



A SURVEILLANCE AND RAPID RESPONSE PLAN (SRR) FOR PRIORITY INVASIVE SPECIES IN KIRIBATI

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SUMMARY

Kiribati comprises 33 mainly small islands in three archipelagos. Many of the islands are uninhabited and represent low invasion risks of IAS, but the biodiversity values (World Heritage, IBAs) on them are often very high with much at stake if IAS did arrive. The inhabited islands are visited by a range of supply vessels and aircraft and other craft, all of which represent degrees of risk of new IAS arriving and others being transported within country. This plan addresses firstly the surveillance measures needed in order to detect new arrivals and changes in IAS distribution internally, and secondly the components of a rapid response plan to deal with incursions of IAS. It provides generic guidelines for surveillance and eradication methodology as well as specific examples of approaches to dealing with those IAS that are likely to make landfall in Kiribati or in new parts of the republic.

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KEY DEFINITIONS

Alien (introduced) species: species that have been transported by people to a new place

Biodiversity: the diversity of life on earth or a location within, e.g. biodiversity of Kiribati

Biosafety: preventing the spread of invasive species and genetically modified organisms

Biosecurity: preventing the spread of invasive species

Biota: plants, animals, fungi, micro-organisms.

Containment: the act of confining an IAS to one area

Control: reducing a population of an invasive species to a set level, e.g. containment, trapping feral cats, etc.

Delineation: defining the boundaries of an incursion or invasion

Ecosystem: living organisms (plants, animals, fungi, micro-organisms, etc.) and their physical environment

Eradication: the total removal of an invasive species population from a site

Genetically modified: organisms whose genetic compositions have been altered artificially

Indigenous or native species: organisms that occur naturally in a place, e.g. all the Kiribati seabirds

Invasive species: introduced species (and rarely native species like crown-of-thorns starfish) that become destructive to the environment, species, or agriculture, etc.

Monitoring: regular consistent surveys which are usually undertaken to measure trends in native species populations

Pathway: The route and means by which IAS could invade Kiribati, e.g. mongoose and other IAS travelling from Hawaii or Fiji in containers on cargo ships is one potential pathway

Pest: Often used to mean the same as IAS, but usually refers to Agricultural IAS

Risk assessment: evaluation of the potential risk of a species invading

Rodent: a rat or mouse

Source: the origin or potential origin of IAS that could invade Kiribati, e.g. Fiji and Hawaii.

Surveillance: repeated surveys to determine if invasive species have arrived.

Terrestrial: on land c.f. marine.

ACRONYMS

ALD	Agriculture and Livestock Division of MELAD
CXI	Kiritimati, Christmas Island
ECD	Environment and Conservation Division
ERP	Emergency Response Plan
FD	Fisheries Department
GAS	Giant African Snail
GEF-PAS	The Global Environment Facility Pacific Alliance for Sustainability
GISD	Global Invasive Species Database (ISSG)
IAS/IS	Invasive alien species or sometimes invasive species if it is a native species

IASC	National Invasive Species Committee of Kiribati
IBA	Important Bird Area of BirdLife International
IMO	International Maritime Organisation
ISSG	Invasive Species Specialist Group of Species Survival Commission of IUCN
IUCN	International Union for the Conservation of Nature
KIEP	Kiribati Integrated Environment Policy
K-NISSAP	National Invasives Species Action Plan of Kiribati
KPA	Kiribati Ports Authority
KPS	Kiribati Police Services
LRD	Land Resources Division of SPC
MELAD	Ministry of Environment, Lands and Agricultural Development
MFMRD	Ministry of Fisheries, Mineral and Resource Development
NBSAP	National Biodiversity Strategy and Action Plan
NZAID	New Zealand Agency for International Development
PII	Pacific Invasives Initiative
PIO	PIPA Implementation Office
PIPA	Phoenix Islands Protected Area
PIPAMC	Phoenix Islands Protected Area Management Committee
SPC	Secretariat for the Pacific Community
SPREP	Secretariat for the Regional Environment Programme
SRR	Surveillance and Rapid Response plan
UNEP	United Nations Environment Programme
WCU	Wildlife Conservation Unit, Kiritimati
YCA	Yellow crazy ant

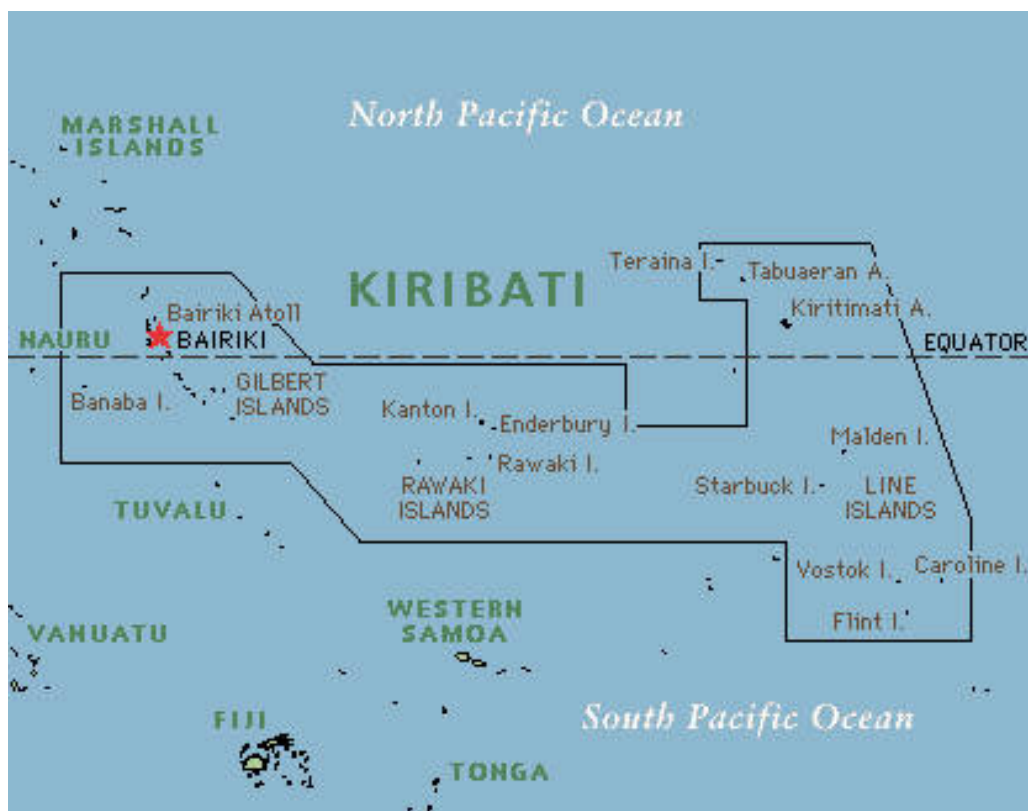


Figure 1 – Map of Kiribati showing location of Gilbert, Phoenix and Line Is.

1.0 INTRODUCTION

Background

Kiribati comprises three archipelagos – Line, Phoenix and Gilberts – with varying social, economic and environmental values, between and within each archipelago. The PIPA is a World Heritage Area and there has been considerable work undertaken there and on Kiritimati in the Line Islands to manage invasive species already present (PIPA Management Plan, Pierce et al 2013). There has also been significant work on strengthening biosecurity across Kiribati (K-NISSAP 2015). Each archipelago has specific invasive species threats facing it based on the above values, plus the type, source and frequency of visitation by national and international visitors (K-NISSAP 2015).

Purpose and structure of SRR

In 2015-16 Kiribati developed and began to implement the K-NISSAP or Kiribati National Invasives Species Action Plan, an integrated plan to manage existing IAS and to put procedures in place to prevent further invasions (GOK 2015). One of the procedures still to be implemented in 2015 was a plan for the surveillance for and rapid response to remove priority invasives species. The current plan provides a generic framework for surveillance and dealing with IAS incursions and also provides examples of surveillance approaches and rapid response procedures for some IAS that are considered likely to reach and establish in Kiribati. This will enable Kiribati to confidently implement targeted surveillance and develop appropriate management responses as needed. It will avoid potentially confusing scenarios of “what IAS do I look for on this island?” and “who takes charge of dealing with this incursion and what is my role?”.

This surveillance and rapid response plan contains the following sections:

- structure of surveillance and response procedures in Kiribati
- priority invasive species and indicator species to be targeted for surveillance
- summary of early detection (surveillance) measures currently in place or planned
- what happens after first detection
- delineating the incursion and planning the response
- response management measures
- example of a rapid response plan.

2. GUIDING LEGISLATION AND POLICIES

Key legislation and policies governing IAS generally is discussed in detail in the K-NISSAP and briefly summarised here. The SRR plan follows these acts and policies:

Biosecurity Act 2011

The purpose of this Act is to prevent the arrival of animal and plant pests and diseases into Kiribati; to control their establishment and spread and regulate the movement of animal and plant pest and diseases and of animal and plant products; to facilitate cooperation in respect of animal and plant diseases; and to make ancillary and related provisions.

Environment Act 1999 (2007 amendment)

This Act includes provision for the management of IAS in the country together with provisions to require mitigation for the potential impacts of IAS and other impacts associated with development proposals.

Fisheries Act 2010 and amendment

This Act and related policies have limited powers relating to IAS except for aquaculture.

Phoenix Islands Protected Area (PIPA) Regulations 2008 (amended 2014)

The PIPA Implementation Office (PIO) is mandated with protecting and managing the PIPA waters and terrestrial biota under the PIPA Regulations 2008 and with its new marine boundaries as in the PIPA (Amendment) Regulations 2014. PIPA is an important World Heritage site and the PIPA Conservation Trust has been established for the long term sustaining of PIPA's pristine environment including IAS management. PIO is responsible for Biosecurity at the PIPA following the PIPA's Guidelines for entering the Phoenix Islands.

Kiribati Integrated Environment Policy (KIEP) 2013

This policy has as its vision "The people of Kiribati continue to enjoy a safe and healthy environment that is resilient to the impacts of climate change and supports livelihoods, human health and sustainable development". It guides MELAD through Acts and Policies including Quarantine Ordinance 1977, Biosecurity Act and the PIPA Regulations 2008, plus the Fisheries Act 2010.

National Biodiversity Strategy and Action Plan 2007-11

A revision to this plan is currently being drafted. This plan is the key guide to ECD in its role of protecting biodiversity and it also provides guidance to Agriculture and Fisheries. There are many supporting documents (e.g. see under PIPA below, note also Kiritimati Bird and Invasive Species Monitoring Plan).

National Invasive Species Action Plan 2015-20

This plan identifies existing IAS present in Kiribati and guides the agencies in managing these and the prevention of further invasions.

PIPA management Plan 2010-14 (Revised)

This plan guides the PIPA in its UN obligations towards managing IAS. Several supporting documents that address specific IAS management in the PIPA include PIPA Biosecurity Action Plan (Pierce 2011, revised 2015) and other guiding documents.

International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004)

This convention was adopted by the IMO requiring ships to have ballast management plans with details all recorded and available for inspection by authorities in countries and ports visited.

3. MANAGEMENT STRUCTURE AND ROLES

Key agencies for the surveillance of and rapid responses to IAS are:

ALD –responsible for coordinating biosecurity at the border and response to border incursions of IAS and further spread domestically.

Quarantine Division of ALD responsible for border security.

ECD and WCU CXI – responsible for managing existing environmental IAS to prevent further spread and impacts in the environment.

PIO – responsible for managing existing IAS and border incursions at PIPA.

Fisheries – responsible for marine invasives.

Police and Customs – responsible any for law and order issues and customs regulations..

4. DETECTING AND UPDATING CHANGE IN STATUS AND DISTRIBUTION OF KEY IAS IN KIRIBATI

About 200 species of alien species have been detected in Kiribati (Pagad 2014). Of these, there are about 15 species that cause significant impacts on ecosystems, agriculture and health (K-NISSAP). Some of these are very widespread, e.g. house mouse, kimoa(Pacific rat), black (ship) rat, feral house cat and some weed species. Others, e.g. cane toad, yellow crazy ant and taro beetle, are each confined to only 1-2 islands (Table 4.1). Thanks to the support of the international community, some species have been totally eradicated from Kiribati, e.g. European rabbit and Asian black rat (Pierce 2012) and others are being targeted for eradication e.g. YCA at Kiritimati (Gruber 2015), or being locally targeted e.g. rats and cats on Kiritimati (Pierce 2013, Pierce and Brown 2013).

Table 4.1 – Summary of existing knowledge of distribution of key IAS within Kiribati

Y = established, y = reported in past, Ex = extinct/eradicated, U = unknown/no recent data, blank = not present in last survey. See below table for key to IAS.

IAS	Mou	R rat	R ex	R ta	Rab	Cat	Toad	YCA	Taro B	Lan	Plu	Leuc	Cas	Wed
Line														
Kiritimati	Y	Y	Y			Y		Y		Y	Y	Y	Y	
Fanning		Y	Y			Y				U			U	
Washington		Y	Y			Y				U			U	
Malden	Y					Y								
Starbuck	U	U	U			U				U	U	U	U	
Flint	U	U				Y				U	U	U	U	
Vostok			Y							U	U	U	U	
Millennium	U		Y			U				U	U	U	U	
Phoenix														
Kanton	U	Y	Y			Y				Y			Y	
Enderbury			Y			Ex								
Rawaki					Ex									
Birnie			Ex											
McKean				Ex										
Manra		Y	y			Y								
Orona			Y			Y								

Nikumaroro			Y											
Gilbert														
Tarawa	Y	Y	Y			Y			Y	Y		Y	Y	Y
Makin	U	U	U			U				U	U	U	U	U
Butaritari	U	U	U			U				U	U	U	U	U
Marakei	U	U	U			U				U	U	U	U	U
Abaiang	U	U	U			U				U	U	U	U	U
Maina	U	U	U			U				U	U	U	U	U
Abemama	U	U	U			U	Y			U	U	U	U	U
Kuria	U	U	U			U	Y			U	U	U	U	U
Aranuka	U	U	U			U				U	U	U	U	U
Nonouti	U	U	U			U				U	U	U	U	U
Tabiteuea	U	U	U			U				U	U	U	U	U
Beru	U	U	U			U				U	U	U	U	U
Nikunau	U	U	U			U				U	U	U	U	U
Onotoa	U	U	U			U				U	U	U	U	U
Tamana	U	U	U			U				U	U	U	U	U
Arorae	U	U	U			U				U	U	U	U	U

Key: Mou = House mouse, R rat = Rattus rattus, R ex = Ratus exulans, R ta = Rattus tanezumi, Rab = European rabbit, Cat = Feral house cat, Toad = Cane toad, YCA = Yellow crazy ant, Taro B = Taro beetle, Lan = Lantana, Plu = Pluchea, Leuc = Leucaena, Cas = Casuarina, Wed = Wedelia trilobata

Whilst current knowledge of IAS status and distribution is well known in the PIPA and some of the Line Islands, data from most of the Gilbert Islands are incomplete (Table 4.1). Staff and visiting biologists should therefore take every opportunity to update the U entries (unknown status) of the above table. Lead agencies for surveillance of the different island groups are described in the Table below.

Table 4.2 – Lead and support agencies for IAS surveillance and response in different Kiribati islands

Island	CXI, Fanning, Washington	Southern Line	PIPA	Tarawa	Outer Gilberts
Lead agency (and support)	ALD (WCU)	WCU (ALD)	PIO (WCU)	ALD (ECD)	ALD (ECD)

5. PRIORITY IAS SPECIES TO BE TARGETED IN SURVEILLANCE AND RAPID RESPONSE (SRR)

In addition to the IAS listed in Table 4.1 above there are additional species that could invade Kiribati (or be transported to new sites within Kiribati) and impact on environmental and social and economic values. These are existing and potentially invasive IAS identified for each Archipelago and in some cases island, given that the PIPA and Line Islands have very high biodiversity values generally. Some specific islands (Rawaki, Birnie and McKean and many motu within Kiritimati Lagoon) are now totally free of IAS and so have exceptionally high natural values. The identification of the priority IAS are based on the K-NISSAP and associated risk assessments for Kiribati biosecurity (PIPA Management Plan, Pierce et al 2013, Pierce and Brown 2015), which includes source of IAS in adjacent nations or even elsewhere in Kiribati with which there is vessel and aircraft contact. The list is provisional only as additional high risk species may be identified and added later.

Table 5.1 – Priority IAS (and their pathways) that could seriously impact specific sites in Kiribati

Species	At risk sites	Potential source and pathway	Key references – K-NISSAP and...
All rodents (mice and several species of <i>Rattus</i> spp.) and cats (<i>Felis catus</i>)	PIPA islands (Rawaki, Birnie, McKean, other islands later)	Other Kiribati islands via supply vessels, yachts; other countries via multiple pathways – above plus fishing vessels, tourism and scientific parties	PIPA Management Plan, Kanton and CXI Biosecurity AP
	Line Islands – Malden (cats and mice currently present, but cats may be eradicated in the future)	Other Kiribati islands via supply vessels, yachts; other countries via multiple pathways as above	Pierce and Brown 2015
	Kiritimati Lagoon motu	Kiritimati lagoon via swimming and lagoon boats	CXI Biota Monitoring (Pierce et al 2013)
Indian (grey) mongoose	All Kiribati entry points especially CXI, Kanton, Betio, Bonriki, via freight vessels, aircraft	Fiji, Honolulu	Samoa report
Yellow crazy ant, <i>Anaplolepis gracilipes</i>	Other points on CXI (present at Ronton); All Kiribati entry points especially CXI, Kanton, Betio, Bonriki via freight fishing and tourist vessels	Already present at CXI and virtually all trading partners including Fiji, Samoa, Honolulu	Pacific Biosecurity 2015
Little fire ant <i>Wasmannia auropunctata</i> and Red imported fire ant <i>Solenopsis invicta</i>	All Kiribati entry points especially CXI, Kanton, Betio, Bonriki via freight, fishing and tourist vessels, yachts	Honolulu and Australia (both), Tahiti, Solomons, Vanuatu, New Caledonia (LFI); China, Hong Kong, Taiwan (RIFA)	Pacific Biosecurity 2015
Brown tree snake <i>Boiga irregularis</i>	All Kiribati entry points especially CXI, Kanton, Betio, Bonriki via supply tourist and fishing vessels	Australia, Guam	Guam snake eradication plan
Small birds e.g. species of myna, sparrow and bulbul	CXI and TRW	Fiji, Honolulu, Australia, Japan	Kiribati myna and sparrow eradication plans 2015/16
Cane Toad <i>Rhinella marina</i>	All Kiribati entry points especially CXI, Kanton, Betio, Bonriki via supply tourist and	American Samoa, Australia, Fiji, French Polynesia, two of the Gilbert Islands	Australian state plans

	fishing vessels, luggage		
Singapore daisy <i>Wedelia trilobata</i>	All Kiribati entry points especially CXI, Kanton, Betio, Bonriki via supply vessels, passengers	Already invading at Tarawa; invasive at virtually all trading countries including Fiji, Samoa, Honolulu	AQIS
Giant African snail <i>Achatina fulica</i>	All Kiribati entry points especially CXI, Kanton, Betio, Bonriki via supply vessels, containers	Invasive at virtually all trading countries including Fiji, Samoa, Honolulu	Fiji biosecurity
Rhinoceros beetle <i>Oryctes rhinoceros</i>	All Kiribati entry points especially CXI, Kanton, Betio, Bonriki via supply vessels	Present at trading countries	SPC
Taro beetle <i>Papuana uniondis</i>	Gilbert Outer islands, PIPA, Line Islands	Trading partners and already present at Tarawa	SPC
Invasive plants already in Kiribati, e.g. <i>Lantana camara</i> , <i>Pluchea indica</i> , <i>Leucaenea</i> and <i>Casuarina</i> , all at CXI and some at Kanton, and Tarawa	Other Kiribati islands especially in Line Islands and PIPA via supply and tourist vessels	Present CXI; some also Tarawa and Kanton	SPC
Bird influenza HPA1	Unknown	Unknown	SPC

Table 5.2 - Locations to implement surveillance for early detection

Y = yes ongoing; (Y) = yes after rats and/or cats eradicated. See below table for island abbreviations:

Group	Gilberts		Phoenix				Line					
Island	S TRW	G outer	K	En	R/B/Mc	Ma/O/N	Ki	K m	Te	Ta	Ma	S,F,V,M
Survey lead	ALD	ALD	PIO	PIO	PIO	PIO	Ag	WCU	Ag	Ag	WCU	WCU
When												
IAS to survey												
Rodents		Y	(Y)	(Y)	Y	(Y)	Y	Y	Y	Y	Y	Y
YCA's/ants	Y		Y				Y	Y	Y	Y		Y
Snails e.g. GAS	Y		Y				Y		Y	Y		
Cats			(Y)	Y	Y	Y		Y			(Y)	Y
Mongoose	Y						Y		Y	Y		
Snakes	Y						Y		Y	Y		
Cane toad	Y	Y										
Mynas, bulbuls	Y	Y					Y					
Beetles	Y		Y				Y					
Weeds – Wedelia	Y	Y	Y				Y		Y	Y		
- Lantana	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y
- Pluchea	Y	Y	Y				Y	Y	Y	Y		Y

- Leucaena	Y	Y	Y				Y	Y	Y	Y		Y
- Casuarina		Y	Y			Y	Y		Y	Y		Y
- misc. weeds	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Key to islands: S TRW = South Tarawa, G outer = Gilbert outer islands, K = Kanton, En = Enderbury, R/B/Mc = Rawaki/Birnie/McKean, MA/O/N = Manra, Orona, Nikumaroro, Ki = Kiritimati, K m = Kiritimati lagoon motu, Te = Terraina, Ta = Tabuerran, Ma = Malden, S,F,V,M = Starbuck, Flint, Vostok, Millenium

6. SURVEILLANCE METHODS AT UNINHABITED ISLANDS

Kiribati islands here are broadly divided into those that are uninhabited and those which are inhabited by people. Uninhabited islands include many which are part of a World Heritage Area (PIPA) and others that are also important wildlife refugia, especially IBAs, in the Line Islands. These islands all tend to be little visited by biosecurity and other technical experts and therefore require maximum targeted surveillance effort when they are visited. This section outlines methods to detect potential IAS and includes Kanton given its “gateway to the PIPA” status.

6.1 Rodents

Biosecurity

Prevention is the best method of avoiding IAS impacts. Follow the biosecurity guidelines for PIPA and CXI. These describe stringent quarantine needed at departure points in foreign countries, plus departure points at CXI, Kanton, Tarawa, and outer islands; stringent biosecurity on vessels themselves; and stringent biosecurity at arrival points including at all the very sensitive sites, e.g. PIPA islands, southern Line islands, etc (refer K-NISSAP, PIPA Management Plan, Pierce et al 2013, Pierce and Brown 2015). Landing permits for the most sensitive islands (Rawaki, Birnie, McKean, Enderbury, Malden and other southern Line islands) should only be given for priority management and research and only if a biosecurity officer is appointed.




Surveillance at uninhabited islands - PIPA islands, CXI motu, Southern Line Islands

Key needs are:

- make use of every visit, particularly those to remote islands, to undertake surveillance. For rat-free motu in Kiritimati lagoon undertake at least two surveillance visits per annum
- try to include evening or night observations, as this is the best time to detect rodents if present, using headlamps at night
- undertake visual searches of all the small islands (<10 ha), and subsample larger islands, selecting likely rodent habitat e.g. vegetation mosaics and bird colonies which would provide feeding opportunities for rodents
- search motu for sign of rodents particularly gnawed coconuts and Te Boi (*Portulaca*), etc.
- Look out for gnawed egg-shells (multiple jagged edges of shell), gnawed seabird bones, distinguish predation from curlews (hole through shell) and cats (side of shell eaten away, large jagged fragments)
- if you see many nests with eggs but few or no chicks of ground-nesting terns and noddies, this would suggest low hatching success, potentially from rats

- if staying for one or more nights, set Victor rat traps baited with peanut butter or other protein lure/bait (fish, etc). Also use tracking tunnels if available. Consider setting traps off the ground (tied to tree trunks, etc.) if crabs or ants are likely to be a problem removing bait or setting traps off)
- measure and photograph any trapped rodents and keep part of specimens preserved where possible - the ear or tip of tail are easy to collect and are good for DNA analyses, but if possible preserve a whole carcass (by freezing or in 95% ethanol) if unsure of the species of rodent
- search for diagnostic features of specimens, e.g. black (ship) rat and Asian black rat have a very long tail (as long or longer than the body), ears are large so that when folded down cover the eyes; kimoa are usually much smaller and has head and body length about equal to tail length and a dark streak on hind foot; mice are small in size and have a musky smell. Norway rats are very large rats with relatively short, thick tails (notably shorter than body length) and small ears which don't reach the eyes if folded over (refer Appendix 4 for more detail).

Some rodent sign

<p>Rodents like this kimoa are active from about 4 pm in the afternoon and onwards through the night. Note small ears, long tail.</p>	
<p>Classic rat predation sign on eggs of Tarangongo (terns)</p>	
<p>Not to be confused with natural (insect/lizard) damage to these Te Kibwi eggs</p>	

6.2 Cats and other large vertebrates

Biosecurity

Cats and other invasive vertebrates such as mongoose, pigs, snakes and cane toads must be stopped from entry to sensitive sites via the same general approach to biosecurity as for rodents, i.e. at source, en route and at arrival points and at all sensitive sites e.g. PIPA islands, CXI and southern Line islands.

Surveillance at Uninhabited Islands - PIPA islands, CXI motu and Southern Line Islands

In general follow the rodent guidelines above with some additional approaches as below:

- staff to be aware of appearances and sign of cats and other potential vertebrate invaders
- search for any predator-killed seabirds and examine sign taking note of bite marks and locations, take many photographs
- document location (including GPS if possible), habitat, time, observer(s), contact details.

Some sign of cats on uninhabited islands





Not to be confused with human poaching sign - here people have left piles of decapitated heads and wings of large birds – Te Taake, Te Koota and Te Etei, not easily preyed on by cats

Always stay alert to the possibility of sighting any of these or any other unusual animals – mongoose, snakes, pigs, cane toad, etc., and their sign, e.g. shed snake skin, pig-rooting sign, etc.



Grey mongoose (above left); Norway rat (above right)



Brown tree snake (above)



Cane toads (above) showing variable colours

Table – Some other sign of large vertebrate IAS to search for. Rodent dropping photo courtesy of Derek Brown

<p>Norway rat droppings are larger than those of other rodent species (refer photo opposite). Refer Appendix 4 for other features of rodent species including specific dimensions of droppings</p>	
<p>Mongoose droppings are similar looking to those of Norway rat. Typically 10-20 mm long often containing insect fragments. Often deposited on structures like this bait station (E. VanderWerf).</p>	
<p>Shed snake skin – this skin is from a brown tree snake in Australia - the snake moults out of its old skin leaving that old skin as one intact piece. Often the shed skin is left draped over plants or inside buildings</p>	



6.3 Invasive ants and other invertebrates


Biosecurity

- Prevention is currently the only viable method of avoiding invasions of invasive ants and other insects, etc. and preventative baiting of Pacific Biosecurity needs to occur at source countries and warehouses, vessels and aircraft, arrival points including ports and warehouses (K-NISSAP 2016). Elsewhere surveillance can occur via lures of sugar and protein.

Surveillance on uninhabited islands

- Check flowers of noni *Morinda citrifolia* as YCAs are attracted to the flowers. If suspicious ants like Yellow crazy ants (see below) are present use paint brush to collect sample of ants in vial and add ethanol
- Routinely (every 6 months or every visit if visited infrequently) set out lures of sugar (sugar water or jam) and protein (peanut butter/fish) at landing points, camp sites, tree groves and around noni (*Morinda citrifolia* bushes) spaced at c.10 m intervals. Aim to place lures in shaded sites if possible.
- Check these lures after c.30 minutes (sooner if it is hot or unshaded) and collect insects in vials as for noni above.



POTENTIALLY INVADING VERY DANGEROUS ANTS – from K-NISSAP	
	<p>Yellow crazy ant</p> <p>These ants and other invasive ants such as little and red-imported fire ants destroy native ants and other insects and also lizard and bird populations. YCAs are 4-5 mm long yellow-brown coloured with erratic movements.</p> <p>YCAs are common in Fiji and Honolulu and have recently invaded Kiribati where an eradication programme is underway.</p>
	<p>Little fire ant</p> <p>These small stinging ants are orange-red to light brown in colour and the workers are only 1.5 mm in length</p> <p>Little fire ants occur in Honolulu, Fiji and many other places and could easily invade Kiribati</p>

	<p>Red imported fire ant</p> <p>These very destructive ants are 3-6 mm long and are reddish coloured.</p> <p>They have invaded several Pacific rim countries including the Brisbane area in Australia, and could easily establish in other countries including Kiribati</p>
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Yellow crazy ants (above) being lured on sugar solution at Kiritimati in 2013. It is possible to use paper, leaves, etc as a base for placing sugar and protein lures.

<p>Giant African snail</p> <p>These are the largest snails in the region measuring – the shells are usually 50-100 mm in length and can reach 200 mm. Photo courtesy Wikipedia - vyperlook.com</p>	
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<p>Taro beetle</p> <p>The adult beetle is black, shiny and 15-20 mm in length. The average life cycle is 22 to 25 weeks. The adult beetles fly from the breeding sites to the taro field and tunnel through the soil and into the base of the taro corm. They then proceed to feed on the growing corm, leaving large holes that degrade the market quality and value of the corm. From BAF Fiji.</p>	
<p>Coconut rhinoceros beetle</p> <p>Above: Adult beetles range from 30 to 63 mm in length and are dark brown or black. The male has a more pronounced horn than the female. The ventral surface (underside) of males and females has reddish-brown hairs, but the female has a fuzzy grouping of these hairs at the tip of the abdomen.</p> <p>Below: Sign of their presence includes holes bored into coconut fronds and v-shaped frond damage. Courtesy USDA.</p>	

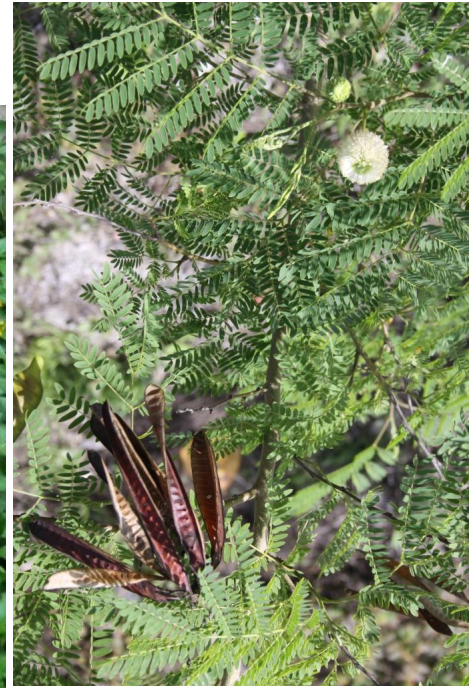
6.4 Invasive plants

Biosecurity

- Follow biosecurity procedures detailed in PIPA and Line Islands biosecurity plans and K-NISSAP.

Surveillance on uninhabited islands

Survey islands for key invasives, e.g. *Wedelia*, *Lantana*, *Pluchea*, *Leucaena*, *Casuarina*, and other invasive or unusual plants including landing and camping areas.



Wedelia (left) with distinctive yellow flowers; *Leucaena* (right) with distinctive flowers and pods.



Lantana (above) with distinctive orange flowers invading the road edge at Kanton in April 2006.



Pluchea indica (left) and *Casuarina equisetifolia* (right) – photos courtesy of commons.wikipedia.org

Refer to Section 9 for responses to the discovery of these or suspicious plants on uninhabited islands.

6.5 Indigenous Biota as indicators of IAS impact

During surveillance for invasive species, population of key indigenous species should be monitored. This can give an indication of whether IAS have recolonised. For example, on de-ratted motu in Kiritimati Lagoon, Bokikokiko and seabirds have responded positively since rat removal (Fig 6.5, Pierce, et al. 2013, 2015). Use standard data sheets e.g. Appendix 1-2.

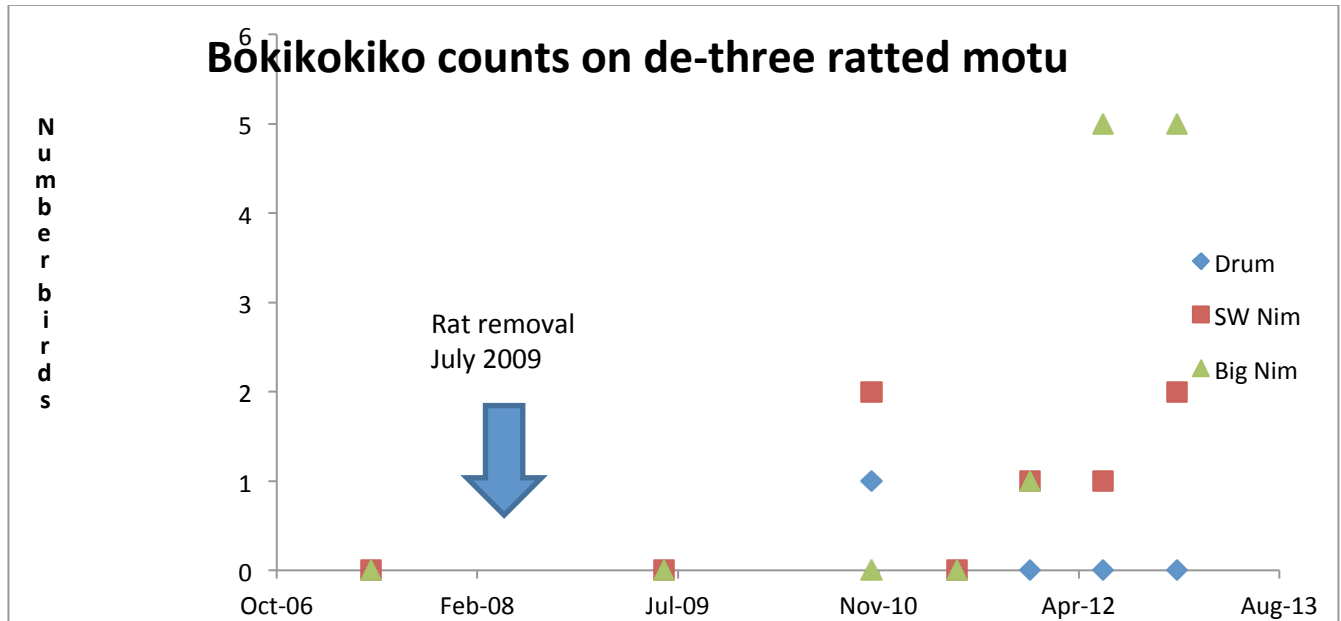


Fig 6.5 – Initial population responses of Bokikokiko on three de-ratted motu in Kiritimati Lagoon.

7. SURVEILLANCE METHODS ON INHABITED ISLANDS

The following sections outline targeted surveillance methods for priority invasive species. However, additional passive surveillance should be promoted via the community, schools, media, etc. to encourage the reporting of unusual biota that could be invasive species.

7.1 Rodents

Biosecurity

Prevention is the most desirable and cheapest method of avoiding invasion by IAS. Follow existing biosecurity guidelines for Kiribati generally and encourage stringent quarantine needed at departure points in foreign countries. Maintain stringent biosecurity at all departure points at CXI, Kanton, Tarawa, and outer islands along with stringent biosecurity on the vessels themselves and stringent biosecurity at arrival points.

Surveillance of rodents on Inhabited Islands – Gilbert Islands and CXI, Fanning, Washington,

- Familiarise oneself with lists of rodents, learn how to identify and detect each of these species, etc. known to be present on each island

- Maintain vigilance for any additional species using methods as for uninhabited islands above as appropriate
- Target arrival points (sea and airports) and villages, dumps and other potential scavenging sites
- Maintain trapping/baiting regimes where the site is a risk for attracting rodents at departure and arrival points
- Raise awareness of community and schools via the Invasive Species Committee (refer K-NISSAP) to encourage reporting of key IAS that could potentially invade.

7.2 Large vertebrates, e.g. mongoose, snakes, large rats, toads, birds

Biosecurity

- Prevention is essential and begins at the source warehouses in other countries and continues on vessels through awareness raising and maintenance of measures such as hygiene, rodent control, checking for birds, etc.. Captains and crews need to be briefed on what IAS to look out for – mongoose, snakes, rats, birds, toads etc., and to have the ability to kill them before arrival in Kiribati. They need to be briefed on emergency responses at Ports of Betio, Kiritimati and Kanton and responses do not include chasing or throwing live animals overboard as these can subsequently swim or fly ashore.

Vertebrate surveillance at arrival and departure points at all inhabited islands

Incursions of large IAS are normally detected either through sightings of the animal or through detection of their sign (refer section 6). Therefore it is important that staff and the general public are aware of the issues and also the type of animal and sign that they should be reporting and to whom to report (ALD).

7.3 Invasive ants and other invertebrates

Biosecurity

- Prevention is essential and begins at the source warehouses in other countries or island groups and continues on vessels.

Invertebrate surveillance at arrival and departure points at all inhabited islands

- All incoming international vessels and aircraft and vessels from CXI must be checked by Biosecurity staff following existing procedures and new preventative baiting procedures being developed by Pacific Biosecurity for ants and other agencies, e.g. SPC. Domestic vessels traveling between CXI and other islands need to have sugar and protein lures in place while there is a risk of YCA transport from CXI sources
- Sea and airport areas and warehouses to be surveyed regularly (e.g. 6 monthly) for invasive invertebrates, including ants (for which sugar and protein lures are currently prescribed by Pacific Biosecurity), beetles, giant African snails
- Staff need to be able to recognise priority invasive ants and other unusual invertebrates.

- Community awareness needs to be raised through schools (refer K-NISSAP and Invasive Species Committee) and the public encouraged to report unusual animals.

8. GUIDELINES FOR INITIAL RESPONSES AFTER DETECTION OF IAS

8.1 Notifications

The initial report or observation of suspected IAS from public or border officer is reported to the senior Quarantine/Ag/PIPA officer. This person is responsible for verifying the details of the report – observer, date, specific locality including GPS points if possible, details of the sighting, including photographs. He or she will question the observer as needed and document all details on an Incident Report sheet. The validity of the report are discussed and considered with technical specialists of the organisation as needed, erring on the side of precaution (“if in doubt check it out”). Complete a Notifications report (refer Appendix for example).

8.2 Preliminary containment and/or removal

In many cases the identity of the reported incursion may be immediately obvious and a precautionary containment action can be taken immediately, e.g. placing all of the suspect items in a secure sealable container; fumigating the area of infestation, e.g. in shipping container where they were initially found; or the removal of a suspicious plant and complete root system from the ground and containing it along with all flowers/seeds in a sealable container. These actions may save considerable effort and cost at a later time particularly if the site is at a location isolated from the normal work place. These details are to be included on the Notifications report.

8.3 Confirm Identification

Check the contained specimen(s) against field guides and IAS databases to confirm identity. If identification is still uncertain contact relevant regional specialists at e.g. SPC, SPREP, PII, including full details of the specimen, photos, etc.

8.4 Delineate area of incursion

The area of the initial invasion (incursion) needs to be defined. In the case of invertebrates and weeds this involves a structured search to determine locations in which the IAS occurs and locations outside. This will assist in assessing feasibility of eradication and the methods to achieve eradication. Summaries of key methods for undertaking delineation are provided for different IAS in Table 8.1 below:

Table 8.1 – Summary of delineation methods for some key IAS incursions

Key IAS	Delineation methods
Rodents on “rodent-free” island	On small islands (i.e. <10) ha, assume IAS is present across the entire island For large island, e.g. Kanton after rats are removed, delineate by: - immediately search the island using a spotlight for rodent tracks and map/GPS sightings and route travelled - immediately set snap-trap over representative parts of island and map/GPS all traps and sites where rodents/no rodents trapped (follow guidelines in PII guidelines for rodent and cat eradication) - immediately use set wax tags in representative parts of the island

	as for traps (try to use only in cooler shaded areas only as the wax can melt) - above will determine if incursion localised, e.g. confined to peninsula near port at Kanton, or more widespread, and assist in planning for eradication response which can be immediate (if sighting(s) confined to peninsula and sufficient fresh bait is on hand)
Mongoose	- on inhabited islands immediately request community to report sightings - on all islands use tracking tunnels and kill traps (e.g. DOC 200's or preferably 250's and Goodnature A24 traps) and cages for trapping animals - refer imminent PII guidance for mongoose
Yellow crazy ant	- on inhabited islands immediately distribute colour YCA brochures and other interpretive material if available and/or request to people that they report unusual ants - immediately follow standard delineation using sugar (jam) and protein (peanut butter/fish) lures on papers/leaves at c. 10 m intervals - check representative stands of flowering noni <i>Morinda citrifolia</i> as YCAs are attracted to the flowers
Giant African snail	- at ports carry out contact search working out from area of incursion, mark locations of and kill any animals found and destroy eggs
Taro and coconut beetles	- carry out searches for sign of damage to specific target plants, e.g. taro, coconut using Agriculture Assistance officers
<i>Wedelia, Lantana, Pluchea, Leucaena, Casuarina</i>	- on inhabited islands immediately distribute colour photos/ brochures if available and/or request people report unusual plants - visual search for live plants using search image for the leaves using AAs as above

8.5 Prepare and implement response plan

The preparation of an eradication plan is normally undertaken by staff and/or a technical expert. Key components of an eradication plan are:

- Goal and objectives – be clear about the goal of eradication and not containment, management, etc
- Background information on the site – physical description, vegetation and map thereof, fauna, human population, vessel/aircraft etc traffic, livestock, climate and weather
- Background information on the IAS incursion, when incursion occurred if known, current rate of spread if known, etc
- Overview of Eradication Plan – general description of the project and feasibility
- Project team – positions ?selected, individuals of agencies and their specific roles; includes technical advisors and other experienced team members
- Task lists allocated to specific members of eradication team
- Operational techniques – general techniques plus details of equipment, timing and duration of use etc., follow-up methods and contingencies
- Timing – start date, time to complete different phases of operation

- Biosecurity of operation to prevent any further incursions of current or other IAS
- Logistics support, e.g. accommodation, food, transport, communications, consents and permits
- Environmental effects, non-target issues and associated mitigation proposed
- Monitoring – pre-, during and post-operational monitoring of target species and indigenous biota
- Health and safety matters
- Communications plan to keep affected community and wider community informed
- Equipment lists documenting all equipment needed and who is responsible for providing each
- Budget and sources of funding, allow contingency component.

9. EXAMPLES OF A DRAFT RAPID RESPONSE PLAN

Refer to the PII Resource kit for rodent and cat eradication.

The following example is for Asian House Sparrows. During a visit to Betio in April 2016, a small flock of Eurasian Tree Sparrows (*Passer montanus*) was detected. The following plan is the first draft of a response plan to eradicate the sparrows.

ERADICATION PLAN FOR EURASIAN TREE SPARROWS AT BETIO

This first draft prepared by Frank Tabeibetai (ALD), Tiare Etei (PIO), George Taoaba (ECD), Ray Pierce, 23 April 2015 with funding from GEF-PAS and support from SPREP.



Eurasian Tree Sparrow at Betio 23 April 2016 (George Taoba/Tiare Etei)

Goal and objectives

The plan is to totally eradicate the invading Eurasian Tree Sparrows as they pose potential risks to crops (including fruits) and a disease risk. Later they could become a general nuisance when common. Preliminary objectives include:

- defining the total numbers present and their local range
- determining behaviour
- implement eradication tasks.

Background information on the site

At present a focal site of the sparrows is the KPA yard beside the container terminals. The birds also move to the adjacent Commerce block and probably further along Betio potentially to KOIL and beyond as there was a possible earlier sighting of these birds on 7 April at the Communications Tower in Betio.

Key physical features of the KPA block are buildings, vehicles, parking area, area vegetated with grasses and weeds, *Casuarina* trees and other trees. Several people walk through this area daily to the KPA canteen and to neighbouring KPA buildings.

Put in representative photos of KPA yard and map of the area.

Background information on the IAS incursion

Incorporate details from ALD “Notifications” document including the following details.

On 7 April 2016 two “small birds” were seen by staff at the Communications Tower in Betio and reported to Agriculture. A subsequent visit by Quarantine staff to the site revealed no further birds.

On 21 April 2016 at 1330 h four birds were seen briefly by Ray Pierce (EcoOceania), Frank Tabeibeti (Quarantine) and Anna Bertram SPREP) at the KPA compound. There they foraged at ground level on grass seeds and weed seeds on the north edge of the compound and flew between here and the *Casuarina* trees (4) on the southern edge of the compound c.50 m away. They were provisionally identified as sparrows, possible house sparrows (*Passer domesticus*), although the calls were noted as markedly softer than New Zealand house sparrows and further observations were needed.

On 23 April more detailed observations, photography and sound recording were obtained by AB, FT, RP, George Taoaba (ECD) Tiare Etei (PIO) at the KPA compound from 0715 to 0930. The birds foraged in the same area but also in the *Casuarina* trees where they appeared to feed on cones of this tree species. The combined observations on plumage and sound recordings revealed that the birds were Eurasian Tree Sparrows (*Passer montanus*).

Background information on the species

The species natural range is Eurasia at wide latitudes east to China, Taiwan and Japan and south to SE Asia, Philippines and tropical Indonesia. The introduced range includes North America and SE Australia where they are considered a pest due to competition with native sparrows (N America) and crop damage (Australia). They are a prohibited species in Western Australia where invading birds are eliminated, usually by shooting (W Kirkpatrick, West Australian Department of Agriculture and Fisheries, pers. comm.). In Kiribati, if they established they could become a locally significant disperser of weed seeds. They are largely seed and fruit eaters and they nest colonially, each pair building a large domed nest made of grasses and twigs typically in a tree cavity or on palm fronds.

Possible source and pathway into Kiribati

Recent shipping from potential source populations of were as follows (FT's Quarantine records):

Date	Ship	Source	Direct to Betio	Tree sparrows present at source
March	Few fishing vessels	Ocean	No	No
23 March	Southern Pearl	Fiji (Suva)	Yes	No
1 April	Kiribati Chief	Vanuatu	No	No
4 April	Coral Islander	Japan (port?)	Yes	Yes

The most likely source and pathway is from Japan via the Coral Islander container ship which travels directly from Japan to Betio. It is worth checking departure port and departure times as it is possible that night departures are more risky in that night-roosting birds could be on board.

Overview of Eradication Plan

The plan proposes to eradicate the Eurasian Tree Sparrow. To achieve this the numbers and geographic extent of the incursion needs to be determined and techniques refined and contingencies identified (see Operational techniques below). General techniques involve pre-feeding and cage-trapping, with other forms of trapping, shooting and potentially poisoning as contingency measures. This approach is considered as feasible.

Project team

- Team leader (ALD rep ideally FB) who coordinates the eradication operation under Biosecurity Act
- Monitoring coordinator (ECD rep/GT) who coordinates surveys
- Surveyors (KPA, ALD, ECD staff)
- Trappers (ALD staff) who undertake the eradication
- Technical advisors (e.g. RP/SPREP)

Task list (incomplete)

- Team leader – revise eradication plan, assign task lists, oversee operation
- Monitoring coordinator – develop and refine monitoring techniques, e.g. using modified myna observation sheet
- Surveyors – follow monitoring coordinator advice in observing birds
- Trappers – build and test cages, prefeed birds, undertake trapping
- Technical advisors – review international eradication approaches for this species and advise team leader, provide other information as needed.

Operational techniques

- Observe feeding areas of birds
- Prefeed feeding areas with bread, etc. for several days until birds are tame and feeding – adapt bread etc. as the birds' preference for type of bread, grain etc. is identified.

- Build and test elsewhere a large cage trap 500 mm x 500 mm x 200 mm high (possible bigger e.g. 700 x 700) with heavy wire frame. Test that this falls evenly from a propped up position on a peg (i.e. the cage does not bounce on landing enabling escape routes). Fish netting needs to be new (no holes), strong and < 10 mm spacing. Make a small slot in roof that is big enough for a rapid entry point for a hand to catch and extract trapped birds (but while the trap is set there should be 1-2 pegs across the slot to prevent escape by birds).
- Kill birds immediately and preserve in 70% ethanol for subsequent genetic tests.
- May need to manage rock pigeons somehow as they could be attracted to bait and so interfere with trapping.
- Contingency plans - observe roosting sites of sparrows in case supplementary trapping methods or shooting (Police or WCU) or baiting (e.g. talon, avicide, etc.) may be needed as contingency.

Timing

- Start date ASAP to remove birds before any breeding takes place. Monitoring bird's daily routine and behaviour is the key need to implement now.
- different phases of the operation may take only a few days to a week.

Logistics support, e.g. accommodation, food, transport, communications, consents and permits

May need to assign vehicle to eradication team.

Need to notify all affected parties – KPA, Commerce, KOIL, Police, etc. – and seek permission for repeated visits.

Containment and movements

Less applicable to sparrows but an incursion of invasive ants and other invertebrates or plants would require a quarantine containment approach to prevent spread via rubbish, etc.

Biosecurity of operation to prevent any further incursions of current or other IAS

The tree sparrows could fly away from the area and so need to be monitored to determine if this happens. Be aware of pathway to Betio and take steps to block this.

Assessment of Environmental effects, non-target issues and associated mitigation proposed

None anticipated. Rock Pigeon may be a by-catch, but this species is also invasive and spreading weed seeds around parts of Kiribati.

Monitoring – pre-, during and post-operational monitoring of target species and indigenous biota

- Develop data sheet and implement monitoring

Health and safety matters

- Standard MELAD approach.
- If poisoning or shooting are to be used as contingency measures, appropriate precautions would need to be taken

Communications plan to keep affected and wider communities informed, and gather information

- Email contact with stakeholders for strategic plans
- Phone contact for tactical day to day work
- Newspaper and/or radio news to encourage the public to report sightings

Equipment lists documenting all equipment needed and who is responsible for providing each

- Binoculars for monitoring and catching (Leader, ECD)
- Trap materials (ALD)
- Vials and Ethanol (ALD)

Budget and sources of funding, allow contingency component

- Minimal costs for materials, e.g. netting, some transport costs.

10. OPERATIONAL TECHNIQUES AND ADVISORS FOR RAPID RESPONSE

Planning format for other IAS invasions should take a broadly similar approach to that described above for Eurasian Tree Sparrows. Operational techniques and advisers will vary however, and below are some recommended approaches for dealing with incursions of other species of IAS - Norway rat, giant African snail, invasive ants, *Wedelia trilobata*, brown tree snake and mongoose.

10.1 Norway rat

- if sighting/incursion is at Port of Betio use combination of bait stations (and Pestoff wax blocks or 20R), and Victor rat traps baited with peanut butter on peninsula to KOIL, etc.;
- at CXI the trap/bait coverage as above needs to be the entire Peninsula between Ronton and Tabwakea.
- at Kanton the trap/bait coverage as above needs to be the entire Peninsula between the Port and Village.
- maintain traps and bait stations at incursion area above until the animal(s) are caught and maintain bait stations/traps for another month for all clear
- advisors – General advice - Pacific Invasives Initiative www.pacificinvasivesinitiative.org and Department of Conservation (NZ) www.doc.govt.nz
 - for specific advice use specialists familiar with Kiribati scenarios, e.g. Derek Brown (NZ) derek.brown@xtra.co.nz

10.2 Mongoose

- immediately use media to describe animals and appeal to public for sightings

- set all available DOC traps and cage traps baited with meat (fish, chicken, etc.) throughout area including keep some traps ahead of sightings

- advisors include SPREP (Samoa) www.sprep.org and PII (Auckland) www.pacificinvasivesinitiative.org

10.3 Giant African Snail

- confine snails to container or other site

- use spray as per Fiji/Pacific Biosecurity

- advisors – Samoa and Fiji Biosecurity www.baf.com.fj

10.4 Invasive ants

- collect and preserve specimens in ethanol and send specimens or photographs to SPC, Pacific Biosecurity, New Zealand Ministry of Primary Industries Plant Health & Environment Laboratory

- delineate the area of incursion/invasion using lures of protein (e.g. peanut butter or fish) and sugar (e.g. jam) and calculate area with GPS (note that for very small invasion areas it may be possible to eradicate the invasion using boiling water, Permethrin sprays, etc.

- advisors - SPC, Pacific Biosecurity, PII, Flybusters Antiants

10.5 Brown tree snake

- maintain surveillance in wider area using headlamps – use diffuse lighting which is ideal for detecting eye-shine (animals tend to turn away from bright light).

- kill any snake found (autopsy for sex, signs of egg-laying)

- advisors – Guam tree snake eradication programme, Australian herpetologists and zoos.

10.6 *Wedelia* (Singapore daisy)

- delineate area of incursion with GPS or map as best as possible

- for small infestations dig plants out by roots taking care to extract all of the root system and burn on fire

- for large infestations use fires, e.g. burn dead coconut fronds, old fibre etc. over the site to burn plant and rhizomes.

- consider alternative approaches as needed, e.g. in tropical Queensland boiling water and steam has achieved some local eradication after 2-3 applications.

- advisors include SPC www.spc.int , Tokelau Administration (have used fire), potentially also Biosecurity and Agricultural departments in Queensland e.g. <https://www.biosecurity.qld.gov.au/> <https://www.daf.qld.gov.au/plants/weeds-pest-animals-ants> and Steam Weeders (Queensland) steamweeders.com.au/

Example of completed island IAS datasheet

Island: Manra		Date: 18/9/16	
Observers (and affiliation): xyz MELAD, PIO		Time start: 0900 Time finish: 1215	
What specific areas of island? All of it or GPS focus areas or describe, e.g. Entire area for 1.5 km north and 1 km south of landing along both the coastal and lagoon edge (see map)			
Weather: Tick one: fine/light wind ; strong wind ; showers x ; other/give details			
Invasive species:			
Rats or rat sign seen or trapped Y/N	Details: 12 Te Io eggs gnawed by rats; plants gnawed, seabird bones gnawed, photos on file 20160418		
Cats or cat sign seen Y/N	Details: 3 pairs of wings of tanguoua freshly dead, many freshly beheaded te io		
Weeds seen Y/N	Details; uncertain suspicious exotic species at landing GPS details (or mark on a map), photographed, dug out by roots and burnt.		
Ant surveys Y/N	Details: 10 jam and peanut lures operated at camp GPS.....for 10 minutes 0930; small black ants common; few orange ants 3 mm long, collected for ID		
Other IAS seen Y/N	Details: old sign of poaching on Te Taake (3)		
Biota			
Vegetation health looks OK except for rat gnawing on some species; plants noted Te Ni (heavy fruiting), Te Ren, Te Mao, Te Kaura, Ten Tanini (all common) Skinks common. Fresh turtle tracks x2 at sandy beach landing, old diggings x20, no others along transect			
Birds species	Estimated no. in surveyed area	Est. no. pairs/ seen	Main nesting stages – courting, incubating, chicks, old chicks/juveniles
Te Tanguoua	50+	50+	Incubating
Te Taake			
Te Eitei are e bubura			
Te Eitei are e aki rangi ni bubura	50	0	0
Te Mouakena	40	22	15 incubate, 7 with chicks/old chicks
Te Kibwi			
Te Koota			
Te Io	3000+	1000+	Nesting on lagon motu – incubate, downy chicks
Te Mangikiri			
Te Tarangongo			
Te Keeu			
Te Manawa			
Te Raurau			
Others:			
Notes: Provide as much information as possible, take plenty of photos of IAS and their sign and health of biota generally, e.g. Recent sign of landing – discarded drink cans (nationality) Cat sign only on S side of landing – may be too dry to north?			

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Appendix 1 - Example of Island IAS datasheet (draft)

Island:		Date:	
Observers (and affiliation):		Time start: Time finish:	
What specific areas of island were searched? (e.g. All of it or GPS focus areas or describe):			
Weather: Tick one: fine/light wind ; strong wind ; showers ; other/give details			
Invasive species:			
Rats or rat sign seen or trapped Y/N	Details:		
Cats or cat sign seen Y/N	Details:		
Weeds seen Y/N	Details:		
Ant surveys Y/N	Details:		
Other IAS seen Y/N	Details:		
Biota			
Birds species	Estimated no. in surveyed area	Est. no. pairs/ nests seen	Main nesting stages – courting, incubating, chicks, old chicks/juveniles
Te Tanguoua			
Te Taake			
Te eitei are e bubura			
Te eitei are e aki rangi ni bubura			
Te Mouakena			
Te Kibwi			
Te Koota			
Te Io			
Te Mangikiri			
Te Tarangongo			
Te Keeu			
Te Manawa			
Te Raurau			
Others:			
Notes: Provide as much information as possible, take plenty of photos of IAS and their sign and of the health of biota generally.			

Appendix 2 – Multi visit motu data sheet currently used by WCU at Kiritimati (Pierce et al 2013).

Note that this multiple-visit format enables monitoring over time to be more easily tracked, easier for summarising from database, etc.

2.3 Multi-visit Island data sheet						
Lagoon						
Motu						
Area (ha)						
Date						
Time						
Observers						
Kimooa/rat sign						
Cat sign						
Poaching						
Te Ruru						
Tangiuoua						
Te Tinebu						
Te Nna						
Bwebwe ni m						
Te Taake						
Mouakena						
Te Kibwi						
Te Koota						
Te Etei area						
Te Etei rangi						
Te Karakara						
Tarangongo						
Te Keeu						
Te Io						
Te Mangikiri						
Te Raurau						
Te Matawa						
Te Kewe						
Bokikokiko						
Skink						
<p>Key: P = present – not counted, Numbers = pairs (p) or individuals (i), J = juvenile, F = flying overhead; <u>underlined</u> = breeding Observers: Notes:</p>						

Appendix 3 – Some equipment and suppliers for vertebrate surveillance and response

Equipment	Type	Supplier	Website & Email	Telephone
Rat bait for stations	Pestoff Rodent Blocks	Animal Control Products Ltd	www.pestoff.co.nz/home info@pestoff.co.nz	64 6 344 5302
Rat bait for hand spread	Pestoff Rodent Bait 20R	Animal Control Products Ltd	www.pestoff.co.nz/home info@pestoff.co.nz	64 6 344 5302
Rat Bait Stations	Rat café stations	PestOff NZ	info@pestoff.co.nz	64 6 344 5302
	PROTECTA heavy-weight rat bait station with key Code:19RBS05	Pest Management Services Ltd	www.nopests.co.nz sales@keyindustries.co.nz	0800 111 466
Victor Rat traps	VICTOR Professional rat trap Code:19RT20	Pest Management Services Ltd	www.nopests.co.nz sales@keyindustries.co.nz	0800 111 466
Glue boards	Packets of glue boards e.g. code 19RGT14 to fit under tunnels 19RGT15	Pest Management Services Ltd	www.nopests.co.nz sales@keyindustries.co.nz	0800 111 466
Fenn traps	Mark 6	Pest Management Services Ltd	www.nopests.co.nz sales@keyindustries.co.nz	0800 111 466
DOC traps	DOC 150 (rats) DOC 200 (rats and mongeese) DOC 250 (mongeese)		www.predatortraps.com	
Wax tags, chew cards, tracking tunnels and tracking tunnel inserts		Connovation Ltd	www.connovation.co.nz	

Appendix 4 – Rodent measurements and identification (Adapted from Cunningham and Moors 1993; PII Resource Kit)

Character	House mouse	Kimoa (Pacific rat)	Black (ship) rat	Norway rat
Weight (max, g)	25	130	225	450
Head and body length (HBL) max in mm	115	180	225	275
Tail length	About HBL	About HBL	More than HBL	Less than HBL
Tail colour	Uniform grey-brown	Uniform dark	Uniform	Pale below; very thick tail
Ear length	12-15 mm	15.5-20.5 mm. May cover eyes when pulled forward	19-26 mm. Easily cover eyes when pulled forward	14-22 mm. Do not cover eyes when pulled forward
Hind foot length (adult)	15-21	24.5-31	28-38	30-41.5
Colour of upper side of hind foot	Uniform grey	Dark streak	Uniform dark	Uniform pale
Fur on back	Dull grey-brown	Brown	Brown or black	Brown
Fur on belly	Uniform grey	White-tipped grey, giving irregular pattern	Uniform white, grey or black	As for kimoa
Droppings (length mm)	3.9-7.6	6.4-9.0	6.8-13.8	13.4-19.1
Number of nipples	10-12	8	10-12 (usually 10)	12
Some habits	Ground-dwelling, poor swimmer	Climbs well, ground-nester; poor swimmer	Expert climber; nests in trees, shrubs; swims infrequently	Ground-dwelling, digs burrows, expert swimmer

Appendix 5 – List of plants and animals mentioned in the text

Asian rat *Rattus tanezumi*
Black or ship rat *Rattus rattus*
Bulbul *Pycnonotus* sp.
Cane toad *Bufo marinus*
Coconut beetle *Oryctes rhinoceros*
Coconut crab *Birgus latra*
Common myna *Acridotheres tristis*
Crown of thorns starfish *Acanthaster planci*
Eurasian tree sparrow *Passer montanus*
European rabbit *Oryctolagus europaeus*
Feral house cat *Felis catus*
Giant African snail or GAS *Achatina fulica*
Green turtle or On *Chelonia mydas*
Hawksbill turtle or On tabwakea *Eretmochelys imbricata*
House mouse *Mus musculus*
Jungle myna *Acridotheres fuscus*
Lantana *Lantana cantareus*
Little fire ant or LFI *Wasmannia auropunctata*
Long-tailed koel *Eudynamis taitensis*
Mongoose (grey mongoose) *Herpestes auropunctatus*
Mosquitoes e.g. *Aedes aegypti*
Norway rat *Rattus norvegicus*
Pigs or Feral Pig *Sus scrofa*
Red imported fire ant or RIFA *Solenopsis invicta*
Red-vented bulbul *Pycnonotus rufiventris*
Singapore daisy *Wedelia trilobata*
Snakes, e.g. brown tree snake *Boiga irregularis*
Sweet-scent *Pluchea*
Taro beetle *Papuana uniondis*
Te Ango *Premna serratifolia*
Te Aroua *Surinana maritime*
Te Bitin or Pacific pigeon *Ducula pacifica*; also refers to *Columba livia*
Te Boi *Sesuvium portulacastrum*
Te Burukam *Casuarina equisetifolia*
Te Bwebwe Ni Marawa or White-throated storm-petrel *Nesofregatta fuliginosa*
Te Etei or Lesser and Great Frigatebirds *Fregatta ariel* and *F. minor*
Te Itai *Calophyllum inophyllum*
Te Kaina *Pandanus tectorius*
Te Kanawa *Cordia subcordata*
Te Kaura *Sida fallax*
Te Kewe or bristle-thighed curlew *Numenius tahitiensis*
Te Kibwi or Brown Booby *Sula leucogaster*
Te Kimoa or Pacific rat *Rattus exulans*
Te Kinongo or Yellow crazy ant *Anaplolepis gracilipes*
Te Kura or Rimatara Lorikeet *Vini kuhlii*
Te Mao *Scaevola taccada*
Te Maukinikin or puncture vine *Tribulus cistoides*
Te Ntenenei *Cassytha filiformis*
Te Ni *Cocos nucifera*
Te Noni *Morinda citrifolia*

Te Raurau or blue noddy *Procelsterna cerulea*
Te Ren or heliotrope *Tournefortia argentea*
Te Ruku *Ipomoea littoralis*
Te Ruru or Phoenix petrel *Pterodroma alba*
Te Taake or Red-tailed tropicbird *Phaethon rubricauda*
Te Tarangongo or Grey-backed Tern *Sterna lunata*
Te Uri *Guaetarda speciosa*
Te Utuete *Lepturus repens*
Te Wao *Boerhavia* spp.
Tilapia *Oreochromis mossambicus*