DIRK HARTOG ISLAND BIOSECURITY IMPLEMENTATION PLAN

A shared responsibility

John Asher and Keith Morris

June 2014 (Revised June 2015)

Department of Parks and Wildlife

Department of Parks and Wildlife
Locked Bag 104
Bentley Delivery Centre WA 6983
Phone: (08) 9219 9000
Fax: (08) 9334 0498

www.dpaw.wa.gov.au

Questions regarding the use of this material should be directed to:

Keith Morris
Science and Conservation Division
Department of Parks and Wildlife
PO Box 51
Wanneroo WA 6946
Phone: 08 94055159
Email: keith.morris@dpaw.wa.gov.au

The recommended reference for this publication is:
Asher, J. and Morris, K. (2014, Revised 2015). Dirk Hartog Island Biosecurity Implementation Plan – a shared responsibility. Department of Parks and Wildlife, Perth.

This document is available in alternative formats on request.

Please note: urls in this document which conclude a sentence are followed by a full point. If copying the url please do not include the full point.

PREFACE

The purpose of this plan is to provide guidance for implementing biosecurity actions to prevent the establishment of new invasive species on Dirk Hartog Island and assist in the success of the “Return to 1616” Dirk Hartog Island ecological restoration project. This plan will be principally implemented by the Department of Parks and Wildlife through its staff, volunteers and contractors with the voluntary cooperation of freehold land owners, tourism operators, private lease holders, visitors to the island, Malgana people, the Shire of Shark Bay and the Australian Maritime Safety Authority by implementing the biosecurity measures outlined in the Dirk Hartog Island Biosecurity Plan (Astron 2012).

Information in this document was based primarily on the Dirk Hartog Island Biosecurity Plan (Astron 2012) and more detailed information on the topics covered in this implementation plan can be found therein.

The department would like to acknowledge and thank the following people and organisations who provided information and/or assisted in the development of this Biosecurity Implementation Plan for Dirk Hartog Island.

- Chevron Australia Pty Ltd
- Geoff Wardle
- Kieran Wardle
- Paul Anderson, Shark Bay Shire
- Bobby Hoult, Malgana representative
- Department of Parks and Wildlife Shark Bay District staff, and
- Dirk Hartog Island Ecological Restoration Project Management Committee

VISION

Biosecurity is a set of preventative measures (quarantine, surveillance and control/eradication) designed to reduce the economic, environmental and community impact of animal and plant pests, weeds and diseases. It is an essential component for the ecological restoration of Dirk Hartog Island.

Our vision is that biosecurity is recognised as a shared responsibility by the Shark Bay and wider community. We believe that working towards this vision will enable the Department of Parks and Wildlife and other Dirk Hartog Island land managers to effectively meet the current and future challenges posed by biosecurity risks. The effective management of biosecurity risks will in turn contribute to community wellbeing by supporting a stronger economy and healthy environment.

1 INTRODUCTION

Dirk Hartog Island is Western Australia's largest island, covering 63,000 hectares and spanning almost 80 kilometres in length. Situated in the Shark Bay World Heritage area on the far western edge of the Australian continent, the island shelters the shallow waters of Shark Bay. The first European landing in Australia occurred on Dirk Hartog Island in 1616. The island was named after the Dutch sea captain who landed at Cape Inscription, the northernmost tip of the island, aboard the *Eendracht*. English explorer William Dampier also visited the island aboard HMS *Roebuck* in 1699, making many detailed observations of the wildlife and vegetation.

In 1616 the island was pristine, with at least 13 ground-dwelling native mammal species. These included small kangaroo-like boodies and woylies, and western barred bandicoots, chuditch and dibblers.

From the 1860s until 2009, the island was used by pastoralists to run sheep. The Cape Inscription lighthouse was established in 1910 and goats were introduced by the lighthouse keepers to provide meat and milk. By the late 20th century the island had become popular with fishing enthusiasts, divers and snorkelers. Feral cats had been introduced and by this time feral cats and goats were well established on the island and only three small mouse-sized native mammal species persisted; the ash-grey mouse, sandy inland mouse and little long-tailed dunnart.

In 2009 Dirk Hartog Island became a national park, providing the Western Australian government, through the Department of Parks and Wildlife with the opportunity to restore its natural environment in partnership with the island's other land mangers and the Shark Bay community.

A conservation priority

As part of a World Heritage area, Dirk Hartog Island has international conservation significance for birds, marine turtles and reptiles, seascapes and landscapes. Its importance on a world scale will be enhanced with the successful re-establishment of lost mammal species, which will make it one of the world's most important islands for mammal conservation.

Threatened species currently inhabiting the island include the western spiny-tailed skink, the Dirk Hartog Island southern emu wren, the Dirk Hartog Island rufous field wren and the Dirk Hartog Island white-winged fairy wren. The native vegetation on the island comprises spinifex grassland and shrubland. At least 266 native plant species, including 10 species of conservation priority (2012), have been recorded there.

Return to 1616: ecological restoration project

The department has embarked on an ambitious project to remove all sheep, goats and feral cats from Dirk Hartog Island, re-establish healthy vegetation and re-introduce mammal species once known to exist there. Significant funds are being invested by the department and the Gorgon Barrow Island Net Conservation Benefits Ffund in a partnership that has the potential to yield world-class conservation outcomes over the next 20 or more years.

The Dirk Hartog Island ecological restoration project will see some of the most extensive feral animal eradications ever attempted in the world with the removal of goats and feral cats. It is at the global forefront of science, conservation and land management. The ground breaking project aims to re-introduce 10 native mammal species that once existed on the island and introduce a further two species considered likely to have been there. It will also involve weed management, vegetation reconstruction and fire management. Biosecurity protocols will be implemented to prevent the introduction of high risk invasive species such as black rats, and the re-introduction of cats. The benefits of restoring the environment of Dirk Hartog Island were identified in 1995 in a plan initiated by the Wardle family. The plan was prepared to instigate the successful operation of a nature based tourism facility while at the same time managing the natural resources and environmental values in such a way so as to ensure the long term sustainability of Dirk Hartog Island (Enviroplan 1995). The ecological restoration project underway will complement this plan through the establishment of native mammals on the island that are rarely seen elsewhere.

The project also provides an opportunity to foster scientific research with a focus on island ecological restoration, with the prospect of partnerships with science and tertiary institutions. The department will consult closely with other key stakeholders, including private landowners, the Shire of Shark Bay, the Australian Maritime Safety Authority and the Malgana community. The department will also consult with the Shark Bay community and provide them with progress reports during delivery of the project.

Biosecurity

Biosecurity measures to protect the island from the accidental introduction of pest and weed species are a major consideration. This biosecurity implementation plan for the island provides protocols and guidelines for the inspection and cleaning of vehicles, equipment and machinery to prevent the accidental introduction of weeds, pests and wildlife diseases.

Biosecurity refers to “mitigating the risks and impacts to the economy, the environment, social amenity or human health associated with pests and diseases” (NEBRA 2012). Invasive or pest species can impact on native flora and fauna in their extent and/or area of occupancy, through competition for food, habitat or direct predation. Invasive species can also impact on tourism through changes in aesthetic and recreation values. Biosecurity is important for the proliferation and diversity of native species, and will have ecological, social and economic benefits on Dirk Hartog Island. Dirk Hartog Island has the potential to support a diverse native mammal assemblage, if critical non-indigenous species are eradicated and future biosecurity actions are implemented.

Historically there have not been any biosecurity strategies to prevent the arrival of non-indigenous species on Dirk Hartog Island. Non-indigenous species (NIS) were introduced to Dirk Hartog Island for pastoral purposes and domestic use, accidentally and as pets and have caused grazing pressure, habitat degradation, competition for resources and predation. NIS are implicated as the main factors in the local extinction of some native species (Burbidge and Manly 2002; Algar *et al*. 2011), and predation by feral cats is a listed key threatening process under the Commonwealth’s Environment Protection and Biodiversity Conservation Act (1999). Ongoing damage is currently being mitigated with the removal of stock species and cats (Algar *et al*. 2011, DEC 2011).

In August 2012, the Dirk Hartog Island Biosecurity Plan was produced which provides an assessment of risk, mitigation strategies for existing NIS, and mitigation strategies to prevent further introductions. This implementation plan is secondary to the Biosecurity Plan and aims to provide a mechanism to implement the aims of the Biosecurity plan, to minimise future

damage to ecosystems on Dirk Hartog Island. Success of biosecurity on Dirk Hartog Island requires collaborative action from landowners, land managers and the community to prevent invasion, and detect and eradicate invasive species if they evade preventative measures.

The Department of Parks and Wildlife has principal responsibility for the implementation of this plan through its staff, volunteers and contractors. However, the success of the "Return to 1616" ecological restoration project will only be achieved through cooperation and the combined efforts of the department, land owners and managers and the Shark Bay community with the implementation of the biosecurity measures outlined in this plan.

1.1 Goals and objectives

The goal of the Dirk Hartog Island Biosecurity Implementation Plan is to provide a practical process of quarantine, surveillance and control / eradication to minimise the risk of introduction or proliferation of NIS and diseases to or within Dirk Hartog Island.

The objectives of the implementation plan are to:

- provide standard operating quarantine procedures and protocols to minimise the likelihood of introduction of NIS and diseases
- provide methods of surveillance to enable early detection of NIS and diseases to eradicate or minimise severity of impact to biodiversity, economy or culture
- provide guidelines to control and, where appropriate, eradicate non-indigenous species while minimising negative impacts on native flora and fauna

2 THE SITE

Dirk Hartog Island is the largest island in Western Australia, covering approximately 63 000 hectares. Dirk Hartog Island National Park was established in 2009 and covers the majority of Dirk Hartog Island, and is an ex-pastoral lease purchased by the Western Australian government. Land tenure on Dirk Hartog Island also includes an area of Unallocated Crown Land at the northern end of the island (Reserve 14918), private freehold (Lot 62, 303, 304 and 305), a reserve for the 'use and benefit of Aboriginal people' (Reserve 50326) and land vested with the Shire of Shark Bay for the purpose of 'heritage precinct' (Reserve 46663) (Figure 1).

Steep limestone cliffs dominate the western side of Dirk Hartog Island while the eastern side of the island is dominated by a low limestone coastline of shallow bays and inlets and sandy beaches. The vegetation is low and shrubby consisting of spinifex hummock grassland and mixed open chenopod shrubland interspersed with areas of bare sand and birridas (gypsum claypans) (DEC 2012). Terrestrial invertebrate fauna on Dirk Hartog Island is poorly understood, but it is possible that it comprises a unique assemblage of short range endemics (Astron 2012).

From the 1860s to 2007, the main land use on Dirk Hartog Island was for pastoral purposes. Sheep (*Ovis aries*) and horses (*Equus caballus*) were introduced in the 1860s to early 1900s for the purpose of pastoralism and goats (*Capra hircus*) for domestic use by the lighthouse keeper, the sheep and goats persisted until destocking began in 2007. There are now no horses on the island and the last known sheep were removed in February 2013. Goat abundance has been severely reduced by an ongoing eradication program due for

completion by June 2018 (Heriot, Parks and Wildlife, *pers. comm*.). Rabbits (*Oryctolagus cuniculus*) were introduced in the mid 1800s, but they failed to establish and are not known to have been re-introduced since. Cats (*Felis catus*) and house mice (*Mus musculus*) spread throughout the island soon after European settlement (Burbidge 2001). Cat eradication is currently being implemented with the goal of complete eradication of cats by June 2018 (DEC 2011). The black rat (*Rattus* spp.) is another significant pest species implicated in island eradications worldwide (Astron 2012). Surveys in 2011 and 2013 for black rats have been conducted on Dirk Hartog Island and at Denham, Useless Loop and Monkey Mia in 2014 with none detected and these will continue on a regular basis.

The intrinsic natural values of Dirk Hartog Island have now changed the main anthropogenic use of the island to tourism and conservation. Tourism includes day visits through to extended stays either camping within the national park or staying on freehold land. The Dirk Hartog Island lodge operates a barge between Cape Ransonnet and the mainland which allows tourists to bring their own vehicle across to the island. The Department of Parks and Wildlife also operates a barge between Denham and Herald Bay to transfer department personnel, vehicles and equipment for the ecological restoration project. The eastern side of the island is relatively easy to access by the boating public and is 35 km from Denham across Denham Sound or 1.5 km from the southern tip to the mainland across South Passage. The island's numerous bays and inlets on the eastern side are also used as a safe anchorage by passing vessels. The ease of access to the island by the boating public presents significant challenges for the successful implementation of biosecurity actions.

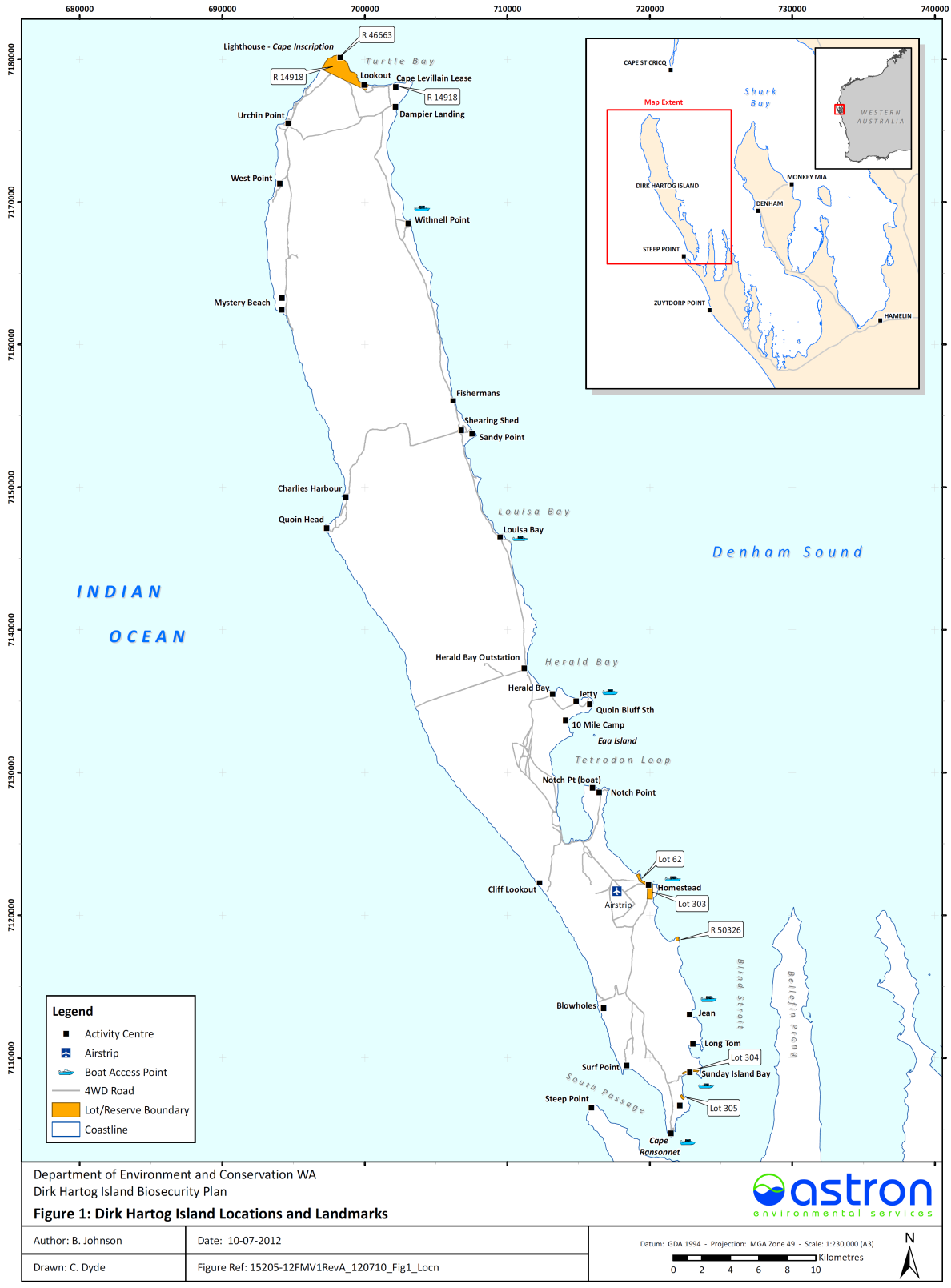


Figure 1. Map of Dirk Hartog Island

3 LEGISLATIVE FRAMEWORK

On state and national levels, the primary legislation relevant to this biosecurity plan are:

- Intergovernmental Agreement on Biosecurity (2012)
- *Conservation and Land Management Act 1984* (CALM Act) governs the declaration and management of protected areas and imposes certain obligations relating to management planning of these areas.
- *Wildlife Conservation Act 1950* provides for specific protection of native flora and fauna on all lands and waters within State boundaries.
- (Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), contains provisions relating to the protection of nationally-listed threatened species and ecological communities and listing of key threatening processes. It also provides protection for world heritage properties and national heritage places. Established by regulation under the EPBC Act, the Australian World Heritage Management Principles provide a guiding framework for managing heritage properties; specifically for preparing and implementing management plans and programs.
- *Environmental Protection Act 1986* (EP Act), which provides for environmental protection in Western Australia through the development of Environmental Protection Policies and the assessment of development proposals and planning schemes for environmental impacts.

Other relevant legislation includes:

- *Biosecurity and Agriculture Management Act 2007*
- *Aboriginal Heritage Act 1972*
- *Bush Fires Act 1954*
- *Heritage of Western Australia Act 1990*
- *Land Administration Act 1997*
- *Native Title Act 1993*
- *Plant Diseases Act 1914*
- *Biological Control Act 1986.*

4 HIGH RISK INVASIVE SPECIES

The level of risk for NIS incursion to Dirk Hartog Island can be assessed by assigning a category of likelihood and a level of consequence for individual species when no quarantine barriers are in place. Scores for likelihood and consequence were multiplied to give a comparative NIS risk score for Dirk Hartog Island (Table 1). Scores of 15 and above place species into a high risk category. Likelihood is an assessment based on the identified pathways to Dirk Hartog Island and review of other island NIS incursions (Astron 2012). A full definition of consequence is supplied in Table 2. A list of the highest risk NIS are listed in Table 3.

Any other non-indigenous and potentially invasive species entering Dirk Hartog Island should also be considered and a risk assessment will be conducted by the department if any new invasive species is found on Dirk Hartog Island (see Section 8).

Table 1: Risk matrix for non-indigenous species introduction and establishment on Dirk Hartog Island. Red shading indicates high risk (score 15-25), yellow indicates moderate risk (score 5-12), green indicates low risk (score 1-4) (Astron 2012).

Likelihood of Occurrence	**CONSEQUENCE**				
	1 - Insignificant	**2 - Minor**	**3 - Moderate**	**4 - Major**	**5 - Catastrophic**
5 - Common occurrence		Invertebrates (10) H-mouse (10)			
4 - Likely					Black Rat (20)
3 - Possible			African boxthorn (9) Ruby dock (9) Mexican poppy (9) Geckoes (9)	Dog (12) *Verbesina* (12) Kapok (12) Tramp ants (12)	Cat (15)
2 - Unlikely		Cane toad (4)		Rabbit (8)	Fox (10)
1 - Practically impossible				Goat/sheep (4)	

Table 2: Definition of consequences relating to the risk matrix for non-indigenous species introduction to Dirk Hartog Island (Astron 2012).

Consequence	**Definition**
Catastrophic	• risk of extinction for native species • very serious environmental degradation • significant ecosystem alteration • persistent, difficult and very costly to eradicate.
Major	• significant impact on native species • serious environmental degradation • ecosystem alteration • eradication possible but costly.
Moderate	• impact on native species • some environmental degradation • ecosystem impact limited to individual native species • possible to eradicate at some cost.
Minor	• minor impact on individual native species • little environmental degradation • minor impact on ecosystems • may not establish and easy to eradicate.

Consequence	Definition
Insignificant	• negligible impact on individual native species • negligible environmental degradation • negligible impact on ecosystems • highly unlikely to establish and easy to eradicate.

Table 3: Highest risk invasive species if introduced to or persisting on Dirk Hartog Island

Invasive species	Current or potential future threat	Consequence	Likelihood of invasion or re-invasion	Risk Category (Shaded as per Table 1)	Probable entry points	Impact description	Goal
VERTEBRATES							
Black rat, *Rattus rattus*	Potential future	Catastrophic	Likely	High	Boat	Predation by exotic rats on Australian offshore islands of less than 1000 km^2 is listed as an EPBC Key Threatening Process.	Complete eradication
Cat, *Felis catus*	Current and potential future	Catastrophic	Possible	High	Boat, car	Cats have been implicated in the demise of many, if not all, medium size mammals once known to be present on the island (Burbidge 2001; Burbidge and Manly 2002). Predation by feral cats is listed as an EPBC Key Threatening Process.	Complete eradication
Dog, *Canis lupus familiaris*	Potential	Major	Possible	Moderate	Boat, car	Wild dogs can hunt small mammals, predate on loggerhead sea turtle eggs and hatchlings, spread	Dogs are not permitted on Dirk Hartog Island

						parasites, disease and weed seeds, and cause land degradation.	National Park.
Rabbit	Potential future	Major	Unlikely	Moderate	None expected	Competition and land degradation by feral rabbits is listed as an EPBC Key Threatening Process.	Complete eradication
House mouse, Mus musculus	Current and potential future	Minor	Common Occurrence	Moderate	Boat	House mice have been implicated in reducing seabird breeding success and depletion of invertebrates and small skinks on islands worldwide (MacKay *et al*. 2007).	Minimise presence. It may not be feasible to eradicate or control due to the size of the island.
Geckoes	Potential future	Moderate	Possible	Moderate	Boat, vehicle, equipment	Potential threat to biodiversity in terms of direct competition with native species for resources and indirectly though causing community-level changes to ecosystems.	Prevent
Cane Toad	Potential future	Minor	Unlikely	Low	Boat, car, food	Key threatening process	Prevent
Goats, *Capra hircus*	Current	Major	Practically	Low	None	Competition and land	Complete eradication

			impossible		expected	degradation by unmanaged goats is listed as an EPBC Key Threatening Process.	
Sheep	Current	Major	Practically impossible	Low	None expected	Land degradation and damage to native flora through grazing.	Complete eradication
INVERTEBRATES							
No high risk species currently identified (Tramp ants assessed as highest risk at Moderate). Conduct a risk assessment and prepare a species action plan as and when required.							
PLANTS ***** denotes ecological impact according to the department's Invasive Plant Prioritisation Process - Mid-West Weed Assessment (DEC 2008)							
Couch (*Cynodon dactylon*)	Current	Minor	Possible	Moderate	Boat, cars	High* Couch spreads rapidly by seed and runners.	Eradication
Wild radish (*Raphanus raphanistrum*)	Current	Moderate	Possible	Moderate	Cars	High* Wild radish is a prolific seeder with long seed dormancy. It is also allelopathic and suppresses competition and is toxic to animals. The seed is spread by animals, wind and water.	Eradication
Japanese pepper (*Schinus terebinthifolius*)	Current	Moderate	Likely	Moderate	Boat, cars	High* Japanese pepper can dominate ecosystems and the berries are spread by birds.	Eradication

Castor oil plant (*Ricinus communis*)	Current	Moderate	Likely	Moderate	Boat, cars	Moderate* Caster oil forms a deep tap root and can out-compete native species. The seeds are poisonous and known to kill birds.	Eradication
Lupin (*Lupinus cosentinii*)	Current	Minor	Likely	Moderate	Cars	Moderate* Blue lupin is a common weed of roadsides and ungrazed areas, invading bush land, heath and disturbed areas. The seeds have some dormancy.	Eradication
False sowthistle (*Reichardia tingitana*)	Current	Moderate	Likely	Moderate	Cars	High* False sowthistle seeds are light and fluffy and can be spread over long distance by the wind.	Control
Ice plant (*Mesembryanthemum crystallinum*)	Current	Moderate	Likely	Moderate	Sea birds	High* Ice plant can form dense mats that prevent the germination of other plants.	Control
Fourleaf allseed (*Polycarpon tetraphyllum*)	Current	Moderate	Likely	Moderate	Cars	Low* Fourleaf allseed is a prolific seeder.	Control
Ruby dock (*Acetosa vesicaria*)	Future	Moderate	Possible	Moderate	Cars, soil	High* Invades disturbed areas impacting native flora and reducing habitat for native fauna. Toxic to grazing animals.	Exclusion (Alert species)

Kapok bush (*Aerva javanica*)	Future	Major	Possible	Moderate	Cars, soil	High* Highly invasive. Displaces native flora and seed spread by wind, animals, vehicles and soil movement.	Exclusion (Alert species)
Mexican poppy (*Argemone ochroleuca*)	Future	Moderate	Possible	Moderate	Cars, soil	High* Declared plant for Shire of Shark Bay, toxic to stock and humans.	Exclusion (Alert species)
African boxthorn (*Lycium ferocissimum*)	Future	Moderate	Possible	Moderate	Birds, cars	High* Weed of National Significance. Highly invasive and known to impact native fauna breeding sites due to spines and dense habitat.	Exclusion (Alert species)
Crownbeard (*Verbesina encelioides*)	Future	Major	Possible	Moderate	Cars, soil	High* Invades disturbed areas and can create a monoculture. Impacts native flora and is toxic to animals.	Exclusion (Alert species)
PATHOGENS AND DISEASE							
Animal Diseases – There is a possibility of animal diseases already on Dirk Hartog Island through the presence of sheep, goats and cats. Native mammals translocated to the island will be subject to the usual department hygiene protocols - SOP No: 16.2 (DPaW 2013). **Plant pathogens** – Due to the aridity of the island common south west pathogens are considered unlikely to survive. Conduct a risk assessment and prepare a species action plan as and when required.							

Eradication, control and exclusion weed species (Astron 2012)

5 MOST LIKELY PATHWAYS FOR INTRODUCTION

5.1 Vessels, Vehicles and Aircraft

The most likely departure and entry points for NIS to enter or exit Dirk Hartog Island are from boat or kayak (including private boats, charter boats to and from Denham and a vehicle carrying barge between Steep Point and the island and Parks and Wildlife barge from Denham to Herald Bay), or aircraft. Less common but also possible is unassisted crossing of the channel separating Dirk Hartog Island from the mainland as this is only 1.5 km wide.

Departure and entry is concentrated at sites on the southern half of the island where the Steep Point and Herald Bay barges land, near the homestead where charter boats cross, and at the airstrip. In addition, approximately half of the coastline at Dirk Hartog Island is accessible by boat so entry and exit points are diffuse. The major pathways and potential invasive species associated with these pathways are described in Table 4 and Table 5.

Table 4: Major departure and entry points for potential invasive species on Dirk Hartog Island.

Pathway	Main departure and entry points	Main activities	Main goods introduced	Potential invasive species
Small vessels (including sea kayaks)	Sandy beaches	• Fishing and recreation Sailing Commercial fishing and shipping activities	• Camping equipment and supplies	• Exotic plants for garden, shade and ornament • Released pet animals (including dogs and cats) • Non-indigenous plants for agricultural purposes or rehabilitation use in saline or disturbed areas • Invasive species from deliberate environmental vandalism • Parasites or disease on avian, marine fauna or translocated animals • Weed seeds • Rats • Invertebrates • Pathogens
	Turtle Bay and other east coast locations e.g. Whithnell Point, Sunday Island Bay	• Recreation boats and research visits during the turtle nesting season	• Camping equipment and supplies	
	Herald Bay	• Parks & Wildlife staff		

Pathway	Main departure and entry points	Main activities	Main goods introduced	Potential invasive species
Barge (s) (Private & Parks & Wildlife)	Cape Ransonnet & Herald Bay barge landings (current) and potential future homestead barge landing	• Visitors • Commuting Parks & Wildlife staff • Servicing the ecological restoration project	• Vehicles • Building materials • Equipment • Machinery • Household goods	• As above
Light aircraft	Airstrip	• Visitors to Dirk Hartog Island • Freehold property owners • Commuting Parks & Wildlife staff • Other visitors including contractors	• Perishables and other supplies for the homestead	• Invertebrates • Parasites and disease • Weed seeds
Helicopter	Helipad at Cape inscription, airstrip or other locations on Dirk Hartog Island	• lighthouse servicing • feral animal control • tourism	• construction material	• Invertebrates • Parasites and disease • Weed seeds
Swimming	Sandy beaches	• Natural cause		• Rodents • Cats
Driftwood	Sandy beaches	• Natural cause		• Invertebrates • Parasites and disease • Weed seeds
Carried by birds	Island-wide	• Natural cause		• Weed seeds • Parasites and disease
Carried by storm winds	Island-wide	• Natural cause		• Invasive birds • Weed seeds
Ship wreck	Island-wide	• Accidental	Not applicable	• Cats • Rodents • Invertebrates • Parasites and diseases

5.2 Pathways for Spread on Island

Table 5: Pathways for spread on Dirk Hartog Island.

Main vector	Pathway	Activities	Potential invasive species
4WD vehicles including quad bikes	Primary pathway • Public tracks • Management tracks	• Tourism • Parks & Wildlife research and management	• Weed seeds • Invertebrates • Parasites and disease • Pathogens
Machinery	• Development including the proposed tourism developments at Sunday Island Bay and Cape Levillain • Works to implement and maintain the ecological restoration project	• Ground disturbance • Visitation by barge and boats • Arrival of construction materials	• Weed seeds • Invertebrates • Pathogens
By foot (footwear and clothing)	• Camp sites • Main heritage areas • Walk paths	• Tourism • Parks & Wildlife research and management	• Pathogens • Weed seeds
Boat	• Camp sites • Popular bays and landing beaches • Barge landing sites	• Tourism • Parks & Wildlife research and management	• Invertebrates • Weed seeds • Pathogens
On native and reintroduced fauna including mammals, birds and reptiles	• Throughout	• Natural	• Parasites and diseases • Weed seeds
Ingestion and defecation by animals	• Throughout	• Natural	• Weed seeds • Parasites and disease
Wind	• Throughout	• Natural	• Weed seeds
Water	• Throughout	• Natural	• Parasites and disease • Weed seeds
Transport of soil and basic raw materials	• Development sites • Freehold • Parks & Wildlife accommodation sites • Camp sites	• Building • Roading • Airstrip	• Pathogens • Weed seeds

6 PREVENTION MEASURES

6.1 Pathway Barriers

To successfully implement biosecurity measures, there need to be multiple barriers preventing invasive species getting on to vehicles, vessels, aircraft, freight and building supplies and protocols in place to detect NIS should they elude the initial barriers.

Barriers to prevent invasive species entering Dirk Hartog Island are outlined in Table 6.

Table 6: Barriers to prevent invasive species entering Dirk Hartog Island

Main pathway	Preventative measures	Method of communicating prevention measures
Small vessels	• Promotion of Biosecurity Protocols • Inspection prior to departure for Dirk Hartog Island i.e. maintain vessels in a clean and tidy state • Public communication and awareness in Shark Bay area and further afield, targeting the recreational boating community	• Biosecurity signage at boat departure and arrival points in Shark Bay • Make available Dirk Hartog Island National Park - Island protection brochure to all boating public and provide to all camping permit holders • Regular articles in Inscription Post and Shark Bay Watch
Barge	• Regular inspections, maintain in a clean state • Avoid transporting high risk items and material onto Dirk Hartog Island (see text box below) • Clean all vehicle, machinery and equipment using methods described in the standard operating procedures. • Inspect and clean/treat all building materials, tools and equipment prior to arrival at the barge transfer point • Install rodent control and surveillance systems on barges and island service vessels • Establish and maintain facilities allowing comprehensive inspection and treatment barriers.	• Vessel Biosecurity and Inspection Log • Barge services to DHI to implement the DHI Quarantine protocols and guidelines • Provide all passengers the Quarantine Implementation Checklist prior to travel • Provide visitors with the Dirk Hartog Island National Park – Island protection brochure
Light aircraft and Helicopter	• Regular inspections, maintain in a clean state. • Avoid transporting high risk items and material onto Dirk Hartog Island (see 'High risk items' list after this table) • Install rodent control and surveillance systems on aircraft • Use departure facilities that allow for comprehensive inspection and treatment of items and material before loading.	• Provide all passengers the Quarantine Implementation Checklist prior to travel • Provide visitors with the Dirk Hartog Island National Park – Island protection brochure • AMSA to include biosecurity protocol with helicopter contract
Freight (including personal equipment) and building supplies	• Check for soil, seeds or animals before loading. • Wrap and seal in plastic, or transport in sealed containers.	• Include biosecurity protocols with contracts or tenders. • Ensure personnel aware of biosecurity protocols.

Main pathway	Preventative measures	Method of communicating prevention measures
Swimming	• Observe and report	• Signage and brochures to request island visitors to report unusual animal and weed sightings to Parks & Wildlife
Driftwood	• Observe and report	• Signage and brochures to request island visitors to report unusual animal and weed sightings to Parks & Wildlife
Carried by birds	• Observe and report • Known bird rookeries to be inspected for new to island weeds	• Signage and brochures to request island visitors to report unusual animal and weed sightings to Parks & Wildlife • Implementation of the DHI Weed Management and Action Plan
Carried by storm winds	• Observe and report	• Signage and brochures to request island visitors to report unusual animal and weed sightings to Parks & Wildlife

High risk items include

- animals, including pets and unscreened reintroduced native animals
- any plant material including native or introduced plants, tube stock, seeds or flowers; and mulch
- soil including soil and mud adhering to vehicles, aircraft, cargo etc.
- brickies sand, basic raw material for roads or aggregate unless sourced from an approved supplier and delivered in premixed bulk bags
- unsealed containers
- second-hand cardboard boxes
- second-hand power equipment or machinery whereby their complex nature makes detailed thorough inspection and clean down impracticable
- untreated or second-hand timber products including firewood and wood with bark not complying to AS1604.
- Personal equipment

(Astron 2012)

6.2 Stakeholders

A list of stakeholders, their area of priority or responsibility and their role in biosecurity prevention associated with that area is shown in Table 7.

Table 7: List of stakeholders and roles in biosecurity prevention.

Stakeholder	Priority locations	Role in biosecurity prevention
Small vessel users (including the community, tourists, local fishermen, Parks & Wildlife staff)	• Sandy beaches	• Observe & report potential NIS to Parks & Wildlife • Check own vessels and personal equipment for NIS • Follow quarantine protocols • Advise others of quarantine protocols
Tourism operators	• Cape Ransonnet barge landing • Airstrip (s) • Dirk Hartog Island Lodge • 4WD tracks throughout island	• Observe & report potential NIS to Parks & Wildlife • Provide advise & quarantine protocols to visitors • Check visitors vehicles, vessels and aircraft for NIS • Check own vessels and/or aircraft for NIS • Follow quarantine protocols
Private lessees	• Cape Levillian ecotourism lease	• As above
Freehold landowners	• Freehold lots	• Observe & report potential NIS to Parks & Wildlife • Check own vessels for NIS • Check building supplies and equipment • Follow quarantine protocols • Advise others of quarantine protocols
Malgana people	• Tumbledown Point Reserve	• As above
Shire of Shark Bay	• Heritage precinct – Cape Inscription	• As above
Australian Maritime Safety Authority	• Lighthouse Reserve	• Follow quarantine protocols • Ensure helicopter contractor is aware of and follows quarantine protocols
Department of Parks and Wildlife	• Dirk Hartog Island National Park • Herald Bay barge landing	• Education through brochures, signs, and meetings • Provide quarantine protocols and brochures to tourism operators and potential island visitors • Follow quarantine protocols • Surveillance • Incursion response & implement operational plans

7 SURVEILLANCE

7.1 Pre-border inspection

The department will implement this Biosecurity Implementation Plan through its staff, contractors and volunteers. Adoption of the plan and protocols by other Dirk Hartog Island land owners/managers, visitors and the local community will be voluntary. The department hopes that the benefits derived by the community from an island where pests are restricted and controlled, and the native plants and animals restored will encourage other island users to adopt this plan and its protocols as best practice.

All reasonable steps to prevent the transfer of NIS and high risk material to Dirk Hartog Island need to be taken. This should include pre-border (i.e. prior to departure) inspections of the Parks and Wildlife barge, other barges and commercial operators and recreational vessels, and all of their cargo, that intend to make landfall on Dirk Hartog Island. The department will conduct inspections of its own vessels and owners and operators of commercial and recreation vessels are encouraged to conduct their own inspections to assist in the implementation of this plan. Inspections should be conducted in accordance with the guidelines and protocols appended to this Plan. These include: Appendix 1 - Guidelines for vehicle and machinery clean down; Appendix 2 – Guidelines for small vessel biosecurity; Appendix 3 - Guidelines for importation of building materials; Appendix 4 - Dirk Hartog Island Biosecurity Strategy - Island quarantine protocol for Parks and Wildlife staff, contractors and volunteers; Appendix 5 - Dirk Hartog Island Quarantine Implementation Checklist for Parks and Wildlife staff, contractors and volunteers and Appendix 6 - Dirk Hartog Island Quarantine Protocol - Notes on inspection of equipment and food including mitigation measures.

Department staff involved with the translocation of native fauna to Dirk Hartog Island as part of the Dirk Hartog Island ecological restoration project will refer to and utilise *Standard Operating Procedure 16.2 Managing disease risk in wildlife management, SOP No: 16.2, Department of Parks and Wildlife, 2013*. This document is intended as an operational guide to minimise the risk of disease hazards. Guidance is designed to raise awareness among department personnel of the potential for disease transmission and to provide advice in regard to minimising the risk of disease transmission between wildlife populations and from wildlife to department personnel and their families (DPaW 2013).

All reasonable measures should be taken for equipment, vehicles, machinery etc. to be cleaned / sealed prior to arrival and loading onto barges at departure points. Barges and vessels carrying cargo should be inspected prior to loading of equipment, vehicles etc. (particularly interior areas such as holds and storage areas) and after loading, immediately prior to departure. It is recommended that all vessels transferring people, equipment, vehicles and machinery to Dirk Hartog Island complete and carry a Vessel Biosecurity Log as shown at Appendix 7.

Items that should be inspected include:

- vehicles and machinery
- cargo, baggage, freight, containers and toolboxes
- packing materials
- equipment
- foodstuffs
- wood materials
- construction materials
- clothing, footwear and luggage.

Vessels known by the department to be travelling to Dirk Hartog Island should be provided with communication material and advice on biosecurity. Island biosecurity pamphlets and the guidelines appended to this plan are available at the department's Shark Bay office.

Aircraft travelling to Dirk Hartog Island should also have pre-border inspections carried out and a biosecurity induction provided by the department to pilots and local air charter companies. Pilots should also provide a biosecurity induction for passengers carried to Dirk Hartog Island. Aircraft may be inspected by the department both pre and post border for this purpose. Any operator contracted by the department to provide a service to Dirk Hartog Island will have biosecurity principles and compliance conditions included in the contract. Other air services to Dirk Hartog Island will be encouraged to implement biosecurity measures and be provided by the department with communication material, and given advice on biosecurity measures.

As with vessels, aircraft inspections should be conducted in accordance with the guidelines appended to this Plan at Appendices 4, 5 and 6.

Where possible, remote surveillance detection systems should be established at Denham marine facilities, Denham airport and on barge and service vessels to provide early warning of the presence of NIS. The department can provide advice on appropriate and effective detection systems.

7.2 Post-border inspection

Where possible the following post-border measures should be followed:

- All cargo should be unloaded and unpacked in a clean and open area during daylight hours.
- It is preferable to have personnel familiar with the identification of high risk NIS responsible for unloading and unpacking (the department can provide information on high risk NIS).
- Foodstuff storage areas should have detection and surveillance systems in place (the department can provide advice on detection and surveillance systems).
- Vessels should be inspected again once making landfall on Dirk Hartog Island.
- Newly arrived vehicles and machinery, and their contents should be inspected to ensure no high risk NIS have arrived on Dirk Hartog Island.

8 AUDIT AND REVIEW

Unscheduled audits of biosecurity performance and implementation of this plan and its protocols by the department will be conducted at times by project management and senior district staff.

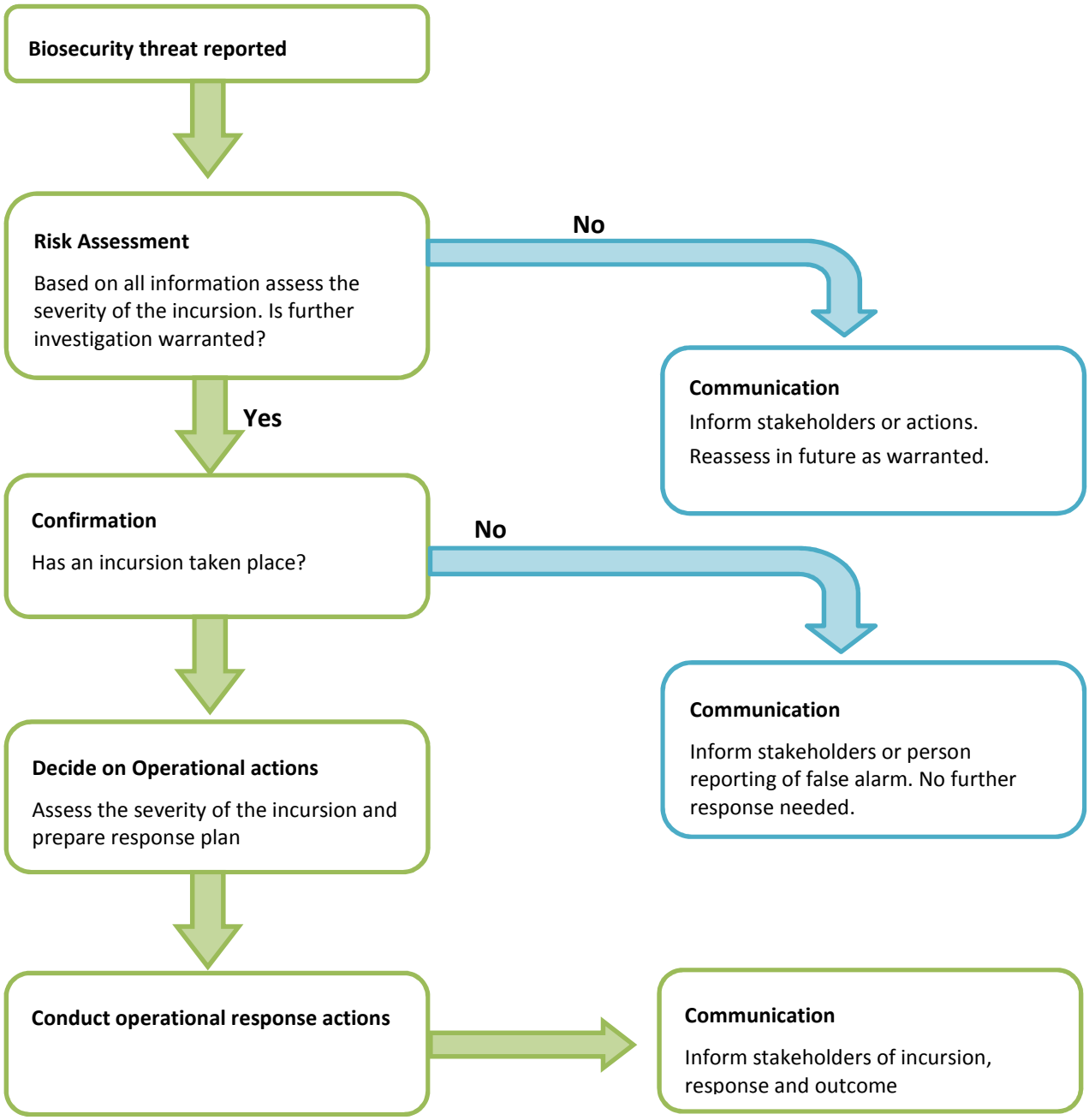
A five year major review of this biosecurity implementation plan will be undertaken. This plan may also be subject to review as situations change in regards to access, barge replacement, development progress, tenure amendments and reintroduction plans.

9 INCURSION RESPONSE

Effective response to an incursion relies primarily on the threat being detected and reported in a timely manner. Once detection has occurred, it should be reported to the department's Shark Bay District office as soon as possible and the decision making process outlined below will determine the operational response. Time is particularly important in responding to incursions, and this should ideally occur before the species has had a chance to spread, breed and establish a population.

Species action plans for the two high risk invasive species to Dirk Hartog Island shown in Table 3 will be applied in the event of an incursion by these species. A species action plan developed by Chevron Australia Pty Ltd for the Barrow Island Gorgon Project "*Gorgon Project, Quarantine Species Action Plan Black rat, Rattus rattus Linnaeus 1758, July 2009"* will be used for reference in the event of a black rat incursion on Dirk Hartog Island. A species action plan will be prepared by the department concerning the potential re-introduction or continuing persistence of the feral cat following conclusion of the cat eradication program.

Decision making process



10 STANDARD OPERATING PROCEDURES

The following documents have been developed to assist quarantine and are appended to this plan:

- Appendix 1 Guidelines for vehicle and machinery clean down
- Appendix 2 Guidelines for small vessel biosecurity
- Appendix 3 Guidelines for importation of building materials
- Appendix 4 Dirk Hartog Island Biosecurity Strategy - Island quarantine protocol for Parks and Wildlife staff, contractors and volunteers
- Appendix 5 Dirk Hartog Island Quarantine Implementation Checklist for Parks and Wildlife staff, contractors and volunteers
- Appendix 6 Dirk Hartog Island Quarantine Protocol - Notes on inspection of equipment and food including mitigation measures
- Appendix 7 Vessel Biosecurity and Inspection Log

11 REFERENCES AND FURTHER READING

Algar, D., Johnston, M., and Hilmer, S.S. (2011). *A pilot study for the proposed eradication of feral cats on Dirk Hartog Island, Western Australia.* Reprinted from: Island invasives: eradication and management / edited by C.R. Veitch, M.N. Clout and D.R. Towns

Astron Environmental Services (2012). Dirk Hartog Island Biosecurity Plan, August 2012, Prepared for Department of Environment and Conservation.

Astron Environmental Services (2012). Dirk Hartog Island Weed Management and Action Plan, November 2012, Prepared for Department of Environment and Conservation.

Burbidge, A.A. (2001). Our largest island*. Landscope* **17(2)**: 16-22.

Burbidge, A. A. and Morris, K. D. (2001). *Introduced animal eradications for nature conservation on W.A. islands [electronic resource]: a review.* Reprinted from: Eradication of island invasives: practical actions and results achieved at the University of Auckland, 19 to 23 February 2001

Burbidge, A.A. and Manly, B.F.J. (2002). Mammal extinctions on Australian islands: causes and conservation implications. *Journal of Biogeography* **29:** 465-474.

Department of Environment and Conservation (DEC) (2008). *Shark Bay World Heritage Property Strategic Plan 2008-2020*. Department of Environment and Conservation, Perth.

Department of Environment and Conservation (DEC) (2011). *Dirk Hartog Island National Park Ecological Restoration Strategic Plan.* Department of Environment and Conservation, Perth.

Department of Environment and Conservation (DEC) (2012). *Shark Bay Terrestrial Reserves and Proposed Reserve Additions – Management Plan No. 75 2012*. Department of Environment and Conservation, Perth.

Department of Environment and Conservation (DEC) (2008). *Invasive Plant Prioritisation Process (IPPP) - Mid-West Weed Assessment*. Department of Environment and Conservation, Perth.

Department of Parks and Wildlife (DPaW) (2013). *Standard Operating Procedure 16.2 Managing disease risk in wildlife management, SOP No: 16.2.* Department of Parks and Wildlife, Perth.

Enviroplan (1995), Dirk Hartog Island Strategic Environmental Management Plan 1995 – 2005, August 1995.

Gillen, K., Rose, D., Morris, K., Sims, C., McCluskey, A.D., Fitzgerald, B. and Gray, G. (2011). *Dirk Hartog Island National Park Ecological Restoration Strategic Plan.* Unpublished document prepared for the Department of Environment and Conservation, Perth.

Chevron Australia Pty Ltd (2009), Gorgon Project, Quarantine Species Action Plan Black rat, Rattus rattus Linnaeus 1758, July 2009

Johnson, B. (2011). Report on the Status of Introduced Rats *Rattus* sp. at Dirk Hartog Island, Shark bay. Unpublished Department of Environment and Conservation report.

Johnston, M., Algar, D., Onus, M., Hamilton, N., Hilmer, S., Withnell, B. and Koch, K. (2010). A bait efficacy trial for the management of feral cats on Dirk Hartog Island, Arthur Rylah Institute for Environmental Research, Technical Report Series No. 205, Heidelberg, Victoria.

MacKay, J.W.B., Russell, J.C., and Murphy, E.C. (2007). *Eradicating House Mouse from* Islands*: Successes, Failures and the Way Forward*. Managing Vertebrate Invasive Species: Proceedings of an International Symposium. Fort Collins.

McCluskey, P. and Fitzgerald, B. (2010). *Cape Inscription Reserve 46663 Management Plan 2010*. Department of Environment and Conservation for the Shire of Shark Bay.

Moore, J. L., Rout, T. M., Hauser, C. E., Moro, D., Jones, M., Wilcox, C. and Possingham, H. (2010). Protecting islands from pest invasion: optimal allocation of biosecurity resources between quarantine and surveillance. *Biological Conservation* **143:** 1068-1078.

NEBRA 2012. National Environmental Biosecurity Response Agreement (NEBRA) (2012).

APPENDIX 1

Guidelines for Vehicle and Machinery Clean down

Standard: That no mud or soil, plant material and/or fauna are present in any form or quantity after internal and external inspection. It is expected that vehicles and machinery are cleaned by owners prior to arrival at the barge transfer point.

1. If available, position the vehicle or machine at a hard-surfaced and fully contained washdown facility.

2. Immobilise the vehicle/machine in a stable and safe position, engine off, handbrake on, chocked if necessary.

3. Unload/remove all cargo and loose items.

4. Examine the vehicle/machine to determine the extent of plant material and soil accumulation.

5. Give special attention to hard to access areas such as under vehicle spare tyres, protective guards, radiators and cross-members. Remove belly plates and guards if possible.

6. Use compressed air to clean internal areas and radiators and then high pressure water to clean tyres, wheel arches, underneath and all panels.

7. Storage areas, toolboxes and all other containers should also be inspected and cleaned.

8. Re-inspect for cleanliness and replace all removed items.

9. Move vehicle/machine directly to barge for loading.

APPENDIX 2

Guidelines for Small Vessel Biosecurity

Standard: That no plant material and/or fauna are present in any form or quantity after internal and external inspection. It is expected that small vessels, including camping gear, food and equipment are cleaned and inspected by owners prior to arrival at the point of departure.

1. Inspect vessel prior to departure for Dirk Hartog Island. i.e. maintain vessel in a clean and tidy state. Check vessel interior for:
    - insects
    - rodents, and
    - plant material
2. Avoid transporting high risk items and material to Dirk Hartog Island, including
    - pets
    - plant material, either native or introduced plants, seeds or flowers
    - soil and mud adhering to camping gear and equipment
    - unsealed containers
    - cardboard boxes
    - fire wood
3. Install rodent bait stations or wax baits on vessels in easy to access or visible locations (for further advice check with the Department of Parks and Wildlife).
    - Inspect bait stations or baits regularly
    - Baits need to be replaced every six months to retain potency
4. Fumigate vessel and cabin spaces with insecticide if the vessel has not been used for some time or if insects and spiders are evident.
5. Carry all garbage back to the port of origin and dispose of appropriately.

APPENDIX 3

Guidelines for importation of building materials

Standard: That no mud or soil, plant material and/or fauna are present in any form or quantity after inspection of building materials and tools and equipment. Sand and aggregate should be free of plant material and/or fauna. Building materials, tools and equipment should be inspected and cleaned/treated by owners prior to arrival at the barge transfer point.

Crates and Pallets

- Crate floor, sides, crevices and corners should be free from discernible evidence of soil, animals, insects, webs, nests of any kind, seeds, plant material or bark.
- Materials, equipment and goods in crate should be free of discernible evidence of soil, animals, insects, webs, nests of any kind, seeds, plant material or bark.
- Goods should be wrapped in foil and sealed or, wrapped in clear plastic and sealed.
- Interior of the crate sprayed with a residual insecticide.
- Pallet has been shrink wrapped in clear plastic, with an opening at the top to allow fumigant entry.
- Pallets and materials should be shrink-wrapped at the point of sale.
- Pallets should be made from plastic, aluminium or steel.
- Pallet floor must be clean.
- Pallet frame must be clean.
- Pallet base must be clean.
- Pallet should be sprayed with residual insecticide prior to shrink-wrapping.
- Materials, equipment and goods on pallet should be free of discernible evidence of soil, animals, insects, webs, nests of any kind, seeds, plant material or bark.
- Goods should be sprayed with a residual insecticide prior to shrink-wrapping.

Steel and pipe

- All materials should be new.
- All surfaces should be washed.
- All faces should be viewed and free of any discernible evidence of plant material and seeds, invertebrates and vertebrates.
- Residual insecticide should be applied to surfaces.
- Where possible all inner surfaces should be washed clean and dried.
- All inner surfaces should be viewed and free of any discernible evidence of plant material and seeds, invertebrates and vertebrates (applies to Box Section Tube)

Packaging

- Residual insecticide should be applied.
- All ends should be capped after internal surfaces inspected (applies to Box Section Tube).

- Preventative fumigation should be carried out on packaged equipment/materials.
- All external surfaces of drummed or bucketed products should be cleaned.
- Components with non-drainable crevices or chambers should be covered and protected.
- There should be no sawdust, dirt and other debris present in containers.

Packaging Material

- All packaging products should be new.
- Packaging should be transparent shrink wrap, no black or other coloured shrink wrapping should be used.
- Minimise areas where soil, plant materials and seeds, invertebrates, vertebrates may collect.
- Polystyrene – should only be in form fitted blocks, not foam pellets.
- All boxes, cartons and crates should be vacuumed prior to use.
- All boxes, cartons and crates should be new.
- Goods should not be stored directly on the ground.
- The following packaging materials should not be used:
    - Hay
    - Straw
    - Husk
    - Bamboo
    - Palm fibres
    - Hemp
    - Wood shavings

Sand and aggregate

- Sand and aggregate should be delivered to the island in bulker bags.
- Bulker bags should be free of discernible evidence of soil, animals, insects, webs, nests of any kind, seeds, plant material or bark prior to filling.
- Full bulker bags should be free of discernible evidence of soil, animals, insects, webs, nests of any kind, seeds, plant material or bark prior to loading onto the barge.
- Sand and aggregate should be sourced from locations known to be free of high risk weeds not present on Dirk Hartog Island, e.g. Ruby dock (*Acetosa vesicaria*), Crownbeard (*Verbesina encelioides*).
- Bulker bags should be treated with residual insecticide after filling.
- Crushers, screens, washers and tanks should be inspected and cleaned immediately prior to a production (batch) run with compressed air and/or high pressure water, or steam cleaned.

Tools and tool boxes

- External surfaces of tool boxes should be cleaned.
- Internal surfaces of tool boxes should be cleaned and free of discernible evidence of soil, plant material, seeds, vertebrates and invertebrates.
- The corners, cracks and crevices of tool boxes should be clean.
- All surfaces of tools should be cleaned and free of discernible evidence of soil, plant material, seeds, vertebrates and invertebrates, with particular attention to nooks and crannies.
- Hollow sections should be blown out with high pressure compressed air.

APPENDIX 4

Recommended island quarantine protocol

For Parks & Wildlife staff, contractors and volunteers

WHY IS THIS PROTOCOL NECESSARY?

This quarantine protocol is part of the Department of Parks and Wildlife's Biosecurity Strategy to prevent introductions and establishment of introduced, or non-indigenous species (NIS) to Dirk Hartog Island National Park (DHINP). Protocols for the monitoring and detection, and eradication of NIS will also be developed.

Dirk Hartog Island is Western Australia's largest island (~63,000 ha) and once supported a diverse array of native fauna. Thirteen species of native mammal were present on the island at the time of discovery by Europeans in 1616. All but three of these have become extinct on the island, and many have restricted distributions elsewhere. The introduction of cats, goats and sheep over the last 200 years have been significant factors in these extinctions. Dirk Hartog is also the site of the largest loggerhead turtle rookery in WA, and still supports the threatened Dirk Hartog Island southern emu-wren, Dirk Hartog Island rufous fieldwren, Dirk Hartog Island white-winged fairy-wren and western spiny-tailed skink. There are also 10 plant species of conservation priority (2012). Recognition of Dirk Hartog Island's biodiversity conservation values was one of the reasons for the establishment of the Shark Bay World Heritage Area in 1991.

The majority of Dirk Hartog Island was declared a National Park in 2009. Over the next 20 years (2012 – 2031), the department will undertake an ecological restoration project which will eradicate the introduced feral cats, feral goats and sheep, control weeds and reintroduce the native mammal species that once occurred on the island. Returning the mammals will not only improve the conservation status of these mostly threatened species, and return the ecological processes that digging and burrowing native animals bring to a landscape, such as aeration of soil, improved water penetration, nutrient recycling, seed dispersal and germination. In addition, the return of native mammals to DHINP will provide eco-tourism opportunities for the Shark Bay community and research opportunities for improving our knowledge of ecological restoration processes.

WHO IS THIS PROTOCOL FOR?

While the National Park covers most of Dirk Hartog Island, there are several other land owners and managers on the island. This quarantine protocol, and the other biosecurity protocols for monitoring and detection, and eradication of NIS, will apply to all department operations on the island. Implementation of these protocols by the department demonstrates its commitment to good quarantine practices to ensure the success of the conservation and restoration program. It is hoped that all land owners, managers and visitors to Dirk Hartog Island will recognise that biosecurity on the island is a shared responsibility that will lead to a more attractive and sustainable island ecosystem, and so embrace these biosecurity protocols.

While this protocol has been developed for use on Dirk Hartog Island, it is also applicable to other islands managed by the department within the Shark Bay World Heritage Area.

This protocol is to be followed by all department personnel, contractors and volunteers working on DHINP. It applies to any vehicles, vessels, aircraft, goods and personnel taken to DHINP for any purpose. The object is to prevent any NIS being taken to the island, as this may lead to damage to the existing island ecosystem and the establishment of additional introduced species.

Table 1 identifies the most important pathways by which introduced species could be transported to Dirk Hartog Island unless quarantine rules are followed.

PATHWAY	EXAMPLES OF ORGANISMS
Personnel and luggage	Seeds, reptiles (e.g. skinks and geckoes)
Food and perishables	Mice, invertebrates (e.g. snails, caterpillars), seeds, fungi
Vehicles, trailers, vessels, aircraft and mobile equipment	Seeds, weeds, cats, mice, rats and reptiles such as geckoes
Sand and aggregate	Mites, invertebrates (e.g. earthworms, insect larvae) Micro-organisms including *Phytophthora*, frogs, weeds, seeds.
Field / research equipment (including traps, tents etc)	Mice, rats, reptiles, invertebrates (e.g. ants, snails, cockroaches, spiders), seeds, animal diseases.
Crated or loose building materials, equipment and goods	Reptiles, cats, mice, rats, seeds, weeds.

Table 1. Pathways for introduction of NIS to Dirk Hartog Island.

PLANNING YOUR TRIP

Seek approval

- Parks and Wildlife staff, research collaborators and contractors must notify the department's Denham office (08 9948 2226) of their proposed visit and provide an itinerary of activities. Parks and Wildlife research staff must complete and forward a field trip advice form to the department's Denham office at least two weeks ahead of the scheduled activity.
- Any activities involving flora or fauna on DHINP will be subject to the relevant access, animal welfare and scientific collecting licences.

Trip preparation

- The team leader reviews all the quarantine protocols and ensure that all team members will comply with them.
- Clean all equipment to be taken to DHINP the island and ensure it free from any organic material.
- Ensure any vehicles, vessels or aircraft are clean and free of any soil, invertebrates, vertebrates and organic material. Ensure that owners and operators of vehicle, vessels, and aircraft are aware of the quarantine procedures applying to DHINP before contracting them and have compliance with them included in contract specifications. If not, arrange to brief them on what is required. If vehicle/vessel/aircraft hygiene is unsatisfactory, clean or use another (clean) vehicle/vessel/aircraft or postpone the trip until they meet quarantine standards.
- Vehicles, vessels and aircraft used by the department will have a quarantine log detailing their quarantine history, and include information on baiting, inspections, cleaning and any quarantine issues.
- Check all food and ensure it is packed and checked according to the quarantine rules.
- Check personnel luggage, clothing and footwear before loading onto the vehicle, vessel or aircraft.
- Make sure there is enough time to do all trip preparation activities – rushing may lead to mistakes.
- Complete the Checklist below to assist with preparation and compliance with this protocol.

Equipment and building materials

- Equipment to be taken to DHINP should be assembled in a clean area with a cement floor.
- Thoroughly inspect all equipment (including personal equipment such as tents and swags/bedrolls) for any signs of insect, seed and other organic and inorganic contamination. Wash and clean as necessary.
- All traps and other field equipment must be scrupulously clean with no soil, animal, plant or bait residue. A high pressure water cleaner is useful for this. Small traps must be packed in sealed (e.g. with duct tape) rodent- and insect-proof boxes. Large (cage) traps must be wrapped in plastic or placed in sealed containers after cleaning. Hessian or cloth used for shade or shelter in traps must be brand new and checked for contamination, particularly seeds.
- Check all equipment and store in rodent and insect-proof boxes (e.g. aluminium or plastic). Spray storage boxes with insecticide and leave for at least 12 hours before packing. Computers, cameras, GPS receivers, and radios must be individually checked and placed into clean air-tight containers.
- Take equipment boxes directly to the departure point, keeping under cover and preventing contamination along the way. Check external surfaces of boxes before loading and re-clean if necessary.
- Where possible, equipment that is going to be used repetitively over a period of time (e.g. traps, camping gear) should be purchased new, taken to Dirk Hartog Island and left in a secure store on the island.

- Building materials should be new and where possible sealed by wrapping in plastic / heat shrink to prevent contamination by unwanted plants, seeds and animals prior to, or during transport to the island.

- Soil / sand / aggregate should be sourced from a clean site and be free of weeds, seeds and other organic material, and transported to Dirk Hartog Island in sealed containers.

Personal clothing and footwear

- All clothing must be clean and free from soil and seeds. Look carefully at velcro joiners, in pockets, socks and trouser cuffs. Normal washing may not kill all organisms.

- Boots and other footwear must be completely free from soil and seeds. Inspect under laces, flaps and the sole treads. Clean them with a stiff brush and wash with a disinfectant.

Food and water

- Water must be transported in clean plastic containers.

- Don't take soil contaminated fruit and vegetables.

- Check fruit and vegetables for invertebrates.

- Pack all food into sealed, clean containers.

- Keep containers in the clean, secure area – do not set them down on soil or other dirty areas before loading.

Plants

- Taking live plants, seeds and rootstock onto DHINP is prohibited, unless for authorised research and management activities.

- The removal of native plants and seeds from DHINP is also prohibited, unless for authorised research or management activities.

Animals

- Taking domestic animals and pets onto the DHINP is prohibited, unless for authorised research and management activities

- Native animal translocations will only be undertaken following preparation of Translocation Proposals and approval by the department's Animal Ethics Committee and Director of Science and Conservation. Translocation Proposals will include protocols to ensure animals and equipment do not transport unwanted plants and animals, or disease to Dirk Hartog Island.

- The removal of native animals from DHINP is also prohibited unless for authorised research or management activities.

Parks and Wildlife vessels

- It is the vessel's master who is responsible for ensuring a quarantine compliant vessel. The master and crew need to ensure that any people, vehicles, trailers and equipment carried is quarantine compliant. They should not accept any passengers or cargo unless they are quarantine compliant.

- Parks and Wildlife operated or contracted vessels will require a quarantine log to be kept detailing the relevant quarantine history for the vessel. This log will include a history of baiting, bait inspections, cleaning, inspections of cargo and passengers and any compliance issues.
- Any vessel contracted by the department will have the quarantine requirements and enforceability included in the contract specification.
- Make sure the vessel's master / operator is aware of this protocol and that they and the crew abide by it.
- Check that the vessel has been inspected and is clean. Arrange fumigation or spraying as necessary. Ensure that rodenticide is in place.
- Ensure that crew members do not throw garbage containing seeds into the sea when they are close to an island, and that they carry all garbage back to the port of origin and dispose of appropriately.

WHILE ON DIRK HARTOG ISLAND

Landing

- Carry only the minimum equipment necessary to do your work or for recreation.
- Never throw soil, plants (including seeds) or animals into the sea near an island – place contaminants in a sealed container and return to the mainland.
- Check that all equipment taken ashore is yours and meets quarantine requirements.
- Reduce the amount of time the vessel or aircraft used for transporting personnel and equipment is on DHINP.

Camping

- Camp only on bare sand areas – do not damage native vegetation, and in areas designated for camping.
- Collect all garbage in sealed containers and return it to the mainland. Separate inorganic recyclable waste (cans, bottles etc) from organic waste. Ensure all waste is stored where animals cannot access it.
- Make sure human waste is covered immediately and completely buried to at least 30 cm. Use toilets provided where possible.
- Do not light fires using timber, either imported or natural. All cooking is to be with fuel stoves.
- Be aware that introduced house mice and several weed species occur on Dirk Hartog Island. Prevent your equipment and food boxes from being contaminated by house mice, weeds and other organic materials while on the island. It is important not to transport plants and animals around DHINP, or between DHINP and the mainland.
- Be observant for any plant or animals that you don't believe is native. Report any sightings to the department's District Manager, Shark Bay District.

AFTER THE TRIP

Reporting

- Following a trip to Dirk Hartog Island all Parks and Wildlife staff, contractors and collaborators, must provide a report to the department's Shark Bay District Manager if any of the following are observed:
  (1) problems encountered with quarantine;
  (2) unusual plant or animal sightings;
  (3) unauthorised camps or other structures; or
  (4) sightings of introduced species.

Storage of equipment

- Clean equipment.
- Store any equipment that is going to be taken back to Dirk Hartog Island in a secure and clean area.
- Where possible, store equipment on Dirk Hartog Island.

APPENDIX 5

DEPARTMENT OF PARKS AND WILDLIFE

DIRK HARTOG ISLAND

Quarantine Implementation Checklist

For Parks & Wildlife staff, contractors and volunteers

The successful ecological restoration of Dirk Hartog Island National Park is dependent on successful eradication of feral goats, sheep and feral cats, and preventing any further introductions of non-indigenous plants and animals. All Parks and Wildlife staff, contractors and volunteers must use this checklist prior to visiting Dirk Hartog Island and other islands within the Shark Bay World Heritage Area.

Personal Gear

□ Is your footwear clean and free from soil and seeds?

- Wipe shoe tread with a dilute bleach or antiseptic solution.
- Inspect treads, laces, inside folds and flaps of footwear.

□ Are your clothes, pockets and day packs free of soil, plant seeds and animals such as cockroaches and spiders?

- Pay particular attention to velcro and socks as these often trap seeds.

□ Have you checked your sleeping bags, bedding and swags to make sure they are free of soil and stowaways?

□ Have you checked your baggage and containers for soil, plant material and animals directly prior to departure? Ensure you have checked the base and lip of each container.

□ Have you checked all wooden items thoroughly for invertebrates such as borers?

Food

□ Is all food transported in clean (internal and external surfaces) sealed containers?

□ Have you checked fresh food for presence of soil and invertebrates such as ants, spiders or snails?

- Wash potatoes and other root vegetables.
- Check leafy greens for invertebrates.

Vehicle

□ Is your vehicle and trailer clean inside and outside? Check particularly the undersides, radiator and tyres of the vehicle. Vegetation and soil often gets jammed between sump guard plates and gearbox guard plates. If in doubt, wash-down and clean inside and outside of vehicle.

□ Inspect vehicles again after wash-down and prior to leaving the mainland:

CHECK – CLEAN – CHECK AGAIN.

□ Go directly to barge after wash-down (preferably via a hard surfaced road)

Vessel

□ Are all your vessels equipment, cargo, baggage, freight, containers and toolboxes clean and free of plant and animals?

□ Have you inspected the vessels interior for pests, especially insects, rodents and seeds? Has the vessel been baited with rodenticide and residual insecticide?

□ Do you have rodent detection devices and bait stations on board the vessel? These must be inspected regularly and any possible detection reported to the department's Shark Bay office. If a mouse or rat is detected on board, it must be killed or captured for positive identification and disposed of appropriately. Baits need to be replaced every six months to retain potency.

Aircraft

□ Are the aircraft (including luggage lockers) and its equipment clean and free of soil, seeds and animals?

- Check particularly seat crevices, carpets and tyres.

□ Are the equipment, food and personal items being loaded onto the aircraft clean and free of soil, seeds, plants and animals?

□ Is the loading area a hard surface, clear of plant material, seeds and loose soil?

□ If transporting animals for approved translocations, is there a barrier provided to prevent fouling of the aircraft interior?

Equipment and building materials

□ Is your equipment and / or building material clean of soil, plant material and animals.

- Inspect closely.
- Purchase new where possible.
- Place in sealed containers where possible.
- Transport raw materials such as sand, aggregate and cement from a clean (i.e. weed free) site in new sealed bags.

□ Are you transporting high risk materials such as used cardboard containers, untreated timber, unsealed items? If so, they need to be clean and free of soil, plant material and animals. Replace cardboard with plastic or metal. Use new where possible.

Animals and Plants

□ No animals or plants (including pets, native and introduced species, tube stock, seeds, flowers or mulch) are to be taken to the Dirk Hartog Island National Park unless part of an approved management program such as eradication or fauna translocations.

□ Any animals taken to Dirk Hartog Island for approved purposes must be in good health and screened for disease.

Surveillance

□ Please be vigilant when preparing to go to Dirk Hartog Island and look out for any plants or animals that might be hitching a ride.

□ When on the island, please look out for plants and animals that may have been introduced.

APPENDIX 6

DEPARTMENT OF PARKS AND WILDLIFE

ISLAND QUARANTINE PROTOCOL

RECOMMENDATIONS ON INSPECTION OF EQUIPMENT AND FOOD INCLUDING MITIGATION MEASURES

Clean and secure storage and preparation area

There should be adequate area set aside for:

- storage and maintenance of equipment used on islands;
- checking and packing supplies needed for the programmes on the islands;
- cleaning and checking items returned from the islands.

Design

- The area must be well lit with no dark corners.
- All removable items need to be taken out and the entire store checked for any gaps and sign of pest damage.
- For rodent proofing, all entrances and holes > 5 mm must be securely sealed, including; under doors (e.g. by using a metal “lip”), around holes for drainpipes or wiring, around windows etc.
- For invertebrate proofing, all gaps must be sealed, however this will probably be impractical and other invertebrate detection and control will be required.
- All windows and doors must shut securely (vents or fly-screen mesh may be required).
- The room should be lined and the floor sealed (painted) to enable easier cleaning / maintenance.
- The store must be clean before use and all rubbish removed.
- No perishable foods to be kept in the store, except those about to be taken to an island.

Vertebrates

Rats and mice are the main targets, but watch out for reptiles (e.g., geckoes, skinks, small snakes) and their eggs, and for frogs. This area should be secure and clean and continuously baited with fresh rodenticide (use a second generation rodenticide such as brodifacoum – pellets are fine, but use wax blocks in damp areas). Follow inspection procedures as laid down below for invertebrates.

When checking gear, place set, unbaited Elliott traps against the walls in the corners of the store, so that a rat or mouse emerging from equipment will run into them.

Invertebrates

Awareness and careful inspection are the most important things for invertebrate biosecurity. It comes down to being aware that invertebrates could be a problem and that **everything** needs to be inspected closely to ensure there are no free-loading passengers.

Ensure that no food sources, which may attract animals like ants, are in or around the quarantine gear store. Water-tight plastic barrels are excellent, as they will be insect-proof as well as waterproof. (These should also largely prevent post-packing infestation.) A clean store area is also important, as this makes it much easier to detect any new arrivals. Pest control should be in operation around the perimeter of the building and should prevent ants establishing inside however, it cannot be relied upon entirely; there is always the need for inspection as well.

Inspecting and packing gear in a clean, open, indoor area is really important. Any pest that emerges is easily seen and can be dealt to quickly, before it escapes. The inspection area should be large enough to allow tents to be unfolded away from the already inspected gear, so that any discovered pest cannot escape into the inspected gear pile. Make sure that the inspection area is clean before you start.

When undertaking the inspection, most invertebrates will be dislodged by shaking or sharply tapping the gear with a timber pole or something similar.

- For items like tents, the more eyes looking the better. If Argentine ant or a similar threat is present, it should make itself very obvious when shaken or tapped but you have to look to see it!
- Most invertebrates will be hiding in folds in material or against the seams, so carefully check these high-risk areas.
- Any holes or recesses in gear should be tapped/hit up-side down, e.g., check for ants in a spade handle. (If you pick up two spades and bang them together while looking for animals the size of ants, you will see them straight away.)
- Check any areas where invertebrate frass is found.
- Ants are good to concentrate on, as the animal to look for, because they are likely to be the smallest invertebrate present.

Clearly, if something does fall out then a closer inspection is warranted and possibly the use of an insecticide spray. Permethrin-based sprays should be used as they have a residual effect, and will kill bugs that walk over the treated surface for up to a couple of months, depending on exposure to weather, etc. Pyrethroid (pyrethrum) based products are knock-down only, and have no residual life beyond about an hour.

In particularly high risk sites (where Argentine ants or similar may be present), keep a can of fly-spray handy so that any invertebrates that fall out can be sprayed immediately. This is more effective than trying to squash ants running in every direction when a nest is discovered.

With bigger items like the boat itself, bang the hull or pontoon and look. Do this in several places as invertebrates generally hate foreign noise, and will attempt to move away from it. Slow-moving animals like slugs and snails are the exception rather than the rule. For them, it comes down to careful inspection. On charter boats, increasing awareness is important. “Take no prisoners” is the rule, squash first and ask questions later!

Weeds

Seeds stowing away on machinery, equipment, building materials, containers, backpacks, clothing or boots have been the mode of entry for some weeds becoming established on islands in the past. Visually check all such items and ensure they are clean and seed-free. Wash large items with a high- pressure hose.

Diseases and microorganisms

Ensure all equipment and building materials are dry and free of soil. Do not take equipment previously used for animal trapping or handling unless it has been sterilised. Sterilise secateurs. Use clean paper and clean metal (not cardboard) separators in plant presses.

APPENDIX 7

DEPARTMENT OF PARKS AND WILDLIFE

Vessel Biosecurity and Inspection Log

Date	Destination	N^{o} of POB	Type of load	Rodent baits present Y/N	Fumigation Y/N	Load & gear inspected Y/N	Vessel inspected Y/N	Comments (including any remedial action required)	Skipper's signature