

NOBANIS – Invasive Alien Species Fact Sheet

Arion lusitanicus (or *vulgaris*)

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Species description

Scientific names: *Arion lusitanicus* (Bank *et al.*, 2007) or *Arion vulgaris* (Moquin-Tandon, 1855) (Anderson, 2005).

The taxonomic status of this invasive pest species is unresolved. The first invasive specimens was misidentified as *A. lusitanicus* (Mabille, 1868), but the original description of *A. lusitanicus* has turned out to refer to a different species than the invader (Castillejo, 1997; Quinteiro *et al.*, 2005). Therefore, the name *A. vulgaris* (Moquin-Tandon, 1855) has by some authors been used as a replacement (e.g. Anderson 2005). However, uncertainty remains as to whether the original description of *A. vulgaris* really applies to the invasive species. The majority of literature about the pest species refers to it as *A. lusitanicus*, which is an argument for retaining the name *A. lusitanicus* until its taxonomic status has been resolved. Throughout this fact sheet I will follow Bank *et al.* (2007) and use the name *A. lusitanicus* when referring to the invasive pest species.

Common names: Iberian slug, Spanish slug (GB), plzák španělsky (CZ), Spanische Wegschnecke, Kapuzinerschnecke (DE), Iberisk skovsnegl, dræbersnegl (DK), Lusitania teetigu (EE), Espanjansiruetana (FI), Spanskur snigil, morsnigil (FO), Spánarsnigill (IS), Spānijas kailgliemezis (LV), Ispanikasis liuas (LT), Iberiaskogsnegl, brunsnegl (NO), Spansk Skogsnigel, mördarsnigel (SE), ślinik luzytański (PL).



Fig 1.Adult *Arion lusitanicus* Photo by: Vagn Nielsen



Fig 2. Juvenile individuals of *Arion lusitanicus*, photo by Inger Weidema.

Species identification

A. lusitanicus is a slug, i.e. it does not have a shell. The respiratory opening (pneumostome) is located on the right side of the slug in the front half of the mantle (South, 1992). The colour of *A. lusitanicus* is often brown, but dark brown to almost black or reddish to yellowish colours also occur. Juvenile specimens have dark lateral bands along the sides, while adults are more uniform in colour. The adult body length is 7-15 cm (Proschwitz and Winge, 1994; Proschwitz, 1989). *A. lusitanicus* is nocturnal and it is most easily observed at twilight or when it rains.

Taxonomy of slugs is often based on their body pigmentation and structure of their reproductive organs, but body pigmentation may depend on age, diet or environment, and reproductive organs can be subjected to considerable ontogenetic, seasonal and physiological variation (Barker, 2001; Jordaens *et al.*, 2002; Jordaens *et al.*, 2001; and references therein). The genus *Arion* comprises 30-50 species, whose identification remains problematic. *A. lusitanicus* is closely related to *Arion ater* (Linnaeus 1758), *Arion rufus* (Linnaeus, 1758) and *Arion flagellus* (Collinge 1893), and it can be very difficult to distinguish between these, since there is an overlap in colour and size (Proschwitz and Winge, 1994). Sometimes, identification is possible through dissection and investigation of the genitalia (Noble, 1992; Proschwitz and Winge, 1994), but molecular techniques have become an important part in species identification.

Native range

A. lusitanicus is an invasive species which has spread and become established in many European countries since the 1950s (Kerney *et al.*, 1979; Kozłowski, 2007; Proschwitz and Winge, 1994; Proschwitz, 1992; Quick H.E., 1952). Earlier, it was assumed to originate from the Iberian Peninsula, a misconception that gave rise to its common name, the Iberian slug (Quinteiro *et al.*, 2005). The region of origin is unknown, but the native range of the species is generally thought to be somewhere in southern Europe, although there is controversy on exactly where and whether this is correct.

Alien distribution

History of introduction and geographical spread

A. lusitanicus is a recent newcomer in the NOBANIS region. The first records of this invasive species are from Austria in 1972 (Reischütz and Stojapal, 1972), Sweden in 1976 (Proschwitz, 1989), Norway in 1988, Denmark in 1991 (Proschwitz and Winge, 1994) and from Poland in 1993 (Kozłowski, 2000c; Kozłowski and Kornobis, 1995). The first record in Finland was in 1990 (Åland Islands) and in 1994 (on the mainland) (Ilmari Valovirta, pers.comm.). The slug has been in the Republic of Ireland since at least 1984 and in Northern Ireland since 2006 (Anderson, 2010). It arrived in the Faroe Islands in 1996, supposedly from Denmark, from where the species is now being introduced almost continuously (Solhøy, 1981; Bloch, 2003; Dorete Bloch, pers. comm.). Today the slug is a common inhabitant in the gardens and potato fields in the Faroe Islands. The slug was observed in Iceland in 2003 and 2004 (Ingimarsdóttir and Ólafsson 2005). The spread in the NOBANIS region is on-going and new countries are being invaded continuously - it was first found in Estonia in 2008 (Eek and Kukk 2008) and was first identified in Lithuania in 2012 (Grita Skujienė, pers comm.).

Pathways of introduction

Dispersal of *A. lusitanicus* to and within the NOBANIS region is mainly through unintentional introduction to new areas by human activity, such as plant trade. The eggs and small slugs are readily transported in potted plants and with soil.

Alien status in the NOBANIS region

Today *A. lusitanicus* is found in Austria, Belgium, The Czech Republic, Estonia, Poland, Germany, Ireland, Denmark, Sweden, Norway, Finland, Lithuania, the Faroe Islands and Iceland, but is expected to have a potential for establishment in all of the countries of the region. See also Table 1. *A. lusitanicus* seems to cope well with the local conditions in the new areas to which it has migrated and it often occurs in high densities. In Southern and Western Norway, *A. lusitanicus* occurs in large numbers and is considered a serious pest. In Norway, the species is distributed more or less continuously along the coast from the Swedish border to just north of Trondheim. Reports from Bodø (further north) have yet to be confirmed. The slug appears to be rare in the inland regions of Norway (Hofsvang, 1995; Hofsvang and Haukeland, 2006). *A. lusitanicus* is common in Finland and can be found in western Finland up to Oulu town and in eastern Finland up to Joensuu town. In Denmark it can be found in most areas and is considered a serious pest, primarily in gardens. In Poland, the first record of the species was from the vicinity of the city of Rzeszów. At present, it is found at many sites of the Podkarpackie district, in the region of Kraków and also on the outskirts of city of Brzeg (between Opole and Wrocław), and locally it is very abundant. On some sites, it is an important factor limiting plant crop growth because it damages many species of both cultivated and uncultivated plants (Kozłowski, 2005). In Estonia, the first record of the species was in Pärnu in South-West Estonia and just after that 2 more localities were discovered in Tallinn and near Paldiski, both in North Estonia (Eek and Kukk 2008).

Country	Not found	Not established	Rare	Local	Common	Very common	Not known
Austria						X	
Belarus							X
Belgium						X	
Czech republic				X			
Denmark						X	
Estonia			X				
European part of Russia							X
Finland					X		
Faroe Islands					X		
Germany						X	
Greenland	X						
Iceland			X				
Ireland				X			
Latvia		X					
Lithuania				X			
Netherlands					X		
Norway					X		
Poland				X			
Slovakia							X
Sweden					X		

Table 1. The frequency and establishment of *A. lusitanicus*, please refer also to the information provided for this species at www.nobanis.org/search.asp. Legend for this table: **Not found** –There are no records of the species in the country; **Not established** - The species has not formed self-reproducing populations (but is found as a casual or incidental species); **Rare** - Few sites where it is found in the country; **Local** - Locally abundant, many individuals in some areas of the country; **Common** - Many sites in the country; **Very common** - Many sites and many individuals; **Not known** – No information was available.

Ecology

Habitat description

A. lusitanicus, like other slugs, prefers moist habitats like deciduous forests, grassland, parks and gardens. *A. lusitanicus* is mostly confined to cultural habitats. In Sweden, 99% of the records of the species are from man-made habitats, while only <1% are from natural woodlands (Proschwitz, 1996). Likewise, in Norway the species is mostly found in private gardens and small grassland areas, and has been reported as a serious pest in field grown strawberries and vegetables. In Poland, *A. lusitanicus* is a typical synanthropic species. The places with frequent slug appearance are gardens and field crops near buildings and rivers, ditches, baulks, wastelands and brushwood (Kozłowski, 2000a; Kozłowski, 2000b). Experience from e.g. Austria, where the species has been introduced for a longer period of time, likewise illustrates that the species has the potential to live both in natural habitats and to become a pest in highly managed agricultural landscapes (Grimm, 2001; Reischütz, 1984b).

Reproduction and life cycle

All terrestrial slugs are hermaphrodites, meaning that each individual acts both as female and male. Some slugs reproduce by self-fertilization, some by out-crossing, and others do a combination of both (South 1992). *A. lusitanicus* is mainly outcrossing, but is able to self-fertilize, even though this does not commonly occur (Hagnell *et al.*, 2006b; Slotsbo *et al.*, 2013).

A. lusitanicus has an annual life cycle (Davies, 1987; Grimm, 2001; Kozłowski and Kozłowski, 2000; Slotsbo *et al.*, 2013), but occasionally large overwintered specimens can be found in the spring (Davies, 1987; Kozłowski, 2007), indicating that semivoltine life-cycles also occur. Field observations from Poland, Great Britain and Switzerland indicate that the majority of *A. lusitanicus* die soon after egg-laying (Briner and Frank, 1998; Davies, 1987), and this has been confirmed by laboratory studies (Kozłowski and Sionek, 2000; Slotsbo *et al.*, 2013).

Egg laying may begin in late June and, if the temperature is not too low, some years continues until December; the exact time varies depending on geographical region and also fluctuates between years within an area. However, egg deposition often peaks in August and September (Grimm, 2001; Kozłowski, 2000c; Kozłowski and Sionek, 2000; Slotsbo, 2012). Eggs are laid in clutches of up to 200, and one slug can lay several clutches (Briner and Frank, 1998; Kozłowski, 2000c; Kozłowski and Sionek, 2000). One slug may produce more than 500 eggs, but normally a single slug lays 200-400 eggs (Kozłowski, 2000c). The eggs are deposited in a variety of places; occasionally unprotected on the surface of bare soil, but most often in more protected places, such as under vegetation or objects lying on the ground or in the soil to a depth of 10 cm. Eggs are often laid in places ensuring humid conditions (Kozłowski, 2000c).

The egg's developmental time and hatching success are influenced by temperature and may vary between regions (Kozłowski, 2000c; Slotsbo *et al.*, 2013). High temperature increases egg development up to a certain limit. At 20 °C, the egg will hatch within 3 to 5 weeks. Most eggs hatch before winter and juveniles are the primary overwintering life stage.

Natural enemies

The slugs have few natural enemies, but badgers, wild boars, hedgehogs and large carabid beetles may eat them (Hatteland, 2010; Proschwitz and Winge, 1994). Blackbirds (*Turdus merula*) have been observed as new predators on the species in Sweden and Denmark (F. Jensen, pers.comm.). Cannibalism is observed, but it is probably only dying conspecifics that are attacked (Solveig Haukeland, pers. comm.).

Dispersal and spread

Arion lusitanicus is an invasive species which has the ability to spread rapidly. Long distance dispersal is mediated mainly by human activity such as transport of soil, compost or plant material that contains adults, juvenile individuals or eggs. The species is probably introduced repeatedly. Transport within countries is also a mode of introduction (Proschwitz and Winge, 1994). Local dispersal by the animals themselves is probably not very far, but once present at a site the slugs have a high reproductive potential (Proschwitz, 1992).

Impact

Affected habitats and indigenous organisms

In grassland, parks and gardens in Sweden and Denmark, the species can cause substantial damage to the vegetation (Proschiwicz and Winge, 1994). From the Faroe Islands, it is reported to eat garden vegetation as well as being a pest in potato fields (Dorete Bloch, pers.comm.). From Austria severe agricultural effects have been reported (Reischütz, 1984a). In Poland, it was found that *A. lusitanicus* feeds on a wide range of plants, both on crops and commonly occurring weeds. A Polish survey found that almost all species of vegetables were severely damaged by the slugs. Indications of the slug feeding were found on 103 plant species. *A. lusitanicus* preferred *Brassica napus* and *Datura stramonium* plants, but showed no interest in *Geranium robertianum* (Kozłowski, 2005; Kozłowski and Kozłowska, 2004). In Germany and Switzerland, *A. lusitanicus* attacks many vegetables, ornamentals and strawberries in private gardens and horticulture. In arable farming (mainly oilseed rape, maize, sunflowers), its damage is usually restricted to the first 2-3 meters along the crop border (Frank, 1998a; Frank, 1998b).

Human health effects

No human health effects have been reported. *A. lusitanicus* secretes copious amounts of mucus. This mucus is very sticky and difficult to wash off. Since the mucus may contain *E. coli* bacteria, most texts recommend not eating vegetables covered with mucus. Another advice often given to private gardeners wanting to manage the species is to wear gloves or use some device to pick up the slugs.

Economic and societal effects (positive/negative)

A. lusitanicus is polyphagous and feeds on a range of crop species as well as dumped plant material and carcasses. In Sweden, the species is reported from strawberry fields and grain storage facilities (J. Hagnell, pers.comm.). No overall assessment of the economic consequences of *A. lusitanicus* has been made, but the species contributes to damage on several horticultural crops (Speiser *et al.*, 2001a). Strawberry growers in Norway have reported more than 50% loss in yield due to *A. lusitanicus*, but proper economic assessments have not been conducted yet (Solveig Haukeland, pers. comm.). In Central Europe, *A. lusitanicus* is a major pest slug species, and most sales of molluscicide pellets in the home and garden market can be attributed to this species – this gives an indirect estimate of the damage they cause (B. Speiser, pers. comm.). Furthermore, there are great impediments to human use of gardens as judged by the number of times this species make headlines in media (often under the alias “killer slug”).

Management approaches

Prevention methods

National border inspection routines to prevent plant pests from being transported with plants and potted material exist, but no special actions are taken as regards *A. lusitanicus*.

It is very difficult to prevent *A. lusitanicus* from entering natural surroundings, if the species is in the vicinity. In a garden, it is possible to use some cultural practices to reduce the slug activity. The method could be called “the method of dry and well managed soils” because soil cultivation, to some extent, prevents *A. lusitanicus* from thriving in an area, as the slugs prefer moist surroundings with a vegetation to hide in (Speiser *et al.*, 2001a).

In small-scale gardening, slug fences may also present a preventive possibility. Naturally, this possibility is only relevant when the area is quite small. The idea of the slug fence is to build a fence around your crop, with a little roof-eave pointing towards the place where the slugs are located, see figure 3 and 4. The eaves of the fence have to be bent in an angle of 45-55° to prevent the slugs from crawling over the fence.



Fig.3 and 4. Examples of slug-fences, the first with an angle of the eave of 90°, the second with an angle close to 45°, photos by: direction.dk and Susanne Mørk Jensen, [Den Økologiske Have](http://DenØkologiskeHave.com).

Eradication, control and monitoring efforts

The occurrence of *A. lusitanicus* varies from year to year and is primarily determined by rainfall and temperature variations during spring and summer. *A. lusitanicus* tolerates substantial water loss, but has little resistance against desiccation and will, therefore, seek to humid refuges during dry periods. Longer drought periods reduce the activity of the slugs. A decrease in activity will reduce foraging of the slugs, which can reduce the development and thereby delay reproduction. Growth of *A. lusitanicus* is highly influenced by temperature. Warm and humid periods will increase activity and growth of slugs, which will increase pest problems by the slugs.

Collecting and killing *A. lusitanicus* has proven the most effective eradication method in home gardens, however, this method has little relevance in professional horticulture or natural or semi-natural sites, since it is labour intensive. Various methods for trapping the slugs have been suggested, ranging from homemade tins with beer as bait to ingeniously constructed (and expensive) devices (see e.g. Hagnell *et al.*, 2006a; Speiser *et al.*, 2001a).

A. lusitanicus becomes more active and is therefore easiest to find during morning or in the evening when dew is falling. Collection of all life stages of the slugs is important - apart from collecting the adult slugs, it is important also to remove the eggs. The eggs are located in lumps of 10-200 eggs

under pots, boards and other items that create a moist microclimate. The adults may be attracted with a variety of smelling attractants, such as beer and decaying fruits etc. (Speiser *et al.*, 2001a).

Collecting slugs early in the season will contribute to reducing the number of eggs laid later in the season. The collected slugs can be killed by either decapitation (with a pair of scissors or a sharp spade), putting them in a container and pouring hot boiling water over them or by putting them in a freezer overnight (in a plastic bag) (Hagnell *et al.*, 2004). The dead slugs should be buried or thrown out, unless they are used as bait to attract more slugs.

In horticulture, biological control has been used to control *A. lusitanicus* (Speiser and Andermatt, 1994). The nematode *Phasmarhabditis hermaphrodita* is a microscopic parasitic worm that is used as a biological control agent against slugs. The infectious nematode larvae actively seek out slugs and probably enter through a small pore near the respiratory canal. Once inside the slug, bacteria are released which induce the slug to stop eating. Slug species susceptible to nematodes will die within 4-21 days after infection (Rae *et al.*, 2007). Unfortunately, the nematodes have a rather poor effect against *A. lusitanicus* (Grimm, 2002; Speiser *et al.*, 2001b). The nematodes are not species specific, and they may therefore be expected to also attack harmless snails and slugs, which may affect the overall biological diversity negatively. However, non-target studies related to their use against the field slug *Deroceras reticulatum* have so far indicated that this risk is not very high (Morand *et al.*, 2004)

The carabid beetle *Carabus nemoralis* has been shown to be a significant predator of *A. lusitanicus* and it may have potential as a biological control agent, but further studies are needed (Hatteland, 2010).

A number of iron compounds are molluscicidal. Iron (III) phosphate is one of these being sold in slug pellets and leads to feeding inhibition and, later, to the death of slugs (Koch *et al.* 2000). It varies between countries if these pellets are recommended as a method for controlling *A. lusitanicus* (Speiser *et al.*, 2001a). Iron (III) phosphate has been taken up on the list of the Council Regulation (EEC) No 2092/91 of 24 June 1991 on organic production of agricultural products and indications, referring thereto on agricultural products and foodstuffs (Annex II, part B) which has the implication that this compound may be used in organic agriculture.

Other molluscicides, such as metaldehyde or carbamates, are also sold as slug pellets (Speiser, 2002). Mostly, these compounds are forbidden or have severe restrictions for usage in Scandinavia, since they are very poisonous for other organisms such as birds, mammals, fish and other water living animals. Therefore these compounds are not recommended to combat *A. lusitanicus*. In Norway, the only molluscicide available to commercial growers is “Judge” (thiodicarb) (Solveig Haukeland, pers. comm.).

Information and awareness

Since *A. lusitanicus* is found in gardens and also has a potential to invade agricultural areas, much attention has been paid to this particular invasive species in newspapers, radio and television. Several Internet sites have been created which describe the species, the problems it creates and how to eradicate it (see links below). Public awareness is judged to be high in relation to this species (Solveig Haukeland, pers. comm., Dorete Bloch, pers. comm.).

By engaging an entire neighbourhood in a joint effort against *A. lusitanicus*, the likelihood of success is increased locally. By a joint effort and common knowledge about possible management methods and the biology of the species it is easier to ensure an effective approach towards this pest species.

Recommendations or comments from experts and local communities

It is important to start control measures early in the season and to encourage neighbours to do the same.

References and other resources

Contact persons

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Links

Göteborg Natural History museum – [information on Arion lusitanicusvulgaris](#) (in Swedish)
Norwegian [paper with key to most common slugs](#) (in Norwegian) www.bioforsk.no - revised april 2006- see under publications
Slugs in the garden – [guide to control measures](#) (in German)
Institute of Plant Protection - [Slugs - dangerous crop pests](#) (in Polish)

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