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**MAINSTREAMING PREVENTION AND CONTROL MEASURES FOR INVASIVE
ALIEN SPECIES INTO TRADE, TRANSPORT AND TRAVEL ACROSS THE
PRODUCTION LANDSCAPE**

**Biosecurity protocols for the transportation of
vessels, cargo and people between islands,
with special reference to protected areas and
islands of high biodiversity value**



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Acronyms

CBD: Convention on Biological Diversity
DoE: Department (or Division) of Environment (now Environment Department)
ED: Environment Department of MEE (formerly DoE)
FAO: Food and Agriculture Organisation of the United Nations
FFEM: Fonds Français pour l'Environnement Mondial (= French GEF)
GEF: Global Environment Facility
GIS: Geographic Information System
GIF: Green Islands Foundation
GISD: Global Invasive Species Database
GoS: Government of Seychelles
GPS: Global Positioning System
IAS: Invasive Alien Species
IBA: Important Bird Area
ICS: Island Conservation Society – Fondation pour la Conservation des Îles (Seychelles)
IDC: Islands Development Company
ISSG: Invasive Species Specialist Group
IUCN: International Union for the Conservation of Nature
MEE: Ministry of Environment and Energy
MWF: Mauritian Wildlife Foundation
NBSAP: National Biodiversity Strategy and Action Plan
NGO: Non-governmental Organisation
NS: Nature Seychelles
NZ: New Zealand
PII: Pacific Invasives Initiative
SAA: Seychelles Agricultural Agency
SIF: Seychelles Islands Foundation
SNPA: Seychelles National Parks Authority
UNDP: United Nations Development Programme

Definitions related to invasive species and biosecurity (From Rocamora & Henriette 2015, in press)

Abatement measures: A series of strict procedures, pertaining to aspects of shipping and aerial transport (such as storage, loading, unloading, pest-proof rooms) aimed at reducing to nearly zero the risk of introducing or reintroducing invasive species. Abatement measures are preventive measures to minimise (abate) the risks of invasion or reinvasion.

Biosecurity: Efforts to prevent the spread of invasive species to islands and sites that are currently free of them, and to reduce risks to the economy, environment and human health through measures that involve prevention, surveillance, exclusion, incursion response, mitigation, adaptation, control and eradication.

Containment: Keeping an invasive species within a defined area.

Contingency: Response to incursion of an invasive species, usually involving a plan to ensure that all needed actions, requirements and resources are in place to eradicate it or bring it under control.

Control: Reducing the density and/or distribution of an invasive species below a pre-defined acceptable level.

Endemic: A native species, *race* (subspecies) or other plant or animal category that is naturally restricted and unique to a particular geographic region or island.

Eradication: The removal of the entire population of an invasive species from an island.

Establishment: The situation in which members of a species are engaging in successful reproduction in a new habitat/island, sufficient to ensure the continued survival of the population.

Indigenous: Refers to a native taxon that occurs naturally - but not exclusively - at the geographical area under consideration.

Introduction / introduced species: Plants, animals and other organisms taken beyond their natural range by people, deliberately or unintentionally; this includes any part, gametes, seeds, eggs, or propagule that might survive and subsequently reproduce. This movement can be within a country, between islands, between countries or continents.

Invasion: The establishment and successful reproduction of an introduced species, and its spread in areas distant from its sites of introduction; this normally has a detrimental effect on native species when it affects natural habitats.

Mitigation: Reducing the likelihood that a risk occurs and/or reducing the impact of the risk if it has already occurred.

Native species: Plants, animals and other life forms that occur naturally on an island or in a specified area, having evolved there or arrived there without human intervention.

Naturalised: Applies to non-native (introduced) organisms which survive in the wild and reproduce successfully to self-sustain their populations. Naturalised species become invasive when they spread into areas distant from its sites of introduction.

Non-target species: Species not meant to be affected by control or eradication operations.

Pathway: The means (e.g. aircraft, vessel), purpose or activity (e.g. agriculture, forestry, horticulture), or a commodity (e.g. timber) by which an alien species may be transported to a new location, either intentionally or unintentionally.

Pest: Normally used in an agricultural sense to refer to an invasive plant (weed) or animal.

Quarantine: Official confinement of living organisms in complete isolation for further inspection, testing and/or treatment as part of biosecurity measures.

Re-invasion: The re-establishment of an invasive species that had been eradicated.

Surveillance: A routine monitoring process to detect the arrival of new incursions of invasive species, as part of biosecurity.

Invasive Alien Species in Seychelles: some background information

(From Rocamora & Henriette 2015, in press)

Invasive species are now considered to be the second biggest threat to the biodiversity of the planet (after habitat destruction), and their consequences represent a huge cost to human societies worldwide. The impacts of invasive species can be extremely severe and often irreversible. The environmental damage is huge; they displace and eliminate native species, and alter the functioning of ecosystems, a problem that is particularly acute in protected areas (Foxcroft et al. 2013). Invasive species have been responsible for the extinction or the decline of many species worldwide, particularly on oceanic islands. Introduced invasive species have seriously impacted Seychelles ecosystems. The ecological trauma that occurred on the archipelago following human colonisation, which started only in 1770, is in great part due to the simultaneous arrival of humans and invasive species (see for example Cheke 2010)...

The arrival of so many new plant competitors, the combined negative effects of introduced insects that cause increased defoliation or compete with natural pollinators, and invasive seed-eating rodents, have considerably disturbed the biology of the plant communities. Apart from outcompeting native vegetation, alien invasive plants indirectly affect native animals too (herbivores, frugivores or insectivores). Some native insects, for example, may have drastically declined because of the extreme rarefaction of their host plants. Invasive plants or animals may also constitute a food source for a predator that will increase in numbers and provoke the decline of native prey species. These trophic cascading effects can generate tremendous indirect impacts on many species and on the functioning of the whole ecosystem (Simberloff 2014). The impact of introduced invasive mammals such as rats and cats, which are known to be responsible for many extinctions and population declines of native species of vertebrates on islands worldwide, has also been tremendous in Seychelles ...

In the past, most attempts to mitigate, control or eradicate invasive species in Seychelles were directed at those invasive species that negatively impacted economically important activities such as agriculture (crops, coconut production, farming) or threatened public health (through mosquito or rat-transmitted diseases). However, during the last 15 to 20 years, efforts have also been directed towards invasive species that threaten native biodiversity, particularly those affecting species found only in Seychelles and threatened with global extinction. During this period, island rehabilitation activities have been undertaken on a minimum of 22 small and middle sized islands, and have involved the eradication of introduced predatory animals, control of invasive plants and replanting of native trees. As a result of this process, individuals of rare endemic species that had been restricted to only a handful of predator-free islands, or those whose natural habitat was vanishing could be transferred to the rehabilitated islands, thereby creating alternative populations that prevented their extinction. The conservation successes achieved by restoring small islands are all based either on the effective eradication or exclusion of introduced predators and competitors, and on the control and elimination of invasive plants. Seychelles has gained considerable experience and is now considered a leading country in this field in the tropical world.

1. Developing biosecurity protocols

Biosecurity can be defined as “efforts to prevent the spread of invasive species to islands and sites that are currently free of them, and to reduce risks to the economy, environment and human health through measures that involve prevention, surveillance, exclusion, incursion response, mitigation, adaptation, control and eradication”.

Box: Some key fundamental principles regarding biosecurity

- **Prevention is better than cure:** preventing colonisation is more effective and cheaper than management measures after invasives have become established. Border control and strict abatement measures must be the first line of defence.
- **Early detection & rapid reaction: eliminate invaders quickly.** When preventive measures fail, locating the invaders before they have a chance to establish and spread is key to their successful eradication.
- **Principle of precaution:** In cases of uncertainty and insufficient scientific knowledge to accurately assess either the risk of a species becoming invasive, or its present or future impact, one should assume that impacts will occur and action should be taken to prevent the species from spreading or becoming established.

The aim of this report is to provide basic biosecurity protocols for the transportation of vessels, people and goods between islands in Seychelles, with special reference to protected areas and islands of high biodiversity value. It also aims at identifying *priority species* already present in Seychelles and requiring a special attention as confirmed or potential invasive species.

This report provides general information and guidelines for the transportation of vessels, people, goods, equipment, material, vegetal and animal creatures (including parts of them or propagules) and any kind of cargo between islands. It focuses on protocols that have been tested (or partly tested) in Seychelles and in other parts of the world, so that they can be adapted and integrated into the management plans of the numerous and very diverse protected areas and islands of high biodiversity value in Seychelles. This includes:

1. Establishing preventive or ‘abatement’ measures and ‘quarantine’ protocols to reduce the risk of invasion;
2. Maintaining surveillance for IAS that may succeed in by passing the above;
3. Initiating emergency procedures to prevent their establishment and colonisation in case of IAS incursion.

This report focuses only on protocols to prevent the spread of IAS within Seychelles, in particular to protected areas and islands of high biodiversity value. A section summarises

simplified procedures that can be applied for the transportation of vessels, goods and people between islands in general, including those non-protected or not considered of high biodiversity value. It does not cover biosecurity protocols for marine invasive species (see Rocamora & Henriette, 2015, in press for summarised information on marine IAS in Seychelles).

Prevention and early detection are the two main principles from which biosecurity protocols and management options can be developed (see Figure 1 below).

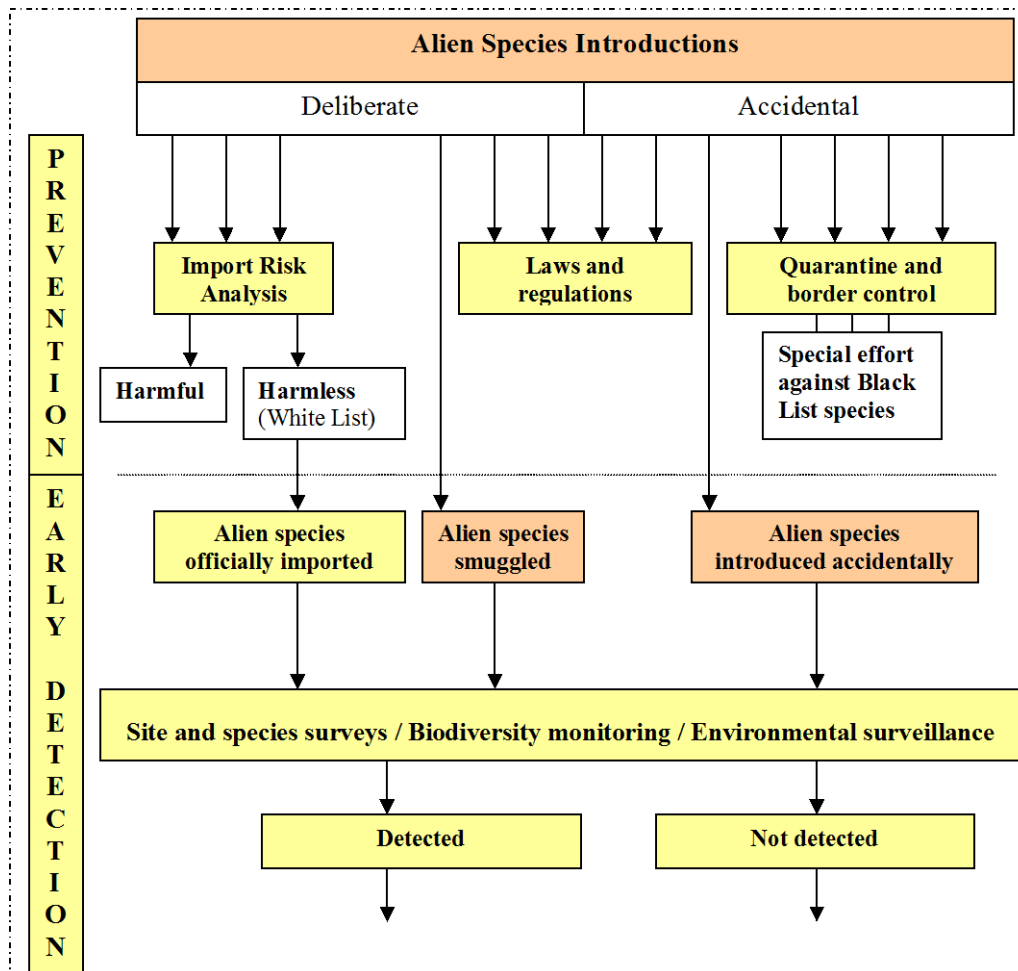


Figure 1. Management options to deal with alien species introductions (Rocamora & Henriette, 2015; after Wittenberg and Cock, 2001). The prevention scheme will result in three different groups of species (authorized, smuggled and accidentally introduced) passing through it and entering the country. Yellow boxes: areas where we can and should act. Orange boxes: areas out of our control.

Box: Why do we need biosecurity protocols?

To prevent introduction of IAS

(The ‘prevention is better than cure’ principle)

- Reducing significantly (eliminating) the risk of introduction.
- Reducing significantly (eliminating) the risk of survival in case introduction has happened.

To prevent survival and establishment of IAS

(The ‘eliminate invaders quickly’ principle when conducting incursion response)

- Improving detection and monitoring methods.
- Improving eradication techniques.

1.1. Policy & Legislation

Seychelles already has a number of national policies and legislation related to biosecurity and Invasive Alien Species.

Policy

- ‘Broad Biosecurity Policy’ (2011) developed between MNR, MoH, MEE to address effects of pests, diseases and IAS to people and environment of Seychelles.
- Seychelles Biosecurity Strategy (2012).

Legislation

- Plant Pests Act [19th June, 1925]
- Plant Protection Act [1st August, 1996]
- Animals (Diseases and Imports) Act [29th December, 1981]
- Animal and Plant Biosecurity Bill (2011),
- Animal and Plant Biosecurity Act, 2014. Supplement to Official Gazette [28th April 2014] Act 10 of 2014.

Whilst current Biosecurity legislation has been recently reinforced to prevent new IAS to get into the country, internal protocols need to be defined to prevent the spread of IAS within the country and its different archipelagos and islands are also required.

1.2. New challenges: alien weeds, invertebrates and disease

Seychelles has already a substantial experience in biosecurity measures against rodents through the implementing of prevention measures to avoid rat invasion or re-invasion in islands. A number of small inhabited islands, some of them protected areas and others non-protected, both uninhabited and inhabited, have succeeded in remaining over the years. This

includes two protected areas owned and managed by NGOs (Cousin Island and Aride Island Special Reserves), private islands with small resident populations (e.g. Cousine, D'Arros), and three private islands (Bird, Frégate, Ile du Nord) with touristic resorts and human populations of 100 to 200 persons including guests where rats were eradicated between 12 to 18 years ago. These islands have all succeeded to remain because they have been able to implement strict prevention measures, also called 'abatement' measures to reduce the risks of reinvasion.

However, biosecurity is not just about rats but also about many other invasive alien species. It can be plants brought in for ornamental purposes or food, weeds the seeds of which can be carried along on visitor's shoes, socks or clothes, insects and other invertebrates hidden in wood or construction material, pathogenic fungi carried by plant material, bacteria or viruses (or parasites) carried by pets or introduced animals that can affect native plants and animals.

With the ever increasing movements of people going abroad and coming back to Seychelles, of people coming to visit Seychelles as tourists, but also with the development of commercial trade with other parts of the world, keeping our islands not just rat-free but also *pest-free* is becoming increasingly challenging.

1.3. Protected areas, but also unprotected areas/islands of high biodiversity value

Also, it not just Protected Areas but also other sites of high biodiversity value in Seychelles that equally deserve to be protected from invasive species. This includes for example small islands such as l'Ilot Frégate, which have remained naturally free of rats, and larger private islands with touristic resorts where rats and/or cats have been eradicated and where Globally Threatened Species of birds, reptiles or invertebrates have been successfully reintroduced. Such sites are not necessarily protected but have been identified as Important Bird Areas (Rocamora & Skerrett 2001) or more generally speaking as Key Biodiversity Areas (Senterre et al. 2013).

This is why the proposed protocols concern not just Protected Areas but also islands (and any other unprotected sites there may be) of high biodiversity value.

In particular, *all islands that are rat-free or/and that are considered of high biodiversity value* (which generally depends on the time since they are rat-free) *are in need of biosecurity protocols*, especially when they are inhabited, as this increases considerably chances for rats to (re)invade these islands.

Protected areas within large rat-infested islands, or areas unprotected but with high biodiversity value within these islands are also increasingly in need of biosecurity protocols, especially when these are visited every year by many (hundreds or thousands depending on the case) that may help to spread some IAS (seeds, fungi, diseases, etc.).

1.4. Existing protocols in Seychelles and other sources of information

About 12 islands of high biodiversity value, including the three fully protected areas of Aldabra, Aride and Cousin Special Reserves (managed by SIF, ICS and Nature Seychelles, respectively) have biosecurity protocols in place. Aride and Cousin have been formally implementing these protocols to prevent invasion from rats and other species since the islands were declared as Nature Reserves in the 1970s. Aldabra has a biosecurity plan only since 2014, but *ad hoc* activities against IAS and some biosecurity measures have been undertaken since it was declared a Special Reserve in 1981.

Islands with biosecurity protocols

- [Aride Island Special Reserve](#) (since 1970s)
- [Cousin Island Special Reserve](#) (1970s)
- Cousine (1990's)
- Frégate (since 2000, reviewed in 2012)
- North Island (2005; reviewed in 2012)
- Denis Island (2003; reviewed in 2012)
- D'Arros (since 2003)
- Conception (MEE/ICS since 2001, reviewed in 2007)*
- Anonyme (2003, reviewed in 2006)*
- Bird (since 1996, mainly for rats)
- Grande Sœur (2010, mainly for rats)*
- [Aldabra Atoll Special Reserve](#) (2014)

(*) *continued enforcement uncertain or difficult to implement*

In blue: Protected Areas

Protected islands or areas with high biodiversity value that have no formal biosecurity protocols

- Curieuse Island National Park
- Silhouette Island National Park
- Marie Louise (Important Bird Area)
- Desnoeuufs (Important Bird Area)
- Cosmoledo atoll (Important Bird Area)
- Goëlettes (Farquhar atoll)
- Many areas that qualify as Key Biodiversity Areas on Mahé, Praslin, La Digue, Félicité, etc.

No formal biosecurity protocols are in place for outer islands that are managed by IDC (Marie-Louise being the only one rat-free and inhabited).

Annex 1 gives a proposed protocol (adapted from Merton et al. 1989) to minimise the risk of invasion by rodents similar to those used in New Zealand and on Round Island, Mauritius. Annexes 2 to 6 describe the existing protocols that are currently being implemented by the managers of Aride, Cousin, Cousine, Ile du Nord and Frégate. The most complex biosecurity protocols that are currently being applied in Seychelles are those that have been defined and

applied daily in islands of high biodiversity value such as Frégate or Ile du Nord (North Island). These protocols were initially put in place mainly to prevent rodent colonisation and require to be progressively extended to other plant, animal and micro-organisms. This is in particular the case for Denis Island, which current protocol is only for rodents. All these protocols were directly inspired by the ones in place in New Zealand when rats were eradicated from these islands.

Since 2003, an *Island Biosecurity Best Practice manual* has been written by the Department of Conservation and updated very regularly (last available version DoC 2010; James Russell & David Towns, pers. comm.). This manual has been one of our major sources of information to illustrate the protocols presented in the next section of the report. Annex 7a provides an example of Biosecurity Protocols for Little Barrier Island (NZ, in DoC 2010), and Annex 7b details what goes into a Contingency Plan.

Other interesting sources of information include the Aldabra Atoll Biosecurity Plan (Harper 2014), and the protocols that have been applied on Aride for the landing of construction materials since 2004. Annex 2 provides an updated biosecurity protocol from May 2014; and further updates have been added by ICS research / conservation officers and scientific committee members (Calabrese et al. 2015, in prep.).

Apart from the Island Biosecurity Best Practice Manual (DoC, NZ), other documents about biosecurity in other oceanic island territories and protected areas have been consulted (see list below). However, information on biosecurity protocols was found to be limited or not easily available for inter-island transportation and protected areas in other tropical island states or territories, such as Galapagos, Samoa, Fiji, Micronesia, Hawaii, Cook Islands, etc.

Examples of other documents consulted

- Code de l'Environnement de la Polynésie Française (PF)
- Quarantine – Risks and Management for Barrow Island (AU)
- Quarantine Strategy for Lord Howe Island (AU)
- Biosecurity Protocols for Little Barrier Island (NZ)
- Stoprats.com (Alaska, USA).
- Contingency plan for pest animal and plant invasions on islands (DoC NZ, March 1999; accessible from the ISSG website).

2. Basic biosecurity protocols for protected areas and islands of high biodiversity value

Box: General basic recommendations for island biosecurity

Adapted from: Department of Conservation 2010. Island Biosecurity Best Practice Manual. Island Biosecurity SOP. Wellington, New Zealand.

1. Have in place as many lines of defence as practical

- Stop pests infesting gear destined for islands prior to departure:

- Practice good hygiene at source (e.g. home or supermarket)
- Implement effective quarantine practices – i.e., checking, secure packing & storage at the quarantine store.
- Check on wharf or other points of departure before leaving

- Stop pests reaching islands:

- Practice good hygiene on transport vessels and aircraft

- Stop pests establishing themselves on islands:

- Check gear on arrival
- Conduct surveillance to detect pests and maintain detection systems
- Maintain contingency readiness and capability

2. Prevent invasion by small organisms

Island biosecurity is not just about rodents and large organisms. It is also about tiny plant seeds and invertebrates, and even microorganisms such as bacteria, fungi and viruses that can produce disease. The threat from invasive species, large and small, will continue to increase. If our biosecurity protocols can prevent creatures this small from reaching our islands, they are more likely to be also effective against much larger organisms.

Biosecurity protocols for protected areas and islands of high biodiversity value should involve three main types of activities: preventive measures, surveillance protocols and emergency procedures to respond to incursions (see for example the Aldabra Biosecurity Plan; Harper 2014; Aride biosecurity protocols for landing materials; Annex 2 and Calabrese et al. 2015).

2.1. Prevention: abatement measures and ‘quarantine’ protocols

Preventive measures are the most efficient and cost-effective way of fighting invasive species. They include limiting the introduction and spread of IAS through strict and adequate regulations, sensitisation and the development of best practices. Some countries and territories, such as Australia, New Zealand or Hawaii, have put a lot of effort into prevention, and this includes proactive public education and communication strategies.

In the case of islands with high biodiversity value, the transport of goods and stores are the main pathways for invasive species (see Table 1 below). However, accidental introduction by people carrying propagules (e.g. weed seeds), spontaneous colonisation by wind, and other natural transportation may also occur.

Table 1: Main carriers and potential invasive alien species transported between islands (Calabrese et al., in prep).

Carriers	Potential invasive species transported
Fruits and vegetables	Invertebrates, seeds, fungi and bacteria
Shoes, socks and clothing	Seeds and soil containing microorganisms
Soil	Microorganisms and nematodes
Packages, boxes, field equipment, tents, backpacks and PVC piping	Invertebrates, rats, reptiles, amphibians, seeds and soil
Garbage	Every type of organism
Human and animal faeces	Seeds and bacteria
Construction Material	Invertebrates (including eggs and larvae)
Supply boat (even if anchored ashore)	Swimming and flying pests (e.g. rats, flying ants etc.)

Small species such as ants or other insects can easily hide in all sorts of cargo. The yellow crazy ant or *fourmi Maldiv* (*Anoplolepis gracilipes*) has spread throughout the tropics travelling as stowaways in cargo. Fruits and vegetables can harbour a wide variety of insects at all stages of their development (eggs, larvae, adults of species such as fruit flies and moths, ants and scale insects). Many invasive species have spread around the world inside containers. The Asian tiger mosquito (*Stegomyia albopicta*) was accidentally introduced to the USA from Japan in the mid-1980s in water collected in used tyres, in which they often breed. Bird droppings on cargo may also introduce avian diseases.

The strict application of *abatement measures* (i.e. preventive measures to reduce the risk of invasion) such as safe loading, landing and unloading procedures for boats supplying these islands, is key to the preservation of a significant part of Seychelles' biodiversity. Hence all goods and commodities brought into a protected area or an area of high biodiversity value need to be subject to the following procedures:

- First, be inspected and screened for any seeds or animals present (including small insects). Chemical treatments may be required to ensure that all cargo is pest-free.
- Be sealed using recommended containers and stored in a pest-proof room on Mahé.
- Be loaded onto a vessel that is kept permanently rat and pest free.
- Upon arrival, be unloaded inside a pest-proof room (or a pest-proof trailer that will bring the cargo to the pest-proof room).

The sooner that biosecurity protocols are implemented in the face of a potential invasion, the higher the chances of intercepting and stopping the invasive species. In other words, it will be much easier to detect and stop invasive plants or animals hidden in goods and commodities while still on Mahé, than during transportation or after the cargo has reached its

destination island. This means that it is worth concentrating biosecurity efforts on mainlands or islands that are logistical hubs, like Mahé or Praslin.

Strict abatement measures to prevent the infestation of new invasive species – or the reinvasion of those that have already been eradicate, are already in place at several private or NGO-owned islands of high biodiversity value, including Aride and Cousin Nature Reserves; Cousine; Frégate; Ile du Nord and Denis (see Annexes 2 to 6), or on governmental protected areas such as Aldabra (Harper, 2014).

Biosecurity documents are dynamic and require frequent revision and updating, and recommended procedures often involve checklists and crosschecks. Information and training on invasive species identification, surveillance protocols and emergency procedures need to be provided to island staff and residents on a regular basis.

Abatement (preventive) measures and ‘quarantine’ protocols include:

Rules for visitors

Strict rules need to be defined to prevent transportation of IAS by any person working or visiting a protected area or island of high biodiversity value. A biosecurity checklist for visitors has for example been prepared for Little Barrier Island (NZ; see Annex 7a). A simplified form has also been produced for Aldabra (Harper 2014).

Personal luggage, including shoes, socks and all clothing (particularly Velcro & pockets) must be cleaned and freed of soil, seeds or invertebrates. All clothing, socks and shoes should be washed and if necessary disinfected, and any sticking seeds removed before packing for a trip to a protected area or an islands of high biodiversity value, and checked carefully by the person who owns it (allow sufficient time before departure in case treatment is required). These precautions also apply to scientific equipment, such as mist-nets, bird bags, measuring instruments (rulers, callipers, etc.). For example, machetes or chain saws need to be disinfected with alcohol or flame from any possible spores. Seeds found on gear need to be destroyed by incineration and invertebrates destroyed with insecticide or deep freezing. Visitors should not eat plants with potentially invasive seeds (e.g. tomato, passion fruit) within 48 hours before departing for certain islands such as Aldabra (Harper 2014).

Inspection and storage prior to transportation: quarantine room management

Making sure that no invasives are present in cargo prior to departure is probably the most important step required. This involves thorough visual checks for invasives and storage in sealed containers to be stored in a room that needs to be kept pest-free at all times.

All cargo items including goods, equipment, food and materials (e.g. for construction) must be thoroughly inspected visually before being packed and shipped to ensure that they are free of soil, animals or plant matter of quarantine concern. During inspection, small items may be shaken to dislodge any potential alien stowaways.

When visual checking is insufficiently reliable or too difficult to perform, chemical treatment of cargo will be required. Insecticide spray should be available at all times to eliminate invertebrates found during inspection. Insecticide should be sprayed regularly in the quarantine room before any biosecurity check is conducted. A large freezer or freezer room can be included as part of the biosecurity room, for freezing high risk dry goods or equipment likely to hold invertebrate eggs/larvae or seeds for 48 hrs before being sent to the islands (Harper 2014).

After inspection, the approved cargo should be properly packed in pest-proof sealed containers before loading. Where possible, store and carry all equipment in plastic airtight containers. Recommended containers to transport goods include plastic boxes and barrels, fish bins, poly-pail type buckets with sealable lids, plastic drums / barrels with screw-on lids ('touque' in French), and heavy PVC water-proof bags. Container with ill-fitting lids, cracks or holes, sealed cardboard boxes and plastic bags are no longer considered appropriate. As a general rule, anything that cannot be sealed properly should not be used.

When large amounts of cargo need to be brought onto the island (e.g. for a construction), close inspection and **fumigation** of all cargo inside a sealed (maritime) container by local pest control companies (e.g. using methyl bromide for 72 hours) is recommended to avoid any unwanted introduction. . It is also preferable to send all cargo into whole containers as this will allow fumigation to be undertaken prior to shipment to the island of destination. Containers must be inspected prior to loading, sealed and fumigated: to confirm that they are free of rats, insects and other contaminants. A certificate "approved for shipment" may be issued for goods that meet inspection criteria. Fumigants are pesticides in a gaseous state. Their effectiveness is determined largely by the: (a) dosage of the fumigant; (b) duration of exposure; and (c) temperature. Certificates of treatment, including fumigation, must contain full details of treatment/fumigation as illustrated in the example below.

Treatment Provider Letterhead	
The goods described below were treated in accordance with the fumigation requirements of the Seychelles Quarantine and Inspection Service.	
Details of Treatment	
Name of fumigant	
Dosage	g/m3
Duration	hours
Minimum ambient temperature during fumigation	
Consignment identifier or numerical link	
.....	
Description of cargo	
Date	
Treatment Provider Signature	

The quarantine room should be kept pest-free (rodents, weed seeds, invertebrates and micro-organism disease carriers). The quarantine room should be kept clean and empty at all times

except during biosecurity checks, with a minimum furniture such as a table and a chair where no invasive species can hide. It should consist of a room where biosecurity checks of items to be shipped can be conducted, plus an adjacent secure (pest-proof) room where items already checked can be stored. Its design should prevent any invasive to come in through the presence of close-fitting (rebtable) doors (no gaps over 5mm for rodent-proofing), sealed windows, possibly an airtight compartment to prevent direct access of rodents into the quarantine room , etc. It should have one way-in and one-way out to facilitate transit. It should be well lit and have no dark corners. Walls should be smooth to prevent rodents to climb. Any windows or ventilation should have metallic mosquito netting. All gaps should be sealed for invertebrate proofing and it is recommended to have as smooth floor painted in a light colour in order to facilitate cleaning and the detection of small invertebrates. It should be kept closed at all times.

Examples of pest-proof room layouts are given in Annex 5 (North Island) or in the Aldabra Biosecurity Plan (Harper 2014).

The quarantine room should have permanent bait stations regularly baited with rodenticide. Kill traps (e.g. snap traps or glue traps) should also be deployed inside the room under closed stations. One insecticide spray should be kept at hand, as well as a stick to kill any invasive rodent, reptile or large invertebrate. Permanent devices to notify the presence of invasives (e.g. gnawing sticks, ink- tracking tunnels for rodents) can also be used.

Containers should also contain rodenticide and bait-stations for rodents (unless fumigated with a powerful pesticide such as methyl bromide that would also destroy them). Officers must verify that pre-loading inspection of all containers has taken place, by checking inspection stickers and documentation. Whenever possible, cargo coming from abroad should be transported as whole containers directly to the destination island rather than being unloaded in Mahé

Vessel and loading procedures at island of departure

Boats and aircraft (planes, helicopters) can provide an invasion pathway. Stowaways may be present in cabins, garbage containers, etc. and also on outside structures above the water line or on the outside of an aircraft (e.g. wheel wells). Quarantine measures on arrival are difficult to enforce and it is recommended to check that boats or aircrafts do not have 'hitchhikers' on board before leaving.

All boats that visit protected areas and islands of high biodiversity value should have permanent rat bait-stations (and where required rattraps) on board. These should also be present in buildings/hangars where aircrafts (planes, helicopters) are parked. Rodenticide poison blocks are to be replaced regularly in bait stations, every 2 to 4 weeks depending of humidity and type of blocks (waxed blocks recommended). The deck and inside of boats, as well as the inside of aircrafts need to be regularly fumigated to be kept as much as possible pest-free (as it is done systematically in all international flights coming to Seychelles).

Stores are taken from the quarantine room directly to the boat or plane only on the day of departure, in order to minimise chances of re-infestation. Vessels or aircraft used for servicing islands must be kept pest free. Boat and aircraft pilots and all service personnel need to be sensitised to the risks of pest invasion by alien species.

Procedures for quarantine or pest-proof rooms, loading at the port of departure, and unloading upon arrival are key to prevent reinvasion and to ensure the long-term success of the operation (see the example of abatement measures for North Island, Annex 5).

It is essential that piers and jetties for supply boats, and plane or helicopter hangars are kept as pest-free as possible. When such facilities have a high probability to be infested by invasives, notably by rats, boats should only be moored the minimum of time required to load the cargo. The following box describes the recommended actions to be conducted on Mahé prior to shipping construction materials to Aride.

Box. Rat abatement measures prior to shipping construction materials to Aride (Calabrese et al. 2015).

- Place a few rat traps and rodenticide bait-stations in storage area and inside the containers where materials are stored (permanently or for as long as required).
- Broadcast rat poison (pellets) 1 week in advance of departure date around the vessel docking area (10kg should be sufficient to cover a total area of 100m x 100m; one pellet every 1 to 2m is enough).
- Place 20-25 rat traps every 10m around the jetty and check them every day one week in advance of departure date (3 days should suffice if pellets have been spread).
- Place 6-8 rat traps on board the vessel every 10m when the vessel is moored at the jetty. Check them every day.
- Put empty 5 litre plastic bottles around all the ropes of the vessel to prevent any rats to climb on them and access the boat.

In view of all the rat and pest free islands of high biodiversity value existing in Seychelles, the establishment of a pest free pier on Mahé that would be available to all island managers is highly desirable. Land could be sold or leased by Government for this purpose to a consortium of private island owners, or to IDC/ICS, a parastatal and an NGO that manage many islands and protected areas of high biodiversity value.

Unloading procedures at island of arrival

Unlike loading procedures, unloading procedures can be very diverse depending on the situation and infrastructure available at the island of arrival; different procedures can be envisaged to unload the cargo.

The most important is that all cargo gets to the pest-proof room that must be present on the island, and is not unloaded and dispatched directly upon arrival without any biosecurity procedure.

If the island has a jetty or a small harbour, then the transport boat can use this facility. If this harbour is protected by a rat-proof fence, it is essential for this facility to be checked and maintained very often (holes repaired immediately, bait stations refilled etc.), this is the case for Frégate Island, which has specific biosecurity procedures for this infrastructure (see Annex 6).

Supply boats should preferably be anchored or at a mooring buoy, especially if there are doubts on whether vessel biosecurity procedures have been properly followed (permanent presence of bait stations, regular spraying or fumigation against insects, general condition and cleaning, not moored overnight at the jetty of a rat infested island, etc.). All the items should then be visually inspected and transferred to a small boat that shall take them ashore and land on the beach. When the imported items are in a container previously fumigated and sealed, they can be taken safely from the boat onto the small landing boats.

If the protected area island does not have a jetty, as it is normally the case, only boats that are regularly checked and submitted to regular biosecurity procedures should be allowed to land on the island's beaches.

A third option is for the case of a barge that can directly beach on the shores of the island, in which case special precautions will be taken as this procedure is more dangerous than the previous ones. In each of these cases, items must be taken to the pest-proof room of the island, normally adjacent to their jetty or their landing beach, or into a pest-proof trailer if the pest-proof room is located elsewhere (when landing beaches vary according to season, as is the case for North Island / Ile du Nord; see Annex 5).

Sealed containers that have been fumigated and which fumigant may still be toxic should be thoroughly ventilated. Inadequately ventilated containers could pose grave health threats to staff involved in their unpacking.

Pest-proof room management and procedures at island of arrival

Normally, all islands that are rat-free and considered of high biodiversity value should have a pest-proof (quarantine) room. Such room should be identical to the ones recommended at the island of departure (see above). When the pest-proof room is adjacent to the beach, the cargo can be unloaded and brought directly into it for inspection. If not; cargo should be landed and taken directly into a pest-proof trailer, as is the case for North Island (see Annex 5). This is the best solution when there are several landing beaches and one single pest-proof room far from them.

When large amounts of supply are to be brought (e.g. construction material), cargo may have to be landed and checked on the beach and a temporary fence may have to be erected, as is the case on Aride. In this scenario, cargo should preferably be landed by a small boat or helicopter, rather than from a barge directly beaching. The box in next section below describes the protocol used on Aride.

Special procedures for transportation of construction material, wood and furniture, heavy machinery and equipment (adapted from Calabrese et al., 2015)

Box. Protocol for the landing of construction materials on Aride (Calabrese et al. 2015, in prep.)

- Build a temporary fence around the area where the boat will beach, from the shore to the boatshed (on beach crest), forming a funnel with the wider part towards the beach. The fence should be in mesh held by a wooden frame. The fence should be c. 1.25 m high of which 0.25m buried in the sand and 1.0 m emerging. Leave a gate at the end of the fence to allow items to pass after being checked.
- Every item landed on the beach has to be visual checked before opening the gate. In case of small boxes, it is preferable to open and check them in the rat-proof room. Alternatively, larger boxes can be checked on the beach although it will be easier for any insect present to escape.
- Elliott traps (c. half dozen, unbaited) placed in wooden boxes (imitations of sheltered places to attract escaping rodents on exposed beaches during offloading) to be set up on the beach during offloading of barges containing food items, cardboard boxes and building material with cavities.
- Set up a grid of 15 x 15 m of rattraps outside the fenced area baited with coconut (prepared in advance). The traps must be continuously checked every 2 to 3 hours following the landing of the first building materials, any sprung traps should be reset and any non-target species accidentally trapped released. Traps should be checked for several days after the last materials have been landed.

All large items that may not fit into the quarantine room should be sprayed with insecticide 24 hours before loading, and visually checked during loading on the boat/plane. This includes sand or crushed rock, aggregate and cement, large wooden or metallic structures, metal and PVC piping, etc. Large rolls of pipes need to be checked on Mahé before shipping, and the ends plugged immediately after inspection. These can be checked using compressed air or water being flushed into them.

Machinery and vehicles (used for or by construction, recreation, agriculture, forestry, utility companies, tourism etc.) must be cleaned before being shipped as these may carry soil, plant material and/or animal “hitchhikers” (rats, mice, geckoes, snails, spiders, cockroaches, ants, etc.). Mud, soil, and plant parts should be cleaned with steam cleaning and/or high pressure water (to 2,000-PSI pressure washer), and fumigation with pesticide applied to prevent infestation by invasive invertebrates.

Care should be taken not to move equipment or machinery from weed-contaminated areas to non-contaminated areas. Travel through weed-infested areas, or during periods when spread of seed or propagules is most likely should be restricted.

Pre-shipment inspection and cleaning requirements must be conducted in an area with adequate lighting and ventilation, and on a hard surface that, even if wet, will not allow soil contamination of clean vehicles. Once cleaned, machinery and vehicles should be brought to

the ship and loaded while preventing new re-infestation from soil adhering to tyres, undercarriage, or any other part/accessory of vehicles. Special attention must be brought to track vehicles with caterpillars.

Timber and wood products (e.g. furniture, wooden crates, pallets, etc.) can host invertebrate species (e.g. beetles, ants) and also fungi when unprocessed, hence strict regulations are necessary to decontaminate any such products.

Timber must be permanently treated or at least temporarily decontaminated (disinfested) before shipment. Permanent treatments are those capable of excluding insect infestation from the timber for its operational life. Temporary or non-permanent treatments (e.g. fumigation) eliminate insect infestation present in the timber at the time of treatment, but do not give residual or on-going protection.

Fumigants only control existing infestations in timber; they do not provide any residual protection against subsequent re-infestation. Consequently, timber treated by fumigation (non-permanent treatment) must be packed in a container or shipped immediately taking into account when the toxicity of the treatment will cease (e.g. methyl bromide degrades within 72 hours). To ensure effective treatment, correct fumigation procedures should be used. Timber and other wood products must not be sealed in materials such as plastic, aluminium foil and tarred or waxed papers as these are gas impermeable and inhibit the penetration of the fumigant.

Importation of plants and animals (for food or farming)

No plants and animals used in agriculture, living or dead, including propagules or parts of them (e.g. seeds, cuttings, leaves, etc.) should be transported from one island to another without specific authorisation from the Seychelles Agricultural Authority. The same applies to ornamental plants and animal pets (Seychelles Veterinary Department). Extreme caution should be taken during such translocations as such plants and animals may carry diseases that may affect agricultural crops and farming, pets, ornamental plants and possibly native present in the destination islands.

Authorisations to transport plants or animals used in agricultural, as pets or for ornamental purposes should be requested to the SAA, and may only be authorised if sanitary risks are considered minimal and on the basis of a certificate from a professional operator that required prophylactic treatments have been conducted.

However, transportation of food items (vegetables, fruits) may be allowed into protected areas or islands of high biodiversity value provided certain basic rules are followed, such as:

- + Any food that contains traces of invertebrates or pathogens should be discarded (e.g. fruits and vegetables to be checked in the pest-proof room for any disease or invertebrate and burned if positive when checked).
- + Fruits and vegetables should be thoroughly washed and any trace of soil removed.

+ Fresh fruits and vegetables should only be consumed at the village or field stations, to facilitate eradication in case of propagation.

Pets should be banned from protected areas and islands of high biodiversity value.

Translocation of wild species of plants or animals

No wild species of animals and plants (both native and *a fortiori* non-native species) or parts of it (e.g. eggs, feathers, larvae, etc.) should be translocated from one island to another without a specific authorisation from the Environment Department of the MEECC. Seychelles has a long history and track record for the translocation of rare and threatened native species (Rocamora & Henriette, 2015), aiming at creating new viable populations to improve their conservation status and secure their future.

Translocations of wild animals and plants should only be performed after proper assessments have been done, including habitat suitability and risks that may be posed to other species in the area/island of destination. Such translocation projects should follow the IUCN ‘Guidelines for Reintroductions and Other Conservation Translocations’ of wild plant and animal populations (IUCN 2013). Authorisation from Environment Department of the MEECC should only be granted if the proposed translocations have followed these guidelines and reached the conclusion that it cannot cause any harm to native species and habitats in the destination islands.

Specific legislation already exists to forbid the transport of certain wild plants or wood to prevent the spread of diseases (e.g. Takamaka *Callophyllum inophyllum* wood cannot be transported between islands to prevent the spread of the Takamaka wilt fungal disease). For this reason, extreme care should be taken to transport any machinery or equipment having been used to cut or transport these species (e.g. machetes or chain saws having been used to cut Takamaka wood should be disinfected with flame or alcohol). The same applies to agricultural machinery and equipment for the same reason.

In the case of native plant material transported (as seeds, seedlings or cuttings) for propagation to islands undergoing a habitat restoration process, standard procedures describing how to ensure that no invasives get transported are required (e.g. no transportation of soil, unless specific treatment is applied, information on diseases associated with specific plants, how to recognize the symptoms so that plant material suffering from this disease are not translocated, etc.).

2.2. Surveillance and maintenance protocols

Whenever preventive measures have failed in preventing the entry of a certain invasive species into a particular protected area or island of high biodiversity value, early detection and rapid reaction are essential to prevent its establishment or its spread, and to have a chance to eradicate it at minimal cost.

This requires an efficient and operational system of surveillance (see for example the one set up by ONF in the public forests of La Réunion; Soubeyran 2010). This is yet to be set up in most protected areas or islands of high biodiversity value in Seychelles.

Surveys should be organised periodically to look for new invasive species, or may be focused on groups of particular concern (e.g. mosquitoes, coccids, woody plants, weeds, etc.). This implies the availability of well trained personnel with sufficient knowledge about identification and sampling techniques for the various taxonomic groups, knowing where and how to look for particular priority species. Specific surveys are required regularly on islands or areas of high conservation value (e.g. hosting endangered species), in sensitive habitats (wetlands) or near entry points (airports, harbours). This includes:

- Regular survey of potential entry points (boat landing sites, helipad, airstrip, etc.) and paths used by visitors and island staff in search of new exotic plant species.
- Availability of surveillance kits comprising traps, lures and other detection devices, and manuals to identify invasive species.
- Maintenance and refilling of all bait stations, traps, gnaw-sticks for rats, etc. set up as part of preventive measures but that require regular checks and maintenance. Table 2 below provides an example of such a maintenance protocol for Aldabra.

Table 2. Maintenance protocol for Aldabra Biosecurity sites (Harper 2014)

Location	Target pest	Technique	Site	Frequency
Biosecurity room on Mahé	Rodents, Invertebrates reptiles	Traps, bait stations, glue boards, and permanent insecticide aerosol	Building and surrounds (2 bait stations, 2 glue traps, 2 rat & 2 mouse traps and one insecticide aerosol inside each room, with 4-6 covered mice/rat traps outside).	Monthly, in addition to daily checks in week leading up to departure of plane/boat
Supply boat	Rodents, Invertebrates reptiles	Bait stations and permanent aerosol insecticides	In hold of boat (6-8 bait stations).	Before and during travel
Aldabra Biosecurity Building	Invertebrates, reptiles	Bait stations, traps glue boards, and permanent aerosol insecticide	In building (2 bait stations, 2 glue boards, 2 rat & 2 mouse traps and one insecticide aerosol, inside room only)	6 monthly and immediately prior to arrival of any boat

Examples or bibliographical references of basic scientific biodiversity monitoring protocols can be found in Rocamora & Henriette, 2015; in press).

2.3. Priority species

Priority species already present in Seychelles and requiring a special attention as confirmed or potential invasive species have been identified as part of the same consultancy, and circulated for discussion during a national workshop (17.12.2014). These lists, available on PCU website (www.pcusey.sc), and in Rocamora & Henriette, 2015, in press, are also provided in Annex 8. These include:

- plant species that are already considered to be fully invasive, i.e. that have spread over vast areas and which already have a confirmed significant negative impact on the ecosystems of Seychelles (Tab. 1 in Annex 8). These can be considered as priority species for action.
- plant species considered only locally invasive or with a limited degree of invasiveness in Seychelles but that are sometimes invasive in other countries, and which could spread and become widely invasive (Tab. 2 in Annex 8). For many of these, we do not have sufficient information yet to say whether these plants are able to spread over wider areas. The fact that they have spread in one or a few places is not sufficient to classify them as fully invasive as their spread may result from specific conditions at a particular time. However, they do deserve special attention.
- Animal species identified as the most important invasive terrestrial animals having an environmental impact in Seychelles. (Tab. 3 in Annex 8). This includes a few species that so far appear to only have a limited impact.
- Alien weeds and creepers that can be considered naturalised, that invade mainly agricultural and other open habitats created or modified by human.(Tab. 4 in Annex 8).
- Plant or animal aliens – invasive or showing signs of invasiveness – that require the greatest special attention to prevent their spread to other islands in Seychelles. (Tab. 5 in Annex 8). Members of the public must be warned not to transport them to other islands. Evidence of spread needs to be reported to local and national authorities, and efforts should be made to eradicate them as soon as they are seen at a new island.

These lists may be incomplete and are intended mainly to provide guidance for prioritisation. They remain open to future additions – and hopefully deletions too if successful control and eradication programmes can be developed for some of them.

Priority species for early detection should also include invasives already present in neighbouring countries or islands that are known to have a high impact on the environment, the economy (agricultural pests, animal diseases), or human health (e.g. mosquitoes, rodents, etc.). Early detection is especially important when these invasives are known to be difficult to control. Such a list of priority species for Seychelles is currently being established as part

as of the Biosecurity project and should be available online during the course of 2015 (www.pcusey.sc).

2.4. Emergency procedures in case of an invasive species incursion

Rapid response is possible only if the area concerned by the invasion is limited. Shortening the delay between the time when the presence of a new alien is reported, its identity revealed and its invasion risks assessed, and the moment when effective ground action is undertaken to remove it is key to the success of the operation.

In cases in which the potential invasiveness of a newly detected alien is already known or can be confirmed rapidly, and if the methods of eliminating it are well known, its eradication should be undertaken immediately.

The establishment of *contingency plans* (i.e. urgent response plans, see definitions on p. 6 and Annex 7b) facilitates decisions and communication, and will ensure that everything required in terms of actions and resources will be in place to eradicate or bring the pest species under control. Anticipating the likely arrival – or the re-infestation – of a common widespread invasive (i.e. rat, mouse, Spiralling white-fly etc.) on islands presently free of these pests is highly recommended. These plans should indicate:

- How to identify the invasive species.
- An estimation of its potential impacts.
- Urgent actions to undertake, and the relevant methods to contain, control or eradicate the species.
- Resource individuals and organisations to be contacted
- Financial and human resources required, and how to mobilise them.

Incursion response plans need to describe what to do first, details of resource persons to contact, etc. They require clear identification of duties and responsibilities and are normally coordinated by the Biosecurity Officer.

Incursion kits containing the necessary equipment to provide an initial response to an invasive species report should be prepared, first to confirm the identity of the invasive species and then to attempt eradication. These can be divided into sections (for example to be used for rodent, bird and invertebrate invasions).

The Department of Conservation of New Zealand has produced various such documents for islands of high biodiversity value (e.g. DoC 2010) and these documents are accessible from the internet. Templates for contingency plans for rodents can be found in the toolkit for the eradication of rats and cats of the Pacific Invasives Initiative (PII 2011). Useful guidelines and templates can also be found in a similar toolkit for Invasive Plant Management produced by the PII (2012).

In the future, modern technologies should improve and facilitate the early detection of invasive species. Remote sensing using aircrafts or satellite imagery, such as ‘LiDAR’ (Light

Detection and Ranging) and hyperspectral imagery, makes it possible to detect the presence of certain invasives in the middle of native plants, depending on the spatial resolution and spectrum-colour resolutions available, both of which are likely to increase significantly in the near future. Genomic techniques like sequencing of nucleic acids are becoming increasingly used to verify with certainty the identity of a particular species, and this can be used to detect the presence of certain invasives at low densities, for example by analysing DNA in faecal samples or regurgitation pellets; the same may be used to detect a hybridisation process between an alien species and a native one.

In the case of rats, for example, all islands (especially those inhabited) need to have permanent bait stations with rodenticide, traps and gnaw-sticks to prevent re-infestation or to detect it immediately should it occur.

The current absence of legal clauses preventing anyone from landing on the beaches of these islands without restriction or control – as permitted under the constitution of Seychelles – is counterproductive. It puts at risk the outstanding biodiversity of these islands, and the efforts invested over many years by the owners/managers and their local and foreign partners (NGOs, private experts, Division of Environment, etc.). It is hoped that this problem can be solved under the new *Seychelles Biosecurity Act* in preparation.

2.5. Organising biosecurity, long-term communication and training

Defining biosecurity protocols and priority species lists is not enough. Full understanding of the problems, strict discipline and excellent organisation are required for biosecurity measures to be effective. Regular controls and audits must be in place to ensure that these procedures are respected and updated so that they continue to be effective. A *Biosecurity Officer*, or a person responsible for the coordination of biosecurity aspects should be nominated for each protected area and each island of high biodiversity value. He should be given the sufficient authority to ensure that the protocols are implemented and that all systems are maintained and remain effective (i.e. refilling and maintenance of bait stations, reordering poison, conducting regular information / training sessions of other staff, visitors, etc.).

However, the main goal of preventing the invasion or re-invasion by invasive alien species, or of controlling / mitigating efficiently those species that have already become established, can only be reached if a ‘culture of biosecurity’ becomes imbedded in the managerial system of a particular island / protected area, and by extension to the whole community of persons inhabiting or using it. Protected areas such as Aride, Cousin, or Aldabra, and inhabited islands of high biodiversity value such as North Island (Ile du Nord), Frégate, Cousine or Denis provide good examples

The contribution of each and every one is required for biosecurity protocols to be successful. Using an image familiar to all those working on islands, it is essential for everyone to be ‘pulling the boat in the same direction’.

Continued public debate and outreach campaign about the need to establish and enforce measures that prevent the spread of invasive species is also highly desirable.

Good communication and training, and coordination of efforts are key to the success of early detection. A network of well trained and informed persons is indispensable and needs to be developed in Seychelles. Information and training will need to include personnel responsible for undertaking surveys, but also professionals (conservation officers, rangers, farmers, tour guides, dive instructors, etc.).

Sensitisation and education activities about the problem of invasive species need also to be directed to young people and the public in general through the media, displays, programmes in school, brochures and publications like this one. We need to develop a general attitude of national responsibility of permanent alert not only from all concerned professionals and stakeholders, but from citizens of Seychelles in general.

The next box summarises a number of basic best practice recommendations in terms of biosecurity for island and property managers.

Box. Some best practice guidelines for island and property managers (From Rocamora & Henriette 2015, in press)

Here are some management recommendations on biosecurity and the control / containment of invasive plants and animals:

- Regularly survey potential entry points (boat landing sites, helipad, airstrip, etc.) and paths used by visitors and island staff in search of new exotic plant species.
- Limit habitat alteration (e.g. construction, roads, fires, paths, etc.) that will favour penetration of invasive plants.
- Contain tourism infrastructure in defined areas and channel visits into natural habitats through well-defined paths.
- Restrict access to areas with high biodiversity value, and implement a policy of visual inspection of shoes, socks and trousers to remove alien seeds from clothing at the starting point of such paths.
- Restrict access to areas with high biodiversity value.
- Use indigenous rather than exotic plants for landscaping. This will contribute to ecosystem restoration.
- Limit and control transfer of earth, sand, plants, etc. between infested and non-infested zones, and restrict vehicular movements between these areas.
- Avoid transporting green waste from one site to another— especially when it contains waste from invasive plants that reproduce by cuttings. Destroy such materials on site, or seal them for transportation. Clean machinery, clothes (especially socks), and shoes used during campaigns to eliminate invasive plants before moving to new areas.
- Keep areas around habitations clean and tidy, and trim vegetation around buildings to prevent access to rodents.
- Strictly control bins and do not leave any sources of food (scraps, fruits, etc.) that may attract rats or provide nourishment that will boost their reproduction. These actions will significantly reduce problems caused by rats.
- Undertake control of problematic species such as rodents or highly invasive plants.
- Communicate with other island managers, NGOs, private experts, etc. about invasive species, levels of infestation, identification, and methods of eradication, control or mitigation.
- Plan to eradicate major pests and prioritise what actions are needed.
- Remove artificial containers of rainwater that provide breeding sites for mosquitoes (e.g. old tyres, empty tins, flower containers, empty coconuts, etc.), both near houses and in natural habitats.
- ...

3. Biosecurity protocols for islands and areas not considered as protected areas or of high biodiversity value

This section describes in a summarised way the recommended general biosecurity principles and regulating procedures to transport plant and animals, and other items such as soil, machinery, vessels and people from one island to another. Simplified protocols inspired from those recommended for protected areas or islands of high biodiversity value (described in Section 2) can be applied for islands/areas unprotected or without such high biodiversity value. In the case of wild plant transportation, standard procedures for collecting and conditioning plant material will need to be defined.

	ISLAND OF DEPARTURE			ISLAND OF ARRIVAL		
	Storage & pre-loading	Loading	Transportation vessel	Transportation vessel	Unloading	Inspection / biosecurity room
Large inhabited islands (Mahé, Praslin, La Digue) except protected and environmentally sensitive areas	No biosecurity protocols unless specifically required by ED (wild plants /animals) & SAA (cultivated & ornamental plants, farm animals & pets)			No biosecurity protocols unless specifically required by ED (wild plants /animals) & SAA (cultivated & ornamental plants, farm animals & pets)		
Other islands unprotected or without high biodiversity value	Simplified biosecurity protocols required for machinery & vehicles, cultivated & ornamental plants, farm animals & pets (by SAA), and wild animals & plants (by ED)			Simplified biosecurity protocols required for machinery & vehicles, cultivated & ornamental plants, farm animals & pets (by SAA), and wild animals & plants (by ED)		None required
Protected islands or areas with high biodiversity value	Biosecurity protocols required by island managers and/or ED (wild plants /animals) & SAA (cultivated & ornamental plants, farm animals & pets)			Biosecurity protocols required by island managers and/or ED (wild plants /animals) & SAA (cultivated & ornamental plants, farm animals & pets)		

	PLANTS ALREADY PRESENT IN SEYCHELLES			
	Cultivated plants for food	Ornamental plants	Wild native plants (standard procedures for collecting plant material)	Wild exotic plants (standard procedures for collecting plant material)
Large inhabited islands (Mahé, Praslin, La Digue) except protected and environmentally sensitive areas	No restrictions unless pest outbreak	Regulated through Phytosanitary certificate except priority list	Forbidden unless special authorisation received	Forbidden unless special authorisation received (no derogation possible for priority list)
Other islands unprotected or without high biodiversity value	Regulated through Phytosanitary certificate and conditions of contention (and not in priority list)	Regulated through Phytosanitary certificate except priority list	Forbidden unless special authorisation received	Forbidden unless special authorisation received (no derogation possible for priority list)
Protected islands or areas with high biodiversity value	Regulated through Phytosanitary certificate (authorised list)	Forbidden in protected areas, regulated as above in islands/areas of high biodiversity value	Forbidden unless special authorisation received	Forbidden

	ANIMALS ALREADY PRESENT IN SEYCHELLES			
	livestock	Pets	Wild native animals	Wild exotic animals
Large inhabited islands (Mahé, Praslin, La Digue) except protected and environmentally sensitive areas	Regulated based on health certification & authorisation	No restrictions unless pest outbreak (authorised list)	Forbidden unless special authorisation received	Forbidden unless special authorisation received (no derogation possible for priority list)
Other islands unprotected or without high biodiversity value	Regulated based on health certification & authorisation	Forbidden (e.g. IDC managed islands) or regulated	Forbidden unless special authorisation received	Forbidden
Protected islands or areas with high biodiversity value	Regulated through Phytosanitary certificate (authorised list)	Forbidden in protected areas, regulated as above in high biod. Value islands	Forbidden unless special authorisation received	Forbidden

	OTHER ITEMS TO BE TRANSPORTED				
	Vessels	Machinery, vehicles & associated equipment	Construction material	Soil	People
Large inhabited islands (Mahé, Praslin, La Digue) except protected and environmentally sensitive areas	No restriction (rodenticide compulsory for commercial boats, recommended for others)	Regulated based on autorisation (steam/pressure cleaning with chemical)	No restriction	Regulated based on autorisation (may be also forbidden to prevent bacterial / fungal disease contamination)	No restriction
Other islands unprotected or without high biodiversity value	No transport of ballast water between island groups (international practice forbids release within 12km from land) + hull cleaned every X months	Regulated based on autorisation (steam/pressure cleaning with chemical)	Autorised based on <u>simplified</u> protocol compliance (inspection, appropriate storage and abatement measures)	Forbidden (manure, soil in potted plant based on autorisation (certificate, checked for pathogens and pests such as pests)	Personal equipment & luggage checked except for hotel clients
Protected islands or areas with high biodiversity value	Release of ballast water forbidden Rodenticide in bait stations	Regulated based on autorisation (steam/pressure cleaning with chemical)	Autorised based on protocol compliance (inspection, appropriate storage and abatement measures)	Forbidden	Personal equipment & luggage checked except for hotel clients (also food, barbecue charcoal, etc.; illegal substances & items checked at same time)

Box: Invasive species – How can you help? (From Rocamora & Henriette 2015, in press)

As a citizen, you can contribute significantly to reduce the impact of Alien Invasive Species in Seychelles, limit their spread and prevent new infestations:

- **Don't pack a pest!** Do not bring any plants (including vegetables and fruits), or animals (including pets) and related unprocessed products into Seychelles – by plane, boat or any other means of transport. To do so is a serious offence. If you have inadvertently brought some, you should declare it immediately upon arrival into the country.

- **Don't bring in a pest!** Do not transport plants and animals between islands without taking precautions and obtaining previous authorisation from government authorities. You may spread dangerous alien invasive species, including new parasites and diseases.

- **Be aware of hitchhikers!** Before travelling to a nature reserve or national park, and to any area or island with high biodiversity such as a pristine native forest or wetland, carefully clean and inspect your clothes, socks, shoes, hiking boots, camping gear and other equipment so as not to transport any alien seeds or wildlife diseases.

- **Don't transmit plant diseases!** When moving equipment between islands, disinfect all instruments that have been used to cut vegetation (machetes, saws, axes, chainsaws, etc.). Use alcohol or a flame to disinfect in order to avoid spreading plant diseases.

- **Keep pets are home!** Never set your pets free in the wild. They will have a very negative impact on native species. There is also a good chance that your pet will suffer or die when having to fend for itself. Call veterinary services to find alternative solutions.

- **Don't release a pest!** Do not discharge old water from your aquarium into rivers and wetlands.

- **Fight rodents and weeds!** Control rodents and plant pests around your house and properties. Eliminate or trim vegetation near your house that could provide a route of travel for rodents to enter your house or climb onto your roof.

- **Fight the bite!** Eliminate all sources of standing water in your property and around your house that could provide habitat for the larvae of mosquitoes that can transmit diseases like Chickungunya and Dengue fever. Keep grass short and remove bushes and tall grasses immediately adjacent to buildings.

- **Go native!** Use native plants as ornamentals in your garden for landscaping.

- **Get involved!** Participate as a volunteer on campaigns working to control invasive plants.

- **Report a pest!** Report any sighting of a suspected new alien to the Department of Environment by phoning the Green line 2 722 111

Together, we can make a real difference!

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National workshop on biosecurity protocols & priority IAS (17.12.14): List of participants

- Mr Eric Blais, Nature Seychelles
- Mr Pierre-Andre Adam, ICS
- Mr Juan Michel, ICS
- Mr Alex Underwood, Nature Seychelles
- Ms Isabelle Ravinia, SNPA
- Mr Paul Jean-Louis, IDC
- Mr David Brown, IDC
- Mr Elvis Stravens, IDC
- Ms Joanna Prosper, PCU
- Ms Philomena Hollanda, Tourism Department
- Mr C. J. Havemann, North Island
- Mr Arjan de Groene, Green Islands Foundation
- Ms Tanya Leibrick, Fregate Island
- Ms Iris Carolus, consultant
- Ms Katy Beaver, PCA
- Mr Randy Stravens, NPPO / PAHS / SAA
- Mr John Nevill, consultant
- Mr Gerard Rocamora, consultant
- Mr Andrew Grieser Johns, PCU

Preparatory meetings

- Meeting with Mr Antoine-Marie Moustache, SAA, on 10.10.14 (Grande Anse)
- Meeting with Mr Will Dogley, Randy Stravens (Plant Protection) & Dr Jimmy Mélanie (Veterinary Department), SAA, and Elke Talma, at Victoria, on 15.10.14
- Meeting with Mr Ronny Renaud, Paul Jean-Louis & David Brown (IDC); Pierre-André Adam, Juan Michel, Uzice Samedi at Victoria on 10.11.59

Preparatory email exchanges

- Licia Calabrese, Melinda Curran & Pat Matyot (Aride Island; ICS)
- Dr Bruno Senterre (PCA & Seychelles Natural History Museum)
- Dane Marx (Frégate Island)
- Julie Gane (Cousine Island)
- April Burt (Cousin Island; Nature Seychelles)
- Dr James Russell (University of Auckland)
- Dr David Towns (Department of Conservation, New Zealand)
- Dr Jean-Yves Meyer (Délégation à la Recherche; Polynésie Française)

5. Bibliographical references / documents consulted

- Broome, K. 2007. Island bio-security as a pest management tactic in New Zealand. In: Witmer, G.; Pitt, W. and Fagerstone, K. (eds.). **Managing vertebrate invasive species: an international symposium**. Pp 104-108. USDA National Wildlife Research Center, Fort Collins, CO, U.S.A
- Calabrese L., Curran M., Matyot P. & Rocamora G. 2015 (working document) **ICS Protocol for the Loading and Landing of Material for the Construction of Multiple Buildings on Aride Island Nature Reserve**. Unpublished internal report. Version 01.04.2015. Island Conservation Society, Seychelles.
- Climo G. & Rocamora G. 2006. **The successful eradication of Black rats from North Island (Seychelles) in September 2005 and proposed strategies to reduce the risks of reinvasions**. Réhabilitation des Ecosystèmes Insulaires (FFEM) Project. Island Conservation Society / North Island.
- Cheke A. S. 2010. The timing of arrival of humans and their commensal animals on western Indian Ocean oceanic islands. **Phelsuma** 18: 38-69.
- Department of Conservation 2010. **Island Biosecurity Best Practice Manual**. Version 2.2. Copy printed on 15/11/14. Government of New Zealand.
- Foxcroft L.C., Pyšek P., Richardson D.M., and Genovesi P. (eds). 2013. **Plant invasions in protected areas. Patterns, problems and challenges**. Dordrecht: Springer.
- Harper, G.A. 2014. **Aldabra Atoll Biosecurity Plan**. Seychelles Islands Foundation, Republic of Seychelles.
- ICS 2014. **Aride Island Nature Reserve. Management Handbook 2014**. Island Conservation Society, Seychelles.
- IUCN/SSC (2013). Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0. Gland, Switzerland: IUCN Species Survival Commission, viiii + 57 pp.
- Merton, D. V.; Atkinson, I. A. E.; Strahm, W.; Jones, C.; Empson, R. A.; Mungroo, Y.; Dulloo, E. and Lewis, R. 1989. **A management plan for the restoration of Round Island, Mauritius**. Jersey Wildlife Preservation Trust.
- Nevill J. 2012. **Denis Island Rodent Protocol**. Green Islands Foundation, Victoria, Republic of Seychelles.
- Pacific Island Initiative. 2011. Resource Kit for Rodent and Cat Eradication. <http://rce.pacificinvasivesinitiative.org>. Accessed on 7th August 2014.

- Pacific Island Initiative. 2012. Resource Kit for Invasive Plant Management. <http://ipm.pacificinvasivesinitiative.org>. Accessed on 7th September 2014.
- Rocamora & Henriette 2015, in press. **Invasive Alien Species in Seychelles. Why and how to eliminate them. Identification and management of priority species.** Collection Inventaires et Biodiversité. Museum national d'histoire naturelle, Paris & University of Seychelles. Biotope Editions, Mèze.
- Rocamora G. & Skerrett A. 2001. **Seychelles**. Pp. 751-768 In: Fishpool, L. & Evans, M.I (eds). **IBAs in Africa and associated islands**. Pisces Publications / BirdLife International. Cambridge, UK.
- Senterre B., Henriette E., Chong-Seng L., Gerlach J., Mougat, J. Vel T. & Rocamora G. 2013. **Seychelles Key Biodiversity Areas: Patterns of conservation value in the inner islands**. Government of Seychelles-GEF-UNDP Biodiversity Mainstreaming Project.
- Soubeyran Y. (coord.). 2010. **Gestion des espèces exotiques envahissantes. Guide pratique et stratégique pour les collectivités françaises d'outre-mer**. Comité français de l'UICN, Paris.
- Tatayah R.V.V., Birch D., Haverson P., Khadun A. & Zuel N. 2007. Successful transport and quarantine of materials using sealable plastic barrels, Round Island, Mauritius. **Conservation Evidence**, 4: 13-15.

ADDITIONAL REFERENCES CONSULTED:

AQIS – Australian Quarantine & Inspection Service, 2006. Cargo containers: quarantine aspects and procedures. Commonwealth Department of Agriculture, Fisheries & Forestry, Australian Government, Canberra, 1-75.

AQIS – Australian Quarantine & Inspection Service, no date. The Cargo Quarantine System: Description of Control/Documentary and Physical Processes. Commonwealth Department of Agriculture, Fisheries & Forestry, Australian Government, Canberra, 1-27.

http://www.affa.gov.au/corporate_docs/publications/pdf/quarantine/border/ccsdcdpp.pdf

IUCN (World Conservation Union), 2000. Guidelines for the prevention of biodiversity loss caused by alien invasive species as approved by 51st Meeting of Council, February 2000 (Information Paper). <http://www.cabi-bioscience.ch/wwwgisp/gtc1.htm> (as the Global Invasive Species Programme On-line Toolkit, in cooperation with CAB International)

Ministerie van Landbouw, Natuur en Voedselkwaliteit (Netherlands), 2005. Protocol for inspection of cut flowers and pot plants destined for the Russian Federation.

http://www9.minlnv.nl/pls/portal30/docs/FOLDER/MINLNV/LNV/UITVOERING/UD_PD/ENGELS/PDINSPPROTOCOLCUTFLOWENG050318.PDF

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 2001. Protocol for military clearance, 1-5.

Wittenberg, R. & Cock, M.J.W. (eds.) 2001. Invasive alien species: a toolkit of best prevention and management practices. CAB International, Wallingford, Oxon, UK, xvii + 228.

6. Annexes

- **Annex 1:** Proposed protocol to minimise the risk of invasion by rodents. Adapted from Merton et al. 1989 (Aride Handbook 2014; Appendix 10).
- **Annex 2:** Biosecurity Protocol for the Loading and Landing of Material for the Construction of Multiple Buildings on Aride Island Nature Reserve.
- **Annex 3:** Cousin Island Protocol For the Prevention of Introductions of Rats and other Invasive Species
- **Annex 4:** Cousine Island biosecurity protocols
- **Annex 5:** Rat abatement and biosecurity protocols for North Island
- **Annex 6:** Frégate Island Private. Policies and Procedures Manual. Loading & Unloading of Cargo - Rat abatement Protocol - Rat Fence Report.
- **Annex 7a:** Biosecurity Protocols for Little Barrier Island, NZ (given to all visitors for ALL biosecurity – even microbes) (in DoC 2010).
- **Annex 7b:** What Goes into a Contingency Plan? (In DoC 2010).
- **Annex 8:** Priority species known to be invasive and problematic in Seychelles, including some not yet confirmed as having a significant impact but that require particular attention (Rocamora & Henriette, 2015, in press).

Annex 1: Proposed protocol to minimise the risk of invasion by rodents *Adapted from Merton et al. 1989 (Arde Management Handbook; ICS 2014)*

The following is a proposed protocol to minimise the risk of invasion by rodents for implementation on Aride Island. It is similar to those used in New Zealand and on Round Island, Mauritius (Merton *et al.*, 1989).

Preventing the arrival of a rodent species is a more effective approach than the difficult task of eradicating them following invasion. The risk of invasion can never be eliminated but general common sense and some simple operating procedures can greatly reduce the risk of rodent invasion. A contingency plan in the case of rodent invasion should be prepared for each island.

Possible invasion sources and proposed prevention techniques (in approximate order of likelihood) are:

Landing of bulk stores:

- Any bulk stores/materials destined for the island should not be left exposed on docks or at customs if possible.
- Holds of schooners and any bulk goods stored on deck fumigated (deck stores can be covered with a tarpaulin and fumigated) before arrival on the island if they cannot be adequately inspected.
- If being transferred to island craft before being landed on the island, make a thorough physical check as being transferred of all hollow goods (boxes, tubes), soft goods (thatching reed, material) and any other nooks and crannies capable of harbouring a rodent. Any risky goods that cannot be checked on the boat should be examined in a rodent-proof room (or if not possible, in a large open space i.e. on the beach by the water line). N.B. Check also for undesirable alien invertebrates, ants, snails etc.
- If being unloaded directly to shore, then examine as above.

Illegal landings to gather seabirds and eggs:

- Irregular patrols by island staff on boat and on foot.
- Foster the goodwill of locals

Landing of small stores from island craft or aircraft:

- If being stored overnight off the island, seal in a box or plastic bag. On arrival examine the containers and seals for damage or signs of disturbance by rodents.
- Any unsealed goods held overnight off the island should be unpacked in a rodent-proof

room on arrival.

From decked fishing boats moored offshore overnight:

- Owners of decked fishing boats (and possibly all fishing boats if resources permit) that moor offshore should be visited and an agreement reached to carry poison bait stations (provided and stocked by island management). Beneficial to owners as reduces rat damage to boat, gear and catch.
- An agreement to moor further offshore (at least 100m, preferably more) should be investigated. This may be impractical for boat owners and generate ill will unless generally agreed to.

Shipwreck:

No prevention techniques.

- Immediately set in place modified eradication protocol to try and eliminate any rodents, suspected or otherwise.

Deliberate introduction:

- Keep good relations with staff and locals.
- Promotion of how valuable these islands are to the local economy (via tourism and employment) which is due to their uniqueness which is because of their rodent free status.
- Promotion of eradication techniques and feasibility with staff.

Via personal luggage:

- Unpack everything on arrival in a room (ideally rodent-proof) with doors closed and if any sign of rodent presence found search for and destroy animal before opening any doors.

In island boat after being moored at Praslin overnight:

- Search cavities, tarpaulins, etc. whilst underway.
- Keep deck maintained so no gaps exist that rodents can use to access below deck space.

Each island should have a room that has been rodent-proofed by sealing any gaps that a rodent could use to escape the room. It should be used for unpacking all stores that are of doubtful rodent freeness. This room should have a minimum of furniture or stores to allow ease of searching.

All island staff should be trained in the detection of rodent presence.

If any rodents do escape onto the island (or are strongly suspected of it) then the rodent invasion contingency plan prepared for each island should be put in effect immediately. This contingency plan should contain an eradication plan (see this report), a budget commitment from the island's controlling authority and mitigation actions to prevent damage to vulnerable species by poisoning, trapping and rat predation. A copy of Cunningham and Moors' (1993) rodent identification guide should be held on each island. Contact should be established with people who have wide experience in rodent eradication techniques for further advice and support.

Evaluation of invasion prevention techniques and recommendations

It is clear from the work on Frégate that to eliminate rats during their colonisation of an island is, at best, difficult. Techniques that quickly detect and/or eradicate individuals as they arrive are necessary. Using permanent defences around areas where rat invasion is most likely (i.e. near landings and mooring sites) is worthwhile. The commonest technique used in New Zealand is a network of poison bait stations around possible invasion sites. There are both advantages (possibly effective, though untested) and disadvantages (long-term use of poisons, poisoning of wildlife, expense) to this. The following adaptations may increase effectiveness (for Seychelles see below).

On staffed islands a network of 100 mm diameter poison bait stations staked firmly in place extending at least 100 m inland and with a 20 m spacing (smaller if seeking to prevent mice from establishing). Baited for at least one month every three months (or permanently if no risk to native wildlife). If rodent sign detected immediately put in operation a full scale GBE (see 9.3).

If one species of rodent is already present then to avoid bait shyness and poison resistance in the resident rat species leave the poison grid unused as a back-up safeguard and instead use traps at the bait station sites for a month in every three months. Trap stations should be permanent, under mesh covers and designed so they can be re-baited with a minimum of disturbance. Traps should be cleaned regularly and protected with 'Fishoilene'. Trap or poison sites should be checked that they are not overgrown or damaged two weeks before trapping or poisoning.

For unstaffed islands use methods as described above except baiting whenever there is a visiting party.

For rat-free islands in the Seychelles the large number of millipedes, crabs and lizards preclude the use of this method effectively. Efforts should be made to detect rats early using passive detection methods - footprint tracking, feeding sign and other rat sign - whenever circumstances permit. Groups of gnaw sticks created from 500 mm lengths of 5 mm diameter soft wood doweling that has been soaked in warm vegetable oil for 24 hours should be deployed around the coast of the island and checked monthly.

	A minimum of 10 rat bait stations on the boats and 10 bait stations at IDC loading area.	Pestex or ICS staff member.	Rat poison to be supplied by Pestex or ICS.
	Send 20 rat traps to ICS Office.		
	Fumigation of all parts of the shipment in the Construction company storage area.	Pestex	To be done in a container or under plastic cover. Pestex to liaise with construction company so that this can be done after the workers have left. When using Phostoxine, there are no risks of toxicity after 36 hours.
	Rat traps to be set on IDC boat and IDC loading area.	ICS or Pestex	Set up at least ten rat traps on the boats, plus the same number at the IDC loading area (all baited with roasted coconut) during at least three consecutive nights.
	Transfer of all the material for the shipment to IDC.	Construction company	Estimated total is around __ tons of cargo.
	Referral inspection of all materials to be shipped for potential invasive alien species.	ICS	This should comprise visual checking of all solid woods, panels, and other material. With special attention to be paid to hollow blocks (even if these have been fumigated) or any parts that have not been fumigated. All boxes containing small parts should be sealed with tape immediately post checking.
	Transfer of material for shipment into the IDC boats.	IDC	Care should be taken not to break seals (see above).
	Protective iron mesh barrier with rat traps to be set up along the beach. Further traps to be set just inland in likely areas for initial rat invasion.	Aride Staff	Around 100 m of 1 meter high mesh 25 cm deep into the sand with at least twenty closed boxes (e.g. cardboard boxes) with rat traps to be set up within the fenced area to attract any rats which may land. This fenced area will help to restrict the movement of any alien species which may arrive on the island to the beach area.
	IDC boat leaves Mahé for Aride.	IDC	
	Setting up a rat-trapping grid at the Landing site- La Cour- Building area..	Aride Staff	An abatement grid of 15 x 15 m of rat-traps to be baited with roasted coconut (prepared in advance). The traps must be checked every 2 to 3 hours following the landing of the first building material, any sprung traps should be re-set and any non threatening accidentally trapped species should be removed (the most common are skinks, crabs, and mice). The traps should continue to be checked for up to one week after the last of the materials have been landed if some problems are reported with the quality of implementation of the biosecurity protocol.
	Unloading from IDC boat to small boats (IDC and Aride ones).	Aride Staff, also selected IDC staff	Material will be unloaded on the beach, then taken directly to the building area after being checked offshore for invasive species, by Aride staff before each landing .
	Unloading from small boats to Aride beaches.	Aride Staff, and construction staff	
	Rapid inspection of all materials on arrival on Aride on the beach in front of protective fence.	Aride staff	This should comprise visual checking of all solid woods, panels, and other material. With special attention to be paid to hollow blocks (even if these have been fumigated) or any other parts that have not been fumigated. Any sealed boxes must be opened only in a sealed room set aside for this purpose . Tools for killing and disabling alien invaders to be ready at hand
	Bringing material from beach to building site.	Construction Staff	

Annex 3: Cousin Island Protocol For the Prevention of Introductions of Rats and other Invasive Species (Source: Cousin Island / NS).

Purpose: The overall objective of this protocol is to protect the critical island biodiversity of Cousin from introductions of rats and other invasive species. The risk of such introductions occurring is low as evidenced by Cousins rat-free status over the past 100 years but the potential consequences of such an occurrence (e.g. the introduction of rats) is extreme. The biggest concern and threat in this situation is staff and visitor complacency. Rats and other invasive species must be dealt with like a fatal disease where prevention is essential. The main objective of this protocol is thus to ensure that:

- All staff are aware of the critical and ongoing nature of this threat
- All staff recognize situations and articles of baggage and freight where threat could occur
- All staff know what their responsibilities are and what actions to take when a potential threat is identified
- All staff know what actions to take when an escape or likely escape has occurred
- This protocol is reviewed with all staff on a regular basis and with volunteers, researchers and other workers coming to the island

Policies & Procedures:

- Only Cousin boats are allowed to land on the island and boats from Cousine and Aride with prior approval
- All other boats must moor at the mooring buoys provided and wait for a Cousin boat to land passengers and freight.
- Boat operators are responsible for the visitors, baggage and freight that they land on Cousin
- No live animals or plants are allowed to land on the island under any circumstances
- Any sealed or closed boxes or crates should be opened and inspected on the beach with contingency measures to prevent and kill any rats or other invasive from escaping
- Boxes, crates and equipment imported into Seychelles (e.g. outboard engines, pumps, generators) or that could attract (e.g. food supplies) and harbor (e.g. pipes, mattresses, stoves) rats and other invasive species should be given special attention
- If an escape of a rat or other invasive occurs on the island or is suspected to have occurred immediate steps to contain and destroy the animal should be taken. Any such incident must immediately be reported to the Chief Warden, Assistant Manager or Warden in charge. The incident should also be reported in the Chief Wardens monthly island report. However, if deemed to be of relatively high risk to other species on the island this should be reported immediately to the office on Mahé.
- The presence of an invasive species once noted and reported should be dealt with through appropriate measures to ensure its removal or destruction, this includes species such as rats, barn owls, cats, crazy ants or any other species deemed to propose a significant threat to the islands plants and animals.

Annex 4: Cousine Island biosecurity protocols (Source: Cousine Island)

INVASIVE SPECIES MANAGEMENT & CONTROL

Description

Invasive alien species can have a devastating effect on any ecosystem, but even more markedly so if that system is a small isolated island where the invasive species can concentrate the damage. Luckily the isolation of the island is also what makes it easier to control the accidental introduction of invasive alien plants and animals. In the unlikely event that an alien animal comes onto the island, it must be killed immediately with a follow up monitoring programme to ensure that no others of the same species are on the island (Barn Owls, Indian Myna's, mice, rats, cats, alien reptiles etc.) All alien plants must be destroyed

Threats of new introduction

There are only 4 ways for invasive and/or alien plants and animals can arrive on the island.

1. **Naturally** – This is luckily applicable to very few plants and birds. Indian Mynas and Barn Owls have been known to fly onto the island from time to time. These are to be trapped or shot. Seeds from alien plants wash up on the beach from time to time and if these germinate, it is necessary to pull these plants out and remove them from the island. Occasionally seeds are also dispersed out of the vegetable garden by tortoises and Seychelles Foddies (and staff!). Paw-paw and soursop are particularly susceptible to spreading. It is necessary to keep an eye out for these plants and remove them.
2. **Barge** – Barges are used in two ways, anchored offshore with cargo being transferred between the island and barge with boat or helicopter (or diesel with pipes) or more rarely the barges are beached. In both cases all cargo should be checked for anything that might be a problem, such as rats, ants, spiders, foreign geckos, cockroaches or even plant seeds where possible to spot them. Check with the Island Manager beforehand that the cargo was fumigated on Mahé. Especially concentrate on fresh produce (if any), building materials and anything imported from Asia (usually spa items). Wood also needs to be checked for any insect damage, as eggs or insects might be inside. If the barge beaches, care must especially be taken to inspect the barge for rats. From the time the barge door is opened until it is closed again, someone must be on guard at all times looking out for rats or mice coming off the barge. Something to kill rats and mice with must be on hand when the doors are opened as well in case anything comes off. If a barge has been on the beach overnight, gnaw sticks must be used to test for rats having come on. These are normal tongue depressors dipped in vegetable oil or peanut butter which will attract the rats to gnaw on the sticks.
3. **Boat** – The boat is the most dangerous mode of transport for plants and animals onto the island. The boatman is supposed to check any fresh produce brought onto the island and it is supposed to be checked in by the chefs immediately. However this is

not a full proof manner and every possible opportunity at least one conservation staff member should look out for anything amongst the cargo brought in by boat. It is also important for all staff to check their own bags to prevent anything from coming on. Ants such as the yellow crazy ant can destroy the island and occurs all over Mahé and Praslin. Flowers brought in for weddings are also a high risk product that should be checked immediately.

4. **Helicopter** – Even though the chances of something brought on by helicopters are very slim, cargo and luggage brought onto the island should be given a quick check as with the boat.

Plants and seeds brought on for the vegetable garden or other purposes need to be without soil as the soil could contain diseases. The plants also need to be sterilised using a bleach and water mixture.

Annex 5: Rat abatement and biosecurity protocols for North Island

Mahé Boat Loading Procedures

(Climo & Rocamora 2006 / ICS FFEM project)

The long-term eradication of rats on North Island requires two things; the successful eradication of existing rats and the prevention of rats reinvading the island. If rats have a chance to reinvade they will. One of the biggest risks to North Island is rat reinfestation through transport to the island of goods and materials. A quarantine procedure for goods coming to the island is essential to prevent rodents arriving accidentally with transported goods.

Measures to stop reinvasion on the island itself is a final precaution. Most of the actual responsibility to ensure that a rat doesn't stow away on route to North Island will fall on the Mahé Office.

The following procedure details the boat loading process for shopping, staff luggage and containerized goods and aims to make the risk of rat Re-introduction from these sources non-existent.

Boat Loading Procedure for Shopping and Staff:

- All island shopping, staff shopping and staff baggage must be packed into the plastic boxes provided before transfer to the boat. Until this system is in place, all independent salesmen and key Mahé personnel must adhere to the following when transporting goods to the cay and subsequent loading:
 - Do not at any time leave boxes standing unattended on jetty during loading;
 - Pipes to be checked for rodents (flow water inside for those that cannot be checked by view) and ends subsequently closed off before putting them on the boat;
 - Extra care should be taken with cartons and bags: these should be carefully checked for chew marks and droppings, and subsequently for hidden invader animals.
 - After checking, cardboard boxes and bags should be immediately properly taped close.
 - Do not load unauthorized plants or animals.
 - Planks to be treated before loading.
- If possible, boats not to stay moored at the jetty overnight. Any loaded boats left in Mahé overnight must have baited bait stations aboard. Cones/bottles to be attached on the mooring ropes. Baiting stations to be set up around the moored boat, on the jetty. Bait stations and block bait will be given to the Mahé office for this purpose. Bait blocks must be replaced weekly (barges) or 2-weekly (boats)
- All containers must be fumigated prior to transport to the island.

- Island Contractors must be informed of the importance to inspect their gear for seeds, rodents or insects before transport to the Island.

Mahé storage of goods:

- Angel Fish complex care taker to place and subsequently monitor and re-bait bait stations around the complex.

Responsibilities:

- Ensuring shopping is packed in plastic boxes – [WHO].
- Ensuring all boats leaving from Mahé have bait stations aboard and bait blocks are regularly changed (use of log book) – [WHO].
- Ensuring contractors are informed of the need to inspect goods for seeds, rodents and insects before transport – GM.
- Supervision of the placing of baiting stations, and their subsequent rebaiting – Environment Assistant & Mahé Staff. Angel Fish complex to be involved.
- Ensuring Mahé office and boats/barges have a sufficient supply of bait and bait stations – Environment Officer.

Process running smoothly and alteration of procedure if necessary – Environment Officer.

Boat (shopping & staff luggage) & Barge (cargo) Unloading Procedures

(Climo & Rocamora 2006 / ICS FFEM project)

The long term eradication of rats on North Island requires two things; the successful eradication of existing rats and the prevention of rats reinvading the island. If rats have a chance to invade they will. One of the biggest risks to North Island is rat re-infestation or other rodent invasion through transport to the island of goods and materials. A proper unloading procedure is essential for the safe unpacking and checking of goods for any rodents that may accidentally come in with transported goods.

The following procedures detail the process for unloading barges (containing cargo) and boats (containing shopping & staff luggage) and aim to make the risk of rat Re-introduction or alien invader animals' invasion from these sources non-existent.

Barge/ Boat unloading procedure:

- All boats/ barges coming to North Island must have permanent bait stations aboard. Any loaded boats/ barges overnighing in Mahé prior to travel to NI must have bait stations placed on board, and poison blocks are to be replaced regularly in boats, and weekly or more often if required in barges (wet blocks to be replaced). Small boats need one bait station, larger boats need 2 – 3 bait stations.
- Unbaited Elliott traps in wooden boxes (imitations of sheltered places to attract escaping rodents on exposed beaches during offloading) to be set up on the beach during offloading of barges containing food items, cardboard boxes and building material with cavities.

- The only cargo items exempted (as per agreement of the General Manager and Environmental Officer), are listed below (*). All other goods, including staff shopping and baggage, must go to the rodent-proof room (“rat room”).
- The rodent-proof trailer must be used to transport goods (cargo, shopping and staff luggage) to the rodent-proof room. For smaller loads, a gator with rodent-proof canopy can be used instead.
- Goods should be packed in rodent-proof sealed containers in Mahé before loading where possible.
- Future cargo should be transported as whole containers rather than being destuffed in Mahé – this will enable fumigation to be undertaken prior to offloading on North Island.

(* Exemptions of cargo items that do not need to go to the rodent-proof room:

The list of exemptions given below are due to the negligible risk of harboring rodents or the difficulty of transporting items to the rodent-proof room. Items that are not taken to the rat room have to be checked on the beach. This is the responsibility of the Maintenance Manager and Security Officer.

- Drums containing petrol, oil, chlorine and hazardous chemicals (if not packed in cardboard boxes)
- Large containers of cleaning chemicals (if not packed in cardboard boxes)
- Crates of drinks
- Cling wrapped packets of water
- Cement
- Aggregate
- Timber planks
- Diesel
- Gas cylinders
- Large unpacked machinery (motor compartments need to be checked on the beach for mice and poison blocks put inside at Mahé prior to transport)
- Cling wrapped tins of chemical product (eg paint)
- Tyres
- Copper
- Metal and PVC piping – large rolls of piping needs to be checked on Mahé and the ends plugged immediately after inspection. These can be checked using compressed air.
- Rolls of building plastic
- Shade cloth

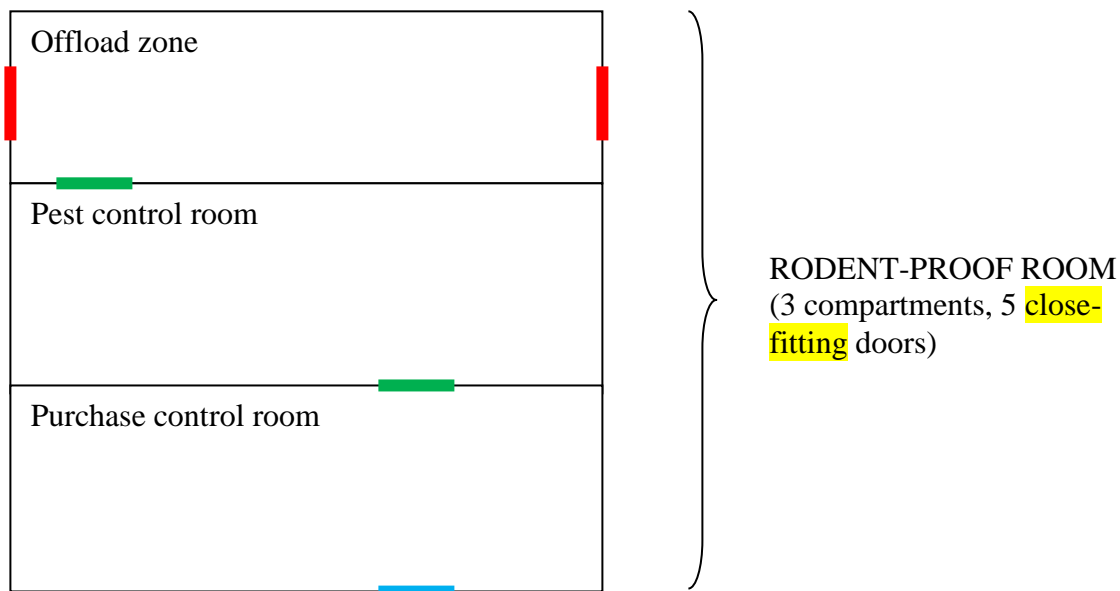
Responsibilities:

- Ensuring that bait stations are placed on incoming boats/ barges and re-baited timely (weekly for barges) – Skipper and [WHO] (Mahé Office). Incoming boats’ baiting to

be verified by the Dive Center Manager (for shopping boats and charter boats), Security Officer and Environment Department's staff.

- Offloaded goods not to be placed on the beach but directly loaded into rat proof trailer and transported to rodent-proof room where goods and staff bags are inspected behind closed door – Maintenance Manager, Security Officer and Central Store Manager.
- Process running smoothly and alteration of procedure if necessary – Environmental Officer.

Rodent (& other pests) proof room procedures (North Island, March 2012)



Offload zone: drive-through with metal roller doors.

Pest control room: quarantine room where goods are checked for pests.

Purchase control room: room where cargo, already checked for pests, is stored, before further dispatching to the different department's stores.

Offload zone

1. Trailer enters and both steel doors are carefully closed, making sure that the bottom rubber is properly sealed and doors are locked (by securing the chain into the metal holders). Only then can the trailer doors be opened and can the offload begin.
2. All goods are to be offloaded directly into the pest control room whilst the 2nd door to the purchase control room remains closed.
3. Only when all goods are offloaded and both pest control doors are closed, can the roller doors be opened again and the trailer removed.
4. This zone is for transport only; strictly nothing to be stored here (maintain easy visibility).
5. Stick ("rat bat") to be kept close by; metal walk-in traps to be set along walls. No objects to be attached to the walls (avoid building "ladders" for animals to climb up which will hinder killing them).

Pest control room

6. Both doors to be closed and checking of all goods to be done immediately.
7. Once all goods are inspected, they are to be immediately moved into the purchase control room.
8. During barge offloads with large cargo volumes to be processed, an exception can be made with checked cargo moved into the purchase control room whilst checking is still ongoing; in such case, the purchase control room's door to the stores should be kept closed.
9. This room is a transit room where only goods awaiting pest inspection can remain for as short as possible. Strictly nothing to be stored here. To maintain easy visibility, all discarded packaging is to be removed.
10. Stick ("rat bat") to be kept close by; metal walk-in traps and bait stations to be permanently placed along the walls.
11. Broken bait stations and traps are to be reported immediately to the Environment Office for replacement.
12. The poison blocks in the baiting stations are to be replaced every 2 weeks by Environment. Blocks to be checked for chew marks (see photo below). Metal walk-in traps to be kept operational at all times (if door closed, trap is to be shaken to detect if an animal was caught, in which case Environment needs to be called immediately).

Purchase control room

13. No goods are to be moved from the pest control room to the purchase control room before pest inspection in the pest control room. Doors are to be kept closed until the inspection has been finalized.
14. Damage to the rodent-proof room needs to be immediately reported for repair by the Central Store Manager/ Security Officer.
15. In charge of supervising the correct implementation of the alien invader avoidance procedures at all times, are:
 - a. for staff luggage only: Security Officer.
 - b. for all other cargo: Central Stores Manager.
16. Any pest animals or suspicious signs of pest animals (see photos) are to be reported immediately to the Environment Officer.

NO DEVIATION FROM THIS PROCEDURE WITHOUT THE APPROVAL OF THE GENERAL MANAGER AND THE ENVIRONMENT OFFICER.

Central Store Manager: further specification of tasks re. pest avoidance

Rodents being a common pest on Mahé, daily cargo sent to North Island therefore requires stringent implementation of procedures to avoid accidental Re-introduction. Avoidance procedures are to be followed at all stages of the transport: on Mahé, on the beach during offloads, as well as during rodent-proof room cargo deliveries and subsequent inspections. Together with the Mahé Logistics Officers, skippers offload teams and security officers, the Central Store Manager therefore plays a key role in keeping North island free of rodents or other potential pests (plants or animals), and will receive training from the Environment Officer during the first week of his/her assignment.

His/her responsibility will include all possible actions to ensure detection, immediate reporting and subsequent immediate destruction of any dangerous pest animal/ plant escaping from cargo arriving in the rodent-proof room, by:

- Thorough cargo inspections: all goods arriving in the rodent-proof room require inspection before release to the relevant departments. Only the Environment Officer can exempt goods from a search. For container offloads, assistance will be given by trained Environment staff. During cargo searches, packaging and goods need to be searched for hidden animals or plants, or any suspicious signs (droppings, chew marks, chewed nesting material) of a rodent.
- Correct through-fare of goods: once goods have been declared safe, they need to be removed from the pest control room before arrival of next cargo, unless a qualified person remains in the room to ensure checked

goods are not contaminated by pest animals escaping from newly arrived cargo into already opened checked boxes still present in the room. Otherwise, all cargo needs to be re-checked before release.

- Reporting: any pest animal/ plant or suspicious sign of an unwanted pest that came on the island via cargo, needs to be immediately destroyed and subsequently reported to the Environment Officer. If assistance is required with the destruction, the Environment Officer/ Landscape Manager need to be called upon immediately, whilst doors need to remain closed at the place of sighting (rodent-proof room or stores) for other staff, and cargo movement needs to be ceased until the Environment Officer has given go-ahead to resume normal work.
- Maintaining rodent-proof room efficiency: any damage or malfunction in the rodent-proof room, jeopardizing its effectiveness to contain an unwanted pest animal escaping from cargo inside the room, needs to be reported in writing to the Maintenance Manager, with the Environment Manager copied in. Maintaining the work place includes regular checks of walls and door mechanisms. Assist the Environment staff with keeping traps and bait stations in rodent-proof room & stores operational.





Baiting station with bait blocks



Metal walk-in trap (requires no bait)



Droppings of rodent.



Chewed material between boxes.



old block
consumed by snails



old block
(by ants)



new block

‘Pest-proof room’ check list (March 2012)

* CSM = central store Manager, S = Security Officer, E = Environment, All = all entering “rat room”


OFFLOAD ZONE	Responsible *	<u>INSPECTION</u>	
		DATE: DONE BY:	
		TICK BOX	COMMENTS
17. Seal both steel doors carefully before opening the trailer door and offloading.	All		
18. Offload all goods directly into the pest control room with door to purchase room closed.	All		
19. When all goods are offloaded: close Pest room door, then open steel doors before trailer exits.	All		
20. Nothing (including removed packaging) stored in Offload zone.	All		
21. “Rat bat ” within easy reach	CSM		
22. Metal walk-in traps operational	CSM, E		

PEST CONTROL ROOM			
23. Close both steel doors and the door to the purchase control room when bringing new cargo in from Offload zone.	All		
24. Check all goods immediately for pests/ suspicious signs, in closed room.	CSM: shopping boats E: barges. S- staff bags.		
25. After checking for pests/ suspicious signs, move checked goods immediately into Purchase control room.	CSM: shopping boats E: barges		
26. No clutter: also remove discarded packaging after each inspection.	CSM, E		
27. Close door to Purchase room again before receiving new unchecked goods.	CSM, E		
28. Transit room only. (No goods to be stored)	CSM		
29. “Rat bat” within easy reach	CSM		
30. Doors are to be kept closed until the inspection has been finalized.	S, A		
31. Permanent rat bait stations re-baited every 14 days	E		
32. Metal walk-in traps operational	CSM, E		

PURCHASE CONTROL ROOM			
33. Only pest-free goods can move to the Purchase control room.	CSM		
34. Any pest animals or suspicious signs (see photos) are to be reported immediately to the Environment Officer.	All		

GENERAL RULES FOR ENTIRE “RAT ROOM”			
35. Report damage immediately	CSM, S, E		
36. Obey at all times to person in charge: -Central Stores Manager. - Staff luggage only: Security Officer.	All		
37. No changes to rules without permission of Environment officer	All		

Annex 6: Frégate Island. Policies and Procedures Manual. Loading & Unloading of Cargo - Rat abatement Protocol - Rat Fence Report.

	Frégate Island Private Policies and Procedures Manual <u>Loading & Unloading of Cargo</u>	POLICY No:	ECO 01/12
		PREPARED BY:	Dane Lee Marx Ecology/Conservation Manager
Department: Ecology		APPROVED BY:	Mr. Paul Van Frank
EFFECTIVE DATE: 01/07/2012	SUPERSEDES NO: 01/05	Page:	1 of 1

STANDARD

- To ensure efficient loading and unloading of Pie Chanteuse

PROCEDURE

Unloading -

- Sailing date and ETA from Mahé office to be established by Purchasing Manager, Ecology to be informed of date of arrival by Purchasing Manager at least a week prior to arrival.
- Skipper of Pie Chanteuse to confirm arrival one day prior with assistant ecology manager or ecology manager, and inform what equipment is required for unloading.
- Stores to establish volume and type of cargo and notify ecology of any special items or requirements.
- If diesel is to be loaded, have bowser and tractor ready in position on the slipway, right rear tanker wheel hard against slipway concrete wall.
- Dry goods, engineering, stores etc requires the flat-bed trailer and tractor and a minimum of five men to load and discharge.
- Two men in the cargo hold to operate sling and pallet, plus three men to pack onto tractor from pallet.
- When the tractor is full, drive with all men to discharge area.
- Unload and pack into stores or container whilst checked by stores department.

Loading -

- Stores manager to send back empty bottles & cold drink crates on flatbed trailer on tractor after discharging arriving goods into stores. Also, store to tally number of items & prepare shipping notification for security.
- Gas bottles and crates to be loaded directly onto pallet in tractor trailer, and then loaded onto Pie Chanteuse.
- Frégate crew assists in packing onto pallets or slinging with ropes in case of gas bottles

ALL RAT ABATEMENT PROTOCOLS MUST BE ADHERED DURING LOADING AND UNLOADING, WITH EXTRA CONCERN.

- No cargo to touch fences or walls, or to be packed adjacent to fences or walls whilst loading or unloading.
- Marina gates must remain closed when not in use, this includes between unpacking.

	Frégate Island Private Policies and Procedures Manual <u>Rat Abatement Protocol</u>	POLICY No:	ECO 18/12
		PREPARED BY:	Dane Lee Marx Ecology/Conservation Manager
Department: Ecology		APPROVED BY:	Mr. Paul Van Frank
EFFECTIVE DATE: 01/07/2012	SUPERSEDES NO: 18/05, 05/00 & 04/00 & 02/00	Page:	1 of 2

STANDARD

- To minimize the risk of re-invasion of rats onto Frégate Island
- To monitor that all Rat Abatement control systems are in place
- To accurately follow up any possible encounter or incident


PROCEDURE

- Boats not belonging to the Frégate Island fleet may not be allowed to dock anywhere with the island.
- Any sanctioned visiting boat must be certified rat free at last port, and have baited rat bait stations on board. Such boats may be granted permission to anchor in the harbour channel, with discretion.
- Any boat not complying with these minimum standards will not be allowed into the harbour at all, and must anchor offshore.
- The Frégate supply barge is to always be fully baited with rat poison and bait traps.
- Any cargo that might conceal rodents (especially shipping containers, thatching material etc.) is to be fumigated before leaving Mahé for Frégate.
- Official certified documentation is to be provided before loading onto Pie Chanteuse.
- The cargo holding shed on Mahé is to be periodically emptied, checked and rat bait stations are to be constantly maintained there.
- Every end of month the Ecology Manager or Ecology Supervisor/Assistant Manager is to check all existing bait stations on Frégate Island, and all Frégate boats. Storage area in Mahé Port to be checked by Gills Pest Control in Mahé.
 - Check for the presence/absence of bait
 - Check the location of the bait station, is it blocked off, or full of sand/debris?
 - Open the bait station and check the bait
 - Check the contents, report any sign of rats, note if bait is eaten, mouldy etc. and re-bait.
 - Certain bait stations (around the Marina) will need to be re-baited every two weeks or more.
 - Complete the bait trap location checklist as you progress through the bait stations.
 - Follow up on any bait traps or items as needed (replace damaged boxes, ensure that bait traps that are moved are left in the correct spot etc.).
 - File all checklists and reports in Ecology Office & check that there is always extra stock of rat poison.

The cost of eradicating rats is extremely high – both in financial terms, and even greater for environmental ramifications. Although Frégate Island has been rat free for many years, it is of absolutely paramount importance that the rat abatement policies are upheld to the fullest and that staff across the island do not grow complacent. The Marina is the most likely point of entry for a future invasion, and thus the Marina manager/supervisor and staff must cooperate fully, remain vigilant, and take responsibility in this regard.

ADDITIONAL MEASURES

- Conduct periodic awareness and “refreshers” for staff.
- Security to be alert for sabotage, previous sabotage attempt suspected.
- Attempt to obtain zone of exclusivity around Frégate to prevent boats landing on shore, possibly through the creation of a marine protected area.
- Staff handbook should include information on rat awareness; induction for new staff should also include this information.
- No used bulk bags are to be brought to Frégate unless fumigated before dispatch. Fumigation is to be organised by the Mahé office through Gills Pest Control.

	Frégate Island Private Policies and Procedures Manual Rat Abatement Protocol	POLICY No:	ECO 18/12
		PREPARED BY:	Dane Lee Marx Ecology/Conservation Manager
Department: Ecology		APPROVED BY:	Mr. Paul Van Frank
EFFECTIVE DATE: 01/07/2012	SUPERSEDES NO: 18/05, 05/00 & 04/00 & 02/00	Page:	2 of 2

Marina

- 1 Under dock bridge
- 2 First gate (corner of first entrance)
- 3 Under barbecue area at Yacht Club
- 4 End of fence at Yacht Club
- 5 End of fence opposite the Yacht Club
- 6 Fence corner before entrance to bridge
- 7 Below entrance to security house
- 8 Inside fence in front of security house
- 9 Scaevola opp. marina on millionaire's lawn
- 10 Scaevola opp. marina on millionaire's lawn
- 11 Scaevola opp. marina on millionaire's lawn
- 12-13 Little Fregate boat (x2)
- 14-15 Fregate bird boat (x2)
- 16 Pie Chanteuse boat

SPA

- 17 Reception

Mechanic workshop

- 18 Corner of ecology workbench area

Banyan Hill

- 19 Under Dr. Happel's villa
- 20 Under the kitchen at the core area

Staff village

- 21 Dustbin area
- 22 Dustbin area
- 23 Kaz Creole
- 24-33 In front of each staff house (x10)

African House

- 34 Outside the kitchen
- 35 Western side of the house (facing road)
- 36 Eastern side of house (facing ocean)

Indian House

- 37 Inside kitchen

Green Indian House

- 38 Inside kitchen
- 39 Outside next to bins

Hydroponics

- 40 Packing shed
- 41 Corridor

MD's House

- 42 Under the balcony

Ecology manager's House

- 43 Outside the kitchen

Management's House

- 44 Outside Chef's house
- 45 Outside maintenance chief's house
- 46 Back of Chef Andre's House (Chalet 3)

Clinic House

- 47 Inside clinic
- 48 Outside clinic
- 49 Porch next to flamboyant

Canteen

- 50 Dry store
- 51 Inside kitchen
- 52 Inside serving area
- 53 Inside coffee area
- 54 Inside corner of canteen

Stores

- 55 Dry store
- 56 Inside store
- 57 Outside store entrance
- 58 Cleaning supply store

Staff shop

- 59 Inside staff shop

Laundry

- 60 Behind driers

Carpenter workshop

- 61 Corner near bandsaw
- 62 By the old furniture store

Incinerator

- 63 Next to dustbins

Other Houses


- 64 Yamsa House
- 65 Outside kitchen of Birdlife House
- 66 Under prefab of mechanics (nursery) house
- 67-69 Hibiscus House (x3)

Hotel

- 70 Outside Villa 6
- 71 Between Villa 5 and 6
- 72 Between Villa 6 and 7
- 73 Under the restaurant

Hotel Kitchen

- 74 Just outside pastry section
- 75 Inside dry store
- 76 Inside dustbin room
- 77 Outside buggy charging area

	Frégate Island Private Policies and Procedures Manual <u>Rat Fence Report</u>	POLICY No:	ECO 19/12
		PREPARED BY:	Dane Lee Marx Ecology/Conservation Manager
Department: Ecology		APPROVED BY:	Mr. Paul Van Frank
EFFECTIVE DATE: 01/07/2012	SUPERSEDES NO: 19/05 & 03/00	Page:	1 of 3

STANDARD


- To minimize the risk of re-invasion of rats onto Frégate Island.
- To monitor the Rat Fence to ensure it is in an optimum state.
- To accurately follow up on any possible damage to the fence.

PROCEDURE


Harbour area is to be kept enclosed by officially approved rat proof fence.
Gates at harbour to be constantly monitored, particularly when **any** boat is docked.
Rust on fence to be monitored and paint reapplied regularly.

Every week the Marina Manager is to thoroughly check the Rat Fence surrounding the Marina, as well as all the bait stations inside the harbour and the boats.

- Inspect Fence from one end to the other, inside and out, checking carefully for any damage to the fence, particularly areas prone to damage such as the turn-downs to the water and around the gates. Check must include the sliding gate and all areas within the fence.
- Check all bait stations inside the fence, in the marina building and on the boats by:
 - Check for presence/absence of baits.
 - Checking the location of the station, is it blocked off, or full of sand/debris
 - Opening the station and checking the bait.
 - Reporting any signs of rodent activity, and replacing the bait if eaten away or mouldy.
- Compile the rat fence report (attached), noting status of all bait stations and rat fence. Thereof follow up accordingly with the Ecology Manager, should any bait station need to be changed or re-baited.

	Frégate Island Private Policies and Procedures Manual <u>Rat Fence Report</u>	POLICY No:	ECO 19/12
		PREPARED BY:	Dane Lee Marx Ecology/Conservation Manager
Department: Ecology		APPROVED BY:	Mr. Paul Van Frank
EFFECTIVE DATE: 01/07/2012	SUPERSEDES NO: 19/05 & 03/00	Page:	2 of 3



	<h2 style="text-align: center;">Frégate Island Private</h2> <p style="text-align: center;">Policies and Procedures Manual <u>Rat Fence Report</u></p>	POLICY No:	ECO 19/12
		PREPARED BY:	Dane Lee Marx Ecology/Conservation Manager
Department: Ecology		APPROVED BY:	Mr. Paul Van Frank
EFFECTIVE DATE: 01/07/2012	SUPERSEDES NO: 19/05 & 03/00	Page:	3 of 3

Rat Prevention Measure	Problem	Identified? (Tick Box)	Resolved? (Tick Box)
FENCE			
Mesh	Damaged / holed/ loose from posts		
Metal Strip	Damaged / loose from posts		
Plastic Pipe	Damaged / loose from posts / missing		
Plastic Pipe	Caked in bird droppings		
Weed Growth	Inside Fence		
Weed Growth	On or Over Fence		
Holes in ground	Under or near fence		
Gate	Damaged / not closing		
Gate	Hole or gap under gate		
Bait Stations: Harbour & Buildings			
Bait Station	Missing / not accessible		
Bait Station	Moved / blocked with sand		
Bait	Needs replacing		
Bait Stations: Boats			
Bait Station	Missing		
Bait Station	Missing or old		
Bait	Needs replacing		
Any other problems?			

Annex 7a: Biosecurity Protocols for Little Barrier Island, NZ (given to all visitors for ALL biosecurity – even microbes) (in DoC 2010).

BIOSECURITY CONDITIONS

Biosecurity conditions are in place to minimise the risk of ecological damage to Little Barrier Island (Hauturu), through inadvertent introduction of potential pest species such as rodents, invertebrates, weeds, fungi and disease. **Following these conditions will ensure you meet the conditions of entry permit. Failure to do so will result in delays, or cancellation of your permit and of your trip.**

The conditions apply to all island visitors staying overnight on the island including DOC staff, volunteers, researchers, contractors, dignitaries, guides and the public.

The designated group leader has the responsibility and accountability to ensure the following conditions are adhered to and that all members of the party are familiar with and comply with them. If for some reason a condition outlined below cannot be adhered to, the onus is on you to advise DOC and to seek a mutually agreed 'one-off' solution. Most of the rules require action prior to arrival at the embarkation point. Make sure your group is fully aware, in advance, of the requirements!

Conditions

1. The Biosecurity Checklist (Page 13) must be completed and the required actions implemented by every person travelling to Little Barrier Island before departure.
2. If you or your equipment have come into contact with wildlife within the last six months, you have visited a poultry farm, aviary or other captive institution, or you intend to handle wildlife on Little Barrier Island then you must also complete the Hygiene Checklist (Page 14) and implement the required actions before departure.
3. An inspection of all gear will be carried out at a quarantine store prior to departure under the supervision of a DOC staff member responsible for island biosecurity. This will involve going through the two checklists and inspecting your gear. The inspection will usually only involve checking high-risk items e.g. footwear, coats, pockets and gaiters etc. but if a risk is identified your belongings may be searched more thoroughly.
4. All gear must be packed and sealed in pest proof containers. Approved container types are fish bins, poly-pail type buckets with sealable lids, plastic drums/barrels with screw-on lids and heavy PVC water proof bags. Any container with ill-fitting lids, cracks or holes of any size will not be permitted. Sealed cardboard boxes and plastic bags are no longer considered appropriate. If you are unable to find something suitable the Department will supply fish bins for your visit at the quarantine store. Packs are not permitted to be taken to Little Barrier Island unless specific approval has been given.
5. Large items should be broken down if possible to fit within sealed containers. If not possible, it is the responsibility of the group leader to bring this to the attention of the DOC staff member responsible for island biosecurity. Specific biosecurity conditions applying to that item or items will be established and agreed upon.
6. Stores must remain in sealed containers at all times in transit. If anything is required to be opened in transit it must be fully repacked and re-sealed in a rodent-secure area.

7. Each and every item must be checked for sign of damage or possible rodent entry immediately prior to off-loading stores on to the island. If any damage is noted, do not send the item ashore until opened, checked and repacked in another container!
8. On arrival at the island all items must be taken directly to the island's quarantine store and, with the door and windows firmly shut, fully unpacked and checked.
9. Do not throw away any food waste while travelling around the island. Apple cores, unwanted fillings from sandwiches, citrus peelings etc must be kept in your bag and returned to the base or boat for disposal.
10. Eggshells must be taken off the island with non-biodegradable rubbish, not disposed of with the biodegradable waste.
11. Wherever possible use proper toilet facilities. If this is not practical, bury all toilet waste to at least 15 cm, and avoid areas closer than 15 metres to any water way.
12. If you observe any previously undetected pest or disease or any evidence of suspected pest or disease presence you must notify the island ranger immediately.

Full detail on the purpose and justification for these regulations can be found in the full Auckland Conservancy Island Biosecurity Plan, available at the Warkworth Area Office.

Alternatively, staff at the Warkworth Area Office are willing to discuss any concerns or queries with you, to ensure a safe and successful trip, both for you and for the island.

Thank you for your co-operation.

BIOSECURITY CHECKLIST FOR VISITORS TO LITTLE BARRIER ISLAND

Please complete prior to arriving at the quarantine store.

Items being transported	Required Action	Tick if in compliance	Inspected by DOC
Pest proof containers	Have I inspected and cleaned every container prior to packing for soil residues, bird droppings, insect/spider presence etc. <i>Remember check the base and lip of each container. Dirty containers must be rinsed in water then soaked or wiped with a dilute bleach or similar antiseptic solution.</i>		
Packs (not permitted unless specific approval has been given)	Have I emptied my pack entirely, vacuumed it out and checked to ensure all seams and side pockets are free of seeds and dirt? <i>The bottoms of packs are notorious for collecting seeds and insects.</i>		
	Is my pack clean, in good condition and secure against stowaways such as mice?		
Footwear	Have I washed my boots and shoes so no seeds or soil are present?		
	Have I checked and cleaned the tread thoroughly?		

	Have I inspected the laces, inner sole, inside folds or flaps in my footwear for soil and seeds?		
Gaiters Raincoats Overtrousers Other outer garments.	Have I thoroughly cleaned my overtrousers, gaiters, raincoat and other outer garments?		
	Have I checked and cleaned all pockets? <i>Turn pockets out for washing.</i>		
	Have I checked all Velcro and seams to remove all soil and seeds? <i>Use a comb to remove seeds from Velcro.</i>		
Clothing	Have I washed and checked all clothing especially fibre pile and wool and all seeds have been removed? <i>Pay particular attention to pockets and Velcro as they trap seeds.</i>		
	Have I inspected my socks, hat and other high risk items for seeds? <i>Socks often have many seeds and you may find that buying a new pair is easier than picking the seeds out of your old ones.</i>		
Bedding	Have I shaken my sleeping bag out and checked for stowaways?		
Food	Have I washed all potatoes and other root vegetables e.g. carrots and kumara so that they are free of soil? <i>Buy prewashed vegetables. Once on the island all food must be kept inside containers or within the bunkhouse and regularly inspected for pests.</i>		
	Have I checked the vegetables which have potential hiding places for insects for invertebrate presence e.g. all leafy green vegetables, broccoli, parsley? <i>Be particularly cautious of home-grown produce or foods from a source where pest treatment is not as effective at removing pests</i>		
Field Equipment	Have I thoroughly cleaned all my equipment so that it is free of any invertebrates, seeds or dirt? <i>Difficult to clean items such as mist-nets or sensitive electronic equipment need to be carefully inspected for foreign residues and if such items are required, DOC staff must be advised. Where possible new items should be purchased and used.</i>		
Other	Have I inspected all items that have not been used for some time?		
Are all items in approved rodent-proof containers?			
Departure Date: / /		Date Inspected: / /	
Visitor Name: Signature:		DOC Officer: Signature:	

N.B. Special precautions must be taken if you or your equipment have come into contact with wildlife within the last six months or you will be handling wildlife on Little Barrier Island. See the Hygiene Checklist on next page for details.

Annex 7b: What Goes into a Contingency Plan? (In Calabrese et al. 2015)

Source: Global Invasive Species Programme, On-line Toolkit <http://www.cabi-bioscience.ch/wwwgisp/gtc4cs12.htm>

A comprehensive contingency plan could be a large document, probably in excess of 50 pages. Very few such plans are available as yet. However, the main headings from the contents page of the draft "Contingency plan for pest animal and plant invasions on islands in the Department of Conservation, Auckland Conservancy" (March 1999) may give some flavour of what could go into such a plan.

Quick Contents

- Seen or suspect a rodent?
- Seen or suspect other new animal pests?
- Seen or suspect a new plant pest?

Contents

- Minimising the risk of rodent invasions
- Contingency plan for rodent invasions
- Minimising the risk of invasion by pest animals other than rodents
- Contingency plan for invasions by pest animals other than rodents
- Minimising the risk of plant pest invasions
- Contingency plan for plant pest invasions

Appendices

- Personnel contact list
- Report sheets
- Data sheets
- Location of equipment

Note the "Quick Contents" right at the start of the document that should allow any person to take correct action in a panic situation. The "Contents" part of the document is also relatively brief but it must be written so that the reader does not have to find any other document to fill basic knowledge gaps. This document includes information on stopping pests getting to islands in the first place - a subject which is just as important as the contingency action but which you may wish to address in a separate document. The "Appendices" are exceedingly important and must be meticulously maintained - again, the document reader should not need to refer to any other document in relation to the important items listed in the appendices.

Of equal importance to the Contingency Plan is the involvement and commitment of all the people involved in caring for the islands. They must all understand the plan and put the protection sections into effect every day. The equipment needed for contingency action must be maintained in perfect working order and stored where the plan says it should be.

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Annex 8: Priority species known to be invasive and problematic in Seychelles, including some not yet confirmed as having a significant impact but that require particular attention (Rocamora & Henriette, 2015, in press).

Table 1: Problematic invasive plants and fungi having a confirmed significant impact on Seychelles environment and landscapes.

Bold: most problematic across main and/or many small islands. **Blue:** priority sp. treated in the book. *Italic:* no consensus on invasive status. +: identified as priority by stakeholder workshop. *: possibly or probably native. §: mainly for coralline islands. (Ag): problematic also for Agriculture. &: proposed creole name. All these species are also highly invasive in other island territories and countries around the world.
(compiled from Kueffer & Vos 2004; Beaver & Mougil 2009; Nevill 2009; Senterre 2009; Biosecurity workshop 12 Oct 2010 and pers. comm. from B. Senterre, K. Beaver, L. Chong-Seng, C. Kueffer & C. Kaiser-Bunbury).

English name	Kreol name	Latin name
WOODY SPECIES		
Cinnamon	Kannel	Cinnamomum verum
Devil tree +	Bwa zonn (Bwazonn)	Alstonia macrophylla
Albizia	Albizya	Falcataria moluccana
Cocoplum	Prin-de-frans (Prindefrans)	Chrysobalanus icaco
Chinese guava +	Gouyav-de-Sin (Gouyavdesin)	Psidium cattleianum
Koster's curse +	Fo watouk	Clidemia hirta
White cedar	Kalis-di-pap (Kalisdipap)	Tabebuia pallida
Red sandalwood/Coralwood *	Lagati	Adenanthera pavonina
Indian laurel	Bwa zozo (Bwazozo)	Litsea glutinosa
White leadtree	Kasi	Leucaena leucocephala
Casuarina *	Sed	Casuarina equisetifolia
Rose apple +	Zanbroza	Syzygium jambos
West indian lantana +	Vyey fiy (Vyeyfiy)	Lantana camara
Australian holly / Christmas berry+	Larb de Nwel	Ardisia crenata
Pawpaw / Papaya §	Papay	Carica papaya
Butter tree	Bwa ber (Bwaber)	Pentadesma butyracea
Coconut tree *	Kokotye / Koko	Cocos nucifera
CREEPERS		
Merremia * (Ag)	Lyanndarzan	Merremia peltata
Devil's ivy or Golden pothos +	(Filodendron)	Epipremnum pinnatum
Japanese climbing fern +	Fouzer zaponnen / Fouzer file §	Lygodium japonicum
Cat-claw creeper	Lalyann grif sat &	Macfadyena unguis-cati
Bengal trumpet/Blue trumpet vine (Ag)	Lalyann tronpet ble &	Thunbergia grandiflora
Hiptage	Lalyann papiyon	Hiptage benghalensis
Arrowhead vine	Lalyann feyaz &	Syngonium podophyllum
Rangoon creeper/Chinese honeysuckle	Santonin	Quisqualis indica
Coral vine/creeper; Bride's tears (Ag)	Lantigonn	Antigonon leptopus
AQUATIC WEEDS		
Water lettuce +	Leti lanmar	Pistia stratiotes
OTHER NON WOODY PLANTS		
Sisal + § (Ag)	Lalwa or lalwes	Agave sisalana
Mauritius hemp/Green-aloe	Lalwa or lalwes	Furcraea foetida
Snakeweed / Porter weed §	Zepible	Stachytarpheta sp. (S. jamaicensis & S. urticifolia)
FUNGAL DISEASES		
Takamaka wilt	Maladi takamaka	Leptographium calophylli

Table 2: Plants locally invasive or with a limited degree of invasiveness in Seychelles, sometimes invasive in other countries and requiring special attention.

Bold: most problematic across main and/or many small islands. **Blue:** priority sp. treated in the book. *Italic:* no consensus on invasive status; * : possibly native; §: mainly for coralline islands; (Ag): problematic also for Agriculture; \$: affects introduced Sandragon *Pterocarpus indicus* but also the overall ecosystem and could also affect natives. Those species with small distributions (e.g. *Acacia mangium*, Water hyacinth) should be eradicated before they became highly invasive. (compiled from Kueffer & Vos 2004; Beaver & Mougat 2009; Nevill 2009; Senterre 2009; Biosecurity workshop 12.11.10 and pers. comm. from B. Senterre, K. Beaver, L. Chong-Seng, C. Kueffer & C. Kaiser-Bunbury).

English name	Kreol name	Latin name
WOODY SPECIES		
Shoebuttan ardisia	(no name)	<i>Ardisia elliptica</i>
Santol	Santol	<i>Sandoricum koetjape</i>
Rubber tree	Kaoutsou	<i>Hevea brasiliensis</i>
Blue strawberry flowers	Bwa demon (Bwademon)	<i>Memecylon caeruleum</i>
Shrubby dillenia	Bwa rouz blan (Bwarouz blan)	<i>Dillenia suffruticosa</i>
African tulip tree / Fountain tree	Pis pis (Pispis)	<i>Spathodea campanulata</i>
Black plum	Bwa mozambik (Bwamozambik)	<i>Vitex doniana</i>
Clove tree	Zerof	<i>Syzygium aromaticum</i>
Bird's eye bush / Mickey mouse bush	Bwa kok (Bwakok) (also Bwademon)	<i>Ochna kirkii</i>
Mickey mouse plant *	Bwa bouke (Bwabouke) (Bwa mang)	<i>Ochna ciliata</i>
Black wattle / Brown salwood	Akasya gran fey	<i>Acacia mangium</i>
Soap pod	Akasya pikan	<i>Acacia concinna</i>
Cashew	Kazou	<i>Anacardium occidentale</i>
Ylang-ylang	Ilangilang	<i>Cananga odorata</i>
Liberian/Robusta coffee	Kafe	<i>Coffea liberica/canephora</i>
Star apple	(no name)	<i>Chrysophyllum cainito</i>
Willow-leaved justicia *	Lapsouli	<i>Justicia gendarussa</i>
CREEPERS		
Heartleaf philodendron	(Filodendron)	<i>Philodendron hederaceum</i>
White convolvulus creeper	(Lalyann)	<i>Merremia dissecta</i>
Puero/Tropical kudzu (Ag)	(no name)	<i>Pueraria phaseoloides</i>
Passion fruit	Fri lapasyon	<i>Passiflora edulis</i>
Wild potato yam (Ag)	Mortora / Ponn Edwar maron	<i>Dioscorea bulbifera</i>
Rosary pea vine / Crab's eye *	Reglis	<i>Abrus precatorius</i>
Asparagus fern	Fouzer	<i>Asparagus setaceus</i>
Japanese honeysuckle	(Chèvrefeuille du Japon)	<i>Lonicera japonica</i>
AQUATIC WEEDS		
Water hyacinth	Lisdo anvaisan	<i>Eichhornia crassipes</i>
White Waterlily	Lisdo	<i>Nymphaea lotus</i>
Minute duckweed	Lantir ver	<i>Lemna perpusilla</i>
OTHER NON WOODY PLANTS		
Upright elephant ear/Giant taro	Vya	<i>Alocasia macrorrhiza</i>
Castor oil plant §	Tantan	<i>Ricinus communis</i>
Prickly chaff flower	Lerb serzan	<i>Achyranthes aspera</i>
Wild pineapple	Zannannan moustikenn	<i>Ananas comosus</i>
Elephant's ear	Kaladyonn	<i>Caladium sp.</i>
Mother-in-law plant / Dumbcane	Vya tang	<i>Dieffenbachia seguine</i>
Black Taro	Sonz	<i>Colocasia esculenta</i>
Golden Bamboo	Banbou	<i>Bambusa vulgaris</i>
FUNGAL DISEASES		
Sandragon or Angsana wilt \$	Maladi Sandragon	<i>Fusarium oxysporum</i>

Table 3: Examples of naturalised alien weeds and creepers invading mainly agricultural and other open habitats created or modified by humans.

Certain species such as Guinea grass and Devil’s pumpkin are known to have also invaded natural habitats in other countries (e.g. Hawaii). *Italic*: no consensus on invasive status.

English name	Kreol name	Latin name
Creeping beggarweed/Spanish clover	Gro tref	Desmodium incanum
Guinea grass	Fatak	Panicum maximum
Common asystasia	Manztou	Asystasia gangetica
Yellow alder / Sundrops	Koket	Turnera ulmifolia var. angustifolia
Coffee senna	Kaspyant	Senna occidentalis (Cassia occ.)
Glorybower / Bleeding heart	Ker de Zezi	Clerodendrum thomsonae
Indian acalypha / Indian nettle	Lerb sat	Acalypha indica
Stonebreaker	Kiranneli	Phyllanthus amarus
<i>Corky-stem passionflower</i>	<i>Lepeka, Lagrenn lank</i>	<i>Passiflora suberosa</i>
<i>Wild passion fruit</i>	<i>Bonbon plim</i>	<i>Passiflora foetida</i>

Table 4. Invasive terrestrial animals with a significant environmental impact in Seychelles

Bold: most problematic across main and/or many small islands. Blue: priority sp. treated in the book. *Italic:* no consensus on invasive status; +: identified as priority by stakeholder workshop; ++: limited or potential impact only; * : hybridises with endemic fodies; **: hybrid from introduced *S. p. picturata* with local race *S. p. rostrata*; §: proposed creole names.

English name	Kreol name	Latin name
MAMMALS		
Black rat +	Lera lakelong §	Rattus rattus
Brown rat +	Lera kosto §	Rattus norvegicus
House mouse	Souri	Mus musculus
Feral cat +	Sat maron	Felis catus domesticus
Tenrec	Tang	Tenrec ecaudatus
Feral goat	Kabri	Capra hirtus domesticus
Feral rabbit	Lapen	Oryctolagus cuniculus
Black-naped hare ++	Liev §	Lepus nigricans
BIRDS		
Common myna +	Marten	Acridotheres tristis
Barn owl +	Ibou	Tyto alba affinis
Indian crow +	Korbo	Corvus splendens
Ringed-necked parakeet +	Kato ver	Psittacula krameri
Red-whiskered bulbul	Zwazo konde	Pycnonotus jocosus
House sparrow+	Mwano	Passer domesticus
Feral chicken	Poul maron	Gallus gallus domesticus
Madagascar turtle-dove**	Tourtrel dezil	Streptopelia madagascariensis
Madagascar Fody*	Kardinal, Sren	Foudia madagascariensis
REPTILES		
Crested-tree lizard +	Lezar sinwan	Calotes versicolor+
Red-eared terrapin +	Torti latanp rouz	Trachemys scripta elegans+
INVERTEBRATES		
Tiger mosquito	Moustik tig §	Aedes albopictus
Crazy ant +	Fourmi maldiv	Anoplolepis gracilipes
Big-headed ant +	Fourmi grolatet §	Pheidole megacephala
Spiralling white-fly	Bigay blan / Mous blan	Aleurodicus dispersus
Coconut white-fly	Bigay blan koko / Mous blan koko §	Aleurotrachelus atratus
Papaya mealy bug §	Bigay blan papay §	Paracoccus marginatus
Giant african snail	Kourpa zean (levros & levpal) §	Achatina fulica /immaculata
Rosy wolf snail ++	Kourpa moustas	Euglandina rosea
(No common name)	Kourpa strie §	Subulina striatella
American cockroach	Kankrela ameriken §	Periplaneta americana
Coccid sp.	Lipou sp.	Icerya sechellarum
White-footed ant +	Fourmi lipyeban §	Technomyrmex albipes
(also alien scale insects and mealy bugs in general)		

Table 5. Island distribution of alien species - invasive or showing signs of invasiveness – that require public attention to avoid spread to other islands (Source: Dogley W. 2009; Nevill 2009, Senterre 2009, and present work).

These invasive species should be reported to Environment Department, concerned island managers and book authors when discovered on new islands.

Scientific name	English name	Distribution (Jan. 2012)
PLANTS		
<i>Ardisia crenata</i>	Australian holly, Coral ardisia	Mahé.
<i>Dillenia suffruticosa</i>	Shrubby dillenia	Mahé.
<i>Litsea glutinosa</i>	Indian laurel	Mahé, Anonyme, Ile au Cerf, Conception & Ste Anne; Frégate.
<i>Clidemia hirta</i>	Koster's curse	Mahé; Silhouette, Ile du Nord; few individuals eliminated on Praslin.
<i>Memecylon caeruleum</i>	Blue strawberry flowers	Mahé, Praslin, Ile au Cerf
<i>Eichornia crassipes</i>	Water hyacinth	Mahé, Praslin, La Digue.
<i>Hiptage benghalensis</i>	Hiptage	Mahé.
<i>Merremia peltata</i>	Merremia	Mahé, Silhouette, Ile Denis.
<i>Lygodium japonicum</i>	Japanese climbing fern	Mahé.
<i>Epipremnum pinnatum</i>	Devil's ivy	Mahé & Ile au Cerf; Praslin, La Digue & Félicité; Silhouette & Ile du Nord; Frégate; Ile Denis.
<i>Macfadyena unguis-cati</i>	Cat-claw creeper	Mahé, Ste Anne.
<i>Quiscalis indica</i>	Chinese honey-suckle, Rangoon creeper	Mahé; Praslin, La Digue, Cousin & Curieuse; Silhouette.
<i>Syngonium podophyllum</i>	Arrowhead vine	Mahé; Praslin, La Digue & Curieuse; Silhouette; Frégate.
<i>Antigonon leptopus</i>	Bride's tears, Coral creeper, Coral vine	Mahé; Silhouette & Ile du Nord; Frégate.
<i>Dioscorea bulbifera</i>	Wild potato yam	Mahé, Silhouette.
<i>Pistia stratiotes</i>	Water lettuce	Mahé, Praslin, La Digue; formerly on Frégate.
<i>Nymphaea lotus</i>	White waterlily	Mahé; Praslin & La Digue.
MAMMALS		
<i>Rattus norvegicus</i>	Brown rat	Mahé & Ste Anne; Praslin & La Digue.
<i>Rattus rattus</i>	Black rat or Ship rat	Mahé, Ste Anne group & Thérèse; Praslin, La Digue, Curieuse, Félicité, Marianne & Ile Ronde (Praslin); Silhouette. All outer islands except Bancs Africains, D'Arros, St Joseph, Marie Louise, Desnoeuvs, Boudeuse & Etoile, St François & Bijoutier (Alphonse group), Goëlettes and Bancs de Sable (Farquhar), and all Cosmoledo Atoll minus Menai (infested).

<i>Mus musculus</i>	House mouse, Common mouse	Mahé, Praslin, Aride, La Digue, Bird; D'Arros, Desnoeufts, Marie-Louise.
REPTILES		
<i>Calotes versicolor</i>	Crested tree lizard; Oriental garden lizard	St Anne. One observed on Eden Island in Aug. 2012.
<i>Hemidactylus frenatus</i>	Common/Asian house gecko	Mahé, Praslin, Silhouette, Bird; Platte, Desroches, Alphonse, Bancs africains, D'Arros, Desnoeufts, Marie-Louise, Poivre, Remire.
<i>Trachemys scripta</i>	Red-eared slider	Mahé.
BIRDS		
<i>Acridotheres tristis</i>	Common myna, Indian myna	All inner islands except Cousin, Cousine, Aride, Ile aux Récifs & Frégate. Absent from all outer islands.
<i>Corvus splendens</i>	(Indian) House crow	Mahé (occasional only).
<i>Passer domesticus</i>	House sparrow	Desroches, D'Arros, Desnoeufts, Marie-Louise, Poivre, Rémire, St. Joseph; Alphonse, St Francois & Bijoutier.
<i>Psittacula krameri</i>	Ring-necked parakeet	Mahé. One eliminated on Silhouette in June 2014.
<i>Pycnonotus jocosus</i>	Red-whiskered bulbul	Assomption (eradication in progress).
<i>Tyto alba (race affinis)</i>	Barn owl	Mahé & Ste Anne group, Praslin, La Digue, Curieuse & Félicité; Silhouette. Occasionally on Anonyme, Conception; Aride, Cousin, Cousine, Grande Sœur, Ile du Nord; Frégate & Bird.
FISH		
<i>Oreochromis mossambicus</i>	Tilapia	Mahé, Praslin, La Digue, Silhouette.
<i>Poecilia immaculate</i>	Guppy	Mahé, Praslin.
INVERTEBRATES		
<i>Bactrocera cucurbitae</i>	Melon fruit fly	Mahé, Praslin, La Digue.
<i>Pheidole megacephala</i>	Big-headed ant	Mahé, Île Ronde (Mahé); Praslin, Aride, Cousin, Cousine, La Digue, Marianne; Desroches, Coëtivy, Farquhar.
<i>Anoplolepis gracilipes</i>	Crazy ant	Mahé, Ste Anne, Anonyme; Praslin, Cousin, La Digue, Petite Sœur, Félicité, Marianne; Bird.
<i>Achatina immaculata</i>	Pink-liped Giant African snail	Mahé, Ile au Cerf, Ile Ronde, Ste Anne & Thérèse; Praslin, Curieuse, Félicité, Grande Sœur and La Digue. Only empty shells have been found on Ile aux Récifs.
<i>Lissachatina fulica</i>	Pale-liped Giant African snail	Mahé, Anonyme, Conception, Ile au Cerf, Ile aux Vaches Marines, Ronde, Longue, L'Islette, Ste Anne & Thérèse; Praslin,

Stegomyia albopicta (*Aedes albopictus*)

Tiger mosquito

Curieuse, Félicité, Grande Sœur & La Digue; Silhouette; Frégate & Bird; D'Arros & Desroches. Confirmed on Mahé, Anonyme, Conception, Ile au Cerf, Longue, Moyenne, Ronde, Ste Anne & Thérèse; Praslin, La Digue & Félicité; Silhouette & Ile du Nord. Also on Bird, Denis, Plate, Desroches and probably D'Arros.

PATHOGENS

Leptographium calophylli
(also *Verticillium calophylli*)

Takamaka wilt disease or
Takamaka verticillium wilt

Mahé, Ste Anne, Ile au Cerf, Longue & Thérèse; Praslin, La Digue, Curieuse, Félicité & Grande Sœur; Silhouette & Ile du Nord; Denis. Possibly on Marianne and Anonyme.