# Compilation and Review of Invasive Alien Species Information for Niue

Draft Report for the Department of Environment

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## Glossary and Definitions

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.

INTRODUCED (= ALIEN 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.

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.

SURVEILLANCE

Monitoring to detect the arrival of new incursions of invasive species.

MONITORING

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

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.

CONTAINMENT

Keeping an invasive species within a defined area.

CONTROL

Reducing the population of an invasive species.

BIOLOGICAL CONTROL / BIOCONTROL

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.

Definitions as set out in the *Guidelines for Invasive Species Management in the Pacific*

# Compilation and Review of Invasive Alien Species Information for Niue

## Introduction

A Global Environment Facility (GEF) funded project is currently being implemented in Niue titled the "*Prevention, Control and Management of Invasive Alien Species in the Pacific Islands".* This is a multicountry project and includes the Cook Islands, Federated States of Micronesia, Kiribati, Marshall Islands, Niue, Papua New Guinea, Palau, Tonga, and Samoa. Activities within the framework of this project include the conservation of priority species and ecosystems and the management of Invasive Alien Species (IAS).

Key activities identified by Niue include

a) Increase public awareness on invasive species through media, workshops, and school presentations: key messages to include feral dogs and cats, domestic pig management, invasive species risks and impacts
b) Write a national strategy and action plan, including emergency response
c) Training/capacity needs are identified and training programs for key invasives management issues are developed and implemented in Kiribati, Niue, PNG and Samoa
d) Build quarantine facility for inspection and housing of organisms suspected of being invasive and items carrying them
**e) Review and compile a Niue IAS bibliography, a database for IAS information, and add data to PESTLIST database**
f) Carry out consultations and improve invasive species legislation, including quarantine act and regulations, provisions for entering private property, ballast water legislation. Use regionally harmonized biosecurity bill if appropriate
g) Develop and establish long term monitoring and GIS for areas with important native biodiversity that may be impacted by invasives
h) Risk assessments
i) Establish risk assessment systems for proposed new introductions and established invasives
j) Review existing pig management strategy, identify achievable management goals, and redesign and implement program
k) Conduct a pilot feasibility study for ten priority weed or vertebrate eradication targets
l) Eradicate invasive species identified in feasibility study

Before any biodiversity conservation planning and action is undertaken, sufficient biological and related information must be gathered in order to make informed decisions and establish appropriate priorities for the formulation of an effective and practical strategy and action plan. Biodiversity information management including data and information on the threats to biodiversity are critical to the success of these projects. Access to, and availability of current and credible biodiversity data and information are a must for setting conservation action priorities, managing pathways of introduction, spread and control of IAS and other threats to biological diversity. Pertinent socio-economic information such as population demographics, land use, trade and economics are necessary and useful to take informed decisions.

This review and compilation of data and information meets one of the targets in the list of activities identified and listed above. The data and information compiled on the impacts of IAS and other key threats on the biodiversity of Niue (focused on endemic and native species that have been assessed using the IUCN Red List criteria and those listed in the National Biodiversity Strategy and Action Plan-NBSAP), and natural areas (focused on those that have been designated as areas of high biodiversity value), aims to provide a resource that can aid in decision making on the management of this threat.

The following areas were identified for this Desk-top review

- IAS known to be present in Niue, developing an annotated inventory
- Priority Pathways of introduction and spread of IAS
- Native species that are assessed as threatened and threats to these species with a focus on IAS but including other threats such as biological resource use, pollution, climate change, human disturbance
- Priority conservation areas, biodiversity they contain and threats to these areas with a focus on IAS and
- Biodiversity and IAS projects undertaken and on-going in Niue

A comprehensive desk-top review was undertaken. Journal articles, reports, project documents and data and information from all significant databases was surveyed for relevant information. All the data and information collated was structured into annotated inventories.

All data and information collated are compiled in sortable annotated lists in Excel format that facilitate analysis and allow users to store, filter, manipulate and graph data. These inventories are annexed to this report (see **Niue Inf 1- Inf 6**). All source information collated has been stored and will be presented.

A concise discussion is presented based on a synthesis of the data and information collated highlighting key endemic and threatened species, threatened ecosystems, conservation issues and key IAS already occurring in the country or at the verge of potential invasion.

The discussion is presented in five sections

- ✓ Section 1- describes the biodiversity of Niue
- ✓ Section 2- describes the priority conservation areas of Niue
- ✓ Section 3- presents a comprehensive account of introduced and invasive species in Niue including their impacts on native and endemic species and priority conservation areas
- ✓ Section 4- presents information on pathways and vectors of introduction and spread of alien and invasive species relevant to Niue
- ✓ Section 5- describes Biodiversity Conservation and Invasive Alien Species Management Projects in Niue

# SECTION 1

## Niue and its biodiversity

Lying west of the Cook Islands and east of Tonga the nation of Niue consists of a single island, the largest raised coral atoll in the world. The island still has an extensive forest cover (65-70% of the land area) though only about 1/6 of this is primary forest. There are five types of natural forest: littoral shrubland, littoral forest, coastal forest, mature forest and secondary forest. There are no streams or rivers or any running water on Niue.

Niue is not biodiversity rich being a relatively young island and isolated from biodiversity hotspots. Documented native terrestrial species include 175 species of vascular plants, 31 bird species, 5 lizard species, 8 species of land crabs, 376 insect species, including 18 species of Indo-Pacific ants and one mammal. Of the 31 bird species , 15 breeding birds and 16 non-breeding birds have been confirmed on the island with two endemic sub-species the Heahea (*Lalage maculosa whitmeei*) and Miti (*Aplonis tabuensis brunnescens*). Marine biodiversity include 70 coral genera, over 240 fish species, 2 species of marine turtles, whales, over 20 species of invertebrates including crabs, giant clams, beche-de-mer and others[1].

Threats to biodiversity include biological resource use, land use change, agriculture & aquaculture, logging, natural system modification, climate change and severe weather impacts and the **impacts of invasive alien species (IAS)**

## Conservation of biological diversity in Niue

Niue is a Party to the Convention on Biological Diversity (CBD). Niue's commitments to the CBD are the basis of all priorities related to the conservation of biological diversity.

The Government of Niue acceded to the CBD in 1996, and the Cartagena Protocol on Biosafety[2] to the CBD in 2003.

The principle instrument for implementing the CBD at the national level is the National Biodiversity Strategy and Action Plan (NBSAP). Niue developed a NBSAP in 2001 formulating a strategy and planned actions for the conservation of biodiversity and its sustainable use. Seven themes are grouped for action- terrestrial habitats, terrestrial species, marine biodiversity, governance, waste management and water resources, **alien invasive species** and public awareness and education.

Measures taken for the implementation of the Convention and their effectiveness have to be reported to the Convention in National Reports. Niue has submitted the First, Second, Third and Fourth National report in 2001, 2002, 2005 and 2009 respectively. A National Report to the Cartagena Protocol was submitted in 2001.

Island biodiversity, mountain biodiversity, forest biodiversity, Inland water ecosystems etc. are thematic programmes under the CBD. Protected Areas is a cross-cutting issue within the CBD[3]. Each of these themes has a programme of work, in the case of protected areas known as the Programme of Work on Protected Areas (PoWPA). Countries are also required to submit action plans related to the PoWPA. Niue submitted a PoWPA Action Plan in 2011.

Niue has ratified the Kyoto Protocol, and, acceded to the World Heritage Convention (WHC) and the United Nations Convention to Combat Desertification (UNCCD). Niue has also signed the Memorandum of Understanding for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region[4]

[1] Niue National Capacity Development Strategy and Action Plan 2008 <http://www.thegef.org/gef/sites/thegef.org/files/documents/document/ncsa-niue-fr-ap.pdf>

[2] The Cartagena Protocol on Biosafety to the CBD is an international agreement which 'aims to ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health'. It was adopted in 2000 and came into force in 2003.

[3] A "protected area" is defined in Article 2 of the CBD as "a geographically defined area, which is designated or regulated and managed to achieve specific conservation objectives"

[4] SPREP Multilateral Environment Agreements (MEA) Database <http://www.sprep.org/attachments/MEA_database.pdf>

## Threatened Species of Niue

The following resources have been used to compile records of endemic and native species of Niue that are under risk of extinction and collate information on their conservation status and threats- they include the IUCN Red List of Threatened Species™[5], Niue NBSAP and National Reports submitted to the CBD and the publication and database- Rare plants of Niue[6]

## IUCN Red List of Threatened Species

The IUCN Red List of Threatened Species™[7] provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. Species are classified as Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) are threatened with the risk of extinction. Other categories include Near Threatened (NT), Lower Risk (Conservation dependant) (LR/cd), Least Concern (LC) and Data Deficient (DD). Species that are Extinct (EX) are also included. The IUCN Red List also provides information on the major threats driving the decline of these species populations.

A query on Niue on the IUCN Red List results in an annotated inventory of 527 species that are known to be native to Niue. **The list includes endemic species, species that are present in Niue but have a native range that includes some Pacific countries, as well as those with a world-wide distribution.** These 527 species out of the estimated 623 described species of Niue[8] have been conservation assessed using IUCN Red List criteria and categories. A majority of the assessed species belong to Animalia (519) - and nine to Plantae.

A majority of the these species occur in the marine biome (486) followed by Terrestrial (39) and Freshwater (2) (see Table 1 for a breakdown of species and biomes). In the marine biome most of the species are found in the shallow marine environment from low waters to depths of 200 mts (600 ft) a zone that is characterized by relatively abundant nutrients and biologic activity because of its proximity to land. Together with the estuarine habitat, it is the most productivity in the sea. This is the zone where corals occur and provide the major food source to fish.

50 of the 528 species assessed are classed into an IUCN threatened category (7 'EN' and 43 'VU'one of which is endemic to Niue). 52 species are classified as 'NT' and 486 as 'LC'. 38 species are classified as 'DD' (Please see Table 2 for the breakdown in Red List categories)

The only single country Niue endemic is the flat-tail sea krait (*Laticauda schistorhynchus*); this species is classified as VU. The species has a very restricted range of less than 300 sq kms. A coral-reef specialist it is associated with coral reef systems; it also requires land to reproduce and lay eggs. Degradation of habitat both in the marine and terrestrial habitat is a major threat to the survival of this species. Mass coral bleaching (because of elevated sea temperatures) leads to declines in live corals, altered prey abundance and loss of refuge sites. On land loss of habitat in the inter-tidal region that it uses is mainly due to any coastal development, rising sea-levels and any extreme weather events. No known conservation actions are underway (Lane & Guinea 2010).

[5] IUCN Red List of Threatened Species < http://www.iucnredlist.org/> It must be noted that the IUCN Red List is a global assessment
[6] Thomas, Michael B. and W. A. Whistler. "Page Title." Rare Plants of Niue. CIEER, March 2013 <http://www.cieer.org/efloras/niue_rare/index.php>
[7] IUCN Red List of Threatened Species < http://www.iucnredlist.org/> It must be noted that the IUCN Red List is a global assessment
[8] IUCN-Oceania Regional Office, 2008. Summary of species on the 2008 IUCN Red List <http://www.sprep.org/att/IRC/eCOPIES/Countries/Niue/41.pdf>

The following species that are native to Niue are those that have wider distribution in the Pacific and globally. Of the seven native species of Niue classified as EN, four are Echinoderms *Holothuria lessoni*, *H. nobilis*, *H. whitmaei* and *Thelenota ananas*. Others include the Giant Wrasse (*Cheilinus undulatus*) (listed on CITES Appendix II), and two reptiles, the green turtle (*Chelonia mydas*) (Listed on CITES Appendix I and CMS Appendix I and II). Deforestation and predation by introduced mammals is noted as a threat to the EN Olive small-scaled skink Skink (*Emoia lawesi*) in American Samoa where the species occurs but no threats are documented in Niue (Allison & Austin 2010).

43 species of Niue are classified as VU. A majority of them (23) are coral species belonging to the following genera *Acropora*, *Alveopora*, *Astreopora*, *Heliopora*, *Leptoseris*, *Montipora*, *Pavona*, *Pocillopora*, *Porites* and *Turbinaria*. Some of the threats to coral reefs are eutrophication, physical disturbance, over-fishing, loss of habitat, sedimentation and predation by crown-of-thorns starfish, leading to coral mortality. A warming climate (where temperature extremes can lead to bleaching and increased susceptibility to disease), increased severity of El Nino Southern Oscillation (ENSO) events and storms, ocean acidification and the spread of coral diseases have been identified as a threat to coral species globally. Coral harvesting for the aquarium trade is another potential threat. Both hard and soft corals that can be used in aquariums are traded (IUCN Red List of Threatened Species).

Other species classified as VU include six Actinopterygii (ray-finned fish) including Bigeye Tuna (*Thunnus obesus*), Blue Marlin (*Makaira nigricans*) and Bumphead parrotfish (*Bolbometopon muricatum*); two Chondrichthyes (cartilaginous fish) including the Whale Shark (*Rhincodon typus*) and Whitetip shark (*Carcharhinus longimanus*); one marine mammal the sperm whale (*Physeter macrocephalus*); three Holothurians *Actinopyga echinites*, *A. mauritiana* and *Holothuria fuscogilva*; and eight seabirds bristle-thighed curlew (*Numenius tahitiensis*), Parkinson's Petrel (*Procellaria parkinsoni*), Chatham Albatross (*Thalassarche eremita*), Campbell Albatross (*Thalassarche impavida*), White-necked Petrel (*Pterodroma cervicalis*), Cook's Petrel (*Pterodroma cookii*), Collared Petrel (*Pterodroma leucoptera*), Buller's Shearwater (*Puffinus bulleri*).

The Fourth National Report of Niue (2009) to the CBD classifies four native species with an 'Endangered' status. They are lupe (*Ducula pacifica*), peka (*Pteropus tonganus*), hega (*Vini australis*) and spotless crake (*Porzana tabuensis*). Their corresponding classification using the IUCN Red List criteria for all the four listed species is LC. Here it must be noted that the conservation status of these species in the IUCN Red List is a global assessment. The Endangered status is a national classification

The complete list of native Niue species that are listed in the IUCN Red List is provided with annotations that include higher taxonomy, synonyms, endemic/native status, IUCN Red List status, common names, biome or system in which the species occurs, year assessed and population trend (see **Niue-Native-Species-Inf-1.1**).

### The Rare Plants of Niue (an extraction from 'Rare Plants of Niue' Michael and Whistler (2013)[6])

Flora of Niue have been documented by several studies since the 18th century and these are accounted in Michael and Whistler (2013) '*Rare plants of Niue'.* Michael and Whistler (2013) document all rare plants in Niue, "most likely due to the following reasons: (1) competition, especially from introduced invasive species; (2) loss of habitat; (3) herbivory; (4) abandonment of cultigens; and (5) natural rarity". The authors cite competition as probably the predominant cause for rarity of these plants. An annotated list of all plants listed in the 'Rare plants of Niue' have been provided in the annexure **Niue-Rare-Plants-of-Niue-Inf-2**. Results of the study and recommendations are described below.

Michael and Whistler (2013)[6] recognise 57 rare flowering plant, fern, and fern-ally as rare on Niue, four of which have been recommended for assessment and inclusion in the IUCN Red List. These are the small epiphytic orchid *Bulbophyllum distichobulbum,* the large littoral grass *Cenchrus caliculatus,* the small littoral herb *Nicotiana fragrans* and the subshrub *Solanum amicorum*.

**Table 1: Species and Biomes**

| Species | Biome |
|---|---|
| 10 | Terrestrial |
| 1 | Freshwater |
| 486 | Marine |
| 6 | Terrestrial/Freshwater |
| 23 | Terrestrial/Marine |
| 1 | Freshwater/Marine |

**Table 2: Native species of Niue that are conservation assessed in the IUCN Red List of Threatened Species**

| IUCN Red List Category | Numbers of species |
|---|---|
| Endangered (EN) | 7 |
| Vulnerable (VU) | 43 |
| Near Threatened (NT) | 52 |
| Data Deficient (DD) | 38 |
| Least Concern (LC) | 387 |

In Niue, there are a number of plant species, which are classified as 'rare'. Rarity in Niuean plants is caused by a number of reasons, and these include:

a) Competition between species, especially from introduced invasive species
b) Habitat loss
c) Herbivory, especially from introduced mammals
d) Abandonment of cultigens in favour of newer, better introduced species
e) Natural rarity

Competition is possibly the most important cause of rarity in Niuean plants. Prior to human settlement, Niuean plant species have developed in a geographically-isolated insular environment for thousands of years, with little change in habitat. Polynesian and later European settlers brought with them alien plant species, which altered the dynamics of native vegetation communities and rapidly spread to new areas, outcompeting native species. Habitat loss is also a significant cause of rarity in Niuean plant species, as

areas of forest were cleared to make way for human habitation and plantations, leading to the extirpation or near-extirpation of many species. The introduction of alien mammals to Niue, such as *Rattus exulans* and *Sus scrofa,* have had negative impacts on native plant species. Rats, in particular, are major seed predators..

There are certain criteria that must be fulfilled before a plant species on Niue can be considered rare, and these criteria are:

a) **Infrequency of collections**. This criterion includes species which have been collected only a few times
b) **Infrequency of modern collections**. This includes species collected once or twice since 1976. The lack of recent specimens is a possible indicator that a particular species is becoming increasingly rare, and requires protection.
c) **Restriction to threatened habitats**. In Niue, this criterion applies to species whose distributions are limited to inland primary forest, which has been cleared over the centuries of human settlement, and is under constant pressures from agriculture and development.
d) **Restricted distribution on Niue**. This includes species which are found in a few relatively small localities on Niue. Species collected once or just a few times in one locality are considered to be restricted in distribution.
e) **Field experience of the author**. The author's experience will determine whether a particular species is indeed rare, or simply under-collected.

Threatened or endangered plants are usually comprised of native species, rare indigenous species have been discussed below; 'the Rare Plants of Niue' resource also includes: rare Polynesian cultigens and rare Polynesian adventives, both groups of which consist solely of non-native plants. These have not been included in this discussion

Rare indigenous species can be divided into four groups: littoral species, inland species (excluding orchids and ferns), orchids, and ferns and fern allies.

Rare littoral species includes plants inhabiting the seashore and whose presence and distribution are affected by the sea, either indirectly or directly. These include *Caesalpinia major*, *Canavalia rosea*, *Cenchrus caliculatus*, *Nicotiana fragrans*, *Operculina ventricosa*, *Portulaca samoensis*, *Solanum amicorum* and *Ximenia americana*

Four of the above species: *Caesalpinia major*, *Canavalia rosea*, *P. samoensis* and *X. americana* are widespread species, but are rare on Niue. *Cenchrus caliculatus*, *N. fragrans* and *S. amicorum* are recommended for inclusion in the National Red List.

Rare inland species include *Allophylus timoriensis*, *Calophyllum neoebudicum*, *Dendrocnide harveyi*, *Drypetes vitiensis*, *Elattostachys apetala*, *Gymnosporia vitiensis, Trema cannabina*, *Wikstroemia foetida*, *Cyrtococcum oxyphyullum*, *Mariscus seemannianus*, *Miscanthus floridulus*, *Pachygone vitiensis* and *Passiflora aurantia*

Rare orchid species include: *Bulbophyllum distichobulbum*, *Bulbophyllum longiscapum*, *Didymoplexis micradenia*, *Eulophia pulchra*, *Geodorum densiflorum*, *Nervilia concolor*, *Tuberlabium papuanum*. All Niuean orchids are on the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendices.

Rare fern and fern ally species include *Angiopteris evecta*, *Amphineuron* cf. *opulentum*, *Diplazium proliferum*, *Lycopodium phlegmari, Monogramma paradoxa*, *Ophioglossum petiolatum*, *Phymatosorus nigrescens*, *Trichomanes taitensis*, *Schizaea dichotoma* and *Vittaria elongata*

Six of the ten listed fern and fern-ally species have only been collected once, and the species *Lycopodium phlegmaria* has not been encountered since 1901 in Niue. Most of these rare fern species are probably found in the areas of remaining forest in the north-central part of the island, as well as in the Huvalu Conservation Area.

# SECTION 2

## Priority Conservation Areas of Niue

The World Database on Protected Areas (WDPA)[9] provides the most comprehensive dataset on protected areas worldwide. The WDPA lists 5 'protected areas' for Niue. These include one Conservation Area (Huvalu Forest Conservation Area), two Heritage and Cultural Parks (Hakupu Cultural and Heritage Park and Traditional village reserves (Fono and Tapu)) and two Marine Reserves (Anono (Namoui) Marine Reserve and Anono Marine Reserve).

Other sites that have been recognised in Niue as areas of high biodiversity value include one Secondary Important Bird Area (the whole of Niue), and a Key Biodiversity Area (KBA) - Huvalu Forest Conservation Area (KBA). Niue is part of two global ecoregions- South Pacific Islands Forests and Tongan tropical moist forests both considered to be 'critically endangered' (see **Niue-Protected-Areas-Inf-3**).

Lack of capacity and enforcements, invasive species, Land-use change and impacts of severe weather events are identified as major threats to the natural areas of Niue. Barriers to effective implementation of conservation activity include a lack of priorities, lack of a management plan, issues with governance (Customary Landownership) (Protected Areas Plan of Work Action Plan, 2011).

***The impact of invasive species on high biodiversity value areas is discussed below.***

# SECTION 3

## Alien and Invasive Species in Niue

The International Union for Conservation of Nature, (IUCN) describes invasive species as "*animals, plants or other organisms introduced by man into places out of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species*." Invasive species can negatively impact native ecosystems and the species they contain. These impacts may disrupt the ecosystem processes, degrade habitats, reduce biodiversity and introduce diseases to flora and fauna

[9] World Database on Protected Areas –Protected Planet < http://www.protectedplanet.net/>

Island ecosystems appear to be more vulnerable to invasions. Island ecosystems tend to have fewer species present and are less complex with distance from the continent; simpler systems are less resilient to new arrivals. Introduced mammal predators (rats, feral cats, mongooses, stoats and pigs) and herbivores (rabbits, deer, goats and sheep), alien invasive plants and introduced diseases have had devastating effects on native and endemic island species and their habitats.

A comprehensive desk-top review was undertaken to compile an annotated inventory of introduced and invasive species recorded in Niue that have impacts on native biodiversity and natural areas (**see Niue-IAS-Inf-4**).

Five main online resources were used they are the IUCN ISSG Global Invasive Species Database (GISD)[10], Pacific Island Ecosystems at Risk (PIER)[11], CAB International Invasive Species Compendium (ISC)[12], FishBase[13] and SeaLifeBase[14]. Additional searches were conducted on Biological Abstracts Database, Google Scholar and other reports. There is a paucity of information on alien species in Niue in peer-reviewed journal articles.

The GISD focuses on alien species known to have negative impacts on native biodiversity and ecosystems. It features over 850 species profiles of some of the most harmful species. While there are taxon and geographical biases on selection of species (due to funding sources and priority themes) that are featured on the GISD, the Oceania region is well represented with a large number of harmful species listed. Other information extracted from the GISD included information on taxonomy, species organism type, common names, habitat type, biome, biostatus information and information on pathways of introduction and spread of these species.

The PIER database is focused on plant species that are known to have been introduced to the Pacific region including the Pacific Rim. Information extracted from PIER included biostatus of alien species at island level, common names in Pacific languages, habitat information and most importantly links to risk assessments conducted for the Pacific region.

CABI ISC is an encyclopedic type of database on invasive alien species that impact biodiversity and livelihoods. CABI maintain compendia on Crop Protection, Forestry, Aquaculture and Animal Health and Production. The CABI ISC lists invasive species that impact biodiversity as well as pests of crops and pathogens. The focus for this project was on species that are known to impact biodiversity and ecosystems.

FishBase and SeaLifeBase are databases focused on all fish species known to science. Data and information included in FishBase includes ecological information, information on traits and distribution at country and ecosystem level including in the introduced range of fish species in the aquatic system (both marine and freshwater). SeaLifeBase consists of similar information on marine species.

396 alien/introduced species have been recorded in natural areas in Niue as a result of the desktop review (365 plant species, one fungi and 30 animal species) [15]. Of the 396 listed species 10 species have uncertain biological status (eight Uncertain if native and two Uncertain if present), 386 are alien to Niue Around 39% (155 species) have been recorded as showing invasive traits or being potentially invasive by

[10] Global Invasive Species Database < http://www.issg.org/database/welcome/>
[11] Pacific Islands Ecosystems at Risk < http://www.hear.org/pier >
[12] CAB International Invasive Species Compendium < http://www.cabi.org/isc/default.aspx?site=144&page=4066>
[13] FishBase < http://www.fishbase.org/>
[14] SeaLifeBase < http://www.sealifebase.org/>
[15] Please note that species that are pests and diseases of agriculture have not been included in this study

information sources consulted and evidenced by impacts. These include 147 plant species, and eight animal species. The remaining 231 species are introduced species that are not specified as being invasive or are not known to be invasive.

A majority of these species occur in the terrestrial habitat (including terrestrial/freshwater and terrestrial/marine), followed by marine.

Annotations that have been recorded for each of the species include higher taxonomy, common names, organism types, species preferred habitats, pathways of introduction and spread, risk assessment scores with links, and any information available on the management of these species.

In the marine habitat the species of concern is the crown-of-thorns starfish (COTS). COTS is native to the Indo-Pacific region, so its provenance in Niue is 'uncertain'. Coral species are the most threatened native species of Niue according to the IUCN Red List of Threatened Species. More surveys are required especially at ports, harbours and high-use areas to determine if any introduced and potentially invasive species have established.

Ten vertebrate invasive species have been recorded, nine on terrestrial areas and one in the freshwater/marine habitat in Niue. They include ship rats, Pacific rats (*Rattus exulans*), house mouse (*Mus musculus*), feral dogs (*Canis lupus*), feral cats (*Felis catus*), feral pigs (*Sus scrofa*), Cattle (*Bos taurus*), wild fowl (*Gallus gallus*), and the Asian house gecko (*Hemidactylus frenatus*) and the Mozambique tilapia (Oreochromis mossambicus).

Rats are seed predators as well as predators of eggs and juveniles of birds species. Ship rats are a potential threat to the endemic Miti/ Polynesian starling (*Aplonis tabuensis brunnescens*), Hega (*Vini australis*) and reptiles.

There is a great deal of anecdotal information on the impacts of pigs on crops due to their rooting but there is less evidence of impacts on biodiversity and natural areas (both rooting and predation). A feasibility report for the sustained management of feral pigs, Parkes et al (2005) was produced for the New Zealand Agency for International Development . It proposed dealing with pigs in three phases 1) better management of domestic pigs and 2) Initial control of feral pigs and 3) sustained control or eradication. Options suggested include hunting and consumption, use of snares and traps, using baits, hunting with trained dogs etc. The project was implemented in the years 1998-1999.

The Asian house gecko is a potenial competitor of native geckos, if it spreads widely.

Wetterer (2006) reports 33 ant species in Niue, 18 Indo-Pacific natives and 15 alien species. Alien species include the Yellow-crazy ant (*Anoplolepis gracilipes*), *Cardiocondyla emeryi*, Roger's ant (*Hypoponera punctatissima*), Singapore ant (*Monomorium destructor*), bicoloured trailing ant (*Monomorium floricola)*, robust crazy ant *(Paratrechina bourbonica*), crazy ant (*Paratrechina longicornis*), forest parrot ants (*Paratrechina vaga*), Big-headed ant (*Pheidole megacephala*), little yellow ant (*Plagiolepis alluaudi*), *Strumigenys lewisi*, *Strumigenys rogeri*, black-headed ant (Tapinoma melanocephalum), similar groove-headed ant (*Tetramorium simillimum*), and *Tetramorium smithi*.

Two of these ants are recorded as being invasive, they are the yellow crazy ant and big-headed ant. The yellow crazy ant is not so widespread as yet. It poses a threat to the country's lizards and invertebrates including the iconic coconut crab (*Birgus latro*).

Other introduced insects of concern include the Southern house mosquito (*Culex quinquefasciatus*) and the yellow-fever mosquito (*Aedes aegypti*).

365 introduced, invasive and potentially invasive plant species are present in Niue, the majority are herbs, vines followed by grasses.

Risk assessments have been undertaken for several hundred plant species in most cases by the Hawai'i Pacific Weed Risk Assessment group and listed on the PIER database. Information on these assessments including scores achieved and links to the assessments have been provided in the matrix. The risk assessment documents are a good source of credible ecological information on the species. Risk assessments are available for 217 species, a majority have achieved scores that denote they are high risk (119) or species to be 'rejected' (37). Details on the risk assessments, scores and links have been recorded in **Niue-IAS -Inf-4**.

Two assessments of introduced and invasive plant species have been conducted in Niue in the early 2000's, Space & Flynn (2000) and Space et al (2004), the latter after destruction by Cyclone Heta. Annotations from the above two studies have been recorded in the matrix **Niue-IAS -Inf-4** including recommendations.

Space et al (2004) listed five species as subject to control and eradication programmes, these include coral vine (*Antigonon leptopus*), Honolulu rose (*Clerodendrum chinense*), money plant (*Epipremnum pinnatum* cv. 'Aureum'), giant sensitive plant (*Mimosa diplotricha*) and Wadelia (*Sphagneticola trilobata*). Details of management action undertaken to manage Wadelia is described below. *Information on other management action will be updated once information is received*

### *Wadelia a recent introduction to Niue- information on management action undertaken*

*Sphagneticola trilobata* (commonly known as Wadelia) is a member of the Asteraceae family, native to tropical America, but cultivated as ornamental groundcover in many tropical and subtropical countries. The species was first recorded in the Pacific Islands shortly before 1965 (Thaman, 1999). Due to its vigorous vegetative reproduction, the species has now escaped cultivation in most Pacific Island countries and in many cases, has become a noxious weed colonising extensive areas. It is usually found in disturbed areas, but is also able to colonise undisturbed areas along coastlines and margins of swamps and mangroves, where it outcompetes native coastal herbaceous species.

The species appears to be a fairly recent introduction in Niue, as it has been encountered in only a few locations; however, the species is believed to be spreading and becoming naturalised. There is the possibility that the weed can colonise large areas of the island and negatively impact on the coconut crab, an economically and culturally significant species, as well as on other native faunas (Thaman, 1999).

Before eradication of *Wadelia* from Niue, the Plant Protection Service of the Secretariat of the Pacific Community assessed several crucial factors on the species' impact on agricultural development (Liebregts, 2001). These factors were:

1. The weed's limited distribution to roadsides and residential areas

2. Vegetative reproduction, which decreases rate of spread as well as apparent infertility of flowers
3. Rapid invasion of the weed into plantation and forests
4. The lack of usefulness of the weed
5. Availability of herbicides effective in controlling the weed
6. Estimated costs of the campaign
7. The anticipated short duration of the campaign

A list of actions were taken as part of the process to eradicate the species from Niue, and these included the declaration of *Wadelia* as a noxious weed, the uprooting of the species where it is found, subsequently followed by an application of Round-up to the entire area of infestation, the placement of signs providing information to the public on the eradication programme in progress, as well as the spread of awareness programmes on the invasiveness of the species and its potential impacts in order to garner public support in identifying more areas of infestation.

A progress report in March 2001 stated that eradication commenced in the first week of March 2001, where areas of infestation were identified and marked, measured and, using a knapsack sprayer, was treated with a solution of Round-up (glyphosphate at 10ml/l). Public awareness was spread by the strategic placement of signboards at major sites around the island. A TV interview was also broadcast. Prior to the start of the eradication programme, a conducted survey indicated that the species was present in a total of 35 sites in 11 villages.

It was found that since the TV interview, 11 new infestation sites were reported by the public, all of which were visited, measured and assessed for treatment.

Application of Round-up was found to reduce *Wadelia* cover by 50 to 70%. It was believed that volume of herbicide applied was insufficient. Heavy rainfall was also believed to have affected the treatment. With the depletion of Round-up, Gramoxone was used and it was found that a single application caused intense defoliation and killed many green stems.

In July 2001, a second progress report stated that a further 6 infested sites were reported due to an increase in public awareness on the weed. There were 52 sites in total. It was found that the eradication programme had made excellent progress, with the weed having been removed in most of the sites that were inspected. Surveillance and continuous monitoring will be undertaken at all treated sites for any regrowth and to determine appropriate times for further application of herbicides. Public awareness programmes will be increased during this period, and any report of *Wadelia* infestation should be responded to immediately (Thaman 1999, Liebregts 2001)

Currently there are no active projects on the mangement of Wadelia due to lack of resources. No data has been documented on the spread of this species recently.

### Impacts of Invasive species on areas of high biodiversity value

Invasive species threats to terrestrial protected areas include degradation of habitat by rooting pigs, habitat loss and alteration due to the spread of invasive alien plants, predation of eggs and juveniles of native birds by rats especially the ship rat.

There is limited information available on the threats to individual sites including marine protected areas.

#### *Huvalu Forest Conservation Area and Key Biodiversity Area*

The Huvalu Forest Conservation Area is situated on the eastern part of the island covering an area of approximately 54 km2 (5,400 ha) surrounding the largest area of primary forest in Niue. It is located between Liku to the north and Hakupu to the south and also includes an area of reef platform about 15 to 20 metres from the high tide mark. This protected area contains all the significan native species of Niue, native birds, peka as well as th native crab.

Huvalu Forest Conservation Area is divided into three areas according to local traditional practices. The core of the reserve around 100 hectares in size is tapu, a most sacred site, and hunting, logging or even research is prohibited. A surrounding area of about 2500 ha of primary forest provides some protection to the core, but is used for hunting and other activities under the management of landowning families and the two village councils. Outside this is a buffer zone of approximately 2800 ha of agricultural land subject to controlled, shifting cultivation to ensure sustainability (Protected Areas Programme of Work Action Plan, 2011).

This area is also classified as a Key Biodiversity Area (KBA) (Conservation International). An assessment was made of the management of the Huvalu KBA conducted survey with support from the Critical Ecosystems Partnership Fund (Polynesia-Micronesia Hotspot) in 2011. A comprehensive report (Butler et al 2012)[16] describes the status of all native species within the area, bird surveys and reptile surveys were undertaken. Status of populations including causes of decline has been documented. The authors observe that the impacts of forest clearance is not significant. Unsustainable hunting remains a major threat.

IAS threats are described: introduced mammal feral cats and ship rats especially predation of eggs and juveniles of native birds are a major threat. Rooting feral pigs the degrade habitats remain a threat although the authors did not observe any significant damage. Pigs are also known to predate on eggs. While Yellow crazy ants were not found to be widespread, they are a potential threat to crabs and reptiles.

This important conservation area is a priority of national conservation action (see **Niue-Biodiversity-IAS-Projects-Inf-6** for more details**)**

## SECTION 4

### Pathways of introduction and spread

Information on the identity of the pathways of introduction and spread of IAS along with details of vectors are necessary for the prevention of introduction of potentially invasive species and also for the containment of further spread of established invasions. This knowledge allows conservation managers to a) Prepare for the arrival of known (and unwanted) potentially invasive species (and other species of

[16] Report to CEPF <http://www.cepf.net/SiteCollectionDocuments/poly_micro/FinalReport_SPREP_FaunaNiueHuvaluForestKBA.pdf>
Butler, D.J., Powlesland, R.G. and Westbrooke, I.M. 2012,. Status of birds, peka (flying foxes) and reptiles on Niue Island – Apia, Samoa : SPREP, 2012.<http://www.cepf.net/SiteCollectionDocuments/poly_micro/Status_birds_Niue_12.pdf>

uncertain status that may prove to be likely to become invasive as determined by a risk assessment), b) Develop monitoring systems for yet unknown (and unwanted) potentially invasive species applicable in specific areas or industries, c) Establish barriers (physical, legislative, community-managed) to the introduction of unwanted species, d) Prepare for the spread of recognized IAS that have already entered a country (or ecosystem) and e) Develop communication campaigns and codes of conduct addressing key stakeholders to support preventative measures (from the Invasive Alien Species Pathway Management Resource[17])

The two key pathways of entry of introduced and potentially invasive species into Niue are through the Air and Shipping (including visiting yatchs) services. Tourist numbers to Niue are not very high . New Zealanders and returning Niueans are listed as the main visitors[18].

Where pressurized aircraft cabins and holds are not screened or treated it is possible for mammals and invertebrates to enter these areas prior to a flight, survive the journey and be released on arrival at the destination. Whilst this may not always happen in adequate numbers for the species to establish in the new location, however it has been shown that for some invasive species the main vector for transference has been an aircraft. Yellow crazy ants (*Anoplolepis gracilipes*) have been spread from their natural range by becoming accidental stowaways on aircraft causing these species to establish globally. The yellow crazy ant through its ability to forage night and day and extremely competitive foraging techniques is causing severe environmental damage through displacing keystone species and by degrading leaf litter, reducing seedling recruitment and speeding up microbial decomposition processes.

Ships ballast water has been the introduction pathway for many damaging and costly invasive species. The ballast water that is pumped into tanks to stabilise cargo ships is continually loaded and discharged to balance a continually changing freight manifest. Water can be taken on in large quantities in one harbour and then discharged in the next; this may be a few kilometres away, or in a new country several thousand kilometres away. When the water is taken on board and likewise when it is discharged there are few controls on what is taken on board in the water, in this way species are spread around the planet and this vector has been the cause of the spread of a large number of pest species.

Ships including yachts also move simple static species when these attach themselves to the ship and form a small colony on a ship's hull. This can develop during a voyage, or between periods of renewed anti-fouling, and are spread merely by their normal processes of reproduction being on a mobile substrate. Depending on the methods of anti-fouling, when a ship is taken into dry dock and has its hull cleaned species that are removed, if not carefully disposed of, can establish locally when the dock is re-flooded or in adjacent waterbodies and drains. This vector provides for the spread of many mollusc, fanworm, algae and aquatic plant species (Information on pathways from the Invasive Alien Species Pathway Management Resource)

Knowledge of pathways and vectors of spread of established IAS is crucial for their containment. Assessing the risk of spread of species is important especially for taking decisions regarding the allocation of scarce resources for the control of established invasive species. Information on pathways and vectors of spread of introduced and invasive species that are known to be present in Niue is provided in **Niue-IAS-Inf-4**. Information on Risk assessment and links to assessments are included for species for which information was available.

[17] The Invasive Alien Species Pathway Management Resource is a toolkit under development <http://www.pathway-toolbox.auckland.ac.nz/>

[18] Statistics Niue <http://www.spc.int/prism/niue/>
New Zealand Ministry of Foreign Affairs and Trade <http://www.mfat.govt.nz/Countries/Pacific/Niue.php>

A sortable list of species and corresponding pathways has been compiled for nearly 900 global alien and invasive species. Both long distance pathway methods and short distance pathways (annotated as 'local') have been listed (see **Pathways-Niue-Inf-5**). This dataset has been compiled from the GISD. Included in the list are known invasive species that are featured in the GISD and their corresponding pathways.

# SECTION 5

## Biodiversity Conservation and Invasive Alien Species Management Projects in Niue

A review was undertaken to compile a list of biodiversity conservation and IAS management projects active in Niue and implemented in the recent past (**see Niue-Biodiversity-IAS-Projects-Inf-6**).

Over 10 individual activities have been recorded, most of them being related to biodiversity conservation. These include the development of the National Biodiversity Strategy and Action Plan and several biodiversity related projects.

Excerpt from Niue and GEF[19]- *Since joining the GEF, Niue received GEF grants totaling US$1,274,930 that leveraged US$105,000 in co-financing resources for seven national projects. These include **three projects in biodiversity**, two in climate change, one multi-focal area, and one in persistent organic pollutants. Similarly, Niue participated in 17 regional and global projects financed by the GEF totaling US$102,267,857 that leveraged US$311,200,879 in co-financing resources. These include five projects in climate change, four in international waters, **four in biodiversity**, two in persistent organic pollutants, one multi-focal area, and one in land degradation. Additionally, Niue, as part of the sub-regional GEF Small Grants Programme, received financial support totaling US$1,447,027 that leveraged US$ 633,949 in co-financing for 105 projects executed by civil society and community-based organizations for the entire sub-regional program. During the current GEF-5 replenishment period (July 2010 - June 2014), Niue received an indicative allocation to **formulate and execute projects for US$1,500,000 in biodiversity**, US$2,000,000 in climate change, and US$1,050,000 in land degradation. To date, Niue has not utilized its STAR allocation.*

Key activities identified by Niue within the framework of the GEF-PAS '*Prevention, Control and Management of Invasive Alien Species in the Pacific Islands*' include the conservation of priority species and ecosystems and the management of IAS. Current progress of these activities has been indicated.

*a)* Increase public awareness on invasive species through media, workshops, and school presentations: key messages to include feral dogs and cats, domestic pig management, invasive species risks and impacts – *fortnightly radio programme and awareness programs by the Environment department are on-going*

*b)* Write a national strategy and action plan, including emergency response – *this activity is currently being implemented*

*c)* Training/capacity needs are identified and training programs for key invasives management issues are developed and implemented in Kiribati, Niue, PNG and Samoa – *A Biosecurity training has been completed in December 2012 and two follow up trainings are scheduled to be carried out in 2014 and 2015*

*d)* Build quarantine facility for inspection and housing of organisms suspected of being invasive and items carrying them- *Plans are in place to buid the facility in 2014*

[19] Niue and the GEF <http://www.thegef.org/gef/sites/thegef.org/files/publication/Niue%20-%20Fact%20Sheet.pdf>

***e)*** **Review and compile a Niue IAS bibliography, a database for IAS information, and add data to PESTLIST database –*currently in progress***

*f)* Carry out consultations and improve invasive species legislation, including quarantine act and regulations, provisions for entering private property, ballast water legislation. Use regionally harmonized biosecurity bill if appropriate – *a first review has been completed and a second review is to be finalised before Parliament before enactment most likely during 2014*

*g)* Develop and establish long term monitoring and GIS for areas with important native biodiversity that may be impacted by invasives – *not yet implemented*

*h)* Risk assessments – *not yet implemented*

i) Establish risk assessment systems for proposed new introductions and established invasives

*j)* Review existing pig management strategy, identify achievable management goals, and redesign and implement program – *not yet implemented*

*k)* Conduct a pilot feasibility study for ten priority weed or vertebrate eradication targets – *not yet implemented*

*l)* Eradicate invasive species identified in feasibility study – *not yet implemented*

## Conclusion

The results of this review provide a baseline for biodiversity data and information for Niue, and a detailed description of the threat of IAS on native species and natural areas in Niue.

Data and information on the distribution of endemic and native species, their conservation status; the extent and distribution of IAS and other threat information are all critical for the prioritization of conservation action. Reliable and current knowledge of the distribution of invasive species, extent of spread and research into the impacts are critical to better management. Information on alien species that have the potential to become invasive, the need for assessing risk before introduction of any alien species and better border control to prevent introductions are other important factors to consider. It is also important to understand which the pathways of spread are so as to prevent the spread of these species from existing infestations. These data and information are necessary for reporting and planning future action.

A two pronged approach was used to access and document data and information for this review- consulting published sources such as databases, journal articles, reports etc.; as well as contacting Department of Environment officials, conservation managers and other practitioners and experts who have been involved in conservation work in Niue. While a considerable amount of information has been collated there are some gaps that have been identified which need to be filled in time.

It is recommended to keep this resource updated by providing all 'new' information to information providers.

An End Note Library has been compiled of various peer reviewed journal articles related to biodiversity of Niue including newly discovered species.

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