

Pest Risk Analysis (PRA) for

Name of organism: *Achatina fulica* (Giant African land snail)

Territory: Cayman Islands Assessment Number: 001/2020

Date: 20/03/2020 Version: 1

PRA type: accidental introduction

All sections should be completed. If not applicable indicate it

Part 1: Initiation

1.1 Summary of assessment results (max. 500 words)

Give a brief summary of the risks of introduction, establishment, spread, impact and overall risk. Fill this part only in after you have completed all the PRA template.

Achatina fulica is considered one of the world's worst invasives. It is a fast-growing polyphagous plant pest that has been introduced from its native range in East Africa to many parts of the world as a commercial food source (for humans, fish and livestock) and as a novelty pet. This species has a very likely risk of introduction and establishment as it is already present in nearby areas (Florida and other Caribbean islands) with similar environmental conditions and trade and passenger links. The spread in the territory might be fairly quick upon arrival (5-25 years until all suitable habitats on the islands are colonised), based on a combination of natural local dispersal and longer distance spread by vehicles. It has demonstrated large impact as a nuisance for the public and it can have a severe impact on the native vegetation, although this effect is very context dependent. On Cayman Islands, it may cause severe disruption to tourism and recreation, mainly due to the accumulation of shells. Small agri-business might also be affected but will most likely be able to adapt by taking up management practices already in use in other regions where the species is established. There is also a risk of competition, predation and disease spread to endemic snails in the territory, although it is difficult to evaluate the magnitude of the potential outcome. Current biosecurity practices against the introduction of *A. fulica* are relatively strong but with high uncertainty as they haven't been able to stop the invasion of other terrestrial snails. Stricter biosecurity measures regarding import regulation, inspection and monitoring of imports and passenger luggage from countries where the species occur and towards Little Cayman should significantly minimize the risk.

1.2 Assessor details

Institution/Department: CABI

Name and Job Title: Pablo González-Moreno; Vaughn Bodden, Kenisha Palmer, Suzy Wood, Norbert Maczey

Address: CABI, Bakeham Lane, Egham, Surrey. TW20 9TY

Phone (office and/or mobile): 01491 892085

Email: p.gonzalez-moreno@cabi.org

Part 2: Background

2.1 Aim of assessment

This section is intended to put the new organism(s) in perspective of the wider activitie(s) having led to conducting this PRA (e.g. previous horizon scanning, recent alerts or interceptions); all technical/scientific words must be explained

Achatina fulica is considered one of the world's worst invasives. It is a fast-growing polyphagous plant pest that has been introduced from its native range in East Africa to many parts of the world as a commercial food source (for humans, fish and livestock) and as a novelty pet. The species is already present in several Caribbean islands, mostly in the Eastern part, but also in Cuba. Furthermore, it has recently become established in Florida (2011), increasing the likelihood of entry to the Cayman Islands as this is a major source of cargo and passengers to the territory. Once escaped, it can easily establish itself and reproduce prodigiously in any tropical and some temperate locations. Thus, it is crucial to identify the potential risks and impacts associated with this major invader were it to become established in the territory.

2.2 Identity

Identify the organism as fully as possible

Scientific name (incl. taxonomic authority, date): *Achatina fulica* (Bowdich 1822)

What is it? (max. 2 sentence description): A large land snail

English name(s): giant African land snail

Family: Achatinidae

Synonyms: *Lissachatina fulica* (Bowdich)

Other taxonomic remarks: Included within the subgenus *Lissachantina*, which some authors have recently treated as a genus; however, at present, no published taxonomic works are available to sustain this treatment (ISC, 2020).

2.3 Images of the species if available

If available, please provide pictures of different stages and habitats



Figure 1: *Achatina fulica* (giant African land snail); various specimens, collected nr. Corrientes, Argentina. May, 2013. ©Roberto E. Vogler & Ariel A. Beltramino-2013.

Annex 3.4 – PRA of Giant African snail for Cayman Islands



Figure 2: *Achatina fulica* in Martinique. ©Charles Schotman



Figure 3: *Achatina fulica* (giant African land snail); eggs. Note scale. nr. Corrientes, Argentina. May, 2013. ©Roberto E. Vogler & Ariel A. Beltramino-2013

2.4 Existence of PRAs for this species

Please indicate if already PRAs for this species exist and which target areas and climatic conditions these cover (for suggestions of websites to check see guidance notes (e.g. [DoA Australia](#)))

Existing PRAs for *Achatina fulica* cover the USA, Australia, and South Africa. In the USA, a mini risk assessment was conducted by Venette and Larson (2004) (<https://www.inhs.illinois.edu/files/4713/4013/9195/afulicapra.pdf>), while in Australia, a risk assessment forms part of the 'Threat specific contingency plan for giant African Snail (GAS)' (<http://nurseryproductionfms.com.au/download/pest-contingency-plan-giant-african-snail/>). A PRA was also conducted in 2015 by the South African Department of Environmental Affairs for South Africa (https://www.environment.gov.za/sites/default/files/docs/riskassessment_forachatinafulica.pdf).

2.5 Biology/Ecology

Please provide background information relevant to your application covering the bullet points in box below whenever applicable; see also guidance notes

- **growth form and size:**

A. fulica is distinctive in appearance and is readily identified by its large size and relatively long, narrow, conical shell. Reaching a length of up to 20 cm, the shell is more commonly in the size range 5-10 cm. The colour can be variable but is most commonly light brown, with alternating brown and cream bands on young snails and the upper whorls of larger specimens. The coloration becomes lighter towards the tip of the shell, which is almost white. There are from seven to nine spirally striate whorls with moderately impressed sutures. The shell aperture is ovate-lunate to round-lunate with a sharp, unreflected outer lip. The mantle is dark brown with rubbery skin. There are two pairs of tentacles on the head: a short lower pair and a large upper pair with round eyes situated at the tip. The mouth has a horned mandible, and a radula containing about 142 rows of teeth, with 129 teeth per row. Eggs are spherical to ellipsoidal in shape (4.5-5.5 mm in diameter) and are yellow to cream in colour

(<https://www.cabi.org/isc/datasheet/2640>).

- **habitat:**

Despite its African origin, *A. fulica* is not confined to tropical environments. It exhibits wide environmental tolerances, and has invaded successfully in the tropics as well as in temperate landscapes. While its principal habitat is natural forests, it has also invaded cultivated land, plantations, disturbed areas, urban/peri-urban areas, riverbanks, wetlands, scrub and coastal areas. This species can reproduce in areas that are too dry for other large snails (Hardouin et al. 1995).

- **lifecycle (e.g. reproduction and dispersal):**

Reproduction - *A. fulica* reproductive potential is extremely high. It is hermaphroditic but must be externally fertilized (rather than self-fertilized). One fertilized snail can establish a population as it can lay up to 1,200 eggs per year. This snail stores sperm, and it can lay fertilized eggs repeatedly after just a single mating (Robinson 2002). After mating, individuals may lay viable eggs for up to 382 days (USDA-APHIS, 2005). Snail lifetimes range from 4.5 to 9 years. It has large eggs, 4.5 to 5.5 mm in diameter that are laid in the soil. The juveniles eat their eggshells before seeking other food including unhatched eggs and organic detritus (USDA-APHIS, 2005). They burrow and remain underground for 5-15 days. Very small and older individuals prefer feeding on detritus and decaying vegetation while snails with shell heights of 5 to 30 mm selectively feed on living vegetation (Fowler and Smith, 2003). Adult size is reached in about six months; after which growth slows but does not cease. Large adults can successfully aestivate (persist in a dormant condition) for 10 months while hatchling snails are restricted to about two months (Venette and Larson, 2004).

Behaviour - This species is nocturnal but may become active at twilight if the day is overcast and the soil is moist and warm. The snail is extremely sensitive to high rates of evaporation. Under moisture stress, it becomes inactive and begins aestivating within 24 hours. However, aestivation can occur independent of moisture. Scientists believe that aestivation may be cyclic. Snails may aestivate as they cling to objects, aiding in their inadvertent spread to new areas on cargo, vehicles or machinery. During unfavourable periods, the snail buries itself 10 to 15 cm (4 to 6 inches) deep in soft soil and may become inactive for up to a year, losing 60% of its weight.

Dispersal – *A. fulica* may travel up to 50 meters overnight (Mead 1979). However, in New Caledonia the snails were found to move an average of 250m per year. 125m per month (particularly in wet weather) should be taken into account for natural dispersal (EASA 2015). Juvenile snails tend to be the most active dispersers with some individuals moving 500m in six months while adults tend to have home ranges (Tomiyama & Nakane, 1993). The spread of *A. fulica* from its native range in East Africa is entirely due to transport by man, usually deliberate, but in a few cases accidental (CABI 2014). Eggs and snails accidentally become attached to agricultural machinery and vehicles and are readily transported in garden waste.

- **hosts:**

Annex 3.4 – PRA of Giant African snail for Cayman Islands

This snail feeds on more than 500 plant species specially stems, leaves, flowers or fruits of a broad range of agriculturally important plants (Bhattacharyya et al 2014). Young of *A. fulica* feed on decaying matter and unicellular algae. Animals with shells between 5 and 30 mm height were observed to prefer living plants (Rout and Barker 2002). It has been recorded on a large number of plants including most ornamentals, and vegetables and leguminous cover crops may also suffer extensively. The bark of relatively large trees such as citrus, papaya, rubber and cacao is subject to attack. The preference for particular plants at a particular locality is dependent primarily on the composition of the plant communities, with respect to both the species present and the age of the plants of the different species (Raut and Barker, 2002). Thakur (1998) found that vegetables of the genus Brassica were the most preferred food item from a range of various food plants tested. Crops in the Poaceae family (sugarcane, maize, rice) suffer little or no damage from *A. fulica*. Seedling plants are also preferred and most likely to be severely damaged (CABI 2015). It is a voracious herbivore, with individuals consuming around 10 per cent of their own weight daily (Schreurs, 1963). While *A. fulica* is mainly vegetarian there is recent evidence that it can also act as a predator of other snails (Meyer et al. 2008).

- **associated pathogens, pests or parasites:**

It is known to transmit the rat lungworm, *Angiostrongylus cantonensis* (Chen), which in humans produces eosinophilic meningitis (Kliks and Palumbo, 1992). This lungworm can be transferred to humans by eating raw, undercooked, infected snail meat and fluids, or contaminated vegetables.

In terms of plant diseases, *A. fulica* distributes in its faeces spores of *Phytophthora palmivora* in Ghana; *P. palmivora* is the cause of black pod disease of cacao (*Theobroma cacao*); the oomycete which also infects black pepper, coconut, papaya and vanilla (Raut & Barker 2002). *A. fulica* spreads *P. colocasiae* in taro and *P. parasitica* in aubergine (*Solanum melongena*) and tangerine (*Citrus reticulata*) (Mead 1961). 2013). Also, *A. fulica* can act as a host of parasites of wildlife and domestic animals, as reported in Brazil (Fischer and Costa, 2010).

- other:

2.6 What is the current distribution of the species

Consider: native range, history of introduction and invasion outside native range

Achatina fulica is native throughout the coastal area and islands of East Africa, ranging from Mozambique in the south, to Kenya and Somalia in the north (Cowie, 2010). It has also been established in other areas of Africa, including Ethiopia, Eritrea, Uganda, Burundi, Rwanda, Democratic Republic of Congo, Ivory Coast, Ghana, Malawi, Zambia, Zimbabwe, South Africa and Madagascar (CABI, 2015). The species owes most of its current wide distribution to human activity (Dharmaraja, 1984) and it is now present everywhere in the Indo-Pacific except Banaba Island, Cook Islands, Lord Howe Island, Nauru, Niue, Norfolk Island, Pitcairn Island, Tokelau, Australia and New Zealand, and has been eradicated from Tuvalu (Cowie, 2000). It was introduced to South America (Brazil) in the late 1980s as a commercial species and is now present in 25 out of 26 Brazilian states and has been found to be spreading in other countries on the continent (Vogler et al., 2013). It is also likely to have become an established part of the snail fauna of West Africa following reports from Côte d'Ivoire, Togo and Nigeria, and a shell has been identified in Morocco (van Bruggen, 1987), the first discovery of this species from anywhere in the Palearctic. In 1989 it was recorded on both Martinique and Guadeloupe in the Caribbean (Schotman, 1989). Since then, the species has spread the Eastern Caribbean islands (From Trinidad and Tobago to Antigua and Barbuda). It has recently established also in Cuba (2014) currently covering more than 14 provinces and the Bahamas. Furthermore, the species has established in Florida (USA) on two occasions. A first introduction attempt took place in 1966, but the population was later eradicated (USDA 2011). Recently, another population was identified in 2011, with a quarantine and eradication program still in place around Miami.

Part 3: Risk of accidental introduction, establishment and spread

3.1 Probability of entry/introduction

3.1.1 Has the species been introduced into other countries and/or have multiple introductions been reported

Yes, the species is a major invader globally. Currently it has successfully spread over a large number of countries in South America, Caribbean islands, Florida (USA), and the Indo-Pacific. Multiple introductions in the same country are very likely (e.g. Florida).

3.1.2 Has the species been intercepted in the territory in the past Please, check existing interception data in the territory

A. fulica is a priority pest and has never been recorded or intercepted in the Cayman Islands.

3.1.3 What are the likely pathways for the accidental introduction of the species?

Consider whether the species or some of its life-stages can easily be overlooked?

There is a huge risk of *A. fulica* being spread and introduced into new locations via trade routes. It is frequently moved with agricultural products, equipment, cargo, plants or soil matter. The snail ability to store sperm is a distinct advantage and could enable a founding population to form from just one individual. *A. fulica* may attach itself to vehicles. Small snails and eggs may be inadvertently transported with agricultural, horticultural, and other commercial products and machinery and the containers they are shipped in (Thiengo et al. 2007). Accidental transport with military equipment may be important (Mead 1961, in Thiengo et al. 2007). Other major pathways for introduction include transport on products, vehicles, containers, pallets and crating, flower pots and other earthenware, quarry products and ornamental rocks, machinery and heavy equipment (Manners and Duff 2015).

Snails may be inadvertently transported with personal belongings or deliberately as a pet (Thiengo et al. 2007). Smith and Fowler (2003, in Venette and Larson 2004) conducted a series of detailed pathway analyses describing the likely arrival of *A. fulica* and three other snail species into the continental US. Their analysis was based on pest interception records from January 1993-June 2003. Baggage constituted the main pathway for giant African snails. Of the 863 interceptions made, 673 were associated with baggage, and another 117 during inspections (Venette and Larson 2004).

3.1.4 What is the probability of the pest being associated with the pathway(s) at origin?

Please give any information available about: prevalence of pest in the source area; occurrence of life stage able to associate with consignment; volume and frequency of movement along the pathway; seasonal timing; pest management procedures applied at place of origin; for definition of probability see guidance notes 3.1.

The species can appear in high numbers in urban, peri-urban and agriculture environments, thus it is moderately possible that it can be inadvertently be attached to agriculture cargo, ornamental plants, landscape shipping, soil or personal luggage. The Cayman Islands' main trading partner is the United States, accounting for over 80 percent of total trade value. Others include Germany, Switzerland, the United Kingdom, Jamaica and Mexico (trade value COMTRADE database). Despite this trade pattern with USA, the species is currently only in Florida, with a very limited distribution in the Miami area, so the likelihood that the snail will be attached to any type of cargo currently remains relatively limited. Cuba might become a source of propagules of the species, but according to the COMTRADE database, trade with the Cayman Islands is mostly restricted to non-food products, so the risk of *A. fulica* being carried in cargo from Cuba is low at the moment if good inspection practices are in place. Still, an underlying risks remains as two species of exotic snails have already established on the island possibly by landscape

Annex 3.4 – PRA of Giant African snail for Cayman Islands

shipping cargo: the Banded Tree Snail (*Orthalicus undatus*) and the Cuban Garden snail (*Zachrysia provisoria*) ([Cayman Compass 2010](#)).

Another likely pathway for Cayman Islands is tourists and passengers from Florida, Cuba or other nearby Caribbean islands where the species is present. The species could be attached to luggage accidentally, particularly for passengers from rural areas or very heavily infested places (e.g. Miami and Antigua). Furthermore, there could be also attempts to import the species as a pet. Particularly in the USA there is a growing trend to keep this species as a pet, although it is illegal (see [change.org petition](#) to change the illegal status).

3.1.5 What is the probability of the pest surviving during transport?

Consider: speed and conditions of transport; duration and vulnerability of life cycle; previous interceptions of the pest; prevalence of pest; commercial procedures during transport (e.g. refrigeration)

The likelihood of survival during transport is very high under any form. The species can easily survive during consignment and transport either as egg or adult. Particularly as an adult in stress or low moisture conditions, it may aestivate as they cling to objects, aiding in their inadvertent spread to new areas on cargo, vehicles or machinery. During these unfavourable periods, it may become inactive for up to a year.

3.1.6 What is the probability of the pest evading existing biosecurity procedures? **Consider:** inspection methods and quality control; certification schemes; chemical treatment

Cargo from countries where it occurs are inspected at the point of entry in order to minimize the risk of entry. The FAO International Plant Quarantine Treatment Manual (FAO, 1981) describes protocols for treatments to eliminate infestations of *A. fulica* on non-plant cargo using hydrogen cyanide and cold treatments (Schotman, 1989). Passenger luggage is difficult to inspect and might be a major way of entry for the species.

3.1.7 What is the probability of transfer from entry point to a suitable host or habitat?

Consider: dispersal mechanisms, including vectors; number of destinations; proximity to suitable hosts; seasonality

The snail might move naturally or assisted by human movement (e.g. car) from the entry point to nearby vegetation. As it is a polyphagous species, any new area with some vegetation could be suitable as a first step for invasion. Thus, the probability of transfer to a suitable habitat is very high.

Summary probability of accidental introduction

Probability of introduction in next 10 years	Very unlikely <input type="checkbox"/>	Unlikely <input type="checkbox"/>	Moderately likely <input type="checkbox"/>	Likely <input type="checkbox"/>	Very likely <input checked="" type="checkbox"/>
Confidence	High confidence <input checked="" type="checkbox"/>	Medium confidence <input type="checkbox"/>	Low confidence <input type="checkbox"/>		

3.2 Probability of establishment

3.2.1 Does the territory provide suitable climatic and habitat conditions for the species to **survive** and **reproduce** under natural conditions unassisted or without human interference (e.g. cultivation, gardens)? **Consider:** climate similarity between the species global range and the PRA area, availability of the habitat conditions required by the species based on its behaviour elsewhere; identify/name specifically the climate/habitat it might survive? Which land-cover? Justify why and provide landmarks as examples; for definition of human interference see guidance notes 3.2.1

Annex 3.4 – PRA of Giant African snail for Cayman Islands

The Cayman Islands have suitable climatic conditions for the species to survive and reproduce as it has already been thriving in nearby territories with similar environmental conditions (e.g. Cuba and Florida). It exhibits wide environmental tolerances and has invaded successfully in the tropics as well as in temperature landscapes. It is a very generalist in terms of habitats so it might be able to survive in secondary forests, agriculture or gardens on the islands.

3.2.2 How likely can the species survive and reproduce indoors or similar habitats (e.g. polytunnels, gardens, urban area)? **Consider:** availability of the habitat conditions required by the species based on its behaviour elsewhere; identify/name specifically the conditions it might survive?

Very likely. Particularly it can survive in gardens and urban area feeding on ornamental plants and detritus.

3.2.3 (only for pests and diseases) If hosts or vectors are required, are these available in the PRA area? **Consider:** abundance of hosts and alternate hosts or vectors and how these are distributed in the PRA area; geographic proximity of hosts to pathway destinations; presence of other suitable species that could be new hosts; compare the known distribution of the pest with ecoclimatic zones in the PRA area; soil factors for soilborne pests; survival strategies; survival in protected cultivation

The species is very polyphagous feeding on more than 500 known species. Upon arrival it is very likely that it will feed on a wide range of plant species.

Summary probability of establishment

Probability of establishment in the wild	Very unlikely <input type="checkbox"/>	Unlikely <input type="checkbox"/>	Moderately likely <input type="checkbox"/>	Likely <input type="checkbox"/>	Very likely <input checked="" type="checkbox"/>
Confidence	High confidence <input checked="" type="checkbox"/>	Medium confidence <input type="checkbox"/>	Low confidence <input type="checkbox"/>		

3.3 Probability of spread

3.3.1 What is the potential spread in the territory? **Consider:** rate and distance of spread elsewhere; natural barriers in PRA area, the occurrence of a dispersal vector or commodity; see also guidance notes 3.3.1

- self-dispersal: this species is able to move around but in short distances, approximately 150 m/month under wet conditions. Adults stay in a home range while juveniles are prompt to cover longer distances.
- direct transport by humans: this is possible if snails are imported as pets. Under this situation, people could move it around the island in a very short time.
- transport via vehicles (e.g. boat, cars, including tyres): snails and eggs can attach to machinery, vehicles and agricultural products in rural areas or gardens. This is probably the fastest way of transport and can easily cover the whole range of the territory in a single year.
- wind drift or via driftwood: not possible
- water: not reported and unlikely
- transport via animals (e.g. berries digested by birds, seeds stuck to wool, etc.): very unlikely
- transport with vectors: not applicable

Annex 3.4 – PRA of Giant African snail for Cayman Islands

Based on these characteristics, we estimate a rate of more than 500 m/year in a combination of natural dispersal from introduction areas and rather frequent long jumps via human transport (mainly vehicles) to other parts of the island.

Summary probability of spread

How quickly can the species spread (excluding deliberately assisted by humans)	Less than 10 m/year. Can't occupy suitable habitats within next 100 years Very slowly <input type="checkbox"/>	Between 10 and 100 m per year. Suitable habitats are likely to be occupied between 50 and 100 years Slowly <input type="checkbox"/>	Between 100 and 500 m per year. Suitable habitats are likely to be occupied between 50 and 100 years Moderate pace <input type="checkbox"/>	> 500 m per year Can occupy suitable habits throughout the territory within 5 to 20 years Quickly <input checked="" type="checkbox"/>	Can occupy suitable habits throughout the territory within 5 years Very quickly <input type="checkbox"/>
Confidence	High confidence <input checked="" type="checkbox"/>	Medium confidence <input type="checkbox"/>	Low confidence <input type="checkbox"/>		

Part 4: Economic and environmental risks

It is important to look at the potential magnitude of the consequences, and to look at distribution effects (who bears risks). Consider potential maximum impact.

Please, **complete this section referencing supporting material**. Please, cite the material in the text and provide a description of where the information in the application has been sourced in the list of references (e.g. from in-house research, independent research, technical literature, community or other consultation, and provide that information with this application). If the information available is scarce, include information about related species (e.g. same genus or family) clearly indicating that it does not correspond to the organism being assessed.

4.1 Risks recorded from outside the territory, which are applicable to the territory

4.1.1 Is the species listed in the following Plant Protection organizations and Invasive lists and if so, what is its status?

America

COSAVE: not in quarantine as it has spread in most South American countries

NAPPO: [regulated eradication areas](#) in Florida. Pest alerts in [Antigua](#) (2008). Quarantine pest in Canada (2019), Mexico (2018) and USA (1994)

OIRSA: not reported

Europe

EPPO: A1 list (1992), A2 list (1993) <https://gd.eppo.int/taxon/ACHAFU/categorization>

EC Plant Health Directive (Council Directive 2000/29/EC): yes/no

Africa

ARC: not mentioned

Others:

CABI CPC

CABI ISC <https://www.cabi.org/isc/datasheet/2640>

GISD <http://www.iucngisd.org/gisd/species.php?sc=64>

Other organizations relevant for the territory (e.g. regional, national...)

China: A2 list (1993) <https://gd.eppo.int/taxon/ACHAFU/categorization>

Israel: – quarantine pest 2009 <https://gd.eppo.int/taxon/ACHAFU/categorization>

Annex 3.4 – PRA of Giant African snail for Cayman Islands

4.1.2 Is there any negative impact of the species on the economy, environment or public health recorded from any parts of its current distribution? Please provide a summary of the available information

Extracted from CABI CPC and ISC datasheets:

Agriculture and ornamental plant: It is difficult to quantify the damage inflicted by *A. fulica* to gardens and crops, but suffice to say that it is considered by most authorities to be the most damaging land snail in the world. However, Civeyrel and Simberloff (1996) believe that the damage done to endemic species of snail by ill-judged biological control programmes outweighs the impact of the pest species. The dramatic population crashes commonly observed in populations of *A. fulica* which had increased rapidly in size following introduction into new environments, may well lessen the deleterious long-term economic impact of the species, though it remains a serious pest in many areas. Raut and Barker (2002) cite several examples of the production of some crops that has proved unsustainable in certain infested areas. Indirectly, *A. fulica* may have an impact as a vector of plant diseases as it has been implicated in the transmission of *Phytophthora palmivora* (Raut and Barker, 2002).

Environment: Cowie (ISSG, 2003) believes the agricultural impacts of *A. fulica* may have been exaggerated, the nuisance factor perhaps being more important. By reaching such enormous numbers and invading native ecosystems they also pose a serious conservation problem by eating native plants, modifying habitat, and probably out-competing native snails. The species might feed also on native slugs and snails. Currently, this behaviour has been only reported in Hawaii for veronicellid slugs (Meyer et al 2016). Therefore, the impact of the species might be very context dependent varying upon the ecosystem (availability of predators or highly palatable species among the endemic flora). For instance, O’Loughlin and Green (2017) did not identify significant impact on litter or seedlings dynamics in rainforests of Christmas Island. On the other hand, there are cases on islands where the species has impacted heavily on rare endemic flora (e.g. Reunion island: Meyer and Picot 2001)

Public health: Perhaps the biggest social impact wrought by *A. fulica* is its nuisance value as large numbers of snails build up. Not only are they unsightly but cadavers smell and create a mess, especially where they are run over by traffic, which invariably happens during rapid growth of numbers. Additionally, empty shells can act as breeding sites for mosquito larvae of different species (CABI, 2014, Jayashankar and Reddy, 2010). *A. fulica* can act as a vector of the human disease, eosinophilic meningitis, which is caused by the rat lungworm parasite, *Angiostrongylus cantonensis*. The parasite is passed to humans through eating raw or improperly cooked snails or freshwater prawns. It is therefore advisable to wash one’s hands after handling the snail. However, Cowie (2000, 2013) states that many other introduced snails in the tropics are vectors of this parasite and the spread of the disease has not definitively been related to the spread of *A. fulica*. In addition, *A. fulica* can act as a vector for another congeneric species, *A. costaricensis*, which is important from a public health standpoint as the causative agent of abdominal angiostrongyliasis, a zoonosis recorded from southern USA to northern Argentina (Thiengo et al., 2007, 2013). It has been also reported that it can transmit and a gram-negative bacterium, *Aeromonas hydrophila*, which causes a wide range of symptoms (Mead 1961).

Animal health: *A. fulica* can act as a host of parasites of wildlife and domestic animals, as reported in Brazil (Fischer and Costa, 2010).

4.2 Economic and socioeconomic effects

4.2.1 Could the species have any negative effect on economic activities in the territory? Please include any information about specific assessments from areas outside the PRA area including experiences with closely related species with relevance for the area of interest (**consider:** reduction in crop yield or quality; reduction in prices or demand, including export markets; increase in production costs (including costs of control); vectoring of other pests of economic importance; extent of phytosanitary regulations imposed by importing countries)

Annex 3.4 – PRA of Giant African snail for Cayman Islands

- agriculture: the impact could be high considering the small agriculture business of the territory. If populations of the snail become very large, farmers might need to spend time and resources controlling the pest (thus medium impact).
- livestock: none
- fisheries: none
- aquaculture: none
- forestry: none
- tourism: if large numbers it might become a nuisance to tourists. This is difficult to predict so the confidence is medium to low
- recreational potential: if large numbers it might become a nuisance and change the aesthetics of the landscape (e.g. accumulation of shells).
- infrastructure: none
- employment rates: none
- other:

4.2.2 Are there any risks of impacts on cultural valuable species, habitats, landscapes, practices or other values? Please include any information about specific assessments from areas outside the PRA area including experiences with closely related species with relevance for the area of interest

- competition with cultural valuable species: not found
- impact on historically valuable practices: not found
- change of landscape: if large numbers it might become a nuisance and change the aesthetics of the landscape (e.g. accumulation of shells).
- value of landscape for recreation: none
- other:

Summary economic and socioeconomic impacts

Make sure the summary score is well linked with the information reported above so the scoring is fully justified (for more information risk levels see guidance notes)

Risk of socioeconomic impact	Very small <input type="checkbox"/>	Small <input type="checkbox"/>	Medium <input checked="" type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
Confidence	High confidence <input type="checkbox"/>	Medium confidence <input checked="" type="checkbox"/>	Low confidence <input type="checkbox"/>		

4.3 Impact on public health

4.3.1 Could there be any impact on public health? **Consider:** Can the species be disease-causing or be a parasite, or be a vector or reservoir for human diseases?

The main impact could be as a nuisance due to the big numbers that could occur (medium impact). In terms of health problems, it might transmit a serious disease but only if people eat them raw or uncooked. Local cuisine includes whelks so people might be familiar with cooking or eating snails, which increase the likelihood of confusion (thus confidence medium). Nevertheless, with proper guidelines and awareness raising such risks can be well mitigated

Summary public health impact

Risk of impact on public health	Very small <input type="checkbox"/>	Small <input type="checkbox"/>	Medium <input checked="" type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
---------------------------------	-------------------------------------	--------------------------------	--	--------------------------------	-------------------------------------

Annex 3.4 – PRA of Giant African snail for Cayman Islands

Confidence	High confidence <input type="checkbox"/>	Medium confidence <input checked="" type="checkbox"/>	Low confidence <input type="checkbox"/>		
------------	--	---	---	--	--

4.4 Impact on animal health

Could there be any impact on animal health? **Consider:** Can the species be disease-causing or be a parasite, or be a vector or reservoir for animals?

The only risk reported elsewhere is that the species could act as reservoir of parasites for pets and wildlife (in Brazil). However, it seems that it hasn't been researched enough so our confidence is very low.

Summary animal health impact

Risk of impact on animal health	Very small <input type="checkbox"/>	Small <input checked="" type="checkbox"/>	Medium <input type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
Confidence	High confidence <input type="checkbox"/>	Medium confidence <input type="checkbox"/>	Low confidence <input checked="" type="checkbox"/>		

4.5. Environmental and ecosystem effects

4.5.1 Are there any threats to native or endemic species? Indicate direct effects on native species; note any aspects related to pollination of native species should be covered in the following question (**consider:** threat to endangered species; impact on keystone species; changed community structure; hybridization with native species)

Possibly the main threat could be the impact on the endemic snails identified on the island: *Cerion copium* (Conchology), *Cerion nanus*, *Strophlops acuta*, *Cerion caymenense*, *Tudora rosenbergiana*, *Chondropoma caymanense*, *Cyclopilsbrya fonticula*, and *Alcudia lewisi* (see [references](#)). Particularly, for *Cerion nanus*, a medium-sized terrestrial snail naturally occurring only in a small patch of dry shrubland in Little Cayman. Potential impacts could be transmission of diseases and direct competition or predation as it has been identified for other snail species (e.g. O'Loughlin and Green 2017). Due to its voracious character the species might also affect the native flora. However, this impact is difficult to evaluate without a proper host-range testing to endemic flora.

4.5.2 What is the level of potential negative impact on ecosystem services in the PRA area? (**consider:** provisioning services (freshwater, wood and fibre, fuel); regulating services (soil formation, natural hazards, water and air quality); cultural services (aesthetic, educational, recreational, spiritual); supporting services (nutrient cycling, habitat stability; pollination) see also guidance notes 4.5.2)

Mostly the impact could be aesthetic and recreational due to the large number of snails and the accumulation of shells in key and valuable natural areas.

Summary environmental impact

Risk of environmental impact	Very small <input type="checkbox"/>	Small <input type="checkbox"/>	Medium <input type="checkbox"/>	Large <input checked="" type="checkbox"/>	Very large <input type="checkbox"/>
Confidence	High confidence <input type="checkbox"/>	Medium confidence <input type="checkbox"/>	Low confidence <input checked="" type="checkbox"/>		

Part 5: Pest risk management

5.1 Prevention

Annex 3.4 – PRA of Giant African snail for Cayman Islands

5.1.1 Which measures **already** in place are suitable to minimise the risk of introduction and establishment **Consider:** inspection of commodities; trapping, disrupting specific pathways, etc.

- **Pre-border:** all plant imports originates in USA. Most of the nursery stock are imported from Florida where all nursery desirous of exporting plants to the Cayman Islands must sign a compliance agreement for quarantine treatment and phytosanitary certificate with the Florida Department of Agriculture. One Cayman Islands inspector is assigned to monitor the eradication program and map of the quarantine zones in Florida, no plants are allowed form nurseries within the quarantine zones.
- **At the border: 100%** inspection of agriculture and ornamental plants cargo and selection of passengers from high risk territories especially where used as a source of food.
- **Post-border:**
 - There are proposed actions to monitor remaining populations of *Cerion nanus* which could help as early warning of the arrival of *A. fulica*. ([National Biodiversity Plan 2009](#)). The populations of *Cerion nanus* have been monitored unregularly but no specific surveys are being done on an annual basis. In grand Cayman the department of environment frequently receives sighting reports from the public of unusual fauna. The invasive banded tree snail (which looks similar to the *A. fulica*) is sometimes brought in mistaken *for A. fulica*. We also do spot checks of protected areas and note look for invasive species sporadically. Currently, Dept. of Environment do have cargo inspections on Little Cayman but they are not strict and would likely miss well-hidden snails or eggs.
 - Plant health inspectors conducts monthly targeted sentinel site monitoring for specific pests, the month of October is specifically for mullusca. Plant nurseries sites where plants are offloaded conducts regular baiting with 4% Metaldehyde any siting would be reported to Department of Agriculture.
 - Environmental awareness of citizens to collaborate in preventive and monitoring measurements. Department of Agriculture has an empty shell received from a training that is used at every annual agricultural show/expo for public education and awareness.

5.1.2 Which measures **not yet** in place are suitable to minimise the risk of introduction and establishment **Consider:** inspection of commodities; trapping, disrupting specific pathways, etc.

- **Pre-border:** environmental awareness of tourists and personal yachts. More strict protocols for agriculture, ornamental plant products, machinery and soil from countries where the species occurs including pre-departure inspections and preventive treatments during transport and confinement (e.g. cold treatment, hydrogen cyanide, molluscicides pellets) based on the potential risk. Control of online purchases and illegal tenancy of terrestrial snails as pets or food source.
- **At the border:** environmental awareness of tourists and personal yachts. Inspection of luggage of passengers from infected countries could be increased. Trapping at the place of entry and inspection.
- **Post-border:** trapping and monitoring at the sites where used vehicles and construction materials are stored Strict and detailed inspection of vehicles and cargo to Little Cayman island.

Summary efficacy of current prevention measures from 5.1.1

Probability of prevention measures being effective	Very unlikely <input type="checkbox"/>	Unlikely <input type="checkbox"/>	Moderately likely <input checked="" type="checkbox"/>	Likely <input type="checkbox"/>	Very likely <input type="checkbox"/>
--	--	-----------------------------------	---	---------------------------------	--------------------------------------

Annex 3.4 – PRA of Giant African snail for Cayman Islands

Confidence	High confidence <input type="checkbox"/>	Medium confidence <input type="checkbox"/>	Low confidence <input checked="" type="checkbox"/>		
------------	--	--	--	--	--

Summary efficacy of proposed prevention measures from 5.1.2

Probability of suitable future prevention measures being effective	Very unlikely <input type="checkbox"/>	Unlikely <input type="checkbox"/>	Moderately likely <input type="checkbox"/>	Likely <input checked="" type="checkbox"/>	Very likely <input type="checkbox"/>
Confidence	High confidence <input type="checkbox"/>	Medium confidence <input checked="" type="checkbox"/>	Low confidence <input type="checkbox"/>		

5.2 Control

5.2.1 What existing control measures available in the territory for the control of other pests can provide adequate control to mitigate the risks described above? **Consider:** cultural practices e.g. irrigation, planting, harvesting methods etc.; pest control programmes; natural enemies; please link to effectiveness, practicality, costs, negative consequences and acceptability

- Eradication: Refer to rapid response protocol for the eradication of *A. fulica* adopted from Bermuda using surveillance and different mechanical and chemical methods.
- Containment to prevent further spread: Activate the Plants Law to restrict the movement of materials from infested area to further prevent the spread.
- Mechanical/chemical control: on the Cayman Islands there are already two introduced species of snails which are becoming a problem in gardens: the Banded Tree Snail (*Orthalicus undatus*) and the Cuban Garden snail (*Zachrysia provisory*). The introduction has been reported in local media so citizens are aware of different types of control (e.g. trapping with beer bait, and Metaldehyde pellets and slug fest liquid).
- Biological control: not known on the territory
- Other (provide additional information):

5.2.2 What additional control measures currently not available in the territory can provide adequate control to mitigate the risks described above? **Consider:** cultural practices e.g. irrigation, planting, harvesting methods etc.; pest control programmes; natural enemies; please link to effectiveness, practicality, costs, negative consequences and acceptability

- Eradication: design specific eradication action plans in case of arrival. Get recommendations from eradication program in Florida. After first identification on September 2011, the Government established an intensive control program. As November 2012, the program had already surveyed, nearly 58,800 properties, collected 101400 snails and provided 22,748 treatments with iron phosphate or boric acid bait ([USDA-APHIS 2013](#)). In February 2013 another molluscicide, metaldehyde, was approved for the program ([FONSI 2013](#)). In 2012, quarantine areas where the species was found were identified and regulated. Strict regulatory protocols were put in place for domestic quarantine for *A. fulica*, restricting any interstate movement of regulated articles (plants, plant parts, yard waste and material capable of transporting snails) from quarantine areas without valid phytosanitary certificates. At the moment, the eradication problem is still ongoing in [8 zones](#) but fortunately several zones have been already released from quarantine thanks to the eradication efforts.
- Containment to prevent further spread: implement quarantine areas and restrict movement of soil and plant material.
- Mechanical/chemical control: For recent tests on efficacy of molluscicides see Smith et al 2013 where an iron-based bait is recommended as moderately higher mortality rate (49%) and more

Annex 3.4 – PRA of Giant African snail for Cayman Islands

environmentally friendly than other options such as metaldehyde-based products. As *A. fulica* is primarily a pest in areas of human habitation, physical control can often be as effective as any other means where they congregate in large numbers. Physical control relies primarily on the collection and destruction of the snails from infested sites, so citizen participation is essential.

- biological control: Mead (1961) reviewed in considerable depth all the species of animals, from microbes to mammals, that either prey on *A. fulica* or may do so given the opportunity, and assessed their potential as biological control agents. Those species that offered the best potential prospects, namely predatory insects and molluscs, had a major drawback: they either failed to survive or become established on introduction, or they were likely to pose a serious potential threat to native species if they did. Thus, considering the occurrence of endemic snails on the territory this method should be well studied in advanced in order to avoid any non-target effects.
- Other (provide additional information):

Summary efficacy of current control measures from 5.2.1

Probability of control measures being effective	Very unlikely <input type="checkbox"/>	Unlikely <input checked="" type="checkbox"/>	Moderately likely <input type="checkbox"/>	Likely <input type="checkbox"/>	Very likely <input type="checkbox"/>
Confidence	High confidence <input type="checkbox"/>	Medium confidence <input checked="" type="checkbox"/>	Low confidence <input type="checkbox"/>		

Summary efficacy of proposed control measures from 5.2.2

Probability of suitable future control measures being effective	Very unlikely <input type="checkbox"/>	Unlikely <input type="checkbox"/>	Moderately likely <input type="checkbox"/>	Likely <input checked="" type="checkbox"/>	Very likely <input type="checkbox"/>
Confidence	High confidence <input type="checkbox"/>	Medium confidence <input checked="" type="checkbox"/>	Low confidence <input type="checkbox"/>		

Other information

Add here any further information you wish to include in this application including if there are any ethical considerations that you are aware of in relation to your application

Is there a need for a more detailed PRA or for more detailed analysis of particular sections of the PRA? (For completion by the Biosecurity group only!)

No Yes

If yes, please forward to FERA or NNS or other suitable organisations

References and information sources consulted

CABI. 2013 *Achatina fulica* (giant African land snail). CABI Invasive Species Compendium. Reviewed by: Vogler R E. Beltramino, A. <https://www.cabi.org/isc/datasheet/2640#E7E741AF-31FE-441D-9548-028185D004E2>

Annex 3.4 – PRA of Giant African snail for Cayman Islands

Cowie R. 2010. *Achatina fulica* (mollusc) (on line). Global Invasive Species Database. <http://www.iucngisd.org/gisd/species.php?sc=64>

Environmental Affairs South Africa (EASA). 2015. Risk Assessment on *Achatina fulica* https://www.environment.gov.za/sites/default/files/docs/riskassessment_forachatinafulica.pdf

Fischer ML, Costa LCM, 2010. O Caramujo Gigante Africano *Achatina fulica* no Brasil ([English title not available]). Curitiba, Brazil: Champagnat Editora, 269 pp
Hardouin J., C. Stievenart & J.T.C. Codjia. 1995. L'achatiniculture - Revue Mondiale de Zootechnie (FAO-AGA; Roma) 2 (83): 29-39.

lii, W. M. M., Hayes, K. A., & Meyer, A. L. (2008). Giant African snail, *Achatina fulica*, as a snail predator. *American Malacological Bulletin*, 24(1), 117–119. doi: 10.4003/0740-2783-24.1.117

O'Loughlin, L. S., & Green, P. T. (2017). The secondary invasion of giant African land snail has little impact on litter or seedling dynamics in rainforest. *Austral Ecology*, 42(7), 819–830. doi: 10.1111/aec.12504

Manners A. and Duff, J. (2015) Threat specific contingency plan for giant African Snail (GAS). Queensland Department of Agriculture, Fisheries and Forestry. 33pp

Mead AR. 1961. The Giant African snail: a problem in economic malacology. The University of Chicago Press, USA;

Meyer, W.M., K.A. Hayes & A.L. Meyer. 2008. Giant African snail, *Achatina fulica*, as a snail predator, *American Malacological Bulletin* 24(1): 117-119.

Meyer JY, and Picot F (2001) achatines attack! The impact of giant african land snails on rare endemic plants in la réunion island (MASCARENE IS., INDIAN OCEAN). Aliens ISSG Num 14 http://www.issg.org/pdf/aliens_newsletters/A14.pdf

O'Loughlin, L. S., & Green, P. T. (2017). The secondary invasion of giant African land snail has little impact on litter or seedling dynamics in rainforest. *Austral Ecology*, 42(7), 819–830. doi: 10.1111/aec.12504

Raut, S.K. & G.M. Barker. 2002. *Achatina fulica* Bowdich and Other Achatinidae as Pests in Tropical Agriculture. In: Barker (Ed.) *Molluscs as Crop Pests*. CABI.

Robinson, D. G. 2002. Introduction to Giant African Snail. Presentation to Giant African Snail Workshop. Inter-American Institute for Cooperation on Agriculture and Ministry of Agriculture, Forestry and Fisheries, Rodney Bay, St. Lucia, December 4-5, 2002. Unpublished.

Tomiyama K & Nakane M (1993) Dispersal patterns of the giant African snail *Achatina fulica* (Ferussac) (Stylommatophora: Achatinidae), equipped with a radio transmitter. *Journal of Molluscan Studies* 59: 315-322.

USDA-APHIS. 2005. *New Pest Response Guidelines. Giant African Snails: Snail Pests in the Family Achatinidae*

USDA-APHIS-PPQ-Emergency and Domestic Programs-Emergency Planning, Riverdale, Maryland. http://www.aphis.usda.gov/import_export/plants/manuals/index.shtml

Annex 3.4 – PRA of Giant African snail for Cayman Islands

USDA-APHIS 2011 Giant African Snail Cooperative Eradication Program: Miami-Dade county, Florida.
https://www.aphis.usda.gov/plant_health/ea/downloads/GAS-MiamiEA.pdf

USDA-APHIS 2013 Giant African Snail Cooperative Eradication Program: Environmental Assessment Supplement https://www.aphis.usda.gov/plant_health/ea/downloads/2013/GAS-metaldehydeEAsupplement.pdf

Smith, T. R., White-Mclean, J., Dickens, K., Howe, A. C. & Fox, A. Efficacy of Four Molluscicides Against the Giant African Snail, *Lissachatina fulica* (Gastropoda: Pulmonata: Achatinidae). *flen* 96, 396–402 (2013).
Thakur S, 1998. Studies on food preference and biology of giant African snail, *Achatina fulica* in Bihar. *Journal of Ecobiology*, 10(2):103-109

Thiengo, S.C., F.A. Faraco, N.C. Salgado, R.H. Cowie & M.A. Fernandez. 2007. Rapid spread of an invasive snail in South America: the giant African snail, *Achatina fulica*, in Brasil, *Biol Invasions* 9: 693-702.

Venette, R.C. and Larson, M. 2004. Mini Risk Assessment Giant African Snail, *Achatina fulica* Bowdich [Gastropoda: Achatinidae]. Available <https://www.inhs.illinois.edu/files/4713/4013/9195/afulicapra.pdf>

Vogler R.E., Beltramino A.A., Sede M.M., Gutiérrez Gregoric D.E., Núñez V., and Rumi A. 2013. The giant African snail, *Achatina fulica* (Gastropoda: Achatinidae): Using bioclimatic models to identify South American areas susceptible to invasion. *American Malacological Bulletin*, 31(1):39-50.

Vogler R E. Beltramino, A A. 2013 *Achatina fulica* (giant African land snail). *CABI Invasive Species Compendium* <https://www.cabi.org/isc/datasheet/2640#E7E741AF-31FE-441D-9548-028185D004E2>

Appendices and referenced material (if any) and glossary (if required)

In case this is an application made for the deliberate introduction of a species/commodity it is recommended that you contact a member of the biosecurity group as early in the application process as possible. Biosecurity can assist you with any questions you have during the preparation of your application including providing advice on any consultation requirements.

Unless otherwise indicated, all sections of this form must be completed for the application to be formally received and assessed. If a section is not relevant to your application, please provide a comprehensive explanation why this does not apply.

Commercially sensitive information must be included in an appendix to this form and be identified as confidential. If you consider any information to be commercially sensitive, please show this in the relevant section of this form and cross reference to where that information is located in the confidential appendix.

Any information you supply to biosecurity prior to formal lodgement of your application will not be publicly released. Following formal lodgement of your application any information in the body of this application form and any non-confidential appendices will become publicly available.