

NATIONAL INVASIVE SPECIES ACTION PLAN



July 2008 - June 2011



MNRE



DEC

NATIONAL INVASIVE SPECIES ACTION PLAN

July 2008 - June 2011

Addressing
"Theme 6 - Biosecurity" of the
National Biodiversity Strategy & Action Plan

FOREWORD

It gives me great pleasure, on behalf of the Government of Samoa, to endorse this Action Plan for the management of invasive species in Samoa. The National Invasive Species Action Plan (NISAP) addresses one of the greatest threats to Samoa's natural heritage, namely, from invasive species.

The NISAP sets out the framework and identifies the key initial actions that need to be undertaken to effectively assess and manage the threats and impacts of new and existing invasive species in Samoa. The actions have been prioritized, with timeframes and identification of the lead agency/group and relevant partners that will be involved in implementation.

The development of this Action Plan was led by staff in the Ministry of Natural Resources and Environment (MNRE) and members of the National Invasive Species (NIS) Steering Committee, and more recently, the Samoa National Invasives Task Team (SNITT). The plan was formulated through a multi-sectoral consultative process involving representatives of a number of in-country governmental and non-governmental organizations as well as national and international experts. We are very thankful for the assistance of all the institutions and individuals who contributed to the development of this plan.

Adequate resource, in the form of funding, personnel and infrastructure, is one of the most crucial elements to the success of this plan. Although a number of invasive species management projects are already underway in Samoa, much more needs to be done. A significant increase in funding and resources is needed to even begin to adequately implement this plan and it is hoped that all partners, including the donor community, will play their part in ensuring that the various elements of the action plan are well funded.

The Government is very happy to present this plan of actions to you, in the hope that the key to its success is in the hands of each and every Samoan.

Soifua.



Faumuina Tiatia Liuga
Minister of Natural Resources and Environment

Executive Summary

Invasive species are one of the greatest threats to Samoa's natural heritage. In fact the impacts of invasive species are immense, costly and usually irreversible and are being increasingly felt in Samoa. Impacts can range from adversely affecting the productivity and subsequent economic output of primary industry, such as agriculture, forestry and fisheries, to impeding cultural practices and traditions, household food security and sustainable livelihoods, and threatening the integrity and biodiversity of natural ecosystems, including vital ecosystem processes.

Samoa's National Invasive Species Action plan (NISAP) is Samoa's response to the threat from invasive species and sets out the framework and identifies the key initial actions that need to be undertaken to effectively assess and manage the threat and impacts of new and existing invasive species in Samoa. The actions have been prioritised, with timeframes and identification of the lead agency/group and relevant partners that will be involved in implementation.

The magnitude of the threat to Samoa from invasive species has been recognised in Samoa's National Biodiversity Strategy and Action Plan (NBSAP). The NISAP builds on the actions identified in *'Theme 6 – Biosecurity'* of the NBSAP, as well as elements of Themes 1, 2, 3 and 7, and pursuing the following objective:

To protect Samoa's native biodiversity from the impacts of invasive species, through effective border control and quarantine, and the development and implementation of effective eradication and management programs.

The NISAP is based on four key elements:

- Developing a strategic approach to the management of established invasive species;
- Improving the knowledge and understanding of key stakeholders and the wider public of invasive species and their impacts;
- Preventing the introduction and establishment of potential invasive species; and
- Fostering regional and international cooperation and collaboration.

Actions such as these need to be supported by building, at all levels, the capacity of government, the community and other agencies to better prevent and manage the risk of invasive species, such as through appropriate training and providing adequate resources. This is an important element highlighted throughout the action plan and is consistent with the Guidelines for Invasive Species Management in the Pacific being developed for future endorsement by SPREP members.

Since 2002 the Division of Environment and Conservation (DEC) of the Ministry of Natural Resources and Environment (MNRE) has taken the lead in developing this action plan. Recognising that a response to the serious issue of invasive species requires a cooperative approach, the action plan has been developed through a widely consultative process, incorporating the views of key stakeholders through the establishment of a National Invasive Species (NIS) Steering Committee, and more recently, the Samoa National Invasives Task Team (SNITT).

This action plan was formulated through a multi-sectoral consultative process involving representatives of various in-country governmental and non-governmental organisations as well as national and international experts. In particular, advisory services were given by representatives of various intergovernmental and Bilateral Aid organisations in the Pacific: the Worldwide Fund for Nature, the Secretariat of the Pacific Regional Environment Programme (SPREP), the Secretariat for the Pacific Community (SPC), the United Nations Development Programme (Apia Office), Conservation International's Pacific Islands Program (CI-PIP), the Pacific Invasives Learning Network (PILN), the Japan International Cooperation Agency (JICA) and AusAID-funded volunteers (Australian Youth Ambassadors for Development Program).

Adequate resource, in the form of funding, personnel and infrastructure, is one of the most crucial elements to the success of this action plan. Among the activities already funded by local budgets are quarantine services under the Ministry of Agriculture and Fisheries and MNRE has provided for the development of a biodiversity database and field research of management techniques for *Merremia*. Further funding from external sources has been secured for freshwater and marine port surveys, myna bird management trials, a rattan eradication project and research on the management of invasive weeds in the Mt Vaea reserve. However, a significant increase in funding and resources is needed to even begin to adequately implement this plan and it is hoped that all partners, including the donor community, will play their part in ensuring that the various elements on the action plan are well funded.

It is intended that this action plan be owned and driven by the Samoan community. This is a living document, to be reviewed annually and revised every three years through a consultative process, and will therefore continue to evolve over time.

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ACRONYMS

AGO	Office of the Attorney General
CC	Chamber of Commerce
CI	Conservation International
DEC	Division of Environment and Conservation
EIA	Environmental Impact Assessment
IRATC	Import Risk Assessment Technical Committee
JICA	Japan International Cooperation Agency
MAF	Ministry of Agriculture and Fisheries
MESC	Ministry of Education, Sports and Culture
MFAT	Ministry of Foreign Affairs and Trade
MNRE	Ministry of Natural Resources and Environment
MOH	Ministry of Health
MWCSD	Ministry of Women, Community and Social Development
MWTI	Ministry of Works, Transport and Infrastructure
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non Governmental Organisations
NISAP	National Invasive Species Action Plan
PAWG	Public Awareness Working Group
PII	Pacific Invasives Initiative
PILN	Pacific Invasives Learning Network
PWG	Prevention Working Group
SAA	Samoa Airport Authority
SNITT	Samoa National Invasives Task Team
SPA	Samoa Port Authority
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
SUNGO	Samoa Umbrella for Non Governmental Organisations
UNDP	United Nations Development Programme

GLOSSARY

Biological Diversity (Biodiversity): The variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (Convention on Biological Diversity). Components include:

Genetic Diversity: The variability in the genetic makeup among individuals within a single species. In more technical terms, it is the genetic differences among populations of a single species and those among individuals within a population.

Species Diversity: The variety of species – whether wild or domesticated – within a particular geographical area. A species is a group of organisms which have evolved distinct inheritable features and occupy a unique geographic area. Species are usually unable to interbreed naturally with other species due to such factors as genetic divergence, different behavior and biological needs, and separate geographic location.

Ecological (ecosystem) Diversity: The variety of ecosystem types (for example, forests, deserts, grasslands, streams, lakes, wetlands and oceans) and their biological communities that interact with one another and their non-living environments.

Biosafety: The policies and actions taken to manage risks from the intentional introduction of new organisms, including genetically modified organisms, which could adversely affect biodiversity, people or the environment.

Biosecurity: The protection of people and natural resources, including biodiversity, from unwanted organisms capable of causing harm.

Border Control: The policies and actions taken to prevent the accidental or illegal introduction of unwanted organisms across national borders. Border control includes re-import pest control, certification, inspection and surveillance, and emergency responses.

Conservation: The prevention and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations.

Invasive Species: Invasive species are species introduced into an area in which they do not occur naturally, usually as a result of human activities, and which threaten environmental or economic resources, or human health, due to the damage they cause, or are likely to cause.

Native Species: A plant or animal species that occurs naturally in Samoa. A synonym is “indigenous”.

Protected Area: A geographically defined area that is protected primarily for nature conservation purposes or to maintain biodiversity values, using any of a range of legal mechanisms that provide long term security of either tenure or land use purpose. It may be either publicly or privately owned.

Species: A group of organisms, sharing common features (similar phenotype) and being isolated from other groups in terms of reproduction.

INTRODUCTION

In 2001, the Government of Samoa released the *National Biodiversity Strategy and Action Plan* (NBSAP) for the conservation and sustainable development of the country's biological resources. The NBSAP identifies invasive species as being one of the greatest threats to Samoa's biodiversity. The National Invasive Species Action Plan (NISAP) addresses this threat, building on the actions identified in 'Theme 6 – Biosecurity' of the NBSAP, as well as elements of Themes 1, 2, 3 and 7, and pursuing the following objective:

To protect Samoa's native biodiversity from the impacts of invasive species, through effective border control and quarantine, and the development and implementation of effective eradication and management programs.

A few necessary changes have been incorporated since the adoption of the NBSAP, including a change in the definition of invasive species and a broadening of the scope of this document by addressing economic and social impacts, along side the environmental impacts.

What are invasive species?

Invasive species are species introduced into an area in which they do not occur naturally, usually as a result of human activities, and which threaten environmental or economic resources, or human health, due to the damage they cause, or are likely to cause.

Invasive species addressed in this action plan include plants, animals, diseases and parasites within marine (including ballast water and sessile species), freshwater and terrestrial environments.

Genetically Modified Organisms (GMO's) are identified as potential invasive species in the NBSAP, however they are not addressed in this action plan. They are addressed separately by a Biosafety Framework Project under the Division of Environment and Conservation (DEC), of the Ministry of Natural Resources and Environment (MNRE).

Invasion pathways

The means by which a new invasive species enters Samoa is known as an 'invasion pathway'. Natural pathways include wind and ocean currents, and through the use of morphological (eg. flight) or behavioural (eg. population budding by some ant species) dispersal mechanisms. However, with increasing global trade and travel, humans are now believed to be the key vector for new invasions (GISP 2000). There are two major categories of human-made pathways:

Intentional introductions – species introduced deliberately for the purpose of agriculture, fisheries and forestry production, or as garden plants, pets, or biological controls. For example, the common myna bird, *Acridotheres tristis*, was introduced to control ticks on cattle and is now itself an invasive species.

Accidental introductions – species introduced unintentionally, such as in ships ballast water, or their hulls, on people's clothing and luggage, or as contaminants on equipment and in imports. For example, the giant African snail arrived in Samoa via ship cargo, and has since spread across both Upolu and Savaii. With over 240 trips to Samoa per year by merchant ships (carrying mainly containerised cargo), as well as cruise liners, warships, yachts and fishing vessels, and over 4000 international flights per year between Samoa and other Pacific or Pacific rim countries carrying thousands of people and baggage, there is significant potential for accidental introductions (Green, 2003). The pathways that have the greatest potential for accidental introductions to Samoa are the sea and air links with New Zealand and American Samoa due to the frequency of movement between these countries, and the extensive use of Pago Pago by international fishing fleets and the US Navy (Green, 2003).

The 'invasives' problem in Samoa

The impacts of invasive species are immense, costly and usually irreversible. Impacts can range from adversely affecting the productivity and subsequent economic output of primary industry, such as agriculture, forestry and fisheries, to impeding cultural practices and traditions, household food security and sustainable livelihoods, and threatening the integrity and biodiversity of natural ecosystems, including vital ecosystem processes.

The devastating impact of invasive species on the environment, production systems (crops), and social values of Samoa has been witnessed in recent years particularly through invasions of taro leaf blight, the giant African snail (*Achatina fulica*), Myna species (*Acridotheres tristis*, *A. fuscus*) and Merremia vine (*Merremia peltata*).

Taro leaf blight not only devastated Samoa's staple food source, but also decimated farmers' incomes from local and overseas markets. Taro production in Samoa dropped by over 95% (Chan, 1995), and the export value fell from \$US 3.2 million in 1993 to only \$US 53,000 one year later (IPGRI, 2002). The costs were much greater though, with the loss of a major food source for many families, and significant financial outlay to support attempts to address the problem using fungicides and changing cultural practices, which ultimately failed. Significant resources continue to be invested in the research and release of blight-resistant taro varieties to rebuild production capacity in Samoa. However, taro crops now face a new threat, the Taro beetle, which is spreading eastward in the Pacific from Fiji, Papua New Guinea, Solomon Islands and Vanuatu (SPC, 2003).

Merremia vine and mile-a-minute (*Mikania micrantha*), both notoriously aggressive species and among the top 30 invasive plants in the Pacific (SPREP, 2000), are widespread and causing significant damage in Samoa. Although the economic costs have not been quantified, the impacts of these vines via the rapid colonisation of disturbed sites, inhibiting the growth of crops and the regeneration of native vegetation (including secondary forest growth) following forestry operations and other disturbance events, is clearly visible and of concern to the community and government. Further research is necessary into the true extent of the distribution and impacts of these vines.

The giant African snail has also been a conspicuous invader over the past decade, rapidly spreading across Upolu and now Savaii with adverse impacts on vegetable and root crops, and garden and native plants. Formal research has not been undertaken, however it is likely that the snail has also modified natural habitats and out-competed native snail species for resources. The snail population appears to have declined since the introduction of a flatworm, *Platydemus manokwari*, however evidence of a direct relationship between the two has not been established, and there is concern that this indiscriminate predator may also become invasive and cause the extinction of many native snails, as has occurred in at least Hawaii (USFWS, 2003), Guam (Hopper and Smith, 1992) and the Northern Marianas Islands (Robinson and Hollingsworth, unpublished report).

The above examples illustrate the extensive impacts of just a few of the many species that are known to be invasive in Samoa. One can only imagine the collective impacts of these and other invasive species, such as crazy ants (*Anoplolepis gracilipes*), myna birds (*Acridotheres tristis* & *A. fuscus*), the red-vented bulbul (*Pycnonotus cafer*), feral¹ pigs (*Sus scrofa*) and cats (*Felis catus*), rats (*Rattus spp.*), and potential invasive freshwater fish species such as tilapia (*Oreochromis mossambicus*, *O. niloticus*), Ivy Gourd (*Coccinia grandis*) in addition to the many other invasive plants, insects and diseases of human health, agricultural and environmental concern (Attachment 4), including:

- Mexican Rubber Tree (Pulu mamoe, *Castilla elastica*)
- Albizia (Tamaligi pa'epa'e *Albizia falcataria*)

¹ A domesticated or captive animal that has escaped into the wild.

- Silktree (tamaligi uliuli, *Albizia chinensis*);
- Ivy or Scarlet fruited Gourd (*Coccinia grandis*);
- Merremia (fue lautetele, *Merremia peltata*);
- Mile-a-minute weed (fue saina, *Mikania micrantha*);
- Koster's curse (la'au lau mamoe, *Clidemia hirta*);
- Navua sedge weed (tuise tele, tuise fiti; *Kyllinga polyphylla*);
- African rubber tree (pulu vao, *Funtumia elastica*);
- Mint weed (vao mini, *Hyptis pectinata*);
- Leucaena (fua pepe, *Leucaena leucocephala*);
- Torvum weed (lapiti; *Solanum torvum*);
- African tulip tree (fa'apasi, *Spathodea campanulate*).

Space and Flynn's (2002) study of invasive plant species of environmental concern also identified a further 106 plant species that are common, weedy, or cultivated in Samoa and which may become invasive in the future, based on their behaviour on other Pacific islands.

As alarming as this is, the reality is that due to limited documentation and research of invasive species to date, there is an inadequate knowledge base of the true extent of invasive species and their impacts in Samoa. One of the priority actions to be achieved under the NISAP is an inventory of invasive species, including their past, present and potential future distribution, impacts and possible actions that can be taken.

Yet, the problem extends beyond the invasive species that have already invaded Samoa, to the many species that may invade in the future, particularly with increasing international trade. Free trade laws may also pose a threat by influencing quarantine policy.

Space and Flynn (2002) identified a further 264 plant species which are invasive on other Pacific islands and pose a threat to Samoa. This list includes such species as the purple plague, *Miconia calvescens*, which is purported to be the most destructive invasive plant in the Pacific. It has become a dominant canopy tree over large areas of Tahiti, severely affecting the dynamics of natural ecosystems, threatening the survival of several endemic species, and contributing to landslides (ISSG, 2003).

The experience of other Pacific islands, particularly Hawai'i, reveals a daunting prospect for Samoa's future if significant preventative steps are not taken against potential invasive species. Invasive species are now Hawaii's key environmental problem, incurring significant costs through direct losses of agricultural and horticultural crops, limited export markets for local produce, and degradation of watersheds. Invasive species are also the primary threat to native wildlife, with 43% of Hawaii's bird species now endangered (TNCH & NRDC, 1992).

The aggressive brown tree snake (*Boiga irregularis*) which has been nominated by the Invasive Species Specialist Group as being among the top 100 of the world's worst invasive species (ISSG, 2003), is a significant threat due to its notorious ability to stowaway in cargo. With up to 12,000 snakes/square mile in Guam, the brown tree snake has had devastating environmental and economic impacts (Fritts & Leasman-Tanner, 2001). It has caused the extinction of nearly all native forest birds, and is expected to have a similar impact on native lizards. It also preys on chickens, eggs and pet animals, and causes frequent and costly power outages. The snake is also mildly venomous and known to attack babies and young children (Fritts & Leasman-Tanner, 2001).

Skelton et al., (2008) has revealed that marine introduced species are well established in the Apia harbour area and are spreading to other areas. About 13 introduced species of both fauna and flora are now recorded from the area. Many deliberately introduced species have demonstrated their invasive tendency while some are known to be serious pests.

Of the 13 introduced species (Attachment 6) records, two marine plant species are of particular concern for Samoa – the green alga *Codium arenicola* and Brown seaweed *Spatoglossum macrodontum*. Populations of the two invasives appear to be expanding. The former with its related species *Codium ovale* have been observed to be rapidly colonising disturbed areas with their tendency to form large clumps that potentially smother other native benthos. Others such as the red bryozoan *Bugula neritina*, *Carijoa rosei* and the Christmas tree hydroid *Penaria disticha* are becoming established. These together with the barnacle *Balanus amphitrites* are known invasives in Hawaii, American Samoa, Guam and Australia. The White crust tunicate *Didemnum perlucidum* is showing signs of becoming invasive. Some other species such as the Red seaweed *Acanthophora spicifera* and the Hollow button weed *Dictyosphaeria cavernosa* are native species but are found to be introduced/invasive in other countries. The Brown seaweed *Sargassum* spp. is a native species but is also becoming a pest.

The seaweed *Kappaphycus* and *Eucheuma* which were introduced to Samoa for fisheries enhancement in 1975, 1991, 1992 and 1999 have no 'wild' populations established. However, they are known invasives in Hawaii (Skelton et al, 2008). Several others intentionally introduced for the same purpose are yet to be discovered from other marine areas of Samoa.

It is widely recognised that once invasive species become established they are extremely difficult to eradicate, therefore prevention is the first and best line of defence, and also the most cost-effective (GISP, 2000). Through the efforts of the Ministry of Agriculture and Fisheries, import risk assessment procedures have been developed to assess the invasive potential of new introductions, and an Emergency Response Plan has been drafted to ensure a rapid response to the detection of new invasions. These are significant steps that are further reinforced by the NISAP.

Appendix 5 lists examples of invasive species management projects planned for implementation during the period of this strategy.

Development of the Action Plan

Invasive species were identified as a priority management theme in the NBSAP. Consequently, DEC took the lead in developing a national implementation action plan for invasive species. Recognising that a response to the serious issue of invasive species requires a cooperative approach, the action plan has been developed through a widely consultative process, incorporating the views of key stakeholders through the establishment of a National Invasive Species (NIS) Steering Committee.

The NIS Steering Committee represented the commitment of over thirty organisations including government agencies, non-government organisations, regional organisations, community groups, private sector, and donors representing stakeholders who have a role in preventing or reducing the impacts of invasive species.

Meetings of the NIS Steering Committee over the past several years, and a workshop held in August 2003, and another in August 2007, culminated in the development of this action plan. Three AusAID-funded volunteers (Australian Youth Ambassadors for Development Program) working within DEC assisted in the early part of the process, and both workshops drew on the invasive species experiences of invasive species management specialists.

In early 2006 a new committee called the Samoa National Invasives Task Team (SNITT) was formed and took over the function of the NIS Steering committee and includes the same memberships. The key role of the SNITT is to act as the coordinating mechanism for this NISAP. In addition, SNITT is actively involved in prevention and management of invasive species in Samoa through its membership and in regional invasive species partnerships such as the Pacific Invasive Learning Network (PILN) and the Pacific Invasive Initiative (PII).

Invasive Species Management Strategies

Invasive species management in the holistic sense is a complement of various methods and/or techniques which are aimed at the prevention/exclusion; containment; control/suppression; mitigation; and removal/eradication of a target species from a designated area. Each technique and or method used achieves a different level of impact reduction and requires various degrees of skill, technology, resources (both human and capital) and commitment and is specific to each target species and prevailing environmental circumstances.

There are four basic management strategies to deal with problematic invasive species: prevention; early detection; eradication and control (CABI 2001). Prevention of introductions is the most ideal and cost-effective option as "prevention is better than cure". There are three major methods by which to prevent species invasions: interception based on regulations enforced with inspections and fees; treatment of material suspected to be contaminated with invasive species and prohibition of certain commodities in accordance with international regulations.

Early detection of potential invaders is usually critical in determining whether eradication is feasible. Early detection involves surveys of the species of concern or a particular site where the species is thought to be found. Since the prospect of early eradication or at least containment of the invasive species is much cheaper than later control or eradication once the species has spread widely, investment in early detection is very worthwhile.

When prevention has failed, the next preferred management option is eradication. However, a very careful assessment of the costs and likelihood of success must be made and sufficient resources mobilised before eradication is attempted. Eradication often requires very significant resources and the employment of many different methods at once, but is preferred over control as costs are not ongoing after eradication is completed. Eradication has most successfully been applied to vertebrate pests (such as rats, pigs and goats), rather than plants or invertebrates which tend to be very hard to eradicate, except in relatively small areas.

The final step in the sequence of management options is the control of invasive species when eradication is not feasible. The purpose of control is to reduce the density and abundance of invasive organisms to below an acceptable threshold. Over the long run control can be very costly because by its nature it must be continued indefinitely unless populations of the pest are reduced to a level where eradication becomes feasible.

Invasive species control uses many of the same techniques as eradication such as mechanical (e.g. pulling weeds), chemical (e.g. using toxic baits against vertebrates or poisons against plants), habitat management (e.g. sanitation, habitat removal, barriers, grazing, flooding and prescribed burning) and prescribed hunting of invasive vertebrates. Biological control can be another very cost-effective measure but careful assessment of the environmental impacts of bio-control agents is necessary before introduction. As with eradication, the integration of several control methods often provides the most effective management strategy.

Guiding Principles

The Guiding Principles outlined in the NBSAP are complemented by the following principles for the purposes of this action plan:

- **Precautionary Principle**

The precautionary principle advocates a 'prevention rather than cure' approach to decision-making, which involves acting to avoid serious or irreparable potential damage, despite lack of scientific certainty of the likelihood or extent of that damage.

- **Ecosystem Approach**

The integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, and recognises that humans are an integral component of ecosystems.

- **Beneficiary pays**

The action plan recognises that in principle the beneficiary should pay for services for which the government currently absorbs the cost. For example, the cost of risk assessments of new species proposed for introduction to Samoa is the responsibility of the individuals or organisation proposing the introduction.

Structure of the Action Plan

The NISAP is based on four key elements:

- Developing a strategic approach to the management of established invasive species;
- Improving the knowledge and understanding of key stakeholders and the wider public of invasive species and their impacts;
- Preventing the introduction and establishment of potential invasive species; and
- Fostering regional and international cooperation and collaboration.

As identified in the NBSAP, actions such as these need to be supported by building at all levels, the capacity of government, the community and other agencies to better prevent and manage the risk of invasive species, such as through appropriate training and providing adequate resources. This is an important element highlighted throughout the action plan and is consistent with the Guidelines for Invasive Species Management in the Pacific being developed for future endorsement by SPREP members.

Implementation of the Action Plan

The NISAP sets the framework and identifies the key initial actions that need to be undertaken to effectively assess and manage the threat and impacts of new and existing invasive species. The actions have been prioritised, with timeframes and identification of the lead agency/group and relevant partners that will be involved in implementation.

It is intended that the action plan be owned and driven by the Samoan community. This is a living document, to be reviewed annually and revised every three years through a consultative process, and will therefore continue to evolve over time.

Roles and Responsibilities

MNRE is the key government agency responsible for facilitating the implementation and monitoring of the action plan. The SNITT will act as a technical sub-committee, chaired by MNRE and involving representatives of key stakeholders, will drive the coordination of the NISAP and report to the Chief Executive Officer of MNRE.

However, all stakeholders, including regional and local NGOs, Government agencies, private businesses and the general community, play an important role in preventing and managing invasive species, and it is intended that they will be actively involved in the implementation of this action plan.

A number of key groups have specific roles and responsibilities in relation to the implementation of the NISAP, as outlined below:

SNITT:

- coordinate the implementation of the action plan, including prioritisation and delegation of actions, and dispersal of available resources;
- provide technical advice to the Chief Executive Officer on issues pertaining to invasive species; and
- monitor, review and report on the progress of implementation, and direct future work and outcomes.

Government Departments

Each relevant Government department is to support and actively participate in the implementation of the NISAP, commensurate with their mandate:

- develop the necessary and appropriate legislative framework to provide for the prevention, control and management of invasive species;
- develop effective policies and programs;
- provide leadership, coordination and resources for research, assessment, management, education and public awareness relating to invasive species;
- promote consultation and a participative approach to the implementation of the NISAP.

Local NGOs:

- contribute knowledge and skills to the development and implementation of actions under the NISAP;
- represent members' interests;
- provide information to members and the broader community;
- facilitate the participation of communities in relevant actions; and
- support community initiatives through the provision of funding and guidance.

Regional and international NGOs and intergovernmental organisations:

- contribute knowledge and skills to the development and implementation of actions under the NISAP;
- share relevant information, research, technical capacity and other resources that will assist Samoa in addressing the issue of invasive species; and
- support local initiatives through the provision of funding and guidance.

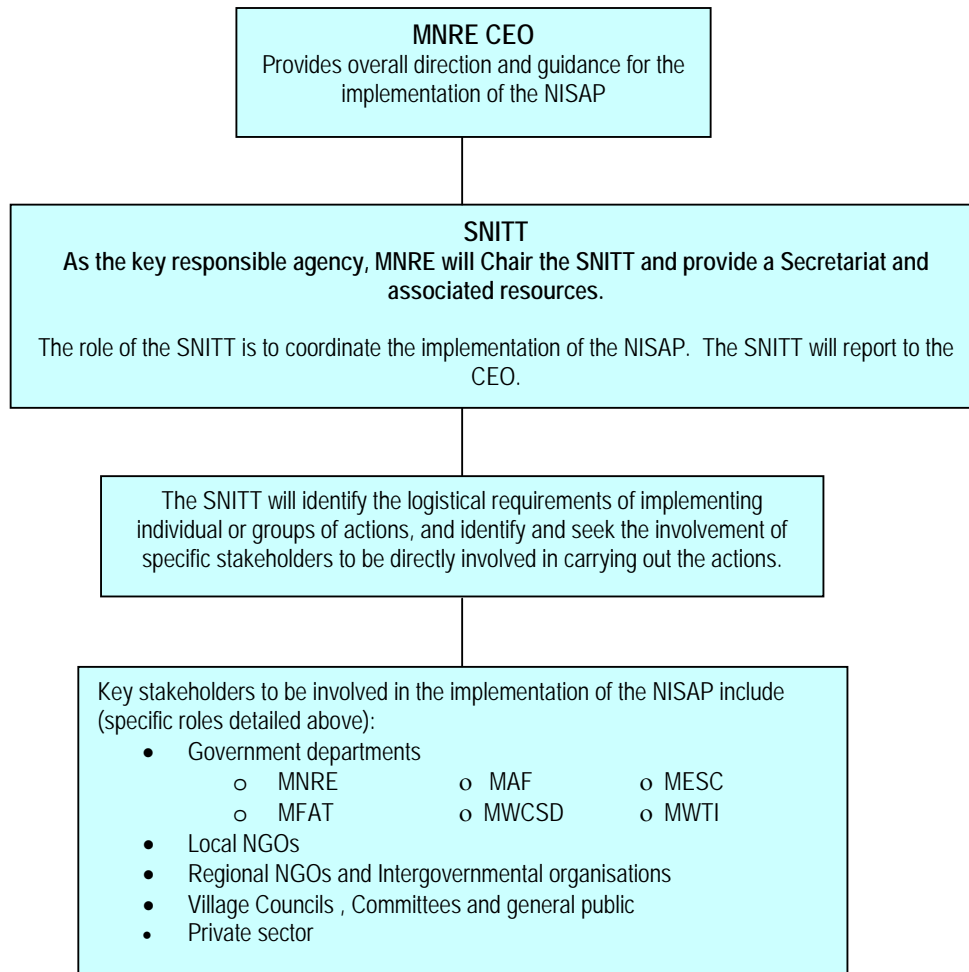
Village Councils, Committees and general public:

- detect and report new invasions;
- contribute their knowledge and skills to the development and implementation of eradication and/or management programs;
- initiate and facilitate the participation of villages in local management initiatives; and
- raise awareness and education in relation to invasive species.

Private Sector:

- revise relevant processes and procedures to minimise the risk of introducing or further spreading invasive specie; and
- work with Government agencies and other relevant stakeholders to address the invasive species problem.

Figure 1. Linkage between key committees and stakeholders



Securing Resources

Adequate resource, in the form of funding, personnel and infrastructure, is one of the most crucial elements to the success of this action plan. Among the activities already funded by local budgets are quarantine services under the MAF, and MNRE has provided for the development of a biodiversity database and field research of management techniques for *Merremia*, and will also provide for administration of the Environmental Impact Assessment requirements under the *Planning and Urban Management Act 2004*. Further funding from external sources has been secured for the freshwater and marine port surveys under the NBSAP Add-on Project, the myna bird management trials, and the upgrading of quarantine services under the Samoa Quarantine Improvement Project.

There may be some capacity for further funding under local budgets, however Samoa cannot realistically fund the entire action plan. External support will need to be sought in the form of grants, technical assistance and equipment, such as through international and regional programmes (UNDP, Global Invasive Species Programme, PII, PILN, CI, SPREP, SPC), non-government organisations, and other donor agencies. Specific needs will be further clarified and proposals developed as the implementation of the action plan proceeds and we gain further knowledge of the invasive species problem facing Samoa.

STRATEGIES AND ACTIONS

Strategy 1: Manage established invasive species					
Objective: To develop appropriate programs and procedures to minimize the impacts of established invasive species by eradicating them where practicable, or otherwise managing them. .					
ACTIONS	LEAD AGENCY/ GROUP	PARTNERS	PRIORITY	TIMEFRAME	OUTPUTS
Identify and Prioritise specific species or key sites for management					
1.1.1 Identify the existing invasive species in Samoa, drawing from the Space and Flynn (2002), Skelton et. Al. (2007) and other studies, as well as further surveys, including: <ul style="list-style-type: none"> - freshwater survey - marine survey - terrestrial invertebrate survey 	MNRE MAF	SUNGO, Communities	High	Year 1-3	Comprehensive list of invasive species produced
1.1.2 Undertake a preliminary assessment of the potential environmental, economic and social impacts and values of each of these invasive species, and prioritise the species accordingly, identifying the top 10 for each species group both terrestrial and aquatic (e.g. plant, vertebrate, invertebrate, pathogens, etc.)	MNRE MAF	SUNGO, Communities	High	Year 1	Impacts assessed and species prioritised
1.1.3 Determine and map where possible the current distribution, past spread, and potential future dispersal of the top 10 species in each group;	MNRE MAF	Communities MWCS D	High	Year 1	Past, present and potential future distribution determined
1.1.4 Record and maintain information relating to all invasive species on a digital database.	MNRE	MAF	Medium	Ongoing	Database updated at least annually
1.1.5 Assess the feasibility of and select appropriate management options for the identified key species above (utilise the guidelines outlined in Attachments 1 and 2), whether at a local or national level, and prioritise and initiate management programs <ul style="list-style-type: none"> - Where necessary, conduct feasibility or pilot studies to determine the problems and constraints (financial, technical, public awareness and support, or legislative) associated with implementing management programs, and the capacity to overcome such constraints. 	MNRE MAF	MWCS D, SPREP, SUNGO, Communities	High	ongoing	Species and sites identified and eradication efforts initiated
1.1.6 Identify small infestations that have the potential to become invasive, eg. Satellite populations of the giant African snail on Savaii, and develop and initiate eradication programs, where feasible. And Where necessary, develop and implement effective restoration methods for affected areas.	MNRE MAF	SUNGO, Communities	Medium	ongoing	Eradication programs commenced.

ACTIONS	LEAD AGENCY/ GROUP	PARTNERS	PRIORITY	TIMEFRAME	OUTPUTS
1.2 Where management is feasible and planned:					
1.2.1 Identify key areas, species, communities, crops and other resources which must be protected from the spread of invasive species.	MNRE MAF	MWCSD, SPREP, SUNGO, Communities	High	Year 1	Key areas identified for protection
1.2.2 Conduct feasibility or pilot studies to determine and test the effectiveness and maintenance of barriers and other preventative measures to stop the spread of priority established invasive species into non-infected areas; - Where practicable, use the adaptive approach to management (Attachment 3)	MNRE MAF	SPREP, SUNGO Communities		As required.	Priority list of species and areas for management action prepared.
1.2.3 Develop and implement effective monitoring of the spread of priority established invasive species.	MNRE MAF	MWCSD, SPREP, SUNGO, Communities	High	ongoing	Barriers and other preventative measures developed and tested
1.2.4 Where feasible, develop and implement management programs to minimise the impact of established infestations of invasive species, taking into account community attitudes, resource requirements, and potential risks and constraints. - Where practicable, use the adaptive approach to management (Attachment 3)	MNRE MAF	MWCSD, SPREP SUNGO Communities	High	ongoing	Management programs developed and implemented for at least the top 5 priority species / areas.
1.3 Other actions to minimise the spread of established invasive species:					
1.3.1 Review legislation and recommend appropriate amendments to ensure adequate support for all management actions	MNRE MAF	AG	High	Year 1	
1.3.2 Identify training needs, and develop and implement necessary training and capacity building programs to strengthen Samoa's capacity to research invasive species impacts and management techniques.	MNRE	MAF	Medium	ongoing	
1.3.3 Review existing protocols to reduce the risk of native species and invasive species escaping from Samoa and invading other nations.	MNRE MAF	MFAT SPREP	High	ongoing	
1.3.4 Review the Vailima Botanic Garden living collection and dispose of any species that have the potential to escape and become invasive.	MNRE	MFAT SPREP	Medium	Year 1	
1.3.5 Incorporate into EIAs an assessment of the invasive threat posed by proposed developments, and introduce mandatory operating procedures as a condition of approval to mitigate the spread of established invasive species, eg. Procedures for the translocation of machinery and equipment.	MNRE	MWTI, MAF, SUNGO	High	Year 2-3	
1.3.6 Review plant species used for revegetation of roadsides and development projects, and restoration efforts in watershed and forestry areas, and develop a list of approved species.	MNRE MAF	MWTI	Medium	Year 1	

1.3.7 Establish a Code of Practice for the plant nursery industry to prevent the sale or distribution of invasive species.	MNRE	SUNGO, Nursery industry MAF	Low	Year 1	
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Strategy 2: Promote public support through awareness and education

Objective: To enhance the knowledge and understanding of the Samoan community to increase levels of compliance and support for preventing the introduction of invasive species that have not yet reached Samoa, and managing those already here.

ACTIONS	LEAD AGENCY/ GROUP	PARTNERS	PRIORIT Y	TIMEFRA ME	OUTPUTS
2.1 Establish a Public Awareness Working Group (PAWG) that is responsible for developing a comprehensive awareness and understanding program that targets key stakeholders and other groups. The sub-committee should undertake the following:	MNRE	MESC, HEALTH, CC, MAF, MWCSO, SPREP, SUNGO	High	Year 1	PAWG established and active
2.1.1 Undertake preliminary public awareness activities, utilising television, radio, newspapers, and also posters and fact sheets.	PAWG	MESC, HEALTH, CC, MAF, MWCSO, SPREP, SUNGO	High	ongoing	Awareness activities undertaken
2.1.2 Conduct workshops of key stakeholders to determine the extent of their knowledge of invasive species and their impacts, their needs and concerns, and the existing and potential role of each group in protecting Samoa and its resources from invasive species.	PAWG	MESC, HEALTH, CC, MAF, MWCSO, SPREP, SUNGO	High	ongoing	Workshops undertaken
2.1.3 Identify target groups and tailor information to meet their needs and concerns - Identify appropriate incentives for community ownership and support	PAWG	MESC, HEALTH, CC, MAF, MWCSO, SPREP, SUNGO	High	Year 1	Workshop results analysed and presented to TSC
2.1.4 Based on the needs assessment, produce, package and disseminate information on invasive species and their impacts, preventing new species from entering Samoa, and the management of existing invasions: - Review secondary school and university curricula and make recommendations; - Review existing government programs to identify opportunities to incorporate information on invasive species, for example, extension programs for farmers and communities to introduce best practice techniques in the management and/or eradication of invasive species; - Enhance awareness of relevant legislation and enforcement	PAWG	MESC, HEALTH, CC, MAF, MWCSO, SPREP, SUNGO	High	ongoing	Program commenced

Strategy 3: Prevent the introduction of new invasive species

Objective 1: To strengthen the existing Import Risk Assessment (IRA) procedure and associated import protocols for proposed new introductions

ACTIONS	LEAD AGENCY/ GROUP	PARTNERS	PRIORITY	TIMEFRAME	OUTPUTS
3.1.1 Establish a Prevention Working Group (PWG) to review relevant legislation and procedures, and recommend necessary amendments to ensure there is appropriate and effective support for the IRA process.	MNRE MAF	SAA, SPA, SPREP, SUNGO, UNDP Other partners: AG, MFAT	High	Year 1	Legislation reviewed and amendments proposed
3.1.2 Develop and introduce EIA procedures for proposed imports of new organisms.	MNRE	MAF	High	Year 1	EIA process in operation for proposed imports of organisms.
3.1.3 Continue to strengthen the IRA process, incorporating comprehensive assessments of environmental, social and economic costs and benefits. - Review the membership of the IRA Technical Committee (IRATC); - Review and recommend improvements to the IRA methodology and consultative process;	IRATC IRATC		High High	ongoing Year 1 ongoing	IRATC reviewed and amendments implemented IRA standards reviewed and improvements implemented
3.1.4 Implement necessary training and capacity building programs to support the IRA process.	PWG		High	ongoing	
3.1.5 Review and update the Pest List (Quarantine) and Biodiversity (DEC) databases to ensure information remains current and readily accessible.	IRATC		High	ongoing	Training needs identified and schedule proposed
3.1.6 Implement the regional strategies and national legislation to prevent the introduction of new marine invasive species.	MAF MNRE		High	ongoing	Databases updated and maintained to meet information needs

Objective 2: To review and enhance the Emergency Response Plan (ERP) to ensure an immediate and effective response to the detection of any potential invasive species

ACTIONS	LEAD AGENCY/ GROUP	PARTNERS	PRIORITY	TIMEFRAME	OUTPUTS
3.2.1 Revise the existing ERP and associated protocols to ensure that appropriate actions are initiated immediately following the detection of potential invasive species;	PWG		High	Year 1	ERP revised and endorsed by key stakeholders
3.2.2 Recommend legislative amendments to ensure effective support for the ERP (undertake in conjunction with legislative review under Objective 1)	PWG		High	Year 1	Legislative amendments recommended
3.2.3 Incorporate the ERP under the National Disaster Management Plan (NDMP), or other appropriate legislation, to ensure adequate resources and support for the ERP.	PWG		High	Year 1	ERP included under the NDMP
3.2.4 Review invasive species present amongst Samoa's trading partners and ensure existing databases include essential information for an effective response, especially potential environmental and economic pests. - Assign species to very high, high, medium and low priority categories.	PWG	MAF	High	ongoing	Species identified & databases updated.
3.2.5 Develop specific contingency plans for high priority species (as identified under Objective 3);	PWG		High	ongoing	Contingency plans developed
3.2.6 Develop and test a simulated invasive species incursion.	MAF & MNRE	Other key stakeholders identified in ERP	Medium	Year 3	Simulation undertaken
3.2.7 Develop a comprehensive illustrated manual that covers the key invasive organisms of most concern to Samoa, based on their potential environmental, social and economic damage. It should include information on their: <ul style="list-style-type: none"> ▪ Biology; ▪ Behaviour; ▪ Potential environmental, economic and social impacts; ▪ Most likely invasion pathways; ▪ Handling and disposal techniques; and ▪ Eradication techniques and strategies. 	PWG	MAF/MNRE	Low	ongoing	Manual produced

Objective 3: Enhance the current inspection and surveillance systems and procedures for potential invasive species.

ACTIONS	LEAD AGENCY/ GROUP	PARTNERS	PRIORITY	TIMEFRAME	OUTPUTS
3.3.1 Identify all likely entry pathways and the relative risk for entry of potential high-priority invasive species (as identified under Objective 2)	PWG	HEALTH, MWTI, CC, MAF	High	Year 1	Entry pathways and level of risk for priority species identified

<p>3.3.2 Assess the adequacy of current surveillance for high-risk invasive species:</p> <ul style="list-style-type: none"> - Assess the effectiveness of existing early-warning traps for the fruit fly and other high risk organisms, and recommend any appropriate changes; - Identify other high priority species for which early warning systems and other specific preventative measures would be valuable (in conjunction with preparation of contingency plans under Objective 2), and identify appropriate mechanisms; - Assess the effectiveness of private and commercial transport and cargo inspections & surveillance, and recommend improvements to aerial and marine pathways - Review current reporting and coordination procedures between agencies, including points of contact, formalise protocols and recommend improvements 	PWG	HEALTH, MWTI, CC, MAF	High	Year 1	Early-warning system reviewed and changes recommended to MOA and TSC for action.
	PWG		High	Year 1	Further preventative measures identified and proposed to MOA and TSC.
	PWG		High	ongoing	Effectiveness assessed and improvements recommended to MOA
	PWG	CC	Medium	Year 2	Review undertaken and protocols formalised
3.3.3 Conduct an audit of current skills and experience, identify important gaps and recommend appropriate training for border control, quarantine and general surveillance.	PWG		High	Year 2 & ongoing	Audit conducted and training program scheduled.

Strategy 4: Foster regional and international cooperation on invasive species

Objective 1: To foster regional and international cooperation on invasive species, to effectively address the threat of potential new invasions and manage established invasive species.

ACTIONS	LEAD AGENCY/GROUP	PARTNERS	PRIORITY	TIMEFRAME	OUTPUTS
4.1.1 Assess Samoa's participation in regional and international conventions, treaties, and non-binding resolutions, and recommend further action in relation to binding and non-binding instruments not yet ratified or endorsed;	MNRE	MAF, SUNGO, MFAT, MWTI, SPREP, UNDP, SPC, USP	Medium	ongoing	Participation in relevant instruments reviewed and further action recommended.
4.1.2 Reinforce Samoa's existing partnerships and establish new links and cooperative arrangements in relation to invasive species to maximise the sharing and exchange of information, research, technologies, technical capacity and other resources.	MNRE	CC, MAF, SUNGO, MFAT, MWTI, SPREP, UNDP, SPC, USP	Medium	Ongoing	Regional collaboration on invasive species further reinforced.

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ACKNOWLEDGEMENTS

- The NIS Steering Committee.
- The Samoa National Invasives Task Team.
- UNDP for support through the Biodiversity Add-on project and the DSS modality.
- People from within and outside Samoa who provided feedback on drafts.
- MNRE-DEC staff.
- Robert McKelleher, Amanda Ozolins and Cristina Davey (AusAID Australian Youth Ambassadors for Development program) who assisted with drafting and coordinating the development of the action plan.
- Dr Mike Braysher – provided technical advice on the management and prevention of invasive species and assisted in compiling the final action plan.
- And other partners: CI, SPREP and PILN.

Attachment 1: Criteria to assess the feasibility of local eradication

(adapted from Braysher & Saunders, 2002)

To help determine whether eradication is likely to be successful, six criteria can be applied: three are essential for the achievement of eradication and three will help managers decide whether eradication is preferable to ongoing control.

Essential criteria

- *Invasive species can be killed at a faster rate than they can replace themselves*

This seems obvious but it is difficult to achieve in practice. There are two main reasons. Firstly, many populations of invasive species have a high natural rate of increase. Secondly, as the density of an invasive species declines, it takes progressively more time and more expense per individual animal to locate and remove the last few individuals.

- *Immigration can be prevented*

This criterion can be met for small islands but is very difficult to achieve over a wide area. If an invasive species can recolonise an area from nearby populations, or by escape or release from captive populations, elimination of the species will at best be temporary. Immigration to a local area may be prevented where a suitable structure and control creates a perfect barrier.

- *All reproductive individuals are at risk from the available techniques*

It is not necessary to remove all individuals of an invasive species at the first attempt. However, all reproductive or potentially reproductive members of the invasive species pest population must be able to be taken by the techniques available. This is rarely possible in part because there is only a limited armory of techniques, and trap-shyness, bait-avoidance, and resistance to poisons, are common among pest animals.

Desirable criteria

- *The invasive species can be monitored at very low densities*

If the invasive species cannot be detected at very low densities, then there is no way of knowing whether all individuals have been eliminated. However, most population assessment techniques cannot detect individuals at very low densities.

- *The socio-political environment supports eradication*

Even when all the technical problems can be met, social and political factors may prevent successful eradication. Community attitudes may oppose killing large numbers of animals on moral, emotional or cultural grounds. Also, eradication is expensive. Political factors may withdraw funds from the program before eradication is achieved.

- *Eradication programs should not have detrimental impacts on native flora and fauna*

Eradication programs should not be implemented if there is potential for the direct and/or indirect effects of the program on the environment to be greater than the expected positive outcomes of removing the invasive species.

Attachment 2: Reality Check — assessing the likelihood that invasive species management in a defined area will be feasible, desirable and effective in reducing impact

A reality check can help determine whether invasive species management is likely to be feasible, desirable and effective. The following questions should be considered. Consultation with individuals, agencies and local stakeholders with knowledge of the species and the area may identify other issues and help answer the questions.

Is management affordable?

Are sufficient resources available to manage the species effectively, both for initial costs and continued management? For eradication, the total cost to eradication should be estimated, so that adequate resources can be identified before even commencing an eradication attempt. For biological control, the total cost of a development, release and monitoring programme may also be estimated. For other long-term management options such as containment and population control by chemical-physical methods, annual costs for maintaining the pest population at a defined level should be estimated.

Consider the following:

- the estimated cost of total eradication, including resources for essential follow-up
- the estimated cost of a biological control programme, including research and development where necessary
- the annual costs of a continuing management programme, such as costs required to bring the pest population to a defined level or to prevent it from spreading beyond defined boundaries
- resources available for adequate monitoring and evaluation.

Is management desirable?

Is the cost of the management plan worth the expected benefits?

For an environmental pest, the benefits may not be readily estimated in economic terms, but for a pest whose primary impact is economic, such as a crop pest which does not also significantly impact natural areas, the costs of management may be directly compared with the expected marginal gain in production. For example, the most effective technique to control rabbits in central Australia may be ripping rabbit warrens. However, the cost per square kilometre to rip rabbit warrens, and long-term follow-up is estimated to be three to four times the gross margin per square kilometre from free-range cattle production.

Is management practicable?

It may be technically possible to undertake management action, but it may be impractical to apply it on the scale necessary. For example, the technique might work at a small experimental site, but farm management practices and other difficulties may make it impractical at a large scale.

Is management environmentally acceptable?

Widespread aerial poisoning for example may have unacceptable impacts on non-target wildlife or domestic animals.

Is management politically and socially acceptable?

Is the proposed action consistent with:

- prevailing government policy?
- local community or catchment group priorities and issues?

The cost and impact of the proposed management may have such negative consequences that action will be blocked at the political level, or may be unacceptable to parts of the community on conservation and/or animal welfare grounds.

Does the action build on past work, and if so how successful has that work been?

Is the action an important initiative that sets the scene for subsequent actions by other key managers such as adjoining landholders?

Is there:

- local enthusiasm and ownership by management for the proposed action on the invasive species?
- commitment to long-term follow-up and maintenance?
- the required neighbour cooperation/support?

Does the work have high demonstration value to encourage similar work in other areas?

Does the work improve the awareness and understanding of the local community about the production and/or conservation values of the area?

Will the work improve our understanding of the effectiveness and efficiency of invasive species management to achieve production and/or conservation outcomes?

NOTE: If the answer to any of these questions is no, then effective management (= reduction of the impact) of invasive species is unlikely or will be difficult. Before effective invasive species management can proceed, the 'no' should be changed to a 'yes', for example, by gaining the support of a key blocking group through a targeted communication campaign.

Attachment 3: Adaptive management

Complete knowledge of the damage caused by invasive species and how to best manage them is often not known. To deal with this uncertainty it is best to adopt an *adaptive* approach to management.

For most species, there is no standard method for all situations, and often there are limited resources and time to research the problem. In these cases the best management approach is to use each invasive species management program as an ongoing experiment from which to learn and build on existing knowledge. This is called adaptive management or 'learning by doing'. The key is to be specific about the objective of each program, to monitor progress and to evaluate results. In doing so it is important to realise that knowledge and insights can come from programs that fail to meet the desired result as well as from those that succeed. Adaptive management is particularly important given the wide range of situations that require the management of invasive species and their impacts. Flexibility is also important, that is, recognising the different circumstances and restrictions at each site, and the need to adapt to changing circumstances or conditions.

Where practicable, the adaptive management approach should underpin the development of the overall outcomes and objectives of management plans for managing invasive species.

Adaptive management addresses the need to:

- accept that knowledge of the system being managed is always incomplete – not only is the science imperfect, but the system itself is a moving target, evolving because of the impacts of management and the progressive expansion of the scale of other human activities;
- develop an integrated experimental design that allows clear separation of the effects of as many changes as possible, so that a sensible balance of management tools and policies can be developed; and
- explore imaginative ways to set priorities for investing in research, monitoring and management.

If the adaptive management approach is to be used as the basis of the management plan, advice should be sought from groups or individuals with appropriate knowledge and experience in its use.

Attachment 4: Priority invasive or potentially invasive plant and animal species in Samoa

* The following priority species list are provisional only and incomplete. They will be revised from time to time as new information comes to hand.

Terrestrial Plant List:

Source: SNITT Working Group and Samoa Invasives Prioritization and Management Planning Workshop, Apia, August, 2007.

Scientific Name	Family	Habit	Samoa Name	Common Name	Invasiveness Category*
<i>Albizia chinensis</i>	Fabaceae	Tree	Tamaligi uliuli	Silk tree	Transformer
<i>Albizia falcataria</i>	Fabaceae	Tree	Tamaligi pa'epa'e	Albizia	Transformer
<i>Antigonon leptopus</i>	Polygonaceae	Vine		Chain of love	Potential Transformer
<i>Ardisia elliptica</i>	Myrsinaceae	Shrub	Togo vao	Shoebutton ardisia	Potential Transformer
<i>Arundo donax</i>	Poaceae	Grass	Fiso palagi	Giant reed	Transformer
<i>Asparagus densiflours</i>	Liliaceae	Herb		Asparagus fern	Potential Transformer
<i>Brachiaria mutica</i>	Poaceae	grass		Para grass	Transformer
<i>Calamus casius</i>	Palmae	Tree	Rattan	Rattan palm	Potential Transformer
<i>Canna indica</i>	Cannaceae	Herb	Fanamanu	Canna lily	Potential Transformer
<i>Castilla elastica</i>	Moraceae	Tree	Pulu mamoe	Panama Rubber tree	Transformer
<i>Casuarina equisetifolia</i>	Casuarinaceae	Tree	Toa	Australian pine	Potential Transformer
<i>Cedrela odorata</i>	Meliaceae	Tree	Sita	Barbados/ Spanish cedar	Potential Transformer
<i>Cestrum nocturnum</i>	Solanaceae	Shrub	Alii o le po/ Teine o le po	Night Cestrum	Transformer
<i>Cinnamomum verum</i>	Lauraceae	Tree	Tinamoni	Cinnamon	Transformer
<i>Clerodendrum chinense</i>	Verbenaceae	Shrub	Losa Honolulu/Fiti	Honolulu rose	Transformer
<i>Clidemia hirta</i>	Melastomataceae	Shrub	la'au lau mamoe	Koster's Curse	Transformer
<i>Coccinia grandis</i>	Cucurbitaceae	Vine		Ivy gourd, Scarlet-fruited gourd	Transformer
<i>Cordia alliodora</i>	Boraginaceae	Tree	Kotia	Ecuador Laurel	Potential Transformer
<i>Cyperus rotundus</i>	Cyperaceae	Sedge	Mumuta	Nut Sedge	Transformer
<i>Dieffenbachia seguine</i>	Araceae	Herb		Dumb cane	Potential Transformer
<i>Dissotis rotundifolia</i>	Melastomataceae	Herb		Spanish shawl	Potential Transformer
<i>Eichhornia crassipes</i>	Pontederiaceae / Liliales	Aquatic herb		Water hyacinth	Transformer
<i>Elaeocarpus grandis</i>	Elaeocarpaceae	Tree	Siapatua	Blue marble tree	Transformer
<i>Funtumia elastica</i>	Apocynaceae	Tree	Pulu vao	African Rubber tree	Transformer
<i>Grevillea robusta</i>	Proteaceae	Tree		Silky oak	Potential Transformer
<i>Hevea brasiliensis</i>	Euphorbiaceae	Tree		Brazilian rubber tree	Potential Transformer
<i>Hedychium flavescens</i>	Zingiberaceae	Herb	Teuila samasama	Yellow ginger	Transformer
<i>Hedychium coronarium</i>	Zingiberaceae	Herb	Teuila paepae	White ginger	Transformer

Scientific Name	Family	Habit	Samoa Name	Common Name	Invasiveness Category*
<i>Hemigraphis alternata</i>	Acanthaceae	Herb	Suipi	Metal leaf, cemetery plant	Potential Transformer
<i>Hypitis pectinata</i>	Lamiaceae	Herb	Vao mini	Mint Weed	Potential Transformer
<i>Ipomoea aquatica</i>	Convolvulaceae	Aquatic herb	Lili vai	aquatic morning glory	Potential Transformer
<i>Kyllinga polyphylla</i>	Cyperaceae	Sedge	Tuise tele, tuise fiti	Navua Sedge	Potential Transformer
<i>Lantana camara</i>	Verbenaceae	Shrub	Latana	Lantana	Potential Transformer
<i>Leucaena leucocephala</i>	Fabaceae	Tree	Fua pepe/Lusina	Leucaena, Wild tamarind	Transformer
<i>Ligustrum robustum</i>	Oleaceae	Shrub/Sm all tree		Privet	Potential Transformer
<i>Ligustrum sinense</i>	Oleaceae	Shrub/Sm all tree		Privet	Potential Transformer
<i>Merremia tuberosa</i>	Convolvulaceae	Vine		Wood rose/Yellow Morning Glory	Transformer
<i>Merremia peltata</i>	Convolvulaceae	Vine	Fue lautetele	Merremia	Transformer
<i>Mikania micrantha</i>	Asteraceae	Vine	Fue saina	Mile-a-minute	Transformer
<i>Mimosa diplotricha</i> <i>syn. invisa*</i>	Fabaceae	Shrub	Vao fefe palagi	Giant sensitive plant	Potential Transformer
<i>Mimosa pudica</i>	Fabaceae	Herb	Vao fefe samoa	Sensitive plant	Potential Transformer
<i>Odontonema tubaeforme</i>	Acanthaceae	Shrub	Totoe	Fire spike	Potential Transformer
<i>Pennisetum purpureum</i>	Poaceae	Grass	Vao Povi	Napier Grass/ Elephant Grass	Potential Transformer
<i>Piper auritum</i>	Piperaceae	Shrub	Ava tonga	Ava Tonga	Potential Transformer
<i>Psidium cattleianum</i>	Myrtaceae	Tree		Strawberry guava	Potential Transformer
<i>Psidium guajava</i>	Myrtaceae	Tree	Kuava	Lemon guava	Potential Transformer
<i>Pueraria Montana var. lobata</i>	Fabaceae	Vine	A'a	Kudzu	Potential Transformer
<i>Scindapsus aureus</i>	Araceae	Vine		Money plant	Potential Transformer
<i>Sesbania grandiflora</i>	Fabaceae	Tree	Sepania	Sesbania	Potential Transformer
<i>Solanum torvum</i>	Solanaceae	Shrub	Vao lapiti	Prickly Solanum, Devils fig	Potential Transformer
<i>Spathodea campanulata</i>	Bignoniaceae	Tree	Fa'apasi	African tulip tree	Transformer
<i>Sphagneticola trilobata</i>	Asteraceae	Herb		Wedelia, Creeping ox-eye	Potential Transformer
<i>Stachytarpheta urticifolia</i>	Verbenaceae	herb	Mautofu tai, mautofu vao, mautofu fualanumoana	Blue rats tail	Potential Transformer
<i>Tibouchina urvilleana</i>	Melastomataceae	Shrub		Glorybush	Potential Transformer
<i>Tephrosia candida</i>	Fabaceae	Shrub	Ava sa	White tephrosia	Potential Transformer
<i>Urochloa maxima</i> (<i>Panicum maximum</i>)	Poaceae	Grass	Vao kini	Guinea grass, Buffalo grass	Potential Transformer

*Species which transform or potentially transform the environments into which they are introduced pose the greatest threat to ecosystems and should be a priority for management

Terrestrial Vertebrates List:

Source: Internet base and desk research on available literatures, Atkinson, I.A.E and Atkinson, T.J.(2000) SPREP: Invasive species in the Pacific: a technical review and draft regional strategy. Sagapolutele 2000. Pacific Islands Invasive Rats.

Scientific Name	English Common Name	Samoan Name	Family	Characteristics	Environmental Impact
<p>1) 1.1) <i>Rattus exulans</i></p> <p>1.2) <i>Rattus rattus</i></p> <p>1.3) <i>Rattus norvegicus</i></p>	<p>Polynesian rat</p> <p>Ship rat</p> <p>Norway rats</p>	<p>Isumu</p> <p>"</p> <p>"</p>	<p>Muridae</p>	<p>Native to South East Asia but dispersed with human across the Pacific region.</p> <p>Native to Asia and almost present in any part of the world</p> <p>Native to Asia and may originated from China. Chiefly found anywhere there is abundant of food.</p>	<p>All three rats recorded caught in Apia in 1924-25 (Boxton & Hopkins 1927). Mostly feed on tree fruits, seeds, insects, invertebrates and any material thing i.e. soap, wood, wire etc</p>
<p>2) 2.1) <i>Acridotheres tristis</i></p> <p>2.2) <i>Acridotheres fuscus</i></p>	<p>Jungle myna</p> <p>Common myna</p>	<p>Maina vao</p> <p>Maina fanua</p>	<p>Sturnidae</p>	<p>Native to India and South Asia. Jungle is darker and slimmer with no yellow skin around the eye. Common has yellow skin around the eye.</p>	<ul style="list-style-type: none"> - omnivorous diet - chase away native birds from their nesting hollows - nest in roofs of houses accumulating droppings which in turn become a breeding ground for disease. - noise disturbance - threat to agricultural crops
<p>3) <i>Bufo marinus</i></p>	<p>Cane toad</p>	<p>Lane</p>	<p>Bufoinae</p>	<p>Native to Central America; may be grey, yellowish, olive brown or reddish brown with pale to dark mottling bellies.</p>	<ul style="list-style-type: none"> - compete for food with native fauna - pollute water catchments areas - has not established in Samoa but is well established in A.Samoa and is therefore a priority for exclusion from Samoa.
Scientific Name	Common Name	Samoa Name	Family	Characteristics	Environmental Impact

4) <i>Pycnonotus cafer</i>	Red vented bulbul	Manu palagi	Pycnonotidae	Native to parts of Asia; distinguished by a conspicuous crimson patch below the root of the tail. Found in scrub, open forest, plains and cultivated areas.	<ul style="list-style-type: none"> - agricultural pest destroying fruits and flowers - aggressive and chases off other birds species - can spread seeds of other invasive species.
5) <i>Sus scrofa</i>	Feral pig	Puaa	Suidae	Native to Europe, strong body with thick neck and mobile snouts that enables uprooting of trees. Omnivorous and breed all year round with a max of 6-10 piglets	<ul style="list-style-type: none"> - uproot tree siblings - spread invasive weed seeds - feed on some invertebrates - destroy bird nestlings and prey on eggs - damage plantations - spread diseases to other animals including humans.
6) <i>Felis catus</i>	Feral cat	Pusi	Felidae	Live abundantly where food is readily available and breed normally with about 4 kittens a year.	<ul style="list-style-type: none"> - disturb nestlings of both sea and land birds near ground. - predator to rats including skink, spiders and insects.
7) <i>Canis familiaris</i>	Feral dog	Maile	Canidae	Keep as family pets or as guards to people's homes.	- considered pests as they prey on population of species of seabirds and mammals
8) 8.1) <i>Oreochromis mossambicus</i> 8.2) <i>Oreochromis niloticus</i>	Mossambique Nile	Tilapia "	Cichlidae	Introduced from Fiji in 1955 for aquaculture reasons. Non-breeding males and females are silverfish in colour while the breeding ones have white lower parts and red margins on dorsal and fins.	- probably compete with native fishes for space (nesting areas) and food
Scientific	Common	Samoa	Family	Characteristics	Environmental

Name	Name	Name			Impact
9) <i>Poecilia mexicana</i>	Topminnow, molly	I'a vai	Poeciliidae	Originally ranges from the Atlantic and Pacific slopes of Southern Mexico and Central America, the Caribbean slope of Colombia and West Indies.	- can deplete fish when introduced outside its native range.

Terrestrial Invertebrates List

Source: Internet base and desk research on available literatures (<http://pbin.nbii.gov/otherinverts/index.asp>)

Scientific Name	Common Name	Samoa Name	Family	Characteristics	Environmental Impact
<i>Achatina fulica</i>	African snail	Sisi Aferika	Achatininae	- Native to East Africa - highly adaptable to a wide range of environment, modifying its life cycle to suit local conditions	- Highly influence economic crops - Vector for human disease i.e. eosinophilic meningoencephalitis
<i>Anoplolepis gracilipes</i>	Yellow Crazy Ant	Loi	Formicidae	- pale yellow body with long legs and antennae - move frantically and frequent changes in direction when disturbed	- kill land crabs - encourage scale insects - disturb immature bird nestlings - compete with other invertebrates
<i>Plutella xylostella</i>	Faatua taimane ai kاپisi	Diamond back moth	Plutellidae	- probably of European origin but has spread throughout the world. - four stages in its life cycle and larva stage is the worst to pose threat to plants.	- damage plant in the family Cruciferae i.e. cabbage, chinese cabbage, watercress.

Scientific Name	English Common Name	Samoan Name	Family	Characteristics	Environmental Impact
<i>Bactrocera xanthodes</i> , <i>B. kirki</i> , <i>B. distincta</i> , <i>B. obscura</i> , <i>B. near xanthodes</i> , <i>B. samoae</i> , <i>B. aenigmatica</i>	Lago tuia o fuala'au aina	Fruit fly	Drosophilidae	- spread throughout the Pacific Is countries - entirely whitish to yellowish, two paired wings	- affect economic crops like breadfruit and papaya
<i>Dysmicoccus neobrevipes</i> <i>Pseudococcus cryptus</i> <i>Planococcus sp</i> <i>Ferrisia virgata</i> <i>Laminicoccus pandani</i> <i>Dysmicoccus brevipes</i>		Mealy bug - annona - cryptic - pacific - pandanua - pandanus - pineapple	Pseudococcidae	- soft segmented oval bodies without outer shell	- affect Taro crops causing Taro bacilliform badnavirus - suck sap from various plants causing wilting, distorted foliage
<i>Oryctes rhinoceros</i>	Manu'ainiu	Rhinoceros beetle	Scarabacidae	- native to southern Asia - black hard body with a cephalic horn larger in molds	- damage coconut palms - feeds on tissue juices - kill seedlings of palm tree - create bore into the crown of palms forming a "V" shaped cuts of fronds that unfurl

Marine Species List::

Source: Skelton, P.A., South, R.G. and Seeto, J. (2008) *Marine Invasive Species Survey of Apia Harbour, Samoa: National Marine Biodiversity Conservation Project*. Apia, Samoa.

Scientific Name	English Common Names	Samoan Common Names	Family	Form	Habitat/Area of occurrence	Invasive in
<i>Acanthophora spicifera</i>	Red seaweed		Rhodomelaceae	Marine plant	Attached to rubble, dead shells, rocks or other hard items in sandy to muddy habitats, from the intertidal to the subtidal.	Native - invasive in some places (e.g. Hawaii), but not in the Pacific islands where it is considered native.
<i>Anadyomena stellata</i>	Crispy green-bladed seaweed		Anadyomenaceae		On rocks, large boulders in shallow sub-tidal area	

Scientific Name	English Common Names	Samoan Common Names	Family	Form	Habitat/Area of occurrence	Invasive in
<i>Balanus amphitries</i>	Striped barnacle		Balanidae	Marine animal	Attached to any solid substratum usually high intertidal areas eg, pylons, piers, pipes & vessels around the Apia wharf. Inner Harbour fringing reef	Probably introduced and naturalized in Samoa. Considered an introduced and invasive in the Hawaiian Islands
<i>Bugula neritina</i>	Red branching bryozoan		Bugulidae	Marine animal	Attached to buoy in the inner harbour	Introduced. Native to the Caribbean believed to have been introduced to many areas, especially in Australia, Southeast Asia and the Red Sea, Indian Ocean and the Mediterranean.
<i>Carijoa riisei</i>	Branching pipe coral, orange soft coral		Clavulariidae	Marine animal	Attaches on artificial hard substrates and grows well in turbid waters	Introduced. Invasive in places like Hawaii.
<i>Codium arenicola</i>	Dead man's fingers	Limu	Codiaceae	Marine plant	Found in Apia harbour specifically in the degraded reef slope areas of Vaiala & the blue holes at Matautu	Introduced possibly from Asia. Similar species of <i>Codium</i> have been proven highly invasive, specifically <i>Codium tomentosoides</i> in New Zealand and South Australia.
<i>Codium ovale</i>	Spongy ball alga	Limu momi lapotopot o	Codiaceae	Marine plant	Degraded reef slope areas of Vaiala & the blue holes at Matautu	This is the first record of this species from Samoa. It was found with <i>Codium arenicola</i> which may suggest that it is a recent introduction.
<i>Dictyosphaeria cavernosa</i>	Hollow button weed		Siphonocladaceae	Marine plant	Intertidal and in sheltered tide pools, on dead corals and on larger algae.	Native to Hawaii, serious blooms have caused ecological impact to its reefs.
<i>Didemnum perlucidum</i>	White crust tunicate or Colonial ascidian		Didemnidae	Marine animal	Subtidal, usually overgrowing coral reef substratum (dead corals, seaweeds, sponges) and artificial substrata. Found growing on wharf pylons.	First described from Guadeloupe and since been reported from throughout the Indian and Pacific oceans, including Guam, New Caledonia and French Polynesia. Considered a recent introduction to Hawaii and other parts of USA.
<i>Gracilaria ephemera</i>	Ephemeral seaweed		Gracilariaceae	Marine plant	Shallow man-made pond near the Apia harbour	
<i>Gymnangium sp.</i>	Golden sea fern		Aglaopheriidae	Marine plant	Found on coral reefs, usually in narrow crevices where water flow is moderately strong	Introduced
<i>Marginella sp.</i>	Margin shells		Marginella	Marine animal	Found in intertidal-shallow waters under rocks, in sand and in algae beds	Introduced. Native in the Caribbean. Only dead shells was found during the survey.
<i>Penaria disticha</i>	Christmas tree hydroid/Feather hydroid		Pennariidae	Marine animal	Attached to artificial & natural hard substrata where there is moderate water movement. Very common as a fouling organism on wharf pilings.	Introduced. Widespread throughout the Indo-Pacific.
<i>Percnon quinotae</i>	Crab	paa	Plausiidae	Marine animal	Observed on buoys	introduced

Scientific Name	English Common Names	Samoan Common Names	Family	Form	Habitat/Area of occurrence	Invasive in
<i>Renouxia antillana</i>	Red algae		Rhodogorgonaceae	Marine plant	Sub-tidal from 1-15m depths	Possibly introduced. New record for Samoa.
<i>Sargassum</i> spp	Brown seaweed	<i>Limu faaleaga mea</i>	Sargassaceae	Marine plant	Common intertidal-shallow sub-tidal, attached to hard substrata	Native species which is now becoming invasive
<i>Spatoglossum macrodontum</i>	Brown seaweed		Dictyotaceae	Marine plant	Confined to the sub-tidal from 3-15 depth, at a degraded site in Vaiala. On rock and rubble, on a sandy, silty substratum. Only a few fragments were collected from a subtidal site near Mulinuu (west)	Introduced with an invasive tendency
<i>Tetraclita japonica</i>	Acorn barnacle		Tetraclitidae	Marine animal	Sites with strong turbulence intertidal Spotted on buoy no. 2, Inner Apia Harbour	Introduced

Attachment 5: Examples of Invasive Species Management Project in Samoa

Priority projects being planned for implementation during the period of this Action Plan

Example 1: Eradication of rats and crazy ants from high priority conservation islands in the Aleipata Marine Protected Area

Eradication of established invasive species is not possible in many situations. However, small offshore islands offer a unique opportunity to achieve such an objective. An eradication project is planned for 2008, to remove rats and crazy ants from the Aleipata islands of Nu'utele and Nu'ulua. The islands are identified as a significant and high priority component of the Aleipata Marine Protected Area, as they represent some of the last remaining habitat for many of Samoa's endangered native wildlife, including threatened bird species. These islands contain a unique range of biodiversity, including the most significant remaining turtle and seabird nesting sites, and are a refuge for the rare ground dove, other land birds and also bats. A goal outlined in the Aleipata Marine Protected Area Management Plan states that: "*the offshore islands (Nu'utele, Nu'ulua, Fanuatapu and Namua) will have a restoration program designed and implemented focusing on rat eradication, endangered birdlife (land and sea bird) and other native wildlife conservation*".

Example 2: Assessment of management techniques and the biological characteristics of the widespread *Merremia* vine at O le Pupu Pu'e National Park.

O le Pupu Pu'e National Park has been identified in the NBSAP as one of the high priority management sites affected by *Merremia* vine. A manual control plot is being developed as part of the current National Parks and Reserves Work Plan 2008/2010. This on-ground action assess the effectiveness of various management techniques in the control of *Merremia*.

Example 3: Control of myna birds

The continuing population expansion of the common myna (*Maina fanua; Acridotheres tristis*) and the jungle myna (*Maina vao; A. fuscus*) is of significant concern. They are particularly aggressive and territorial birds which actively compete with native species for food and nesting sites. They are also negatively impacting crops by feeding on bananas and papaya.

A trial project has been completed under the joint DEC/SPREP *Samoa Bird Conservation Project*, which tested the feasibility of a selective and humane multi-catch trap that was designed and tested in Australia. The trial was

undertaken in Apia, and the success of the trial expanded the implementation of the project through partnerships with villages. Currently the Government is planning a major national control program for the myna bird.

Example 4: Mt. Vaea Restoration Project

The first phase of a long term project led by MNRE and Conservation International (CI) to restore the Mt. Vaea Forest Reserve to its original native vegetation has been completed. The objective of the project is to successfully manage invasive weeds in the reserve and replant the area with native species. Furthermore, the lessons learnt from this project will have wide application for the management of invasive weeds throughout Samoa and overseas.

Project planning activities began at the end of 2007 with a plant inventory and survey of the 78ha project area within the reserve, which took 6 weeks to complete. Protocols are being drawn up for monitoring of other biota, such as skinks and molluscs. In addition 12 bird survey stations have been identified in the reserve and surveys are being carried out every 3 months, before, during and after the restoration work. A consultant for CI led the vegetation survey, and has analysed the data and developed a 5-year restoration plan which includes research into the removal and management of 5 key invasive tree species severely impacting the reserve at present. It is hoped that implementation of the restoration plan will commence in 2008, once further funds have been secured.

Example 5: The Rattan Palm Management

The Rattan Palm (*Calamus caesius*) was intentionally introduced in the early 1990's by the Samoan Forestry Division (then of MAFF) for trial and observation through a FAO sponsored programme investigating its' potential as a commercial crop species for furniture production in Samoa. The palm was planted for trial in three main locations on Upolu Island (Vailima, Papaseea and Togitogiga) but there is a great concern over its un-intentional spread (by man or other animals such as birds or rats) to other parts of the country. So far, little has been documented about where rattan was planted in Samoa making the work of the SNITT team quite complicated. The information gathered through informal discussions with the forestry staff have been used as the basis for planning and implementing the eradication programme.

In 1998 when it was advised that this plant had potential invasiveness, an eradication attempt was made. Unfortunately, many plants were missed in the original eradication effort or actually re-established. Plants at Papaseea have actually flowered, seeded and produced thousands of seedlings, which are being removed and will require continued monitoring for the next several years. Should Rattan Palm become naturalized in Samoa it could render agricultural lands unsuitable for cultivation and be a serious threat to our native forests, making the eradication of this plant a management priority for Samoa.