

# Alien Non-Arthropods of Malta and Sicily



## Alien Non-Arthropods of Malta and Sicily



Authors

Vera D'Urso      Salvatore Brunetti  
Antonino Puglisi      Thomas Cassar  
Giorgio Sabella

ISBN: 978-9918-0-0637-3



Cover Photo Credit:  
Salvatore Brunett

ISBN: 978-9918-0-0637-3

This project is part-financed by the European Union European Regional Development Fund (ERDF), through the INTERREG V-A Italy-Malta Programme. Co-Financing rate 85% EU Funds, 15% National Funds

# Contents

---

1. Actinopterygii .....	7
<i>Ameiurus melas</i> (Rafinesque, 1820) .....	9
<i>Carassius auratus</i> (Linnaeus, 1758) .....	13
<i>Cyprinus carpio</i> Linnaeus, 1758.....	17
<i>Esox lucius</i> Linnaeus, 1759 .....	21
<i>Gambusia holbrooki</i> Girard, 1859 .....	24
<i>Lepomis gibbosus</i> (Linnaeus, 1758) .....	28
<i>Micropterus salmoides</i> (Lacépède, 1802) .....	32
<i>Salmo trutta</i> Linnaeus, 1758 .....	36
<i>Sarmarutilus rubilio</i> (Bonaparte, 1837).....	41
2. Amphibia .....	47
<i>Pelophylax bedriagae</i> (Camerano, 1882) .....	49
<i>Xenopus laevis</i> (Daudin, 1802) .....	52
3. Aves .....	55
<i>Alectoris chukar</i> (J. E. Gray, 1830) .....	57
<i>Myiopsitta monachus</i> (Boddaert, 1783).....	60

<i>Psittacula krameri</i> (Scopoli, 1769).....	65	<i>Indotyphlops braminus</i> (Daudin, 1803).....	128
4. Mammalia .....	71	<i>Podarcis siculus</i> (Rafinesque-Schmaltz, 1810) .....	132
<i>Atelerix algirus</i> (Lereboullet, 1842) .....	73	<i>Trachemys scripta</i> (Thunberg in Schoepff, 1792).....	136
<i>Myocastor coypus</i> (Molina, 1782).....	76		
<i>Ovis aries</i> Linnaeus, 1758.....	81		
<i>Rattus norvegicus</i> (Berkenhout, 1769).....	86		
5. Mollusca .....	91		
<i>Arion vulgaris</i> Moquin-Tandon, 1855 .....	93		
<i>Dreissena polymorpha</i> (Pallas, 1771).....	98		
<i>Helisoma duryi</i> (Wetherby, 1879).....	102		
<i>Otala punctata</i> (O. F. Müller, 1774).....	105		
<i>Potamopyrgus antipodarum</i> (J. E. Gray, 1843) .....	108		
<i>Sinanodonta woodiana</i> (Lea, 1834).....	111		
6. Platyhelminthes.....	115		
<i>Bipalium kewense</i> Moseley, 1878 .....	117		
7. Reptilia.....	121		
<i>Chamaeleo chamaeleon</i> Linnaeus, 1758.....	123		
<i>Hemorrhois algirus</i> (Jan, 1863) .....	126		

# Introduction

---

Alien species, also known as Invasive Alien Species, are organisms introduced beyond their native range by human actions, with the potential for significant ecological and socio-economic impacts. The movement of these species across borders, facilitated by trade and travel, has amplified their spread, making it crucial to understand and manage the challenges they pose for preserving biodiversity and ecosystem stability.

This booklet is dedicated to addressing invasive animal species in the Mediterranean islands of Malta and Sicily, shedding light on their biology, impact, and potential management strategies. Designed to serve scientists, site managers, environmental authorities, and the general public, it provides a comprehensive synthesis of available data concerning the most critical terrestrial and freshwater Invasive Alien Species, excluding arthropods and species described as parautochthonous as defined under Article 1 of the decree 19 January 2015 in Italian law.

Organized into seven classes (Actinopterygii, Amphibia, Aves, Mammalia, Mollusca, Platyhelminthes, and Reptilia), the booklet offers datasheets and images encompassing taxonomy, morphological descriptions, ecology, potential threats, and management approaches for each species.

# 1. Actinopterygii

# *Ameiurus melas* (Rafinesque, 1820)



(Chordata: Actinopterygii: Siluriformes: Ictaluridae)

## Main synonyms

*Pimelodus cupreoides* Girard, 1859; *Amiurus brachyacanthus* Cope, 1880.

## Common names

Black catfish; Black bullhead.

## Short description

Body cylindrical anteriorly and compressed posteriorly; head broad and depressed. Adults are generally 25-31 cm long, weighing less than 400 g. The two sexes are difficult to distinguish (the female is noticeably fuller in the breeding season). The mouth is wide with 4 pairs of barbels. The dorsal fin is short, the pectoral ones are wide and rounded, the caudal has a straight or slightly convex margin. It has blackish-brown colours, which tend to be blackish-green on the back, until gradually lightening towards the sides. The belly is yellowish-white. At the base of the tail, there is generally a clear

vertical band. Juveniles have a series of small round spots along the flanks that disappear as adults.

#### Place of origin and global distribution

Originally from Canada, the United States and Mexico, *A. melas* has been introduced in many states of Europe (including Italy), South America and other states of the USA. Present in Europe since the nineteenth century; most of the introductions in Italy between 1897 and 1898, in the two ichthyological centres of Brescia and Rome, for breeding.

#### Distribution, frequency and first record for Sicily

Stabilized exotic species; introduced in Sicily in the 20th century (Russo et alii, 1999) spread from dam reservoirs to the upstream river network, further expanding their distribution range on the Island.

#### Distribution, frequency and first record for Malta

Not present.

#### Habitat or preferred invading habitat

It lives in warm or temperate waters, in shallow muddy bottoms, and is rich in vegetation. Preferred habitats are the waters of lakes and ponds and water reservoirs, but *A. melas* can be found in secondary habitats, such as rivers and streams or even irrigation canals.

#### Introduction source

There were various causes of introduction (both voluntary and involuntary): its use as a fish species for sport fishing and for breeding, its use as an ornamental species, intentional releases into nature, natural phenomena such as floods and interconnections between waterways.

#### Ecology

*A. melas* is active only during the twilight and night hours because it is a rather photophobic species. It tolerates oxygen deficiencies very well and survives even in degraded environments. The fry in the first months of life feeds on plankton and small aquatic invertebrates; they live in groups for a few weeks, controlled by the male parent, until they reach 2-3 cm in length. The adults feed on vegetables, organic detritus, fish eggs, fry, crustaceans, molluscs and annelids. Towards two years



of age, sexual maturity is reached, with reproduction in the spring period. *A. melas* has slightly poisonous sharp spines, both on the dorsal and on the pectoral fin, which straightens when these fish are attacked their predators are very few. *A. melas* tends to form high-density concentrated populations; specimens live 4-5 years.

#### Possible control methods

Eradication and/or control through chemical products, such as rotenone (unfortunately it is a non-species-specific product and therefore harmful to other non-target species). A valid method can be mechanical removal by selective fishing techniques; this species is easy to capture, and even massive removal operations are considered possible. Potential use of acoustic and radio tagging also PIT tagging, including remote sensing.

#### Invasive category/local potential threat

*A. melas* has been classified in several European regions at “medium” or “high” risk of invasiveness; it is considered invasive in Italy; although there are no precise data regarding its invasiveness in Sicily, it can be considered a potentially invasive and dangerous species. In fact, due



to its predation, it reduces/inhibits the growth of other species in the environment in which it is introduced and trophic competition with populations of native species is also possible.

#### Remarks

*A. melas* is known to naturally hybridize with its close congeners *A. nebulosus* and *A. natalis*, which are species difficult to distinguish from each other.

#### Literature

Gherardi, F., Gollasch, S., Minchin, D., Olenin, S. & Panov, V. E. (2009) Alien invertebrates and fish in European inland waters. In: *Handbook of alien species in Europe* (pp. 81–92). Springer, Dordrecht.

Marrone, F., & Naselli-Flores, L. (2015) A review on the animal xenodiversity in Sicilian inland waters (Italy). *Advances in Oceanography and Limnology*, 6 (1-2): 2–12.

Russo, G., La Rocca, S., Violani, C. & Zava, B. (1999) Contributions to the knowledge of Sicilian freshwater fishes. II. Notes on some allochthonous species recently introduced. *Doriana*, 7 (308): 1–7.

Rutkayová, J., Biskup, R., Harant, R., Šlechta, V. & Koščo, J. (2013) *Ameiurus melas* (black bullhead): morphological characteristics of newly introduced species and its comparison with *Ameiurus nebulosus* (brown bullhead). *Reviews in Fish Biology and Fisheries*, 23 (1): 51–68.

## *Carassius auratus* (Linnaeus, 1758)



(Chordata: Actinopterygii: Cypriniforme: Cyprinidae)

#### Main synonyms

*Cyprinus thoracatus* Valenciennes, 1842; *Cyprinus langsdorfii* Valenciennes, 1842; *Cyprinus gibeloides* Cantor, 1842; *Carassius granddoculis* Temminck & Schlegel, 1846; *Carassius burgeri* Temminck & Schlegel, 1846; *Cyprinus chinensis* Gronow, 1854; *Carassius coeruleus* Basilewsky, 1855; *Carassius pekinensis* Basilewsky, 1855; *Cyprinus maillardi* Guichenot, 1863.

#### Common name

Goldfish.

#### Short description

It can reach a maximum length of about 50 cm and a weight of 1.8 kg. Elongated and stocky body, covered with large shiny scales; long dorsal fin with 15-21 rays; a toothed spine at the base of the dorsal and anal fins. The anal fin in the male is concave, while in the female it is convex. The mouth is small, without barbels. Wild populations range in colour from gold to olive green, or even creamy white. The

colour of the back is generally brownish, and the sides and belly are yellowish with dark reflections. It is extremely polymorphic: elongated specimens are found in still waters, while very squat individuals can be found in large lakes and rivers.

#### Place of origin and global distribution

This species appears to be native to East Asia, but has been so long since introduced to other areas that it is extremely difficult to reconstruct its original range. Recent studies would prove that its native area is in China. Introduced in many regions, the species is sub-cosmopolitan being known for: Africa, Europe, Asia, Australia and the American continent.

#### Distribution, frequency and first record for Sicily

Introduced in an unspecified period, however in the 20th century, the goldfish is frequent and stabilized, already reported for some time in Sicily in the Simeto basin (Ferrito & Tigano, 1995), in the Irminio river and other watercourses.

#### Distribution, frequency and first record for Malta

In the Maltese archipelago there are no reports of the presence of this species in nature, despite several introductions in freshwater systems (Benjamin Camilleri, personal communication).

#### Habitat or preferred invading habitat

Its typical habitat includes ponds with submerged aquatic vegetation. It tolerates high levels of turbidity, temperature fluctuations between 0 °C and +35 °C, low levels of dissolved oxygen, various conditions of salinity and aquatic pollution, showing adaptability and resistance to environmental adversities.

#### Introduction source

*C. auratus* has acquired a pan-global distribution through its widespread introduction for ornamental purposes. Deliberate escapes and releases have resulted in natural populations in over 20 countries, and its actual distribution is probably much wider than known.

#### Ecology

The goldfish have an omnivorous diet that includes planktonic crustaceans, phytoplankton, insect larvae, fish eggs and fry, benthic

vegetation and detritus. Foraging goldfish can create high turbidity levels, leading to the decline of aquatic vegetation. The lifespan is between 6 and 7 years, with a maximum of 30 years.

#### Possible control methods

The goldfish represents the most typical example of the harmfulness deriving from the introduction of non-native species into inland waters. It is therefore essential to launch action plans that effectively contrast the introduction of golden crucian carp and other non-native fish fauna into natural environments and conservation and management actions for each basin in wetlands rich in endemic fauna. The dissemination of correct information regarding the purchase and breeding of goldfish, as well as the foresight to avoid further releases of these into the wild, could be a good “weapon” for the management of this species.

#### Invasive category/local potential threat

*C. auratus* is considered one of the most invasive species in the world and poses a serious threat to native communities on all continents (except Antarctica); successfully competes with many other cyprinids sharing its same ecological niche; particularly penalized by its presence are the carp and the tench with which the goldfish establishes a trophic and environmental competition. Invasive freshwater fish can have heavy ecological impacts on receiving ecosystems and are one of the main factors in the decline of aquatic fauna at the global level.



### Remarks

*C. auratus* is now considered a species that evolved by domestication from *C. gibelio* and can be considered one of the best-known fish. Today there is no other ornamental fish as popular and easy to keep as goldfish and it has also become one of the most commonly used laboratory animals, especially in the field of physiology. More than 300 varieties with the most imaginative shapes are known on the market.

### Literature

Ferrito, V. & Tigano, V. (1995) The distribution of the ichthyofauna in the Simeto basin (Sicily). *Cybium*: 187–198.

## *Cyprinus carpio* Linnaeus, 1758



(Chordata: Actinopterygii: Cypriniformes: Cyprinidae)

### Main synonyms

None.

### Common name

Common carp.

### Short description

In its wild form *C. carpio* can reach up to 1 m in length and about 37 kg in weight; it has an elongated body with large scales. The colour depends on the environmental conditions in which it is found, such as the colour of the water or the background. It is generally yellow / green-brown on the head, sides and dorsally, while the abdominal part may be yellowish or whitish. The head is relatively small, with thick extensible lips, adorned with four barbels (the maxillaries shorter than the mandibular ones). For domestic and ornamental use, there are albino and coloured strains (koi carp, Indonesian coloured carp).

### Place of origin and global distribution

Species native to central Eurasia, bred in China at least since 475 B. C., from where it also spread naturally, and even more so because it was introduced in more than 80 countries around the world, many of which far from the native range. Currently, *C. carpio* is established on all continents except Antarctica.

### Distribution, frequency and first record for Sicily

The historical presence of carp in Sicilian water bodies is rather controversial (for authors it is a parautoctonous species, while others claim that some were introduced in Sicily at the beginning of the twentieth century). *C. carpio* is considered an invasive species in Sicily and appears to be expanding in the territory. Although there is not yet a Regional Fish Charter (and therefore a complete knowledge of the distribution of the species in Sicily). Its presence is ascertained in many river basins (including that of the Simeto) and many natural and artificial lakes.

### Distribution, frequency and first record for Malta

Not present in the wild.

### Habitat or preferred invading habitat

Rivers, streams, lakes, ponds, estuaries and lagoons represent the main habitats; irrigation channels, and water tanks in general, are secondary habitats.

### Introduction source

The species was distributed all over the world, originally introduced for aquaculture, for ornamental or productive purposes since the Roman age; then it was further spread and widely distributed for angling. The repeated escapes in nature over time of individuals initially confined to ponds have led to naturalized encounters. *C. carpio* is considered the third most introduced fish species in the world. Even today in many areas, *C. carpio* is used in ponds or for captive fishing (as it is a fast-growing species in eutrophic waters and has high tolerance to adverse environmental conditions). It is also a fish much appreciated by fishermen in many countries, where its introduction in many areas of the world has led to a significant development of aquaculture and

carp breeding because it is an important species for the economy of these places.

### Ecology

Species with gregarious behaviour and fast-growing, highly adaptable to different environments; very mobile locally; has a high reproductive potential. It feeds on zooplankton in its juvenile stage and later becomes a benthic feeder, also preying on the eggs of other fish species. With its feeding behaviour, it eradicates the vegetation and mixes the seabed, clouding the water and thus preventing the normal photosynthetic activity of benthic macrophytes, which go to death; favours a greater proliferation of algae (including cyanobacteria). It is a long-lived species, (record of 47 years of age).

### Possible control methods

Any introduction made to aquaculture farming should be seen as a potential addition to wildlife in the recipient country, as was the case with *C. carpio*, which is very difficult and costly to control. It will likely be transported illegally or deliberately internationally.

### Invasive category/local potential threat

In the Global Invasive Species Database, it is one of the 100 worst invasive alien species in the world; It has proved invasive outside its native range. In some areas, the negative direct and indirect impacts of *C. carpio* on aquatic ecosystems have been demonstrated; it competes with other fish species, even rare and threatened native ones, it preys on their eggs, causes habitat modifications and alters the trophic levels of the natural benthic communities and the nutritional regimes of the species.

### Remarks

The status of *C. carpio* is not clear everywhere. The erroneous assignment of the status of autochthonous or allochthonous species in some regions has repercussions on the correct interpretation of biocoenoses and conservation issues; the wide distribution of this species may not always be due to invasiveness.

## Literature

- Carpio, A. J., De Miguel, R. J., Oteros, J., Hillström, L., & Tortosa, F. S. (2019) Angling as a source of non-native freshwater fish: a European review. *Biological Invasions*, 21(11): 3233–3248.
- Duchi, A. (2018) Indici di qualità ambientale ISECI e NISECI: proposta d’inserimento di *Tinca tinca* (Linnaeus, 1758) nelle comunità ittiche di riferimento della Sicilia. *Biologia Ambientale*, 32 (1): 1–4.
- Ferrito, V., & Tigano, C. (1995) The distribution of the ichthyofauna in the Simeto basin (Sicily). *Cybium*, 19 (2): 187–198.

## *Esox lucius* Linnaeus, 1759



(Chordata: Actinopterygii: Esociformes: Esocidae)

### Main synonyms

*Esox boreus* Agassiz, 1850.

### Common names

Great northern pike; American Pike.

### Short description

The adult average length is about 1-1.40 m with weights of 20 kg, and females have bigger dimensions than males. They have a duck-beak head, flattened and lengthen, and their big dimension mouth has plenty of hook teeth. The colour of the pikes depends on the environment; often their back and sides are dark shadowed green, with pale rounded or elliptical spots. Their belly is whitish, and their dorsal, anal and caudal fins are marked with plain dark strips.



### Place of origin and global distribution

Currently, the presence of the pikes is extended to Asia and Europe, where they were introduced in North America at the end of the XX century.

### Distribution, frequency and first record for Sicily

American pikes are stabilized and widespread in Sicily. The species was first reported in the Simeto River in 1991, near Ponte Pietralunga and Castellaccio (Ferrito & Tigano, 1995), and later in the basin of the Irminio River.

### Distribution, frequency and first record for Malta

Absent.

### Habitat or preferred invading habitat

The species lives in lakes, ponds or secondary watercourses of streams and rivers. In the Baltic area can be found even in brackish water.

### Introduction source

Voluntary introduction.

### Ecology

Sometimes, in the arctic lakes, American pikes are the only species living in a particular water body. They are usually solitary and territorial animals. The American pikes are not used to long migrations, but some specimens can move for long distances. It is an opportunistic species, and can predate every kind of available fish, as well as crustaceans, amphibious and other little vertebrates; also, it has been reported some episodes of cannibalism. The American pikes hunt hiding between water flora and waiting for their preys. They can alter the fish composition due to their competition and predation.

### Possible control methods

The common techniques used to control the population of *E. lucius* include the culling and the use of chemical agents (e. g. rotenone); this last practice has to be evaluated carefully, because of its potentially dangerous effects on non-target species.

### Invasive category/local potential threat

This species can be highly invasive, and in many different countries it has been reported a negative ecological impact after its introduction; it can cause local alterations of the habitats.

### Remarks

Despite the negative impact that the American pikes can have on ecosystems, in some cases they can be a natural balancer. They usually choose weak or sick preys; they can also limit the excessive proliferation of other fish, especially cyprinids. American pikes can be infected by parasites, among which platyhelminths, and, when eaten rare, they can also infest humans.

---

### Literature

- Ferrito, V. & Tigano, C. (1995) The distribution of the ichthyofauna in the Simeto basin (Sicily). *Cybium*, 19 (2): 187–198.
- Marrone, F. & Naselli-Flores, L. (2015) A review on the animal xenodiversity in Sicilian inland waters (Italy). *Advances in Oceanography and Limnology*, 6 (1/2): 2–12.
- Welcomme, R. L. (1988) International introductions of inland aquatic species. *FAO Fish Technical Paper*, 294: 1–318.

# *Gambusia holbrooki* Girard, 1859



(Chordata: Actinopterygii: Cypriniformes: Poeciliidae)

## Main synonyms

*Zygonectes atrilatus* Giordania & Brayton, 1878.

## Common name

Eastern mosquitofish.

## Short description

Males can reach a length of 35 mm while females are larger and can be 60 mm long. Their body is slightly compressed with a big, flattened head. They have big eyes and a small mouth. Eastern mosquitofish may have a transparent-grey colour, with blue-sparkle sides and a silver area under their bellies. Their colourless fins have transversal lines of black spots. Male anal fin has been modified into a gonopodium, used to transfer spermatozoa.

## Place of origin and global distribution

*G. holbrooki* is a native and common species of the freshwaters along the east coast of the USA. Currently, it is widespread in almost all the continents, except for the Antarctic, as a result of human transportation.

## Distribution, frequency and first record for Sicily

Introduced in Sicily between 1925 and 1927, because of the anti-anopheles fight to defeat malaria (Consoli, 1928; Veronesi et alii, 1997), today it is stabilised, common and widespread.

## Distribution, frequency and first record for Malta

Few specimens were reported from several permanent ponds, including Ta' Sarrafu in Gozo and form a small sustainable population in Chadwick Lakes in Malta (Benjamin Camilleri, personal communication).

## Habitat or preferred invading habitat

Their native habitat is level ground ponds, lakes, and watercourses; Eastern mosquitofish prefer slow shallow waters, and the dark-coloured substrates are given by sand, mud, and the presence of vegetation. The species can be found both in not disturbed and polluted body waters, including urban discharges characterised by poor-quality waters. The *G. holbrooki* can easily disperse in low waters (only 3 mm) and can use drains and natural canals to scatter among water bodies.

## Introduction source

Due to the larvicidal action against the *Anopheles* mosquitos, *G. holbrooki* was intentionally introduced by humans to control mosquito populations and all the diseases they can transmit (especially malaria and dengue).

## Ecology

Eastern mosquitofish can resist and tolerate a wide variation of environmental conditions (salinity and dissolved oxygen). The species may predate many different aquatic organisms of small dimensions, and because of this, it can cause the decline of the population of autochthone fish, amphibians and invertebrates. *G. holbrooki*

predates the juvenile fish and the eggs of other autochthone fish. Moreover, this species may attack all dimensions of fish by biting their fins. *G. holbrooki* can quickly increase the dimensions of its population thanks to its rapid sexual maturity, its high rate of survival of young specimens, and its high reproductive capacity (up to three generations in a year). The Eastern mosquitofishes are viviparous fish, with a gestation that lasts 3-4 weeks. The clutch can reach 40-60 juvenile fish.

#### Possible control methods

The management of Eastern mosquitofish, and generally of alien fish, should focus on the prevention of new introduction and the limitation of its diffusion. The eradication of the fish after the settlement is usually impossible because its population is highly prolific. The restoration of the damaged ecosystems (e. g. protecting the riparian corridors, reducing to the minimum the loss of habitat, reactivating the natural full capacity and implementing environmental control to limit the diffusion and the increase of the alien population) may consent to the reinforcement of the autochthone fauna and the control/disappearance of the *Gambusia*.

#### Invasive category/local potential threat

*G. holbrooki* introduced in new areas can spread rapidly; it is among the 100 species most invasive of the world, due to its ability to colonise new habitats its high fecundity, the high rate of juvenile fish survival and the rapid growth of its population. In Sicily is an invasive species with a serious impact on autochthone ecosystems. As in the rest of Italy, it has been observed a certain decline in the population of *Aphanius fasciatus* (a vulnerable species in Italy and inserted in the II



attachment of the directive Habitat and the Bern convection), that has been correlated, also, to the introduction of *G. holbrooki*. In the eastern south of Sicily, it has been highlighted a drastic decline in the population of *A. fasciatus* has disappeared in some river pods.

#### Remarks

*G. holbrooki* is a sister species of *Gambusia affinis*; they are morphologically similar, and only at the end of the 1980s they have been recognised to be two different species. Because of this taxonomic confusion, the world distribution of these two species is still ambiguous. Together, *G. holbrooki* e *G. affinis* are freshwater fish more abundant and spread all over the world.

---

#### Literature

- Consoli, N. (1928) Gl'interventi di piccola bonifica nella lotta contro la malaria in Sicilia. Francesco Sanzo e C., Industria Tipografica Editrice, Palermo, *Rivista Sanitaria Siciliana*, 18: 108 pp.
- Ferrito, V. & Tigano, C. (1996) Decline of *Aphanius fasciatus* (Cyprinodontidae) and *Salaria fluviarrilis* (Blennidae) populations in freshwaters of Eastern Sicily. *Ichthyological Exploration of Freshwaters*, 7: 181–184.
- Marrone, F., & Naselli-Flores, L. (2015) A review on the animal xenodiversity in Sicilian inland waters (Italy). *Advances in Oceanography and Limnology*, 6 (1-2): 2–12.
- Veronesi, R., Bellini, R. & Celli, G. (1997) Ruolo di *Gambusia holbrooki* nel contenimento dei culicidi e suo impatto sulle biocenosi acquatiche. *Biologia Ambientale*, 3: 24–40.
- Walton, W. E., Henke, J. A., & Why, A. M. (2012) *Gambusia affinis* (Baird & Girard) and *Gambusia holbrooki* Girard (Mosquitofish). A handbook of global freshwater invasive species: 261–273.



# *Lepomis gibbosus*

## (Linnaeus, 1758)



(Chordata: Actinopterygii: Perciformes: Centrarchidae)

### Main synonyms

*Sparus aureus* Walbaum, 1792; *Sparus mocasinus* Rafinesque, 1814; *Labrus anutus* Mitchilli, 1817; *Pomotis catesbein* Valenciennes, 1831; *Apomotis phenax* Cope & Jordan, 1877.

### Common name

Pumpkinseed.

### Short description

Oval body, strongly compressed laterally. Back and upper part of brown to golden green or olive green. Lighter underside. It reaches 40 cm in length in its native range, while it is smaller (about 10 cm) in European inland waters. Sexual dimorphism is not evident. The eggs are amber

in colour, have a diameter of about 1 mm and can adhere to the substrate. During the spawning period, the dominant males acquire a brighter hue, while the non-territorial males have a colouration similar to that of the females.

### Place of origin and global distribution

*L. gibbosus* is native to the eastern regions of North America. Also introduced in other areas of North and South America, Europe (at the end of the 1800s), Africa and Asia Minor. It is stabilized in all these geographical areas, demonstrating the ability to establish itself even in cold climate countries. Introduced in Italy in Lombardy in 1900, today it is widely distributed in Italian inland waters, including the islands.

### Distribution, frequency and first record for Sicily

Accidentally introduced species (Nocita & Zerunian, 2007) probably in the 20th century, reported for Sicily without providing precise data on the localities and certainties on its stabilization.

### Distribution, frequency and first record for Malta

There is no information on the presence of *L. gibbosus* in Malta, but in the future, it could establish and find conditions to become invasive (Fernández-Delgado & Argüelles, 2015).

### Habitat or preferred invading habitat

It inhabits low and vegetated banks of rivers with slow-flowing waters, or artificial canals, marshy environments and estuaries of rivers with brackish water (but only in areas affected by freshwater inputs), preferring lake environments. In Southern Europe populations of *L. gibbosus* are easily established in regulated rivers and reservoirs and are less successful in natural streams.

### Introduction source

There are various pathways of *L. gibbosus*: 1) use as an ornamental species in open ponds; 2) sport fishing and extensive fish farming; 3) forage for farmed piscivorous fish. More recently, it is also used as a pet fish by aquarists, for this purpose it is taken from the wild as it is a species not traded in aquarium shops.

## Ecology

Fast-growing gregarious freshwater species that can live up to 12 years. Its diet is mainly based on invertebrates (insects, crustaceans, molluscs, annelids), but also on vertebrates (amphibian larvae, fish fry and fish eggs). The species has a high fecundity, and during the reproductive period (May-August) each female produces about 600 to 7000 eggs per season. *L. gibbosus* is a pioneer species in disturbed areas as it has high adaptability: it is a species with excellent swimming skills, a generalist habitat, with good resistance to environmental variations (e.g. temperature changes); it is not affected by progressive degradation of the waters and in many cases, it has an advantage over the native species. Effective competitor of native fish due to aggressive behaviour, high reproductive potential and high trophic plasticity.

## Possible control methods

Eradication of *L. gibbosus* is nearly impossible in large watersheds once the species has become established. Preventive measures such as halting transfers (intentional or otherwise), banning trade, and educating stakeholders and the public about the impact of this species can have been therefore important.



## Invasive category/local potential threat

It is included among the invasive alien species of Union interest and relevance, even if its impact remains poorly assessed in Europe. *L. gibbosus* has been reported as a predator of fish eggs (contributing to the decline of some native fish species). Recent studies suggest that *L. gibbosus* is aggressive towards native fish species and could alter the trophic levels, entering into competition with other species, and modifying the natural benthic communities. It also has a potential negative impact on aquaculture and fisheries both through competition with other species and through the transmission of parasites and diseases. It represents a potential danger locally due to its remarkable adaptability and fecundity.

## Remarks

In the early 1900s, repeated introductions were necessary for the establishment of *L. gibbosus*, with large specimens. In the 1930s, the species was blamed for the decline of the native Eurasian perch (*Perca fluviatilis*), but this hypothesis was never verified. Direct evidence of adverse impacts is scarce.

## Literature

Fernández-Delgado, C. & Argüelles, L. C. (2015) EU non-native organism Risk Assessment scheme. risk assessment template v1.0 (27-04-15).

Nocita, A., & Zerunian, S. (2007) L'ittiofauna aliena nei fiumi e nei laghi d'Italia. *Biologia ambientale*, 21 (2): 93–96.

# *Micropterus salmoides* (Lacépède, 1802)



(Chordata: Actinopterygii: Perciformes: Centrarchidae)

## Main synonyms

*Huro nigricans* Cuvier, 1828; *Grystes nobilis* Agassiz, 1854; *Grystes nuecensis* Baird & Girard, 1854; *Grystes megastoma* Garlick, 1857; *Pikea sericea* Fowler, 1938.

## Common names

Largemouth bass, Black bass.

## Short description

The body is tapered and robust, 40-97 cm long, can weigh just over 10 kg and can live up to 20 years. The dorsal fin is hollowed out in its median section, the tail fin is biloba. The mouth is wide, and the jaws extend beyond the posterior edge of the eyes. The livery varies according to the environment and age. The back is greenish or brownish-green; the flanks and the belly are whitish or white-yellowish. The fins are clear, brown, yellowish-brown. The specimens typically have a streak or black shading along the lateral line, from snout to tail. The eye is golden.

## Place of origin and global distribution

The native range of *M. salmoides* extends from the northeastern United States to northern Mexico. It has a cosmopolitan distribution. In Europe it was introduced in 1883 in Germany; in 1897 in Northern Italy and spread throughout the peninsula and islands.

## Distribution, frequency and first record for Sicily

Introduced in the 20th century although no precise data were available on the date of first introduction in Sicily (Naselli-Flores & Marrone, 2019), certainly already reported at the end of the 90s. The Largemouth bass is stabilized and invasive, present and frequent in many Sicilian lakes and rivers, including the Lake of Pozzillo, the Lake of Nicoletti, the Dam of Olivo, the Lake of Rosamarina, the Lake of S. Rosalia, the Lake of Dirillo, and Rivers Simeto, Dirillo, Irminio and Tellaro. Species bred in aquaculture also in Sicily.

## Distribution, frequency and first record for Malta

Not present.

## Habitat or preferred invading habitat

It inhabits lakes, ponds, swamps, and rivers, and usually prefers muddy or sandy substrates, mostly in warm, calm and clear waters, often in areas of coastal coasts or lakes with an abundance of aquatic vegetation, both emerging and submerged. It is present in both natural and artificial environments.

## Introduction source

Primarily introduced for sport fishing, *M. salmoides* is one of the most popular freshwater fish in the world. Introductions of *M. salmoides* are generally conducted by sport fishing agencies and fishermen, often without any consideration of the ecological consequences of this. Species raised in aquaculture.

## Ecology

It bears a salinity of up to 13 ‰. The young feed on crustaceans, insects and small fish; the adults feed on eggs, fish, shrimps, amphibians, and sometimes rats; sometimes this species is cannibal. It is very voracious and practices stalking. Due to its numerous sharp spines, swimming speed and large size, the adult of *M. salmoides* is



well protected from predation by other fish. It is usually preyed upon by birds such as herons, bitterns and kingfishers. Adults mate between the ages of 5 and 12. Spawning occurs from spring to summer. Adult males during this period become aggressive and territorial; they build the nest on muddy bottoms of not very deep waters and once deposited they will protect the brood; an average of 5000-7000 individuals are born from a nest. Its growth is rapid.

#### Possible control methods

It is a species towards which targeted containment actions have been undertaken (prohibition of entry or release after capture, suppression after capture, prohibition of transport, etc.), expressly mentioned in the regulations of the Italian Regions, relating to the sport fishing sector in inland waters. For the Region of Sicily, however, the individual provinces have issued their regulations. One type of control would involve the physical isolation of the populations introduced, with the use of barriers, such as blocks or electrical networks. On the other hand, biological control would be unlikely, given the low number of natural predators, although the juveniles can be preyed upon by a series of larger fish. Eradication may involve the use of chemical agents (e. g. rotenone) to induce mortality within the introduced populations, although such methods should be evaluated for their potential



effects on non-target species. It is essential to avoid events of new introductions in nature with particular attention to the release (intentional or not) of specimens from aquaculture.

#### Invasive category/local potential threat

Since 2004 the species has been included in the list of the “100 worst invasive alien species in the world” by the IUCN. It is a capable invader, strong competitor and predator of native fish species, it can have intense predation at multiple trophic levels, thus altering ecosystem processes. Estimates relating to the specific impacts of colonized habitats have not been quantified and therefore its invasiveness should be considered as a potential threat to freshwater biodiversity. Locally invasive and potentially very dangerous species.

#### Remarks

The species is raised in aquaculture for the food quality of its meat (e. g. in China).

#### Literature

- Baldaccini, G. N., & Ercolini, P. (2016) Gestione della fauna ittica alloctona: riflessioni sulla normativa di settore. *Biologia Ambientale*, 30: 57-66.
- Brown, T. G., Runciman, B., Pollard, S., & Grant, A. D. A. (2009) Biological synopsis of largemouth bass (*Micropterus salmoides*). *Canadian Manuscript Report of Fisheries and Aquatic Sciences*, 2884: 1–26.
- Marrone, F., & Naselli-Flores, L. (2015) A review on the animal xenodiversity in Sicilian inland waters (Italy). *Advances in Oceanography and Limnology*, 6 (1-2): 2–12.
- Pereira, F. W., e Vitule, J. R. S. (2019) Il persico trota *Micropterus salmoides* (Lacepède, 1802): impatti di un potente predatore di pesci d'acqua dolce al di fuori del suo areale nativo. *Recensioni in biologia dei pesci e pesca*, 29 (3): 639–652.

# *Salmo trutta* Linnaeus, 1758



(Chordata: Actinopterygii: Salmoniformes: Salmonidae)

## Main synonyms

None.

## Common name

Brown trout.

## Short description

The Brown trout takes its name from the general brown or golden-brown colour; the sides are silvery or yellow and the ventral part is white or yellowish. It has dark spots, sometimes surrounded by a light halo, more abundant dorsally and on the sides. The colouring varies according to the habitats frequented. It can grow quite large, reaching 31 kg in weight, however, in the wild it reaches around 9 kg in weight.

## Place of origin and global distribution

Brown trout occur naturally throughout Europe, western Asia and North Africa, but can now be found on every continent excluding Antarctica. In Italy, the Brown trout can be considered indigenous only for the watercourses that belong to the catchment area of the Danube.

## Distribution, frequency and first record for Sicily

Introduced in the 20th century and reported by Tigano & Ferrito (1996) for South Eastern Sicily. During the 70s and 80s, many introductions of allochthonous trout were made throughout Southeastern Sicily and in particular the Brown trout was reported in the basins of the Dirillo, Irminio and Tellaro rivers. The species was more widespread on the island in the past, today it seems to be localized in the rivers of South-Eastern Sicily.

## Distribution, frequency and first record for Malta

Absent.

## Habitat or preferred invading habitat

Although Brown trout prefer cool water temperatures and moderately good water quality, they can survive, grow and reproduce under a wide range of habitat conditions. The optimal temperature range is between 15-18 °C but the populations of this species can reach high densities even when average temperatures exceed 20 °C, their maximum tolerance threshold is around 30 °C. *S. trutta* can live in different habitats including estuaries, marine habitats, fjords, lakes, ponds, streams and rivers, proving to have great ecological plasticity. In Sicily only occur in natural rivers. Sicilian populations are residents, they do not go to the sea and reproduce in waterways.

## Introduction source

The species was introduced for food purposes to compensate for the lack of local fish, but also for sport fishing.

## Ecology

Brown trout reaches sexual maturity after 3-4 years and reproduces in fresh water, the female produces about 10000 eggs and spawning occurs in shallow water where the eggs are then covered with fine

gravel or sand. After hatching, brown trout fry remains in the sand for about 2-3 weeks, then emerge in early spring and begin to feed in the water column. This trout feeds mainly during the day on an omnivorous diet, using larger prey as their body size increases, they begin to feed on fish when they reach a size of around 15-30 cm in length and when this occurs their growth increases considerably. They can be diadromous, fluvial, residential, migratory, sedentary and territorial. Of course, this plasticity and wide niche space have facilitated their successful invasion and establishment worldwide.

#### Possible control methods

There are several systems aimed at limiting the spread of the species, including preventive isolation which is done using artificial barriers that prevent its dispersion and translocation; the eradication that can be carried out with the use of chemicals (e. g. rotenone and antimycin



which are toxic to fish) and mechanical actions such as electrofishing, traps and nets. Finally, it is extremely important to regulate the sale, of fishing licenses and sport fishing.

#### Invasive category/local potential threat

Thanks to their ecological plasticity and their omnivorous and opportunistic diet, in many ecosystems this species competes and has the better of native species. Brown trout is regarded as one of the “world’s worst invasive alien species” by international conservation authorities for its impact on native species. It can be hybridized with native trout species. In Sicily, in the 1980s, in the river basins of the province of Ragusa, hybridizations with the native Sicilian trout *Salmo cetii* took place, leading to the formation of intermediate populations between the native and non-native ones.

#### Remarks

Brown trout range expansion has followed two main pathways, an initial release, followed by successful local establishment, and a secondary spread from naturalized populations (i. e. dispersal and colonization).

---

#### Literature

- Duchi, A. (2014) Relazione tra lunghezza e frequenza fenotipica di *Salmo cetii*/ *Salmo trutta* ed i loro ibridi in un corso d’acqua Siciliano (Irminio, Ragusa). Atti XIII Congresso Nazionale Associazione Italiana Ittiologi Acque Dolci – Sansepolcro (AR). *Italian Journal of Freshwater and Ichthyology*, 1: 207–210.
- Lorenzoni, M., Carosi, A., Tancioni, L. & Nonnis Marzano, F. (2021) Petromizonti, Actinopterygii (freshwater). In: Bologna, M. A., Zapparoli, M., Oliverio, M., Minelli, A., Bonato, L., Cianferoni, F. & Stoch F. (eds.), Checklist of the Italian Fauna. Version 1.0. Last update: 2021-05-31.
- Marrone, F. & Naselli-Flores, L. (2015) Distribuzione della fauna ittica nelle acque interne dell’areale ibleo: la provincia di Ragusa. Atti 10° Convegno Nazionale A.I.I.A.D., Montesilvano (PE), 2-3 aprile 2004. *Biologia Ambientale*, 20 (1): 291–294.

Naselli-Flores L. & Marrone F. (2019) Different invasibility of permanent and temporary waterbodies in a semiarid Mediterranean Island. *Inland Waters*, 9 (4): 411–421.

Tigano, C. & Ferrito, V. (1996) I pesci delle acque interne e di estuario. *Atti del Convegno su La Fauna degli Iblei tenuto dall'Ente Fauna Siciliana*, Noto, 13 e 14 maggio 1995: 81–102.

## *Sarmarutilus rubilio* (Bonaparte, 1837)



(Chordata: Actinopterygii: Cypriniformes: Cyprinidae)

### Main synonyms

*Leuciscus lascha* Costa, 1838; *Leuciscus sardella* Valenciennes, 1844; *Rutilus italicus* Calderoni, 1981.

### Common name

South European roach.

### Short description

Medium-small size, (20 cm max length), tapered body, small head and subterminal mouth; dorsum grey-brown and silvery flanks with a darker longitudinal band. The even fins and the anal fin are orange-red, more evident in the reproductive period (the only period in which sexual dimorphism is also evident, for which the males take on a more vivid colour and, on their head, appear small horny formations, called nuptial tubercles).

### Place of origin and global distribution

*S. rubilio* is an endemic species of central-southern Italy (spread from



Liguria to Campania on the Tyrrhenian side and from Marche to Molise on the Adriatic side). For some authors, this species is autochthonous also in Emilia-Romagna, and in the Ionian basins of Basilicata. Until the 1960s it was also present in Lake Trasimeno, where it probably became extinct due to competition with the Sun perch *Lepomis gibbosus* (L. 1758). *S. rubilio* is considered a transfaunate species in other Italian regions, such as Calabria and Sicily.

#### Distribution, frequency and first record for Sicily

Reported for the first time in the 1980s (Tigano & Ferrito, 1986) in the Salso basin (Southern Imera). The release of the South European roach in Sicily is due to a transfaunation, with particular conservation implications; in fact, while this species is decreasing in its original range (so much so that it is considered an almost endangered species), in Sicily, it is constantly expanding, colonizing both lotic and lentic environments. This increase in the diffusion of *S. rubilio* in the Sicilian territories is also due to the lack of controls on the introduction of fish species. This fish has colonized several Sicilian water bodies where its structured and sometimes abundant populations exist; more precisely the Simeto basin and in the Iblean area (River Tellaro and the Tellesimo and Prainito streams) and the province of Trapani (with specimens of the species probably coming from the nearby Belice River).

#### Distribution, frequency and first record for Malta

Absent.

#### Habitat or preferred invading habitat

Ubiquitous species with a wide ecological value in moderately flowing and shallow waters, from the foothills to the coasts, areas at the mouth of rivers, canals and coastal lagoons. It is a frequent species in small streams subject to considerable seasonal variations in flow, where, in periods of drought, individuals survive confined in small perennial pools.

#### Introduction source

Transfaunate species, probably accidentally introduced together with fry of other species used for sport fishing.

#### Ecology

Gregarious species, it forms numerous schools, often in association with other cyprinids. It prefers substrates mixed with rock, crushed stone, sand and gravel; It also lives well in basins with mainly muddy bottoms and is rich in submerged vegetation. It tolerates only very slight concentrations of salinity. Omnivorous with a diet that varies according to age and seasonal cycles, feeding on aquatic insects, worms, molluscs, crustaceans, plankton, algae and organic debris. In winter, it hibernates under boulders or in ravines in the deep waters of rivers. *S. rubilio* preys on water snakes, ichthyophagous birds and other fish but also on carnivorous aquatic invertebrates (crustaceans, aquatic insects), which during dry periods attack eggs, larvae and fry. Sexual maturity is reached at one year of age in both sexes and reproduction takes place in spring.

#### Possible control methods

There is currently no control method for this species. Sicily represents *S. rubilio* as a sort of “ex-situ” conservation area; this must be considered in the management of *S. rubilio* on the island, to opt for either its eradication, as it is a potentially invasive species, or to maintain it.





### Invasive category/local potential threat

*S. rubilio*, in all its native range, is placed in the category of “almost threatened”, while everywhere it has been introduced (transfaunated), including Sicily, it has become invasive. The native populations of *S. rubilio* lately tend to decline the species has disappeared from many lakes and has a fragmentary presence in several rivers (the distribution area for this species has decreased by 30% in 10 years due to both alteration of the habitat due to canalizations and the construction of dams, both by competition and predation mainly by and by more competitive alien species).

### Remarks

According to phylogenetic data, the genus *Sarmarutilus* seems to have evolved in the pre-Messinian era, but only survived in the Tuscany-Lazio district. Before the description of the genus *Sarmarutilus* in 2014, the species was known as *Rutilus rubilio*. Until shortly after the middle of the last century, the species had economic value limited to the regions where it was widespread. *S. rubilio* is a species close to being evaluated as Vulnerable (VU); listed in Appendix II of the Habitats Directive 92/43 / EEC; it is also included among the protected species in the Berne Convention (annexe III); it is included in the General Action Plan for the Conservation of Italian Freshwater Fish.

---

### Literature

- Balestrieri, A., Prigioni, C., Remonti, L., Sgrosso, S. & Priore, G. (2006) Feeding ecology of *Leuciscus cephalus* and *Rutilus rubilio* in southern Italy. *Italian Journal of Zoology*, 73 (2): 129–135.
- Duchi, A. (2014) Ampliamento dell'areale della Rovella (*Rutilus rubilio*, Bonaparte, 1837) in Sicilia: nuove segnalazioni nell'areale ibleo ed in provincia di Trapani. *Italian Journal of Freshwater and Ichthyology*, 1: 221–224.

Lorenzoni, M., Carosi, A., Tancioni, L. & Nonnis Marzano, F. (2021) *Petromizonti, Actinopterygii (freshwater)*. In: Bologna, M.A., Zapparoli, M., Oliverio, M., Minelli, A., Bonato, L., Cianferoni, F. & Stoch, F. (eds.), Checklist of the Italian Fauna. Version 1.0. Last update: 2021-05-3.

Tigano, C. & Ferrito, V. (1986) Sulla presenza di *Rutilus rubilio* (Bonaparte 1837) in Sicilia (Pisces, Cyprinidae). *Animalia*, 13 (1/3):109–124.

## 2. Amphibia

---

# *Pelophylax bedriagae* (Camerano, 1882)



(Chordata: Amphibia: Anura: Ranidae)

### Main synonyms

*Rana levantina* Schneider & Sinsch, 1992.

### Common name

Levant water frog; Bedriaga's frog.

### Short description

A rather large frog ranging between 43-95 millimetres in length, with females often being larger than males; body colour usually brown to olive green with a variable pattern of dark blotches, and a green line running mid-dorsally from snout-tip to the base of the spine. Tadpoles are yellowish to greyish-brown dorsolaterally, and whitish ventrally. These characters make it readily distinguishable from the only other wild amphibian in the Maltese Islands, the native *Discoglossus pictus pictus*.

### Place of origin and global distribution

Native to Turkey, Syria, Jordan, Israel, Iraq, Lebanon and Egypt; in Europe, it is present on some of the easternmost Greek islands, as well as in Cyprus. Introduced to Malta.

### Distribution, frequency and first record for Sicily

Not present.

### Distribution, frequency and first record for Malta

Present and established in the Maltese Islands. So far, the only confirmed self-sustaining population on Gozo occurs at Ta' Sarraflu pond in Kerċem, Gozo, although unconfirmed calls have been reported from Wied tax-Xlendi on the same island. In Malta, an established population is distributed along the Wied l-Imselliet/Wied tal-Ħżejjen/Wied ta' Għajn Rihana valley system (Mgarr/Bidnija). The first record was reported by Sciberras & Schembri (2006) as *Rana bedriagae*.

### Introduction source

Introduced deliberately by humans; individuals initially kept as pets were released into the wild.

### Habitat or preferred invading habitat

Freshwater pools.

### Ecology

Though this species is unlikely to become widely distributed throughout the Maltese Islands due to its inability to migrate across arid land, its presence at Ta' Sarraflu Pond is concerning. *P. bedriagae* has been documented to be a voracious predator of a wide range of organisms, including many native species such as the painted frog *Discoglossus pictus pictus*, the shrew *Crocidura sicula*, and a variety of indigenous arthropods. This paired with the fact that Ta' Sarraflu pond is one of the few permanent freshwater bodies in the entirety of the Maltese archipelago, and is a refuge for rare freshwater-inhabiting native species, implies that the ecological impact of *P. bedriagae* may be quite significant.

### Possible control methods

Physical collection and removal of tadpoles and adults from the site.

### Invasive category/local potential threat

Cannot disperse itself well but has a high impact when introduced to a freshwater site.

### Remarks

The present-day population at Ta' Sarraflu Pond is probably constituted of descendants of specimens released there deliberately in the 1990s by humans, though this has not been confirmed, and the motivation for the introduction is unknown. This species is unlikely to become widespread in the Maltese Islands without human intervention, though the Ta' Sarraflu population is stable and self-sustaining.

### Literature

Sciberras, A. & Schembri, P. J. (2006) Occurrence of alien Bedriaga's frog (*Rana bedriagae*) Camerano, 1882 in the Maltese Islands, and implications for conservation. *Herpetological Bulletin*, 95: 2–5.



# *Xenopus laevis* (Daudin, 1802)



(Chordata: Amphibia: Anura: Pipidae)

## Main synonyms

None.

## Common name

African clawed frog.

## Short description

The *Xenopus* are the only frogs which have toes on their clawed hind legs and *X. laevis* is the largest species of this genus. The males are usually 5-6 cm long and weigh about 60 g, while the females can reach 12 cm in length and weigh even 200 g. They have smooth skin, whitish ventrally and greenish-grey dorsally, sometimes they can be completely albinos.

## Place of origin and global distribution

Native species of sub-Saharan Africa; introduced in Arizona, California, Mexico, Chile, Ascension Island, Indonesia, Japan, St. Helena, Israel, United Kingdom, France, Italy, Portugal and Spain.

## Distribution, frequency and first record for Sicily

First report for Sicily in June 2004 in the drainage area of the river Iato and the artificial lake Poma (Lillo et alii, 2005). Currently, in Sicily, there is at least one viable population confirmed by the capture of a large number of individuals of different sizes (Lillo et alii, 2011).

## Distribution, frequency and first record for Malta

No data.

## Habitat or preferred invading habitat

This species can successfully colonize areas with a Mediterranean climate such as central Chile, the southwestern United States and Sicily. It lives in most water bodies with a preference for stagnant waters.

## Introduction source

Often sold as a pet, it is also widely used as a laboratory animal.

## Ecology

It is a generalist species which feeds on invertebrates, but also on small vertebrates including other amphibians; it is also known for its cannibalism, and is therefore considered a potential threat to freshwater fauna. The tadpoles take about 3 months to metamorphose. Adults reach sexual maturity in about a year, and captive adults can live up to 20 years.

## Possible control methods

Control over the sale and release of farmed animals into the wild.

## Invasive category/local potential threat

Low invasiveness locally, but a potential threat in environments where it manages to acclimate where it can become a potential invasive taxon.

## Remarks

The ease with which it reproduces, the relatively short time to reach sexual maturity, and its resistance to diseases and infections, combined with its ecological plasticity, explain its worldwide diffusion.

---

## Literature

Faraone, F. P., Lillo F., Giacalone, G. & Lo Valvo, M. (2008) The large invasive population of *Xenopus laevis* in Sicily, Italy. *Amphibia-Reptilia*, 29: 405–412.

Lillo, F., Faraone, F. P. & Lo Valvo, M. (2008) *Xenopus laevis* in Sicilia: areale, invasività e impatto. In: Convegno: Le specie alloctone in Italia: censimenti, invasività e piani di azione. Regione Lombardia e Museo Civico di Milano. *Memorie della Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* 36 (1): 71.

Lillo, F., Faraone, F. P. & Lo Valvo, M. (2011) Can the introduction of *Xenopus laevis* affect native amphibian populations? Reduction of reproductive occurrence in the presence of the invasive species. *Biological Invasions*, 13: 1533–1541.

Lillo, F., Marrone, F., Sicilia, A., Castelli, G. & Zava, B. (2005) An invasive population of *Xenopus laevis* in Italy. *Herpetozoa*, 18 (1/2): 63–64.

## 3. Aves

---



# *Alectoris chukar* (J. E. Gray, 1830)



(Chordata: Aves: Galliformes:  
Phasianidae)

## Main synonyms

None.

## Common names

Chukar; Chukar partridge.

## Short description

A relatively large and robust bird reaching just over 30 centimetres in body length, with a rather rounded body; the throat is adorned with a patch of white feathers, bordered by a continuous thick black stripe

which circles the throat patch from above the beak, extending over the eyes, and meeting at the breast; the beak and legs are red; the flanks are distinctively marked with parallel stripes of white and rufous-black; tail short and stubby.

#### Place of origin and global distribution

Native to Asia from Turkey east to Nepal; introduced to various countries in the Americas; Australia and New Zealand, and Malta.

#### Distribution, frequency and first record for Sicily

Absent in wildlife. In the past has been tentative of introduction fortunately unsuccessful up to now, also in a small island (Favignana and Marettimo).

#### Distribution, frequency and first record for Malta

First recorded in the literature by Sciberras (2009) as present on the island of Comino, where it has been since the 1990s and is well-established and abundant on this island.

#### Habitat or preferred invading habitat

On Comino, it occurs in phrygana, around old and abandoned buildings and in Aleppo pine stands.

#### Introduction source

Released deliberately on Comino by a resident for hunting purposes.

#### Ecology

Eggs are laid in an uncomplicated nest directly on the surface of the ground. The chukar partridge feeds on seeds and insects, and forages in groups (on the island of Comino). On the island, breeding occurs around April though not exclusively within that month.

#### Possible control methods

Removal of eggs and culling of adult birds.

#### Invasive category/local potential threat

Poses a significant threat where it has become established. As a seed-feeding and insectivorous bird, the Chukar partridge represents a threat to native biodiversity on Comino for many reasons. The insular

environment of Comino magnifies the birds' effects on the ecosystem – intraguild interference with native birds and direct predation pressure on native arthropods among others.

#### Remarks

None.

---

#### Literature

Massa, B., Lo Cascio, P., Ientile, R., Canale E. D. & La Mantia, T. (2015) Gli Uccelli delle isole circumsiciliane. *Il Naturalista siciliano*, 39 (2): 105–373.

Massa, B., Ientile, R., Aradis & A. Surdo, S. (2021) One hundred and fifty years of ornithology in Sicily, with an unknown manuscript by Joseph Whitaker. *Biodiversity Journal*, 12 (1): 27–89.

Sciberras, A. (2009) Short notes on the introduced avifauna of Comino Island and some of their interactions with local herpetofauna. *Central Mediterranean Naturalist*, 5 (1): 46–49.





# *Myiopsitta monachus* (Boddaert, 1783)



(Chordata: Aves: Psittaciformes: Psittacidae)

## Main synonyms

None

## Common name

Monk parakeet

## Short description

*M. monachus* is a small squat parrot (28-33 cm, in length; weight 90-120 g), with a wingspan of 31-34 cm. At the hatching, the young are covered with a yellow down; they become immature young of a brighter green, with a greenish forehead. There are no sexual dimorphism females and males have identical plumage in adult individuals (the

latter are generally slightly larger, except during the breeding season when females slightly increase body mass). The bill is pale orange or dull yellow, the iris is dark brown. The adults have forehead, cheeks, lower parts and legs grey or whitish and the upper parts are green (with the back and upper coverts of the tail tending to yellowish); helmsman green coloured blue along the rachis; dark blue remiges.

## Place of origin and global distribution

Native to the sub-subtropical and temperate regions of South America (plains east of the Andes in Bolivia, Paraguay, Uruguay, South Brazil and Argentina). Introduced in the eastern United States (Florida and New York), Northern Brazil, Southern Canada, Spain, Italy, France, Belgium, Germany, Austria, Holland, Czech Republic, Kenya, Japan, Bermuda, Puerto Rico, Bahamas and England; in Europe, it has naturalized nuclei in Belgium, Germany, the Czech Republic, Spain, the Balearic Islands, Italy.

## Distribution, frequency and first record for Sicily

Between the end of the 80s and the beginning of the 90s, *M. monachus* colonized the urban centre of Catania, building nests on palms of the genus *Washingtonia* (Lo Valvo et alii, 1993) or on the palms of the Canary Islands, *Phoenix canariensis*. Also observed in Syracuse in the years 1984-85 where, however, it was never found later. It is an acclimatized and rare species.

## Distribution, frequency and first record for Malta

Absent in the wild.

## Habitat or preferred invading habitat

In the regions of origin, the monk parakeet prefers open habitats, and populates woods, agricultural land, plantations, orchards, bushes and Cactaceae formations, urban areas and forests from low altitudes up to 1600 m asl (except the subspecies *M. m. luchsii*, linked to mountain habitats up to 3000 m a.s.l.). *M. monachus*, in the areas where it is introduced, on the other hand, lives almost exclusively in urban areas, preferring open spaces, including parks, planted city areas, golf courses, farms, gardens and orchards.

### Introduction source

Introduced voluntarily as a pet in the 1970s, becoming very popular in the pet trade, it then originated populations in the wild, from specimens who have accidentally escaped, or intentionally released.

### Ecology

In native areas, *M. monachus* is sedentary, distinctly social and gregarious (able to vocalize and communicate with a large vocabulary of screeches, screeches and noises, with eleven or more different calls that each elicit a different response from the other specimens). Its diet is very flexible, but mainly it is a granivorous bird, generalist of seeds such as corn, millet, sorghum, sunflower and others. In winter these parakeets usually gather to feed in large flocks of several hundred individuals and some act as sentinels on high perches, to spot predators. It also feeds on shoots, and with its large bill, it bites pieces of fruit from ornamental and exotic plants (nuts, berries, palm fruits) and manages to break even the cones of conifers to reach the seeds; sometimes it supplements the diet with invertebrates. In non-native areas, the flocks are formed by 15-20 specimens, often up to a hundred, but, with no more than 4 specimens during the reproductive period. *M. monachus* is the only parrot that, instead of exploiting pre-existing cavities, builds its own nest by weaving sticks and thorny branches; the nest is used all year round for perching and is almost always built at about 10 meters or more from the ground; very often on palm trees, or among the highest branches of broad-leaved and conifers or, even on artificial structures, such as buildings, electric pylons, telephone poles. A nest can be used by a single couple, but often has several separate chambers, to accommodate several couples and in this case, it can be as large as 1 m in diameter and weigh about 200 kg. In the area of origin, this species reproduces from August to November (on average, there are 7 eggs per brood). Upon hatching, the pullets are fed by their parents for about 40 days, until they reach a weight of about 106 grams before flying off.

### Possible control methods

Stricter laws would be needed to regulate the possession, transport and trade of this species. The timely identification of the species in nature is important, for a quick management response, considering

that the optimal possibilities for the management of large populations of parakeets in an urban environment (including eradication and numerical control) depend on the local context. The use of firearms has been successfully applied in the eradication of new emerging nuclei in some areas of the United States. In densely populated urban areas, an alternative is trapping with special traps, but the complete removal of large urban populations is never possible. Research is needed to limit damage to agriculture, but it is useful to use a combination of methodologies (e. g. traps and bollards).

### Invasive category/local potential threat

In Sicily, it is not a common species and has limited diffusion with a stable trend so it does not currently represent a serious threat but its presence should be carefully monitored. In Argentina, where *M. monachus* is a native species, it causes heavy damage to crops; although there is no comparable damage in any other invaded region, monk parakeet could cause serious damage to crops, as it attacks citrus groves and cereal fields. *M. monachus* is a very common species in the ornamental and pet animal trade and therefore spreads easily; it can adapt also to cold climates and, in the invaded areas, nesting nuclei arise in urban areas and also in natural environments when specimens in captivity are released, intentionally or accidentally. The



monk parakeet competes with native species of birds and bats for the use of nests and shelters, and drives other birds away from feeders, with even serious impacts, locally. The large nest structures built by *M. monachus* can cause serious damage to power lines and endanger the stability of trees in cities. Like all species belonging to the Psittacids, it represents the natural reservoir of *Chlamydia psittaci*, an agent of human psittacosis.

#### Remarks

*M. monachus* is a species listed in CITES, to contrast its excessive exploitation with the international trade of specimens. The first release into the wild, in the Italian territory, took place in Milan in 1934 and led to the formation of a small breeding population; the colony went extinct in 1946 probably due to predation by rats. In Italy, in 1999, a consistency of over 200 specimens was estimated, especially in urban parks and gardens of different cities (however, the number of individuals present in the semi-wild state is unknown).

#### Literature

- Andreotti, A., Baccetti, N., Perfetti, A., Besa, M., Genovesi, P. & Guberti, V. (2003) Mammiferi ed Uccelli alloctoni in Italia: analisi del fenomeno, impatto sulla biodiversità e linee guida gestionali. *Quaderni di conservazione della Natura*, 2: 1–194.
- A. VV. (2008) Atlante della Biodiversità della Sicilia: Vertebrati terrestri. *Studi e Ricerche dell'ARPA Sicilia*, 6: 1–230.
- Lo Valvo, M., Massa, B. & Sarà, M. (1993) Uccelli e paesaggio in Sicilia alle soglie del terzo millennio. *Il Naturalista Siciliano*, 17 (suppl.): 1–373.
- Pârâu, L. G., Strubbe, D., Mori, E., Menchetti, M., Ancillotto, L., van Kleunen, A., White, R. L., Luna, A., Hernández-Brito, D., Le Louarn, M., Clergeau, P., Albayrak, T., Franz, D., Braun, M. P., Schroeder, J. & Wink, M. (2016) Rose-ringed parakeet *Psittacula krameri* populations and numbers in Europe: a complete overview. *The Open Ornithology Journal*, 9 (1): 1–31.

## *Psittacula krameri* (Scopoli, 1769)



(Chordata: Aves:  
Psittaciformes: Psittacidae)

#### Main synonyms

None.

#### Common names

Rose-ringed parakeet.

#### Short description

*P. krameri* is a bird of medium size (37-43 cm long and with a wingspan of 42-48 cm), with green plumage, a long and pointed tail, bluish



above and other below; grey-green legs and curved red beak; yellow iris. The sexes are similar, except for the black and reddish collar and the bluish tinge on the head present only in the adult male. Juveniles are very similar to females, but with a more yellowish plumage, a shorter tail and a pink, black-tipped bill.

#### Place of origin and global distribution

Species native to tropical Africa north of the equator and southern Asia from Pakistan to India and Bangladesh. It has been successfully introduced in Mauritius and Hawaii islands, Zanzibar, Egypt, Israel, Jordan, Oman, Kuwait, Iraq, China, the United States and Europe. Recently reported from South America. The taxonomy of the populations introduced is uncertain; according to some scholars, it seems more probable that the populations introduced in Europe are of Asian origin.

#### Distribution, frequency and first record for Sicily

From 1990 there were accidental escapes of specimens in captivity, which colonized the urban parks of Palermo, irregular records of pairs in Catania and Siracusa (Lo Valvo et alii, 1993); also recorded in Enna, Avola (SR), Pozzallo (RG) and Porto Empedocle (AG). Nesting on palms belonging to the genera *Phoenix*, *Washingtonia*, or in cavities of large trees, such as *Platanus*. The only stable populations are those of the city of Palermo, where *P. krameri* is present and increasing in different localities. In various other locations and some small islands, such as Favignana and Alicudi, there have been reports of single specimens, which show the great ability of this species to adapt and colonize new territories.

#### Distribution, frequency and first record for Malta

Absent in the wild.

#### Habitat or preferred invading habitat

The Rose-ringed parakeet is a very adaptable species, able to inhabit a great variety of environments as long as they are characterized by the presence of tall trees. In its areas of origin, it is found in environments such as wooded savannahs, scrubs, and secondary forests and is not uncommon in gardens and cultivated fields. *P. krameri* in Europe and the Mediterranean is found in parks and gardens in urban areas,

representing the most abundant species of parrot, with numerous populations, scattered in several countries.

#### Introduction source

Since the late 1960s, deliberate escapes and releases of this popular cage bird created wild populations almost all over the world, but especially in Europe until 2007, when the EU banned further imports of this bird into its member countries.

#### Ecology

In the countries of origin, the Rose-ringed parakeet, social and gregarious, forms flocks which can exceed 1000 individuals and which gather on large dormitory trees. These parrots in nature feed on seeds, fruit, flowers, berries and for some subspecies even nectar. The flight is fast and direct, accompanied by very loud vocalizations. It nests in the hollows of the trunks, under the roofs and in the cracks of old walls and also on trees (as in Sicily). *P. krameri* reaches maturity when it is three years old. Its reproductive success in invaded areas depends on the potential predators present and on the environmental temperature, which can compromise the hatching



of the eggs. The reproductive season varies according to the occupied area; e. g. from August to November in Africa, from December to May in India and from May to August in Italy. After mating, the female lays 3 to 5 eggs which it hatches, alone, for about 22 days. The young are fed by both parents for about 45 days, after which they can leave the nest, even if they are fed for another two weeks.

#### Possible control methods

It is essential to prevent the colonization of new areas by this species. However, the management of large parakeet populations (including eradication, and numerical control) depends on the local context (e.g., in cases where there are rare native species that use cavities for nesting or as a refuge, as well as the risk of damage to crops, more drastic management actions are justified). Citizens should also be involved, inviting them not to feed these animals, or to limit their populations in urban areas. Damage to agriculture can be minimized through the use of firearms, traps for trapping and deterring or techniques for the removal of these birds; however, more research is needed to identify more effective methods. To avoid new introductions, all parakeet species should be indicated as 'invasive species of local and regional importance' (as per Articles 11 and 12 of EU legislation no. 1143/2014). In the future, the removal of populations in the early stages of the invasion is desirable.

#### Invasive category/local potential threat

*P. krameri* is listed among the 100 worst alien species in Europe, because it impacts, both directly and indirectly, locally nesting avian species for various reasons, such as competition for nesting cavities and food, aggression towards other animals near its nest and transmission of parasites. It is considered harmful to crops, especially those of cereals, coffee and vegetable gardens. However, there are native species that benefit from the introduction of the presence of *P. krameri*, because e. g. there are more cavities available, or the predatory pressures are less, thanks to the mobbing behaviour that this parakeet carries out towards perceived predators. Throughout much of its Asian range, *P. krameri* is known to cause severe damage to crops and stored grains. Should the consistency of naturalized populations increase (currently

a growing trend in some areas), *P. krameri* could cause consistent damage to agricultural production in Europe as well.

#### Remarks

4 subspecies occupy different portions of the native range, two of which are present in Africa and two in Asia (from Pakistan to India).

---

#### Literature

- Andreotti, A., Baccetti, N., Perfetti, A., Besa, M., Genovesi, P. & Guberti, V. (2003) Mammiferi ed Uccelli alloctoni in Italia: analisi del fenomeno, impatto sulla biodiversità e linee guida gestionali. *Quaderni di conservazione della Natura*, 2: 1–194.
- AA. VV. (2008) Atlante della Biodiversità della Sicilia: Vertebrati terrestri. *Studi e Ricerche dell'ARPA Sicilia*, 6: 1–230.
- Lo Valvo, M., Massa, B. & Sarà, M. (1993) Uccelli e paesaggio in Sicilia alle soglie del terzo millennio. *Il Naturalista Siciliano*, 17 (suppl.): 1–373.
- Pârâu, L. G., Strubbe, D., Mori, E., Menchetti, M., Ancillotto, L., van Kleunen, A., White, R. L., Luna, A., Hernández-Brito, D., Le Louarn, M., Clergeau, P., Albayrak, T., Franz, D., Braun, M. P., Schroeder, J. & Wink, M. (2016) Rose-ringed parakeet *Psittacula krameri* populations and numbers in Europe: a complete overview. *The Open Ornithology Journal*, 9 (1): 1–31.

## 4. Mammalia

---

# *Atelerix algirus* (Lereboullet, 1842)



(Chordata: Mammalia: Eulipotyphla: Erinaceidae)

### Main synonyms

*Aethechinus algirus* (Lereboullet, 1842).

### Common names

North African Hedgehog; Algerian Hedgehog.

### Short description

A large, rotund mammal reaching up to 25 centimetres in length; body covered in soft spines dorsally; whitish to cream-coloured soft fur on the underbelly, legs and head, often with brown markings on the face near the snout.

### Place of origin and global distribution

Native to northwest Africa; introduced to Spain, the Balearic archipelago, France and the Maltese Islands.

### Distribution, frequency and first record for Sicily

Absent.

### Distribution, frequency and first record for Malta

First mention in the literature by Gulia (1898). It is widespread and present on all three of the largest islands (Malta, Comino and Gozo).

### Habitat or preferred invading habitat

Agricultural land, garrigue, valleys and gardens.

### Introduction source

Introduced deliberately by human beings, probably to control insect populations around human habitation.

### Ecology

The Algerian Hedgehog feeds on a wide range of invertebrates including insects, earthworms, snails and slugs; it may also opportunistically feed on reptiles such as young snakes, or proteinaceous sources of food left out by humans, such as cat food. It is a nocturnal mammal, residing beneath dense and tangled vegetation during the day, emerging at night to feed. Litters are present between June and September, with up to seven hoglets birthed by a female for each litter. When threatened, the hedgehog remains motionless and exposes its spiny dorsal surface to would-be predators.

### Possible control methods

See remarks.

### Invasive category/local potential threat

Moderate ecological threat.

### Remarks

The North African hedgehog represents a threat to local biodiversity due to direct predation of native invertebrates and reptiles and through intraguild interference with native insectivores. Despite this, it is a locally protected species due to its charismatic nature, so no measures of control can be taken.

### Literature

Gulia, G. (1858-1859) Repertorio di storia naturale Anglo-Maltese. Malta, 68 pp.

Khaldi, M., Ribas, A., Barech, G., Hugot, J., Benyettou, M., Albane, L., Arrizabalaga, A. & Nicolas, V. (2016) Molecular evidence supports the recent anthropogenic introduction of the Algerian hedgehog *Atelerix algirus* in Spain, Balearic and Canary Islands from North Africa. *Mammalia*, 80 (3): 313–320.



# *Myocastor coypus* (Molina, 1782)



(Chordata: Mammalia: Rodentia:  
Myocastoridae)

## Main synonyms

*Mastomys popelairi* Wesmael, 1841.

## Common names

Nutria, Coypu.

## Short description

A large rodent, with a head and body length between 40 and 60 cm, tail length between 25 and 45 cm and a weight between 6 and 9 kg. The body is massive and stocky, the head is broad with small eyes and ears, large white whiskers and evident yellow incisors. The cylindrical tail is

scaly and scarcely hairy. The hind legs are webbed. The soft coat is of very variable colour, from fawn to almost black (cases of albinism are not rare).

## Place of origin and global distribution

The original range of *M. coypus* extends from Brazil, Bolivia and Paraguay to Argentina and Chile. From the 1920s to 1930s, Nutria was imported to North America, Asia, Africa and Europe. It is currently present in most of continental Europe, with stable natural populations in Austria, Finland, Hungary, Holland and Russia; and it is also present, albeit with a more uncertain status, in the Balkans, Greece, and Spain. *M. coypus* was eradicated in Great Britain, while it is particularly common in France (here, the first report for Europe in 1935), Germany and Italy. In the latter, the species was imported at the end of the 20s of the twentieth century, and its first reports in nature occurred in Campania, Lazio, Tuscany and Veneto. The current Italian distribution of Nutria is continuous in the Center-North, but small populations are present in Campania, Calabria, Sicily and Sardinia.

## Distribution, frequency and first record for Sicily

*M. coypus* were present in the Irminio River (RG), but the Managing Body of the reserve highlighted how the species was no longer reported locally after the flood of the Irminio river in April 2012 (ISPRA, 2021). Introduced here on an uncertain date, it probably dates back to the 1930s for commercial purposes. *M. coypus* colonized the mouth and banks of the Irminio River, almost as high as the city of Ragusa.

## Distribution, frequency and first record for Malta

Absent.

## Habitat or preferred invading habitat

It is a species linked to the wetlands of still or weakly flowing waters (fresh or brackish), characterized by thick vegetation (embankments, banks of canals, rivers, lakes and swamps) and limited slope of the banks, in generally flat and hilly areas.

### Introduction source

At the end of the last century there were repeated introductions over time of this species as farm animals for fur, but these activities turned out to be less and less profitable and were gradually abandoned. Thus, began to occur the first voluntary and accidental releases of *M. coypus* in nature where groups of individuals have naturalized, forming nuclei capable of self-sustaining and expanding, to form populations.

### Ecology

The species is well adapted to aquatic environments; the Nutria usually lives in small colonies settled in humid environments. It builds shallow nests in riparian vegetation and shallow water, but generally digs complex burrows along the banks of water bodies, sometimes with submerged entrances, with one or more domed chambers up to one meter high. Its trophic niche is essentially vegetarian because it ingests 700 / 1500 g of vegetables per day (approx. 25% of its body weight); occasionally, however, it can also feed on Mollusks; variations in the diet occur seasonally and are linked to the different availability of trophic resources, even if the most used foods are roots, leaves, tubers, rhizomes of aquatic plants. This wide choice of food allows the otters to exploit a wide range of phytocoenoses. The sexual maturity for this species is reached at a very early age (only 6 months for the males). The gestation period on average is 132 days; females can reproduce on average 2.7 times a year, with about 5 young at a time.

### Possible control methods

The control of the nutria populations must be carefully evaluated case by case, also based on the available economic resources. The timeliness of the interventions and the drafting of an operational plan that coordinates all the phases of the interventions to be carried out are factors that affect the success of the interventions. Indeed, eradication in very large Nutria populations is impossible; but for those isolated nuclei, such as those of Sardinia and Sicily, on the contrary, it is not only a possible action, but it represents an urgent and necessary measure. For the prevention of damage, for example, to keep the Nutria away from crops, electrified fences are used, or protection works of the embankments. Prolonged interventions are also implemented aimed at keeping the number of individuals in a population low, with

methods of capture using cages on the ground, or floating rafts (and of suppression of these with methods of euthanasia). The control interventions implemented so far have had different results, but they have not stopped the increase in the population on a national scale.

### Invasive category/local potential threat

Species with proven high invasiveness, representing a threat to biodiversity; it is included among the invasive species at the EU level, and included among the 100 most dangerous alien species in the world. The Nutria exerts significant impacts on continental and/or island ecosystems, due to alteration of the habitats caused mainly by its feeding and excavation activities, negatively impacting plant and animal biocoenoses. This impact takes place with the intensive grazing of Nutria on plant communities which causes rarefaction or disappearance of certain plant essences, with consequent alteration of the characteristic habitats of wetlands; in addition, there is interspecific competition with indigenous animal species, especially birds that undergo alteration of their habitat. The excavation activities of the embankments carried out by the Nutria cause flooding risks. Furthermore, the Nutria is a reservoir species for some parasites such as *Fasciola hepatica* and *Leptosira* sp. The impact of the species is also on agriculture locally significant damage has also been recorded to some crops such as sugar beet, wheat, corn, etc.



## Remarks

The Nutria feeds on hydrophytic plant species important for the habitats of humid environments, such as water lilies (*Nymphaea* spp.), reeds (*Phragmites* spp.) and cattails (*Thypha* spp.) which, disappearing locally, transform the ecosystems of the humid areas. This drastic local reduction of hydrophytes also determines the local disappearance of animal species from these environments, such as the Bittern (*Botaurus stellaris*), the Marsh harrier (*Circus aeruginosus*) and the *Panurus biarmicus*. In Italy, the destruction of the nests and/or the predation of eggs and pullets of the *Chlidonias hybrida*, of the Little Grebe (*Tachybaptus ruficollis*), of the Moorhen (*Gallinula chloropus*) and of the Mallard (*Anas platyrhynchos*) has been reported. On the Citizen Science platform of iNaturalist (data sent by ATIt to ISPRA), a report of coypu at the mouth of the Irminio River in 2014 is reported (ISPRA, 2021).

## Literature

- Andreotti, A., Baccetti, N., Perfetti, A., Besa, M., Genovesi, P. & Guberti, V. (2003) Mammiferi ed Uccelli alloctoni in Italia: analisi del fenomeno, impatto sulla biodiversità e linee guida gestionali. *Quaderni di conservazione della Natura*, 2: 1–194.
- AA. VV. (2008) Atlante della Biodiversità della Sicilia: Vertebrati terrestri. *Studi e Ricerche dell'ARPA Sicilia*, 6: 1–230.
- Cocchi, R. & Riga, F. (2001) Linee guida per il controllo della Nutria (*Myocastor coypus*). *Quaderni di Conservazione della Natura*, Ministero dell'Ambiente - Istituto Nazionale della Fauna Selvatica, 5: 1–42.
- ISPRA (a cura di Cocchi, R. & Bertolino, S.) (2021) Piano di gestione nazionale della Nutria *Myocastor coypus*: 1–58.

# Ovis aries Linnaeus, 1758



(Chordata: Mammalia: Cetartiodactyla: Bovidae)

## Main synonyms

None.

## Common name

European mouflon.

## Short description

The systematics of the genus *Ovis*, to which the European mouflon belongs, is extremely controversial and subject to frequent revisions. In the recent checklist of Italian Mammals (2019), the Mouflon is mentioned with the same scientific name as the domestic sheep which, according to the most recent views, it would represent a re-wild form. The Mouflon is a smaller species than its relatives and some domestic breeds, which manifests sexual dimorphism in appearance, weight and body size, indicate respectively first for males and then

for females, they are length 127-145 / 120 -130 cm; height 75-80 / 70-75 cm; weight 40-60 / 30-40 kg. Males are more robust and weigh about 30% more than females and have large strongly curved horns that extend with age; they have long hair on the neck, on the chest and the forelegs and a whitish "saddle" (a lateral spot, not very marked in the females). Color, length and thickness of the coat are determined by the photoperiod. It is generally darker (chocolate brown) and of greater density and length in winter.

#### Place of origin and global distribution

According to the most recent views, the European mouflon originated from wild Asian sheep (originated in turn from domesticated Asian mouflon strains) which were brought to Sardinia by man about 8000 years B. C.; then introduced also in Corsica and, probably after a phase of pre-domestication, they were released in nature 6000-7000 years B. C. The first introduction in continental Europe is not known (this species is documented as an ornamental animal in parks and gardens, already in the Middle Ages), but the first records in nature date back to the 18th century. Today, wild herds of European mouflon are found in Austria, Belgium, Bulgaria, Croatia, Czech Republic, mainland France, Corsica, Germany, Hungary, Luxembourg, Poland, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine and also islands off the coast of Denmark, Finland and Greece. Herds confined exclusively to fenced areas, on the other hand, are present in Belarus, Lithuania, Macedonia, the Netherlands, Portugal and Romania. The European mouflon was introduced in the 70s and 80s in mainland Italy and today has about forty colonies, distributed in almost all regions, and also in some areas of Argentina, Chile and the United States (California, Texas and Hawaii), as well as the Kerguelen Islands (Indian Ocean).

#### Distribution, frequency and first record for Sicily

In Sicily, European mouflons were introduced in the 1980s by a private individual on the island of Marettimo, where they settled and spread (AA.VV., 2008).

#### Distribution, frequency and first record for Malta

Absent.

#### Habitat or preferred invading habitat

The European mouflon prefers mountainous areas, rich in ecotone areas between pastures and woods, with rocky and stony areas, often between 1000 and 1500 m of altitude. In Corsica and Sardinia, it inhabits areas with dense Mediterranean scrub, but it also adapts to high mountain environments. Populations introduced to Europe can survive in a wide variety of environments from small Mediterranean islands to northern coniferous forests, that is, from sea level up to altitudes above 2000 m.

#### Introduction source

It has been introduced in many European countries and elsewhere, mainly for hunting purposes.

#### Ecology

European mouflon specimens are typically most active at sunrise and sunset, devoting most of their time to feeding. In the middle of the day, they tend to rest. Ruminants feed mostly on grasses, but they also manage to graze hard and leathery plants not generally consumed by most of Ungulates, thus managing to survive in particularly arid habitats. The females with their young live all year round in large flocks, while the males form separate and less numerous groups or live solitary, especially if elderly. In October (or later in colder environments), there is the mating season. In spring, pregnant females move away from the group and give birth to 1 or 2 young (able to move and walk immediately after birth), which are suckled regularly. In summer, females with offspring and males up to the second year of age gather to form flocks of 30-40 individuals. In nature, the predators of the European mouflon are mainly the wolf (*Canis lupus*) and the lynx (*Lynx lynx*), and in particular in central and eastern Europe, the brown bear (*Ursus arctos*). Juveniles can also be preyed upon by foxes (*Vulpes vulpes*), large eagles and wild dogs. Furthermore, wild boars are known to prey on domestic lambs, and therefore the same can be expected for mouflon lambs. The domestic sheep can live up to 22 years on the farm; while in nature the average longevity of the European Mouflon is about 15 years.



### Possible control methods

For forest regeneration, the European mouflon, is subject to hunting monitoring in most countries where it is present and, in many regions, the harsh winters and predation, contribute to the numerical control of its populations. The populations of European mouflon introduced into island ecosystems, such as that on the island of Marettimo in Sicily, must be monitored over time and possibly subjected to control to avoid damage and degradation due to excessive grazing on the island's vegetation. In Italy, containment strategies are necessary because, in addition to the negative effects on vegetation related to overgrazing, there is the risk of negative impacts on the populations of Alpine chamois (*Rupicapra rupicapra*) and Apennine chamois (*Rupicapra pyrenaica*). In Europe, on the other hand, in countries where the abandonment of agricultural practices and breeding causes the extension of the scrub-forest area, (with increased risks, such as higher rates of fire and loss of biodiversity due to the disappearance of pastures), the behaviour of the European mouflon could be exploited as a natural alternative to the maintenance of mosaic landscapes due to grazing.

### Invasive category/local potential threat

The European mouflon is a potentially invasive species because it is very generalist and adaptable, able to feed on a wide range of plants, sometimes causing environmental imbalances, even to the variation of ecosystems, with negative impacts both on native species and on agriculture in contexts such as small islands or very arid environments. In most countries, there is little evidence of serious adverse effects (although there has been little research on the subject), although the European mouflon in Hawaii and the Canary Islands has caused severe adverse effects on native vegetation. In Italy, since the 90s, there has been a significant increase in numbers due both to the high productivity of some populations and to the introduction of new colonies. Furthermore, the European mouflon is a receptive species to all infections of sheep and goats.

### Remarks

It is assumed that the European mouflon is derived from re-wild populations of domestic sheep stocks (*Ovis aries*) which in turn would derive from domesticated strains of Asian mouflon (*Ovis orientalis*).

Currently, the Mediterranean populations present in Cyprus, Corsica and Sardinia (and consequently also those deriving from founders from these islands) are designated as *Ovis aries* (ICZN, 2003). It is considered very likely that the "native" populations of European mouflon of Corsica and Sardinia originated from populations of domestic sheep (also designated with the name of *Ovis aries*) introduced on these two islands in an early phase of domestication and subsequently re-wild.

---

### Literature

- Andreotti, A., Baccetti, N., Perfetti, A., Besa, M., Genovesi, P. & Guberti, V. (2003) Mammiferi ed Uccelli alloctoni in Italia: analisi del fenomeno, impatto sulla biodiversità e linee guida gestionali. *Quaderni di conservazione della Natura*, 2: 1–194.
- AA. VV. (2008) Atlante della Biodiversità della Sicilia: Vertebrati terrestri. *Studi e Ricerche dell'ARPA Sicilia*, 6: 1–230.
- ICZN (2003) Opinion 2027. *Bulletin of Zoological Nomenclature*, 60 (1): 81–84.
- Loy, A., Aloise, G., Ancillotto, L., Angelici, F. M., Bertolino, S., Capizzi, D., Castiglia, R., Colangelo, P., Contoli, L., Cozzi, C., Fontaneto, D., Lapini, L., Maio, N., Monaco, A., Mori, E., Nappi, A., Podesta M., Russo, D., Sara, M., Scandura, M. & Amori, G. (2019) Mammals of Italy: an annotated checklist. *Hystrix*, 30 (2): 87–106.



# *Rattus norvegicus* (Berkenhout, 1769)



(Chordata: Mammalia: Rodentia: Muridae)

## Main synonyms

*Mus surmolottus* Severinus, 1779; *Mus javanus* Hermann, 1804; *Mus maurus* Waterhouse, 1837; *Mus maniculatus* Wagner, 1848; *Mus magnirostris* Mearns, 1905

## Common names

Norway rat; Brown rat

## Short description

Adults weigh 250-520 g; linear measurements: head-body 214/290 mm; tail annulated and almost glabrous, dark above and light below (170/230 mm, usually slightly shorter, 80-100%, of the head-body length). Compared to the *Rattus rattus*, it is slightly larger in size, with

less pronounced auricles and a hairier coat (dorsally grey-brown and whitish below). In young, specific determination based on somatic characteristics is very difficult. Puppies are born blind, deaf and naked, weighing approximately 6 g.

## Place of origin and global distribution

The Brown rat is native to southeastern Siberia and northern China. Currently cosmopolitan (absent in the arctic areas); present in Europe since the Middle Ages but the massive invasions date back to the 18th century.

## Distribution, frequency and first record for Sicily

In Sicily *R. norvegicus* was introduced in 1700; today it is widespread and naturalized; especially in the larger inhabited centres, it is linked to the sewer pipes. In recent times this species has colonized the islet of Isola delle Femmine where it was then successfully eradicated in 2007-2008 (Canale et alii, 2019). Since then, no specimens have been reported on this island; the vegetation cover has also increased and nesting of the Sardinian reed bill and the blackbird have been observed. In Sicily, is a widespread species (AA. VV., 2008).

## Distribution, frequency and first record for Malta

*R. norvegicus* is included among the wild mammals of Malta and is widespread in Malta and Gozo. Past carrier of plague epidemics on the island; was the species investigated in this territory, as part of an important control plan of its populations in 1944, from which it turned out to be the murid with a dominant presence in the Maltese archipelago, infesting mostly in farms in the countryside, in farm buildings and surroundings of these (Barnett, 1948).

## Habitat or preferred invading habitat

This species is linked to urbanized environments often in sewers, landfills and ports; it is also found in rural and humid environments, such as banks of rivers and canals with riparian vegetation and brackish coastal habitats or near chicken coops and shelters for domestic animals. Being a good swimmer, from the mainland, *R. norvegicus* can reach and colonize small islands near the coast; instead, its presence on islands more than 500 m from the mainland is due to accidental human transport. *R. norvegicus* has mostly been

observed in large islands where humans are also found; it is generally quite rare in Mediterranean coastal rocky environments, inhabiting mainly degraded environments with the presence of water.

#### Introduction source

*R. norvegicus* is a strictly anthropophilic species, which has spread thanks to trade and transport. Its colonization in Europe probably dates back to the end of the 18th century AD, mainly due to the intensification of trade with the countries of northern Asia, its native area.

#### Ecology

Anthropophilic species, gregarious and nocturnal, which lives in family groups or colonies in underground burrows dug at the base of the buildings and on the banks of canals and rivers. With favourable climatic and alimentary conditions, the colonies can reach very high densities. Mainly vegetarian, but with great plasticity in eating habits, consuming food remains of all kinds, waste, carrion, invertebrates, and eggs. In some cases, it can also become a predator of small mammals. This plasticity allows it to adapt to numerous environments with the most disparate food availability. In Mediterranean countries, *R. norvegicus* competes with *Rattus rattus*, being larger in size, more adaptable and much more aggressive. *R. norvegicus* is reported among the sporadic prey of the Barn Owl (*Tyto alba*). When the environmental conditions are favourable, a female can reproduce all year round (even up to seven litters). Males become sexually mature around three months of age, while females are around four. The gestation lasts about 24 days and at the end 3-15 puppies are born and weaned around a month. The average life span of *R. norvegicus* in the wild is two years, while in captivity even four years.

#### Possible control methods

The populations of *R. norvegicus* are often subjected to regular control, using rodenticides, necessary for the disinfection operations. In recent decades, increasingly effective eradication techniques have been developed which currently ensure excellent probabilities of success (at least in the case of not too-extensive island environments). In some cases, it is necessary to intervene following an integrated approach, for example, trapping and application of rodenticides to minimize poisoning of non-target species.

#### Invasive category/local potential threat

*R. norvegicus* is among the most invasive species in all the countries where it is found, since it causes damage to biodiversity, because it negatively impacts the development of plant successions, and weighs, with its predatory activity, on vertebrate and invertebrate fauna (also hindering in some contexts the reproductive success of aquatic avifauna species, nesting on the ground or floating vegetation). The impact of *R. norvegicus* is significant on the islands, places where it has already led to numerous extinctions of endemic taxa. The damage is also economic (e.g. damage to foodstuffs due to contamination with faeces and urine; or damage to crops and farmyard animals); moreover, it causes health damage since it can transmit diseases such as plague, typhus, salmonella, rabies, yellow fever, leptospirosis (either directly with the manure on food or indirectly through fleas, ticks or mites its parasites).



## Remarks

None.

---

## Literature

- AA. VV. (2008) Atlante della Biodiversità della Sicilia: Vertebrati terrestri. *Studi e Ricerche dell'ARPA Sicilia*, 6: 1–230.
- Barnett, S. (1948) Rat control in a plague outbreak in Malta. *Journal of Hygiene*, 46 (1): 10–18.
- Canale, D. E., Di Dio, V., Massa, B., & Mori, E. (2019) First successful eradication of invasive Norway rats *Rattus norvegicus* from a small Mediterranean island (Isola delle Femmine, Italy). *Folia zoologica*, 68 (1): 29–34.
- Spagnesi, M. & De Marinis, A. M. (a cura di) (2002) Mammiferi d'Italia. *Quaderni di Conservazione della Natura*, 14, Ministero Ambiente-Istituto Nazionale della Fauna Selvatica: 1–310.

## 5. Mollusca

---

# *Arion vulgaris* Moquin-Tandon, 1855



(Mollusca: Gastropoda: Stylommatophora: Arionidae)

## Main synonyms

None.

## Common name

Spanish slug.

## Short description

Adults are 6-12 cm long and generally weigh 5-15 grams. They have a variable colour between the different populations ranging from yellowish to brown, up to bright orange and reddish; juveniles have dark lateral bands with paler bands on the sides above and below



these. The pneumostome is visible anteriorly on the right side of the mantle near its margin; the mantle is well evident and grainy coat; the foot fringe is broad.

#### Place of origin and global distribution

*A. vulgaris* appears to be native to southern France and Catalonia (Spain), having since spread throughout much of central, northern and eastern Europe. It is considered to be invasive across western and central Europe, from the Pyrenees to eastern Poland and from southern France to north Italy, Austria and Slovakia and within an isolated range in eastern Bulgaria. Its introduction outside the original range is documented starting from the early 1950s and it is plausible that it will expand further east and north-east.

#### Distribution, frequency and first record for Sicily

Reported for the first time in 2003 as *A. lusitanicus* in a nursery of ornamental and fruit plants in the Palermo area, near Cefalù (Reitano et alii, 2007).

#### Distribution, frequency and first record for Malta

Absent.

#### Habitat or preferred invading habitat:

Spanish slug prefers environments with dense and permanent vegetation, such as gardens, meadows and uncultivated areas, as well as being very frequent in compost sites; it is also present in cultivated environments.

#### Introduction source

*A. vulgaris* has been spread by international trade. Introduction into new areas is always accidental and appears to occur with the movement of plant materials through the horticultural trade and gardening, a feature facilitated by often high population densities. In many regions it is well established and has partially replaced the large autochthonous aryonids, *A. rufus* and *A. ater*, especially in man-made habitats, to the point of becoming a serious problem. There has been considerable interbreeding with *A. rufus* and *A. ater* throughout its range and the resulting hybrids are vigorous and can contribute to large local increases in numbers; its frequent hybridization probably

facilitates the expansion of its range. It can be expected to eventually arrive outside European countries such as North America.

#### Ecology

It is a species active mainly at night, and can also be found in the early morning or the evening; it often hides among the leaves or the debris on the ground or under rocks or pieces of wood. Mating takes place after sunset, and can last even two or three hours; eggs are white, slightly transparent, soft-shelled, about 2.5 mm in diameter; the eggs are not buried, but deposited on the ground, possibly covered by dead leaves or other debris. Egg laying (up to 400 per specimen) takes place between September and November, and hatching takes place in early spring; in particularly favourable environments (warm and humid), there may be even two generations per year. Adults generally die after laying eggs. Although it is a preferably herbivorous species, it is an omnivore. Spanish slug damage was found on more than 100 plant species both cultivated and wild.

#### Possible control methods

Plowing and other methods of soil cultivation significantly reduce snail populations, and the removal of vegetation deprives *A. vulgaris* of shelters. The nematode *Phasmarhabditis hermaphrodita* (Rhabditidae) is a moderately efficient biocontrol agent for many snail species including *A. vulgaris* juvenes. Attempts at biological





control have also been made with Chinese ducks in horticultural crops, with promising results. For chemical control of *A. vulgaris*, bait pellets containing metaldehyde or carbamate are commonly used.

#### Invasive category/local potential threat

Potentially the species is considered extremely invasive and a serious horticultural pest in large parts of Europe. Spanish slug has become the most frequent terrestrial mollusc species in large parts of central Europe. In addition to causing extensive damage to crops, it has also partially displaced native *Arion* species in some areas of its range. Very little is known about the spread rates of this species. However, there is now evidence to suggest gradual spread and introgression with local species of large *Arion* in areas where *A. vulgaris* has become established. The ability to colonize of *A. vulgaris* is related to several factors: its propensity for hybridizing with native large *Arion* species to produce vigorous adaptable forms; its ability to colonize environments disturbed by human activities with the possibility of passive dispersal through trade, and particularly transport on living plants. The garden centre trade and horticulture are particularly implicated. Also, the ability of *A. vulgaris* to utilize a great variety of food sources must aid dispersal and colonization. In gardens, plant diversity is positively associated with abundance of *A. vulgaris*. *A. vulgaris* is a serious pest of some vegetable crops (especially Brassicaceae, Cucurbitaceae, Triticeae, and lettuce), vegetable seedlings, ornamental plants, low-growing fruits (as strawberries) and herbs within gardens, regularly causing severe losses.

#### Remarks

*A. vulgaris* is part of a complex of species that can only be distinguished by observing the genital systems. Juveniles' lateral bands distinguish them from juvenes *A. rufus* and juvenes and adult *A. subfuscus*. It must be said that *A. vulgaris* would normally feed only on the dead parts of a plant, which it can recognize thanks to the absence of certain chemical compounds produced by the living parts; however, cultivated plants often do not produce these substances at all, which pushes the snail to consume them in full.

---

#### Literature

Reitano, A., Liberto, F. & Sparacio, I. (2007) Nuovi dati su Molluschi terrestri e dulciaquicoli di Sicilia. Primo contributo (Gastropoda Prosobranchia Neotaenioglossa; Gastropoda Pulmonata Basommatophora, Stylommatophora). *Il Naturalista siciliano*, 31 (3-4): 311–330.

# *Dreissena polymorpha* (Pallas, 1771)



(Mollusca: Bivalvia: Myida: Dreissenidae)

## Main synonyms

None.

## Common name

Zebra mussel.

## Short description

Sessile bivalve mollusc between 25 and 35 mm in size with triangular shell and pointed umbo; the shell is yellowish brown with black and white zigzag bands (hence the common name of zebra mussel).

## Place of origin and global distribution

*D. polymorpha* is native to the Pontic-Caspian region. Information relating to his invasion dates back to the 18th century in Russia; during the 19th century, the species spread to most of the aquatic systems of central and western Europe. From the end of the eighties of the twentieth century colonizes a wide variety of lakes and watercourses on the Atlantic side of the USA. It was found in Italy for the first time in 1969 in Lake Garda and later in several lakes in Northern Italy and Central Italy.

## Distribution, frequency and first record for Sicily

The first report for Sicily is from September 2013 when a population of *D. polymorpha* was found in the artificial lake of S. Rosalia (Ragusa) (Colomba et alii, 2013).

## Distribution, frequency and first record for Malta

Absent.

## Habitat or preferred invading habitat

Its typical environments are estuaries, rivers and lakes with rigid substrates suitable for fixing. It prefers mesotrophic water bodies. In both native and invaded areas, it frequents estuaries and inland waters with hard and soft bottom habitats, running and stagnant waters, and brackish coastal lagoons.

## Introduction source

The water released into the lake of S. Rosalia due to the introduction of fish may have been one of the main sources of introduction of *D. polymorpha* into Sicily; the species seems to have successfully stabilized in the reservoir of the artificial lake with large aggregations; it is likely that in the future there will be a further increase in its propagation and diffusion rate which will lead these organisms to colonize the Irminio river basin and other basins. The main pathways of the expansion are through inland navigation, the transport of mussels attached to the hulls of boat hulls, with ballast water, fish farming and fishing equipment.

## Ecology

Zebra mussel tolerates temperatures ranging from  $-2\text{ }^{\circ}\text{C}$  to  $40\text{ }^{\circ}\text{C}$  (the greatest development occurs between  $18\text{-}20\text{ }^{\circ}\text{C}$ ) and brackish water up to 7‰; it is found up to depths of 12 m in brackish water and 60 m in lakes. It tolerates low oxygen content in water for several days and survives out of the water in wet-cold conditions for up to 3 weeks. It has separate sexes, fertilization is external and is a species characterized by high fertility; in fact, a single female produces between 30000 and 40000 eggs per year. The larvae lead a planktonic life, usually between 8 and 10 days, then attach themselves to a rigid substrate with the filaments of the byssus. The average life is between 3 and 6 years. Adults that anchor themselves to the substrate can reach a high density in the order of thousands of specimens per square meter.

## Possible control methods

To reduce the risk of spread of the species through boats and fishing gear, it is advisable to adopt adequate control actions both mechanical (removal of attacked mussels by scraping, UV light, electric currents) and chemical through the use of antifouling paints, chemicals metalorganics, chlorine. In addition, the disinfection of ballast water is recommended.

## Invasive category/local potential threat

According to the IUCN Global Invasive Species Database (GISD) (2022), *D. polymorpha* is one of the 100 most dangerous invasive alien species worldwide and its impact on ecosystems and damage to the economy is well-known. Where the species has settled, it forms populations with a higher density than that of the native species and, in terms of biomass, it is usually the dominant species of the benthic fauna.

## Remarks

*D. polymorpha* competes for space and food with native mussels and other filter-feeding organisms; moreover, it is a bio-accumulator of pollutants and large shell deposits cause serious alterations to the habitat. The high ability of the zebra mussel to filter causes changes in the composition of species and the density of benthic invertebrates; decreases the density of phytoplankton and zooplankton, and the concentrations of chlorophyll and suspended material, increases the transparency of the water with consequent growth of macrophytes.

Many economic impacts mainly concern fishing (interference with fishing gears, alteration of fish communities), aquaculture (fouling of cages), water withdrawals (clogging of water intake pipes), and navigation (encrustation of hulls).

## Literature

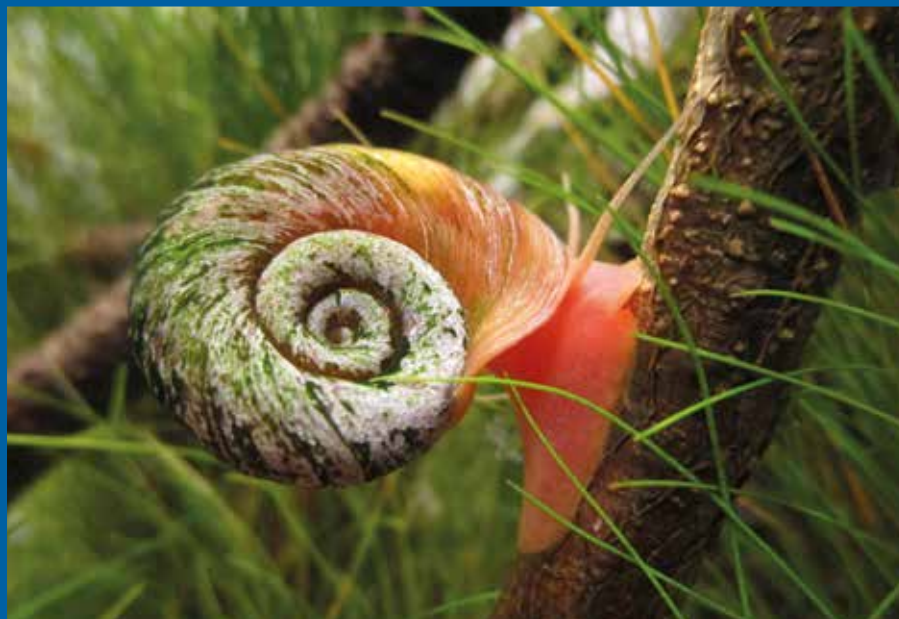
Colomba, M. S., Liberto, F., Reitano, A., Grasso, R., Di Franco, D. & Sparacio, I. (2013) On the presence of *Dreissena polymorpha* Pallas, 1771 and *Sinanodonta woodiana woodiana* (Lea, 1834) in Sicily (Bivalvia). *Biodiversity Journal*, 4 (4): 571–580.

DAISIE (2009) Handbook of Alien Species in Europe. Springer ed. Invading nature: springer series in invasion ecology, vol. 3, 421 pp.

Global Invasive Species Database (2022) Species profile: *Dreissena polymorpha*. Downloaded from <http://www.iucngisd.org/gisd/speciesname/Dreissena+polymorpha> on 08-06-2022.



# *Helisoma duryi* (Wetherby, 1879)



(Mollusca: Gastropoda: Hygrophila: Planorbidae)

## Main synonyms

*Planorbis intercalaris* Pilsbry, 1887; *Planorbis preglabratus* W. B. Marshall, 1926.

## Common name

Seminole rams-horn snail.

## Short description

Shell 10 millimetres tall and 25 millimetres in diameter; shell sinistral and planorbid, with up to five expanding whorls coiled in the same plane; growth lines evident; umbilicus wide and deep; external colour of shell light brown; internal colour white; flesh orange.

## Place of origin and global distribution

Native to the southern USA, now sub-cosmopolitan.

## Distribution, frequency and first record for Sicily

Reported for the first time for Sicily for Syracuse (Giusti et alii, 1995; Manganelli et alii, 1995). Subsequently mentioned (Reitano et alii, 2007) for Cefalù (PA), the Botanical Gardens of the University of Catania and Palermo and the University Hospital of Palermo. In recent years, the species has had a rapid diffusion in Sicily, as evidenced by the aforementioned finds, usually with small and numerous populations, in artificial waters such as pools and fountains.

## Distribution, frequency and first record for Malta

First recorded by Giusti et al. (1995), this species has been recorded from Wied il-Luq (Buskett), Qormi, San Anton Gardens (Attard) and Argotti Gardens (Floriana). It appears to be extinct in the wild but several populations occur in private aquaria, garden centres, plant nurseries and public gardens with freshwater.

## Habitat or preferred invading habitat

Freshwater with vegetation or algae – natural streams and pools, as well as man-made environments such as ponds, aquaria and reservoirs.

## Introduction source

Introduced for the aquarium trade, from which escapees established self-sustaining populations in the wild.

## Ecology

Detritivorous, feeding on organic matter such as dead plants, dead aquatic insects, dead fish and algae. Eggs are deposited in a gelatinous mass attached to surfaces such as rocks and aquatic plants.

## Possible control methods

Collection by hand.

## Invasive category/local potential threat

Moderate; this species may represent a threat if it establishes itself in natural waterways as it may proliferate rapidly, however, its feeding habits are not as damaging as other aquatic species which tend to feed directly on living vegetation or prey on living animals.



## Remarks

None.

## Literature

Giusti, F., Manganelli, G. & Schembri, P. J. (1995) The non-marine molluscs of the Maltese Islands. Monografie. Museo Regionale di Scienze Naturali, Torino, 15: 1–607.

Manganelli, G., Favilli, L., Giusti, F. & Bodon, M. (1995) Gastropoda Pulmonata. In Minelli, A., Ruffo, S. & La posta, S. (eds). Checklist delle specie della fauna italiana, 17. Edizioni Calderini, Bologna.

Mifsud, C., Sammut, P., & Cachia, C. (2003) On some alien terrestrial and freshwater gastropods (Mollusca) from Malta. *The Central Mediterranean Naturalist*, 4 (1): 35–40.

Reitano, A., Liberto, F. & Sparacio, I. (2007) Nuovi dati su Molluschi terrestri e dulciacquicoli di Sicilia. 1° contributo. (Gastropoda Prosobranchia Neotaenioglossa; Gastropoda Pulmonata Basommatophora, Stylommatophora). *Il Naturalista siciliano*, 31 (3-4): 311–330.



# *Otala punctata* (O. F. Müller, 1774)



(Mollusca: Gastropoda: Stylommatophora:  
Helicidae)

## Main synonyms

*Helix apalolena* Bourguignat, 1867.

## Common name

Spanish snail.

## Short description

Helicoidal shell about 20 millimetres tall and 30 millimetres in diameter, wholly reddish-brown or striped with pale and dark brown, always with abundant white speckles; inner spiral bordered with dark brown or black; inside of shell shiny black-brown; flesh grey to yellowish-grey.



### Place of origin and global distribution

Native to the Iberian Peninsula and possibly also the Maghreb; introduced to France, Corsica, Sardinia, the Maltese Islands, southern South America and Florida (USA).

### Distribution, frequency and first record for Sicily

No data.

### Distribution, frequency and first record for Malta

First recorded by Mifsud et alii (2003) as *Otala lactea*, later revealed to be a misidentification of *O. punctata* by Barbara & Schembri (2008). It has been recorded from Mosta and Baħrija Valley.

### Habitat or preferred invading habitat

Gardens, garden centres, agricultural fields, plant nurseries, naturally vegetated areas.

### Introduction source

Likely introduced through the importation of plants destined for installation in plant nurseries from which the snail then escaped into neighbouring areas.

### Ecology

“The species is mostly nocturnally active, particularly with dewfall, which facilitates mobility. *O. punctata* aestivates, sealing its aperture with an epiphragm. During its active season, the snail feeds on foliage, favouring dense ruderal vegetation for grazing” (Camilleri et alii, 2021). It has been found feeding on Jerusalem artichoke, grapevines and cabbage in the Maltese Islands.

### Possible control methods

Removal by hand; baited traps.

### Invasive category/local potential threat

High; though only two populations have been found in the Maltese Islands, this species has established itself in a prominent agricultural area whose produce is distributed throughout the archipelago and thus colonization of new sites is almost certain; this species may become a significant agricultural pest and threat to native flora in the future.

### Remarks

None.

### Literature

- Barbara, N., & Schembri, P. J. (2008) The status of *Otala punctata* (Müller, 1774), a recently established terrestrial gastropod in Malta. *Bollettino Malacologico*, 44 (5-8): 101–107.
- Camilleri, J., Cassar, L. F., & Schembri, P. J. (2021) Distribution and abundance of the alien helicid *Otala punctata* (Müller, 1774) (Mollusca Helicidae) at Baħrija, Malta, a site of agricultural and conservation importance. *Il Naturalista siciliano*, 45 (1-2): 55–70.
- Mifsud, C., Sammut, P., & Cachia, C. (2003) On some alien terrestrial and freshwater gastropods (Mollusca) from Malta. *The Central Mediterranean Naturalist*, 4 (1): 35–40.

# *Potamopyrgus antipodarum* (J. E. Gray, 1843)



(Mollusca: Gastropoda: Littorinimorpha:  
Hydrobiidae)

## Main synonyms

*Amnicola corolla* Gould, 1847; *Rissoina fuscozona* Suter, 1908.

## Common name

New Zealand mud snail.

## Short description

*P. antipodarum* is a prosobranch gastropod with a small conical shell (height up to about 7 mm); the shell has a right-handed coil, with 4-8 whorls separated by deep furrows, and it has a piriform opening; the colour varies from grey to medium-light brown to yellowish. The snail is usually 4-6 mm long but can reach 12 mm in the areas where it is native; the body is of variable colour, most often light grey, with the presence of white, yellowish and brown spots; it has two thin cephalic tentacles at the base of which there are small blackish eyes; a thin horny operculum is present on the dorsal portion of the foot and seals the mouth of the shell when the snail withdraws into it.

## Place of origin and global distribution

The species is native to New Zealand. It has now spread widely and has become naturalized, and an invasive species in many areas including Australia, Tasmania, Japan, Iraq, USA, Canada, Turkey, Lebanon, and Europe (since 1859 in England, has now spread to nearly the whole of Europe). It was first reported in Italy in 1961 and in about 40 years it has colonized all continental regions and Sicily.

## Distribution, frequency and first record for Sicily

Stabilized species, reported in the Irmínio River (province of Ragusa) in 1997 (Bodon et alii, 2005) and subsequently in other water bodies of the provinces of Syracuse and Catania.

## Distribution, frequency and first record for Malta

Absent.

## Habitat or preferred invading habitat

It is a species with wide ecological value, it occupies lotic, freshwater and brackish lentic habitats, even moderately polluted up to 50-60 meters of depth, although mainly at depths of less than 10 meters. It adapts to any type of substrate, from rocky to muddy and benefits from high nutrient flows allowing for filamentous green algae growth. Under favourable conditions, it can reach very high densities.

## Introduction source

Accidental introduction, mainly with fish restocking.

## Ecology

New Zealand mud snail is a nocturnal grazer-scaper, feeding on plant and animal detritus, epiphytic and periphytic algae, sediments and diatoms; it is ovoviviparous and parthenogenic, sexually functional males are present (less than 5% of the total population in native areas but nothing in areas where the species is alien). The rapid reproduction rate of the snail is causing the number of individuals to increase rapidly in new environments.

## Possible control methods

A trick is not to release this species into nature if kept in an aquarium.

### Invasive category/local potential threat

It is considered the 42nd worst alien species in Europe and the second worst alien gastropod in Europe. Its dispersal is facilitated by various factors such as euryoeciousness, parthenogenesis which determines a large number of individuals making the species highly invasive, dispersal with fish restocking, and transport during monitoring of water courses. It can pass through the digestive system of predatory birds and fishes unscathed; it can also survive and emerge for several weeks on humid substrates. The number of individuals making up the populations can alter the chemical conditions of the water which may not be tolerated by indigenous species; it may cause the disappearance of other freshwater molluscs with which it competes for food resources.

### Remarks

New Zealand mud snails are commonly infected with trematode parasites which control their number, an almost non-existent problem in the territories where it is alien.

### Literature

Bodon, M., Cianfanelli, S., Manganello, G., Pezzoli, E. & Giusti, F. (2005) Mollusca Gastropoda Prosobranchia ed Heterobranchia Heterostropha. In: Ruffo, S. & Stoch, F. (eds) Checklist e distribuzione della fauna italiana. *Memorie del Museo Civico di Storia Naturale di Verona*, serie 2, Sezione Scienze della Vita, 16: 79–81.

Gherardi, F., Bertolino, S., Bodon, M., Casellato, S., Cianfanelli, S., Ferraguti, M., Lori, E., Mura, G., Nocita, A., Riccardi, N., Rossetti, G., Rota, E., Scalera, R., Zerunian, S. & Tricarico, E. (2008). Animal xenodiversity in Italian inland waters: distribution, modes of arrival, and pathways. *Biological Invasions*, 10: 435–454.

## *Sinanodonta woodiana* (Lea, 1834)



(Mollusca: Bivalvia:  
Unionida: Unionidae)

### Main synonyms

*Anodonta edulis* Heude, 1874.

### Common name

Chinese pond mussel.

### Short description

It is a large freshwater bivalve mollusc, which can reach 30 cm in length; the shell is large, thin and light, oval in shape with a widely rounded ventral margin, with slightly protruding umbones showing thin parallel wrinkles and a hinge without teeth. The external surface of the shell shows evident growth striae and is covered by a thin outer layer (periostracum) which varies from green, in young specimens, to blackish-brown in adults. The nacreous inner layer is very evident.

### Place of origin and global distribution

*S. woodiana* is native to eastern Asia; its native range is very wide and goes from the Amur River basin (Asian Russia) to Cambodia, China, Japan, Thailand, Malaysia and Taiwan. Its expansion began in the second half of the 20th century and can be found in the Indonesian islands, America and Europe where it was first reported in 1996.

### Distribution, frequency and first record for Sicily

In 2012 it was reported in the province of Ragusa in the Santa Rosalia artificial lake (Colomba et alii, 2013). The discovery in 2012 of specimens larger than 19 cm, aged over 8 years, suggests that the entry of the species took place at least 10 years earlier.

### Distribution, frequency and first record for Malta

Absent.

### Habitat or preferred invading habitat

It prefers habitats with high temperatures and a limited flow, the optimal thermal conditions vary between 10 °C and 35 °C. It avoids strong water turbulence, coarse sediments and gravelly substrates and normally tends to form aggregations of more individuals. The distribution and density of the species depend on the thermal conditions, the flow of water and the characteristics of the substrate.

### Introduction source

The presence of *S. woodiana* in Lake Santa Rosalia, an artificial basin for irrigation built in 1980 on the Irmínio River (South-Eastern Sicily), seems to be due to the introduction of farmed fish species for sport fishing parasitized by mussel larvae.

### Ecology

The larvae, like those of all Unionidae, have an obligatory parasitic stage known as “glochidium”. The larva attaches itself with a hook to the gills or fins of the host fish for several weeks, and then detaches and falls towards the bottom where it completes maturation and begins to lead a free life. It is a generalist species that can parasitize even native fish species, and both juveniles and adults can successfully adapt to a wide range of environmental conditions.

### Possible control methods

Considering that this species is sympatric with many species of fish, to prevent its spread, it is necessary to pay close attention to the fish species that are introduced.

### Invasive category/local potential threat

According to the IUCN Global Invasive Species Database (GISD) (2006), *S. woodiana* is one of the 100 most dangerous invasive alien species in the world with considerable economic and ecosystem impacts.

### Remarks

Being an excellent filter feeder, this mussel can have negative effects on the passage of organic matter in the sediment and in the water column, with serious consequences for the ecosystem. In Sicily, the increase in populations and the spread to various lakes and rivers could have a negative impact on native sedentary invertebrates. Finally, native Unionidae mussels appear to be threatened by competition for food, space and hosts.

---

### Literature

- Colomba, M. S., Liberto, F., Reitano, A., Grasso, R., Di Franco, D. & Sparacio, I. (2013) On the presence of *Dreissena polymorpha* Pallas, 1771 and *Sinanodonta woodiana woodiana* (Lea, 1834) in Sicily (Bivalvia). *Biodiversity Journal*, 4 (4): 571–580.
- Douda, K., Vrtílek, M., Slavík, O. & Reichard, M. (2011) The role of host specificity in explaining the invasion success of the freshwater mussel *Anodonta woodiana* in Europe. *Biological Invasions*, 14:127–137.
- Kraszewski, A. & Zdanowski, B. (2007) *Sinanodonta woodiana* [Lea, 1834] [Mollusca] - a new mussel species in Poland: occurrence and habitat preferences in a heated lake system. *Polish Journal of Ecology*, 55 (2): 337–356.
- Renda, W. & Niero, I. (2014) Nuove segnalazioni di *Sinanodonta woodiana woodiana* (Lea, 1834) (Mollusca: Bivalvia: Unionidae) per il sud Italia. *Notiziario S.I.M.*, 32 (2): 14–16.

## 6. Platyhelminthes



# *Bipalium kewense* Moseley, 1878



(Platyhelminthes: Rhabditophora:  
Tricladida: Geoplanidae)

## Main synonyms

*Bipalium manubriatum* Sharp, 1891; *Placocephalus isabellinus* Geba, 1909; *Bipalium costaricense* Hyman, 1939.

## Common names

Hammerhead flatworm; Hammerhead worm.

## Short description

Long, slim-bodied, dorsoventrally flattened, slimy body; apical region flattened and spread out in a semicircular shape (hence 'hammerhead'); colour may vary but usually dull brown to ochre with several greyish lines running parallel from the 'neck' down along the dorsal side of the body; individuals may grow to great lengths, more than twenty centimetres.

### Place of origin and global distribution

Probably native to Southeast Asia, now cosmopolitan.

### Distribution, frequency and first record for Sicily

Reported for the first time generically for Sicily in 1995 (Bello et alii, 1995). Observed by G. Torre in contrada Gelso (Milazzo, Messina) on 30 April 2021 (<https://www.inaturalist.org/observations/75868342>).

### Distribution, frequency and first record for Malta

First recorded in a garden in Sliema by Lanfranco (1975). It has since been found in Attard as well. This species does not appear to be very common, and can only persist in habitats which remain moist year-round.

### Habitat or preferred invading habitat

Gardens and plant nurseries where the soil is kept moist.

### Introduction source

Unknown, most likely through 'stowaway' individuals in imported soil such as in plant pots.

### Ecology

An earthworm predator, immobilizing terrestrial annelids and everting its pharynx to begin the digestion of its prey. Though sexual reproduction is possible, this species tends to rapidly colonize new areas due to asexual fragmentation. It cannot survive for long in dry habitats, however, and requires a moist or damp refuge.



### Possible control methods

Collection.

### Invasive category/local potential threat

Moderate threat.

### Remarks

This species may pose a threat to native earthworm species which are essential for soil health, but it appears that *B. kewense* is not able to spread into natural areas of the Maltese Islands which become exceptionally dry during the seasonal drought.

### Literature

Bello, G., Falleni, A., Fredj, G., Gremigni, V., Hochberg F. G. & Vernet, G. (1995) "Turbellaria Gnathostomulida, Orthonectida, Dicyemida, Nemertea". In Minelli, S., Ruffo, S. & La Posta, S. (eds) Checklist delle specie della fauna italiana. Caldeini, Bologna, 4: 1-35.

Lanfranco, E. (1975) *Bipalium kewense* Mosley (Platyhelminthes) in Malta. *The Maltese Naturalist*, 2 (2): 50.

## 7. Reptilia

---

# *Chamaeleo chamaeleon* Linnaeus, 1758



(Chordata: Reptilia: Squamata: Chamaeleontidae)

## Main synonyms

*Chamaeleon vulgaris* Daudin, 1802; *Chamaeleon parisientium* Bosca, 1880; *Chamaeleo saharicus* Müller, 1887

## Common names

Common chameleon; Mediterranean chameleon

## Short description

A rather large reptile, between 20 to 40 centimetres in length when mature; overall colour varies and changes with the animal's moods; usually dark green, brown or yellowish-grey but may turn black when threatened; several whitish marking runs along each side of the body; eyes bulging and turreted; head crested; tail long and prehensile.

### Place of origin and global distribution

Native to North Africa, the Middle East, the Iberian Peninsula, Crete and maybe Cyprus islands. Introduced to Southern Italy, Malta, other Greek islands and the Canary Islands.

### Distribution, frequency and first record for Sicily

It is not present in the wild in Sicily, although it has been reported several times in urban and peri-urban areas (first record by Grohmann, 1832; after Aradas, 1868 and Doderlein, 1881).

### Distribution, frequency and first record for Malta

Present and established in the Maltese Islands, where it is extremely widespread and present in both Malta and Gozo. Relatively common, the first record was Gulia (1890).

### Habitat or preferred invading habitat

Agricultural land, gardens, garrigue, valleys, and virtually any other habitat with vegetation supporting enough prey.

### Introduction source

Individuals from North Africa were introduced deliberately by priests around 1880, released in a private garden in St. Julians, from which they spread.

### Ecology

Feeds on a wide range of animals, usually arthropods, though it has been known to feed on vertebrates such as wall lizards; prey is captured by rapid extension of the tongue which grips the animal and drags it back into the mouth as the tongue is drawn in. Chameleons usually inhabit trees and large shrubs, being mostly arboreal, but it is perhaps surprising to note that in the Maltese Islands, they traverse large swathes of land on the ground. Eggs are laid directly in a hole dug by the female in the ground.

### Possible control methods

N/A.

### Invasive category/local potential threat

Spreading; relatively high risk.

### Remarks

The common chameleon represents a significant threat to local biodiversity, especially to native arthropods on which it feeds voraciously; particularly at risk are those insects which rest among the branches of shrubs and trees, or pause momentarily to land on them, where they are within reach of the chameleon's extendable tongue. Chameleons have been observed directly preying on native pollinators and vulnerable taxa. The reptiles also seem to be spreading rapidly throughout the archipelago, most likely through human capture and re-release on private property; though initially restricted to St. Julians in the past, the reptile has found a foothold across the three largest islands of the archipelago. Despite all of this information, the chameleon remains protected by law, and thus no measures of control can be implemented against it.

---

### Literature

- Andreone, F., Angelici, F. M., Carlino, P., Tripepi, S., & Crottini, A. (2016) The common chameleon *Chamaeleo chamaeleon* in southern Italy: evidence for allochthony of populations in Apulia and Calabria (Reptilia: Squamata: Chamaeleonidae). *Italian Journal of Zoology*, 83 (3): 372–381. doi:10.1080/11250003.2016.1186236.
- Aradas, A. (1868) Sul Camaleonte siculo. *Atti Società Italiana di Scienze Naturali*, 11: 439–443.
- Doderlein, P. (1881) Rivista della fauna sicula dei vertebrati. Classe de' Rettili e de' Batraci. *Nuove Effemeridi Siciliane*, 11: 35–49.
- Grohmann, F. S. (1832) Nuova descrizione del Camaleonte siculo. *Giornale di Scienze Lettere e Arti di Palermo*, 39: 145–153.
- Gulia, G. (1890) Erpetologia maltese. *Il Naturalista Maltese*, 1 (2): 14–15.



# *Hemorrhois algirus* (Jan, 1863)



(Chordata: Reptilia: Squamata: Colubridae)

## Main synonyms

*Zamenis florulentus* Gervais, 1857.

## Common names

Algerian ship snake.

## Short description

A rather long snake reaching between 75 to 100 centimetres in length; overall greenish-brown with distinctive black bars along its length.

## Place of origin and global distribution

Native to North Africa, from east Morocco to Egypt.

## Distribution, frequency and first record for Sicily

Absent from Sicily.

## Distribution, frequency and first record for Malta

In Malta, it is present and established in Valletta and Floriana, especially along bastion walls. Uncommon and localized. First record by Borg (1939) as *Zamenis algyrus*.

## Habitat or preferred invading habitat

Gardens, abandoned buildings and bastion walls.

## Introduction source

Borg (1939) hypothesizes that this species was introduced accidentally through importation of firewood around the late 1910s/early 1920s.

## Ecology

Active by day and dusk; otherwise secreting itself within rubble walls, among building ruins or within the cracks and crevices of old bastion walls. It hunts other reptiles such as wall lizards and geckos, though it may also feed on rodents such as mice and young rats.

## Possible control methods

N/A.

## Invasive category/local potential threat

Low.

## Remarks

Though this snake may pose a threat through direct predation of native reptiles and intraguild interference with native snakes, its population seems to be restricted to Valletta and Floriana and does not appear to be spreading, hence its invasiveness is relatively low. It may also represent a biological control agent of urban-dwelling pest rodent species, though its ecology in Malta has not been studied well.

## Literature

Borg, J. (1939) Our insect visitors. *Archivum Melitense*, 10: 191–197.

# *Indotyphlops braminus*

## (Daudin, 1803)

(Chordata: Reptilia: Squamata: Typhlopidae)

### Main synonyms

*Tortrix russelii* Merrem, 1820; *Argyrophis truncatus* Gray, 1845; *Onychocephalus capensis* Smith, 1846; *Glauconia braueri* Sternfeld, 1910.

### Common names

Flowerpot snake; Brahminy blindsnakes.

### Short description

*I. braminus* is a species of snake that has only populations of females, of reduced dimensions among the smallest existing (with a total length of the body that rarely exceeds 190 mm); tubular and thin in shape, with a shiny, silver-anthracite grey or purple colour, both in young and in adults. The head and tail are blunt and are difficult to distinguish from each other (however, there is a tiny pointed spur on the tail). The neck is indistinct, and the eyes are reduced to small spots of dark pigment under the scales of the head.

### Place of origin and global distribution

Native to the Indo-Malayan region; this species has been introduced in tropical and subtropical zones of at least 54 countries, in Africa, the Americas, Asia and Australia (including many islands of the Atlantic, Indian and Pacific Oceans). In Mediterranean countries, its presence has been reported in Egypt, Libya, mainland Spain, Balearic Islands. Recent finds also in Canary, Madeira, Sicily, Ischia, and Malta islands.

### Distribution, frequency and first record for Sicily

*I. braminus* was found for the first time in the spring of 2017 (Faraone et alii, 2019), on the western side of Sicily, near Paceco in the province of Trapani; in the following years, again in the same garden, other individuals were found (one specimen in 2018 and two immatures in 2019) identified both on a morphological and molecular basis. The finding of these specimens was related to the proximity of a nursery

(even if the imports of land or plants between 2008 and 2018 in the nursery in question had been very limited since only Sicilian materials were grown there). The spread of this species in Sicily is not yet well documented and further investigations on the territory are necessary.

### Distribution, frequency and first record for Malta

In the spring of 2020, two specimens were found and collected in a public space in Marsa, which is the largest outdoor sports facility with a large turf for the golf course (Vella et alii, 2020). The morphological identification of the adult specimens found was confirmed by genetic analysis. The presence in Malta of *I. braminus* could be due to accidental importation through translocation of the substrates; the soil in the area of the finds had not been imported recently, therefore *I. braminus* may have been present for years, without ever having been detected or the species may have recently been imported into the neighbouring lands from where it then spread. Further research is also needed in Malta to know the real spread of this species.

### Habitat or preferred invading habitat

Adults and juveniles are often found in urban and agricultural areas, where they can be locally abundant, mostly in areas associated with nurseries, golf courses, compost stores, farms and agricultural gardens including home gardens, botanical gardens and parks, surviving in artificial ecosystems that recreate a warm and relatively humid tropical habitat necessary for the survival of this species in arid countries.

### Introduction source

Probably, it is the most widespread terrestrial snake species in the world, due to introductions related to man and the international trade in potted plants, but such introductions are difficult to reconstruct; the species is more evident in tropical and subtropical regions where stabilized populations are found. Furthermore, its reproductive biology also facilitates its dispersal and increases its colonization potential.

### Ecology

Brahmin blind snakes can live in loose soil but also in leaf litter, piles of sawdust, rotting trunks and under rocks and other surface debris

and occasionally on trees; they can also be found in plant pots and rarely emerge on the surface (this facilitates the passive transport of specimens, which go unnoticed) *I. braminus* is characterized by low mobility and poor dispersal capacity; it feeds on small prey, such as eggs, larvae and pupae of ants, termites and beetles. The spawning period varies from place to place. In subtropical areas, e. g. in the Canary Islands, this period coincides with the end of the rainy season. This snake is not poisonous and is harmless to humans. Minute snakes *I. braminus* are excellent burrowers and do not bite for defence and, if discovered, will typically try to escape by burrowing. If caught, they can press the tip of the harmless tail against the attacker and can release foul-smelling substances from two glands at the base of the tail. This species is parthenogenetic: all individuals are females and can lay from 1 to 8 eggs when they reach maturity which occurs when they reach a length of about 95 mm.

#### Possible control methods

When the presence of *I. braminus* is already known in a locality, monitoring should be carried out for this alien species in the neighbouring areas to have an early diagnosis and to be able to implement strategies to control its invasiveness. However, particular attention should be paid to the identification of *I. braminus*, since it can easily be mistaken for an earthworm and go unnoticed, managing to establish new populations wherever it is unintentionally transported. Better monitoring of this species at the European level must be carried out as a precautionary measure to ensure a minimum impact on indigenous biodiversity, and to implement a better import control strategy, thus preventing the costly management of its eradication.

#### Invasive category/local potential threat

The successful dispersal of this species is attributed to two reasons: it can live in plant pots, therefore, it can be easily dispersed through international trade and due to its reproductive strategy, as parthenogenesis increases the potential expansion of the population, making this snake invasive. Due to its trophic preferences, it can negatively impact the invertebrate communities present in the areas where it is found due to predation, and it could also compete with local predators for the same prey or transmit pathogens and parasites to

vertebrates. The impact of *I. braminus* on the ecosystems in which it is introduced is almost completely unknown. It has the characteristics to establish itself and become invasive even in our territories with impacts that are difficult to predict.

#### Remarks

One trait to distinguish *I. braminus* from earthworms is that the brahminy blindsnakes are not segmented. There are currently no known subspecies of *I. braminus*.

---

#### Literature

- Faraone, F. P., Barraco, L., Giacalone, G., Muscarella, C., Schifani, E. & Vecchioni, L. (2019) First records of the Brahminy blind snake, *Indotyphlops braminus* (Daudin, 1803) (Squamata: Typhlopidae), in Italy. *Herpetology Notes*, 12: 1225–1229.
- Vella, A., Vella, N., Mifsud, C. M. & Magro, D. (2020) First records of the Brahminy blindsnake, *Indotyphlops braminus* (Daudin, 1803) (Squamata: Typhlopidae) from Malta with genetic and morphological evidence. *Natural and Engineering Sciences*, 5: 122–135. 10.28978/nesciences.832967.

# *Podarcis siculus*

## (Rafinesque-Schmaltz, 1810)



(Chordata: Reptilia: Squamata: Lacertidae)

### Main synonyms

None.

### Common names

Italian wall lizard.

### Short description

It is a medium-sized lizard (23-24 cm) with a robust body, has a very variable phenotype and this has generated the description of numerous subspecific taxa. In Sicily, it shows a high degree of polymorphism with a prevalence of reticulated patterns towards the west and a greater presence of striated or uniformly coloured individuals in eastern Sicily (with various exceptions). The colour of the body varies from

green, green-yellow to brown with the lighter lower parts that are normally white-yellowish or light green, rarely pink or red; it has been noted that in some Sicilian localities, such as Pantelleria, the forms of hyperchromatism seem to be more frequent. The species almost always has one or more blue axillary ocellar spots which are very marked in males. It is often confused with a sympatric lizard, *P. waglerianus*, however, *P. siculus* has a greater tendency to red ventral hyperchromatism and continuity of the light superciliary striae, has larger dimensions, significant morphometric differences and does not present the yellow colour of the throat very evident in *P. waglerianus*.

### Place of origin and global distribution

Its native range is restricted to the Italian peninsula and Sicily; *P. siculus* has been introduced with certainty in Portugal, Spain, France, Turkey, North Africa and the United States; more recently its introduction has been postulated in the Tyrrhenian Islands, Corsica and Sardinia, and the islands and coastal areas of the eastern Adriatic.

### Distribution, frequency and first record for Sicily

This species was accidentally introduced to Lampedusa in the late 90s of the twentieth century, where there is currently a well-stabilized population (Lo Valvo & Nicolini, 2001).

### Distribution, frequency and first record for Malta

Absent.

### Habitat or preferred invading habitat

*P. siculus* frequents diverse habitats such as natural grassy areas, roadsides, scrub meadows, coastal dunes, agricultural environments, pine plantations, parks, urban areas, stone walls, and buildings.

### Introduction source

Unkown.

### Ecology

The reproductive activity changes according to the altitude and the climate, generally one or two oviposition occurs, however, in the coastal areas, and in particular in the small islands, the populations can reproduce up to 3 times a year with several eggs laid for each cycle



which varies from 2 to 5. The period of activity varies according to the environments, in the hills and mountains it takes place between March and April until October-November while in the coastal areas, there is no real winter latency and the specimens are active for most of the year. The diet is extremely generalist, based on a wide food spectrum, its most frequent preys are Coleoptera, Diptera, Hymenoptera, Formicidae, Heteroptera and Molluscs Gastropods as well as a certain consumption of vegetables that seem more frequent in the populations of the smaller islands and islets minors; the predation of juveniles of Painted discoglossus was also observed.

#### Possible control methods

Accurate control of the parts of vegetation and artefacts transported by man.

#### Invasive category/local potential threat

The field lizard usually uses trees and artefacts as a refuge, therefore being present in large quantities, it is very easy for it to be accidentally transported. The ecological plasticity (it is a generalist species), the behaviour and the propensity to be dispersed by man, make *P. siculus* an extremely efficient invasive in most of the regions in which it has been introduced, which can successfully compete with native species producing negative effects on ecosystems.

#### Remarks

It is the most widespread lizard in Sicily (where it originates), except on the islands of Linosa, Lampiona and Lampedusa where the Maltese lizard (*P. filfolensis*) is present. In Lampedusa, although both *Podarcis* species are present, the *P. siculus* population is more consistent. In Sicily and in the areas where it is native, it is not a threatened species (IUCN category, LC least concern); however, it is included in Annex II of the Berne Convention and Annex IV of the Habitats Directive (43/92 / EEC).

#### Literature

- AA. VV. (2008) Atlante della Biodiversità della Sicilia: Vertebrati terrestri. *Studi e Ricerche dell'ARPA Sicilia*, 6: 1–230.
- Faraone, F. P. (2011) Indagini sulla variazione fenotipica in ambienti insulari e microinsulari delle specie di *Podarcis* Wagler, 1820 (Reptilia, Lacertidae) presenti in Sicilia e alcune isole circumsiciliane. Tesi di dottorato in Biologia animale XXII ciclo, Università degli Studi di Palermo, Dipartimento di Biologia Animale “G. Reverberi”.
- Lo Cascio, P. & Corti, C. (2008) Indagini sull'ecologia dei rettili sauri della R.N.O. e del S.I.C. Isola di Lampedusa. *Il Naturalista siciliano*, 32 (3-4): 319–354.
- Lo Valvo, M. & Nicolini, G. (2001) Presenza di una piccola popolazione di Lucertola campestre *Podarcis sicula* (Rafinesque Schmaltz, 1810) sull'isola di Lampedusa (Isole Pelagie). *Il Naturalista siciliano*, 25 (suppl): 95–97.
- Silva-Rocha, I., Salvi, D. & Carrettero, M. A. (2012) Genetic data reveal multiple origins for the populations of the Italian wall lizard *Podarcis sicula* (Squamata: Lacertidae) introduced in the Iberian Peninsula and the Balearic Islands. *Italian Journal of Zoology*, 79 (4): 502–510.





# *Trachemys scripta* (Thunberg in Schoepff, 1792)



(Chordata: Reptilia: Testudines: Emydidae)

## Main synonyms

*Testudo serrata* Daudin, 1802; *Emys vittate* Gray, 1831; *Emys elegans* Wied, 1839; *Emys cumberlandensis* Holbrook, 1840; *Emys sanguinolenta* Gray, 1855; *Trachemys lineata* Gray, 1873

## Common names

Read-eared slider turtle, Slider terrapin, Read-eared terrapin

## Short description

It is a medium-sized freshwater turtle (13-20 cm in length, but adult females can even reach 30 cm), characterized by a more or less elongated red or yellow spot on both sides of the head and by the neck with yellow streaks. The plastron is yellow and may have dark green or black spots and ocelli. The carapace in the juveniles is olive green

or brown and becomes progressively darker as the age progresses. The skin is greyish, green or brown, with yellow streaks. The legs are webbed, well adapted to aquatic life. Males are generally smaller than females, with a longer and more robust tail, distinctly longer claws, and slightly concave posterior plastron.

## Place of origin and global distribution

The original range includes the southeastern regions of the United States and the areas around the Gulf of Mexico. Introduced worldwide, it has been reported from the wild in Europe, Japan, Southeast Asia, West Indies, Australia, New Zealand, and America (in regions where it is not native).

## Distribution, frequency and first record for Sicily

First record back to 1993 (Lo Valvo, 1998). The species is frequently reported and has a wide but fragmented distribution. To date, no evidence of the presence of reproducing populations of *T. scripta* is confirmed in Sicily. The diffusion of the species is due to the continuous release of adult or sub-adult specimens in nature. It is very probable, however, that small stabilized nucleuses are present in Sicily, thanks to favourable climatic conditions. Egg layings are documented at Lake Pergusa, and a population with an unknown number of specimens is present at the mouth of the Irminio River.

## Distribution, frequency and first record for Malta

Observed in both Malta and Gozo (Speybroeck, 2007), but without further indications. Despite several introductions, there is no evidence of reproducing population to date in the Maltese Archipelago. The reports deserve further confirmation for an assessment of the distribution and frequency of this species in the Maltese Archipelago.

## Habitat or preferred invading habitat

It is a wetland-bound aquatic turtle for which nearly any type of water body can provide a suitable habitat. Its favourite habitat is represented by bends in watercourses, marshes and ponds with rich submerged vegetation, muddy bottom and the presence of sites suitable for thermoregulation, but it is also found in artificial water basins. The intentional release of specimens has occurred mainly in urban and suburban areas, but also in agricultural contexts and many natural and semi-natural environments.

### Introduction source

Through the trade of especially specimens of the subspecies *T. s. elegans*. Due to the uncontrolled global market, it has become the most widespread pond turtle species on the international pet market. However, careless management has led to its gradual diffusion in nature in various parts of the world: the individuals sold on the market were generally young only a few centimetres but, due to their rapid growth, were often abandoned. In 1997, the subspecies *T. s. elegans* was included in the European CITES lists; today the sale of this subspecies is prohibited. Unfortunately, however, the trade soon adapted to the importation of other subspecies.

### Ecology

The diet of the juveniles is carnivorous, whilst the adults are opportunistic and also eat vegetables. The reproductive rate depends on the temperature. Individuals do not feed at body temperatures below about 10°C and young may die at temperatures below 4°C. Several studies have shown that the Slider terrapin can compete with native European tortoises for food, spawning sites and basking sites for thermoregulation. It is believed that adult specimens can reproduce mostly in countries with a Mediterranean climate. They winter on the bottom of water bodies, in the mud, or buried near the banks, but it is however believed that even in Italy the winter survival of the juveniles is very limited.

### Possible control methods

Control of commercial activities is necessary because, despite the ban on trade, it is still possible to find the species for sale on some websites, fairs and itinerant markets. To contrast its secondary expansion, containment measures are needed, associated with greater control in the wild of the populations living in syntopia with other species of autochthonous pond turtles or in sites of high biodiversity in the Natura 2000 network or other protected areas.

### Invasive category/local potential threat

*T. scripta* is included in the list of the 100 most invasive species in the world. In Italy, there are numerous verified cases of reproduction which lead to affirm that the species is stabilized and invasive and this can also be considered in Sicily, although there is no certainty about

its stabilization. In Sicily, it is potentially dangerous due to possible ecological impacts on indigenous communities, and above all due to possible competition with the endemic Sicilian Pond turtle (*Emys trinacris*).

### Remarks

The European Union (EU) has adopted restrictive measures on the trade and breeding of *T. scripta* thus prohibiting its transportation, purchase, sale, exchange, release and breeding (Commission Implementing Regulation 2016/1141 of 13 July 2016). In optimal environments, invasive *T. scripta* could reach larger population sizes compared with native aquatic turtles, and it is also favoured in the interspecific agonistic interactions for resources because of its larger body size. *T. scripta* can also have a significant impact on amphibians, arthropods, molluscs and aquatic vegetation. Furthermore, it is a potential vector of viruses and bacteria, in some cases also transmissible to humans (for example, it is a carrier of various *Salmonella* serotypes).



## Literature

- AA. VV. (2008) Atlante della Biodiversità della Sicilia: Vertebrati terrestri. *Studi e Ricerche dell'ARPA Sicilia*, 6: 1–230.
- Bella, S. & Turrisi, G. F. (2005) Status e conservazione dei Testudinati in Sicilia. WWF Sicilia, 50 pp.
- Liuzzo, M., Termine, R. & Marrone, F. (2020) First evidence of an egg-laying attempt of feral *Trachemys scripta* (Schoepff, 1792) in Sicily (Lake Pergusa, Italy). *Herpetology Notes*, 13: 365–368.
- Lo Valvo, F. (1998) Status e conservazione dell'erpeto fauna siciliana. // *Naturalista siciliano*, 22: 53–71.
- Ministero dell'Ambiente e della Tutela del Territorio e del Mare (con il supporto di ISPRA in collaborazione con SHI) (2018) Linee guida per la corretta detenzione degli animali da compagnia appartenenti a specie esotiche invasive (D.Lgs 230/2017, art. 27, comma 4). Appendice per la testuggine palustre americana, *Trachemys scripta*. Maggio 2018: 1–5.
- Speybroeck, S. (2007) Herpetological trip to Malta 25th of April – 2nd of May 2007. Herpetofauna of Europe. <https://www.hylawerkgroep.be/jeroen/index.php?id=38>.

## Photo credits

---

Page No.	Credit
9	George Chernilevsky
11	Emőke Dénes
13	Robert Aguilar
15	James St. John
17	George Chernilevsky
21	Jik jik
24	Smithsonian Environmental Research Center
26	Smithsonian Environmental Research Center
28	Bernard Dupont
30	Simon Pierre Barrette
32	Totti
34	Robert Pos
36	Helge
38	Eric Engbretson
41	Andrea Battisti
43	Riccardo Novaga
49	Hans Schneider
51	Paysant
52	Brian Gratwicke
57	McCarty
59	Imran Shah
60	Bernard Dupont
63	Bernard Dupont
65	Charles J. Sharp
67	Bernard Dupont
73	Matthew Calleja
76	Salvatore Brunetti
79	Petar Milošević
81	Rolf Dietrich Brecher
86	Dunpharlain
89	Zeynel Cebeci
93	Syrio
98	Salvatore Brunetti
101	Salvatore Brunetti

102	Dat doris
104	Dat doris
105	Ferran Turmo Gort
108	Stephen Moore
111	Francisco Welter Schultes
117	Pierre Gros
118	Piter Kehoma Boll
123	Matthew Calleja
126	Mourad Harzallah
132	Salvatore Brunetti
135	Salvatore Brunetti
136	Salvatore Brunetti
139	Salvatore Brunetti