keywords

Romania, invertebrates, neophyte, invasive alien species, introduction rate

## 1. The present state of alien species management in Romania

In recent years, invasive alien species (IAS) have become a high-profile policy worldwide. IAS are a major threat that requires international cooperation and a multidisciplinary approach at different levels: academic, administrative and local communities. Taking measures to limit the impact of IAS is also a compulsory requirement of the countries that are parties to international conventions. Romania has signed both the Convention on Biological Diversity and the Bern Convention. The **Convention on Biological Diversity** (ratified by Law 58/1994) has identified IAS as a major cross-cutting theme. This global treaty requires Parties “as far as possible and as appropriate, (to) prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species” (Article 8h). In 2002, the CBD Conference of the Parties adopted a specific Decision and Guiding Principles to help Parties implement this requirement. The Decision urges Parties, other governments and relevant organisations to prioritise the development of IAS strategies and action plans at national and regional levels and to promote and implement the CBD Guiding Principles.

The **Bern Convention** (Convention on the conservation of wildlife and natural habitats in Europe), adopted by Romania (Law 13/1993), requires “to strictly control the introduction of non-native species” (Article 11.2.b). Since 1984, a range of actions has been initiated for a more effective implementation of this article. These include the adoption of Standing Committee recommendations on general IAS issues and specific problems, production of technical reports, organisation of workshops and establishment of an IAS Experts’ Group. Recognising the threat posed by alien species, the Council of Europe has adopted the European strategy on invasive alien species (Genovesi and Shine 2011).

In 2009 the Romanian Ministry of the Environment issued a ministerial order (979/2009) on the introduction of alien species, intervention on

IAS, and the reintroduction of native species listed in the annexes of the EU Birds and Habitats Directives (adopted in Romania by emergency ordinance 57/2007 and later by Law 49/2011). There is no national list of alien species or IAS provided by the ministry, only the reference and link of the Pan-European Inventory of Alien Species DAISIE website (<http://www.europe-aliens.org/>). While the DAISIE list was the result of an extensive collaborative project, no institution from Romania was involved, so the usefulness of the database is limited at national level. The National Biodiversity Strategy and Action Plan (2011) criticise the absence of a clear national record of the number of invasive alien species and state that an assessment of the number of listed species present in Romania that are part of the DAISIE database is necessary.

Romania presently lags behind many other countries of the world that have developed strategic frameworks to address IAS in a holistic way. Whilst Europe’s complex characteristics can make it harder to develop and implement common trade and movement policies, this should not be used to postpone decisive and balanced action. The common trade and movement policy for the plant health sector developed under the European and Mediterranean Plant Protection Organization (EPPO) shows that coordination and cooperation is feasible.

The impacts of many past invasions could have been reduced if European States had uniformly applied the best appropriate practices and taken rapid action to eradicate the introduced species following early detection. Most biological invasions now threatening Europe might have been prevented by greater awareness of IAS issues and a stronger commitment to address them. Current inaction in many - though not all - European states and sectors may threaten the region’s biodiversity, public health and economic interests. In line with international policy, it is now essential to develop efficient cooperation at a national and regional level to prevent or minimise the adverse impacts of IAS. The present situation in Romania according to the Third National

Report CBD (2005) is characterised by: low public awareness and opposition to government intervention and regulations; shortage and inaccessibility of scientific information (for species identification, risk analysis, detection and mitigation techniques, etc.); absence of clear and agreed priorities for action; ease of introduction and movement, inadequate inspection and quarantine; inadequate monitoring capacity; lack of effective emergency response measures; outdated or inadequate legislation; poor coordination between government agencies, local administration and other stakeholders.

The National Biodiversity Strategy and Action Plan (2011) identified four operational objectives for the control of invasive species:

Prevent the intentional and unintentional introduction of alien species.

Early detection and identification of new potential invaders before penetrating the national territory;

Early response to the penetration of invasive alien species.

Management of naturalised species and of the expanding area thereof in view of eradication, limitation and control.

These objectives are further detailed into 15 actions related to the control of IAS, which unfortunately have not been implemented until now. For example the following actions were due by 2011 or 2012, but none has been completed so far: action F2 “*Development and maintenance of a register and database of alien species*”, action F4 “*Development and adoption of technical norms on the introduction and control of alien species from neighbouring and/or exotic areas*”, action F5 “*Ratification of the Convention on Ballast Water Management and development of further implementation measures*”, and action F8 “*Mandatory monitoring of bilge waters and fouling on boats discharging bilge water or careening in harbours, and of sediments on the bottom of bilge tanks where resistant forms may develop*”. Perhaps the most urgent action is to finalise the National list of invasive species (action F1) due in 2013 and considered a high priority.

## Definitions

Alien species refers to all species and subspecies introduced outside their natural habitat, both past and present, from all taxonomic groups. This includes any part of the organism: gametes, seeds, eggs, or propagules that might survive and later reproduce. We will not consider in the present report viruses, prions, bacteria, domestic stray animals and genetically modified organisms.

Invasive alien species (IAS) refers to any alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. The invasive status is usually assessed from exponential population growth and/or range expansion.

Neophyta refers to alien plant species introduced after ca. 1500 (Pysek et al. 2002, 2004; Richardson et al. 2000).

Archaeophyta refers to alien plant species introduced before 1500.

## 2. Review of the alien species

Based on the information gathered until now from public databases (e.g. DAISIE <http://www.europealiens.org>, NOBANIS <http://www.nobanis.org>, Global Invasive Species Database <http://www.issg.org/database/welcome/>, Invasive Species Compendium <http://www.cabi.org/isc/>, EPPO databases <http://www.eppo.int/DATABASES/databases.htm>, etc.), scientific literature and our own data, we compiled a list of alien species reported in Romania. We have grouped them in several categories: plants, aquatic (freshwater and marine), and terrestrial animals (invertebrates and vertebrates).

### 2.1 Plants

During the last decade four synthetic studies on alien plant species in Romania were done: Dihoru (2004) published a selected list of 66 invasive species; Anastasiu and Negrean (2005) reported 435 alien species, of which 384 are neophytes; in 2009 the same

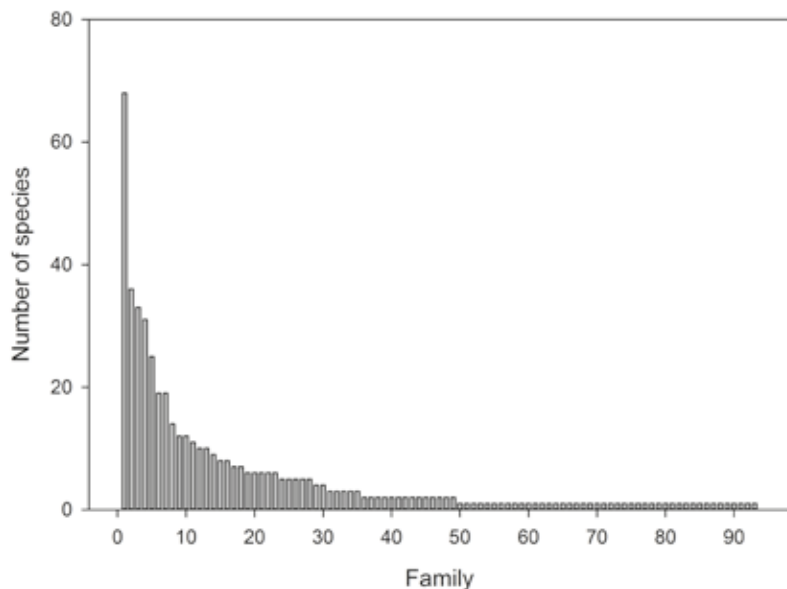


Fig. 1. The species richness of neophytes per family

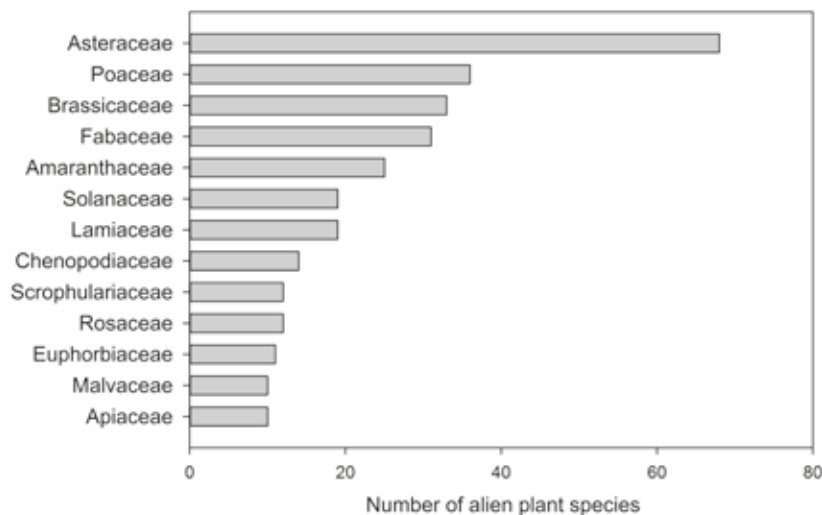


Fig. 2. The plant families comprising the highest number of neophytes

authors discussed the distribution of 365 neophytes in Romania, of which 38 are considered invasive; and finally Sirbu and Oprea (2011) compiled a list of 671 alien plant species, of which 112 are considered invasive. The differences in the number of alien species reported by these authors are due to incomplete literature review and differences in taxonomical composition of the alien flora. For example, a number of species listed in Flora Europaea (Tutin et al. 1964-1980; Tutin et al. 1993) as naturalised in Romania are not confirmed by the investigators (e.g. *Lycium chinense*, *Punica granatum*, *Jasminum officinale*, *Gossypium herbaceum*), while other species listed in Flora Europaea as alien are considered native (e.g. *Abutilon theophrasti*, *Artemisia annua*, *Colutea arborescens*, *Calendula arvensis*, *Cyperus difformis*, and *Asperula arvensis*). There are also 31 species reported as alien to Romania (Anastasiu and Negrean 2009; Sirbu and Oprea 2011) that are not included in DAISIE database (DAISIE 2008).

We have compiled a list of 490 neophytes whose presence in Romania has been confirmed, belonging to 93 families (Fig. 1). Of these, 13 families comprise 61% of the total number of alien plant species (Fig. 2), while 58 families have only 1-2 alien species (14.7% of the total number of alien plant species). A large proportion of the neophytes are ornamental (59%) and were deliberately introduced.

The location and time of introduction are relatively difficult to assess properly, since often the date of reporting is long after the introduction occurred. Based on the location of the first published occurrence records of alien species in Romania, we mapped the number of citations for each county that allows us to identify the main gates for alien plant species in the country (Fig. 3). The published reported dates of introduction vary widely during decades based on the frequency of studies (Fig. 4A) but overall, the cumulative rate of introduction shows a clear linear pattern (Fig. 4B). Many neophytes are known from only several localities, and 53 species reported more than 50 years ago were not reconfirmed recently, but were included in the list. For example, *Urtica pilulifera*

was reported for the first time in Constanța harbour in 1876, not seen again for more than 100 years, but recently reported in Costinești, Constanța County (Răduțoiu and Costache 2012). The counties where neophytes were first reported are presented in Fig. 3. The apparent “hotspots” for neophytes are the results of both a higher entry rate due to trade, e.g. along the Black Sea harbours (Anastasiu et al. 2011), but also an indicator of the number of botanists (e.g. Iași, Bucharest, Sibiu), a trend described as “the botanist effect” (Moerman and Estabrook 2006). This can be seen at province level (Table 1), the highest density being reported from the Danube Delta. The majority of the neophytes reported in Romania are from North America, Asia and the Mediterranean (including North Africa, the Middle East and South Europe) (Table 2, Fig. 5).

In addition to the plant species discussed previously, there are 112 species and clones of alien tree species introduced by foresters, the majority with a restricted distribution. Alien tree species with a larger range were included in the species list, especially since six species are invasive: *Acer negundo*, *Ailanthus altissima*, *Amorpha fruticosa*, *Cytisus scoparius*, *Fraxinus americana*, and *Fraxinus pennsylvanica* (Third National Report to the UNCBD 2005). Regarding species invasiveness, there is still much debate regarding its definition, so the number varies from 38 (Anastasiu and Negrean 2009) to 112 (Șirbu and Oprea 2011).

## 2.2 Freshwater species

The present list of alien freshwater species reported in Romania includes 44 species: 28 fish and 16 invertebrate species (Bănărescu 1964; Bij de Vaate and Hulea 2000; Covaciu-Marcov et al. 2011; Gavriloiu and Chiș 2007; Grossu 1986; Iacob and Petrescu-Mag 2008; Micu and Telembici 2004; Nalbant et al. 2004; Părvulescu et al. 2009; Popa et al. 2006, 2007; Popa and Popa 2006; Popa and Murariu 2009; Skolka 1998; Skolka and Gomoiu 2001; Staraș and Oțel 1998) (Table 3). The majority of the species come from North America and Southeast Asia (Fig. 6).

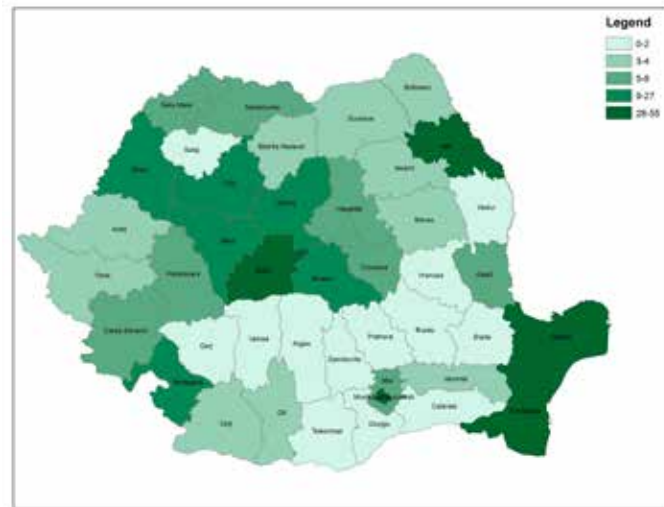


Fig. 3. The location by county of the first occurrence of neophytes (N=358 species) reported in Romania

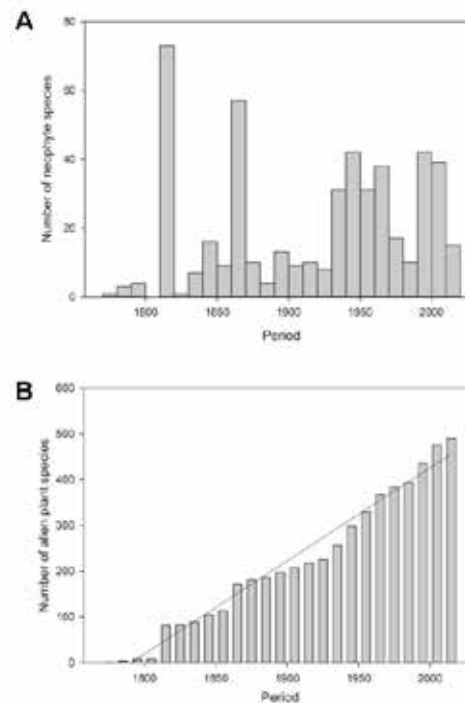


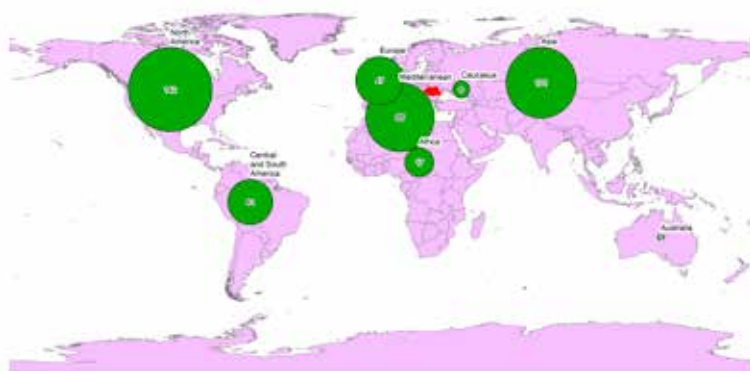
Fig. 4. (A) The reported time of introduction for 490 neophytes, along decades between 1778 and 2012; (B) The accumulation rate of neophytes during 1778-2012 ( $n=490$ ,  $R^2=0.97$ )

**Table 1.** The number and density of neophytes in different regions of Romania.

Province/Region	Area (km <sup>2</sup> )	Number of neophytes	Density of neophytes (number/1000 km <sup>2</sup> )
Moldova	44022	268	6.09
Transilvania	57807	252	4.36
Muntenia	52486	239	4.55
Dobrogea	12124	191	15.75
Banat	18966	162	8.54
Crisana	17171	129	7.51
Danube Delta	3446	118	34.24
Oltenia	24095	111	4.61
Maramures	8283	85	10.26

**Table 2.** The geographic origin of 450 neophytes in Romania.

Geographic origin	Number of species	Percentage
Africa	17	3.8
Asia	101	22.4
Australia	1	0.2
Caucasus	6	1.3
Europe	47	10.4
Mediterranean	95	21.1
North America	142	31.6
Central and South America	41	9.1

**Fig. 5.** The geographic origin of 450 neophytes in Romania

The rate of introduction based on reported introduction dates for 35 freshwater alien species is shown in Fig. 7. The inventory and the range extent of the alien species are still little known. For example, Škraba et al. (2013) reported the presence of the Chinese mitten crab *Eriocheir sinensis* H. Milne Edwards, 1853, along the Serbian sector of the Danube River since 1995, but it was not recorded on the opposing Romanian sector of the river.

## 2.3 Marine species

Along the Romanian Black Sea coast, a total number of 58 alien animal species was reported, of which one was a fish species and the rest were invertebrates (Alexandrov and Berlinsky 2005; Băcescu 1967; Băcescu et al. 1971; Gomoiu 1972, 1984, 2005; Gomoiu and Porumb 1969; Gomoiu and Skolka 1996, 1997, 1998; Gomoiu et al. 2002; Grossu 1962; Gubanova 2000; Harbison and Volovik 1993; Khvorov et al. 2006; Leppäkoski and Olenin 2000; Micu and Micu 2004; Micu and Niță 2009; Micu et al. 2010, 2011; Morduhai-Boltovskoi 1968; Paavola et al. 2005; Paspalev 1933; Pitiș and Lăcătușu 1971; Porumb 1959a, 1959b, 1980, 1994-1995; Reise et al. 1999; Skolka 1982; Skolka 1998; Skolka and Gomoiu 2001, 2004; Skolka and Preda 2010; Surugiu 2008; Tabarcea and Timofte 2012; Temnykh and Nishida 2012; Valkanov 1936; Zaitsev 1998; Zaitsev and Öztürk 2001; Zinevici et al. 2011). Since the absence from the Romanian Black Sea coast is either temporary or they are present and yet unreported, in our analysis we will consider 31 additional alien invertebrates reported from the Black Sea. The largest group is represented by crustaceans, easily transported with ballast water or hull fouling (Table 4). Very few species were intentionally introduced, e.g. *Crassostrea virginica* (Gmelin, 1791), for aquaculture. The majority of alien species reported in the Black Sea originates from the Atlantic Ocean or are cosmopolitan (Fig. 8). The cumulative rate of introductions shows a steady increase in the number of alien species (Fig. 9).

## 2.4 Terrestrial species

There are 390 alien terrestrial species reported in Romania, of which 37 are vertebrates (2 reptiles, 19 birds and 17 mammals) and 353 are invertebrates (Bálint et al. 2010; Bădeanu et al. 2009; Beenen and Roques 2010; Blank et al. 2010; Cean 2009; Četović et al. 2011; Cochard et al. 2010; Coeur d'Acier 2010; Denux and Zagatti 2010; Drăghia 1970; Gagi 2012; Giurgincă 2006; Glavendekić 2006; Grozea et al. 2012; Kenis and Roques 2010; Kis 1990; Kovács et al. 2006; Lopez-Vaamonde et al. 2010; Mancu 2005; Markó 1998; Mifsud et al. 2010; Moscaliuc 2009; Navajas et al. 2010; Negrea 1989; Nentwig and Kobelt 2010; Nețoiu 2003; Pellizzari and Germain 2010; Perju and Teodor 1998; Perju et al. 2009; Popa and Roșca 2011; Popescu 2004; Preda and Skolka 2009, 2011; Rabitsch 2010; Radu 1960; Rákósy 2009a, 2009b; Rákósy and Ruicănescu 1998; Rasplus et al. 2010; Reynaud 2010; Romașcu and Lemeni 1972; Ruicănescu 2009; Ruicănescu and Alexandru 2009; Ruști 1994; Schneider 2010; Skuhrová et al. 2010; Stoev et al. 2010; Tăușan and Markó 2011; Teodorescu et al. 2005, 2006; Teodorescu and Matei 2010; Tomescu 2009; Urák 2005, 2009; Wetterer 2009). The latter are dominated by insects with 285 species (representing 80.7%). The taxonomic composition is presented in Table 5.

The highest number of alien invertebrate species originates from Asia and North America (Fig. 10). Most of them have arrived accidentally to Romania, e.g. by trade, and with imports of plant material. Species, such as *Aphis gossypii* Glover, 1877 (Homoptera: Aphididae) and *Callosobruchus chinensis* (Linnaeus, 1758) (Coleoptera: Bruchinae), are now present in more than 40 countries (Roques et al. 2009). Several were intentionally introduced as biological control agents in Romania (e.g. *Encarsia formosa* Gahan, 1924; Hymenoptera: Aphelinidae) (Teodorescu and Matei 2010) or in neighboring countries (e.g. *Harmonia axyridis* Pallas, 1773; Coleoptera: Coccinellidae) (Brown et al. 2008).

Table 3. Major taxa of freshwater alien species reported in Romania.

Taxa	Number of species	Percentage
Annelida-Oligochaeta	1	2.3
Entoprocta	1	2.3
Platyhelminthes-Trematoda	2	4.5
Mollusca-Gastropoda	5	11.4
Mollusca-Bivalvia	5	11.4
Arthropoda-Crustacea	2	4.5
Chordata-Pisces	28	63.6

Table 4. Taxonomic composition of the marine alien species reported along the Romanian Black Sea coastline.

Taxa	Number of species	Percentage
Porifera	1	1.1
Cnidaria	9	10.1
Ctenophora	3	3.4
Annelida-Polychaeta	10	11.2
Annelida-Oligochaeta	1	1.1
Mollusca-Gastropoda	2	2.2
Mollusca-Bivalvia	8	9.0
Arthropoda-Crustacea	51	57.3
Bryozoa	1	1.1
Chordata-Ascidiacea	2	2.2
Chordata-Pisces	1	1.1

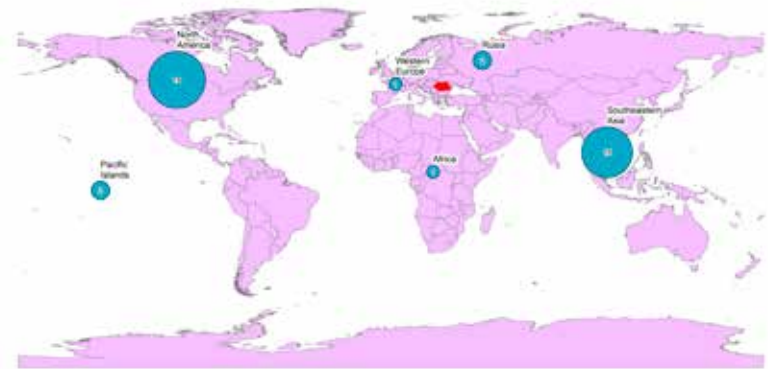


Fig. 6. The geographic origin of the 44 freshwater alien species inventoried in Romania

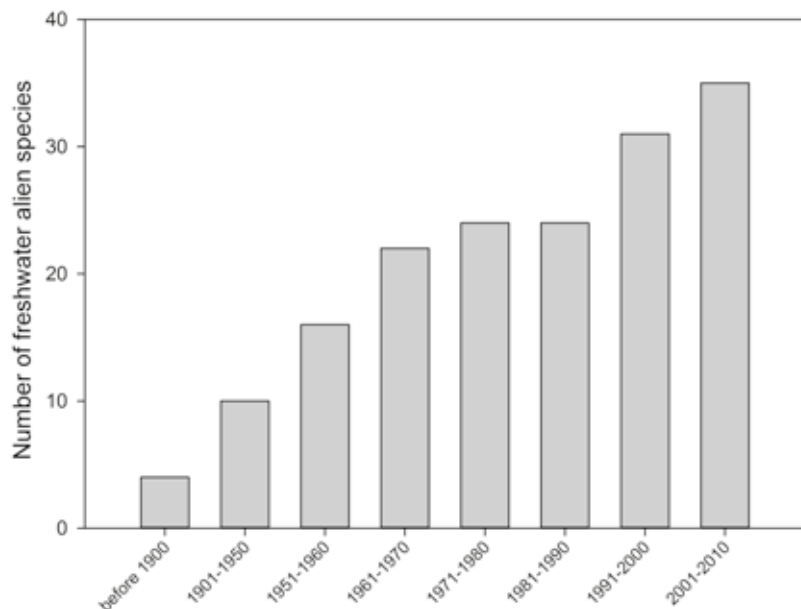


Fig. 7. The rate of accumulation of freshwater alien species in Romania, based on known introduction dates for 35 species

Table 5. The taxonomic composition of alien terrestrial species reported in Romania

Taxa	Number of species	Percentage
Nematoda	15	4.2
Myriapoda Diplopoda	2	0.6
Myriapoda Chilopoda	1	0.3
Malacostraca Isopoda	3	0.8
Arachnida Araneae	28	7.9
Arachnida Acari	16	4.5
Entognatha Collembola	3	0.8
Insecta Dermaptera	1	0.3
Insecta Blattodea	4	1.1
Insecta Orthoptera	1	0.3
Insecta Coleoptera	62	17.6
Insecta Lepidoptera	45	12.7
Insecta Hemiptera	88	24.9
Insecta Diptera	12	3.4
Insecta Thysanoptera	11	3.1
Insecta Phthiraptera	12	3.4
Insecta Siphonaptera	2	0.6
Insecta Psocoptera	12	3.4
Insecta Hymenoptera	35	9.9

### 3. Alien species management initiatives

During the last decade several research projects on alien species were done in Romania. This in turn triggered an increase in publications on alien species, the most important being “Neobiota din România”, a volume comprising 26 papers on different topics regarding alien species, both animals and plants (Rákósy and Momeu 2009). A web site now provides updated information on the topic of alien species in Romania (<http://specii-invazive.ro>).

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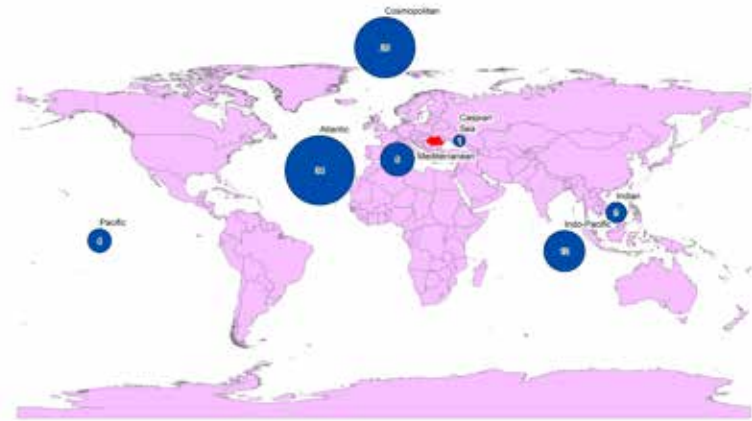


Fig. 8. The geographic origin of the marine alien species inventoried along the Romanian Black Sea coastline

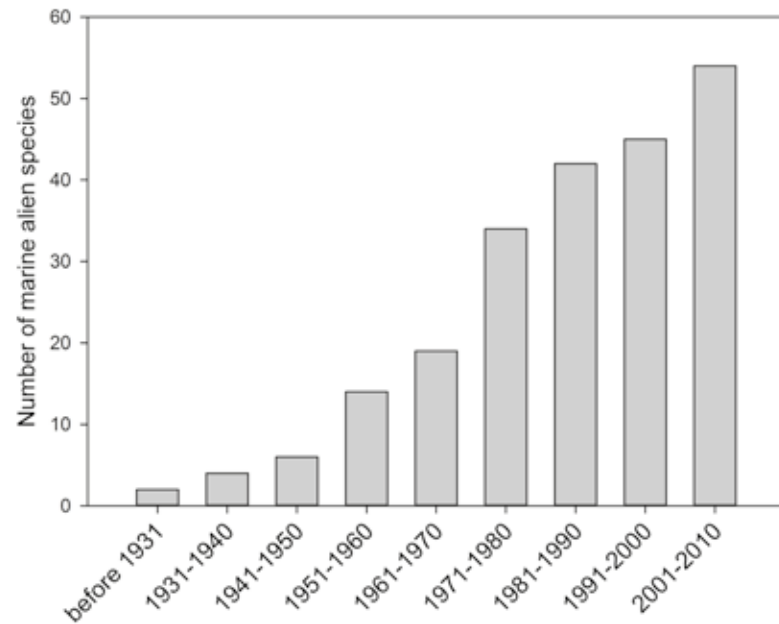


Fig. 9. The rate of accumulation of marine species along the Romanian Black Sea coast, based on known occurrence dates for 54 species



Fig. 10. The geographic origin of alien invertebrate species in Romania (n=300)

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