



BATTLING INVASIVE SPECIES IN THE PACIFIC

OUTCOMES OF THE REGIONAL GEF-PAS IAS PROJECT

PREVENTION, CONTROL AND MANAGEMENT OF
INVASIVE ALIEN SPECIES IN THE PACIFIC ISLANDS
2011–2016





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Secretariat of the Pacific Regional Environment Programme (SPREP)

PO Box 240
Apia, Samoa
sprep@sprep.org

www.sprep.org

Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures

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CONTENTS

KEY TERMS, CONCEPTS AND ACRONYMS	4
FOREWORD	5

THE GEF-PAS IAS PROJECT	7
GEF-PAS IAS PARTICIPATING COUNTRIES	7
VISION: A FUTURE WITHOUT INVASIVE SPECIES	8

INVASIVE SPECIES IN THE PACIFIC	9
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A PACIFIC RESPONSE TO INVASIVE SPECIES	12
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FOUNDATIONS	14
Generating support <small>OUTCOME 1.1.</small>	14
Building capacity <small>OUTCOME 1.2.</small>	16
Legislation, policy and protocols <small>OUTCOME 1.3.</small>	18

PROBLEM DEFINITION, PRIORITISATION AND DECISION-MAKING	20
Baseline and monitoring <small>OUTCOME 2.1.</small>	21
Prioritisation <small>OUTCOME 2.2.</small>	22
Research on priorities <small>OUTCOME 2.3.</small>	23

MANAGEMENT ACTION	25
Biosecurity <small>OUTCOME 3.1.</small>	25
Management of established invasives <small>OUTCOME 3.2.</small>	26
Restoration <small>OUTCOME 3.3.</small>	31

LESSONS LEARNED	33
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STEPPING UP THE FIGHT	35
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PROJECT ACKNOWLEDGEMENTS	38
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Pacific islands intimately connect land and sea.

Rats, cats, and other invasive species quickly destroy these links, particularly by preying on native forest seeds, forest birds, sea birds, and other vital ecosystem components. Effective management of invasive species is key to protect terrestrial and marine systems, supporting their function and increasing their resilience to change.



KEY TERMS, CONCEPTS AND ACRONYMS

Most of the terms, concepts, and acronyms used in this document are defined at first mention in the text. The following occur frequently and are defined here for ease of reference. Terminology for invasive species has not been standardised internationally, and some of the terms below are defined in the specific context of the Pacific islands.

biocontrol or biological control: Controlling an invasive species by introducing a natural enemy, such as an insect or fungus, that specifically attacks the target species and does not attack other native or economically important species.

biosecurity: Sometimes used to include all aspects of invasive species management, but in this document used in the more restricted sense of preventing the spread of invasive species across international or internal borders, including between islands.

containment: Keeping an invasive species within a defined area.

control: Reducing the population of an invasive species.

effective management: Achieving operational success (e.g. reducing the pest to defined levels) and desired outcomes (reduced impact and recovery of impacted values) of invasive species management.

introduced species: Plants, animals and other organisms taken beyond their natural range by people, deliberately or unintentionally.

invasive species: Introduced species that become destructive to the environment or human interests; can also include some native species that proliferate and become destructive following environmental changes caused by human activities.

monitoring: Programmes to detect change, e.g. in the distribution of invasive species, the success of management projects etc.

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

region: When not otherwise qualified, means the Pacific Ocean, with specific reference to the island states and territories that are members of SPC and SPREP

surveillance: In this document, defined as monitoring to detect the arrival of new incursions of invasive species.

Acronyms

GISD: Global Invasive Species Database

NBSAP: National or Territorial Biodiversity Strategy and Action Plan

NISSAP: National or Territorial Invasive Species Strategy and Action Plan

PIER: Pacific Island Ecosystems at Risk (www.hear.org/pier)

PILN: Pacific Invasives Learning Network

SPC: Pacific Community: www.spc.int

SPREP: Secretariat of the Pacific Regional Environment Programme: www.sprep.org

FOREWORD

We are a diverse group of people in the Pacific region, which spans a third of the earth's surface and encompasses about half of the global sea surface. We have ~2,000 different languages and ~30,000 islands.

Pacific ecosystems are one of the world's biodiversity hotspots, with a large number of species found only in the Pacific and nowhere else. There are 2,189 single-country endemic species recorded to date. Of these species, 5.8 per cent are already extinct or exist only in captivity. A further 45 per cent are at risk of extinction. We face some of the highest extinction rates in the world.



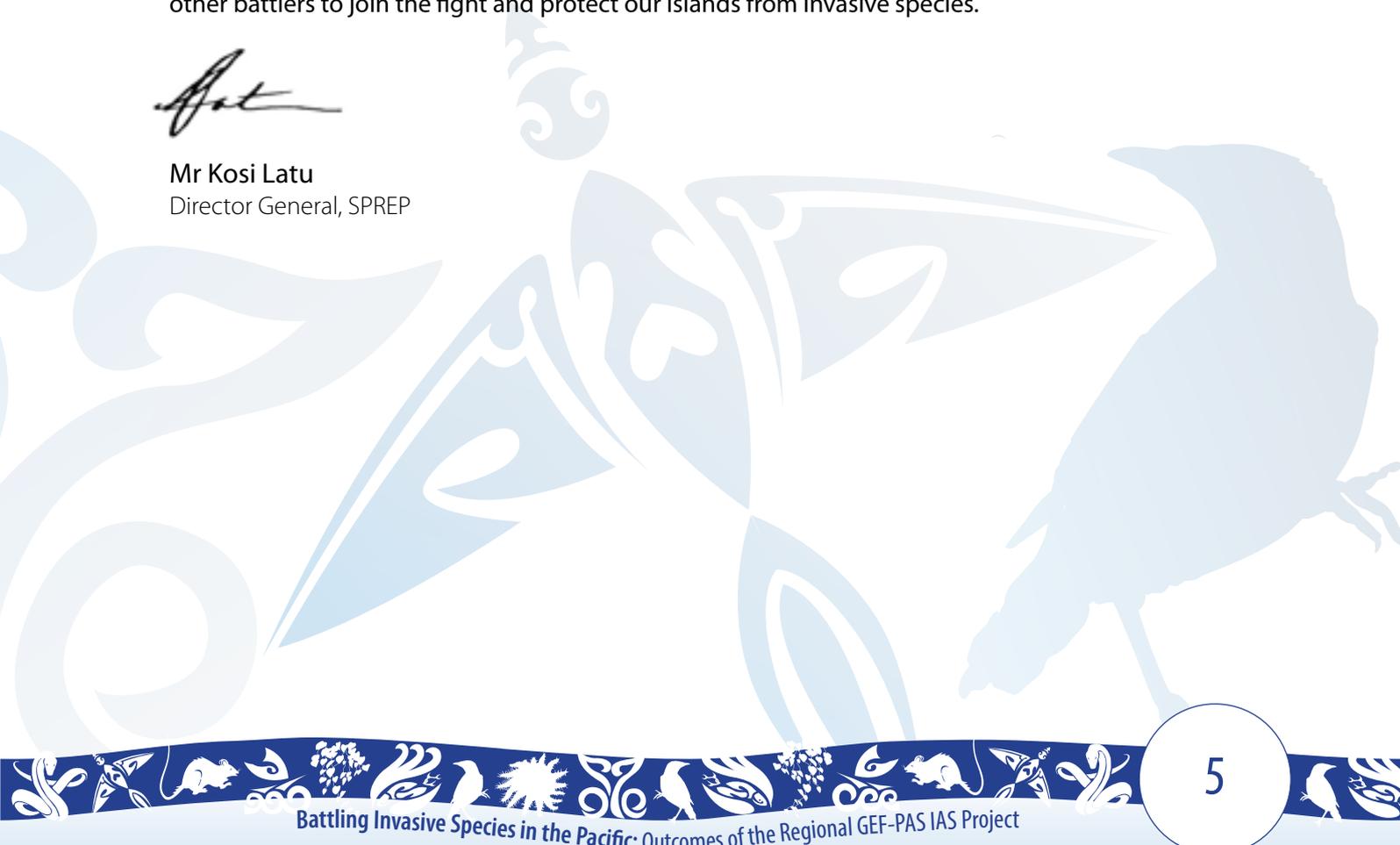
The largest cause of extinction of single-country endemic species in the Pacific is the impact of invasive species. Invasives also severely impact our economies, ability to trade, sustainable development, health, ecosystem services, and the resilience of our ecosystems to respond to natural disasters.

Fortunately, we can do something about it.

Even in our diverse region, we share many things in common. We are island people, we are self-reliant, and we rely heavily on our environment to support our livelihoods. We also share many common invasive species issues as we are ultimately connected. Sharing what we learn regionally benefits us and our families economically, culturally, and in our daily lives.

This publication is a snapshot of how Pacific Invasive Species Battlers are protecting their islands with the assistance of the Global Environment Facility's Pacific Alliance for Sustainability (GEF-PAS) project "Prevention, control and management of invasive alien species in the Pacific". The project, one of the largest investments in invasive species management in Pacific history, has raised the benchmark of invasive species management in the Pacific and enhanced the regional mechanisms that are the envy of other oceanic regions. We hope the people within this story inspire and assist other battlers to join the fight and protect our islands from invasive species.

Mr Kosi Latu
Director General, SPREP





P. Skelton, SPREP



L. McPake

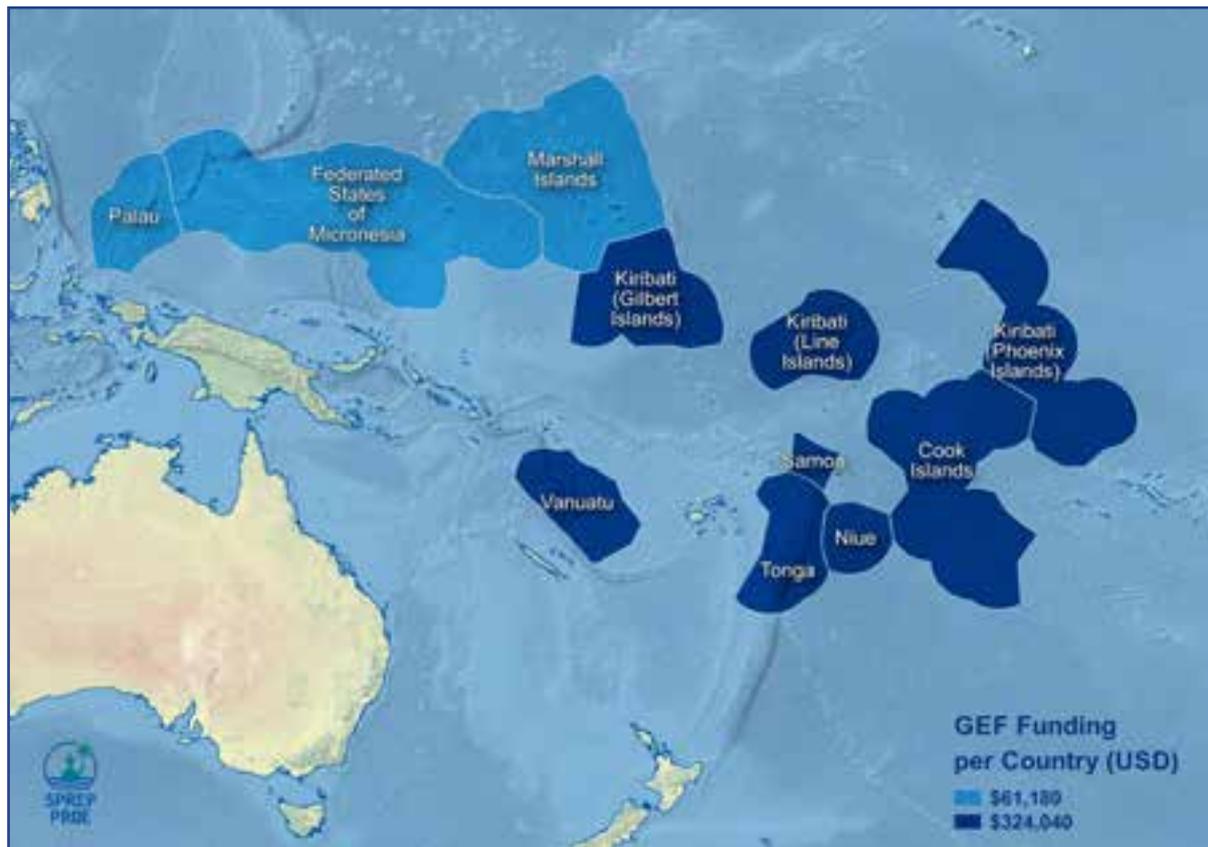


P. Skelton, SPREP

THE GEF-PAS IAS PROJECT

Prevention, control and management of Invasive Alien Species in the Pacific Islands (IAS project) was implemented by the United Nations Environment Programme (UNEP) and executed by SPREP and national partner agencies from 2011 to 2016. The IAS project goal was to 'conserve ecosystems, species and genetic diversity in the Pacific Region.'

The IAS project structure followed the 'Guidelines for Invasive Species Management in the Pacific' with three major components: (i) Foundations; (ii) Problem Definition, Prioritisation and Decision-making; and (iii) Management Action.



VISION: A FUTURE WITHOUT INVASIVE SPECIES

Islands without invasives have greater populations of native species and more complete terrestrial and marine assemblages, including critically endangered species, such as hawksbill and green sea turtles, which are preyed on by rats. Linkage is restored of land and sea systems through birds and forest relationships (e.g. sea birds crossing land/sea boundaries).

Larger bird populations and healthy forests boost marine ecosystems through healthy nutrient transport, avoiding erosion and siltation, increasing economically valued species such as fish and manta rays. Healthier ecosystems are more resilient to the effects of climate change.

Livelihoods will not be threatened by direct and indirect competition with invasive species once those species have been successfully managed, and the costs of invasive species prevention are lower than the costs of reaction to damage caused by invasive species. Pacific islands without invasives are stronger, more resilient, and better equipped to address their development plans.



INVASIVE SPECIES IN THE PACIFIC

Small Island Developing States of the Pacific region are highly vulnerable to the impacts of invasive species. Sustainable Pacific livelihoods depend upon limited resources, but island biodiversity is rapidly being altered or lost. Biodiversity loss is not simply an environmental issue but also affects human livelihoods and national economies.

Pacific ecosystems make up one of the world's biodiversity hotspots, with a large number of species found only in the Pacific and nowhere else. In fact, there are 2,189 single-country endemic species recorded to date. Of these species, 5.8 per cent are already extinct or exist only in captivity. A further 45 per cent are at risk of extinction. The Pacific faces some of the highest extinction rates in the world.

The largest cause of extinction of single-country endemic species in the Pacific is the impact of invasive species. The 2013 State of Conservation in Oceania assessment showed that invasive species are the most important driver of species loss in the region and contribute directly to the loss of ecosystem function and loss of resilience to respond to climate change threats.

Invasive species also severely impact Pacific economies, ability to trade, sustainable development, health, ecosystem services, and the resilience of ecosystems to respond to natural disasters. The effects of invasive species cross land and sea boundaries: For example, disrupted island forests with invasive species have altered (often smaller) bird populations, altering the surrounding marine environment (McCauley et al. 2012).

The status of the invasive species issue in the Pacific is "poor" according to the report on the State of Conservation in Oceania (2013).

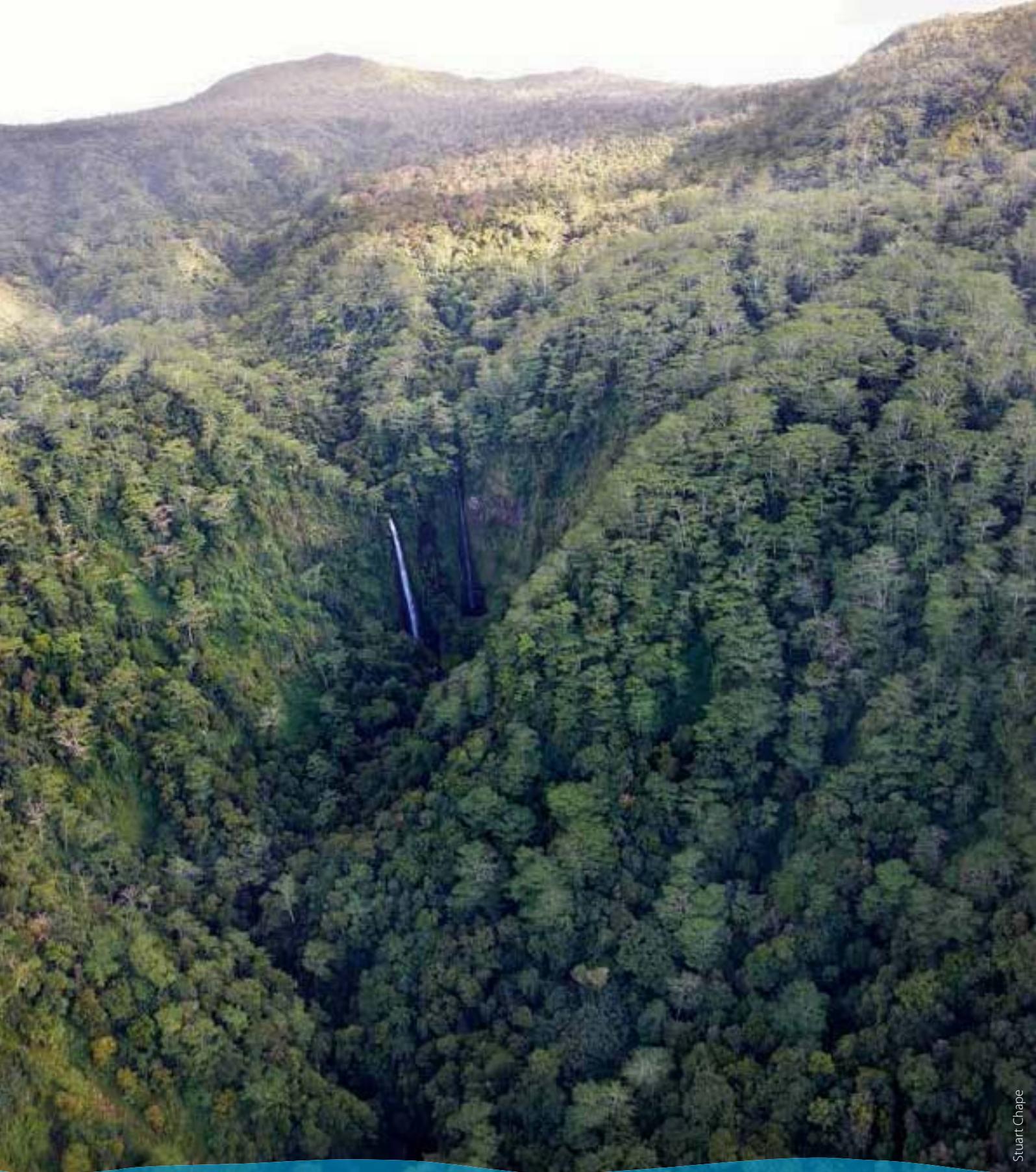
Invasive species are an economic problem. Pacific communities depend on transport and trade, and the management of invasives is a necessary cost of such movement between islands and nations. Increased trade and transport introduce non-native species to the Pacific islands in greater numbers than ever before, resulting not only in severe ecological impacts but also in economic impacts on production, tourism, and trade. The spread of plant, vertebrate, and invertebrate invasive species and diseases costs the region millions of dollars in economic impacts annually and threaten biodiversity and livelihoods. The threat is worsened by the limited human, material, and financial resources available to small island states to prevent and manage invasive species.



D. Moverley, SPREP



C. Vanderwoude



To many people, this scene looks like beautiful natural habitat, rich in biodiversity and providing vital ecosystem services. The canopy is in fact dominated by invasive, shallow-rooted Tamaligi trees. In December 2012, Cyclone Evan toppled a massive number of these and other invasive trees throughout catchments in Samoa, resulting in flooding and the destruction of essential infrastructure such as bridges, water supplies and villages.

For the brave invasive species battlers who choose the path of protecting their islands, the beauty enjoyed by others is often foregone for the realisation that their valued landscapes are under threat. Informed action will save the real beauty of native habitat before it is forgotten entirely.

In 2015, the Nature Conservancy project 'The impacts of Invasive Species' estimated the global annual costs of impacts and control efforts associated with invasive species to equal five per cent of the world's economy. Note that these values are only part of the true costs of invasive species.

After Cyclone Evan (2012) in Samoa, the bulk of the fallen trees that caused flooding and damaged infrastructure were invasive Tamaligi (*Albizia chinensis*), now abundant in Samoan forests. See image opposite.

Invasive species are a climate change problem. Community resilience to climate change depends on diversity of options. Disrupted islands with low diversity lose their capacity for recovery. Disrupted forests are more prone to storm damage and lose capacity to serve as carbon sinks. Local, sustainable food security and environmental resilience depend on genetic and functional diversity of species and environments. The removal or effective management of invasives boosts the diversity and population numbers of other species and restores interactions that drove the evolution of those species in their unique context. Healthy communities and ecosystems are more resilient.

Invasive species are a conservation problem. Invasive species pose great threats to native species in the Pacific and are responsible for the extinction of more native species than any other cause (Kraus and Duffy 2010). Eradication or effective management of invasives has significant effects: for example, rat removal has doubled the population of a reptile species, removed 20% of turtle predation, and increased bird breeding success from 0–5% to ≥85% (Harper & Bunbury 2015). Many endemic, at-risk, or endangered species, some serving as species reservoirs for other threatened populations, would benefit from invasive species management.

Invasive species management is a sustainable development solution. National management plans that address the threats of invasive species strengthen capacity for sustainable development, and preventing and managing invasive species is cheaper than the devastation caused by established invasives. Critical habitats would be supported and restored through invasive species eradication or effective management, with flow-on effects on birds, plants, reptiles, insects, crustaceans, and more. Invasive species directly lower biodiversity and lead to species extinctions; their removal alters physical and genetic population structure (Harper & Bunbury 2015). Ecotourism and agriculture will be boosted by healthy island ecosystems.

From 1992 to 1993, the invasive disease taro leaf blight destroyed Samoa's USD ~4 million export business and led to the loss of about 40 traditional cultivars.

Small Pacific communities, who depend on traditional and modern fishing, hunting, and agriculture, rely on healthy ecosystems for sustainable livelihoods. People and invasives compete directly for some food sources. Invasive species management helps Pacific people engage with their ecosystems on their own terms.

Invasive species management helps meet country commitments. Broad-ranging negative impacts of invasive species on biodiversity—and demonstrated substantial recovery following eradication or effective management of invasives—align invasive species management with the goals of the Convention on Biological Diversity. Invasive species management directly addresses Aichi Target 9 but also Targets 1, 5, 7, 8, 11, 12, 15, 19 and 20 and supports progress toward paragraph 95 of the SAMOA Pathway (3rd United Nations World Conference of Small Island Developing States 2014 Outcome document).

Increasing island resilience, a product of invasive species management, supports national contributions to the UNFCCC ecosystem resilience-building goals as well as commitments to action against climate change as part of the regional level Pacific Islands Framework for Action on Climate Change (PIFACC).

In this context, a project was designed to begin work targeting broad, multi-nation outcomes.

A PACIFIC RESPONSE TO INVASIVE SPECIES

Invasive species management programmes with related national management plans supported by increased local capacity will help Pacific people engage with their ecosystems using locally relevant best practices.

Local staff equipped with appropriate tools and skills are needed for invasive species management, stakeholder engagement, and consultative decision-making. An ideal future scenario for invasive species management will include ecosystem-based adaptation at island and nation scales, involve local communities, build capacity, use a multi-partner approach, and communicate successful strategies and tools.

Key regional resources support this effort:

The “**Guidelines for Invasive Species Management in the Pacific: A Pacific Strategy for managing pests, weeds and other invasive species**” provide a comprehensive framework for the region and at the national level, endorsed in 2009 by both SPREP and SPC members. This framework is used throughout the Pacific for structuring the Action Plans within National or Territorial Invasive Species Strategies and Action Plans (NISSAP or TISSAP). The Guidelines provide a means of measuring national, territorial, and regional progress and success. The Guidelines were used to structure the IAS project and are used here to present the efforts throughout the project region.



The Guidelines were implemented to achieve the objective of reducing the environmental, economic, and human health impacts of invasive species in both terrestrial and marine habitats in the Pacific region. The classification of invasive species management themes within the Guidelines allows current and future invasive species management activity and success to be measured both nationally and regionally.



Pacific Invasive Species Guidelines Reporting Database:

A database of national, territorial and regional progress in implementing the “Guidelines”, with indicators on priority invasive species initiatives.

Pacific Invasive Partnership: SPREP coordinates this umbrella group of invasive species experts focused on coordinating invasive species assistance in the Pacific. The PIP aims to build cooperation among Pacific experts who provide assistance to Pacific countries and territories.
www.sprep.org/Pacific-Invasives-Partnership/invasive-partnerships

Pacific Invasives Learning Network: SPREP coordinates this peer network of cross-sectoral invasive species practitioners in the Pacific. The PILN aims to build cooperation between Pacific countries and territories on invasive species issues. There are PILN teams in all but three Pacific countries and territories. www.sprep.org/piln



Regional Invasive Species Battler Resource Base:

A searchable resource base providing the latest information on invasive species issues, case studies, and introductory guides on common invasive species issues. Designed to increase capacity of Pacific countries and territories in an effective and efficient manner. www.sprep.org/piln/resource-base

The regional **Pacific Invasive Species Battler series** launched in 2016 with nine booklets to date focused on common invasive species issues, based on Pacific examples and serving the Pacific region.



FOUNDATIONS

Solid foundations are essential for long-term sustainability and political support, by all stakeholders and the community. Generating support may require addressing cultural barriers to change, raising awareness of the impacts of invasive species, and assuring the community that actions to be taken are safe and beneficial. To reinforce this support through positive outcomes, capacity to manage invasive species must be developed along with effective legislation, policies, and procedures to underpin invasive species management.

THEME Generating support

PROJECT OUTCOME 1.1.

The impacts of invasive species on biodiversity, economies, livelihoods and health are widely understood, and actions to manage and reduce them are supported.

A royal visit to Toloa Rainforest by His Majesty King Tupo VI and Her Majesty Queen Nanasipau'u raised the profile of invasive species management in Tonga. School scholarships were also presented by Her Majesty Queen Nanasipau'u to the top three Tupou College forest restoration team members at a National School prize-giving.

Awareness of invasive species is important to create or support actions. For countries to take control of their responses to invasives, the first steps were to develop awareness in communities (local to national, and across a range of social roles), to mainstream invasives issues, to create or access long-term external funding mechanisms, and to generally increase the support for invasive species issues.

Engaging posters were made by teams in Palau, Vanuatu, and the Cook Islands to communicate which species were invasive, what they affected, and boost the idea that individuals can take action. Outreach is a vital component of battling invasive species because an educated, engaged community produces fast, effective action.



V. Hakaumotu



C. Iacovino, SPREP

Traditional methods of raising awareness, such as school visits, were supplemented by the use of social media, including SPREP's [Pacific Environment Information Network](#). Social media is commonly used in the islands due to quick loading time and widespread access compared to traditional media. Facebook posts by the Niue invasives management team in collaboration with Coconut Wireless have reached 2 million views, many times the population of Niue (1,190).

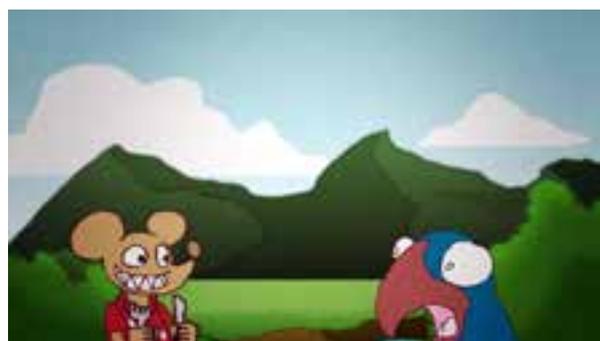
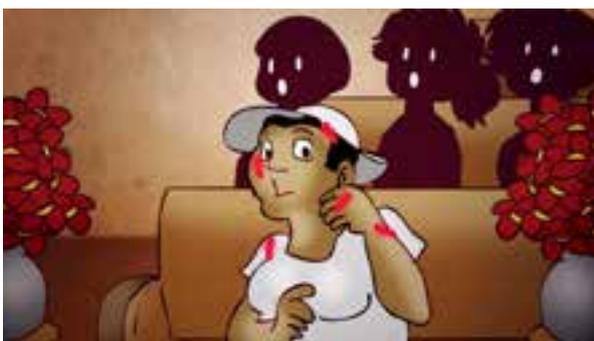
The 'Stop the Little Fire Ant' campaign was used for school challenges in Samoa, with 17 schools actively involved. The campaign includes a cartoon animation, audio files, and factsheets. All the materials are collected on the SPREP website and can be used freely for school, community, or project activities. A regional school challenge is also underway, ending in November 2016.



Airai Elementary School, Palau. Joel Miles, NISC, Bureau of Agriculture, Palau.



Chanel College, Moamoa, Samoa



A. Rollis, SPREP



The institutions, skills, infrastructure, technical support, information management, networks and exchanges required to manage invasive species effectively are developed.

The maintenance of indigenous rights and tradition relies on sustainable environmental management, with local participation in decision-making as well as action. Participation of local communities and partners is necessary for sustainable invasive species management.

Particularly given the strong customary land ownership in the Pacific, on-site management requires whole-of-community engagement, and the strong community ties in the Pacific are a strength for invasive species early detection and rapid response. Local people with site knowledge and experience were integral to project implementation and benefited from learning new field techniques and scientific approaches, enhancing regional capacity. Direct engagement with field action makes local communities more likely to maintain site management, value their environment, and support or generate future conservation.

Biosecurity training was provided in Kiribati, and a multi-country workshop was held in Samoa to support the prevention of invasive species movements between islands.

Training to detect and manage little fire ants was conducted in Vanuatu.

A workshop on eradicating rodents from small islands was held in 2015, with participants from Kiribati, RMI, Tonga, and Wallis et Futuna practicing the eradication techniques on Malinoa and Motutapu islands in Tonga. The removal of the rats has already boosted bird populations, such as the fuleheu or wattled honey eater (*Foulehaio carunculata*) and misi or Polynesian starlings (*Aplonis tabuensis*). Black-naped terns (*Sterna sumatrana*) were nesting and had eggs on the beaches of both islands.

D. Moverley, SPREP

A study tour of ecological restoration sites in the Auckland region of New Zealand was held in 2015, with participants from American Samoa, Niue, Samoa, and Tonga. Honest talks with the people who carried out the restoration work provided motivation and proof that restoration can be done.

Practical solutions are just as important as information. An agrichemical store and safe storage system was built for Niue's invasive species management team. The storage facility was built to New Zealand standards, with staff equipped to handle the hazardous materials safely as they target priority weeds according to best practices. Agrichemicals used for weed control have been specifically selected for safety to people and the environment and stored, managed and used in compliance with the New Zealand Standard for Agrichemical Management.

The fourth Pacific Invasives Learning Network (PILN) meeting brought Pacific practitioners together. The majority of participants said that the most valuable part of the workshop was the connection with peers, for example, "sharing what other countries are doing about their invasive species and learning the different methods used" and "peer learning and exchange of experience".

PILN is designed to facilitate peer learning and rapid information sharing throughout the Pacific region.

Experts shared new tools, such as the Pacific Invasive Ant Toolkit, as well as a summary of regional information on available and effective weed biological control agents for the Pacific and key information for estimating costs of invasive species eradications.

Participants valued time to share their efforts with other countries and learn or gain ideas from the actions elsewhere.

The gathering was also used as a chance to collect samples from the region to further scientific research on invasive species.



A. Bertram, SPREP



T. Straza, SPREP



P. Skelton, SPREP



J. Miles



T. Straza, SPREP



A. Bertram, SPREP



T. Straza, SPREP



T. Straza, SPREP





Appropriate legislation, policies, protocols and procedures are in place and operating, to underpin the effective management of invasive species.

National Invasive Species Strategies and Action Plans (NISSAP) were created for seven countries and reviewed for one; several are still awaiting endorsement by national governments. NISSAP were created through substantial stakeholder consultations ensuring future buy-in and increased awareness of the national issues across a broad cross-sectoral base. Each includes an Action Plan based on the "Guidelines", providing an opportunity to measure and analyse between countries consistently. There was a clear need for separate action plans for the different states of the Federated States of Micronesia and also for national level biosecurity to allow for differing jurisdictional priorities and groups of stakeholders. The NISSAP for Kiribati has an action plan for each island chain, reflecting their isolation from each other. NISSAP support the National Biodiversity Strategy and Action Plan (NBSAP) and help incorporate invasive species issues into national legislation and community action.



D. Moverley, SPREP



SPREP

Biosecurity bills were reviewed for three countries: Niue, Tonga, and Vanuatu. Niue now arguably has the best example of a harmonised biosecurity bill in the Pacific that incorporates environmental concerns along with traditional concerns that affect agriculture and trade. Environment agencies are often reliant on other mandated agencies to complete the final stage of approval by the government. This may mean that there are delays following the revision of legislation before it enters into law.



PROBLEM DEFINITION, PRIORITISATION AND DECISION-MAKING

The Pacific region is under-resourced regarding research capability and invasive species, biodiversity, and ecosystem data. The limited resources available for invasive species management demands that achievable goals are prioritised based on research and available data and that priorities meet the expectations of all stakeholders. Further, as Parties to international environmental agreements such as the Convention on Biodiversity, the region needs to show progress and success in meeting their obligations under these agreements.



Stuart Chape

Systems are in place to generate baseline information on the status and distribution of invasive species and to detect changes, including range changes and emerging impacts.

Baseline surveys are important to determine which invasive species are present within a pre-determined area, such as a country, island, or site, and the extent to which they are evident.

Desktop reviews were completed for the Federated States of Micronesia, Kiribati, Marshall Islands, Niue, Tonga, and Vanuatu. These reviews provide an inventory of invasive species recorded within a country, invasive species recorded in countries connected by airlines and shipping to provide a biosecurity watch-list, biodiversity that may be threatened, protected and valued sites, and other information relevant to making decisions on priority invasive species actions by stakeholders. Local information was added to the baseline studies through stakeholder consultations and workshops to create a true picture of invasive species, their threats, and management within the country reflected in the NISSAP.



M. Sotoa, Samoa MNRE

Efforts were directed to establishing a baseline of information on the status and distribution of invasive species and a programme for detecting change, including range changes and emerging impacts. SPREP has developed and installed a Pacific Region Weed Led Management Database System in both Niue and Samoa. This system is available now for other Pacific countries and territories. The system is designed to simply store, retrieve, and analyse spatial data relating to priority weed species and their location for which eradication is the objective, including their control at individual site level, control methods, and quantitative measures of management success. Each database system has a nationally customised user interface and relevant images to improve data integrity, while the back-end architecture is consistent, allowing future regional analysis to determine management lessons learnt per species and compare different methods and their success throughout the Pacific. The success indicators also provide justification in meeting multinational environmental agreements and will help to assess progress in the implementation of NISSAPs.

Surveys to create baselines of biodiversity values or to assess the feasibility of specific management actions were completed at sites including invasive species surveys for Huvalu Conservation Area in Niue, Malden Island in Kiribati (in the Line Islands), the Toloa Rainforest and Mount Talau in Tonga, and lagoons in Samoa to determine the distribution of invasive seaweeds and crown of thorns sea stars. Myna bird populations were surveyed in Samoa, and little fire ants were surveyed in Vanuatu. This project also supported other regional efforts such as the invasive species components of the Vava’u Rapid Biological Assessment in Tonga executed primarily by the GEF-PAS Integrated Island Biodiversity project.



P. Skelton, SPREP

Fieldwork can be tough, time-consuming work, with great efforts made by staff and communities to gain direct new information on the ground, to ground-truth or supplement the desktop reviews.



Effective systems are established and implemented to assess risk and prioritise invasive species for management.

Weed risk assessments can be costly and time-consuming, and vital information for assessments such as seed viability may not be known. Given the limited resources available to Pacific island countries and territories and the existence of almost 2,000 species with existing weed risk assessments for the Pacific, the most effective first step is to ensure that existing weed risk assessments are being used. This was a focus of the project and resulted in the Battler series publication “Find answers online to common invasive species questions”.

Weed risk assessments contribute to prioritisation of target species, areas, and activities in combination with stakeholder consultation and local knowledge during NISSAP formulation.



D. Moverley, SPREP



P. Skelton, SPREP

Research is completed for priority invasives, including species biology and impacts, and development of effective control techniques.

Within the project, some countries conducted their first research on invasive species. The knowledge and skills gained will enable continued research, necessary because the problem of invasive species is never finished. New invasives coming along new pathways are a present and future threat as regional and international travel and shipping increase.

Myna bird populations were studied in Samoa to determine the distribution and population. These values were used along with characteristics of the species and existing records of past control measures to develop a feasibility plan for controlling the bird populations and identifying where further research may be needed.

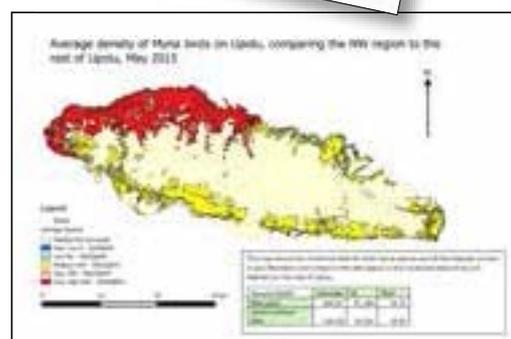
A list of native and beneficial plants for host-range testing was agreed upon with local experts in Vanuatu to ensure a biological control agent that targets African tulip tree (*Spathodea campanulata*) would only specifically affect the target species. This resulted in the native species *Dolichandrone spathacea* being obtained and shipped to South Africa for inclusion in the host-range testing of candidate agents being conducted.

Host-range testing of one candidate biological control agent (an eriophyid mite cf. *Colomerus spathodeae*) has been completed, and an environmental impact assessment that will allow formal permission to release the agent in Vanuatu is being prepared. Host-range testing of a second candidate agent, a flea-beetle *Paradibolia coerulea*, is progressing well.

Pig management trials were completed in Niue including the use of lured enclosure traps, professional hunting, a newly developed toxin (encapsulated sodium nitrite [ESN]), and snares. The most effective options were professional hunting and possibly the ESN toxin after further familiarisation to the local community. The enclosure traps were limited by the current telecommunications ability in Niue required to remotely close the trap doors as well as the behaviour of the Niuean pigs, which tend to roam individually rather than as family groups, meaning that it is likely possible to catch one pig at a time rather than a whole family unit. The snares were determined to be inhumane not only for the pigs but also dogs and other animals that could get trapped in the snare for some time before they were either killed or released.

Control methods were also trialled for taro vine (*Epipremnum aureum*) in Niue. This climbing plant grows up to 20 meters tall and covers from the forest floor to the canopy within a significant area of North and South Alofi. Isolated infestations where it has been spread as an ornamental plant and by cyclone events also occur throughout Niue. A suitable method was developed for isolated infestations and areas that are prone to distribution by cyclonic winds. Small taro vine parts are easily distributed by cyclonic winds around the island where they can easily take root with already established aerial roots.

The State of Conservation in Oceania (2013) reported the numbers of known introduced and invasive species in broad system types. However, marine and aquatic systems are understudied and poorly monitored, so these values are likely underestimates.





Stuart Chape



MANAGEMENT ACTION

Despite success in the previous thematic areas, until management action takes place on the ground, the invasive species problem just keep growing. Species go extinct, ecosystems continue to collapse, and ecosystem services, livelihoods and sustainable development continue to degrade, simultaneously through the whole region. Management action is the most crucial step: tangible actions are needed to achieve results.

THEME Biosecurity

PROJECT OUTCOME 3.1.

Mechanisms are established to prevent the spread of invasive species across international or internal borders and quickly detect and respond to those that arrive.

A key action for environmental protection is to prevent the spread of invasive species across international or internal borders. The four main stages are pre-export control, pre-border control, at-border control, and post-border rapid response.

Niue created a harmonised Biosecurity Bill which allows environmental concerns to be addressed along with the traditional agriculture and trade concerns.

Early detection and rapid response (EDRR) plans have been created for the Cook Islands, Kiribati, and Samoa. The plans detail the staff and funding requirements, identify best practices regarding known target species, and convey decisions made about the country's approach to the known and potential invasive species. Simulation exercises were completed to identify gaps before a response becomes necessary.

The Battler series booklet "Catch it early: Invasive Species Early Detection and Rapid Response" outlines the components of effective invasive species response systems.

The creation of response plans, training of staff, and procurement of equipment needs to be supported by ongoing engagement, regular refresher simulation exercises, and greater public awareness to maintain fast responses to incursions. The accidental introduction of six mongooses to Tonga in 2016 demonstrated the need for rapid, planned response action.



D. Moverley, SPREP



D. Moverley, SPREP



V. Hakaumotu

The impacts of established invasive species are reduced or eliminated by eradication, biological control, containment or physical-chemical control.

Eradication

The rate of vertebrate eradications has increased approximately 43% over the past 5 years in the Pacific. Between 2011 and 2014, 41 eradications have been successful on 5 animal species in 12 Pacific island countries and territories. Plant eradications require a longer commitment, particularly those with long-lived seeds.

Rat predation is a primary driver of bird extinctions in the Pacific. Eradicating rats and other vertebrate pests has huge positive environmental effects on a landscape and local communities, including the restoration of ecosystem services and adaptation to climate change. Following positive outcomes during the rat eradication on small islands workshop on Malinoa and Motutapu islands in the southern Tonga group, two further islands, Fangasito and Luahaipo in the Vava'u island group, were targeted for rat eradication. Building capacity within country teams for small island eradications complements larger eradication projects that require more technical assistance and financing.

Kiribati is celebrating the successful eradication of myna birds in Betio. The two species of myna that were in Kiribati, the common myna (*Acridotheres tristis*) and the jungle myna (*A. fuscus*), are two of the world's most destructive invasive species because they carry diseases and parasites, compete with native birds for food and nest sites, and damage food crops such as breadfruit and papaya. The work to eradicate these species began in 2014 with a pre-eradication survey and development of an operational plan prior to the eradication itself.

Unlike eradicating animals, eradicating weeds can take considerable on-going management as the sites need to be systematically controlled following the germination of seeds waiting dormant in the seed bank but before they mature and set further seed. If this process can be maintained for as long as the seeds of the plant are viable, then eradication is possible.

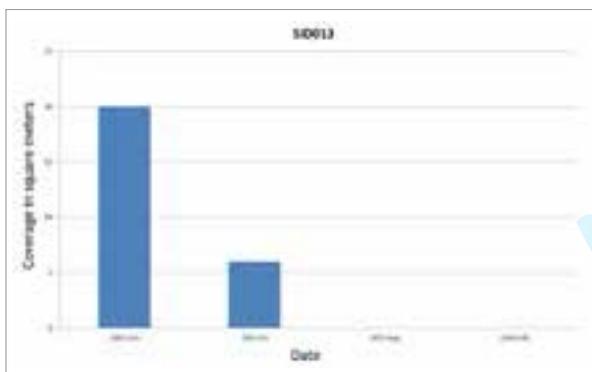
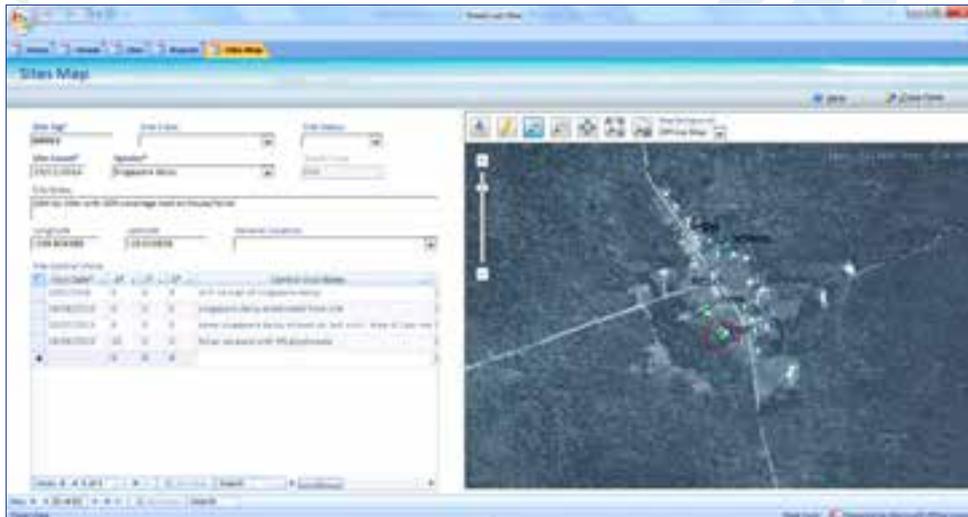


Keith Marshall takes aim at a myna beside the Betio landfill, Kiribati. D. Butler; Ministry of Environment, Lands, and Agricultural Development, Government of Kiribati.



Senituli Finau prepares rat bait stations. D. Moverley, SPREP

Eradication is the objective for three weed species in Niue, one in the Cook Islands, and three in the Marshall Islands. The three weeds targeted for eradication in Niue are chain of hearts (*Antigonon leptopus*), Singapore daisy (*Wedelia trilobata*), and bronze-leaved Clerodendrum (*Clerodendrum quadriloculare*). This programme now includes many best practices for controlling each species, including agrichemical and equipment selection for the most effective result and adherence to a lowest toxicity principle; implementation of the NZ Standard NZS:8409 "Management of Agrichemicals" including storage, use, and disposal; and adoption of the Pacific Priority Weed Management System Geo-Database, which stores, analyses, and reports geographically referenced information of each site and its management activities, including the success of control operations.



Analysis of a successfully eradicated Singapore daisy site from the Priority Weed Management System.

In the Cook Islands, ongoing control of red passionfruit vine (*Passiflora rubra*) on Mauke Island has eliminated all adult plants and is focused on controlling seedlings as they germinate from the soil. This has resulted in desirable species recovering from being outcompeted by this fast growing vine.

The Marshall Islands has been successfully treating their priority weeds on the main atoll of Majuro. Other infestations on Bikini and Kili have been problematic due to the high expense and time required to visit the atolls, resulting in irregular control of these infestations.



Biocontrol of weeds

Widespread weeds can sometimes be targeted using biological rather than chemical or physical control: 36 natural enemies have established on 19 weed species in the Pacific. Since 1911, 17 countries and territories have deliberately released biological control agents on weeds in the Pacific. There are many opportunities with existing agents and new target species.

Unlike biological control agents that were introduced to target invasive animals, such as the Indian mongoose for controlling snakes and the rosy wolf snail for controlling giant African snail which were devastating to those islands to which they were introduced, the use of biological control to manage widespread weeds has been much more successful and much safer following standard international protocols such as host-specificity testing on other possible desirable plants. Internationally, 483 agents have been released with none resulting in unpredictable non-target effects.

The development of biological control agents for weeds can be initially expensive. However, once agents are researched and located, they can provide an endless service of controlling invasive plants to a degree where their impact is greatly reduced. Further, once the initial agents are confirmed as effective, it is relatively cheap to move them to new countries or locations following any additional location-specific host-testing that may be required.

Vanuatu was fortunate to benefit from two new agents being developed for African tulip tree under a Landcare New Zealand project with the Cook Islands. The agents required minimal further host specificity testing and are due to be introduced to Vanuatu in the near future.

Palau has benefited from many years work on *Mikania micrantha*, which has a natural rust enemy already established in many countries. Accordingly, previous host specificity testing has been carried out extensively for many countries, leaving just one plant for which Palau was required to do tests on. The rust is now in Palau and being released into the field. It is planned that the rust will be moved to some states within the FSM, such as Yap, where *Mikania micrantha* is a serious weed. *Mikania micrantha* is located in 20 Pacific countries and territories; however, the rust agent has only been introduced to 6 to date.



Long-term or sustained control

Long-term management is often required for invasive species that cannot be eradicated due to their value as a cultural or livelihood resource or simply the amount of resources required to do so. Such management requires ongoing resourcing but may be the only option available, so the value that is being protected from the invasive species needs to outweigh the cost of management.

Managing pigs is a balance between cultural or food needs and environmental needs. Domestic pigs are kept in pens as an important food source, but pigs that get out of pens cause a lot of damage. Investing in upskilling locals to the level of professional hunters has paid off in Niue. In 12 months, approximately 130 pigs have been hunted by locals, reducing the population by one half from the estimated pre-hunt total. Professional pig-hunting dogs, global positioning systems, and expert mentoring has resulted in a sustainable, low-cost method for managing pigs on Niue.

In Samoa and Vanuatu, crown of thorns starfish is the target of on-going control. Although a native species, crown of thorns can become invasive following modifications to the environment by man or natural disasters such as tsunamis and cyclones. In both countries, the local communities are provided with tools, procedures, and support to lower the impact that the outbreaks have on their local marine ecosystem.



P. Skelton, SPREP



H. Tongatule



D. Moverley, SPREP



H. Aholahi



D. Moverley, SPREP

Site- and asset-based management

Many invasive species are already widespread in the Pacific and impacting biodiversity, including in protected natural areas. When this is the case, there are still options to protect these species and ecosystems with a site-led or asset-based approach.

Exclusion of invasive species is an option if the surrounding environment contains widespread or otherwise unmanageable invasive species which may affect high-value areas. It can also be used as a short-term measure until a solution becomes available. On Mount Talau National Park in the Vava'u islands of Tonga, a rare plant *Casearia buelowii*, which is endemic to Mt Talau and only survives through less than 20 individuals, was being continually undermined by pigs, exposing the roots to damage and the heat of the sun. A Tongan pig fence was constructed around the site to exclude the pigs until a long-term pig management solution can be found.

Widespread invasive species may also be contained to restrict their arrival in un-infested areas. On Niue, the primary infestation of taro vine is situated within the villages of Alofi and Alofi South. Isolated infestations are targeted to contain the infestation to the primary infestation site.

The containment of myna birds in Samoa may be a realistic option for management.

K. Stone, VEPA



Following invasive species management, the best methods are determined and implemented to facilitate effective restoration of native biodiversity or recovery of other values.

While the Guidelines has a narrow focus on restoration, restoration is widely understood to include many actions such as weed control, animal control, re-vegetation, and reintroduction of locally extinct species. The target of restoration is improved function by restoring key components of an ecosystem and thereby its ecological integrity.

Restoration supports species recovery and the continued provision of ecosystem services. Ideally, restoration involves the community at multiple scales because restoration is a long-term, if not continual, process.

The Kingdom of Tonga is restoring two key ecological sites: the Toloa Rainforest and Mt Talau. The Toloa Rainforest restoration efforts include a rat control programme via bait stations for the whole forest to save native bird and plant species from predation. Replanting of native trees in the rainforest began in 2014 to improve structure and size and to reintroduce plant species that have gone extinct within the forest. Planting will continue until the extension of the forest is complete and the forest sub-canopy and disturbed sites are restored. Weed and rat control will continue into the future. Toloa Rainforest is the last remaining stand of native forest on the main Tongan island of Tongatapu and serves as an educational resource for the schools of Tonga.

A key aspect of the project is making information readily available for people who visit the forest, and many of these informational products explain native species and invasive species threats. A trail, with rest and wildlife viewing stops throughout, has also been developed.

Hengahenga, or Tongan whistler, are recovering on Mt Talau following rat control. Rodents have been controlled for a year with statistically significant increases in the number of Tongan whistler (endemic to Vava'u) and other birds such as the Polynesian triller and Polynesian starling. Rats heavily impact the survival and productivity of the Tongan whistler because the birds build an open bowl nest that is easily accessed by rats.

The control programme is run by the local community with the assistance of the Vava'u Environmental Protection Association. It uses a rat bait-take database that captures, stores, and reports on bait take at each bait station during the programme and allows analysis of bait take to inform success at lowering the rat population, identify areas of high rat activity, and allow for more economical use of the bait.



D. Moverley, SPREP



K. Stone, VEPA



D. Moverley, SPREP



H. Tongatule



D. Moverley, SPREP



Samoa has also embarked on restoring two important sites, Mount Vaea Reserve and O Le Pupu Pu'e National Park. On Mt Vaea, the focus has been on controlling widespread weeds, which form 90 per cent of all stems within the survey sampling plots. Following weed control, each area is re-vegetated with native trees which quickly form a canopy, reducing the ability of the light-demanding weed species to grow. The weed species that are adapted to grow under low light conditions are regularly managed. Six hectares of Mt Vaea have now been restored, with the on-site nursery having provided 19,000 trees for volunteers and the local village to plant.

The focus at O Le Pupu Pu'e has been on planting to suppress the *Merremia peltata* infestations that are restricting regeneration following disturbances such as cyclones. Again, the closed canopy of the re-vegetated areas is suppressing this light-demanding species.



D. Moverley, SPREP



Samoa MNRE



LESSONS LEARNED

The Pacific islands can manage invasive species with support regionally, technically, and from their peers.

The project, as designed, was very ambitious, with over 100 activities spread over ten countries. Despite this scale, most activities were successful, with some outcomes exceeding those expressed within the project document.

The “Guidelines for Invasive Species Management in the Pacific” provide an effective framework to plan invasive species programmes and can be directly used to plan actions within National Invasive Species Strategy and Action Plans.

Regional support was vital in achieving quality outcomes and reporting to the implementing agency. The restructuring of the project for the last two years allowed support to be increased substantially.

Empowering country coordinators and stakeholders through coaching, capacity building, and support in country is the most important means to sustain invasive species management capability.

The Pacific Invasive Learning Network is the most effective means for Pacific practitioners to work together and learn from each other. PILN creates and supports the regional flow of information about invasive species management. PILN requires sustained support.

Successful projects resulted in increased visibility and support by local communities, other related sectors, and at the political level. This support is indicated by institutionalisation within government agencies of a core invasive species role, as has been the case in some countries, and the commitment to progressing invasive species management within the following Global Environment Facility replenishment cycles and other funds.

Together, we can win the fight against invasive species.



STEPPING UP THE FIGHT

Invasive species are a continual threat to Pacific islands, particularly with increasing trade and transportation. Effective biosecurity combined with early detection and rapid response can substantially reduce the risk of new invasions.

The management of species that have already arrived is key for the survival of Pacific species in fragile, small environments. Regional support is essential for a Pacific response to invasive species.

The policy efforts begun with this project need sustained national support, such as implementation of the NISSAP and institutionalisation of core invasive species positions. Countries must commit to management action.

Invasive species management is an important component of ecosystem resilience and response to climate change. Invasive species management should be considered as one of the most important tools in programmes supporting adaptation and response.

Sustainability of invasive species management requires human capacity and funding for the targeted work. Capacity is a combination of the number of staff, level of training, and level of engagement of staff, decision-makers, and communities.

The key funding necessary for Pacific invasive species management is vital for training to increase the technical capacity of local staff, transportation of experts and materials throughout the large region, and technological capacity, including tools and compounds used for management.

The benefits of preventing, controlling, or eradicating invasive species are clear. Continued invasive species management will preserve or restore Pacific environments, economies, and human health. The species mentioned here are some of the key threats along with other species of invasives, such as mosquitoes that carry human diseases or brown tree snakes that cause significant economic costs.

With the mandate from its national members, SPREP plays a key regional support role in mentoring, facilitating, and connecting environmental managers. The regionally focused tools developed in the IAS Project within the framework of the "Guidelines for Invasive Species Management in the Pacific" have set a comprehensive foundation for future action to protect Pacific islands from the impacts of invasive species.



PROJECT ACKNOWLEDGEMENTS

Country coordinators

The National Coordinators were a crucial link in the successful implementation of the project. In future similar projects, country coordinators should be appointed before the inception workshops so that the coordinators are involved from the outset for greater project awareness and participation in the decision-making process. Countries that did not have specific staff for roles within the project struggled to meet basic reporting, implementation, and financial requirements due to competing duties. The value of coordinator and staff continuity cannot be over-emphasised. Staff turnover results in loss of capacity, institutional and project knowledge, and significant resources that had been expended on the development of the staff member.

Several people in each nation assisted with the GEF-PAS IAS project at multiple levels, and the coordination efforts from members of environmental and climate change ministries are valuable.

Cook Islands	Joseph Brider	Director of Environment
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	Marii Marae	Project Manager
	George Taoaba	Project coordinator
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	Sauni Tongatule	Project Overview Manager (Director of Environment)
	Huggard Tongatule	Project Coordinator
	New Aue	Quarantine Officer
	Poi Okesene	Project Operational Assistant
Palau	Charlene Mersai	Former Project Manager
	Dr Joel Miles	Project Coordinator
RMI	Warwick Harris	Project Manager
	Henry Capelle	Head of Quarantine
Samoa	Fuatino Matatumua-Leota	Project Manager (assistant CEO of MNRE)
	Taupau Maturu Paniani	Project Coordinator
	Suemalo Talie Foliga	Principal National Parks and Reserves Officer
Tonga	Atelaite Lupe Matoto.	Project Manager (Head of Environment Department)
	Viliani Hakaumotu,	Project coordinator
Vanuatu	Donna Kalfatak	Project manager
	Molu Bulu	Project coordinator
	Lily Fatdal	Former Project coordinator

Primary Funding Agency

Global Environment Facility

Implementing Agency

United Nations Environment Programme

Executing Agency

SPREP

The Secretariat of the Pacific Regional Environment Programme was established by its member governments in 1992, to support regional cooperation and coordination of the protection, management, and sustainable development of the Pacific island environment. SPREP currently has a membership of 21 Pacific island countries and territories and five metropolitan countries. Our work is guided by the *SPREP Strategic Plan (2016–2026)*, developed by SPREP member countries and territories. The Secretariat, based in Apia, Samoa, works with members and partners to deliver on environmental management and sustainable development in the region.

SPREP Invasive Species Programme

The SPREP Invasive Species Programme provides a regional dimension to national invasive species management actions. A vital part of this work is building cooperation between Pacific countries and territories, partners, donors, and technical experts, facilitated by the programme's regional support strategy.

GEF-PAS IAS Project Management Team

Greg Sherley (Project Assurance, UNEP)
David Moverley (Project Manager, SPREP)
Anna Bertram (Project Facilitator, SPREP)
Gianluca Serra (Project Facilitator, SPREP)
Posa Skelton (Project Support, SPREP)

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James Atherton
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David Butler
Jack Craw
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Natasha Doherty

Kelvin Floyd
Richard Griffiths
Carlo Iacovino
Steve Menzies
Bill Nagle
Glen Osborne

Shyama Pagad
Quentin Paynter
Ray Pierce
James Stanford
Tiffany Straza
Cas Vanderwoude



Join the Fight

Protect our islands from invasive species

Håfa Adâi

Aloha

Mogetin

Rahn Anim

Iokwe

Alii

Kaselehlie Len Wo

Mauri

Ekawomir Omo

Mālō te ma'uli

Halo

Tālofa nī

Halo

Tālofa

Halo

Tālofa

Ni sa Bula Fakaalofa lahi atu

Bonjour

Mālō e lelei

Kia Orana

Ia Orana

Bonjour

Hello

Kia Ora

