

Compile and Review Invasive Alien Species Information for the Cook
Islands

Report for the National Environment Service

Coordinator of the Invasive Alien Species (IAS) in the Cook Islands Project

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January 2014



NATIONAL ENVIRONMENT SERVICE
TU'ANGA TAPOROPORO
COOK ISLANDS



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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*](#)

Compile and Review Invasive Alien Species Information for the Cook Islands

Introduction

A Global Environment Facility (GEF) funded project is currently being implemented in the Cook Islands titled the "*Prevention, Control and Management of Invasive Alien Species in the Pacific Islands*". This is a multicountry project and includes the Niue, Federated States of Micronesia, Kiribati, Marshall Islands, 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 deliverables for the Cook Islands include

Table 1: List of Activities identified by the Government of Kiribati for implementation as part of the GEF funded project 'Prevention, Control and Management of Invasive Alien Species in the Pacific islands'. This information has been extracted from the table of 'Key Deliverables'

RELEVANT OUTCOMES	IDENTIFIED ACTIVITIES
1.1 The impacts of invasive species on biodiversity, economies, livelihoods and health, are widely understood and actions to manage and reduce them are supported.	Develop a community training and awareness program and implement it.
1.1.2 80% of management projects will implement outreach to ensure that the importance of IAS environmental, social and economic impacts is more widely understood.	Carry out awareness program through community workshops and media broadcasts
1.2. The institutions, skills, infrastructure, technical support, information management, networks and exchanges required to manage invasive species effectively are developed. 1.2.1 National invasive Species Coordinators are appointed and multi-sectoral national invasive species committees are formed for seven participating countries and carryout regular meetings 2 or more times per year	Position established to coordinate activities under this project
1.2.2. Seven participating countries update or write National Invasive Species Strategies and Action Plans to ensure a high quality & that they are harmonized with the regional Guidelines for Invasive Species Management in the Pacific.	Write a National Invasive Alien Species Strategy and Action Plan

3.1 Mechanisms are established to prevent the spread of invasive species across international or internal borders and quickly detect and respond to those that arrive.	Revise and enhance risk analysis and EDRR systems with the Ministry of Agriculture to include invasives that impact biodiversity.
3.1.2. Early detection and rapid response (EDRR) procedures are established for priority potential invaders (e.g. snakes, ants, mongoose, plants etc.) for the 5 countries identified in Appendix 6 of the Project	Ship rat early detection surveillance (trapping and monitoring for sign)
3.2. The impacts of established invasive species are reduced or eliminated by eradication, biological control, containment or physical-chemical control.	Determine and implement best management practices for <i>Cuscuta</i> and Beach Burr on Rarotonga and Pukapuka respectively
3.2.1. Best practices are determined and implemented for invasive species management of priority species and sites identified in Appendix 6 of the Project Document.	Determine and implement best management practices for sand flies on Aitutaki and Mitiaro
3.2.2 Priority invasive species are eradicated (completely removed) from islands where feasible (7 projects in 5 countries identified in Appendix 6 of the Project Document).	Eradicate red passion fruit using best management practices.
3.2.3. Biocontrol agents are developed and released for appropriate target invasives for targets in 3 or more countries.	Rearing and redistribution of agents for priority invasive species including <i>Mimosa invisa</i>
5.1. Project integrity and accountability for deliverables is maintained.	Inception workshop, independent evaluations, audits
5.1.1 UNEP standards of transparency, accountability and success metrics are objectively assessed for all ten participating countries:	

The objective of this consultancy is to carry out a desktop review and compilation of relevant databases, documents and literature of IAS of the Cook Islands to assist with the development of an 'Invasive Alien Species, Early Detection Rapid Response System (EDRR)' for the Cook Islands and prioritise and plan management action of IAS already present in the country.

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.

The following areas were identified for this Desk-top review leading to the development of a comprehensive **IAS database for the Cook Islands**

- An annotated inventory of IAS
 - By island, invasiveness and habitat
 - Those that have negative impacts on Cook Island biodiversity and natural areas
- An annotated inventory of 'at risk' invasive species in neighbouring countries with pathways of introduction and dispersal
- An annotated inventory of key endemic and threatened species
- An annotated inventory of designated natural areas and ecosystems

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.

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

The discussion is presented in four sections

- ✓ Section 1- presents a comprehensive account of alien and invasive species in the Cook Islands including their impacts on native and endemic species and natural
- ✓ Section 2- presents information on 'at risk' alien and invasive species present in neighbouring countries and key trading partners including pathways and vectors of introduction and spread
- ✓ Section 3- describes key endemic and threatened species of the Cook Islands
- ✓ Section 4- describes the priority conservation areas and ecosystems of the Cook Islands

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 **Cook Islands Supporting Inf Excel file**). All source information collated has been stored and will be presented.

SECTION 1

Alien and Invasive Species in the Cook Islands

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

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 Cook Islands that have impacts on native biodiversity and natural areas (**see Alien & Invasive Species Inf 1 in Cook Islands-Supporting Inf Excel file**).

Six main online resources were used they are the IUCN ISSG Global Invasive Species Database (GISD)¹, Pacific Island Ecosystems at Risk (PIER)², CAB International Invasive Species Compendium (ISC)³, FishBase⁴ and SeaLifeBase⁵ and the Cook Islands Biodiversity and Natural Heritage Database⁶

A survey of invasive plant species of environmental concern, was conducted by the US Department of Agriculture, Forest Service, Institute of Pacific Islands Forestry in 2002, at the request of the Government of the Cook Islands

¹ Global Invasive Species Database < <http://www.issg.org/database/welcome/>>

² Pacific Islands Ecosystems at Risk < <http://www.hear.org/pier> >

³ CAB International Invasive Species Compendium < <http://www.cabi.org/isc/default.aspx?site=144&page=4066>>

⁴ FishBase < <http://www.fishbase.org/>>

⁵ SeaLifeBase < <http://www.sealifebase.org/>>

⁶ McCormack, Gerald, 2007. Cook Islands Biodiversity Database, Version 2007.2. Cook Islands Natural Heritage Trust, Rarotonga <<http://cookislands.bishopmuseum.org/search.asp>>

The survey was carried out on the islands of Rarotonga, Aitutaki, 'Atiu, Mangaia, Ma'uke and Miti'aro. Species reported by the Cook Islands Natural Heritage Project were used for the other islands (Manuae, Manihiki, Nassau, Palmerston, Penrhyn, Pukapuka, Rakahanga, Suvarrow and Takutea) as well as for some of the uncommon cultivated species on the surveyed islands.

The objectives of the survey were to:

- (1) identify plant species presently causing problems to natural and semi-natural ecosystems;
- (2) identify species that, even though they are not presently a major problem, could spread more widely or are known to be problem species elsewhere;
- (3) confirm the absence of species that are a problem elsewhere and, if introduced to the Cook Islands, could be a threat there; and
- (4) make appropriate recommendations.

(Source: Space and Flynn 2002)

Results of this survey recorded in tables that are relevant to this study have been included in the Supporting Inf (**see Space and Flynn 2002 Inf 1.3.1 to 1.3.3 in Cook Islands Supporting Inf Excel file**)

Additional searches were conducted on Biological Abstracts Database, Google Scholar and other reports. There is a paucity of information on alien species in Cook Islands 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.

The Cook Islands Biodiversity and Natural Heritage database currently provides an annotated inventory of 4256 species (4213 that are extant and 43 extinct)⁷. Species include native, endemic, alien (introduced) including those that are naturalised.

Results of the desktop review indicate that 474 alien/introduced species that are known to have invasive traits (invasive and potentially invasive) have been recorded in the Cook Islands. Of these 435 are plant species, 37 animal species, one Oomycete and one Protozoan)⁸. Of the 474 listed species 1 species has uncertain biological status (*Acanthaster planci*- crown-of-thorns starfish which is known to be native to the Indo-Pacific region). A majority of these species occur in the terrestrial habitat (including terrestrial/freshwater and terrestrial/marine), followed by marine.

A review of databases and literature was conducted to assign biological status to the species based on evidence of impacts and any notes on aggressive growth. 167 species have been classified as 'invasive' while the 'invasiveness' of the remaining 307 species have been listed as 'Not specified'.

⁷ This complete inventory was not extracted for this project as the focus of this activity is on known alien invasive species and key endemic and threatened species.

⁸ Please note that species that are pests and diseases of agriculture have not been included in this study

Records of alien and invasive species have been created by islands where this information was known. However, biological status has been assigned to the country (Cook Islands record). Biological status has also been assigned to islands based on the survey of Space and Flynn in 2002.

Annotations based on PIER attributes 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. (see **Alien-Invasive-Species- Inf 1.1 in the Cook Islands- Supporting Inf Excel file**)

Additionally, an annotated inventory of invasive species impacts on native, endemic threatened species has been recorded. (see **Invasive-Species-Impacts- Inf 1.2 in the Cook Islands Supporting Inf Excel file**). Annotations include the location, invasive species, biological status, impact mechanism and impact outcome.

Space and Flynn (2002) had developed a table of cultivated species in the Cook Islands that could be potentially invasive. This table has been reproduced (see **Space & Flynn Inf 1.3 in Cook Islands Supporting Inf Excel file**)

The review process is a critical part of this project. It is envisaged that all the records created will be reviewed and corrections made and gaps identified. Revisions to the dataset will be made based on comments before finalisation of the invasive alien species inventory.

SECTION 2

Pathways of introduction and spread

Invasive Alien Species Early Detection & Rapid Response (EDRR) comprises of early detection of alien species invasions, identification of the alien species, assessment of risks of its spread and impacts and a development of a rapid response plan

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 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 Resource⁹)

The two key pathways of entry of introduced and potentially invasive species into island nations are through the Air and Shipping (including visiting yachts) services.

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

⁹ The Invasive Alien Species Pathway Management Resource is a toolkit under development
<<http://www.pathway-toolbox.auckland.ac.nz/>>

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.

Inventories of species both native and known invasive species were created for the most significant trading partners of the Cook Islands (in terms of potential introduction of species through human mediated introductions). The countries included Fiji, Tonga, Samoa, French Polynesia, New Zealand, Australia and the United States of America. The lists were merged and compared to the inventory of alien and introduced species in the Cook Islands. The inventory was distilled to a list of species that are known to be invasive and present in the above seven countries but absent in the Cook Islands. Over 1300 species were identified. Pathways of introduction were identified for each of these species and listed. The pathway terms were adopted from the schema used in the documenting of similar information in the GISD. **(see Pathways Inf 2.1 in the Cook Islands Supporting Inf Excel file).**

It must be noted that this exercise of identification of species that may be of potential risk to the Cook Islands was merely one of matching lists of species. No research was conducted to evaluate the potential risk based on climate matching etc.

Space and Flynn (2002) included two tables of information that are relevant to this section 1) "Priority species for exclusion from the Cook Islands" and 2) "Species that are invasive elsewhere in similar ecosystems but were not seen on our visit and are not reported in the literature as being present in the Cook Islands", both of which have been included in this report **(see Space & Flynn 2002 Inf 2.1 and 2.2 in Cook Islands Supporting Inf Excel file)**

SECTION 3

Cook Islands and its biodiversity

The Cook Islands lies about half way between Hawaii and New Zealand and consists of the northern Cook Islands (seven low-lying, sparsely populated coral atolls) and the southern Cook Islands (eight elevated, fertile volcanic isles where most of the population lives).

Rarotonga, in the southern Cook Islands is the largest island at 67 sq km out of a total land area of 236 sq km. Forests on the upper slopes of Rarotonga are some of the best remaining examples of primary montane rain and cloud forest in eastern Polynesia. Coral reefs support over tens of hundreds of fish species, stony corals, molluscs, crustaceans and echinoderms (including 20 sea cucumber species). The diversity and abundance of species is greatest around volcanic islands compared with *makatea* (uplifted islands).

Conservation of biological diversity in the Cook Islands

The Cook Islands is a Party to the Convention on Biological Diversity (CBD)¹⁰. The Cook Island's commitments to the CBD are the basis of all priorities related to the conservation of biological diversity. The Government of Cook Islands acceded to the CBD in 1993. The principle instrument for implementing the CBD at the national level is the National Biodiversity Strategy and Action Plan (NBSAP). Cook Islands developed a NBSAP in 2002 formulating a strategy and planned actions for the conservation of biodiversity and its sustainable use. Eight themes are grouped for action- Endangered species management, Invasive species management, Ecosystem management, Equitable sharing of benefits and access to biodiversity, Management of knowledge related to biodiversity, Biodiversity awareness and education, Mainstreaming of biodiversity, and, Financial resources and mechanisms for biodiversity

Measures taken for the implementation of the Convention and their effectiveness have to be reported to the Convention in National Reports. Cook Islands has submitted the Fourth National report in 2011

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. Each of these themes has a programme of work, in the case of protected areas known as the

¹⁰ Convention on Biological Diversity (CBD) < <http://www.cbd.int/>>

Programme of Work on Protected Areas (PoWPA)¹¹. Countries are also required to submit action plans related to the PoWPA. Cook Islands submitted a PoWPA Action Plan in 2011.

In addition to the CBD, the Cook Islands is a signatory to the Convention concerning the Protection of the World Cultural and Natural Heritage - World Heritage Sites¹², Convention on the Conservation of Migratory Species of Wild Animals (CMS)¹³, Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention)¹⁴- extended to the Cook Islands by New Zealand, and the International Plant Protection Convention (IPPC)¹⁵. Cook Islands has also signed the Memorandum of Understanding for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region¹⁶

Endemic and Threatened Species of Cook Islands

The following resources have been used to compile records of endemic and native species of the Cook Islands that are under risk of extinction and collate information on their conservation status and threats- they include the IUCN Red List of Threatened Species™¹⁷, Cook Islands NBSAP and National Reports submitted to the CBD, and the Cook Islands Biodiversity and Natural Heritage Database.

IUCN Red List of Threatened Species

The IUCN Red List of Threatened Species 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.

¹¹ Programme of Work on Protected Areas (PoWPA)

<<http://www.cbd.int/protected/implementation/actionplans/>>

¹² Convention concerning the Protection of the World Cultural and Natural Heritage - World Heritage Sites <

<http://whc.unesco.org/en/conventiontext/>>

¹³ Convention on the Conservation of Migratory Species of Wild Animals (CMS) < <http://www.cms.int/>>

¹⁴ Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention) <

http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0__>

¹⁵ International Plant Protection Convention (IPPC) < <https://www.ippc.int/>>

¹⁶ SPREP Multilateral Environment Agreements (MEA) Database

<http://www.sprep.org/attachments/MEA_database.pdf>

¹⁷ IUCN Red List of Threatened Species < <http://www.iucnredlist.org/>>

A query on 'Cook Islands' on the IUCN Red List results in an annotated inventory of 611¹⁸ species that are known to be native to the country. **The list includes species that have been declared extinct, endemic species, species that have a restricted range that includes some Pacific countries, as well as those with a world-wide distribution.**

These species have been conservation assessed using IUCN Red List criteria and categories. A majority of the assessed species belong to Animalia (597) - and 14 to Plantae.

A majority of the these species occur in the marine biome (523) followed by Terrestrial (31) and Terrestrial/Marine (22) (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.

63 of the 611 species assessed are classed into an IUCN threatened category (8 'Endangered (EN)' and 55 'Vulnerable (VU)'); 15 species have been declared Extinct (EX). 52 species are classified as 'Near Threatened (NT)', one species as 'Lower Risk- Conservation Dependant (LR/cd)' and 436 as 'Least Concern (LC)'. 46 species are classified as 'Data Deficient (DD)' (Please see Table 2 for the breakdown in Red List categories)

Table 2: Species Biomes

Terrestrial	31
Freshwater	4
Marine	523
Terrestrial/Freshwater	13
Terrestrial/Marine	22
Terrestrial/Freshwater/Marine	6
Freshwater/Marine	12
	611

¹⁸ The actual query result is 612 species- this includes *Homo sapiens* which has been excluded in this case

Fifteen species are listed as 'Extinct (EX)' in the IUCN Red List, these include 14 Gastropods and one bird - the Mysterious starling. Three additional native/ endemic plant species have been listed as 'Extinct/ Extirpated' in the Cook Islands Biodiversity and Natural Heritage Database. The database lists 43 species (including the 15 in the IUCN Red List) as extinct, the 43 species include both native as well as alien species.

Table 3: Native species of Cook Islands that have been conservation assessed using the IUCN Red List criteria

IUCN Red List Category	Numbers of species
Extinct (EX)	15
Endangered (EN)	8
Vulnerable (VU)	55
Lower Risk (Conservation dependant)	1
Near Threatened (NT)	52
Data Deficient (DD)	46
Least Concern (LC)	434

The causes for the extinction of the Gastropods has not been described in the IUCN Red List. Predation by introduced and invasive brown rats (*Rattus norvegicus*) is believed to have caused the extinction of the Mysterious starling.

25 species are listed as Cook Island Endemics in the IUCN Red List, of these 15 are listed as 'Extinct (EX)' (see above) and 10 are Extant (those that are still alive), these include six bird species, three fish and one reptile.

The six endemic bird species are Cook Islands Reed-warbler (*Acrocephalus kerearako*), Rarotonga starling (*Aplonis cinerascens*), Atiu Swiftlet (*Collocalia sawtelli*), Rarotonga Flycatcher (*Pomarea dimidiata*), Cook Islands Fruit-dove (*Ptilinopus rarotongensis*), Mangaia Kingfisher (*Todiramphus ruficollaris*). The only extant endemic reptile is the Cook Islands skink (*Emoia tuitarere*). See Table 3 for the IUCN Red List status of these extant endemic species with comments on the threat of IAS and any conservation action (completed, on-going or

planned) for the conservation of these species populations. [This information is an extraction from the ISSG- Island Biodiversity and Invasive Species Database]

The three endemic fish are all Actinopterygii (ray-finned fish)- Peppermint Angelfish (*Centropyge boylei*), Narc Angelfish (*Centropyge narcosis*) and the fairy wrasse (*Cirrhilabrus claire*). No invasive species threats have been recorded for these species.

63 Cook Island natives are classified as 'Threatened with the risk of extinction', eight classified as Endangered (EN) and 55 Vulnerable (VU). The majority of them are in the marine biome (38), nine occur in Terrestrial/ Marine habitats and eight are Terrestrial species. Endangered species include four sea cucumbers (Holothuridae), the Blue whale (*Balaenoptera musculus*), Giant wrasse (*Cheilinus undulatus*) which is more Endangered in the Southern Cooks than the Northern Cook Islands (pers.comm Ministry of Marine Sources (MMR) February 2014), the the Terrestrial Micronesian skink (*Emoia adspersa*) and the Marine/Terrestrial Green turtle (*Chelonia mydas*). However, there are indications that the Critically Endangered (CR) Hawksbill turtle (*Eretmochelys imbricata*) seems to be more endangered than the green turtle in the Cook Islands (pesr.comm Ministry of Marine Sources (MMR) February 2014).

Species classified as 'Vulnerable (VU)' include 25 hard corals belonging to the Order Scleratina, six Cartilaginous fish (sharks and stingrays), four Ray-finned fish (groupers, marlin and tuna), three sea cucumbers, six land birds - five endemic and the native Blue lorikeet (*Vini peruviana*), eight migratory seabirds, one migratory waterbird, the endemic Cook Islands skink and one plant the Island Nesoluma (*Nesoluma polynesianum*).

Table 4: Status of Extant endemic species of the Cook Islands

SPECIES	CONSERVATION STATUS	THREAT DESCRIPTION
<i>Acrocephalus kerearako</i> (Cook Islands Reed warbler)	Near Threatened	The Cook Islands Reed-warbler occurs on two small islands, Mangaia and Miti'aro. Data on population trends and estimates are currently unavailable. It occurs on a range of habitat types, including woodland, gardens and reeds (BirdLife International, 2012). The primary threat appears to be the presence of as assortment of introduced species, especially on Mangaia Island. The species has to coexist with the aggressive, territorial and invasive common myna (<i>Acridotheres tristis</i>). Potential predators such as cats (<i>Felis catus</i>), Pacific rats (<i>Rattus exulans</i>) and black

		rats (<i>Rattus rattus</i>) are also present within the range of Reed warbler. Agricultural developments as well as extensive browsing by feral goats (<i>Capra hircus</i>) can lead to severe habitat fragmentation and modification (BirdLife International, 2012). The feasibility of eradicating the common myna has been evaluated, at the value of \$100,000 and is supported by local people. Future recommendations for conservation of this species include implementation of this eradication, surveys to determine population size so that future trends can be established, and setting up of protected areas of forest (BirdLife International 2011).
<i>Aplonis cinerascens</i> (Rarotonga starling)	<i>Vulnerable</i>	The Rarotonga starling is endemic to the island of Rarotonga, Cook Islands. The current population is estimated at 600 to 1700 mature individuals (BirdLife International, 2012). It is threatened by a range of invasive species such as the common myna and black rats. The species, like many native avian species, is also susceptible to introduced disease (BirdLife International, 2012). The species is believed to benefit from conservation management of the Rarotonga Monarch, which involves intensive rat control. Recent surveys have successfully provided a more accurate population size estimate.
<i>Collocalia sawtelli</i> (Atiu swiftlet)	<i>Vulnerable</i>	Endemic to the Cook Islands the swiftlet is now restricted to the island of Atiu. The total population is estimated at 350 mature individuals and is thought to be stable (BirdLife International 2011). Main threats to the Atiu swiftlet include predation of chicks by the coconut crab (<i>Birgus latro</i>) and the land crab (<i>Cardisoma longipes</i>). Pacific rats are present on Atiu and may also pose a threat to this species. Disturbance caused by ecotourism in one of the nesting caves could also present a problem (BirdLife International 2011). A programme to control rats has been implemented. The programme includes baiting to prevent arrival of Black rats (not present on Atiu), increased community vigilance through reporting of rats in cargo, and response with traps and toxic bait. Control of Pacific rats close to breeding caves is recommended. Surveys of the population have been conducted and resurveying is recommended. Other recommendations include excluding crabs from breeding caves, monitoring and regulation of tourism and investigating the possibility of translocation to other islands (BirdLife International 2011).
<i>Emoia tuitarere</i> (Cook Islands skink)	<i>Vulnerable</i>	Some taxonomic uncertainty exists in terms of the status of the native Cook Islands skink as a separate species from <i>Emoia trossula</i> . It is found between sea level and 300 meters above sea level, is both arboreal and ground-dwelling and is endemic to Rarotonga in the Cook Islands. Found to prefer areas of intact

		<p>native forest the skink is rare in areas of coastal development. Invasive predators are likely to affect these skinks to a certain degree. Rats (Black rat, Brown rat; Pacific rat), Feral cats, Mice (<i>Mus musculus</i>) and Feral pigs (<i>Sus scrofa</i>) are all present on Rarotonga. It is suspected that populations may be especially susceptible to irruptions of yellow crazy ants (<i>Anoplolepis gracillipes</i>) (Allison <i>et al</i>, 2013). Surveys, monitoring and research to clarify taxonomic status are recommended. It is not known if this species occurs in any protected areas.</p>
<p><i>Pomarea dimidiata</i> (Rarotonga flycatcher)</p>	<p><i>Vulnerable</i></p>	<p>Endemic to Rarotonga, Cook Islands, where its distribution is chiefly confined to the Totokoitu, Turoa and the western Avana valleys. The global population is believed to be stable, and numbers are estimated at 310 mature individuals (BirdLife, 2012). Threats to the population include predation pressures by introduced mammals such as black rats and cats. Other threats include habitat modification or destruction due to weed invasion, forest clearance, and cyclone damage (BirdLife, 2012). A detailed account of management action undertaken for the conservation of this species has been described in Section 4.</p>
<p><i>Ptilinopus rarotongensis</i> (Cook Islands Fruit Dove)</p>	<p><i>Vulnerable</i></p>	<p>Endemic to the Cook Islands, it now only occurs on the islands of Rarotonga and Atiu (BirdLife International 2008). The population is estimated at 250-999 mature individuals (BirdLife International 2011). On Rarotonga, it is commonest in hillside and upland forest, often visiting the horticultural lowland areas. On Atiu, it is found in a wide variety of wooded habitats, including the fringes of plantations as well as forest growing on the makatea (a raised coral limestone platform) (BirdLife International 2011). The Black rat occurs on Rarotonga but does not appear to pose any threat to this species. The introduced common myna is likely to reduce nesting success of this species in horticultural and village areas, but does not penetrate into heavily forested areas. Introduced exotic avian diseases are also potentially a threat to the Cook Islands Fruit-dove (BirdLife International 2011). This species may benefit from conservation measures carried out for the Rarotonga Flycatcher, which includes intensive rat control. Recommendations to manage threats to this species include taking precautions to prevent the introduction of introduced species, especially Black rat on Atiu (BirdLife International 2011).</p>

<p><i>Todiramphus ruficollaris</i> (Mangaia kingfisher)</p>	<p><i>Vulnerable</i></p>	<p>The Mangaia kingfisher is confined to Mangaia island. The population appears to be stable with numbers estimated at between 400 and 700 individuals. It inhabits makatea (raised limestone forest) and mature secondary forest and prefers to nest in coconut and barringtonia tree cavities. The common myna (<i>Acridotheres tristis</i>) competes aggressively with the kingfisher for food and increases the likelihood of nest failure. Cats, Pacific rats and black rats are potential kingfisher predators. In addition browsing goats and pigs increase forest fragmentation and decrease forest regeneration, respectively (BirdLife International 2012). While there have been no conservation actions put in place for the Mangaia kingfisher several studies and invasive species eradication feasibility assessments have been made. In 1996 survey, vegetation and rat-trapping studies were conducted to establish baseline information for conservation. A year later a species census (using the Distance Sampling Method) was conducted. A myna eradication feasibility study in 2006 and concluded that such an eradication would be possible at a cost of NZ\$ 100 000. Finally a study to determine Mangaia kingfisher nesting success in an area with a high density of mynas was started in 2006 (BirdLife International 2012).</p>
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Major threats to the species classified as 'Threatened with the risk of extinction' especially in the marine biome include exploitation (fisheries, aquarium and live food trade), and habitat loss due to anthropogenic causes. Invasive species threats are significant to land birds as well as migratory sea and water birds.

Cook Islands Biodiversity and Natural Heritage Database and the National Biodiversity Strategy and Action Plan (NBSAP)

The Cook Islands Biodiversity and Natural Heritage Database was used as the primary information source to develop the list of endemic and native species that are considered 'seriously nationally endangered' during the development of the NBSAP. 65 plant and animal species were identified- 31 endemic plant species of which 11 species are listed as 'seriously endangered', and 34 native plant and animal species that are classified as 'seriously nationally endangered'. However, no data or information is available on the threats or pressures on these species. It is recommended that this gap needs to be urgently addressed.

The complete list of native Cook Island species that are listed in the IUCN Red List as well as the NBSAP 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 (see **Native-Biodiversity-Inf-3 in the Cook Islands Supporting Inf Excel file**). The data publisher is also listed.

SECTION 4

Priority Conservation Areas and Ecosystems of the Cook Islands

The National Biodiversity Strategy and Action Plan (NBSAP)¹⁹ of the Cook Islands has formulated a set of activities to realise its commitment under-

Theme C: Ecosystem Management

Strategic Goal C: *Conserve important ecosystems through a system of protected areas with regulated and monitored activities.* These activities include

- a) Establish an independent Suvarrow National Park Authority to administer the Cook Islands' only national park on behalf of all the major stakeholders. A management group with the responsibility to conserve the atoll's wildlife, and to monitor and control revenue-generating activities.
- b) Develop a programme to select areas to establish a national system of community-based protected areas to protect important terrestrial ecosystems.
- c) Develop a programme to select areas to establish a national system of community-based protected areas to protect important reef and lagoon ecosystems.

The Cook Islands has developed an 'Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas' - (PoWPA)²⁰ in 2011. The PoWPA Action Plan recognises the status, priority and timeline for key actions of the PoWPA that include the following Actions:

Action 1: Formalization of the National Biodiversity Stakeholder Steering Committee

Action 2: Establishment of the Suvarrow National Park Authority

Action 3: Strengthening of Suvarrow National Park Work Plan

Action 4: Biodiversity Conservation Regulations

¹⁹ National Biodiversity Strategy and Action Plan- Cook Islands, 2002 < <http://www.cbd.int/doc/world/ck/ck-nbsap-01-en.pdf>>

²⁰ Programme of Work on Protected Areas (PoWPA) Action Plan 2011
<<http://www.cbd.int/protected/implementation/actionplans/country/?country=ck>>

Action 5: Ecological Gap Assessment

Action 6: Valuation Assessments

Action 7: Financial Resource Trust Fund

Action 8: Rarotonga Cloud Forest Reserve Park

[Source Programme of Work on Protected Areas (PoWPA) Action Plan- Cook Islands 2011]

The World Database on Protected Areas (WDPA)²¹ provides the most comprehensive dataset on protected areas worldwide. The WDPA lists 18 'protected areas' for the Cook Islands, four in the terrestrial biome and 14 in the marine biome. These include Suvarrow National Park (a whole island protected area) and the Takitumu Conservation Area in southeastern Rarotonga, home of the kakerori (*Pomarea dimidiata*), as well as several areas marked as Ra'ui (Ra'ui is a traditional system whereby access to a particular resources or area is forbidden for a given period).

The Cook Islands Government National Environment Service²² lists several additional protected areas that have been designated primarily for the conservation of species. The lists have been presented by islands, also included are whole island reserves.

Other sites that have been recognised in the Cook Islands as areas of high biodiversity value, these include two Endemic Bird Areas (EBAs)- the Southern Cook Islands EBA and Aitutaki, the secondary EBA area²³. The Southern Cook Islands (EBA) covers the islands of Mitiaro, Atiu, Mauke, Rarotonga and Mangaia. It includes the range of the 'Vulnerable (VU)' Cook Islands Fruit-dove (*Ptilinopus rarotongensis*), Atiu Swiftlet (*Collocalia sawtelli*), Mangaia Kingfisher (*Todiramphus ruficollaris*), Rarotonga Monarch (*Pomarea dimidiata*), Rarotonga Starling (*Aplonis cinerascens*); 'Near Threatened (NT)' Cook Islands Reed-warbler (*Acrocephalus kerearako*) and 'Least Concern (LC)' Chattering Kingfisher (*Todiramphus tutus*). The Mysterious Starling (*Aplonis mavornata*) known from Mauke, Cook Islands, is now 'Extinct (EX)' due to overpredation by introduced brown rats. Aitutaki, one of the northernmost islands of the

²¹ World Database on Protected Areas –Protected Planet 2013 < <http://www.protectedplanet.net/>>

²² The Cook Islands, National Environment Service- National Parks and Conservation Areas < http://www.environment.gov.ck/index.php?option=com_content&view=article&id=72&Itemid=95>

²³ BirdLife International 2013: Country profile Cook Islands < <http://www.birdlife.org/datazone/country/cook-islands> >

Southern Cook Islands group, is treated separately as a Secondary Endemic Bird Area, it consists of the range of the 'Vulnerable (VU)' Blue Lorikeet (*Vini peruviana*)

The 'Cook Islands tropical moist forests' terrestrial Ecoregion is one of 9 that forms the Global Ecoregion²⁴ of the South Pacific Island Forests. The Cook Islands tropical moist forests are considered some of the best examples of primary montane rain and cloud forest in Eastern Polynesia. They have been given a 'Critical/Endangered' status. The primary threat to the fauna and flora in this ecoregion is recognised as the spread and impact of IAS such as rats, cats and tramp ants (WWF 2013).

Five Key Biodiversity Areas (KBAs) have been identified in the Cook Islands (Atiu, Mangaia, Suvarrow Atoll, Takitumu Conservation Area, Takutea Wildlife Sanctuary). KBAs are areas of international importance based on their importance of maintaining species populations.

An annotated inventory was created of all designated sites and identified areas of high biodiversity value. (see **Designated Areas Inf 4 in Cook Islands Inf 4 Supporting Inf Excel file**)

The impact of invasive species on some of the key high biodiversity value areas and their management is described below.

Suvarrow National Park

Suvarrow atoll is composed of 30 small motu (islets) which is renowned for its breeding seabird populations (Evans 2011; BirdLife International 2013). It has been identified as a Key Biodiversity Area (KBA) and Important Bird Area (IBA) because of its globally significant seabird populations and threatened marine species (Critical Ecosystems Partnership Fund n.d.).

Suvarrow is an important central Pacific Ocean breeding area for several species of tropical seabird including sooty terns (*Sterna fuscata*), lesser frigates (*Fregata ariel*), brown noddies (*Anous stolidus*), red-tailed tropicbirds (*Phaethon rubricauda*) and boobies (*Sula* spp.) (Jones 2001). The atoll has the only large colonies of sooty terns (>40 000 breeding pairs) and brown booby (*Sula leucogaster*) in the Cook Islands (Jones 2001).

²⁴ The Global Ecoregions is a science-based global ranking of the Earth's most biologically outstanding terrestrial, freshwater and marine habitats. It provides a critical blueprint for biodiversity conservation at a global scale <http://wwf.panda.org/about_our_earth/ecoregions/about/>

Wildlife on the atoll is threatened by invasive species namely the Pacific rat (*Rattus exulans*), black rat (*R. rattus*), Norway rat (*R. norvegicus*) and perhaps mice (*Mus musculus*) (Evans 2011). Seabird species particularly impacted by rodents include black noddies, brown noddies and sooty terns (Evans 2011).

In 2013 a rodent eradication campaign was carried out on Suwarrow by BirdLife International, Te Ipukarea Society and the Cook Island National Environment Service (BirdLife International 2013). (Sponsors consisted of the Critical Ecosystem Partnership Fund, European Community, the David and Lucile Packard Foundation, SPREP, the Global Environment Facility, the Pacific Invasives Initiative, New Zealand Department of Conservation, Wildiaries and Nick Hayward) [sourced from ISSG Island Biodiversity and Invasiove Species Database- IBIS]²⁵

An initial feasibility study was carried out as reported by Evans (2011). The study identified the on-going risk of rats spreading from rat-infested motu to rat-free motu and recommended rat eradication to eliminate this risk and allow recovery of sea birds populations on infested motu. The study highlighted the importance of operational planning including obtaining information on rodent distribution and crab densities (as crabs are alternate consumers of bait). Hand broadcasting of the anticoagulant toxin brodifacoum via cereal-based pelleted bait was identified as the best option for the method of eradication due to the relative accessibility of the motu. The study recommended the treatment of motu known to be rat-infested (Anchorage, Motu Tou and Motu OneOne) with two applications of bait (10kg/ha each) 7 to 10 days apart during the “winter” months of July to August.

The feasibility study was followed by an operational plan (Karika *et al.* 2013) which outlined the three main phases of the eradication strategy: pre-operational monitoring, cutting of tracks to establish a bait grid lines and the actual application of bait. It named the personnel involved in the eradication (a team leader from the Te Ipukarea Society, four members from Rarotonga, two park rangers and a rat eradication technician). The plan identified the permits and approvals necessary and the deadlines by which they needed to be obtained and established the possible timeline of the eradication. It also contained estimates of the amount of track (3km to 5km) which would need to be cleared in order to construct the 25x25m baiting grids on each

²⁵ Island Biodiversity and Invasive Species Database (IBIS) <<http://ibis.fos.auckland.ac.nz/>>

motu. Suitable conditions for bait application were identified as nil rain or rain in quantities not exceeding 10mm in 24hrs. In the plan it was acknowledged that the presence of high densities of crabs would require higher rates than the 10kg/ha allotted. There are no available follow up monitoring reports of the outcome of the 2013 rat eradication.

Takitumu Conservation Area

The Takitumu Conservation Area in southeastern Rarotonga is home of the Rarotonga Monarch or *kakerori* (*Pomarea dimidiata*). The *kakerori* once listed as Critically Endangered (CR)' in the IUCN Red List of Threatened Species, is endemic to Rarotonga, Cook Islands, where its distribution is chiefly confined to the Totokoitu, Turoa and the western Avana valleys. Currently the global population is believed to be stable, and numbers are estimated at 310 mature individuals (BirdLife, 2012).

The population of *kakerori* declined rapidly, and in 1989, numbers were estimated at just 29 individuals (Robertson 2000; Robertson et al., 2008). In 1989 The Kakerori Recovery Plan was drafted and recommended a cost-effective recovery programme for the *kakerori* by targeting its predators, as well as a scientific study aimed at evaluating the effectiveness of the work (Hay and Robertson, 1988 in Robertson et al., 2008). Bait stations were set up in the Totokoitu Valley in 1989, where the majority of the population was situated. The bait station network was later expanded into the Turoa and Avana valleys. Poisoned baits (contained brodifacoum) were placed in specific areas from September through December to decrease rat numbers during the breeding season. Breeding success rates in poisoned and unpoisoned areas were recorded and compared (Robertson et al., 2008).

In 1995, the Recovery Plan was updated to include recommendations to investigate the feasibility of initiating and maintaining an insurance population on an island in the southern Cook Islands (Atiu or Aitutaki), which was free of *R. rattus* (Robertson et al., 2008).

In 1996, the 155-ha Takitumu Conservation Area (TCA), was adopted as a conservation area as part of the South Pacific Biodiversity Conservation Programme (SPBCP). In 1998, a population census was carried out, where as many young individuals of the species as possible were colour banded (Robertson, 2000).

In 2002, the TCA received funding from the Pacific Initiative of the Environment (PIE) to shift the focus from species recovery to long-term sustainable management of the population at about 250 individuals on Rarotonga. Intensity of poisoning efforts were reduced in order to determine the levels of predator control that can be maintained.

Between 2001 and 2003, 30 individuals were translocated to Atiu in a series of three transfers as part of the aim to establish an 'insurance' population (Robertson et al., 2008).

The objectives of the sustainable management programme included:

1. Mist-netting and colour-banding as many individuals as possible in order to determine breeding productivity and to record annual survival rate
2. Decreasing annual rat poisoning effort by replacing bait in each bait station fortnightly
3. Transferring a further 10 juveniles to Atiu in 2003 and
4. Monitoring survival of individuals on Atiu

The August 1998 population census in the Takitumu Conservation Area estimated numbers at 160 individuals, and a 5% population increase from 1997 to 1998 was recorded (Robertson, 2000). Annual adult survival was quantified at 92.2%, but out of the minimum 39 fledglings raised in the 1997/1998 period, only 22 yearlings were positively identified (Robertson, 2000).

The population increased each year from 1989, with 100 individuals in 1995, 200 by 2000 and 282 individuals by 2002 (Robertson et al., 2008). In 2000, the species was downlisted by the IUCN Red List from 'Critically Endangered (CR)' to 'Endangered (EN)' (BirdLife International, 2008; Robertson et al., 2009). In 2003, the population increase of the species in Rarotonga was recorded at 8%, growing from 272 birds (10 were transferred to Atiu) to 293 (Robertson et al., 2008).

Monitoring of the population on Atiu found that breeding was successful, and in the period 2006/2007, a minimum of 43 adult individuals of *kakerori* was estimated. 11 fledglings were known to have been raised during the period, though the total is thought to be higher (Robertson et al., 2008). By 2007, the global population of the species had risen to 314 individuals, with 271 on Rarotonga, and 43 on Atiu.

In 2012, the species was further downlisted by the IUCN Red List from 'Endangered (EN)' to 'Vulnerable (VU)', and the existing global population is estimated at 380 individuals, though

continuing conservation management is required to sustain the level of success. [sourced from ISSG Island Biodiversity and Invasive Species Database- IBIS]

Conclusion

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

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.

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

A bibliography has been compiled and source information provided. Links have been provided to electronic sources where available.

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