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Assessment of the risk to Norwegian biodiversity from the import and keeping of terrestrial gastropods in terraria

Opinion of the Panel on Alien Organisms and Trade in Endangered Species of the Norwegian Scientific Committee for Food and Environment

Report from the Norwegian Scientific Committee for Food and Environment (VKM) 2017:33
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Preperation of the opinion

The Norwegian Scientific Committee for Food and Environment (Vitenskapskomiteen for mat og miljø, VKM) appointed a project group to answer the request from the Norwegian Environment Agency. The project group consisted of two VKM members from the VKM Panel on Alien Organisms and Trade in Endangered Species (CITES), two external experst, and a project leader from the VKM secretariat. One VKM member from the Panel on Plant Health and one from the Panel on Animal Health and Welfare evaluated and approved the final opinion drafted by the project group.

Authors of the opinion

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Assessed and approved

The opinion has been assessed and approved by the Panel on Alien Organisms and Trade in Endangered Species (CITES). Members of the panel are: Vigdis Vandvik (chair), Hugo de Boer, Jan Ove Gjershaug, Kjetil Hindar, Lawrence R. Kirkendall, Anders Nielsen, Eli. K. Rueness, Odd Terje Sandlund, Kjersti Sjøtun, Hans K. Stenøien and Gaute Velle.

(Panel members in alphabetical order after chair of the panel)

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Competence of VKM experts

Persons working for VKM, either as appointed members of the Committee or as external experts, do this by virtue of their scientific expertise, not as representatives for their employers or third-party interests. The Civil Services Act instructions on legal competence apply for all work prepared by VKM.

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Summary

The Norwegian Scientific Committee for Food and Environment (VKM) was asked by the Norwegian Environment Agency to undertake an assessment of the risks of negative impacts on biodiversity in Norway resulting from the import of terrestrial gastropods for private keeping in enclosed terraria.

The committee was first asked to determine which species of terrestrial gastropods that are available for trade and relevant for domestic (hobby-based) keeping in Norway. Second, the committee was asked to assess the biotic, abiotic, and ecological properties of terrestrial gastropods in general that would determine whether a particular gastropod species could survive, and subsequently spread, and thus have the potential to have a negative impact on the Norwegian biodiversity. Third, an assessment of the risk of negative impact on biodiversity was to be undertaken for the relevant gastropod species, based on the biotic, abiotic, and ecological criteria considered to be of importance. Finally, the Norwegian Environment Agency asked the committee to provide a summary of the most relevant properties of terrestrial gastropods for predicting possible negative impacts on biodiversity in Norway, to assist in future import application evaluations. The committee was asked to adopt a 50-year perspective in this assessment. Furthermore, any known negative effects on biodiversity of the exporting country should be stated in the report. These factors should, however, not be included as a part of the actual risk assessment.

VKM appointed a project group consisting of two members of the Panel on Alien Organisms and Trade in Endangered Species, and two external experts on terrestrial gastropods, in addition to the VKM Secretariat, to respond to this request. The Panel on Alien Organisms and Trade in Endangered Species has reviewed, revised and finally approved the report prepared by the project group.

VKM adopted a two-stage procedure, including an initial screening of all species included in the Terms of Reference, and a risk assessment of the species judged to have the potential for establishment in Norway. The initial screening identified taxa with the potential for establishing populations in Norway, based on similarities between climatic conditions in Norway and the organism's current distribution. For most of the tropical species, the taxon's likelihood of establishment was deemed very unlikely, and no further assessment were conducted. However, tropical species listed as one the 100 worst invasive alien species in the world were included for further assessment. In cases where the climate conditions of the taxon's current habitat resemble those of Norway, either now or in a 50-year perspective, a risk assessment was carried out for that taxon in stage two of the procedure. Where very limited or no background information existed, taxa were classified as having "lack of information" and were not assessed further.

The project group screened 116 species for establishment potential under Norwegian climatic conditions. The species belong to 22 different families in 13 superfamilies, spread across three orders of gastropods. Of these, 83 tropical and subtropical species were deemed very unlikely, with low uncertainty, to establish populations in Norway based on the climate conditions in their native range. These species were not assessed further as we concluded that they pose minimal threat to Norwegian biodiversity due to their low establishment potential.

Thirty-three species were assessed in stage two of the procedure as they have potential for establishing populations in Norway, or because they are on the list of the top 100 worst invasive alien species in the world. Species known to inhabit Mediterranean areas, and which have recently expanded northward (both due to climate change and increased trade of goods), were also investigated further. For the risk assessment, the project group used an adaptation of the Great Britain Non-Native Species Secretariat's risk assessment template, as this covers all aspects of the Terms of Reference. The stage two assessment includes evaluating the probability of entry, a further and more detailed appraisal of the probability of establishment, estimating the probability of spread, an assessment of environmental consequences or impact, and finally an overall risk rating for the taxon in question.

Two of the 33 species for which a full risk assessment was conducted are on the list of the worst alien invaders (*Achatina fulica* and *Euglandina rosea*), while 31 have climatic niche overlap with Norway, and thus assessed as having the potential for establishing populations in Norway. For four of these species we did not find sufficient information to perform a risk assessment. Of the remaining 29 species, 18 were determined to be associated with a low risk, while ten species are associated with a moderate risk (*Achatina fulica*, *Anguispira alternata*, *Anguispira strongylodes*, *Camaena cicatricosa*, *Cantareus apertus*, *Eobania vermiculata*, *Euglandina rosea*, *Helix lucorum, Rumina decollate,* and *Theba pisana*). We would like to emphasize that the current climate of Norway is probably too cold for the establishment and spread of the species associated with a moderate risk (except the *Anguspira spp.*, that are moderately likely to establish, but have a minor impact). However, the species will probably be able to establish in Norway under warmer future climatic conditions in a 50-year perspective. *A. fulica* may be an exception since it requires even warmer conditions than are likely to occur in Norway within 50 years, and is thus very unlikely to establish. This species was assessed as having moderate risk because of its extensive invasive history elsewhere in the world and potential for massive impact on Norwegian biodiversity, should it establish. The expected impacts on biodiversity in Norway from the species assessed as having a moderate risk are species-dependent, and vary from unknown effects to negative effects on native flora and negative effects on populations of native snails and slugs. There is also a potential for the spread of pathogens that can infect various native animals, a risk of damage to crops and gardens, and a risk of spreading parasites that can infect humans.

We assess *Helix aspersa* to be associated with a high risk. *H. aspersa* has an extensive invasion history, causing major impacts in South and Central America, Australia and South Africa. It is considered to be a garden and agricultural pest in many areas where it has been introduced, and can act as a host for parasites that can infect both gastropods, birds and mammals.

The most important biotic and abiotic factors that determine whether an alien gastropod species can be established and spread in Norway are: temperature (e.g., the species tolerance for low temperatures, the reproductive mode (hermaphrodites have a greater potential) and fecundity. In addition, slugs need more humid habitats than snails, while snails in general require a more calcium rich habitat to survive, which both limit their potential distribution ranges in Norway.

Keywords: VKM, environmental risk assessment, Norwegian Scientific Committee for Food and Environment, Norwegian Environment Agency, terrestrial gastropods, entry, stablishment, introduction, spread, biodiversity, pathogens, alien organism, invasive species.

Sammendrag på norsk

Vitenskapskomiteen for mat og miljø (VKM) fikk høsten 2017 i oppdrag av Miljødirektoratet å vurdere risikoen for uheldige følger for biologisk mangfold ved innførsel og hold av landlevende snegler i lukkede terrarier.

Bestillingen inkluderte en kartlegging av hvilke arter av landlevende snegler som er aktuelle for privat hold i Norge basert på hvilke arter Miljødirektoratet har mottatt søknader om, og hvilke arter som er tilgjengelige i handelen i utlandet og som der sannsynlig at Miljødirektoratet vil få søknader om. VKM ble videre bedt om å vurdere hvilke biotiske, abiotiske og økologiske egenskaper ved snegler som vil være avgjørende for om de kan overleve i norsk natur og eventuelt spre seg, og dermed kan være en trussel for det biologiske mangfoldet i Norge. Etter kartlegging og vurdering av egenskaper skulle VKM gjennomføre en risikovurdering av arter som potensielt kunne spre seg i norsk natur og/eller ha stort skadepotensial, basert på de kriteriene som ble avdekket som viktige i kartleggingen. Miljødirektoratet ønsket også en oppsummering av de viktigste egenskapene som gjør at en snegleart kan ha negativ innvirkning på norsk biologisk mangfold, for bruk i evalueringer av fremtidige søknader av nye arter. VKM ble bedt om å vurdere risiko for uheldige følger for biologisk mangfold ut fra et 50-årsperspektiv. VKM ble også bedt om å inkludere informasjon om effekter på økosystemtjenester der dette er kjent, samt potensielle negative effekter på biologisk mangfold i eksportlandet. Disse siste punktene skulle imidlertid ikke inngå som en del av selve risikovurderingen.

For å besvare oppdraget, utnevnte VKM en arbeidsgruppe bestående av to medlemmer fra VKMs faggruppe for fremmede organismer og handel med truede arter (CITES), samt to eksterne eksperter på landlevende snegler i tillegg til VKMs sekretariat. Faggruppen for fremmede organismer og handel med truede arter (CITES) har gjennomgått og revidert utkastet fra arbeidsgruppen og godkjent den endelige rapporten.

Arbeidet ble delt i to faser, en screeningsfase og en risikovurderingsfase. I screeningsfasen ble det identifisert arter (ev. grupper på høyere taksonomisk nivå) med utbredelsesområder som klimatisk sett ikke overlapper med norske områder og/eller arter som er på listen over de 100 mest invaderende arter i verden. Disse kriteriene sorterte ut arter fra tropiske-, og subtropiske strøk, samt ørken, og en del tempererte arter). Alle arter som ble eliminert i screeningsfasen, ble vurdert til å ha lav sannsynlighet for etablering i Norge. Arter som gjensto etter screeningen ble risikovurdert i del 2. For enkelte arter forelå det lite eller ingen informasjon. Disse ble klassifisert som «lack of information» og ikke risikovurdert videre.

VKM har totalt gjennomgått 116 arter fordelt på tre ordener, 13 superfamilier og 22 ulike familier. Av disse lever 83 i tropiske og subtropiske områder og ble kategorisert til å ha lav sannsynlighet, med lav usikkerhet, for etablering i Norge basert på de klimatiske forholdene der de kommer fra. Disse ble ikke gjenstand for en fullstendig risikovurdering da vi

konkluderte med at de utgjør en minimal risiko for Norsk biologisk mangfold basert på deres minimale etableringspotensial.

Vi fant at 33 arter måtte risikovurderes basert på at de er på listen over verdens 100 mest invaderende arter, eller har leveområder der de klimatiske forholdene ikke er helt forskjellig fra norske forhold, når en legger et 50-årsperspektiv til grunn. Disse artene ble vurdert videre i del 2. Arter fra Middelhavet som i de senere år har spredt seg nordover (enten aktivt eller passivt) ble også tatt med til den endelige risikovurderingen.

For risikovurderingen i del 2 brukte VKM en tilpasset versjon av en risikovurderingsmal utarbeidet av Great Britain Non-Native Species Secretariat. Spørsmålene som stilles i malen er dekkende for å besvare bestillingen fra Miljødirektoratet. Artene er vurdert i detalj for ulike aspekter knyttet til biologi, potensiale for etablering og spredning i Norge, og uheldige følger for biologisk mangfold hvis disse etablerer seg i norsk natur. Basert på en helhetsvurdering av disse vurderingene ble gitt en sammenfattende risikokarakterisering.

To av de 33 artene som VKM har risikovurdert er på listen over verdens mest invaderende arter (*Achatina fulica* og *Euglandina rosea*), mens 31 av disse har overlappende klimatiske nisjer med Norge og således vurdert til å ha potensiale for å etablere seg i Norge. For fire av artene var det såpass mangelfull informasjon at de ikke kunne vurderes. For 18 av de 29 resterende artene ble risiko for å kunne ha negative innvirkninger på biologisk mangfold vurdert til å være lav, mens ti arter (*Achatina fulica*, *Anguispira alternata*, *Anguispira strongylodes*, *Camaena cicatricose, Cantareus apertus*, *Eobania vermiculata*, *Euglandina rosea*, *Helix lucorum, Rumina decollata* og *Theba pisana*) ble vurdert å ha medium risiko. Det er viktig å fremheve at dagens klima er mest sannsynlig for kaldt for at disse ti artene skal kunne etablere seg og spre seg (med unntak av *Anguispira* artene som har en moderat risiko for å etablere seg, men minimalt skadepotensiale), men gitt det varmere klimaet som forventes i et 50 års perspektiv er det prosjektgruppens vurdering at disse vil kunne klare seg i Norge. Unntakrt her er antagelig *A. fulica* som kreven enda høyere temperaturer enn det som forventes i Norge, selv i et 50 årst perspektiv. Denne arten er det således svært liten risiko for at vil kunne etablere seg i Norge, men den ble vurdert til å ha medium risiko siden den er en svært invaderende art med potensiale for massive negative invirkninger på naturen, dersom den skulle etableres i Norge. De negative konsekvensene for biologisk mangfold knyttet til artene med medium risiko gjelder i hovedsak fare for norsk flora, men også norsk fauna gjennom å være en trussel mot norske sneglearter. Artene kan også fungere som vektorer for parasitter som kan påvirke andre viltlevende arter i Norge. Utover dette registrerer VKM at enkelte landlevende snegler også kan skade hager og jordbruk og overføre sykdommer til husdyr og mennesker.

Prosjektgruppen vurderer risikoen for negative følger for biologisk mangfold ved import av flekkbåndsnegl (*Helix aspersa*) til å være høy. *H. aspersa* er en utpreget invaderende art som har spredt seg til Sør- og Mellom-Amerika, Australia og Sør-Afrika og hatt store negative innvirkninger på naturen der. Arten er betegnet som en skadegjører på jord- og

hagebruksplanter i de områdene der den har blitt introdusert, og er også vert for en rekke parasitter som kan infisere både snegler, fugler og pattedyr.

De viktigste biotiske og abiotiske faktorene som avgjør om en fremmed snegleart er i stand til å etablere seg og spre seg i Norge er: temperatur (spesielt artens nedre toleransegrense), hvordan de formerer seg (hermafroditter har et større potensiale), samt artens fekunditet. Snegler uten skall behøver et fuktigere miljø enn snegler med skall, mens de med skall er avhengig av kalkrik grunn for å kunne overleve. Begge disse parameterne er med på å begrense deres potensielle utbredelsesområder i Norge.

Abbreviations and glossary

Abbreviations

CBD: Convention on Biological Diversity

CITES: Convention on International Trade in Endangered Species of Flora and Fauna

GB-NNRA: Great Britain Non-native Risk Assessment

GB-NNSS: Great Britain Non Native Species Secretariat

IUCN: International Union for the Conservation of Nature

WMSBD: Worldwide Mollusc Species Database

Glossary

Alien organism (IUCN definition): a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (*i.e.*, outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes, or propagule of such species that might survive and subsequently reproduce.

Biodiversity: Biological diversity at all scales: the variety of ecosystems in a landscape; the number and relative abundance of species in an ecosystem; and genetic diversity within and between populations as defined by the Convention on Biological Diversity (CBD). The Norwegian Nature Diversity Act defines biodiversity as ecosystem- and species variability and interspecies genetic variability, as well as the ecological relationships between ecosystem components.

Biomes: Distinct biological communities that have formed on Earth in response to a shared physical climate

Cross-fertilization: Fertilization of eggs with sperm from another individual (as opposed to self-fertilization).

Eosinophilic meningoencephalitis: Inflammation of the brain, characterized by a higher percentage of white blood cells (eosinophils) in the cerebrospinal fluid.

Gastropod: Taxonomic class of animals that include snails and slugs. The gastropods constitute the majority of species in the phylum Mollusca and include terrestrial, aquatic, and marine species.

Hermaphrodite: An organism that has both male and female reproductive organs, and can mate with all members of the same species. Many hermaphrodites also have the ability to self-fertilize, and can reproduce sexually if no mate is found.

Hybridization: The production of offspring by interbreeding between different species or semi-species.

Introgression: The incorporation of genetic variants (alleles) from one species or semispecies into the genetic makeup of another.

Invasive Alien Species (IUCN definition): Invasive alien species are animals, plants or other organisms introduced by humans into places out of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species.

Non-native organism: See Alien organism.

Monophyletic: A group of organisms that includes the most recent common ancestor and all of its descendants is monophyletic.

Omnivorous: Animals that have the capability to feed on materials of both plant- and animal origin.

Oviparity: Species that lay eggs and deposit these outside their body are oviparous.

Ovoviviparity: Species that lay eggs but retain the eggs within their body cavity until hatching are ovoviviparous.

Paraphyletic: A group of organisms that includes the most recent common ancestor and only some (not all) of its descendants is paraphyletic

Pest species: An organism that has detrimental effects on crops, livestock, or forestry.

Polyphyletic: A group of organisms without a single recent common ancestral species, which has been grouped together by superficially similar features, is polyphyletic.

Slugs: A paraphyletic group of gastropods without an outer protective shell.

Snails: A paraphyletic group of gastropods with an outer protective shell that they can retract into for protection against dehydration, predators, or other threats.

Species complex: A group of species that are very similar, both morphologically and genetically, and thus very difficult to distinguish. Species complexes often exhibit high levels of morphological variation and of self-fertilization.

Supercooling: Physiological method to survive sub-zero temperatures by lowering the freezing point of body fluids, accomplished by producing high concentrations of soluble compounds (osmolytes like glycerol) in the body.

Background as provided by the Norwegian Environment Agency

Following the entry into force of the Regulations relating to alien organisms under the Norwegian Nature Diversity Act on January 1st, 2016, the Norwegian Environment Agency has received several requests for import of terrestrial gastropods intended for private, indoor, keeping.

The purpose of the Regulations relating to alien organisms is to prevent the entry and spreading of alien organisms that have, or could have, negative impact on the Norwegian nature diversity, including biodiversity.

As a basis for processing applications, the Norwegian Environment Agency needs assessments of the risk of adverse impacts on biodiversity stemming from the import and keeping of terrestrial gastropod species relevant for trade in Norway at this point.

Terms of reference as provided by the Norwegian Environment Agency

The Norwegian Environment Agency requests the Norwegian Scientific Committee for Food and Environment (VKM) to:

I) Determine which species of terrestrial gastropods that are available for trade and relevant for domestic - hobby based – keeping in Norway.

II) Assess the biotic and ecological properties (*e.g.* habitat, diet, behaviour) and abiotic tolerance limits (*i.e,* in relation to humidity, pH and temperature) of terrestrial gastropod species that would dictate whether the species may or may not survive and spread in the Norwegian habitat if it were released or escapes.

III) Assess the biotic and ecological properties (*e.g.* habitat, diet, behaviour) of terrestrial gastropod species, which would indicate whether they would have any negative impact on biodiversity, including the spread of pathogens, if such information is available.

IV) Undertake an assessment of the risks of negative impacts on biodiversity in Norway stemming from the import and keeping of the terrestrial gastropods identified under part I of these terms. The risk assessment should be based on the biotic and abiotic properties emerging from part II and III of these terms.

V) Provide a summary of which properties of terrestrial gastropods that emerged from the risk assessment (part IV) as most relevant for determining whether a

species could have negative impact on biodiversity. Additionally, a qualitative analysis of the available literature for these properties should be provided. Also, if there are specific differences in the requirement for information between taxa (*i.e.*, between different genera within the same family), this should be included in the report.

The time frame for the risk assessments of adverse impacts on biodiversity should be 50 years, or 5 generations for organism with a generation time of more than 10 years. This is in accordance with the time perspective considered by the Norwegian Biodiversity Information Centre. If climatic changes are likely to influence the assessment of specific species in particular, beyond the given time frame, this should be stated, but not influence the risk assessment.

In cases where taxa are likely to affect ecosystem services or may be particularly affected by climate change beyond the specified time frame, this should be stated in the report. Furthermore, if a species is CITES listed, or if there is any known negative effects on biodiversity of the exporting country should be stated in the report. These factors should, however, not be included as a part of the actual risk assessment.

The Norwegian Environment Agency also requests that the Norwegian Scientific Committee for Food and Environment takes note of requirements for risk reducing measures specific to terrestrial gastropods (extending on the demands for general caution and labelling of animals for import, as specified in chapter V and §25 of the Regulations relating to alien organisms, respectively). If so, suggestions for risk reducing measures to eliminate the threat should be included in the report to aid in future evaluations on import management policies.

1 Introduction

1.1 Problems related to invasive non-native species

Over half a century ago, the renowned British ecologist Charles Elton famously referred to the effects of invasive species as "one of the great historic convulsions in the world's fauna and flora" (Elton, 1958). Invasive non-native species are now recognized as one of the major threats to global biodiversity (Hassan et al., 2005). Numerous examples exist of intentional and unintentional introductions of non-native species causing severe impacts on native biodiversity and ecosystem functions (Kenis et al., 2009; Scalera et al., 2012; Williamson, 1996). In Europe, the number of non-native species is increasing, and an important part of the increase is attributed to non-native invertebrates (Scalera et al., 2012). Indeed, gastropods represent a substantial part of non-native species worldwide (Lowe et al., 2000); however invasive plants and vertebrates have received most attention in the scientific literature (Kenis et al., 2009, VKM, 2016).

The Norwegian "Black List" presents an overview of non-native species in Norway and the ecological impacts they pose on native ecosystems, and also lists important vectors for non-native introductions (Gederaas et al., 2012). These include escape of agricultural (including forestry) and ornamental plants and animals, fish and game, ballast waters, and naturalization of biological control agents. In Norway, the climate is a limiting factor for the establishment and spread of many non-native species. However, we can expect that some non-native species may be able to establish in the future as a consequence of global warming (VKM, 2016).

Non-native species that successfully spread and establish in nature are classified as "invasive" if they cause environmental or economic damage (although some scientists use the term more generally for any widely established non-native species). VKM uses the World Conservation Union (IUCN) definition of invasive alien species, where having a negative impact on native ecosystems is a criterion (VKM, 2016).

In order to establish a viable population, non-native species must colonize and reproduce successfully. There can be a lag of decades to centuries between initial colonization and the ultimate spread of an alien species (Simberloff, 2011b). Few non-native species successfully colonize a new region, few colonizing species spread, and fewer yet cause significant environmental or economic damage (Lockwood et al., 2013; Simberloff, 2013).

Multiple colonizations from a variety of sources is especially favourable for successful establishment and spread. Colonizations by small numbers of individuals from a single source suffer from low genetic variation, which may, for some taxa, reduce the likelihood of long-term success (Lee, 2002).

The likelihood of successful establishment is thus correlated with so-called *propagule pressure*, which is a function of the numbers of individuals colonizing, the number of locations being colonized, the frequency of colonization, and how well the introduced individuals thrive in their new environment (Lockwood *et al*., 2013).

One major threat posed by invasive non-native species is competition with native flora and fauna. This may exclude native species from their habitats, causing local extinctions, such as *Arion vulgaris* causing displacement of, and hybridizing with, native slugs (Hatteland et al., 2015). Other invasives might act as predators of native fauna (*e.g*. *Euglandina rosea* preying on native snails (Simberloff and Rejmánek, 2011) or as herbivores on native vegetation (*e.g*. *A. vulgaris* in grasslands: Buschmann et al., 2005). Impacts of introduced species are magnified when they act synergistically with one another or with a native pest, a process termed invasional meltdown (Simberloff and Von Holle, 1999).

Several invasive gastropods have also been shown to act as important vectors for diseases to humans and animals like *Achatina fulica* that has the potential to spread *Angiostrongylus cantonensis*, the rat lungworm, which causes eosinophilic meningoencephalitis in humans (Stockdale Walden et al., 2017) (see also section 1.6.5).

1.2 Invasive gastropods

1.2.1 Worldwide

Terrestrial gastropods, with approximately 30-35,000 described species (Bouchet and Rocroj 2005, Aktipis et al., 2008), are commonly referred to as snails and slugs; the former with an external shell, whereas the latter either carry a reduced shell or lack an external shell. Many gastropod species are regarded as invasive, and some like *A. vulgaris* and *E. rosea are* on the IUCN list of the 100 worst invasive species in the world (DAISIE project, Lowe et al., 2000). Many of these species, like "the Iberian" or "Spanish" slug *A. vulgaris,* have been unintentionally introduced to new countries and continents, where they often occur as pests in gardens, parks, and crops. However, there are also examples of species being introduced intentionally, for food or as pets. *A. fulica* or "the giant African snail" is an example of the latter; it is native to East Africa, but has been introduced to, and successfully colonized, many parts of the world, including Asia and South and North America. *A. fulica* has multiple negative impacts: it is reported as a major pest in horticulture and agriculture, it outcompetes native snails, and it damages wild plants. Furthermore, it is a vector of plant diseases such as *Phytophtora palmivora* (Schotman, 1989). *E. rosea* or "the rosy predator snail" is another example of an intentionally introduced snail. This snail is native to North America, but was introduced to islands in the Pacific and Central America as a biological control agent of *A. fulica*. It turned out to be a poor control agent, however, and instead spread and resulted in major negative effects on native species, including extinctions, such as for endemic species like *Partula* spp. (Clarke et al., 1984). About one third of all known mollusks extinctions since 1500 AD are thought to have been caused by introduced *E. rosea*

(Régnier et al., 2009). It is currently also invasive in Africa and Asia. The "pancake slug" *Veronicella sloanii* is an example of a slug that is kept as a hobby animal, which is also a pest. This slug originates from Jamaica, and has become an agricultural pest in Florida, with the potential for further spread in the Americas (Cowie et al., 2009).

1.2.2 In Norway

In total, 14 alien gastropod species have been recorded in Norway (Artsdatabanken), of which 9 have established populations in antropogenous, semi-natural and to various degree natural habitats. Furthermore, four of these species are regarded as invasive: *Arion vulgaris*, *Deroceras invadens* (also referred to as *D. panormitanum*), *Oxychilus draparnaudi* and "the leopard slug" *Limax maximus.* The additional 10 species are the slugs; *Arion rufus, Milax gagates, Lehmannia valentiana* and *Boettgerilla pallens,* and the snails; *Helix pomatia*, *Cornu aspersum*, *Xerolenta obvia*, *Helicella itala*, *Zonitoideus arboreus, Cepaea nemoralis*. *Arion vulgaris* is by far the most invasive of these species, being a serious pest in gardens and crops, as well as having negative ecological effects in semi-natural and natural habitats. The latter include negative effects on native slug species (Hatteland et al., 2015) as well as negative effects on plant diversity (Buschmann et al., 2005). This slug has a relatively high reproduction rate and has dispersed to large areas of southern Norway and scattered parts of northern Norway (Hatteland et al. 2013). The first records of *A. vulgaris* in Norway date from 1988, when the species was found in Molde, Langesund and Fredrikstad (von Proschwitz and Winge, 1994). By the end of 1990s, it had spread and become a pest in many areas of southern Norway (Dolmen and Winge, 1997). Prior to being introduced to Norway, *A. vulgaris* was widespread in Europe including southern Sweden and thus could have been predicted to be a potentially invasive species in Norway. However, the fact that the species thrives reasonably well in colder climates, even being a pest inside the Arctic Circle, is surprising based on data from its native range in Central Europe.

Helix pomatia or "the Roman snail", which has established populations in semi-natural and natural habitats, is to date the only snail that has been intentionally introduced to Norway (for food). *Cepaea nemoralis* was probably introduced unintentionally during the mid-1800s (Økland, 1925). Despite its long history in Norway it is still only found in some areas in southern Norway, suggesting invasion potential is limited.

1.3 Factors controlling invasiveness

Gastropods are simultaneous hermaphrodites mainly reproducing by cross-fertilization. Many species are also capable of producing self-fertilized eggs ('selfing'). The extent of selfing varies between species and species groups. Regardless of mating strategy, only a few individuals may be sufficient to establish a population. For example, two specimens of *A. fulica* were brought to India from Mauritius. From these two individual snails, the species spread throughout much of South Asia (EOL, 2017). In addition to selfing, gastropods have other strategies that facilitate invasiveness. Single strains may invade large areas while in their native range forms a complex of different strains with facultative selfing, as in the case

of invasive populations of *Rumina decollata* in North America (Selander and Kaufman, 1973). Further, some species, such as *A. fulica*, can store transferred sperm within the body for up to two years and lay eggs over a period of several months after only a single mating (Thiengo et al., 2007). Moreover, some introduced species, like *A. vulgaris*, are able to hybridize with closely related native species, causing introgression in areas with high abundances of the alien species (Hatteland et al. 2015; Noble and Jones 1996; Rowson et al., 2014). This is especially true for slugs, which often belong to species complexes.

Factors limiting the potential for survival and establishment are drought and temperatures being either too high or too low. For instance, several species in Norway, such as the gastropod pest *Lehmannia valentiana,* have only been recorded in greenhouses, possibly because they are not able to survive low winter temperatures. A range of natural enemies of gastropods have been studied (see review in Barker, 2002), including both parasites and predators. In general, gastropods on land are preyed upon by beetles such as ground beetles (Carabidae) or firefly (Lampyridae) beetle larvae, other insects, birds, rodents, and small mammals, particularly chipmunks, voles and shrews (Burch and Pearce., 1990, Elwell and Ulmer, 1971). They can also be eaten by other gastropods (von Proschwitz, 1994). Although the extent to which natural enemies may prevent alien species from becoming invasive is unclear, such interactions may partly explain why alien gastropod populations often stabilize at some point after introduction.

1.4 Land snails as hobby animals in Norway

There are about 500 persons that keep snails for hobby use in Norway (pers. comm. Tarald Stein; see Appendix III). Most keep only a few (<5) individuals of one to a few species, often species from the African family Achatinidae. These are large-sized and fairly easy to keep in terraria. The species thrive at room temperatures, or slightly higher, and at humidity around 80%. Correct temperature and humidity can be achieved in closed terraria by spraying the substrate with water and using a heating mat. Common species in trade typically feed on vegetables and fruit, whereas less common species may also be predators, such as *Rumina decollata*. More dedicated persons (around 50) also keep species that may be more demanding, *e.g.* with special requirements regarding food, moisture, and temperature. These persons are more likely to import specimens from abroad than less dedicated hobby snail-keepers.

About 90% of the terrestrial gastropods traded in Norway are from captive breeding, and the rest include specimens caught in the wild abroad and then imported. The (occasional) introduction of Specimens from the wild are added to the breeding stock to ensure a healthy gene pool in the confined captive gastropod populations, even though they could also introduce new parasitres. Some species are hard to acquire from wild populations and originate from captive breeding abroad, *e.g*. *Pleurodonte sp.* and *Caracolous sp.* from Cuba

and *Hadra webbi* from Australia. New species in trade generally originate from wild populations, but this is a very small proportion of the total number of snails in trade.

It may be difficult to determine the cause of death for well-kept specimens. Toxins and parasites from food may cause death, and organically grown lettuce, in particular, is often associated with death of gastropods kept in terraria. Among enthusiasts there is concern about parasites, and beginners are often warned against importing specimens caught in the wild.

Gastropods in terraria need to escape or be released, intentionally or unintentionally, in order to pose a risk for colonization, establishment, and spread in nature. Some species lay a large number of eggs (>600 per year), which may be released either accidentally or intentionally, and experience from Germany and the UK suggests that owners have released specimens into the wild when the number of gastropods in the terraria becomes too high (Pers. comm. Tarald Stein; see Appendix III). It is clear that the likelihood of unintentional release of eggs, *e.g.* through disposal of substrate during cleaning of the terraria, increases with the number of eggs produced. However, the mortality of eggs and juveniles is usually much higher than that of adults, and release of eggs or even of small juveniles does not necessarily lead to colonization, establishment, and spread.

1.5 Challenges relating to taxonomic uncertainty

Gastropods (snails and slugs) are the largest class in the phylum Mollusca, comprising approximately 30,000–35,000 land-living species (Bouchet and Rocroj, 2005, Aktipis et al., 2008). In general, the phylogenetic relationships between most terrestrial gastropods are poorly resolved, and within many families the literature operates with unresolved species complexes. For instance, within the Arionidae family (to which *A. vulgaris* belongs), there are several species complexes, and often it is necessary to combine both morphological and genetic characteristics to identify species correctly. Importantly, despite the morphological distinction between snails and slugs, these names do not refer to monophyletic groups, as the protective shell has been lost several times during evolution.

Most of the terrestrial gastropod species are small to medium sized (> 1 cm), while a few reach larger sizes (the largest species > 20 cm). Most species are discretely grey-brown in colour and patterning, but a few have brightly coloured shells, some with polymorphic patterns. Many species exhibit a large variation in shell characteristics, and there is considerable overlap in characteristics between species. Anatomical characteristics and molecular genetic data are poorly known in many families, especially for tropical genera and taxa. Although new knowledge is accumulating, there is still a limited literature available for many groups or for many geographical areas.

1.6 Biology and ecology of terrestrial gastropods

1.6.1 Habitat

Gastropods inhabit a range of different habitats from very humid tropical areas to arid deserts. Some species, like the Roman snail (*H. pomatia*) are even highly cold adapted, surviving mainly by supercooling in the winter and thriving in alpine and sub-arctic areas (Nicolai et al., 2004). However, many species favour milder and wetter areas and are often night active, and this is especially the case for slugs that have no shell to protect themselves from dry and sunny conditions. Snails, on the other hand, tend to tolerate dry conditions much better (Heller, 2001) and all gastropods occurring in deserts are snails. Furthermore, snail species (especially larger ones) often depend on calcareous soils to build up their shells and are thus restricted to such habitats. Other species are true forest species, some being tree dwellers.

1.6.2 Fecundity

Most of the terrestrial gastropods are oviparous (see review by Heller et al., 2001). However, there is substantial variation in the period for which different species retain their eggs inside the reproductive tract, to and some even retain the eggs until they hatch (ovoviviparity). The number of eggs produced also varies greatly between species, and many of the common taxa lay several hundred eggs at a time. Many gastropods mate as young adults, and some are able to store sperm for subsequent fertilization. Both semelparity (one reproduction) and iteroparity (several reproductions) are common reproductive strategies among terrestrial gastropods. Semelparous species often have annual or biennial life cycles, depending on climatic factors. Iteroparous species tend to have longer life cycles, lower mortality, and fewer offspring per reproductive output.

Slugs are almost exclusively short lived (often up to 2 years), but many snail species have longer life spans lasting for several years and even some for many years. *H. pomatia* is one of the species with a long life span, and specimens of over 30 years have been found (von Proschwitz, 2009).

1.6.3 Dispersal

Gastropods can disperse through natural means or by human activities. The most important mechanisms are unintentional, human mediated spreading, particularly through transport of biological material (*e.g.,* plants for nurseries, in traded soil, and in or on various other goods). For example, the snail *Rumina decollata,* has been found to hitchhike on lavender seedlings from Italy to the UK, and on roof tiles from Spain to the USA (Matsukuma and Takeda, 2007). Interestingly, many invasive gastropods are introduced to North America from Europe, but none the other way around. Further, gastropods are also dispersed intentionally by humans for food (*e.g.*, escargot) or kept as hobby animals.

In terms of natural dispersal, the gastropod pest species *E. rosea* has been show to spread at a rate of about 1.2 km per year (Clarke and Johnson, 1984). However, more rapid dispersal is observed when gastropods hitchhike on animal vectors, such as birds, insects and mammals (van Leeuwen and van der Velde, 2012, but see Maciorowski et al., 2012, and references therein).

1.6.4 Diet

Most terrestrial gastropods are herbivores, often feeding on a range of plants, including garden plants and crops that are generally low in secondary defensive compounds. However, omnivory is also common, and some are partly or exclusively predators, often feeding on other gastropods. Gastropods are also important detrivores in many ecosystems.

1.6.5 Pathogens

The long evolutionary history of gastropods, including the co-evolution of parasites, and the wide variety of often humid habitats to which snails and slugs have adapted make these ideal hosts for a wide variety of parasites. Some parasites have evolved a very tight relationship with their (intermediate) hosts, especially trematodes, and would therefore not spread rapidly in new environments. However, others, especially nematodes, are more flexible in their (intermediate) host use and will therefore have a greater potential to spread (Pers. comm. Arne Skorping; see Appendix III).

On a global scale, diseases caused by gastropod-borne pathogens are major contributors to severe health problems. However, the vast majority of infections of humans and other vertebrates stems from flatworms (Platyhelminthes) and roundworms (Nematoda) using freshwater snails as intermediate hosts. In particular, trematodes in the genus *Schistosoma* (*e.g., S. mansoni* and *S. haematobium*), which cause schistosomiasis, represent a significant threat to human health as more than 300 million people suffer from this disease worldwide (Giannelli et al., 2015). Parasites, and especially trematodes and other flatworms, can also affect the biology, behaviour, fecundity, and the population dynamics of aquatic gastropods directly, as seen in the *Austrolittorina* (O'Dwyer 2014), *Lymnea,* and *Biomphalaria* species (Sandland and Minchella, 2003). It is thus apparent that aquatic gastropods, as vectors of various diseases, have the potential to influence biodiversity in a negative manner. Although some important diseases are also caused by parasites transmitted and spread by terrestrial gastropods, overall they pose a smaller threat to both human health and biodiversity than aquatic gastropods.

Apart from specific parasites that have been documented to harm humans or livestock, the pathogen loads of the more than 90,000 gastropod species (Bouchet & Rocroj, 2005, Aktipis et al., 2008) are generally poorly investigated at the species level. However, in species for which pathogens have been studied in detail, a long list of parasites has been found. In general, and for the sake of risk assessment, we can divide the gastropod-borne pathogens into three categories: (**I**) pathogens that only spread to other gastropods, (**II**) those that

can infect other animals, and (**III**) those that can infect humans and have the potential to cause illness. In terms of risk assessment in reference to biodiversity, the two first categories are of higher importance, while the third category is obviously of greater interest to the public, and thus has been studied in greater depth. A complicating factor in this categorization is the number of different pathogens that do not have gastropods as their definitive host, but use these as intermediate hosts, pathogens which primarily fall into categories II and III.

Category I includes ranges of different invertebrates and parasites that have terrestrial gastropods as their main or definitive host. These include mites, ciliates, some green algae (*e.g. Microsporidia*), several bacteria, and eight families of nematodes (Morand et al., 2004). Of special interest among the nematodes are those of the genus *Phasmarhabditis*; *P. hermaphrodita* is used as a biological agent to control invasive gastropods, and is sold under the commercial name of "Nemaslug®" in Norway and other European countries (De Lay et al., 2014).

Category II mainly consists of roundworms (*i.e.*, nematodes) and flatworms (especially tapeworms and trematodes), which use terrestrial gastropods as either first or second intermediate host, and have birds, reptiles or mammals (*e.g.*, cats, rodents, dogs, and sheep) as their primary host (Gianelli et al., 2016, Tsukasa Waki, 2017). These include the suicide-inducing flatworms like *Leucochloridium paradoxum* that manipulate the behaviour of the host (*e.g.*, *Succinea putris*) to behave abnormally and thus enhance transmission of the parasite to their avian primary host (Wesołowska & Wesołowski, 2014). The trematode *Dicrocoelium dendriticum* is well known for its ability to take control over infected non-vertebrate hosts (Pybus, 2001). These use a range of different species, including several terrestrial gastropods as intermediate hosts (Manga-Gonzales et al., 2001) and complete their lifecycle in various mammals, often ruminants like sheep. Nematodes of the superfamily Metastrongyloidea (better known as "lungworms") infect a wide range of mammals in Norway, including moose, deer, reindeer, foxes, and dogs. These nematode infections can result in serious diseases and even the death of their definitive hosts, thus also affecting the population structure of these mammals (Pybus 2001 and pers. comm Arne Skorping. See Appendix III).

Category III parasites transmitted from terrestrial gastropods appear to be limited to a few species, and includes, most importantly, *Angiostrongylus cantonensis*, which is a major cause of eosinophilic meningitis in humans (Walden et al., 2017). It is often referred to as the rat lungworm since various rats, including the brown rat *Rattus norvegicus*, is the definitive host (Mackerras and Sandars, 1955, Lv et al., 2008). Another important pathogen in this category is *Listeria monocytogenes.* Invasive slugs, such as *A. vulgaris*, can act as vectors of *L. monocytogenes* that can cause listeriosis in both farm animals and humans. The snails and slugs can directly infect humans, and especially pet owners, through their slime and faeces (Libora et al., 2010), which both might end up on the keepers' hands and be transferred to the mouth by various means. Investigations from Norway showed that 43% of the tested slugs were infected (Gismervik et al., 2014), and it is reasonable to believe that both native

terrestrial gastropods, as well as other alien organisms, could act as vectors of this pathogen.

Some species of terrestrial gastropods have been studied in detail in terms of their parasite load. One of these is the Thumbnail awlsnail (*Subulina octona*). This species has been found to carry the trematodes *Tanaisia bragai, Platynosomum illiciens,* and *Postharmostomum gallium*, the tapeworm *Davainea proglottina,* and the nematodes *Aelurostrongylus abstrusus* and *Angiostrongylus vasorum;* these nematodes may use frogs (*A. vasorum*) or birds, rodents, amphibians, or reptiles as paratenic hosts (Maldonado, 1945, Brandolini, 1997, Ferreira et al., 2009, Wesołowska & Wesołowski,, 2014), but their definitive hosts are felids (*A. abstrusus*) (Maldonado 1945, Ash 1962) and canids (*A. vasorum*) (Bessa et al., 2000). In addition, *Subulina octona* also serves as an intermediate host of the nematode *A. cantonensis* (De Almedia Bessa et al. 2000).

Another species that has been more thoroughly investigated, due to its dual use as both food and pet, is the Giant African land snail, *Achatina fulica.* Investigation of wild-caught individuals of this species showed that these contain a high prevalence of pathogenic microorganisms, including *Salmonella*, *Pseudomonas*, *Bacillus*, *Staphylococcus*, *Micrococcus*, *Escherichia coli,* and *A. cantonensis* (Libora et al., 2010, Nyoagbe et al., 2016). However, for *S. mansoni* at least, this is carriage rather than having any lifecycle potential. Furthermore, parasite loads are significantly lower in captive-bred specimens, as the parasites rely on the definitive host to complete the lifecycle. It is estimated that about 90% of the terrestrial gastropods in trade in Norway stem from captive breeding. For the most common species, like those in the Achatinidae family, it is estimated that >99% of the individuals are bred in Europe (Tarald Stein pers. comm. See Appendix III).

It is also worth mentioning that native terrestrial slugs also act as hosts and transmitters of naturally occurring parasites. In a recent study from Norway (Ross et al., 2016), 62.5% of the 32 sample sites were found to be positive for nematodes; the nematodes were from five different families. Twelve slug species were investigated in this study, and nematodes were found in 7 of these, but only 18.7% of the slugs were infected. However, this study only investigated nematode infections. If also other parasites and pathogens are considered, the prevalence of native parasites and pathogens detected would be expected to be much higher.

1.7 Potential for successful establishment in a 50-year perspective

The potential for successful establishment of non-native species should be considered in a 50-year perspective (see Terms of Reference). This means that future climates should be considered. Gastropods are ectothermic organisms and directly influenced by the temperature in their habitats, through physiological processes and bioenergetics. Rates of growth and development are strongly determined by temperature regimes that influence enzymatic kinetics, activity patterns, feeding, assimilation, respiration, emergence time, etc.

(Sweeney, 1984). Warmer temperatures speed up physiological processes (Buisson et al., 2013; Parmesan and Yohe, 2003), and could cause increased number of generations per year, altered relative abundances of taxa, and species replacements (Velle et al., 2010). Acclimation has been shown in some gastropod species, but not in others, suggesting there is a potential for at least some species to thrive beyond the thermal conditions they experience in their native range. *Arion vulgaris* is a good example showing this possibility (Hatteland et al., 2013), and certainly other gastropod species may also be capable of spreading much further north their native distribution implies. In cold regions, some snails may be adversely affected by warmer winters. This is because they migrate into the soil during winters to avoid sub-zero temperatures. They will emerge once the temperatures warms up during mid- or late winter, leaving the organism vulnerable to sub-zero temperatures should the temperature drop again.

Many of the land snails covered in this report are currently unable to survive in Norway due to a short growing season and a long, harsh winter. Their development requires more accumulated degree-days than are currently available in Norway today and they are unable to survive cold winter temperatures. Some of these species can be expected to survive in a future climate, when the length of the growing season increases and the winters become less harsh (Iacarella et al., 2015). In this respect, the future climates of most interest are those of the warmest areas of Norway, where the probability of survival is highest. Future climates are covered under section 2.2.

2 Methodology and data

2.1 Methodology for evaluation

VKM adopted a two-stage procedure, including an initial screening of all species identified as relevant for trade in Norway (see Terms of Reference) and a risk assessment of the species evaluated as haveing the potential to establish in Norway.

The initial screening identified taxa with the **potential for establishing populations in Norway** based on either the similarity between climatic conditions in Norway and the organisms' current distribution (see question 2.8 in Table 2.1.3-1.) or on the species being particularly invasive, and thus listed as one of the top 100 most invasive species globally (Lowe et al., 2000). The screening was performed based on available literature (section 2.2). If the **potential for establishment was assessed as being very unlikely**, then no further assessments were conducted for the taxon, since it is unlikely to be able to survive outside captivity in Norway.

If the climate conditions in the current distributional range and habitat of the taxon resemble that of Norway, either now or in a 50-year perspective, then this taxon was included in the risk assessment in the second stage of the risk assessment procedure. The assessment included evaluating the probability of entry, a further and more detailed evaluation of the probability of establishment, the probability of spread, an assessment of environmental consequences/impact, and finally an overall risk assessment for the taxon.

For some species limited information exists. These were classified as "**Lack of information**".

2.1.1 Initial screening phase

The complete list of species (Tables 3.1.1-1 and 3.1.1-2) was initially screened to determine whether an in-depth risk assessment was needed based on whether the species inhabits a climate comparable to that of Norway (including a 50-year perspective), and whether the species is considered particularly invasive, and thus listed as one of the top 100 most invasive species globally (Lowe et al., 2000). Species known to inhabit Mediterranean areas, and which have recently expanded northward (both due to climate change and increased trade of goods), were also investigated further.

For some gastropods, the initial screening started at genus level. If the distribution of the genus extended into areas potentially resembling Norwegian conditions, then the Panel assessed each of the species listed within the genus separately.

The initial screening included one of the following two categories (see table 2.1.4-2 for definitions);

1. **Very unlikely:** Low potential for establishment in Norway as climate conditions in the native range differ substantially from Norwegian conditions (*e.g.*, native range is in tropical climates and regions). These species were not assessed further due to the low probability of establishment under Norwegian climate conditions, even in a 50-year perspective.
2. **Unlikely – Very likely:** The species can potentially establish in Norway as climate conditions in the native range is potentially similar enough for successful establishment, or it inhabits Mediterranean areas and have had a recent Northward expansion. The species might also originate from a more tropical climate, but is listed as one of the top 100 most invasive species globally. All species assigned to this group in the initial screening were subject to a complete risk assessment, if possible.

A third category was introduced during the second phase if there was not enough information to undertake a complete risk assessment (only valid for category 2 species):

3. **Lack of information**: The available information on the distribution, climate tolerance, and biology of the species is too limited to conduct a meaningful risk assessment. This category mostly contains species from tropical regions, but the available knowledge is limited and the species' climate tolerance and habitat requirements are not documented. The species assigned to this category could not be assessed further.

2.1.2 Risk assessment scheme

Risk assessments were conducted primarily at the species level, but in a few cases groups of closely related species with similar ecology were analysed jointly. In order to conduct a full risk assessment of the species determined to have the potential for establishment in the initial screening, the Panel used a modified version of the Non-native Species Secretariat for Great Britain form (GB Non-native Risk Assessment scheme, or GB-NNRA, (http://www.nonnativespecies.org/home/index.cfm), with permission to adapt the template granted by the GB-NNRA.

The form was developed by a consortium of risk analysis experts in 2005, and has since been improved and refined, and then tested and peer-reviewed by risk analysis experts operating with similar forms in Australia and New Zealand (Roy et al., 2013). The GB-NNRA form complies with the Convention on Biological Diversity and reflects standards used by other forms, such as the Intergovernmental Panel on Climate Change, the European Plant Protection Organisation, and the European Food Safety Authority.

The GB-NNRA methodology is a qualitative risk assessment method, which comprises a range of questions covering all aspects requested in the Terms of Reference of this report. The questions cover the organism's probability of entry and the pathways of entry,

establishment and spread, and the potential impact the organisms may have on biodiversity and ecosystem services.

A wide range of organisms have been assessed based on this method, including the red-eared terrapin (*Trachemys scripta elegans)*, Italian crested newt (*Triturus carnifex*), Quagga mussel (*Dreissena rostriformis bugensis*), and many more (see http://www.nonnativespecies.org/index.cfm?sectionid=51). Among these previous assessments are several cases related to import and keeping of organisms for specific objectives, *e.g.*, a selection of arthropods was risk assessed by VKM using a modified version of the protocol (VKM, 2016).

The original risk assessment method is divided into two major sections (A & B). Only section B was used for the risk assessment in the current report.

In **Section B,** organisms identified from the initial screening as having the potential for establishment, are evaluated in greater detail. The conclusions for the different stages of the risk assessment; entry, establishment, spread, and impact are presented separately.

For each question, the assessor ranks the uncertainty of their response, and also can add further comments. For the taxa assessed in the current assignment, assessors could indicate the level of uncertainty behind a particular response and add further comments to clarify.

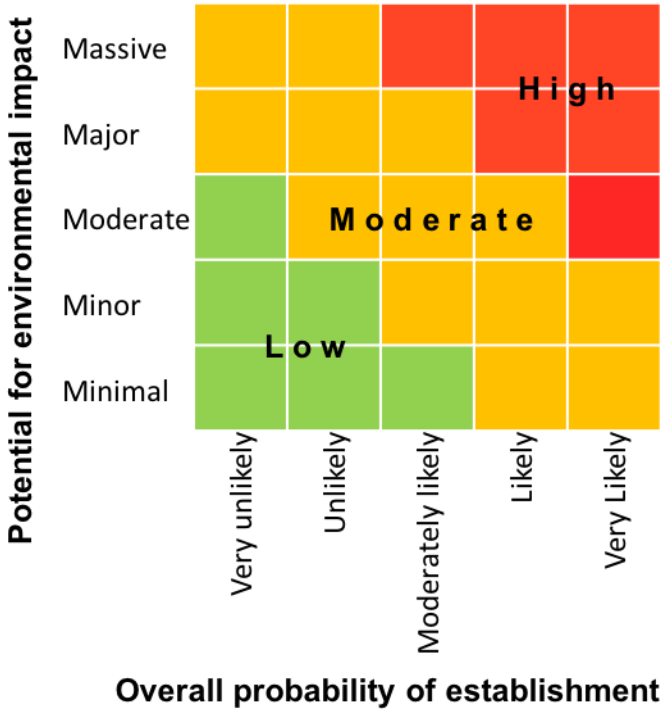

Figure 2.1.2-1. The conclusions of the risk assessments (Low, Moderate, or High) are based on the overall probability of establishment (which includes entry, establishment and spread) and the potential for environmental impact on Norwegian biodiversity.

Based on the assessment of the overall probability of establishment (based on the probability of entry, probability of establishment, spread), and potential for environmental impact on Norwegian biodiversity, the risk assessor ended the assessment with a "Conclusion of the risk assessment" placing the species (or species group) in one of the following categories (Figure 2.1.2-1):

1. **Low risk**
2. **Moderate risk**
3. **High Risk**

2.1.3 Modified GB-NNRA protocol

The unaltered version of the EU NON-NATIVE SPECIES RISK ANALYSIS – RISK ASSESSMENT TEMPLATE V1.0 (27-04-15) can be found here: http://www.nonnativespecies.org/index.cfm?pageid=143. The adapted version used for all risk assessments in the current report is provided below, and the specific changes made on the original template are listed in Appendix I.

Table 2.1.3-1 The adapted version of the GB-NNRA protocol.

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE [choose one entry, delete all others]**	**UNCERTAINTY [choose one entry, delete all others]**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	Unlikely Moderately likely Likely	low medium high	
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	Unlikely Moderately likely Likely	low medium high	
1.3. Estimate the overall likelihood of entry into Norwegian nature.	Unlikely Moderately likely	low medium high	

	Likely		

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Very unlikely unlikely Moderately likely Likely Very likely	low medium high	
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	Very unlikely unlikely Moderately likely Likely Very likely	low medium high	
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	Very unlikely unlikely Moderately likely Likely Very likely	low medium high	
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	Very isolated Isolated Moderately widespread Widespread Ubiquitous	low medium high	
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	Very unlikely unlikely Moderately likely Likely very likely	low medium high	See also 3.3
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	Very unlikely unlikely Moderately likely Likely Very likely	low medium high	
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the	Very unlikely unlikely Moderately	low medium high	

founder population?	likely Likely Very likely		
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is it to establish in Norway? (If possible, specify the instances in the comments box.)	Very unlikely Unlikely Moderately likely Likely Very likely	low medium high	
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Very unlikely Unlikely Moderately likely Likely Very likely	low medium high	

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	Very unlikely unlikely Moderately likely Likely Very likely	low medium high	
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	Very unlikely Unlikely Moderately likely Likely Very likely	low medium high	
3.3. How likely is it that spread of the organism within Norway can be completely contained?	Very unlikely Unlikely Moderately likely Likely Very likely	low medium high	
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	[insert text]	low medium high	
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to	Very unlikely unlikely Moderately	low medium high	

indicate any key issues).	likely Likely very likely		

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (*i.e.*, past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal minor moderate major massive	low medium high	
4.2. How much impact would there be if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?	minimal minor moderate major massive	low medium high	
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (*e.g.*, pathogens)?	minimal minor moderate major massive	low medium high	
4.4. How much impact do other factors (which are not covered by previous questions) have? (Specify these other factors in the comments box)	NA minimal minor moderate major massive	low medium high	
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal minor moderate major massive	low medium high	
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	[insert text + attach map if possible]	low medium high	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway	Minimal Minor Moderate	low medium high	

(despite any natural control by other organisms, such as predators, parasites, or pathogens that may already be present).	Major Massive		

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50-years perspective), if any, are most likely to affect the risk assessment for this organism?	[insert text]	low medium high	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	[insert text]	low medium high	

2.1.4 RISK SUMMARIES

	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	very unlikely unlikely moderately likely likely very likely	low medium high	
Summarise Establishment	very unlikely unlikely moderately likely likely very likely	low medium high	
Summarise Spread	very slowly slowly moderately rapidly very rapidly	low medium high	
Summarise Impact	minimal minor moderate major massive	low medium high	
Conclusion of the risk assessment	low moderate high	low medium high	

2.1.5 Rating and descriptions

In order to provide clear justification of the ratings given in the risk assessment template, the Panel used ratings and adapted versions of the descriptors from Appendix E in the Scientific Opinion of the European Food Safety Authority (EFSA., 2015).

Table 2.1.4-1 Rating of probability of entry into Norwegian nature.

Rating	Descriptors
Unlikely	The likelihood of entry would be low because: • a limited number of individuals is expected to be in trade, AND • relatively few and large eggs laid per year (<600), reducing the potential for unintentional disposal of brood outside terraria.
Moderately likely	The likelihood of entry would be moderate because: • a limited number of individuals is expected to be in trade, OR • relatively few and large eggs laid per year (<600), reducing the potential for unintentional disposal of brood outside terraria
Likely	The likelihood of entry would be high because: • a relatively large number of individuals is expected to be in trade, AND • many and small eggs ladi per year (>600), increasing the potential for unintentional disposal of brood outside terraria

Table 2.1.4-2 Rating of the probability of establishment.

Rating	Descriptors
Very unlikely	The likelihood of establishment would be very low because: • environmental conditions are unsuitable throughout Norway, • of the absence or very limited availability of required foods (including host plants), • the occurrence of other considerable obstacles prevents establishment.
Unlikely	The likelihood of establishment would be low because: • environmental conditions are unsuitable in most parts of Norway, • of the limited availability of required foods (including host plants), • the occurrence of other obstacles prevents establishment.
Moderately likely	The likelihood of establishment would be moderate because: • environmental conditions are suitable in a few areas of Norway, • required foods (including host plants) are abundant in a few areas of Norway, • no obstacles to establishment occur.
Likely	The likelihood of establishment would be high because: • environmental conditions are suitable in some parts of Norway, • required foods (including host plants) are widely distributed in some areas of Norway, • no obstacles to establishment occur. • Alternatively, the species has already established in some areas of Norway.
Very likely	The likelihood of establishment would be very likely because: • environmental conditions are suitable in most parts of Norway, • required foods (including host plants) are widely distributed in Norway, • no obstacles to establishment occur. • Alternatively, the species has already established in Norway.

Table 2.1.4-3 Rating of the probability of spread.

Rating	Descriptors
Very unlikely (minimal)	The likelihood of spread would be very low because: • the species has limited spreading capabilities, • highly effective barriers to spread exist (*e.g.*, patchy distribution of habitats), • required foods and nesting resources are not or very rarely present in the area of possible spread.
Unlikely	The likelihood of spread would be low because: • the species has limited spreading capabilities, • effective barriers to spread exist (*e.g.* patchy distribution of habitats), • required foods and nesting resources are occasionally present.
Moderately likely (moderate)	The likelihood of spread would be moderate because: • the species has limited spreading capabilities, • partly effective barriers to spread exist, • required foods and nesting resources are abundant in some parts of the area of possible spread.
Likely (major)	The likelihood of spread would be high because: • the species has effective ways to spread, • no effective barriers to spread exist; • required foods and nesting resources are abundant in some parts the area of possible spread.
Very likely	The likelihood of spread would be very high because: • the species has effective ways to spread, • no effective barriers to spread exist, • required foods and nesting resources are widely present in the whole risk assessment area.

Table 2.1.4-4 Rating of the assessment of impact.

Rating	Descriptors
Minimal	No impact on local biodiversity
Minor	Potential impacts on local biodiversity are within normal fluctuation
Moderate	Impacts may cause moderate reductions in native populations
Major	Impacts may cause severe reductions in local populations with consequences for local biodiversity and ecosystem functions and services
Massive	Impacts may cause severe reductions in local biodiversity (local extinctions), with severe consequences for ecosystem functions and services

Table 2.1.4-5 Ratings used for describing the level of uncertainty.

Rating	Descriptors
Low	Information is available on the species distribution, ecological requirements and climate tolerance. No subjective judgement is introduced. No unpublished data are used.
Medium	Some information is missing on the species distribution, ecological requirements and climate tolerance. Subjective judgement is introduced with supporting evidence. Unpublished data are sometimes used.
High	Most information is missing on the species distribution, ecological requirements and climate tolerance. Subjective judgement may be introduced without supporting evidence. Unpublished data are frequently used.

2.2 Sources of information

2.2.1 Scientific literature

Some of the species considered in this risk assessment have been studied quite extensively, but there is a total lack of scientific information for others. Furthermore, many of the scientific studies on the focal species here are of little relevance for an environmental risk assessment. Examples are descriptive studies on morphology, usefulness as bioindicator for heavy metal contamination, and laboratory studies of phenotypic plasticity. The uncertainty given for each species in the risk assessment reflects the available relevant scientific literature of relevance to the aspects relevant for the risk assessment. Information on species extensively studied on aspects relevant for the risk assessment is associated with low uncertainty, but information on species for which there is a lack of scientific information is associated with high uncertainty. A list of the references used in the risk assessment is provided for every species. Key sources of scientific literature have been ISI Web of Science and Google Scholar. Through searches in these databases, primarily by use of the species name (or synonyms), relevant literature has been identified. In some instances, additional literature has been found by searching in the literature list of relevant published articles.

2.2.2 Governmental databases and private websites

We also conducted a general Google search using the Scientific or English species name. These searches sometimes revealed webpages containing relevant information and references to relevant scientific literature not found in the scientific databases mentioned above. Some webpages link to databases maintained by experts or governmental organizations, such as WMSDB, AnimalBase, Encyclopaedia of Life, Global Invasive Species Database (IUCN), IUCN redlist, and the Animal Diversity Web. These databases are useful as they sometimes provide a summary of ecological knowledge for particular species and give references to relevant scientific literature. However, many species do not occur in such databases and for many of those that are listed, the accompanying information is limited. Many of the species also have dedicated pages on Wikipedia. However, we chose not to use such information directly, but rather searched through the references on Wikipedia for relevant information from the primary sources of information.

Google searches also returned a limited number of hits from private web sites and "hobby-based" literature. Some generally good private sites exist, such as "Taralds snegleblogg", Landsnails.org, BugZuk.com, PolyPed.de, www.exotic-pets.co.uk and Pet Snail Forum. These sites often provide experience-based species-specific information on how to keep and breed gastropods, such as requirements and preferences for food, temperature, and humidity, as well as information on reproduction (*e.g.*, number of eggs per clutch). Some sites also act as a market place for shells or live specimens of terrestrial gastropods, giving an indication on the degree of trade associated with that particular species.

2.3 Considerations of climate

Climate envelope modelling can be used to assess the suitability of new habitats for non-native species. However, this approach must be augmented with an understanding of the species' ecological niche, including both climatic and other ecological requirements (Jimenez-Valverde et al., 2011).

Due to the number of species to be assessed and the limited information on the environmental- and ecological requirements of most of them, in this risk assessment VKM used an approach that includes a comaprison of the climate in Norway and the climate where the species is native. VKM restricted the assessment of the potential for establishment in the initial screening to the climatic niche, and considered that species originating from regions with climates similar to that of Norway, either now or in a 50-year perspective, have the potential for establishing in Norway.

The globally averaged combined land and ocean surface temperature shows a warming of 0.85 °C (0.65 °C to 1.06 °C) over the period 1880 to 2012, for which multiple and independently produced datasets exist (IPCC, 2013). The rate of the warming has accelerated towards the present. Future climate change is expected to vary heterogeneously between and within regions and according to season. Currently, the warmest annual mean temperature in Norway is found in coastal southern Norway at 8.0 °C (period 1971-2000). The warmest summer temperatures are in the southern part of Østlandet and the coastal areas of Sørlandet, with an average of about 17 °C. Given the mid-range CO_2 emission scenario (RCP4.5), warm areas can expect an annual temperature increase of 2.0 °C by the year 2066, with the highest increase (2.4 °C) during the winters (Table 1). The increase in temperature is more pronounced given the emission scenario RCP8.5. The number of growing season days will also increase under both climate scenarios (Table 1). This climate analysis is taken from the VKM report "Assessment of the risks to Norwegian biodiversity from the import and keeping of terrestrial arachnids and insects" (VKM, 2016a).

Table 2.3-1 Modelled climate change (increase in temperature, precipitation, and growing season days) from the period 1971-2000 and towards year 2067 under the CO_2 emission scenarios RCP4.5 (emission peak 2040-2050, then decline) and RCP 8.5 (business as usual). These two scenarios are considered most robust by the IPCC, and recommended. The projections are based on an ensemble of ten different climate models. Source: klimaservicesenter.no.

	Whole of Norway, RCP 4.5	**S-E Norway, RCP 4.5**	**Whole of Norway, RCP 8.5**	**S-E Norway, RCP8.5**
Annual °C	2.2	2.0	3.3	3.0
Summer °C	2.0	1.9	2.9	2.6
Winter °C	2.5	2.4	3.5	3.2
Annual ppt %	6.7	2.4 / 6.0	10.7	6.6 / 10.2

Winter ppt %	5.6	6.7 / 17.2	7.1	6.7 / 17.2
Summer ppt %	10.5	1.6 / 2.3	12.5	1.5 / 2.3
Growing season days	0-60	0-60*	0-60	30-60

Summer= June, July, August; winter= December, January, February. *Small areas in southernmost Norway may experience up to 60 days increase. Ppt= precipitation.

Given a realistic temperature increase of 2 °C, the average annual temperature will reach a maximum of 10 °C in Norway in 2067. The mean temperatures of coastal southern Norway will increase to about 4.5 °C during winter. However, periods with sub-zero temperatures and snow cover can be expected to be even shorter in 2067 than suggested by the modelled increase in winter temperatures. This is because the daily minimum temperatures are increasing about twice as fast as the daily maximum temperatures (IPCC, 2013).

Given the model errors involved (about +/-0.7 °C) and a precautionary principle, VKM assumes an annual mean temperature of 11 °C in 2067, which is in accordance with scenario RCP8.5. Using this scenario has been recommended by the Norwegian Biodiversity Information Centre (Sandvik et al., 2015).

The amount of precipitation will also increase during the next 50 years (Table 2.3-1). Some species of gastropods prefer dry habitats, but most species prefer damp habitats. The increase in precipitation, especially during the summer months when the snails are most active, suggests that habitat quality will increase and many species will potentially thrive. However, the exact response to precipitation is complex since environmental factors other than precipitation may limit the spread of snails, such as the need for calcareous bedrock for house-bearing snails.

3 Answers to the terms of reference

3.1 Species relevant for trade in Norway

Species that were included in the risk assessment, are found in Table 3.1.1-1 and 3.1.1.2. To be included on the list the species needed to fulfilled at least one of the following criteria;

1. The Norwegian Environment Agency has previously received an application for import of the species
2. The species is relevant for trade and keeping in Norway, as assessed by the hearing experts.

Based on the initial screening phase, most of the species were found to have climate requirements that deemed establishing populations in Norway as being "Very unlikely", with low uncertainty. These species were not assessed further as we concluded that they pose minimal threat to Norwegian biodiversity due to their low establishment potential. These are listed in Table 3.1.1-1.

The species listed in Table 3.1.1-2 could not be excluded based on this climate criterion and were subject to a full risk assessment, provided that relevant information was available.

Table 3.1.1-1 List of species for which the probability of establishment in Norway was deemed "Very unlikely" in the initial screening phase. Taxonomy follows Bouchet, P. & Rocroi, J.-P. (2005).

Order	Superfamily	Family	Species
Littorinimorpha	Littorinoidea	Pomatiidae	*Tudora megacheilos*
Stylommatophora	Acavoidea	Acavidae	*Acavus haemastoma*
Stylommatophora	Acavoidea	Acavidae	*Acavus phoenix*
Stylommatophora	Acavoidea	Acavidae	*Acavus superbus*
Stylommatophora	Acavoidea	Acavidae	*Ampelita xystera*
Stylommatophora	Acavoidea	Acavidae	*Helicophanta bicingulata*
Stylommatophora	Acavoidea	Acavidae	*Helicophanta farafanga*
Stylommatophora	Acavoidea	Acavidae	*Helicophanta gargantua*
Stylommatophora	Acavoidea	Acavidae	*Helicophanta ibaroensis*
Stylommatophora	Acavoidea	Acavidae	*Helicophanta magnifica*
Stylommatophora	Acavoidea	Acavidae	*Helicophanta souverbiana*
Stylommatophora	Acavoidea	Acavidae	*Leucotaenius favannii*
Stylommatophora	Acavoidea	Acavidae	*Oligospira waltoni*
Stylommatophora	Acavoidea	Strophocheilidae	*Chiliborus rosaceus*
Stylommatophora	Acavoidea	Strophocheilidae	*Megalobulimus oblongus*
Stylommatophora	Acavoidea	Strophocheilidae	*Strophocheilus bridgesi*
Stylommatophora	Acavoidea	Strophocheilidae	*Strophocheilus chilensis*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina achatina*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina albopicta*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina balteata*

Stylommatophora	Achantinoidea	Achantinidae	*Achatina bandeirana*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina craveni*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina degneri*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina glutinosa*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina iostoma*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina iredalei*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina reticulata*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina rodatzii*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina schweinfurthii*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina tincta*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina varicosa*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina vassei*
Stylommatophora	Achantinoidea	Achantinidae	*Achatina zanzibarica*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina adelinae*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina boettgeri*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina camerunensis*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina immaculata*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina marginata*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina papyracea*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina porphyrostoma*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina purpurea*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina puylaerti*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina rhodostoma*
Stylommatophora	Achantinoidea	Achantinidae	*Archachatina ventricosa*
Stylommatophora	Achantinoidea	Achantinidae	*Atopocochlis exarata*
Stylommatophora	Achantinoidea	Achantinidae	*Burtoa nilotica*
Stylommatophora	Achantinoidea	Achantinidae	*Callistoplepa barriana*
Stylommatophora	Achantinoidea	Achantinidae	*Lignus auripigmentum*
Stylommatophora	Achantinoidea	Achantinidae	*Lignus solimanus*
Stylommatophora	Achantinoidea	Achantinidae	*Limicolaria aurora*
Stylommatophora	Achantinoidea	Achantinidae	*Limicolaria flammea*
Stylommatophora	Achantinoidea	Achantinidae	*Limicolaria martensiana*
Stylommatophora	Achantinoidea	Achantinidae	*Limicolaria numidica*
Stylommatophora	Achantinoidea	Achantinidae	*Lissachatina fulica hamillei*
Stylommatophora	Achantinoidea	Achantinidae	*Lissachatina fulica rodatzi*
Stylommatophora	Achantinoidea	Achantinidae	*Metachatina kraussi*
Stylommatophora	Achantinoidea	Achantinidae	*Perideriopis fallensis*
Stylommatophora	Achantinoidea	Achantinidae	*Pseudoachatina colorata*
Stylommatophora	Achantinoidea	Achantinidae	*Pseudoachatina connectens*
Stylommatophora	Achantinoidea	Achantinidae	*Pseudoachatina dennisoni*
Stylommatophora	Achantinoidea	Achantinidae	*Pseudoachatina laeiana*
Stylommatophora	Clausilioidea	Clausiliidae	*Oospira vanbuensis*
Stylommatophora	Clausilioidea	Clausiliidae	*Phaedusa paviei*
Stylommatophora	Dyakioidea	Dyakiidae	*Bertia brookei*
Stylommatophora	Helicarionoidae	Ariophantidae	*Cryptozona bistralis*
Stylommatophora	Helicarionoidea	Ariophantidae	*Hemiplecta distincta*
Stylommatophora	Helicarionoidea	Ariophantidae	*Tanychlamys amboinensis*

Stylommatophora	Helicarionoidea	Helicarionidae	*Ryssota otaheitana*
Stylommatophora	Helicoidea	Camaenidae	*Hadra webbi*
Stylommatophora	Helicoidea	Camaenidae	*Pancala batanica*
Stylommatophora	Helicoidea	Humboldtianidae	*Humboldtiana montezuma*
Stylommatophora	Helicoidea	Monadeniidae	*Monadenia fidelis*
Stylommatophora	Helicoidea	Pleurodontidae	*Pleurodonte excellens*
Stylommatophora	Helicoidea	Pleurodontidae	*Pleurodonte isabella*
Stylommatophora	Helicoidea	Pleurodontidae	*Pleurodonte marginella*
Stylommatophora	Helicoidea	Pleurodontidae	*Zachrysia provisoria*
Stylommatophora	Helicoidea	Polygyridae	*Mesodon normalis*
Stylommatophora	Orthalicoidea	Bulimulidae	*Plectostylus coquimbensis*
Stylommatophora	Orthalicoidea	Bulimulidae	*Plectostylus reflexus*
Stylommatophora	Orthalicoidea	Bulimulidae	*Plectostylus variegatus*
Stylommatophora	Streptaxoidea	Streptaxidae	*Edentulina obesa*
Stylommatophora	Testacelloidea	Spiraxidae	*Poiretia compressa*
Stylommatophora	Testacelloidea	Spiraxidae	*Poiretia cornea*

Table 3.1.1-2 List of species for which negative impact on Norwegian biodiversity could not be assessed to be "Very unlikely" in the initial screening phase, and thus were subjected to a more thorough risk assessment. Taxonomy follows Bouchet, P. & Rocroi, J.-P. (2005).

Order	Superfamily	Family	Species	
Stylommatophora	Achantinoidea	Achantinidae	3.1.1	*Achatina fulica*
Stylommatophora	Achantinoidea	Subulinidae	3.1.2	*Paropeas achatinaceum*
Stylommatophora	Achantinoidea	Subulinidae	3.1.3	*Rumina decollata*
Stylommatophora	Achantinoidea	Subulinidae	3.1.4	*Rumina saharica*
Stylommatophora	Achantinoidea	Subulinidae	3.1.5	*Subulina octona*
Stylommatophora	Helicoidea	Bradybaenidae	3.1.6	*Euhadra amaliae*
Stylommatophora	Helicoidea	Camaenidae	3.1.7	*Camaena cicatricosa*
Stylommatophora	Helicoidea	Helicidae	3.1.8	*Cantareus apertus*
Stylommatophora	Helicoidea	Helicidae	3.1.9	*Caucasotachea calligera*
Stylommatophora	Helicoidea	Helicidae	3.1.10	*Caucasotachea vindobonensis*
Stylommatophora	Helicoidea	Helicidae	3.1.11	*Eobania vermiculata*
Stylommatophora	Helicoidea	Helicidae	3.1.12	*Helix albescens*
Stylommatophora	Helicoidea	Helicidae	3.1.13	*Helix aspersa*
Stylommatophora	Helicoidea	Helicidae	3.1.14	*Helix lucorom*
Stylommatophora	Helicoidea	Helicidae	3.1.15	*Helix lutescens*
Stylommatophora	Helicoidea	Helicidae	3.1.16	*Helix melanostoma*
Stylommatophora	Helicoidea	Helicidae	3.1.17	*Helix philibinensis*
Stylommatophora	Helicoidea	Helicidae	3.1.18	*Helix secernenda*
Stylommatophora	Helicoidea	Helicidae	3.1.19	*Hemicycla sp.*
Stylommatophora	Helicoidea	Helicidae	3.1.20	*Leptaxis undata*
Stylommatophora	Helicoidea	Helicidae	3.1.21	*Loxana vondeli*
Stylommatophora	Helicoidea	Helicidae	3.1.22	*Marmorana sp.*
Stylommatophora	Helicoidea	Helicidae	3.1.23	*Neohelix albolabris*

Stylommatophora	Helicoidea	Helicidae	3.1.24	*Otala lactea*
Stylommatophora	Helicoidea	Helicidae	3.1.25	*Otala punctata*
Stylommatophora	Helicoidea	Helicidae	3.1.26	*Theba pisana*
Stylommatophora	Helicoidea	Helicidae	3.1.27	*Tingitana shioum*
Stylommatophora	Punctoidea	Discidae	3.1.28	*Anguispira alternata*
Stylommatophora	Punctoidea	Discidae	3.1.29	*Anguispira strongylodes*
Stylommatophora	Testacelloidea	Spiraxidae	3.1.30	*Euglandina rosea*
Stylommatophora	Zonitoidea	Zonitidae	3.1.31	*Zonites algirus*
Systellommatophora	Veronicelloidea	Veronicellidae	3.1.32	*Laevicaulis alte*
Systellommatophora	Veronicelloidea	Veronicellidae	3.1.33	*Veronicella sloanii*

3.2 Biotic and abiotic factors that determine the potential for survival, establishment and spread of terrestrial gastropods in Norway

For gastropods initially kept terraria to enter nature, they need to escape or be released, either intentionally or unintentionally. The potential for unintentional disposal of eggs or juveniles from private keeping of gastropods, *e.g.*, while cleaning terraria, can be expected to depend on the total number of eggs. Unintentional release is more likely when the number of eggs or specimens is large.

Environmental factors (biotic and abiotic) act as a filter in terms of allowing only those species that possess specific combinations of traits, which enable them to cope with the given conditions, to survive and persist in a given locality (Keddy, 1992). Climatic factors (means and extremes in precipitation and temperature through the year, etc) are important factors determining the distribution of organisms. For some snails, a determining (*i.e.* restricting) factor will be the demand for chalky soil in their habitat. The estimation of the probabilities of the assessed species to establish in Norway is based on a comparison of climatic data from the original distribution area with climatic data for Norway. As the distribution area in some cases is wide or not well characterized, this estimation becomes rather rough in some cases. At first thought it seems probable that species from areas in North America with the same climatic conditions could easily establish in Scandinavia, but this does not seem to be the case. Although several European snail and slug species have established in North America, the opposite has not taken place (von Proschwitz et al., 2017). An example of this is that the North American snail *Zonitoides arboreus*, which lives in areas with climate similar to that in Northern and Middle Europe, and is easily spread by humans. Although it has established itself indoors in the greenhouse environment in Europe, outdoor records a remarkably few. The reasons for this remain unclear, but can probably be found in details of the climatic and other habitat condition demands, along with a limited ability to spread and compete with the local fauna. A special problem for some species may be that they overwinter as eggs, which in many cases are more sensitive to cold and drought than the adult snail/slug – although the opposite may also be the case.

Another important factor that determines whether a species can survive in the Norwegian environment, is the species' abilities to spread and reproduce successfully in the new area. Spread of land snails may take place passively by transport with other organisms serving as vectors; long-distance birds, and, to a lesser extent, mammals, are important potential vectors (see Maciorowski et al., 2012, and references therein). There are also many examples of human activities playing an important role in the spread of many snail and slug species, particularly associated with trade, especially of plants, and by being attached to vehicles and agricultural machinery, or transported in garden waste. As all pulmonate snails are hermaphrodites, and many species are also able to self-fertilize, a single snail or snail egg may act as a founder of a new population.

Other abilities that may facilitate the establishment of populations and occur in some of the species considered here, are the ability to store semen for long periods after copulation, ovovivipary (the sensitive egg stage does not enter the environment), and sexual maturity before the shell has reached its final size. These properties are especially noted among the species in the Subulinidae. The sensitivity of the eggs to drought and low temperatures (frost) is an important factor, as is the time (season) of reproduction in the species' native area, and possible plasticity in the timing and duration of the reproductive period. However, the details of these factors are unknown for most species.

Some species originating from the Mediterranean and SW Europe, especially those in the families Helicidae and Hygromiidae, have, by the help of man, spread northwards in Europe in recent decades. Some of them have reached and established in Denmark and southern Sweden. Although suitable habitats for most of these species occur less frequently in Norway, the establishment of at least some of them in Norway seems possible, especially in a scenario with a markedly warmer climate. Some of the members of the family Helicidae considered in this report (especially the genus *Helix*), belong to this group of species.

3.3 Biotic and ecological properties of terrestrial gastropods that determine the potential for a negative impact on biodiversity in Norway

Most studies on invasive gastropods have focused on their role as agricultural pests. Knowledge of their negative impacts in wild ecosystems is relatively scant. Several key elements of gastropod biology are relevant to their potential for becoming invasive. First of all, their ability to sustain dense populations is relevant. Some species might have self-regulated populations, never reaching high densities, while others can sustain populations with extremely high densities under optimal conditions (*e.g.*, *Theba pisana, Otala punctata, Cepaea vindobonensis, Camaena cicatricosa).*

In order to assess the potential for developing large populations, it is important to know the species' reproductive potential, *i.e.*, the number of eggs laid per year. Some species can lay up to 1200 eggs annually, potentially enabling them to establish large populations fast. In

this aspect, generation time is also relevant, as some species can become reproductive within a year and lay eggs several times per year, but others mature only after several years and lay eggs just once per year.

The species' breeding system can also affect its invasion potential, as hermaphrodite species, some of which are able to self-fertilize, have a higher potential for establishment and population increase than species requiring a sexual partner for reproduction. Some species can store sperm and lay eggs multiple times after only a single mating (*e.g.*, *Laevicaulis alte*).

Potential effects on biodiversity depend on the alien species' dietary requirements. Some species (*e.g.*, *Paropeas achatinaceum*) may damage the roots of plants by feeding, whereas others are foliage feeders, causing harm to the aboveground parts of the plants. Other species are carnivorous (*e.g.*, *Euglandina rosea*) with potentially negative effects on its prey populations. Many species are omnivorous, and can harm a diverse array of other species. There are also examples of invasive species competing with native gastropods (*e.g.*, *Theba pisana*). Some species may also spread pathogens to plants, animals, and humans (*e.g. Achatina fulica*) (see section 1.6.5).

3.4 Risk of negative impacts on biodiversity in Norway from terrestrial gastropods which are relevant for trade

We have based our selection of species included in this risk assessment on either that the Norwegian Environment Agency has received an application for their import, or that the species is relevant for trade and keeping in Norway, as assessed by the hearing expert. Of 116 species on the initial list, 83 of were deemed to be very unlikely to establish populations in Norway, either now or in a 50-year perspective. Thirty-three species from the initial list have a geographical distribution in the wild that suggests that they have the potential to establish and spread under Norwegian climates, now or in a 50-year perspective, or that they are included on the list of the top 100 worst invasive alien species in the world. These species were subject to a full risk assessment. We found that 18 species posed "Low risk" to Norwegian biodiversity, and of these 18 "Low risk" species, four of the assessments were considered to have "Low" uncertainty and 14 "Medium" uncertainty. None had "High" uncertainty. Ten species were designated as being of "Moderate risk", with eight species considered to have "Medium" uncertainty, one to have "Low" uncertainty and one to have "High" uncertainty. One species was considered to be of "High risk" with "Medium" uncertainty. In addition, for four species insufficient information was found to perform a risk assessment. Risk summaries for all 33 species that were subject to the full risk assessment are listed in Table 3.4.-1.

Table 3.4-1. Conclusions from the assessment of risk to Norwegian biodiversity with uncertainty. NA = A risk assessment was not performed due to lack of information. The full risk assessments can be found in Appendix II.

Species name	Risk	Uncertainty
Achatina fulica	moderate	low
Anguispira alternata	moderate	medium
Anguispira strongylodes	moderate	high
Camaena cicatricosa	moderate	medium
Cantareus apertus	moderate	medium
Caucasotachea calligera	low	medium
Caucasotachea vindobonensis	low	medium
Eobania vermiculata	moderate	medium
Euglandina rosea	moderate	medium
Euhadra amaliae	NA	
Helix albescens	low	medium
Helix aspersa	high	medium
Helix lucorom	moderate	medium
Helix lutescens	low	medium
Helix melanostoma	NA	
Helix philibinensis	NA	
Helix secernenda	low	low
Hemicycla sp.	low	low
Laevicaulis alte	low	medium
Leptaxis undata	low	medium
Loxana vondeli	low	medium
Marmorana sp.	low	medium
Neohelix albolabris	low	medium
Otala lactea	low	low
Otala punctata	low	low
Paropeas achatinaceum	low	medium
Rumina decollata	moderate	medium
Rumina saharica	low	medium
Subulina octona	low	medium
Theba pisana	moderate	medium
Tingitana shioum	NA	
Veronicella sloanii	low	medium
Zonites algirus	low	medium

3.5 Important parameters for future assessments

3.5.1 Ranked summary of biotic and abiotic factors

The main abiotic factor limiting the establishment of alien gastropods in Norway is climatic conditions. Although many gastropods can hibernate during cold periods, such adaptations are most prominent in species that occasionally experience cold conditions. In general, sub-zero temperatures and cold winters impede the establishment of populations of many of the species that are assessed here. Precipitation and air humidity are also important factors that limit the possibility of establishment for many species, particularly slugs. Many slugs are nocturnal as an adaptation to avoid desiccation. Snails need calcareous soils as they require calcium to develop their shells and many species cannot thrive in acidic conditions.

The main biotic factors determining whether a terrestrial gastropod species will establish and spread in Norway are the species reproductive system (hermaphrodites pose a special risk), fecundity (many small eggs pose a greater risk than few or large eggs, due to the risk of unintentional deposition). Another important biotic factor that can influence both biodiversity and humans (including their livestock) is the species ability to serve as a host for gastropod-borne pathogens and parasites.

3.5.2 Intra taxa differences

Gastropod taxonomy is, in general, poorly understood and, historically it has been based on shell morphology. Recent reassessments of several groups have revealed that numerous snails that were previously given distinct species names are, in fact, the same species but with contrasting shell morphology or found at different locations. Studies have shown that these intraspecific differences might stem from both environmental and genetic factors (Wolda, 1969). We have however, not found studies presenting intraspecific differences in biological traits that are relevant for this risk assessment.

3.5.3 Assessment of the quality of available literature

The scientific literature on gastropods is extensive, due to the huge number of species that exist and that they are easy to rear for laboratory studies. Many species are also large and conspicuous, making them attractive for naturalists. However, there are surprisingly few studies that focus on those factors that limit the distribution of a particular species. Several invasive gastropods have been studied in more detail, and for these we have been able to find relevant studies on environmental impact, mostly in relation to agriculture. We have therefore obtained information on species distributions, reproduction, and climate tolerance from sources other than scientific publications, such as online databases and various web sites (see section 2.2.2).

4 Precautionary measures

The species addressed in this risk assessment are all kept as pets and the risk of specimens escaping from captivity will always exist. Adult individuals range in size from about 1 cm for the small species, and up to 20 cm for the larger ones, so for some species, even adult individuals have the potential to escape. The main threat, as assessed by the project group, is the potential for unintended entry into nature when the terraria are cleaned, as small eggs may easily be overlooked and deposited as waste, compost, or directly into nature. Sanitizing deposits from the terraria (*e.g.*, through baking the earth in the oven) before disposal has the potential to reduce this risk greatly.

Information regarding the potential threat associated with deliberate release could reduce the risk of this occurring. In the legal pet trade, traders actively inform their customers on responsible keeping of pets, including information about the consequences of releasing non-native organisms to natural ecosystems. Licenced pet traders in Norway regularly run campaigns on various aspects of responsible keeping of the animals that they trade in, including background information on which species are legal and why.

If gastropods are released, management campaigns are required to limit the risk of further spread. Collection and destruction of the snails and their eggs can be effective. Physical barriers that prevent movement of snails, including the use of a strip of bare soil around the crop, a screen fence, or even an electric fence made from wire mesh (*e.g.*, GISD, 2017), can contribute to containment. A number of natural or artificial molluscicidal chemicals are also available. Lastly, various biological control agents are available, such as the use of nematodes (see section 1.5.5 on Pathogens).

A note of caution is recommended regarding gastropod-borne pathogens, as various gastropods could be hosts for serious zoonotic pathogens like *Angiostrongylus cantonensis* and *Listeria monocytogenes* (see section 1.5.5). As pathogens can be transmitted through faeces and slime, information concerning precautionary measures, such as hand sanitation, should be distributed to owners to reduce the risk to human health.

5 Uncertainties

5.1 Taxonomical and nomenclatural uncertainties

There are two parallel, but closely connected, problems regarding taxonomic and nomenclatural uncertainties. The first concerns the lack of modern taxonomic revision – How many species are there? Which are only morphological or colour variants? Which characteristics can be used to distinguish species? The second deals with nomenclature. Many names are synonyms (different names given to the same species), mostly due to old descriptions being based only on shell characteristics, or on material collected in geographically distant areas. A minor problem is homonymy (the same name given by different authors for different species). Stable taxonomy and nomenclature are essential for understanding biological diversity, conservation work, and identification of problems with invasive species.

Two examples of this problem can be seen in gastropod families with species that are kept as terrarium pets worldwide:

i) The family Subulinidae comprises many genera and species in the tropics and subtropics. There has been no proper taxonomic revision of the family, and the delineations between the genera and species are far from clear. There are also several nomenclatural problems and uncertainties for some taxa. Several species have been spread worldwide by humans, mainly by trade with plants. *Subulina octona* is perhaps the most common species offered for sale online. There are, however, good reasons to believe that more than one species is offered for sale under this name, as it belongs to a large and unresolved species complex, in addition to there being morphologically similar genera.

ii) The family Achatinidae comprises species from tropical and subtropical areas of Africa. The largest of all land snail species are found in this family: *Achatina fulica* may reach a height of almost 20 cm. They have become the most popular of all land snails kept as pets. There are numerous names for species, subspecies, and varieties used in the extensive texts in pamphlets, brochures, popular books, and net pages. As with the Subulinidae, the use of the names is highly variable, and in many cases, incorrect. There is an urgent need for a modern revision, concerning both taxonomy and nomenclature of the entire family. With the help of humans, *A. fulica* has been spread worldwide to areas with suitable climates, and may occur as a severe pest. It is listed among the 100 worst invasive species in the world.

5.2 Uncertainties relating to climatic tolerance and niche

Climate influences the distribution of most species, and is an integral factor when we assess the likelihood of establishment and spread of alien species in Norway. Nevertheless, it should be highlighted that the exact climatic tolerance for most of the gastropods that we have assessed is poorly known. Based on the distribution of species and biomes on Earth, there is little, if any, overlap between species in tropical and subtropical regions, and species at high latitudes, such as Norway. Because of this, it is fair to assume that tropical and subtropical species will not be able to establish and spread in Norway. Such gastropod species have not been subject to a full risk assessment in the current report. For temperate species, however, assumptions on survival in Norway need better justifications. These species have therefore been subject to a full risk assessment, based on the similarities between climate conditions in the species' native range and the climate of Norway, now or in a 50-year perspective.

Some gastropod species with a native distribution in tropical or subtropical regions have established reproducing populations in the artificially heated environments of greenhouses, including in Scandinavia. For the species that we have assessed, this is especially true for species belonging to the family Subulinidae. However, it seems highly improbable that they would be able to establish populations outside artificially heated environments, even in the case of the most pessimistic of projected climate changes.

With respect to the task of evaluating the effects of climate change over the next 50 years, several factors create uncertainties in climate projections based on different CO_2-increase scenarios. First, there is a lack of knowledge about the sensitivity of the climate system on Earth. Second, the general circulation models used to model future climates have limitations (ICPP 2013). Projections that follow scenarios with a low CO_2 emissions, such as RCP4.5, are, in general, more certain than projections that follow scenarios with a high CO_2 emissions, such as RCP8.5. Also, the upper boundary of the climate projections is beset with larger uncertainties than the lower boundary. In attempting to cancel out uncertainties in the general circulation models, many researchers have chosen to base climate projections on an ensemble of models. VKM has adopted projections made by the Norwegian Centre for Climate Services (*Norsk klimaservicesenter*) that are based on an ensemble of ten different climate models (Hanssen-Bauer et al., 2015)

The projected annual mean temperature for Norway in 2067 under scenario RCP8.5 is 3.3 °C with an upper boundary (90th percentile) of 4.6 °C and a lower boundary (10th percentile) of 2.8 °C (Hanssen-Bauer et al., 2015). Under RCP2.5, the projected temperature is 2.2 °C with an upper boundary (90th percentile) of 3.2 °C and a lower boundary (10th percentile) of 1.6 °C. The uncertainties of the modelled winter- and summer temperatures are similar to the uncertainties for annual temperature.

5.3 Uncertainties relating to the species general biology

In addition to climate, several abiotic and biotic factors determine the habitat selection, natural distribution, and ability to spread to and colonize new areas for any particular species. Access to calcium is an important factor for all gastropod species with shells. Land snails can take up calcium in two ways: 1. through absorption through the sole directly from different substrates (calcareous bedrock or soil, bones, shells of other snails, concrete, bricks etc.); 2. with food (decaying leaves from deciduous trees in the ground litter – different tree species produce leaves with different degrees of available calcium). Most areas or habitats in Norway do not have extensive calcareous rock and therefore are not very suitable for land snails with high calcium demands, such as the species with large shells addressed here.

Many species of land snail are food generalists, feeding on dead or living plant tissues. Some species may have more specific demands, but in most cases, this is poorly described. It seems probable that species living in areas with, and feeding on, different species within the same plant genera present in Europe (*e.g.*, North America) may establish here more readily and switch their diet to other plants within the genus (*cf.* climate section above).

Generally, species that are ecologically less specialized with respect to environmental factors (climate, calcium, and food) have wider distributions – and should be able to colonize new areas more easily. Also, many species with a high tolerance to human impact in the habitats and the ability to live in man-made habitats, easily colonize such habitats in other parts of the world with similar climates (*e.g.* several European slug species in North America).

6 Conclusions

Several species of terrestrial gastropods are considered invasive and cause negative impacts on biodiversity worldwide. Nine non-native terrestrial gastropods have already established in Norway, and *A. vulgaris,* in particular, is considered as highly invasive. Humans are a major cause of the spread of non-native gastropods. A risk assessment of new species relevant for import to Norway is therefore timely and important. Specific traits that make terrestrial gastropods more likely to establish populations in Norway include hermaphroditism, self-fertilizing, and high fecundity, and the possibility to disperse over long distances using birds as vectors (see sections 3.2, 3.3, and 3.5.1).

In total, 116 species of terrestrial gastropods were identified as being available for trade and relevant for domestic (hobby-based) keeping in Norway (see section 3.1). In the initial screening phase, we found that the risk of negative impacts on biodiversity in Norway stemming from the import of terrestrial gastropods for private keeping was "Very unlikely" for 83 species. Establishment of these 83 species in Norway was assessed as being very unlikely since the climate of Norway is too cold now and will still be too cold within 50 years, compared with the climate of the native range of these species (see section 1.6 on potential for future establishment). We conclude that these 83 species (listed in Table 3.1.1-1) pose minimal threat to Norwegian biodiversity due to their low establishment potential.

Species with a geographical distribution in the wild that suggests they might be able to establish and spread under Norwegian climates now or in a 50-year perspective (31 species), or they are on the list of the top 100 worst invasive alien species in the world (two species), were subject to a full risk assessment. These have the potential to have a negative impact on Norwegian biodiversity. There were 33 species in this category. Of these 33 species, we did not find sufficient information to perform a full risk assessment for five species, namely *Helix melanostoma*, *Helix philibinensis*, *Euhadra amaliae*, *Anguispira strongylodes,* and *Tingitana shioum*. Nineteen of the species are associated with a low risk, while ten species are associated with a moderate risk (*Achatina fulica*, *Anguispira alternata*, *Anguispira strongylodes*, *Camaena cicatricosa, Cantareus apertus*, *Eobania vermiculata*, *Euglandina rosea*, *Helix lucorum, Rumina decollata* and *Theba pisana*). The present climate of Norway is likely too cold for the establishment and spread of the species associated with a moderate risk (except the *Anguispira* species), however these species will probably be able to establish in Norway within a few years or in a 50-year perspective, given warmer climates. *A. fulica* may be an exception since it requires even warmer conditions than are likely to occur in Norway within 50 years. This species was assessed as having moderate risk because of its extensive invasive history elsewhere in the world and potential for massive impact on Norwegian biodiversity, in the very unlikely scenario tah it should be established. The expected impact on biodiversity in Norway from the species associated with moderate risk are species-dependent and varies from little know effects to negative effects on native vegetation, effects on native populations of gastropods and pathogens that can infect

various native animals. There is also a risk of damages to crops and gardens, in addition to risk of spreading parasites that can infect humans.

We assess that *Helix aspersa* is associated with a high risk. *H. aspersa* is native to the Mediterranean and has established populations under a wide range of conditions worldwide, including under climate conditions deviating from that occurring in its native range, including sub-zero temperatures. The species is seen as a major garden and agricultural pest in many areas where it has been introduced, and also act as a host for unwanted parasites.

Terrestrial gastropods can act as vectors for a wide range of parasites and pathogens (see section 1.6.5 on pathogens). However, as the majority of the most common species of terrestrial gastropod available for trade for domestic use are captive bred (see Appendix III), the risk to human health associated with import of terrestrial gastropods should be low, especially if appropriate precautionary measures are taken (see section 4 on precautionary measures).

This risk assessment should be considered in the light of how many individuals of each species are likely to enter Norway through the route considered here (only private import for hobby-based keeping in terraria). There are about 500 persons that practice this hobby in Norway, and many of them only keep a few (<5) individuals of one to a few species. However, the biotic and abiotic factors that determine the potential for a terrestrial gastropods species to become a pest are also relevant for snails and slugs that enter the country through other means, like hitchhikers on imported plants and soil. In the opinion of the Panel such events have much greater potential for resulting in entry of invasive gastropods that can establish and spread in Norway.

7 Data gaps

The availability of data on terrestrial gastropod species is highly variable. Some species are extensively studied, whereas for others there is little, if any, available data. General data gaps include:

- Taxonomic revision and nomenclature. This is covered under section 5.1.
- Species-specific temperature tolerance data, and especially lower tolerance limits. This is covered under section 5.2.
- Various mechanisms for dispersal, including hitchhiking on birds and spread by humans.
- We lack detailed knowledge of species distribution for some of the taxa assessed in this report.
- Knowledge on the ecological impact of terrestrial gastropods.
- Knowledge on the pathogens spread by snails, both regarding the species of. gastropods and the species of pathogens (see also section 1.6.5 on pathogens).
- Knowledge on the impacts of the pathogens spread by snails, including impacts on ecosystems and human health.

8 Additional information

8.1 Ecosystem services

Alien species may have a negative effect on ecosystem services, without affecting Norwegian biodiversity. These negative effects could include detrimental impacts on plants and crops in greenhouses, given that the species thrives under these conditions and has an invasive nature (*i.e.*, high fecundity, and small, elusive eggs).

Some gastropods, like the Iberian slug *A. vulgaris,* have also been shown to impact significantly on the recreational use of home gardens, thus negatively affecting this ecosystem service.

Gastropods are important herbivores and fungivores in many ecosystems, and most species feed on a range of different plants, fungi, algae and lichens. Gastropods are also important detritivores, thus contributing significantly to nutrient cycling. Major changes in the diversity and abundance in the gastropod fauna in a given area due to invasive species may thus also have cascading effects on nutrient cycling.

However, as these species do not pose a direct threat to Norwegian biodiversity, these potential effects on ecosystem services have not been taken into account during the risk assessment.

8.2 Negative impacts on biodiversity of the exporting countries

None of the species that have been assessed in this project are listed in CITES. Of the about 90.000 species of gastropods (Bouchet and Rocroj, 2005, Aktipis et al., 2008), only two genera are listed as in Appendix I (*Achatinella* and *Polymita*), while two species (*Strombus gigas* and *Papustyla pulcherrima*) are listed in Appendix II of CITES. No gastropod species are listed in Appendix III.

Regardless of CITES status, many species of gastropods may be harvested at an unsustainable rate in the exporting countries. This may be especially the case for species that are hard to breed in captivity, like *Helicophanta* species from Madagascar and *Edentulina obesa* from Cameroon (See Expert opinion in Appendix III here).

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Appendix I

Modifications made to the GB-NNRA protocol for risk assessment of terrestrial gastropods intended for private keeping in terraria.

The unaltered version of the EU NON-NATIVE SPECIES RISK ANALYSIS – RISK ASSESSMENT TEMPLATE V1.0 (27-04-15) can be found here:
http://www.nonnativespecies.org/index.cfm?pageid=143

Specific changes made to the original version of the GB-NNRA questionnaire:

EU chappeau: Removed entirely as our focal area is solely Norway.

Section A: Removed entirely; we have developed a tailored initial screening procedure for our purpose.

Section B: Several aspects are deleted, others are subject to minor alterationsm, and some are merged to better fit the purpose. In all instances "Europe" is changed to "Norway". We have removed all questions related to economic impact as none of the species have documented invasion histories in areas with climate conditions resembling Norway. For the sections "Probability of spread" and "Probability of impact" the questions have been rephrased in an attempt to improve the language and to increase precision, and to make them better suited for this particular type of risk assessment. The scale of responses here is also changed and now follows the scale used in most of the questions under "Probability of entry" and "Probability of establishment". The scale of "Uncertainty" is reduced to three levels: "low", "medium" and "high" as the information available on the species we assessed is too course to allow for a finer scale of uncertainty. See list of detailed alterations below.

Probability of entry
1.1. Pathways removed since the assessment is restricted to gastropods in private holding in terraria.

1.2. Removed since the assessment is restricted to gastropods in terraria.

1.3. Removed, the pathway is always intentional.

1.4. Slightly altered (now numbered 1.1).

1.5. Removed since survival is depending on environmental conditions and treated under Probability of Establishment.

1.6. Removed since the assessment is restricted to gastropods in terraria.

1.7. Removed, the pathway is always intentional.

1.8. Removed since the assessment is restricted to gastropods in terraria and may escape or be released at any time of the year.

1.9. Altered to transfer from the pathway to Norwegian nature (now numbered 1.2).

1.10. Removed, the pathway is always intentional.

1.11. Altered to entry into Norwegian nature (now numbered 1.3).

Probability of establishment

1.12. As is (now numbered 2.1).

1.13. As is (now numbered 2.2).

1.14. As is (now numbered 2.3).

1.15. As is (now numbered 2.4).

1.16. Removed, none of the species assessed require particular host organisms.

1.17, 1.18, 1.19, 1.21. Merged (now numbered 2.5).

1.20. Removed.

1.22, 1.23 Merged (now numbered 2.6).

1.24. Removed.

1.25. As is (now numbered 2.7)

1.26. As is (now numbered 2.8).

1.27. Removed.

1.28. As is (now numbered 2.9).

Probability of spread

2.1. As is (now numbered 3.1).

2.2. As is (now numbered 3.2).

2.3. Re-phrased (now numbered 3.3).

2.4. As is (now numbered 3.4).

2.5. Removed. None of the species assessed has established in Norway.

2.6. Removed. None of the species assessed has established in Norway.

2.7. Removed. None of the species assessed has established in Norway.

2.8. Removed. None of the species assessed has established in Norway.

2.9. As is (now numbered 3.5).

Probability of impact

2.10. Deleted. Not possible to assess economic impact based on the limited information available.

2.11. Removed. Not possible to assess economic impact based on the limited information available.

2.12. Removed. Not possible to assess economic impact based on the limited information available.

2.13. Removed. Not possible to assess economic impact based on the limited information available.

2.14. Removed. Not possible to assess economic impact based on the limited information available.

2.15. Rephrased (now numbered 4.1).

2.16. Removed. None of the species is currently established in Norway.

2.17. Removed. None of the species is currently established in Norway.

2.18. Removed. None of the species is currently established in Norway.

2.19. Removed. None of the species is currently established in Norway.

2.20. Removed. None of the species is currently established in Norway.

2.21. Removed. None of the species is currently established in Norway.

2.22. Rephrased (here numbered 4.2).
2.23. Removed. Potential impact on human health is covered in the risk analyses under question number 4.3.
2.24. As is (now numbered 4.3).
2.25. Rephrased (now numbered 4.4).
2.26. As is (here numbered 4.5).

2.27. Rephrased (here numbered 4.6)

Additional number 4.7 with summary of impact: Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).

Additional questions – climate change
3.1 As is, but added that we are assessing a 50-year perspective (now numbered 5.1).
3.2 Removed. The focal perspective is 50-years.

3.3 As is, but added a list of aspects to be assessed is added, namely: establishment, spread, impact on biodiversity, and impact on ecosystem functions (here numbered 5.2).

Additional questions – Research
Removed.

Risk summaries
Unchanged.

Appendix II

Detailed assessments of the probability of entry, establishment and spread and the risk of impact of selected gastropod species

Species: *Achatina fulica* (Ferussac, 1821)

English common name: Giant African snail

Synonyms: *Lissachatina fulica* (Bowdich)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	moderately likely	medium	Escape or release from captivity as egg or small specimen. Lays up to 1200 eggs per year.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	Escape or release as egg or small specimen
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Very unlikely	medium	*A. fulica* is native to East Africa and has been introduced to several countries by humans. Some authors claim the species also is found in temperate habitats, having adapted to cooler climates (up to 40 degrees North), while modelling state it will not spread north of

			Florida and requires a minimum of 34° C. It is presently not found north of Florida in North America
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	Very unlikely	low	It is tolerant of a wide variety of environmental conditions and is closely associated with tropical and subtropical moist broadleaf- and tropical and subtropical dry broadleaf forest. It requires areas rich in calcium. *A. fulica* occurs in a large number of countries around the world, but all of the countries in which it is established have tropical climates with warm, mild year-round temperatures and high humidity
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	Moderately likely	medium	The conditions may be within the tolerance in warm Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	very isolated	low	Need warm areas
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	Moderately likely	low	The species is spreading in various regions and only intensive and expensive eradication campaigns has to some extent stopped the spread
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	very likely	low	The species has a great reproductive potential since it lays many eggs. It is hermaphroditic and one individual may in theory start a new population. Also, transferred sperm can be stored within the body for up to two years; these snails can lay eggs over a period of several

			months after only one mating.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	very likely	low	Two individuals of the snail were brought to India from Mauritius. From these two individual snails, the species spread throughout much of South Asia
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	unlikely	low	Internationally, it is the most frequently occurring invasive species of snail. All of the countries in which it is established have tropical climates with warm, mild year-round temperatures and high humidity.
2.9. Estimate the overall likelihood of establishment in Norway	Very unlikely	low	The species is invasive, but the climate is likely too cold in Norway now and within 50 years.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	Moderately likely	medium	Snails are slow moving, in general reducing their capacity to spread. However, the species is spreading where it has been introduced.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	very likely	low	Most dispersal of *L. fulica* has occurred accidentally, with all developmental stages becoming attached to machinery (*e.g.*, road construction, landscaping, agricultural machinery and vehicles) and are readily transported in garden waste
3.3. How likely is it that spread of the organism within Norway can be completely contained?	unlikely	medium	The species is spreading and can occur in high density, however, it is likely too cold in Norway
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	

3.5. Estimate the overall potential for future spread for this organism in Norway	very unlikely	low	Too few potential habitats in Norway

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • The section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (*i.e.* past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	massive	low	Due to damage on agriculture, the IUCN has placed *Achatina fulica* on the list of the top 100 worst invasive alien species in the world. It is known to eat at least 500 different types of plants, including peanuts, beans, cucumber, peas and melons. If fruits and vegetables are not available, the snails will eat a wide variety of ornamental plants, tree bark, and even paint and stucco on houses. It breeds rapidly, out-competes native species of snails and reaches large numbers in short periods due to their prolific breeding habits.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	major	low	*A. fulica* may spread *Angiostrongylus cantonensis* (rat lungworm in humans that causes eosinophilic meningoencephalitis) *Angiostrongylus*

			costaricensis (causes abdominal angiostrongyliasis) *Schistosoma mansoni* (causes schistosomiasis). Damage may be caused by the spread of disease through the transmission of plant pathogens. It distributes in its faeces spores of *Phytophthora palmivora* (cause of black pod disease of cacao; the oomycete which also infects black pepper, coconut, papaya and vanilla. *A. fulica* spreads *P. colocasiae* in taro and *P. parasitica* in aubergine and tangerine. Specimen should not be handled with bare hands (see also section 15.5.5 on pathogens)
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	medium	high	Other parasites of unknown threat to biodiversity: *Aelurostrongylus abstrusus*, *Trichuris* spp. *Hymenolepis* spp. Strongyloides spp
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	major	high	There is no good evidence that biological control agents can control *A. fulica*
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Irrigated agricultural areas in the warmest parts of southern Norway	medium	

4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	massive	low	A wide variety of horticulture and medicinal plants are known to be attacked by this snail, thereby decreasing resources for humans, animals and other species. It also spread pathogens to plants, animal and humans. It is placed on the on the list of the top 100 worst invasive alien species in the world by the IUCN.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming and precipitation	medium	Southern Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Achatina fulica*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Very unlikely	low	The species is invasive, but the climate is likely too cold in Norway now and within 50 years
Summarise Spread	Very unlikely	low	Internationally, it is the most frequently occurring invasive species of snail, however, there are too few or no potential habitats in Norway.
Summarise Impact	massive	low	A wide variety of plants are known to be attacked by this snail, thereby decreasing

			resources for humans, animals and other species. It also spread pathogens to plants, animal and humans. It is placed on the on the list of the top 100 worst invasive alien species in the world by the IUCN.
Conclusion of the risk assessment	moderate	low	*A. fulica* will likely not be able to complete a life cycle in Norway now or in 50 years. However, the species poses a massive risk should it establish.

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Species: *Anguispira alternata* (Say, 1816)

English common name: The flamed disc or Flamed tigersnail

Synonym: *Pyramidula alternate*

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	Escape or released from captivity as egg or small specimen. Lays up to 40 eggs per year.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	Escape or release as egg or small specimen
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Very likely	low	*A. alternata* is native to the Nearctic region north to southern Canada. It is a temperate climate species, although it can tolerate temperatures as low as -14°C. It requires exposure to low temperatures before it will reproduce, indicating that reproduction is linked to the end of hibernation at the end of colder winter months and that survival in Norway in very likely
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	Very likely	low	*A. alternata* is found in a variety of habitats, including forests, weedy roadsides, along railroads and well as gardens or vacant lots in urban areas. It is commonly found around trees and rocks in wooded areas.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	Very likely	medium	It thrives in conditions similar to that of protected conditions.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	Widespread	low	
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	Moderately likely	medium	
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	very likely	low	*A. alternata* is hermaphroditic, and in theory one specimen is enough to start a new colony

2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	unlikly	medium	We have found no reports that the species is invasive. It has declined during the last 30-40 years in some parts on North America
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	likely	medium	The environmental conditions in southern Norway are similar to the conditions in its native area. However, the species does not seem to be invasive elsewhere.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread)	unlikely	medium	Snails are slow moving, in general reducing their capacity to spread.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	Moderately likely	medium	Snails are known to hitchhike on goods
3.3. How likely is it that spread of the organism within Norway can be completely contained?	unlikely	high	
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Calcareous areas in mid- to southern Norway	medium	It has been suggested that the observed decline in the species is caused by acidification, suggesting it needs non-acidic or calcareous soils
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	Moderately likely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT

Important instructions:

- When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.

QUESTION	RESPONSE	UNCERTAINTY	COMMENTS
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	low	medium	*A. alternata* feeds on decaying plant material and fungi. Since they are often found in trees, they also likely graze on bark-dwelling algae. We have not found documentation stating it provides harm
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	major	low	It may serve as intermediate hosts for *Parelaphostrongylus tenuis* (Nematoda) and *Postharmostomum helicis* (Trematoda) where small mammals are the main host (see also section 1.6.5 on Pathogens)
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	major	high	Specific predators are not known for this species, but in general, land snails are preyed on by lampyrid beetle larvae or other insects, birds, rodents, and small mammals, particularly voles and shrews.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Areas with calcareous soils	medium	

4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minor	medium	No negative impact is found in its native area. However, potential impacts in Norway are not known, *e.g.* competitions or herbivory on local species

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	It may thrive in mid- and southern Norway now and also in northern Norway in a warmer future
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Anguispira alternata*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	likely	low	The environmental conditions in southern Norway, and especially on non-acidic and calcareous soils, are similar to the conditions in its native area. *A. alternata* is terrestrial and found in a variety of habitats. It hibernates during winters.
Summarise Spread	moderately likely	low	The species is not invasive elsewhere. It has declined abundance in some parts of its native area, most likely because of acidification. The environmental conditions in a large part of Norway is similar to the conditions in its native area.
Summarise Impact	minor	medium	No negative impact is found in its native area. However, potential

			impacts in Norway are not known, *e.g.* competitions or herbivory on local species
Conclusion of the risk assessment	moderate	medium	*A. alternata* can most likely establish in some Norwegian areas. No negative impact is found in its native area, however, potential impacts in Norway are not known

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Species: *Anguispira strongylodes* (L. Pfeiffer, 1854)

English common name: Southeastern Tigersnail

Synonyms (according to Turgeon, 1998): *Anguispira strongyloides* (Pfeiffer, 1854), *Anguispira alternata strongylodes*, *A. a. crassa*, *A. a. macneilli*, *A. crassa*, *A. macneilli*, *Helix strongyloides*, *Pyramidula alternata rarinotata*.

A. strongylodes has been reported in 15 USA states in the southeast from east Texas to northern Florida, north to Illinois and Virginia. In Tennessee, *A. strongylodes* has been found in close association with limestone and neutral soils in wet areas, very steep slopes and high elevations and late-successional forests, particularly oak-cedar forests (Coney et al, 1982). The species is in trade.

We have not found sufficient information on the species to perform a full risk assessment. However, according to molecular and morphological characteristics, Clutts (2008) found a large overlap among several species of *Anguispira*. There is an extreme variation in shell characteristics among intra- and inter-specific populations within *Anguispira* (Clutts, 2008; Hubricht, 1985), and no clear distinction could be made between *A. strongylodes* and *A. alternata* in color patterns that supposedly distinguish these species (Clutts, 2008), which may suggest that *A. strongylodes* should be synonymized with *A. alternata*. The two species also overlap in distribution. Until further studies have been performed on the ecology and taxonomy of *Anguispira* and *A. strongylodes*, we suggest that the risk assessment for *A. strongylodes* adheres to the risk assessment for *A. alternata*, however, the uncertainty should be high. Conclusion of the risk assessment for *A. strongylodes* is Medium risk with a high uncertainty.

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Species: *Cantareus apertus* (Born, 1778)

English common name: Green garden snail

Synonyms: *Helix aperta* (Born, 1778), *Helix naticoïdes* (Draparnaud, 1801), *Helix tapada* (Hartmann, 1821), *Helix tupada* (Hartmann, 1821)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	large	Escape or released from captivity as egg or small specimen. It has been introduced several places and it is edible, but not used on a large scale.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. Lays eggs in soil. Its medium size (shell diameter up to 28mm) and invasive history suggest it is capable of passive spread.
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Moderately likely	medium	The species is native to the Mediterranean coast (Europe and north Africa). It has been introduced, and established, in New Zealand and Australia. However only under frost-free conditions.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity	unlikely	medium	Prefer coastal areas with maritime influence. It thrives in habitats influenced by human

between other abiotic conditions in Norway and the organism's current distribution?			activities.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	Moderately likely	medium	It is a generalist herbivore and thrive in agricultural areas, suggesting the potential for establishment in protected conditions. There is however, no records of greenhouse invasions.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need frost-free conditions, i.e. areas warmer than what is currently experienced in Norway.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	medium	The species is medium sized and easy to detect. It is seen as a plant pest suggesting that it can be hard to contain if it establish a population.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	Its invasion history suggest that it only established under frost-free conditions and that it has not adapted to cold conditions, *e.g.* north of the Alps.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	Moderately likely	medium	It has been introduced several places around the world, but only under frost-free conditions.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Moderately likely	medium	The climate is too cold in Norway now, but in a 50-year perspective, areas with frost-free conditions might become suitable.

PROBABILITY OF SPREAD
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.

QUESTION	RESPONSE	UNCERTAINTY	COMMENT
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snail are slow at migrating, and the species is medium sized, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Snails are generally known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and relatively easy to detect. Due to its climatic requirements, the areas of potential establishment and spread is currently non-existent.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	In its native area, it thrives in a Mediterranean climate. All areas where it has successfully established are also frost-free. In a 50-year perspective, coastal areas of southern Norway might become frost-free and could therefore provide suitable conditions for establishment and spread.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT

Important instructions:

- When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- The questions start with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.

QUESTION	RESPONSE	UNCERTAINTY	COMMENTS
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	moderate	medium	In New Zealand and Australia, it is seen as a pest species with negative effects on both agriculture and native vegetation.
4.2. How much impact would there	NA	medium	Not known, but there are

be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	NA	high	No information available
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	Its distribution is temperature- limited and the potential for establishment and potential impact is depending on frost-free conditions. In a 50-years perspective frost-free conditions might occur in Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	Moderate	medium	

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	If frost-free winters become common the species might be able to establish and spread.
5.2. What aspects of the risk assessment are most likely to	Establishment	high	

change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	and spread.		

RISK SUMMARIES for *Cantareus apertus*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Moderately likely	medium	The climate is too cold in Norway now, but in a 50-year perspective, this might change.
Summarise Spread	unlikely	medium	
Summarise Impact	moderate	medium	In New Zealand and Australia, it is seen as a pest species with negative effects on both agriculture and native vegetation.
Conclusion of the risk assessment	moderate	medium	

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Species: *Camaena cicatricosa* (Müller, 1774)

English common name: Scarred Camaena

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your	unlikely	medium	*C. cicatricosa* is in trade, but not in large numbers. It may escape or be released from captivity as egg or small

comment discuss how likely the organism is to get onto the pathway in the first place			specimen. Lays up to 25 eggs per clutch.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	unlikely	medium	It is a tropical and sub-tropical species, suggesting that the climate in Norway is too cold
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	Need warm and wet conditions. It is an omnivore
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	medium	Conditions will be more suitable for the species
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	very isolated	high	
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	high	The species is locally found in high densities in a variety of habitats, suggesting that eradication is difficult
2.6. How likely are the biological characteristics (including			Not known

adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?			
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	unlikely	high	No information suggests that it is invasive
2.9. Estimate the overall likelihood of establishment in Norway	unlikely	medium	

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	low	Snails are slow moving, in general reducing their capacity to spread. It is a large-sized species, suggesting that hitchhiking by adults is unlikely
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	medium	It can disperse active (self–initiated) and passively (hitchhiking). It can be transported for private keeping
3.3. How likely is it that spread of the organism within Norway can be completely contained?	unlikely	high	
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and wet areas in south western Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway

separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	major	low	The camaenids mainly feed on green plants and humus, and often harm a large number of crops, landscape plants and forest, leading to a depression in yield and a reduction in quality.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	major	low	Can spread zoonotic food borne parasitic disease, the rat lung worm in humans (*Angiostrongylus cantonensis*) and potentially have a major impact on human and animal health (see also section 1.6.5 on pathogens). Specimen should not be handled with bare hands
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	major	high	
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Warm and wet areas in south western Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other	major	low	Can cause a depression in yield and a reduction in crop quality. Can spread the rat lung worm in

organisms, such as predators, parasites or pathogens that may already be present).			humans (*Angiostrongylus cantonensis)* and potentially cause damage to human and animal health

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Camaena cicatricosa*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	medium	Likely too cold in Norway
Summarise Spread	unlikely	medium	Potential habitats are too scattered
Summarise Impact	major	low	Can cause a depression in yield and a reduction in crop quality. Can spread the rat lung worm in humans (*Angiostrongylus cantonensis)* and potentially cause damage to human and animal health
Conclusion of the risk assessment	moderate	medium	It is most likely too cold in Norway, but the species can potentially have impact if it establishes in Norway

References

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Species: *Caucasotachea calligera* (Dubois de Montpéreux, 1840)

Synonyms: *Helix (Tachea) atrolabiata* (Frankenberger, 1919); *Tachea argonautarum* (Roszkowski, 1919); *Caucasotachea atrolabiata* (Krynicki, 1833); *Caucasotachea lencoranea* (Mousson, 1863); *Helix calligera* (Dubois de Montpéreux, 1840)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals •			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	high	Escape or released from captivity as egg or small specimen. Traded as a pet online.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	high	Eggs of most Helicidae are laid in the soil and can therefore easily be disposed unintentionally. Detailed information on egg laying habits and size/number of eggs of this species is not known. Shell diameter up to 35mm.

1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Unlikely	Medium	The species is native to Georgia and northern parts of Turkey where it occurs from the coast of the Black sea up to mountains reaching several thousand meters. However, the temperate continental climate zone, the only climate zone occurring both in Norway and in Georgia, is not included in the species distribution map provided by Mumladze (2014). Annual mean temperature seems to be a driver for its distribution.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	Need calcareous bedrock. Prefer southern slopes suggesting temperature sensitivity
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	The conditions may be within the tolerance in Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition	unlikely	medium	The species is large and easy to detect. In its native range, it co-occur with other species of similar size, suggesting

from existing species or predators, parasites or pathogens in Norway?			competitive abilities towards other coexisting species (Mumladse 2014).
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	high	Breeding system is unknown; there is lack of information on number and size of eggs, effects of inbreeding and self-fertilization capacity.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	medium	The species has not spread from its native distribution.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Moderately likely	medium	The climate is likely too cold in Norway now, but may be within the tolerance of the species within 50 years.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	very unlikely	medium	Snail are slow at migrating, and the species is large, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Some snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is large and appears not to occur in high densities in it native range.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	It prefer south facing slopes in its native area

3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	low	The species seems not to have any strong impact on the ecosystem in its native range.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today. It also occur in sympatry with closely related species within its native range.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	medium	The species seems not to have any strong impact on the ecosystem in its native range. No history of invasions elsewhere.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	It's distribution is temperature limited and the potential for establishment and potential impact is confined to the warmer parts of Southern Norway

			and maybe the Trøndelag region.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	low	The species seems not to have any strong impact on the ecosystem in its native range. No history of invasions elsewhere.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and maybe spread.	high	

RISK SUMMARIES for *Caucasotachea calligera*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Moderately likely	medium	The climate is currently too cold in Norway now, but may be within the tolerance of the species within 50 years.
Summarise Spread	unlikely	medium	
Summarise Impact	minimal	medium	The species seems to have a minimal impact on the ecosystem in its native range. No history of invasions elsewhere.
Conclusion of the risk assessment	low	medium	

References

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http://www.ruthenica.com/documents/Continental_Russian_molluscs_ver2-3.pdf

Mumladze, Levan (2014), 'Sympatry without co-occurrence: exploring the pattern of distribution of two Helix species in Georgia using an ecological niche modelling approach', Journal of Molluscan Studies, 80 (3), 249-55.

Species: *Cepaea vindobonensis* (Férussac, 1821; Pfeiffer, 1828)

Synonyms: *Helix vindobonensis* (Pfeiffer, 1828), *Helix (Tachea) vindobonensis var. Balcanica* (Kobelt, 1903)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	Moderately likely	low	Currently in trade and can possibly enter trade in Norway. It is listed as "easy to care for" on the www.myhappysnails.com webpage. Escape or released from captivity as egg or small specimen. Lays up to 50 eggs per clutch (year?).
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	unlikely	medium	Escape or release as egg or small specimens (shell diameter up to 21mm)
1.3. Estimate the overall	unlikely	medium	

likelihood of entry into Norwegian nature.			

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Unlikely	Medium	The species is southeast Europe and Asia, from Caucasus to Poland. It is thermophilic, inhabiting usually open warm shrub vegetation, preferably on sheltered southwards exposed slopes and valleys. Towards its northern distributional limit (Poland) it prefers south-facing exposed valley slopes. Climate conditions are currently too cold in Norway for the species to establish. In a 50-year perspective this might change.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	low	Prefer southern slopes suggesting temperature sensitivity.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	The conditions may be within the tolerance in Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	unlikely	low	The species is medium sized, conspicuous and easy to detect. In its native range, it co-occurs with other species of similar size, suggesting competitive abilities towards

			other existing species
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	In its native range is seems to have stable population sizes. Its reproductive capacity coupled with life expectancy seems to suggest that it has limited capacity of rapid population increase (Staikou 1998). There is lack of information on effects of inbreeding and self-fertilization capacity.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	low	Despite its relatively wide distribution, there is no documentation of the species spreading from its native distribution.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	unlikely	medium	The climate is likely too cold in Norway now, but may be within the tolerance of the species within 50 years.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	very unlikely	medium	Snail are slow at migrating, and the species is medium sized, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Some snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and conspicuous. IN its native range it can occur in high densities (*e.g.* in Hungary), but

			towards its climate tolerance limit high population densities are not expected.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	It prefer south facing slopes in its native area
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	very unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	low	The species seems not to have any strong impact on the ecosystem in its native range.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today. It also occur in sympatry with closely related species within its native range.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	Moderate	medium	The species has been shown to be able to act as intermediate host for parasitic nematodes (Elaphostrongylus, Muellerius, Protostrongylids) (Panayotova-Pencheva 2011, Georgiev 2003)
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any	minimal	medium	The species seems not to have any strong impact on

natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?			the ecosystem in its native range. No history of invasions elsewhere.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	It's distribution is temperature limited and the potential for establishment and potential impact is confined to the warmer parts of Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minor	low	The species seems not to have any strong impact on the ecosystem in its native range, but can act as host for unwanted parasites

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and maybe spread.	high	

RISK SUMMARIES for *Cepaea vindobonensis*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	medium	The climate is currently too cold in Norway now, but may be within the tolerance of the species within 50 years.
Summarise Spread	very unlikely	low	There is no history of invasions elsewhere.
Summarise Impact	minor	low	The species seems not to have

			any strong impact on the ecosystem in its native range, but can act as host for unwanted parasites
Conclusion of the risk assessment	low	medium	

References

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http://www.iucnredlist.org/details/156371/0

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Panayotova-Pencheva, M. (2011), 'ROLE OF SOME SNAILS SPECIES DISTRIBUTED IN BULGARIA AS INTERMEDIATE HOSTS OF SMALL LUNGWORMS (NEMATODA: PROTOSTRONGYLIDAE)', Comptes Rendus De L Academie Bulgare Des Sciences, 64 (3), 389-94.

, 1821) in northern Greece', Journal of Molluscan Studies, 64, 297-308., 1821) in northern Greece', Journal of Molluscan Studies, 64, 297-308.

Species: *Eobania vermiculata* (O. F. Müller, 1774)

English common name: Chocolate-band snail

Synonyms: *Helix vermiculata.* The taxon has been assigned numerous names. See http://www.bagniliggia.it/WMSD/HtmSpecies/4541350005.htm, for a list of synonyms (20 additional).

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of	unlikely	low	Has been introduced several places and it is edible. Commercial production in

origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place			Greece. Escape or released from captivity as egg or small specimen. Lays up to 70 eggs per year.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs *e.g.* while cleaning terraria. Its medium size (shell diameter up to 32mm) and invasive history suggest it is capable of passive spread.
1.3. Estimate the overall likelihood of entry into Norwegian nature.	Moderately likely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Moderately likely	medium	The species is native to the Mediterranean coast (Europe and north Africa). It has been introduced, and established, in Belgium, Germany, Hungary, the Netherlands, the USA, Japan, South Africa, Egypt, Israel, Saudi Arabia, Jordan, Iran and Australia (although the populations in Australia seems to have gone extinct). A recent detection of established populations in Belgium and the Netherlands (and a single specimen found in London in 2006) suggest that it is capable of surviving winters colder than in it native range.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	likely	medium	Prefer coastal areas with maritime influence. It thrives in habitats influenced by human activities, including agricultural areas.
2.3. How likely is it that the organism will become established in protected conditions (in which the	likely	medium	It is a generalist herbivore and thrive in agricultural areas, suggesting the potential for

environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions			establishment in protected conditions. There is however, no records of greenhouse invasions.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	medium	It has established populations under climate conditions colder than experienced in its native range. However, it's most northern population is in the Netherlands where winter temperatures are warmer than what is currently experienced in Norway. In a 50-year perspective this might change.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	Moderately likely	medium	The species is medium sized and easy to detect. It is seen as a plant pest suggesting that it can be hard to contain if it establish a population. The populations previously recorded in Australia appears however, to have gone extinct.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	Its invasion history suggest that it only established under warmer conditions and that it has not adapted to cold conditions, i.e. north of the Netherlands
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations. The species is hermaphroditic and can establish a population from a single individual.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	Moderately likely	medium	It has been introduced several places around the world, but only under climate conditions warmer than what is found in Norway today.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Moderately likely	medium	The climate is too cold in Norway now, but in a 50-year perspective, areas with frost-free conditions might become

			suitable.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	Moderately likely	medium	Snail are slow at migrating, and the species is medium sized.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Its invasion history suggests that hitchhiking by adults is possible; *e.g.* the population in Belgium, most likely arriving with marine cargo. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	Although the species has a history of invasions around the world, its medium size makes it relatively easy to detect. Due to its climatic requirements, the areas of potential establishment and spread are currently non-existent in Norway.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	In its native area, it thrives in a Mediterranean climate. All areas where it has successfully established are also warmer than Norway. In a 50 year perspective coastal areas of southern Norway might become frost-free and could therefore provide suitable conditions for establishment and spread.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	Moderately likely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken

into account. This is done in later questions at the end of the assessment.
- Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.

QUESTION	RESPONSE	UNCERTAINTY	COMMENTS
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	moderate	low	In other parts of the world where it has established it is seen as a pest species with negative effects on both agriculture and wild vegetation.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	major	medium	
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	medium	Its distribution is temperature limited and the potential for establishment and potential impact is depending on warmer conditions than what is found in Norway today. In a 50-years perspective, climate conditions might become favorable in Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway	major	medium	In other parts of the world where it has established it is seen as a pest species

(despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).			with negative effects on both agriculture and wild vegetation.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	If temperatures increase in Norway the species might be able to establish and spread.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread.	high	

RISK SUMMARIES for *Eobania vermiculata*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	Moderately likely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Moderately likely	medium	The climate is too cold in Norway now, but in a 50-year perspective, this might change.
Summarise Spread	Moderately likely	medium	It is able to spread passively by hitchhiking
Summarise Impact	major	medium	In other parts of the world where it has established it is seen as a pest species with negative effects on both agriculture and wild vegetation.
Conclusion of the risk assessment	moderate	medium	

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Species: *Euglandina rosea* (Férussac 1821)

English common name: Rosy wolfsnail oer Cannibal snail

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	high	Escape or release from captivity as egg or small specimen. Several sources state it lays 30-40 eggs per year and one source that is can lay 600 per year.
1.2. How likely is the organism to be able to transfer from captivity	moderately likely	medium	Escape as egg or small specimen

to a suitable habitat or host in Norwegian nature?			
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	unlikely	medium	*E. rosea* is native to southeastern United States and temperatures are likely too cold in Norway now. However, it has been known to go into hibernation during winter months and emerge in April/May, suggesting that it possibly may be able to survive in Norway in a few scattered areas within 50 years.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	moderately likely	low	*E. rosea* can be found in warm habitats in natural forests, planted forests, ruderal/ disturbed, scrub/ shrublands and urban areas
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	The conditions may be within the tolerance in warm Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	medium	Need warm areas
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	very likely	low	The species is spreading in various countries, despite intensive eradication campaigns
2.6. How likely are the biological characteristics (including	very likely	low	It was deliberately spread as a biological control agent. Once

adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?			established, natural spread is the main means of spread. It spread across the island of Moorea at the rate of about 1.2 km per year. The snail is a hermaphrodite, and in theory one individual can start a new population.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	likely	low	The species is currently spreading where it has been introduced (Pacific Island and Pacific Rim groups, Indian Ocean islands and the Caribbean). It has also been introduced into India, Taiwan and Japan
2.9. Estimate the overall likelihood of establishment in Norway	unlikely	medium	The species is invasive, but the climate is likely too cold in Norway now. It can go into hibernation during winters and emerge in April/ May, suggesting that it is uncertain whether it can survive in Norway within 50 years.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	unlikely	medium	Snail are slow at migrating, and the species is large, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	Moderately likely	medium	It can disperse active (self–initiated) and passively (hitchhiking). It can be transported for private keeping and with goods.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	unlikely	medium	The species is spreading and can occur in high density, however, it is likely too cold in

			Norway
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway	very unlikely	low	Too few potential habitats in Norway

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	massive	low	This species is a fast and voracious predator, hunting and eating other snails and slugs. It has caused caused decline and extinctions in native snail populations where it has been introduced. Due to this, the IUCN has placed *E. rosea* on the list of the top 100 worst invasive alien species in the world.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	major	low	
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms,	major	high	May be predated by rats and possibly limit the feral spread of the snail.

such as predators, parasites or pathogens that may already be present in Norway?			
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Irrigated agricultural areas in the warmest parts of southern Norway	medium	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	massive	low	This species is a fast and voracious predator, hunting and eating other snails and slugs**.** It has caused caused decline and extinctions in native snail populations where it has been introduced. Due to this, the IUCN has placed *E. rosea* on the list of the top 100 worst invasive alien species in the world.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	Southern Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Euglandina rosea*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	Moderately likely	high	Need to escape from captivity or be released intentional or unintentional. Large clutch size
Summarise Establishment	unlikely	medium	The species is invasive, but the climate is likely too cold in Norway now. It can go into

			hibernation during winters and emerge in April/ May, suggesting it is not impossible that it can survive in Norway within 50 years.
Summarise Spread	very unlikely	low	Too few potential habitats in Norway now
Summarise Impact	massive	low	This species is a fast and voracious predator, hunting and eating other snails and slugs**.** It has caused caused decline and extinctions in native snail populations where it has been introduced. Due to this, the IUCN has placed *E. rosea* on the list of the top 100 worst invasive alien species in the world.
Conclusion of the risk assessment	moderate	medium	Most likely, *E. rosea* will not be able to complete a life cycle in Norway now or in 50 years. However, the species can hibernate during winter and we have not found research on survival at temperatures similar to Norway. Given the massive risk since the species is one of the 100 worst invasive alien species in the world, we conclude with moderate risk.

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Species *Euhadra amaliae* (Kobelt, 1875)

This is an arboreal/ deciduous tree-dwelling species endemic to Japan. The adult shell size is approximately 3cm. The species is in trade, however, we have not found sufficient information on the species to perform a full risk assessment.

Species: *Helix albescens* (Rossmässler, 1839)

Synonyms: *Helix vulgaris* (Rossmässler, 1839), *Helix vulgaris kubanensis* (W. Kobelt, 1906), *Helix vulgaris roseni* (W. Kobelt, 1906), *Helix intermissa* (C.A. Westerlund, 1897), *Helix obtusalis* (J.R. Bourguignat, 1860), *Helix obtusalis bicincta* (W. Kobelt, 1877), *Helix obtusata* (E.A. Rossmässler, 1837), *Helix obtusata balionis* (O. von Retowski, 1889),

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
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QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the	unlikely	medium	The species is edible and traded as food. Due to its size, it might also appear attractive as a pet. Escape or released from captivity as egg or small specimen. Lays up to 25 eggs per clutch.

first place			
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. Shell diameter up to 38mm)
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	likely	high	It is native to the area surrounding the Black Sea. IUCN reports that its current distribution is in Ukraine, as far inland as Kiev. Kramarenko and Leonov (2011) on the other hand, suggest it is only found in the coastal regions of the Black Sea and the Sea of Azov, while AnimalBase states that it is no longer found in Bulgaria. Depending on the geographic range of its native area it might occur in areas with climate conditions resembling what is found in Norway today.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	Moderately likely	medium	Its preferred habitats are lowland walls, ruins, gardens and parks.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	medium	Although IUCN states that the species is not in trade, several web pages have the species for sale as food. It should therefore be possible for it to thrive in artificial conditions.
2.4. How widespread are habitats or	isolated	medium	It thrives in human-modified

species necessary for the survival, development and multiplication of the organism in Norway?			habitats, such as gardens and parks. These habitats occur in Norway, but are not wide-spread
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	unlikely	medium	The species is medium sized and easy to detect. It also appears to have a fragmented population structure in its native range due to local populations going extinct
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	There are no records of the species establishing beyond its native range.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	unlikely	medium	There are no records of establishment outside its native range.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	unlikely	high	Although the species might live under climate conditions similar to what is found in some parts of Norway, there are no records of establishment outside its native range

PROBABILITY OF SPREAD

Important notes:

- Spread is defined as the expansion of the geographical distribution of an alien species within an area.

QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	high	Snail are slow at migrating, and the species is medium sized. Hitchhiking by adults might still be possible, but no information exists on this.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	unlikely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be

(Please list and comment on the mechanisms for human-assisted spread.)			transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and relatively easy to detect. In its native range sub-populations have been reported to go locally extinct.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Calcareous, densely populated areas in southern Norway	low	In its native area, it thrives in human modified habitats.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT

Important instructions:

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- Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.

QUESTION	RESPONSE	UNCERTAINTY	COMMENTS
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	medium	No records of negative impact
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available, suggesting that the species have limited impact on the ecosystem in its native range
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any	minimal	high	No information available, but due to the lack of

natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?			information on impacts in its native range and that it has not established beyond its native range, its potential impact appears to be limited
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	medium	Although its native range might hold climates similar to what can be found in Norway it most likely needs calcareous soils
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	Minimal	high	No information available, suggesting that the species have limited impact on the ecosystem in its native range

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Temperature and precipitation	low	Climate tolerance unclear, but "optimal" conditions for reproductions is said to be 25°C and 100% air humidity.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment	high	

RISK SUMMARIES for *Helix albescens*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	high	Might be able to establish under Norwegian conditions, but its climate requirements are unclear
Summarise Spread	unlikely	medium	
Summarise Impact	Minimal	high	No information available, suggesting that the species have

			limited impact on the ecosystem in its native range
Conclusion of the risk assessment	low	medium	There are no records of the species establishing populations outside its native range.

References

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http://www.animalbase.uni-goettingen.de/zooweb/servlet/AnimalBase/home/species?id=3570

Species: *Helix aspersa* (O.F. Müller, 1774)

English common name: Brown Garden Snail

Synonyms: *Cornu aspersum* (O.F. Müller, 1774). See also: http://www.bagniliggia.it/WMSD/HtmSpecies/4540000005.htm for an extensive list of synonyms.

SECTION B – Detailed assessment			
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QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	The species is edible and traded as food. Due to its large size, it is attractive as a pet. Escape or released from captivity as egg or small specimen. Lays up to 80 eggs per clutch and up to 6 clutches per year.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning

Norwegian nature?			terraria. Shell diameter up to 40mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	Moderately likely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	likely	low	It is native to the Mediterranean, but has established populations throughout the world also under climate conditions deviating from what is found in its native range. It can survive sub-zero temperatures, but is appears that winter temperatures are limiting its current distribution.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	likely	medium	It thrives in shrubs, forest, agricultural fields, gardens and parks, and prefer areas where it can seek shelter from predators. It is not as dependant on calcareous soils as *e.g. Helix pomatia.*
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	low	It can thrive in human modified areas.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	medium	It thrives in shrubs, light forest as well as agricultural fields, gardens and parks, habitats that are not widespread in Norway.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators,	likely	medium	The species is large and easy to detect, but has established, in many parts of the world where it has been introduced.

parasites or pathogens in Norway?			
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	likely	medium	
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	likely	medium	The species is seen as a garden and agricultural pest in many areas where it has been introduced and seems to be able to establish under wide range of conditions.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	likely	medium	

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	Moderately likely	medium	Snail are slow at migrating. Its invasion history suggests it is able to spread.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	likely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	unlikely	medium	The species is large and relatively easy to detect. Its invasion history suggests it is able to spread.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Calcareous, areas southern Norway	low	In its native area, it thrives in human modified habitats and its Mediterranean origin suggests that the warmer, southern parts of Norway is most susceptible

			for an invasion.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	likely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	major	low	It has an extensive invasion history with major impact in certain areas.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	minor	medium	It can act as a host for several parasites, *e.g.* the cat lungworm *Aelurostrongylus abstrusus* affects the domestic cat and other felids worldwide.
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA		
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	major	medium	It has an extensive invasion history with major impact in certain areas.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The southern, warmer parts of Norway	low	It can survive sub-zero temperatures, but its Mediterranean origin suggests that the warmer, southern parts of Norway is most susceptible for an invasion.

4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	major	medium	

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Temperature and maybe precipitation	low	Increased temperatures in might facilitate the probability for successful establishment in Norway.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment	high	

RISK SUMMARIES for *Helix aspersa*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	Unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	likely	medium	Most likely able to establish under Norwegian climate conditions
Summarise Spread	likely	medium	
Summarise Impact	major	medium	It has an extensive invasion history with major impact in certain areas. It is also host for unwanted parasites
Conclusion of the risk assessment	high	medium	Its climate tolerance and invasion history suggest that it can become a problem if introduced to Norway

References

http://www.bagniliggia.it/WMSD/HtmSpecies/4540000005.htm

https://snegler.wordpress.com/ikke-tropiske-snegler/helix-aspersa/

http://www.molluscs.at/gastropoda/terrestrial.html

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Bezemer, T. M.; Knight, K. J. (2001). "Unpredictable responses of garden snail *Helix aspersa* populations to climate change". Acta Oecologica. 22: 201–208. doi:10.1016/s1146-609x(01)01116-x.

Species: *Helix lucorum* (Linnaeus, 1758)

English common name: Turkish snail

Synonyms: *Helix (Helix) anaphora* (Westerlund, 1889), *Helix (Helix) annosa* (Mascarini, 1892), *Helix (Helix) atrocincta* (Bourguignat, 1883), *Helix (Helix) candida* (Mascarini, 1892), *Helix (Helix) elongata* (Bourguignat, 1860), *Helix (Helix) nigrozonata* (Bourguignat, 1883), *Helix (Helix) presbensis* (Kobelt, 1905), *Helix (Helix) rypara* (Bourguignat, 1883), *Helix (Helix) straminea* (Briganti, 1825), *Helix (Helix) straminiformis* (Bourguignat, 1876), *Helix (Helix) virago* (Bourguignat, 1883), *Helix (Helix) yleobia* (Bourguignat, 1883), *Helix (Pomatia) dorylaensis* (Naegele, 1903)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	likely	high	The species is edible and traded as food. Due to its large size, it is attractive as a pet. It is collected in the wild and not reared. Escape or released from captivity as egg or small specimen. We have not found information on number of eggs.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning

Norwegian nature?			terraria. Shell diameter up to 60mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	Moderately likely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	likely	low	It is native to the eastern Mediterranean and the Black Sea region but has established populations as far north as Paris, France, in Austria, south of Vienna and in the Czech Republic in Prague. It has spread and established populations throughout Europe under climate conditions deviating from what is found in its native range. It can survive sub-zero temperatures.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	likely	medium	It thrives in shrubs, light forest as well as agricultural fields, gardens and parks, habitats
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	low	It can thrive in human modified areas.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	medium	It thrives in shrubs, light forest as well as agricultural fields, gardens and parks, habitats that are not widespread in Norway.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition	likely	high	The species is large and easy to detect, but has established, throughout continental Europe. No records of eradication

from existing species or predators, parasites or pathogens in Norway?			campaigns.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	likely	medium	
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	likely	medium	It can tolerate sub-zero temperatures and is currently spreading northwards in Europe.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	likely	medium	

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	Moderately likely	medium	Snail are slow at migrating. Its invasion history suggests it is able to spread.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	likely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	unlikely	medium	The species is medium sized and relatively easy to detect. Its invasion history suggests it is able to spread.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Calcareous, areas southern Norway	low	In its native area, it thrives in human modified habitats and its Mediterranean origin suggests that the warmer, southern parts of Norway are most susceptible

			for invasion.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	likely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minor	high	It is spreading northwards in Europe, but its impact is unclear
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	minimal	high	Not known
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA		
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minor	high	Although it is spreading northwards the extent of impact is unclear.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	It can survive sub-zero temperatures, but its Mediterranean origin suggests that the warmer, southern parts of Norway is most susceptible for an invasion.
4.7. Estimate the expected impacts of the organism if it is able to	minor	high	It is spreading northwards in Europe, but the impact

establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).			is not yet clear.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Temperature and maybe precipitation	low	Increased temperatures in might facilitate the probability for successful establishment in Norway.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment	high	

RISK SUMMARIES for *Helix lucorum*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	likely	medium	Most likely able to establish under Norwegian climate conditions
Summarise Spread	likely	medium	
Summarise Impact	minor	high	It is spreading northwards in Europe, but the impact is not yet clear
Conclusion of the risk assessment	moderate	medium	Its climate tolerance suggest that it might establish in Norway, but whether it can become a problem is unclear

References

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Helix lutescens (Rossmässler 1837)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	The species is edible and is most likely picked together with *Helix pomatia*. It is however, not traded as food. Due to its size, it might be attractive as a pet. Escape or released from captivity as egg or small specimen. Lays up to 50 eggs per year.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. Shell diameter up to 37mm.
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in	unlikely	low	It is native to Eastern Europe with main distribution in Hungary, Slovakia, Serbia and Poland. It is also known from

Norway and the organism's current distribution?			Romania (Transylvania), Moldavia and Ukraine. It is confined to lowlands suggesting that its distribution is temperature limited. Its continental distribution also suggest that it prefer drier areas than most of Norway.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	It thrives in dry and sunny slopes in lower altitudes.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	low	It can thrive in human modified areas and is often found in gardens and cemeteries, suggesting that it thrives in habitats with strong human influence.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	medium	
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	unlikely	medium	The species is medium sized and to detect. There are no records of invasions beyond its native range.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the	unlikely	low	There are no records of invasions elsewhere.

instances in the comments box.)			
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	unlikely	medium	

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snail are slow at migrating. Its lack of invasion history suggests it has limited ability to spread.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	Moderately likely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	high	The species is medium sized and relatively easy to detect. Its invasion history suggests it has limited ability to spread.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Calcareous, areas southern Norway	low	In its native area, it thrives in human modified habitats and its continental origin suggests that the drier, warmer, southern parts of Norway is most susceptible for an invasion.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm	minimal	low	It is spreading northwards

is caused by the organism within its existing geographic range, excluding Norway?			in Europe, but its impact is unclear
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	minimal	high	Not known
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA		
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	high	No records of environmental impact
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	high	There is limited information available on impact, which may suggest that the impact is negligible. However, the impact is still unclear.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Temperature and maybe precipitation	low	Increased temperatures in might facilitate the probability for successful establishment in Norway.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment	Establishment	high	

• Spread • Impact on biodiversity • Impact on ecosystem functions			

RISK SUMMARIES for *Helix lutescens*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	medium	Unable to establish under current Norwegian climate conditions
Summarise Spread	unlikely	medium	
Summarise Impact	minimal	high	There is limited information available on impact, which may suggest that the impact is negligible. However, the impact is still unclear
Conclusion of the risk assessment	low	medium	Its current distribution suggest that its spread is temperature limited. In a 50-year perspective this might change

References

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http://www.animalbase.uni-goettingen.de/zooweb/servlet/AnimalBase/home/species?id=1607

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Species: *Helix melanostoma* (Draparnaud, 1801)

This is a Mediterranean species found both in Europe and in North Africa. The adult shell size can exceed 35mm. Extent of trade is unclear, but it seems that shells can be bought online. We have not found sufficient information on the species to perform a full risk assessment.

Species: *Helix philibinensis* (Rossmässler, 1839)

This is a Mediterranean species found in Greece and Bulgaria. There are also records from Albania and Italy. The adult shell size can exceed 33mm. It inhabits rocky habitats in mountains. Extent of trade is unclear, but it seems that shells can be bought online. We have not found sufficient information on the species to perform a full risk assessment.

Reference

http://www.iucnredlist.org/details/156305/0

Species: *Helix secernenda* (Rossmässler, 1847)

Synonyms: *Helix albanica* (Wohlberedt, 1907), *Helix bicincta* (Kobelt, 1906), *Helix dimidiata* (Kobelt, 1906), *Helix edlaueri* (Urbanski, 1970), *Helix kormosi* (Kobelt, 1906), *Helix montenegrina* (Wohlberedt, 1901), *Helix njegusensis* (Kobelt, 1906), *Helix pomatiaeformis* (Kobelt, 1906), *Helix subalbescens* (Kobelt 1906), *Helix subligata* (Kobelt, 1906), *Helix subobtusata* (Kobelt, 1906)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	high	Due to its size, it might be attractive as a pet. Escape or released from captivity as egg or small specimen. Number of clutches and eggs per year is unknown.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	unlikely	low	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. Shell diameter up to 60mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	low	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**

2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Very unlikely	low	It is native to the Balkan area; Istrian Peninsula, along the Dalmatian coastal area (Croatia and Montenegro), Albania and western Macedonia to Epirus, Korfu Island and the Ossa Mountains (Greece) suggesting that its distribution is temperature limited. Its distribution also suggest that it prefer drier areas than most of Norway.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	Very unlikely	medium	It thrives in rocky, Mediterranean habitats, but also in streamside vegetation.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	na	high	No records of populations establishing in protected conditions.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	Very isolated	low	Most likely non-existent
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	Very unlikely	medium	The species is medium sized and to detect. There are no records of invasions beyond its native range.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	na	high	No information available
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.

2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	Very unlikely	low	There are no records of invasions elsewhere.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Very unlikely	medium	

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snail are slow at migrating. Its lack of invasion history suggests it has limited ability to spread.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	Moderately likely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	high	The species is medium sized and relatively easy to detect. Its invasion history suggests it has limited ability to spread.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Calcareous, rocky areas southern Norway	low	In its native area, it thrives in rocky habitats and its Mediterranean origin suggests that the drier, warmer, southern parts of Norway is most susceptible for an invasion.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	unlikely	low	

PROBABILITY OF ENVIRONMENTAL IMPACT
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future

impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	low	There are no records of environmental impact in areas where it currently occur
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	na	high	Not known
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA		
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	low	No records of environmental impact
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	low	No records of environmental impact

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Temperature and maybe precipitation	low	Increased temperatures in might facilitate the probability for successful establishment in Norway.

5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment	high	

RISK SUMMARIES for *Helix secernenda*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	low	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	low	Unable to establish under current Norwegian climate conditions
Summarise Spread	unlikely	low	No records of the species spreading beyond its native range
Summarise Impact	minimal	low	There are no records of environmental impact in areas where it currently occurs
Conclusion of the risk assessment	low	low	Its current distribution suggest that its spread is temperature limited. In a 50-year perspective this might change

References

http://www.iucnredlist.org/details/156514/0

Species (genus): *Hemicycla sp.* (Swainson, 1840)

Hemicycla is a genus of medium sized land snails endemic to the Canary Islands, counting 40 species according to IUCN. Bank and Neubert (2017) list 47 species and subspecies, revealing an unclear taxonomy within this genus. However, all species have very limited distribution, confined to a single island (except *H. sarcostoma* that is widespread on Fuerteventura, Lobos, Lanzarote, La Graciosa and Montana Clara), suggesting strict habitat requirements. *H. hedybia* is, according to the IUCN distribution map, distributed throughout the Canary Islands, but the map is based on a single observation by Mabille in 1882. Some of the species have overlapping distributions. The genus is probably prone to taxonomic uncertainties as several species have been described back in the 19th century, but never seen again. Of the 40 IUCN listed species, 14 are data deficient and only 9 are categorized

as least concern. More details on the distribution and threats to the particular species can be found on the IUCN redlist web page.

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	Most of the species in this genus are rare and the potential for extensive trade of live animals is limited. However, some of the species are in trade. Escape or released from captivity as egg or small specimen. Information on number of eggs/clutches per year is lacking. However, since their populations are small and generally confined to small areas, their reproductive capacity is most likely limited.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	unlikely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria.
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Very unlikely	low	The species in this genus are endemic to the Canary Island. Although the Teide mountain on Tenerife reaches 3718 m.a.s.l. and has an alpine climate, none of the species are found at high altitudes.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in	Very unlikely	low	The Canary Islands are young, volcanic islands consequently having different bedrock compared to Norway. Bedrock

Norway and the organism's current distribution?			and climate defines the vegetation, resulting in environmental conditions very different from what is found in Norway
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	The conditions may be within the tolerance in Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway. In their native range, they have small and isolated distributions, suggesting strict habitat requirements.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	unlikely	low	All species in this genus are medium sized, conspicuous and easy to detect.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	Very unlikely	medium	None of the species has been extensively studied, but they all have small and confined distributions, suggesting limited capacity of spread.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	low	The species have narrow distributions and there is no documentation that any of them have spread.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Very unlikely	low	Abiotic conditions in their native range is very different from what is found in Norway.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	very unlikely	medium	Snail are slow at migrating, and the species is medium sized, suggesting that hitchhiking by adults is unlikely. The small and confined distributions of the species in their native range also suggest limited spreading capacities.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Some snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species are medium sized and conspicuous.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm areas in southern Norway	low	Climate currently lo cold in Norway
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	very unlikely	low	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	low	
4.2. How much impact would there be, if genetic traits of the organism			Not known, but there are no likely candidates for

were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			hybridization in the Norwegian fauna today. It also occur in sympatry with closely related species within its native range, though degree of interbreeding is unknown.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	minimal	medium	Their small and isolated populations seem not to have any environmental impact
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	low	The species seem not to have any strong impact on the ecosystem in their native range. No history of invasions elsewhere.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	Their distributions are strongly limited and the potential for establishment and potential impact is confined to the warmer parts of Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	low	The species seem not to have any strong impact on the ecosystem in their native range. No history of invasions elsewhere.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment	Establishment and maybe	high	

• Spread • Impact on biodiversity • Impact on ecosystem functions	spread.		

RISK SUMMARIES for *Hemicycla sp.*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Very unlikely	low	The climate is currently too cold in Norway. All species seem to have strong environmental requirements, limiting the potential for establishing beyond their native range
Summarise Spread	very unlikely	low	No history of invasions elsewhere
Summarise Impact	minimal	low	The species seem not to have any strong impact on the ecosystem in their native range.
Conclusion of the risk assessment	low	low	

References

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Castro, J. M., et al. (2012), 'Hemicycla (Hemicycla) fuenterroquensis (Gastropoda: Helicoidea: Helicidae), a new species from La Palma, Canary Islands', *Zootaxa,* (3527), 72-78.

Alonso, M. R. and Ibanez, M. (2007), 'Anatomy and function of the penial twin papillae system of the Helicinae (Gastropoda : Helicoidea : Helicidae) and description of two new, small Hemicycla species from the laurel forest of the Canary Islands', *Zootaxa,* (1482), 1-23.

Neiber, M. T., et al. (2011), 'Hemicycla (Adiverticula) diegoi (Gastropoda: Pulmonata: Helicidae), a new species from Tenerife, Canary Islands, with a phylogenetic analysis of conchologically similar species in the genus Hemicycla Swainson, 1840', *Zootaxa,* (2757), 29-46.

Ibáñez, Miguel, et al. (1997), 'Distribution of land snails (Mollusca, Gastropoda, Pulmonata) on the island of Gran Canaria (Canary Islands) in relation to protected natural areas', Biodiversity & Conservation, 6 (4), 627-32.

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Bank & Neubert (2017) Checklist of the land and freshwater Gastropoda of Europe. http://www.marinespecies.org/aphia.php?p=sourceget&id=279050

Species: *Laevicaulis alte* (Férussac, 1822)

English name: Tropical leatherleaf

Synonyms: *Vaginula alte* Férussac, 1821; *Vaginulus alte* Férussac, 1821; *Vaginula leydigi* Simroth, 1889

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	*L. alte* is in trade, but not in large numbers. It may escape or be released from captivity as egg or small specimen in order to enter Norwegian nature. It lays up to 100 eggs per clutch.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Very unlikely	medium	*L. alte* is African in origin and has been introduced to warm areas of southern Asia, Australia and many Pacific Islands
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in	Very unlikely	medium	

Norway and the organism's current distribution?			
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	The conditions may be within the tolerance in Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	very isolated	medium	
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	moderately likely	high	
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	Very likely	medium	The species is invasive and is spreading elsewhere. It is an omnivore and have a short generation time. It can store transferred sperm within the body for long periods after only one mating. Also, is a protandric hermaphrodite i.e.; they change sex from male to female during their lifetime.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	likely	low	Invasive elsewhere.
2.9. Estimate the overall likelihood of establishment in Norway	Very unlikely	medium	The species is invasive and is spreading elsewhere, however climates in Norway are likely too cold.

PROBABILITY OF SPREAD
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within

an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	unlikely	medium	Snails are slow moving, in general reducing their capacity to spread. The species is large sized (8 cm long), suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	medium	It can disperse active (self–initiated) and passively (hitchhiking). It can be transported for private keeping and with goods.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	moderately likely	high	
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm areas in southern Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	moderate	low	It is considered a pest species and consumes vegetable crops, fruits and weeds
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g.	major	low	This species is an intermediate host for *Angiostrongylus cantonensis*, the rat lung

diseases)?			parasite of humans. Specimen should not be handled with bare hands (see also section 1.6.5 on pathogens).
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	moderate	high	
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	warmest areas in south Norway	low	Agricultural areas are most vulnerable
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	moderate	low	*Laevicaulis alte* consumes vegetable crops, fruits and weeds and is considered a pest species. It is also an intermediate host for *Angiostrongylus cantonensis*, the rat lung parasite of humans.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Laevicaulis alte*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**

Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Very unlikely	medium	The species is invasive and is spreading elsewhere, however climates in Norway are likely too cold
Summarise Spread	low	high	
Summarise Impact	moderate	low	*Laevicaulis alte* consumes vegetable crops, fruits and weeds and is considered a pest species. It is also an intermediate host for *Angiostrongylus cantonensis*, the rat lung parasite of humans
Conclusion of the risk assessment	low	medium	It is most likely too cold in Norway now and within 50 years, but the species can potentially have a major impact if spread to Norway

References

Cowie 1997; Cowie et al. 2008; Cowie et al. 2009; Naggs et al. 2003; Solem 1964; Thome 1989

Badal Das, Lucky Parida (2015). Morphometric studies of the tropical leatherleaf slug Laevicaulis alte from prachi belt of Odisha. Journal of Entomology and Zoology Studies 2015; 3 (3): 132-134

Barker, G.M. 1979. 411-437. The introduced slugs of New Zealand. New Zealand Journal of Zoology. 6:3 1979

Species: *Leptaxis undata* (Lowe, 1831)

Synonyms: *Helix undata*

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**

	[chose one entry, delete all others]	[chose one entry, delete all others]	
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	Unlikely	high	Currently in trade in Norway and is very easy to hold. Escape or released from captivity as egg or small specimen. Detailed information on egg laying habits and size/number of eggs of this species in particular is not known.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	high	There is potential for unintentional disposal of eggs juveniles, *e.g.* while cleaning terraria. Shell diameter up to 30mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	moderately likely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Unlikely	Medium	The species is native to Madeira, and amateur web pages states that they need temperatures in the range of 16-30°C to survive.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	Need calcareous bedrock to produce its thick shell.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not	unlikely	medium	The conditions may be within the tolerance in Greenhouses, however, we have found no records of its presence in greenhouses

considered protected conditions			
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	unlikely	medium	The species is medium sized and easy to detect, at least as adults.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	high	It's a highly omnivorous species eating both plants and other snails. It is also fast reproducing.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	medium	The species has not spread from its native distribution.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	unlikely	medium	The climate is likely too cold in Norway even within a 50-year perspective.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snail are slow and although this species is said to be relatively fast moving. The species is medium sized (up to 30mm in diameter), suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted	unlikely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting

spread.)			materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and therefore easy to detect.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	very unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	low	
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			No information available
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	NA	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	NA	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	medium	The species seems not to have any strong impact on the ecosystem in its native range. No history of invasions elsewhere.
4.6. Indicate any parts of Norway	Warm and	low	It's distribution is

where environmental impacts are particularly likely to occur (provide as much detail as possible).	calcareous areas in southern Norway		temperature limited and the potential for establishment and potential impact is confined to the warmer parts of Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	medium	The species seems not to have any strong impact on the ecosystem in its native range.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and maybe spread.	high	

RISK SUMMARIES for *Leptaxis undata*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	medium	The climate is currently too cold in Norway now, but may be within the tolerance of the species within 50 years
Summarise Spread	very unlikely	low	No history of invasions elsewhere
Summarise Impact	minimal	medium	The species seems not to have any strong impact on the ecosystem in its native range
Conclusion of the risk assessment	low	medium	

References

Cameron, R. A. D. and Cook, L. M. (1989), 'Shell size and shape in Madeiran land snails: do niches remain unfilled?', *Biological Journal of the Linnean Society,* 36 (1-2), 79-96.

Koene, J. M. and Muratov, I. V. (2004), 'Revision of the reproductive morphology of three Leptaxis species (Gastropoda, Pulmonata, Hygromiidae) and its implication on dart evolution', *Malacologia,* 46 (1), 73-78.

https://snegler.wordpress.com/ikke-tropiske-snegler/leptaxis-undata/

Species: *Loxana vondeli* (Pallary, 1928)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	Unlikely	high	Currently not in trade in Norway. Online trading focusing mostly on shells only. Escape or released from captivity as egg or small specimen. Number of clutches/eggs per year is unknown.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	unlikely	high	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. Shell diameter up to 40mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity	Unlikely	Medium	The species is native to Morocco suggesting its climate requirements are much warmer

between climatic conditions in Norway and the organism's current distribution?			than what is found in Norway
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	low	Moroccan conditions, also beyond climate conditions are very different from what is found in Norway
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	The conditions may be within the tolerance in Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	unlikely	medium	The species is medium sized and easy to detect, at least as adults.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	NA	high	No information available on the species general biology, including dietary requirements
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	medium	No information on that the species has spread from its native distribution.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	unlikely	medium	The climate is likely too cold in Norway even within a 50-year perspective.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snails are slow moving, in general reducing their capacity to spread. The species is medium sized (up to 40mm in diameter), suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium in size and therefore easy to detect.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	very unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	high	
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic			No information available

makeup and making their environmental effects more serious?			
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	NA	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	NA	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	medium	No history of invasions elsewhere.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Warm and calcareous areas in southern Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	high	We have found no information on impact, which may suggest the impact is limited

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and maybe spread.	high	

RISK SUMMARIES for *Loxana vondeli*

	RESPONSE	UNCERTAINTY	COMMENT
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Very unlikely	medium	The climate is too cold in Norway now, and in a 50 year-perspective
Summarise Spread	very unlikely	medium	
Summarise Impact	minimal	high	We have found no information on impact, which may suggest the impact is limited
Conclusion of the risk assessment	low	medium	

References

https://www.conchology.be/?t=66&family=HELICIDAE&species=Loxana%20vondeli

Species (genus): *Marmorana sp* (Hartmann, 1844)

Genus that needs taxonomical reassessment. Some species have previously been placed in the genus Helix. All species native to Italy. Two species (*M. muralis*, and *M. serpentine*) have been introduced to Mediterranean France.

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE [chose one entry, delete all others]**	**UNCERTAINTY [chose one entry, delete all others]**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the	Unlikely	high	Currently not in trade in Norway. Escape or released from captivity as egg or small specimen. Number of clutches/ eggs per year is unknown.

first place			
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	unlikely	high	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. Shell diameter up to 20mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Unlikely	Medium	The genus is native to Mediterranean Italy suggesting its climate requirements are warmer than what is found in Norway, also in a 50 years perspective
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	low	Mediterranean conditions, also beyond the climatic, are different from what is found in Norway
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	The conditions may be within the tolerance in Greenhouses, however, we have found no records of its presence in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	unlikely	medium	The species are medium sized and easy to detect, at least as adults.

2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	NA	high	No information available on the species general biology, including dietary requirements
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	medium	Two of the species in this genus have spread from its native distribution, but only to other areas with Mediterranean climate (southern France).
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Very unlikely	medium	The climate is likely too cold in Norway even within a 50-year perspective.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snails are slow moving, in general reducing their capacity to spread. The species are medium sized (15-20mm in diameter), suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Some snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and therefore easy to detect.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	
3.5. Estimate the overall potential for future spread for this organism in	very unlikely	medium	

Norway (using the comments box to indicate any key issues).			

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	high	No record of environmental harm elsewhere
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			No information available
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	NA	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	NA	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	medium	No history of invasions elsewhere.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Warm and calcareous areas in southern Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	high	There are no records of environmental harm elsewhere, which may suggest limited impact

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and maybe spread.	high	

RISK SUMMARIES for *Marmorana sp.*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Very unlikely	medium	The climate is too cold in Norway now, and in a 50 year-perspective
Summarise Spread	very unlikely	medium	
Summarise Impact	minimal	high	There are no records of environmental harm elsewhere, which may suggest limited impact
Conclusion of the risk assessment	low	medium	

References

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Fiorentino, V., et al. (2009), 'POPULATION DYNAMICS OF AN URBAN POPULATION OF THE LAND SNAIL MARMORANA SERPENTINA (GASTROPODA: PULMONATA)', Malacologia, 51 (1), 201-09.

Fiorentino, Viviana, et al. (2010), 'Historical biogeography of Tyrrhenian land snails: The Marmorana–Tyrrheniberus radiation (Pulmonata, Helicidae)', Molecular Phylogenetics and Evolution, 55 (1), 26-37.

Species: *Neohelix albolabris* (Say 1817)

English common name: Whitelip snail

Synonyms: *Helix albolabris, Triodopsis albolabris*, *Polygyra albolabris*

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	high	Escape or released from captivity as egg or small specimen. Number of clutches/eggs per year is unknown.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. It is among the larger land snails in North America, shell diameter up to 40mm.
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	likely	medium	The species is native to the eastern USA and Canada. In the northern parts of its distribution the climate is similar to what can be found in Norway
2.2. How likely is it that the organism will be able to establish in	likely	medium	It inhabits forest areas where it feeds on fungi.

Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?			
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	It feeds primarily on fungi, but also on vegetables and fruit. It could therefore have problems finding food in greenhouses. In other types of protected conditions where fungi is more likely to occur, it might thrive. There is however, no records of invasions beyond its native range.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	medium	It thrives in humid forests and can survive under climate conditions similar to what is found in Norway. It prefers calcareous soils and will have problems under too acidic conditions.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	Moderately likely	medium	The species is medium sized and easy to detect.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	Its invasion history suggest that it has not spread beyond its native range.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	unlikely	medium	There are no records of establishment outside its native range.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	unlikely	medium	Although the species can thrive under climate conditions similar to what is found in some parts of Norway, it has never established population outside

			its native range

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snail are slow at migrating, and the species is medium sized, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Some snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and relatively easy to detect.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Calcareous areas in southern Norway	low	In its native area, it thrives in forests. However, acidic conditions are unfavourable and it will most likely not be able to establish populations in dense and acidic spruce forests.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its	minimal	medium	No records of negative impact

existing geographic range, excluding Norway?			
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available, suggesting that the species have limited impact on the ecosystem in its native range
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	high	No information available, but due to the lack of information on impacts in its native range and that it has not established beyond its native range, its potential impact appears to be limited
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	medium	Although its native range holds climates similar to what can be found in Norway it most likely needs calcareous soils
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	Minimal	high	No information available, suggesting that the species have limited impact on the ecosystem in its native range

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	na	low	Climate conditions is not limiting its establishment in Norway
5.2. What aspects of the risk assessment are most likely to	na		

change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions			

RISK SUMMARIES for *Neohelix albolabris*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	medium	Its establishment in Norway is not climate limited
Summarise Spread	unlikely	medium	
Summarise Impact	Minimal	high	No information available, suggesting that the species have limited impact on the ecosystem in its native range
Conclusion of the risk assessment	low	medium	There are no records of the species establishing populations outside its native range.

References

http://www.carnegiemnh.org/science/mollusks/va_neohelix_albolabris.html

McCRACKEN, GARY F., PETER F. BRUSSARD. 1980. Self-fertilization in the white-lipped land snail *Triodopsis Albolabris*, Biological Journal of the Linnean Society, Volume 14(3-4): 429–434, https://doi.org/10.1111/j.1095-8312.1980.tb00117.x

http://explorer.natureserve.org/servlet/NatureServe?searchName=Neohelix+albolabris

, 35 (2), 399-406.

Species: *Otala lactea* (O. F. Müller, 1774)

English common name: Milk snail

Synonyms: *Helix ahmarina* (J. Mabille 1883), *Helix canariensis* (Mousson 1872), *Helix jacquemetana* (J. Mabille 1883), *Helix lactea* (O.F. Muller 1774)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals •			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	Moderately likely	medium	Currently in trade in Norway and has been introduced several places and it is edible. Escape or released from captivity as egg or small specimen. Lays up to 70 eggs per clutch, twice a month, and deposit the eggs in loose soil.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles *e.g.* while cleaning terraria. Shell diameter up to 36mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Unlikely	low	The species is native to the wester Mediterranean (Europe and north Africa). It has been introduced, and established, in southern USA, the Caribbean south America and Australia. However only under climate conditions far warmer than Norway.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	Prefer rocky heathlands, grasslands and steppes.

2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	unlikely	medium	It is a generalist herbivore, potentially feeding also on horticultural plants. There are however, no record of pest outbreaks in greenhouses
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	medium	The species is medium sized and easy to detect. It is seen as pest in some of the areas where it has been introduced (Bermuda and California), suggesting that it can be hard to contain if it establish a population
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	Produces up to 70 eggs per clutch, twice a month, suggesting high reproductive potential.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	low	It has been introduced several places around the world, but with limited impact. It is however seen as a pest in some areas, *e.g.* California, where the climate is Mediterranean as in its native range.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Very unlikely	low	The climate is likely too cold in Norway now, but may be within the tolerance of the species within 50 years.

PROBABILITY OF SPREAD
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within

an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snail are slow at migrating, and the species is medium sized, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Some snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and relatively easy to detect. Due to its climatic requirements the areas of potential establishment and spread is non-existent.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	In its native area it thrives in a Mediterranean climate. Amateur web pages indicate that it needs temperatures in the range of 20-25°C
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	very unlikely	low	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minimal	low	In most areas where it has been introduced it appears to cause minimal harm, except from areas with Mediterranean climate resembling what it experience in its native

			range.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	medium	The species seems not to have any strong impact on the ecosystem in its native range.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	It's distribution is temperature limited and the potential for establishment and potential impact is confined to the warmer parts of Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minimal	low	Negative impacts are only recorded in habitats with Mediterranean climate.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate	Establishment and	high	

change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	maybe spread.		

RISK SUMMARIES for *Otala lactea*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	Moderately likely	medium	Need to escape from captivity or be released intentional or unintentional. Large clutch size.
Summarise Establishment	Very unlikely	low	The climate is currently too cold in Norway now, even in a 50-year perspective
Summarise Spread	very unlikely	low	Based on its invasion history in other areas where it has been introduced, climate seems to limit its distribution
Summarise Impact	minimal	low	Negative impacts are only recorded in habitats with Mediterranean climate
Conclusion of the risk assessment	low	low	

References

http://entnemdept.ifas.ufl.edu/creatures/misc/gastro/terrestrial_snails.htm

Invasive Alien Species: A Toolkit of Best Prevention and Management Practices

edited by Rüdiger Wittenberg, Matthew J. W. Cock

http://idtools.org/id/mollusc/factsheet.php?name=Otala%20spp.

https://snegler.wordpress.com/ikke-tropiske-snegler/otala-lactea-melkesnegl/

La Pierre, K.J., Harpole, W.S. & Suding, K.N. Biol Invasions (2010) 12: 3025. https://doi.org/10.1007/s10530-010-9693-z

Araya, Juan Francisco (2015). Current status of the non-indigenous molluscs in Chile, with the first record of Otala punctata (Müller, 1774) (Gastropoda: Helicidae) in the country and new records for Cornu aspersum (Müller, 1774) and Deroceras laeve (Müller, 1774). Journal of Natural History Vol. 49 , Iss. 29-30

Species: *Otala punctata* (O. F. Müller, 1774)

English common name: Spanish snail

Synonyms: *Helix punctata* (Muller, 1774)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	high	Has been introduced several places and it is harvested as it is edible. If abiotic conditions allow it could be introduced and kept in high densities for harvesting. Escape or released from captivity as egg or small specimen. Number of clutches/eggs per year is unknown.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs and juvenmiles, *e.g.* while cleaning terraria (Barbara and Schembri, 2008). Shell diameter up to 39mm.
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Unlikely	low	The species is native to the wester Mediterranean (Europe and north Africa). It has been introduced, and established, in southern USA, the Caribbean south America and Australia. However only under climate conditions far warmer than Norway. In Italy, it's

			distribution is confined to coastal areas up to 40 m.s.a.l., suggesting limited climate tolerance.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	Prefer agricultural areas and coastal plains.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	Moderately likely	medium	It is a generalist herbivore and prefer agricultural areas, suggesting the potential for establishment in protected conditions. There is however, no records of greenhouse invasions.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need areas warmer than what is currently experienced in Norway
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	medium	The species is medium sized and easy to detect. It is seen as a minor plant pest (Araya 2015), suggesting that it can be hard to contain if it establish a population, although successful, but expensive, eradication campaigns have been conducted.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	Reproductive biology unknown, but potential for passive spread from horticultural facilities has been suggested
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	very unlikely	low	It has been introduced several places around the world, but with limited impact. It was however, seen as a pest in South Africa were it was

			removed through a successful eradication campaign in 1989 (Herbert & Sirgel, 2001). Successful eradication in a plant nursery has also been reported from Malta.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Very unlikely	low	The climate is too cold in Norway now, and in a 50-year perspective.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)	unlikely	medium	Snail are slow at migrating, and the species is medium sized, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and relatively easy to detect. Due to its climatic requirements, the areas of potential establishment and spread is non-existent.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	In its native area, it thrives in a Mediterranean climate. All areas where it has successfully established also hold warm climates, suggesting that it needs high temperatures to survive.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	very unlikely	low	

PROBABILITY OF ENVIRONMENTAL IMPACT

Important instructions:

- When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.

QUESTION	RESPONSE	UNCERTAINTY	COMMENTS
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	medium	low	In the USA and on Malta it is seen as a potential pest species, although there are no records of serious pest outbreaks in these countries. The species has been seen as a pest in South Africa, where it has later been successfully eradicated.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minimal	medium	The species seems not to have any strong impact on the ecosystem in its native range.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	The distribution is temperature-limited and the potential for establishment and potential impact is confined to the warmer parts of Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway	moderate	low	In the USA and on Malta it is seen as a potential pest species, although there is

(despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).			no records of serious pest outbreaks. The species has been seen as a pest in South Africa, where it has later been successfully eradicated.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50-year perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and maybe spread.	high	

RISK SUMMARIES for *Otala punctata*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Very unlikely	low	The climate is too cold in Norway now, and in a 50-year perspective
Summarise Spread	very unlikely	low	Based on its invasion history in other areas where it has been introduced, climate seems to limit its distribution and negative impacts are only recorded in habitats with Mediterranean climate
Summarise Impact	moderate	low	In the USA and on Malta it is seen as a potential pest species, although there are no records of serious pest outbreaks. The species has been seen as a pest in South Africa, where it has later been successfully eradicated.
Conclusion of the risk assessment	low	low	

References

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Species: *Paropeas achatinaceum* (Pfeiffer, 1846)

English common name: Indonesian awlsnail, A Terrestrial Snail (USA).

Synonyms: *Bulimus achatinaceus* L. Pfeiffer, 1846; *Lamellaxis javanicum* (Reeve, 1849), *Prosopeas javanicum* (Reeve, 1849) sensu Cooke, 1934, *Allopeas javanicum*. Naggs (1994) suggested that *Paropeas achatinaceum* is an unresolved species group.

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	The species is in trade, however the degree of trade seems to be limited at the present. Need to escape or be released from captivity as egg or small specimen. It is about 16 mm long, suggesting it lays well under 50 eggs per year
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	Escape as egg or small specimen
1.3. Estimate the overall	unlikely	medium	

likelihood of entry into Norwegian nature.			

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	very unlikely	medium	Temperatures are likely too cold in Norway. The species is native to the tropics and sub-tropics of southeast Asia
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	Unlikely	medium	
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	moderately likely	medium	
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	very isolated	medium	Need warm areas and calcareous bedrock.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	medium	The species is small-sized and may be hard to detect. It occurs in high density in its range and is spreading.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	very likely	low	The global long term trend increase is >25%
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.

2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	likely	low	The species is currently spreading elsewhere
2.9. Estimate the overall likelihood of establishment in Norway	very unlikely	medium	The species is invasive, but the climate is likely too cold in Norway now and within 50 years.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	Moderately likely	high	Snails are slow moving, in general reducing their capacity to spread, however the species is small, suggesting that hitchhiking is possible.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	low	It is a small sized species, and its eggs and specimen are easily transported in soil or via ornamental or crop planting materials. Hitchhiking on herbs have been recorded to Miami from abroad and from Miami and within USA.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	unlikely	medium	The species is spreading and can occur in high density, however, it is likely too cold in Norway
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway	very unlikely	low	Too few potential habitats in Norway

PROBABILITY OF ENVIRONMENTAL IMPACT
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.

QUESTION	RESPONSE	UNCERTAINTY	COMMENTS
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	moderate	medium	May cause damage to roots of horticultural plants by feeding. Also suggested to cause decline is native snail species by competition
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	major	low	The snail can be main host for nematodes and intermediate host for several parasites, including *Angiostrongylus cantonensis* in wild rats, Trematode (Brachylaimidae) in birds and mammals. Specimen should not be handled with bare hands (see also section 1.6.5 on pathogens).
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	moderate	high	May be predated by rodents and possibly limit the feral spread of the snail.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Irrigated agricultural areas in the warmest parts of southern Norway	medium	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators,	moderate	low	Can impact native snails and horticultural plants. The snail can be primary and intermediate host for several parasites, including

parasites or pathogens that may already be present).			*Angiostrongylus cantonensis*, the rat lung parasite of humans

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Paropeas achatinaceum*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	very unlikely	medium	The species is invasive, but the climate is likely too cold in Norway now and within 50 years
Summarise Spread	very unlikely	low	Too few potential habitats in Norway
Summarise Impact	moderate	medium	Can impact native snails and horticultural plants. The snail can be primary and intermediate host for several parasites, including *Angiostrongylus cantonensis*, the rat lung parasite of humans
Conclusion of the risk assessment	low	medium	It is most likely too cold in Norway, but the species can potentially have a major impact if spread to Norway

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Species: *Rumina decollata* (Linnaeus, 1758)

English common name: The decollate snail

Synonyms: *Bulimus decollatus* Draparnaud, 1805; *Helix decollata* Linnaeus, 1758; *Orbitina incomparabilis* Germain, 1930; *Orbitana truncatella* (Germain, 1930)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	The species is in trade, but not in large numbers. It grows to about 40 mm in length and produces about 200 eggs per year.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	
1.3. Estimate the overall	unlikely	medium	

likelihood of entry into Norwegian nature.			

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	moderately likely	medium	Need warm to temperate condition. The species is Mediterranean and spreading. In Sweden, it has no permanent population but is occasionally found to reproduce. It has also been found in the vicinity of Århus in Denmark.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	Need some calcareous bedrock.
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	low	The species is found in greenhouses, *e.g.*, in the UK.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	medium	Need warm areas and calcareous bedrock.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	high	The species is small-sized and may be hard to detect. It occurs in high density in its range and is spreading
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	likely	medium	The species can self-fertilize and in theory one specimen can create a new population
2.7. How likely is it that the organism could establish in Norway	likely	low	Studies have been performed that indicate one morph of the

despite low genetic diversity in the founder population?			species is spreading, suggesting low genetic diversity. Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	likely	low	The species is currently spreading elsewhere
2.9. Estimate the overall likelihood of establishment in Norway	moderately likely	medium	The climate is likely too cold in Norway now, but may be within the tolerance of the species within 50 years.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	Moderately likely	medium	Snails are slow moving, in general reducing their capacity to spread, however this is small a species, suggesting that hitchhiking is possible
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	low	It is a small sized species, and its eggs are easily transported in soil or via ornamental or crop planting materials. Hitchhiking on lavender seedling (from Italy to UK) and roof tile (from Spain to USA) have been recorded.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	moderately likely	high	The species can occur in high density, however, it is likely too cold in Norway at the present. It can self-fertilize so theoretically only one individual is enough to create a new population
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	Cultivated habitats with frequent irrigation
3.5. Estimate the overall potential for	moderately	medium	

future spread for this organism in Norway	likely		

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	major	low	*R. decollata* is a voracious predator, and feeds readily upon common garden snails and slugs and their eggs. It is therefore used as biological control agent in the USA. The snail eats plant matter as well, and was long considered a minor plant pest. When used as control agent, the damage it causes to plants is considered minor when compared with the benefit of its predation on garden snails and other pest species of snails. It will also consume harmless local species of land gastropods, and beneficial annelids.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	Not known. The snail can be food for rodents.
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected	moderate	medium	It is thought that rodents

impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?			may limit the feral spread of this snail.
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Irrigated agricultural areas in the warmest parts of southern Norway.	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	major	low	*R. decollata* is a voracious predator. It feeds readily upon local species of land gastropods and annelids, and their eggs. The snail eats plant matter as well, and is considered a minor plant pest.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Rumina decollata*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	moderately likely	medium	The climate is likely too cold in Norway now, but may be within the tolerance of *R. decollata* within 50 years
Summarise Spread	moderately	medium	Hitchhiking on seedlings have

	likely		been recorded. It can also self-fertilize so theoretically only one individual is enough to create a new population.
Summarise Impact	major	low	*R. decollata* is a voracious predator. It feeds readily upon local species of land gastropods and annelids, and their eggs. The snail eats plant matter as well, and is considered a minor plant pest.
Conclusion of the risk assessment	moderate	medium	The species will likely not establish in Norway now, but may establish in Norway within 50 years. If it establishes, it may have an impact on Norwegian biodiversity.

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Species: *Rumina saharica* Pallary, 1901

Synonyms: *Bulimus decollatus var. truncate* (Mousson, 1854), *Bulimus decollatus var. gracilis* (Pfeiffer, 1856), *Rumina decollata var. saharica* (Pallary, 1901)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	*Rumina saharica* is in trade, but not in large numbers. It need to escape or be released from captivity as egg or small specimen. It produces up to 30 eggs per hatch.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately	medium	
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	unlikely	medium	It is a sub-tropical snail, which naturally occurs in southern Europe and around the Mediterranean.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	high	The sister species *Rumina decollate* is found in greenhouses in the UK. *R. decollate* and *R. saharica* have similar natural distribution and similar morphology.
2.4. How widespread are habitats or	very isolated	medium	Need warm areas and

species necessary for the survival, development and multiplication of the organism in Norway?			calcareous bedrock.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	high	The species is small-sized and may be hard to detect. It may presently be spreading to southern France. Alternatively, the species is native to France but have previously been mis-identified to *R. decollate.*
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	likely	low	The species can self-fertilize and in theory one specimen can create a new population
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	unlikely	high	The species do not seem to be invasive elsewhere. However, mis-identifications of *R. saharica and R. decollate* may have caused bias on potential distribution and spread
2.9. Estimate the overall likelihood of establishment in Norway	unlikely	medium	The climate is likely too cold in Norway

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	Moderately likely	medium	Snails are slow moving, in general reducing their capacity to spread. It is a small sized species, suggesting that hitchhiking is possible
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	medium	It is a small sized species, and its eggs are easily transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	moderately likely	high	The species can occur in high density, however, it is likely too cold in Norway. It can self-fertilize so theoretically only one

			individual is enough to create a new population
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minor	medium	No reports on harm from elsewhere, however the species is a predator and may potentially consume harmless local species of land gastropods, and beneficial annelids.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	major	low	This species is intermediate host for a number of parasites, including parasites in domestic cats and chicken. (see also section 1.6.5 on pathogens)
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be	minor	high	

present in Norway?			
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Agricultural areas in the warmest parts of southern Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	minor	medium	No reports on harm from elsewhere, however the species is a predator and may potentially consume harmless local species of land gastropods, and beneficial annelids.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Rumina saharica*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	medium	The climate is likely too cold in Norway
Summarise Spread	low	medium	
Summarise Impact	minor	medium	No reports on harm from elsewhere, however the species is a predator and may potentially consume harmless local species of land gastropods, and beneficial annelids.
Conclusion of the risk assessment	low	medium	

References

Aydın Örstan, Notes on the reproduction of Rumina saharica from Turkey (Pulmonata: Subulinidae) Zoology in the Middle East Vol. 45 , Iss. 1,2008

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Species: *Subulina octona* (Bruguière, 1789)

English common name: Miniature Awlsnail, Trumpet snails.

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	It seems the species is rare in trade, however the degree of trade may change. Need to escape or be released from captivity as egg or small specimen. It produces up to 6 eggs per hatch.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	very unlikely	medium	It is a tropical species, which naturally occurs in the Caribbean and in tropical America

2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	Very likely	low	The species is found in greenhouses in many European countries, *e.g.*, Sweden and Denmark.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	very isolated	medium	
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	very likely	medium	It is one of the mostly widely dispersed introduced land snails in the world and is showing a high reproductive capacity
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	very likely	low	This species has been introduced and is spreading worldwide in the tropics
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	unlikely	medium	This species is invasive elsewhere, but the climate is likely too cold in Norway
2.9. Estimate the overall likelihood of establishment in Norway	Very unlikely	medium	This species has been introduced worldwide in the tropics, but the climate is likely too cold in Norway

PROBABILITY OF SPREAD
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.

QUESTION	RESPONSE	UNCERTAINTY	COMMENT
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	Moderately likely	medium	Snails are slow moving, in general reducing their capacity to spread, however, it is a small sized species, suggesting that hitchhiking is possible
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	medium	It is a small sized species, and its eggs are easily transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	moderately likely	high	The species can occur in high density however, it is likely too cold in Norway. It is a hermaphrodite so theoretically only one individual is necessary to create a new population
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm areas in southern Norway	medium	Especially areas with cultivated regions, gardens, at margins of arable fields
3.5. Estimate the overall potential for future spread for this organism in Norway	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT

Important instructions:

- When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment.
- Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.

QUESTION	RESPONSE	UNCERTAINTY	COMMENTS
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	moderate	medium	It is considered as a minor pest in gardens or nurseries by making holes in cultivated plant leaves
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for	major	medium	It is also an intermediate host for a number of parasites, including

other damaging organisms (e.g. diseases)?			parasites in domestic cats and chicken (see also section 1.6.5 on pathogens)
4.4. How much impact do other factors (which are not covered by previous questions) have?	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minor	high	
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur	Warmest parts of southern Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	moderate	medium	Damage to plants may occur. It is also an intermediate host for a number of parasites, including vectors for domestic cats and chicken. (see also section 1.6.5 on pathogens)

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Subulina octona*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional

Summarise Establishment	Very unlikely	medium	This species has been introduced worldwide in the tropics, but the climate is likely too cold in Norway
Summarise Spread	likely	medium	The species is currently increasing in geographic distribution and abundance
Summarise Impact	moderate	medium	Damage to plants may occur. It is also an intermediate host for a number of parasites, including parasites in domestic cats and chicken
Conclusion of the risk assessment	low	medium	The species can potentially have some environmental impact, but will most likely not establish in Norway

References

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Proschwitz, T.v. 2005 Faunistiskt nytt 2004 - snäckor, sniglar och musslor inklusive något om kinesisk skivsnäcka Gyraulus chinensis (Dunker) och amerikansk tropiksylsnäcka Subulina octona (Bruguière) - två för Sverige nya, människospridda snäckarter, p 35-61

Species: *Theba pisana* (O. F. Müller, 1774)

Synonyms: *Helix pisana* (Müller, 1774), *Helix albella* (Linnaeus, 1758)

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	high	Has been introduced several places and it is harvested as it is edible. Escape or released from captivity as egg or small specimen. Number of clutches/eggs per year is unknown.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	There is potential for unintentional disposal of eggs juveniles, *e.g.* while cleaning terraria. Shell diameter up to 25mm
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Moderately likely	medium	The species is native to the Mediterranean coast (Europe and north Africa). It has been introduced, and established, in California, South Africa, the Netherlands, SW Great Britain, Ireland, Asia and Australia. However only under frost-free conditions.
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	Prefer coastal areas with sandy soil, but has also become an agricultural pest in Australia and South Africa.

2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	Moderately likely	medium	It is a generalist herbivore and thrive in agricultural areas, suggesting the potential for establishment in protected conditions. There is however, no records of greenhouse invasions.
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	isolated	low	Need frost-free conditions, i.e. areas warmer than what is currently experienced in Norway.
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	likely	medium	The species is medium sized and easy to detect. It is seen as a plant pest suggesting that it can be hard to contain if it establish a population. It can occur in high densities.
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	unlikely	medium	Its invasion history suggest that it only established under frost-free conditions and that it has not adapted to cold conditions.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	likely	low	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway? (If possible, specify the instances in the comments box.)	Moderately likely	medium	It has been introduced several places around the world, but only under frost-free conditions.
2.9. Estimate the overall likelihood of establishment in Norway (mention any key issues in the comments box).	Moderately likely	medium	The climate is too cold in Norway now, but in a 50-year perspective, coastal areas with frost-free conditions might become suitable.

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this	unlikely	medium	Snail are slow at migrating, and

organism will spread widely in Norway by *natural means*? (Please list and comment on the mechanisms for natural spread.)			the species is medium sized, suggesting that hitchhiking by adults is unlikely.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*? (Please list and comment on the mechanisms for human-assisted spread.)	unlikely	medium	Snails are known to hitchhike on goods. It is also possible for eggs and juveniles to be transported in soil or via ornamental or crop planting materials.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	likely	medium	The species is medium sized and relatively easy to detect. Due to its climatic requirements the areas of potential establishment and spread is currently non-existent.
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and calcareous areas in southern Norway	low	In its native area, it thrives in a Mediterranean climate. All areas where it has successfully established are also frost-free. In a 50 year perspective coastal areas of southern Norway might become frost-free and could therefore provide suitable conditions for establishment and spread.
3.5. Estimate the overall potential for future spread for this organism in Norway (using the comments box to indicate any key issues).	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	moderate	medium	In South Africa and Australia, it is seen as a pest species with negative effects on both agriculture and native vegetation. There are also reports of interspecific competition with native snails.

4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	NA	high	No information available
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minor	high	No information available
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	The warmer parts of Norway	low	Its distribution is temperature limited and the potential for establishment and potential impact is depending on frost-free conditions. In a 50-years perspective frost-free conditions might occur in Southern Norway.
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	moderate	medium	It is a pest species within its current geographical range. There are also reports of interspecific competition with native snails.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	If frost-free winters become common the species might be able to establish and spread.
5.2. What aspects of the risk	Establish	high	

assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	ment and spread.		

RISK SUMMARIES for *Theba pisana*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Moderately likely	medium	The climate is likely too cold in Norway now, but it may be able to establish and spread in a 50-year perspective if frost-free winters become more frequent
Summarise Spread	unlikely	medium	
Summarise Impact	moderate	medium	It is a pest species within its current geographical range. There are also reports of interspecific competition with native snails.
Conclusion of the risk assessment	moderate	medium	

References

Odendaal, L.J., Tanya M. Haupt, Charles L. Griffiths (2008). The alien invasive land snail *Theba pisana* in the West Coast National Park: Is there cause for concern? Koedoe 50(1):93-98

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van Elden, Sean, et al. (2015), 'Plant selection and grazing activity of the invasive snail Theba pisana in coastal Algoa Bay, South Africa', African Zoology, 50 (3), 227-31.

Species: *Tingitana shioum* (Pallary, 1910)

Synonym: Alabastrina shioum (Pallary, 1910)

This is a Moroccan species, which appears to be endemic to the area of Skoura. The adult shell size can exceed 30mm. Extent of trade is unclear, but it seems that shells can be bought online. We have not found sufficient information on the species to perform a full risk assessment.

References

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Species: *Veronicella sloanii* (Cuvier, 1817)

English common name: Pancake Slug

Synonyms: *Veronicella sloanei* (Cuvier, 1817 (misspelling)); *Vaginulus sloanei* Ferussac; *Veronicella laevis* Blainville, 1817

SECTION B – Detailed assessment			
PROBABILITY OF ENTRY			
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin? Sub-note: In your comment discuss how likely the organism is to get onto the pathway in the first place	unlikely	medium	*V. Sloanii* is in trade, but not in large numbers at the present. The degree of trade can change fast. It lays about 30 eggs per hatch.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	It can fit through small gaps easily and escape through lids
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	Medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	Very unlikely	medium	The species is native to tropical and subtropical America, strongly suggesting it is too cold in Norway
2.2. How likely is it that the	unlikely	medium	Need warm and wet conditions

organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?			and is an omnivore
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	medium	
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	Very isolated	high	
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	moderately likely	high	
2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	very likely	low	The species is spreading elsewhere and considered invasive. It is a hermaphrodite and in theory one individual can start a new population
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	likely	low	The species is spreading and considered invasive elsewhere
2.9. Estimate the overall likelihood of establishment in Norway	Very unlikely	medium	Likely too cold in Norway now and in 50 years

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this	unlikely	low	Snails are slow moving, in

organism will spread widely in Norway by *natural means*?			general reducing their capacity to spread. It is a medium/large sized species, suggesting that hitchhiking is unlikely
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	medium	It can disperse active (self–initiated) and passively (hitchhiking)
3.3. How likely is it that spread of the organism within Norway can be completely contained?	moderately likely	high	
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm and wet areas in south western Norway	low	
3.5. Estimate the overall potential for future spread for this organism in Norway	unlikely	high	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	moderate	medium	This species is an agricultural pest, but not recorded damage to natural habitats.
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?			Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	major	low	The species serve as intermediate hosts of the nematode *Angiostrongylus costaricensis* which causes abdominal angiostrongyliasis in humans and rodents. Specimen should not be handled with bare hands (see also section 1.6.5 on pathogens).

4.4. How much impact do other factors (which are not covered by previous questions) have?	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	moderate	high	
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Agricultural areas in the warmest south western Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present).	moderate	low	The species serve as intermediate hosts of the nematode *Angiostrongylus costaricensis* and is an agricultural pest

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	Warming and precipitation	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Veronicella sloanii*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	Very unlikely	medium	Likely too cold in Norway now and in 50 years
Summarise Spread	moderately	medium	

	likely		
Summarise Impact	moderate	low	The species serve as intermediate hosts of the nematode *Angiostrongylus costaricensis* and is an agricultural pest
Conclusion of the risk assessment	low	medium	The species can potentially have a major impact, but only on agriculture (probably not natural habitats), and will most likely not establish in Norway

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Species: *Zonites algirus* (Linnaeus, 1758)

English common name: Algiers Snail

Synonyms: *Zonites anthesi* (Kobelt, 1903), *Zonites cytherae* (E. von Martens, 1891) *Zonites garganicus* (Pollonera, 1909), *Zonites lesbicus* (Fuchs & Käufel, 1934), *Helix algirus* (Linnaeus, 1758), *Helix algira* (Linnaeus, 1758), *Missing garganicus* (Pollonera, 1909)

SECTION B – Detailed assessment
PROBABILITY OF ENTRY
Important instructions: • Entry is the introduction of an organism into Norway. Not to be confused with spread, which is the movement of an organism within Norway. • Entry in this context is defined as escape from captivity by (un)intentional release of eggs, juveniles or adult animals

QUESTION	RESPONSE	UNCERTAINTY	COMMENT
1.1. How likely is it that the organism will travel along this pathway from the point(s) of origin?	unlikely	medium	The species is in trade, but not in large numbers. The size is maximum 42 mm, suggesting is lays well below 600 eggs.
1.2. How likely is the organism to be able to transfer from captivity to a suitable habitat or host in Norwegian nature?	moderately likely	medium	
1.3. Estimate the overall likelihood of entry into Norwegian nature.	unlikely	medium	

PROBABILITY OF ESTABLISHMENT			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1. How likely is it that the organism will be able to establish in Norway based on the similarity between climatic conditions in Norway and the organism's current distribution?	unlikely	high	
2.2. How likely is it that the organism will be able to establish in Norway based on the similarity between other abiotic conditions in Norway and the organism's current distribution?	unlikely	medium	
2.3. How likely is it that the organism will become established in protected conditions (in which the environment is artificially maintained, such as wildlife parks, glasshouses, aquaculture facilities, terraria, zoological gardens) in Norway? Sub-note: gardens are not considered protected conditions	likely	medium	
2.4. How widespread are habitats or species necessary for the survival, development and multiplication of the organism in Norway?	Very isolated	medium	Needs calcareous bedrock and warmth
2.5. How likely is it that establishment will occur despite management practices (including eradication campaigns), competition from existing species or predators, parasites or pathogens in Norway?	moderately likely	high	

2.6. How likely are the biological characteristics (including adaptability and capacity of spread) of the organism to facilitate its establishment in Norway?	moderately likely	medium	The species is originally from Greece and NW Asia minor. It is introduced to southern France and Italy.
2.7. How likely is it that the organism could establish in Norway despite low genetic diversity in the founder population?	Likely	Medium	Snails are in general showing strong genetic population structures, most likely due to local populations stemming from small founder populations.
2.8. Based on the history of invasion by this organism elsewhere in the world, how likely is to establish in Norway?	unlikely	medium	It is spreading in Italy and France, but there is no information suggesting that it invasive.
2.9. Estimate the overall likelihood of establishment in Norway	unlikely	medium	The species was introduced to southern France and Italy, but has not spread further

PROBABILITY OF SPREAD			
Important notes: • Spread is defined as the expansion of the geographical distribution of an alien species within an area.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
3.1. How likely is it that this organism will spread widely in Norway by *natural means*?	unlikely	medium	Snails are slow moving, in general reducing their capacity to spread. It is spreading north in southern Europe. However, the climatic requirements are poorly known.
3.2. How likely is it that this organism will spread widely in Norway by *human assistance*?	likely	medium	It can disperse active (self–initiated) and passively (hitchhiking). It can be transported for private keeping and with goods.
3.3. How likely is it that spread of the organism within Norway can be completely contained?	moderately likely	high	
3.4. Based on the answers to questions on the potential for establishment and spread in Norway, define the area endangered by the organism.	Warm areas in southern Norway	medium	Areas with cultivated regions, gardens, at margins of arable fields.
3.5. Estimate the overall potential for future spread for this organism in Norway	unlikely	medium	

PROBABILITY OF ENVIRONMENTAL IMPACT			
Important instructions: • When assessing potential future environmental impacts, climate change should not be taken into account. This is done in later questions at the end of the assessment. • Each section starts with the impact elsewhere in the world, then considers impacts in Norway separating known impacts to date (i.e. past and current impacts) from potential future impacts.			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
4.1. How much environmental harm is caused by the organism within its existing geographic range, excluding Norway?	minor	medium	
4.2. How much impact would there be, if genetic traits of the organism were to be transmitted to other species, modifying their genetic makeup and making their environmental effects more serious?		high	Not known, but there are no likely candidates for hybridization in the Norwegian fauna today.
4.3. How much impact does the organism have, as food, as a host, or as a symbiont or a vector for other damaging organisms (e.g. diseases)?	moderate	high	This species is host for the nematode parasite *Phasmarhabditis neopapillosa.* The species can most likely also be parasite on existing snails in Norway. Effects are not known.
4.4. How much impact do other factors (which are not covered by previous questions) have? (specify in the comments box)	NA	high	No information available
4.5. How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Norway?	minor	high	
4.6. Indicate any parts of Norway where environmental impacts are particularly likely to occur (provide as much detail as possible).	Agricultural areas in the warmest parts of southern Norway	low	
4.7. Estimate the expected impacts of the organism if it is able to establish and spread in Norway (despite any natural control by other organisms, such as predators, parasites or pathogens that may	moderate	high	This species has little if any negative effects in its native area. However, it is host for the nematode parasite *Phasmarhabditis neopapillosa, which* most

already be present).			likely also can infest existing snails in Norway. Effects are not known.

ADDITIONAL QUESTIONS - CLIMATE CHANGE			
QUESTION	**RESPONSE**	**UNCERTAINTY**	**COMMENTS**
5.1. What aspects of climate change (in a 50 years perspective), if any, are most likely to affect the risk assessment for this organism?	warming	low	South-Western Norway will become warmer and wetter.
5.2. What aspects of the risk assessment are most likely to change as a result of climate change? • Establishment • Spread • Impact on biodiversity • Impact on ecosystem functions	Establishment and spread	high	

RISK SUMMARIES for *Zonites algirus*			
	RESPONSE	**UNCERTAINTY**	**COMMENT**
Summarise Entry	unlikely	medium	Need to escape from captivity or be released intentional or unintentional
Summarise Establishment	unlikely	high	It is likely too cold in Norway now and within 50 years, however its climatic requirements are poorly known.
Summarise Spread	low	medium	The species was introduced to southern France and Italy, but has not spread further.
Summarise Impact	low	medium	This species has little if any negative effects in its native area. However, it is host for the nematode parasite *Phasmarhabditis neopapillosa, which* most likely also can infest existing snails in Norway. Effects are not known.
Conclusion of the risk assessment	low	medium	

References

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Appendix III

Referat av mailkorrespondanse med høringsekspert Tarald Stein

Ang. omfanget av sneglehold i Norge pr i dag:

«Den største norske sneglegruppa på facebook har 503 medlemmer www.facebook.com/groups/AKSnorge/.En del av disse kan være folk som ikke har snegler ennå eller folk som har hatt snegler før. Samtidig finnes det helt sikkert snegleeiere som ikke er medlemmer der. Jeg vil anta at 500 snegleeiere kan være litt i overkant, men et greit tall å forholde seg til. Dette er hovedsakelig folk som har afrikanske kjempesnegler, men andre arter kommer gjerne i tillegg for noen få (ca 50 personer)»

Ang. omfanget av viltfangede individer i handelen:

«Jeg vil anslå at ca. 10% av sneglene i hobbyen er viltfangede, resten fra oppdrett. For de vanligste artene (achatinidae) importeres det av og til viltfangede for å bedre genstammen, men ellers er over 99% av disse artene fra oppdrett i Europa»

«Noen arter er det ikke mulig å få tak i viltfangede dyr av p.g.a. opphavsland. Det gjelder f.eks. Pleurodonte/Caracolous fra Cuba og *Hadra webbi* fra Australia. For disse vil det da være 100% oppdrett»

«Nye arter på markedet er den gruppen med flest viltfangede (bortimot 100%), men dette utgjør en svært liten andel av hobbyen.»

«I tillegg har vi noen arter som har vist seg vanskelige å få oppdrett på, men som jevnlig importeres til Europa. Det gjelder f.eks. Helicophanta sp. og Edentulina obesa.>

«Av nettbutikkene er det noen som bare satser på oppdrett (f.eks. landsnails.org), andre utelukkende import (f.eks. bugzuk.com) og noen som gjør begge deler (f.eks. polyped.de, sender ikke til Norge).»

Ang. dødelighet og parasitter innen hobbyen:

«Ofte er det vanskelig å vite hva snegler dør av, man har ingen tillit til at veterinærer kan svare, spesielt siden forråtnelsen begynner så raskt at en obduksjon fort blir vanskelig. Mitt inntrykk er at giftstoffer i mat og miljø er den viktigste årsaken til at velholdte dyr dør. Spesielt er såkalt økologisk salat en gjenganger, og her kan det jo være nematoder involvert. Med jevne mellomrom blir det oppmerksomhet rundt faren for parasitter, og nybegynnere advares derfor mot å kjøpe viltfangede snegler. Fra egen erfaring har jeg aldri opplevd

massedød i mer enn ett terrarie av gangen, så jeg tviler på at parasitter kan spre seg utenfor/mellom terrarier. De fleste holder ulike arter adskilt.»

Ang. risikoen for at arter rømmer og eventuelt etablerer seg:

«Den største risikoen for at fremmede snegler havner i norsk natur fra hobbyen knytter seg til arter som mange har og som legger mange egg, som *Achatina achatina* og *A. fulica*. Dette har man erfaring med fra andre europeiske land (Tyskland og Storbritannia), der dyr har blitt satt ut når eierne har gått lei. Ingen av disse har klart å etablere seg. Egg på vidvanke utgjør i disse tilfellene mindre risiko, siden både egg og unger fort blir mat for predatorer, og de er mer avhengige av høy temperatur, luftfuktighet og kalk enn de voksne.»

«Interessen for mindre/tempererte arter er svært liten og de interesserte tar hobbyen mer alvorlig. I denne kategorien kan egg på vidvanke utgjøre et større problem, men siden antallet eiere og antall egg er mindre reduseres risikoen betraktelig.»

Referat av mailkorrespondanse med høringsekspert Arne Skorping

Ang. parasitter i terrestriske snegler og deres potensielle verter i Norge:

«Snegl er først og fremst mellomverter for trematoder (digener), nematoder og, i noen få tilfeller, cestoder. Når det gjelder trematoder så har disse generelt høy spesifisitet for første mellomvert (altså sneglen) - det vil si at de er ofte kresne i forhold til hvilken art de kan utvikle seg i. Det betyr at eksisterende parasitter i Norge, som f.eks. *Fasciola* eller *Dicrocoelium* ikke nødvendigvis får nye mellomverter hvis nye sneglearter etablerer seg. Men nye snegl kan selvfølgelig dra med seg nye trematodearter.

Med nematoder er det annerledes. Det er særlig parasitter i overfamilien Metastrongyloidea som her er aktuelle. De går vanligvis under navnet «lungeormer», selv om de kan finner i mange ulike organer hos en lang rekke pattedyr. I Norge er særlig arter tilhørende slekten *Elaphostrongylus* godt kjent, fra rein, hjort og elg. Metastrongylider er generelt ganske patogene, dvs de gir sykdom og død, særlig hos unge individer. I motsetning til trematoder er disse parasittene svært lite kresne på hvilke arter av snegl de kan bruke som mellomvert. Det vil si at hvis vi får etablert tette populasjoner av nye sneglearter så kan disse fungere som mellomverter for nematoder, noe som igjen kan gi økt overføring av parasitter til ville dyr.

Lungenematoden *Angiostrongylus vasorum* er for eksempel funnet i brunsnegl (*A. lusitanicus*). Den går i hund og rev. Også kattens lungeorm, *Aleurostrongylus abstrusus*, er funnet hos denne sneglen - og denne parasitten kan også gå i gaupe. Når vi får så tette populasjoner av snegl som vi ser mange steder med brunsnegl, gir dette en helt annen epidemiologisk situasjon enn tidligere. Vi har mange nematoder i denne gruppen, som nå

ser ut til å være forholdsvis sjeldne i Norge, men som kan bli mye vanligere. Det gjelder for eksempel:

Protostrongylus-arter i hare

Varestrongylus spp. i rådyr og hjort

Crenosoma striatum i piggsvin

Crenosoma vulpis i rev (fjellrev?), ulv og mårdyr

Angiostrongylus dujardini i smågnagere

Aleurostrongylus falciformis i grevling

Skrjabingylus nasicola i mårdyr

Ingen av disse artene er noen fare for mennesker, men de kan ha påvirkning på bestandsstørrelse hos ville pattedyrpopulasjoner. Den eneste nematoden i denne gruppen som kan infisere menneske er *Angiostrongylus cantonensis*. Den går i hjerne og lunger og kan medføre hjernehinnebetennelse. Den sprer seg fra tropiske strøk, men er ennå langt unna Norge.»