

Report

Comprehensive Desk-top Review of Biodiversity, Conservation and Invasive Species Information for the Kingdom of Tonga

Compiled for the Secretariat of the Pacific Region Environment Programme (SPREP)

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Introduction

Situated between Fiji to the west and Samoa to the northeast, the Kingdom of Tonga (referred to as Tonga) is comprised of 171 scattered islands of which less than 50 are inhabited. The islands are mainly composed of limestone formed from uplifted coral. Current critical environmental concerns have arisen due to deforestation; damage to coral reefs and the introduction and spread of invasive alien species. Anthropogenic pressure has resulted in extensive modification of all ecosystems on the limestone islands of this group. Only uninhabited and steep volcanic islands still support large tracts of forest.

Tonga supports a wide diversity of plants and unique vertebrates. Flora includes 419 fern and angiosperm species, including some striking Hibiscus species. Tonga is home to 20 species of land and freshwater birds with one bird, the Near Threatened (NT) Tongan whistler (*Pachycephala jacquinoti*), notable as a single island endemic. More than 100 000 sooty terns (*Sterna fuscata*) are estimated to breed in the volcanic crater on Fonualei. The volcanic islands of Late and Tofua have some of the best remaining high diversity native forest and still support large populations of birds and reptiles.

Tonga is a participant in two significant multi-country projects, supported by the Global Environment Facility (GEF), that are focused on the conservation of biodiversity and the management of major threats that cause biodiversity loss. The two projects are 1) the GEF-PAS (GEF –Pacific Alliance for Sustainability) Island Biodiversity Project titled ‘Implementing the Island Biodiversity Programme of Work by integrating the conservation management of island biodiversity’, and 2) The GEF-PAS Pacific Invasive Project titled ‘Regional (Cook Islands, Micronesia, Kiribati, Marshall Islands, Niue, Papua New Guinea, Palau, Tonga, Vanuatu, Samoa): Prevention, Control and Management of Invasive Alien Species in the Pacific Islands’. The United Nations Environmental Program (UNEP) is the Implementing agency and the Secretariat of the Pacific Regional Environment Program (SPREP) the Executing Agency for the two projects.

The focus of the participating countries in the **GEF – PAS Island Biodiversity Project** that includes the Small Island States (SIDs) of Cook Islands, Nauru, Tonga and Tuvalu is on the implementation of the Convention on Biological Diversity (CBDs) Island Biodiversity Program of Work (IBPOW). Conservation and restoration of priority species (threatened) and ecosystems (both terrestrial and marine) at risk; and the sustainable use of island biodiversity through improved systems and processes (including resource assessment and monitoring, legislation, information management, capacity and awareness building) are the two main areas of activity. Key activities planned to be carried out in Tonga include conservation of the Tongan megapode, and surveys of natural areas on the focus island groups of Vava'u and Niuas.

The participating countries in the **GEF-PAS Pacific Invasive Project** which includes Tonga, have committed to undertake national activities related to the management of the introduction and spread of

invasive alien species (IAS) contributing to the implementation of the Pacific Islands Invasive Species Guidelines.

Key activities that will be implemented by Tonga as part of this project include the development of mechanisms to factor IAS management into national and regional decision making processes; proposition of a new biosecurity law using the regionally harmonized Biosecurity Bill; development of a IAS national strategy and action plan; review of laws related to the management of IAS; implementation of pilot management projects for priority IAS identified in the national action plan; outreach and awareness raising on the impacts of IAS on biodiversity and natural areas and collation of baseline information about the status and distribution of IAS and the establishment of a program for detecting change.

Biodiversity data and information are crucial to well-informed decision making in the implementation of biodiversity conservation action, yet these data and information are not readily available. One of the problems is the complexity of biodiversity data and information in terms of bio-status and distribution. Also, these data and information are dispersed, sometimes outdated and are not available in ready to use and compatible formats.

Baseline information on the status and distribution of biodiversity and natural resources serve as a benchmark for monitoring and the development of biodiversity indicators and trends. 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. These data and information are necessary for reporting and planning future action.

Planning action related to the sustainable use of island biodiversity including resource assessment requires socio-economic data- such as data on population and human development, and economic conditions.

To meet this need the Executing Agency SPREP invited consultants to undertake a *'Comprehensive Desk-top Review of Biodiversity, Conservation and Invasive Species Information for the Kingdom of Tonga'*. The Invasive Species Specialist Group (ISSG) of the Species Survival Commission (SSC) of the International Union for Conservation of Nature (IUCN) was commissioned to undertake this comprehensive review.

Six areas were identified for this Desk-top review

- IAS known to be present in Tonga, developing an annotated inventory
- Priority Pathways of introduction and spread of IAS
- Priority conservation areas, biodiversity they contain and threats to these areas with a focus on invasive alien species (IAS) and relevant socio-economic data
- 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.
- Biodiversity and IAS projects undertaken and on-going in Tonga

All data and information collated were to be 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 **INF 1- INF 7**). All source information collated has been stored and will be presented to SPREP.

A concise discussion is presented based on a synthesis of the data and information collated and recommendations made 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.

Tonga is a Party to the Convention on Biological Diversity (CBD). A brief synopsis of Tonga's activities as part of its commitments to the CBD is outlined as these are the basis of all priorities related to the conservation of biological diversity.

Convention on Biological Diversity and Tonga

The Convention on Biological Diversity (CBD) entered into force in 1993. The three main objectives of the CBD are: 1) The conservation of biological diversity; 2) The sustainable use of the components of biological diversity; and 3) The fair and equitable sharing of the benefits arising out of the utilization of genetic resources. 193 countries including the Tonga are parties to the Convention. The Government of Tonga acceded to the CBD on 19 May, 1998, and ratified the Cartagena Protocol on Biosafety to the CBD on 18 May 2003. 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. Tonga ratified the Cartagena Protocol in 2003.

The principle instrument for implementing the CBD at the national level is the National Biodiversity Strategy and Action Plan (NBSAP). Tonga developed a NBSAP in 2006 formulating a strategy and planned actions for the conservation of biodiversity and its sustainable use.

Measures taken for the implementation of the Convention and their effectiveness have to be reported to the Convention in National Reports. Tonga has submitted the First and the Fourth National report in 2006 and 2009 respectively.

Protected Areas is a thematic programme within the CBD just as island biodiversity, mountain biodiversity, forest biodiversity, Inland water ecosystems etc. 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". 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. Tonga has submitted a thematic report on Protected Areas in 2003 and a PoWPA Action Plan in 2011 outlining actions for implementation against the priority PoWPA goals.

In 2010 at the tenth Conference of the Parties in 2010 the CBD adopted a revised and updated Strategic Plan for Biodiversity 2011-2020 that included twenty targets called the Aichi targets to serve as a framework for the establishment of regional and national targets. Countries are encouraged to establish national targets in the framework of the Aichi Biodiversity Targets and in revising and updating national biodiversity strategies and action plans in line with the Strategic Plan for Biodiversity 2011-2020.

Threatened Species of Tonga

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. The IUCN Red List also provides information on the major threats driving the decline of these species populations.

673 species listed under Tonga have been conservation assessed using IUCN Red List criteria and categories¹. The Tonga National Biodiversity Strategy and Action Plan (NBSAPs²) lists over 140 native and introduced species (of cultural, medicinal and timber value, as well as inshore and offshore fish species) as ‘threatened’. Additions to this list as well as revision to the status of these species are made in Tonga’s Fourth National Report to the CBD³. Details of the ranking are provided below

An annotated inventory (**INF Tonga Species 1.1**) of these native species was compiled in a matrix including information on higher taxonomy, synonyms, common names, biome, and IUCN Red List status and population trends. In addition to the 673 species from the IUCN Red List 15 species from the National Threatened list were included in this inventory. These species have been conservation assessed using IUCN Red List criteria.

Over 95% (662) of these assessed species belong to Kingdom Animalia and 26 Plantae. Major classes include bony fish (315), cartilaginous fishes (9), stony corals (228), hydrozoans (4), birds (49), mammals (21), reptiles (13), crustaceans (8), molluscs (15), flowering plants (13), and monocots (8), mangrove species (2), and one conifer, cycad and fern.

Less than 10% (68 species) of these species are classified as ‘threatened’ – ‘Critically Endangered (CR)’ (5), ‘Endangered (EN)’ (6) and ‘Vulnerable (VU)’ (56); 75 species are classified as ‘Near Threatened (NT)’. Please see **Table 1** for a breakdown of the classification. Of the ‘threatened species’ 45 are stony corals, five birds, four molluscs, three cartilaginous fish, five reptiles, two mammals, two flowering plants and one conifer and cycad.

The majority of these species are found in the Marine biome followed by Terrestrial and Freshwater. **Table 2** provides a breakdown of species and biomes. In the marine biome the majority of the species

¹ Categories and Criteria <<http://www.iucnredlist.org/technical-documents/categories-and-criteria>>

² National Biodiversity Strategy and Action Plan 2006 <<http://www.cbd.int/doc/world/to/to-nbsap-01-en.pdf>>

³ Fourth National Report to the CBD 2010 <<http://www.cbd.int/doc/world/to/to-nr-04-en.pdf>>

are found in the marine neritic zone⁴. The neritic zone together with the estuarine habitat, cause the most productivity in the sea. This is the zone where corals occur and provide the major food source to fish like tuna. In the terrestrial biome the majority of the species are found in forests and in the freshwater biome in inland wetlands.

It must be noted that the IUCN Red List classification is a global assessment of the species.

Table 1: Species of Tonga - IUCN Red List Category

IUCN Red List Category	Numbers of species
Extinct (EX)	1
Critically Endangered (CR)	5
Endangered (EN)	6
Vulnerable (VU)	57
Lower risk/Conservation dependent (LR/nt)	3
Near Threatened (NT)	75
Data Deficient (DD)	40
Least Concern (LC)	501
Total	688

Table 2: Species & Biomes

Species	Biome
33	Terrestrial
3	Freshwater
567	Marine
4	Terrestrial/Freshwater
34	Terrestrial/Marine
17	Freshwater/Marine
16	Terrestrial/Freshwater/Marine

⁴ Shallow marine environment extending from mean low water down to 200-metre (660-foot) depths, generally corresponding to the continental shelf. Neritic waters are penetrated by varying amounts of sunlight, which permits photosynthesis by both planktonic and bottom-dwelling organisms. The zone is characterized by relatively abundant nutrients and biologic activity because of its proximity to land.

A comprehensive review was undertaken to assess all known impacts (with a focus on the threat of IAS) on species classified as CR, EN, and VU (threatened) as well as species classified as NT. The results of this review have been recorded in the matrix. A description of the threat, the threat mechanism and outcome of this impact is included. IAS are identified. Location of occurrence of these species is recorded where information was available. Please see **INF Tonga Species 1.2**.

Biological resource use, followed by climate change & severe weather, habitat loss, invasive alien species, and human intrusion & disturbance are major threats. The key threat mechanisms are harvesting & fishing- Biological resources use followed by habitat alteration and degradation and predation by IAS. The outcomes of these impacts are decline in species population numbers and habitat loss.

Some of the threats to coral reefs recorded in Tonga are eutrophication, physical disturbance, over-fishing loss of habitat, sedimentation and predation by crown-of-thorns starfish, leading to coral mortality and collapse of fisheries. The most disturbed areas recorded in Tonga are - Faga'uta lagoon in Tongatapu (eutrophication, major coral mortality and collapse of fisheries); Nuku'alofa and adjacent northern Tongatapu (physical disturbance, loss of habitat, eutrophication, over-fishing, coral mortality); inner Neiafu harbour in Vava'u (sedimentation, crown-of-thorns starfish, over-fishing, coral mortality); and Pangae harbour on Lifuka Island in Ha'apai (eutrophication, high coral mortality).⁵ A warming climate where temperature extremes can lead to bleaching and increased susceptibility to disease, increased severity of 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. Live hard coral species exported from Tonga are from the following genera *Acropora*, *Stylophora*, *Millepora*, *Pocillopora*, *Turbinaria*, *Tubastrea*, *Favia*, *Fungia*, *Pavona*, *Porites*, *Hydnophora*, *Montipora*, *Tubipora*, *Galaxea* etc.

Overfishing (both commercial and recreational fishing) including the live reef fish trade, and habitat degradation of coral reefs are some of the threats to threatened marine fish species. Finfish from shallow water reefs are a major source for subsistence as well as artisanal fisheries. Offshore bottom-fish fishery, commercial fishery of tuna species is prevalent. Traditional shark noosing in Tonga is carried out on the outlying reefs and areas.

The Southern Giant clam (*Tridacna derasa*) and the Trevoro clam (*Tridacna tevoro*) are classified as VU. The Southern Giant clam is included in CITES Appendix II. There is an urgent concern that populations are overfished in spite of bans on harvesting of wild specimens (imports have been recorded from Tonga)⁶.

One species, the endemic Tonga ground skink (*Tachygyia microlepis*) is classified as 'Regionally extinct' in Tonga. The causes of extinction are believed to be habitat loss, colonization by humans along

⁵ Vieux *et al* in Wilkinson, C. (ed.) 2004. Status of Coral Reefs of the World: 2004. Volume 1, Australian Institute of Marine Science Townsville, Queensland, Australia. 301 p

⁶ CITES *Tridacna derasa* Röding, 1798 AC22 Doc. 10.2 Annex 8d

with associated predators such as dogs, pigs and rats⁷. The Pacific sheath-tailed bat (*Emballonura semicaudata*) native to several Pacific nations -found on the islands of Eua and Niuafo'ou on Tonga, is known to have been last collected in 1989. The Olive small-scaled skink (*Emoia lawesi*) is native to Samoa, American Samoa, Niue and Tonga. The major threat is recorded as deforestation in all its native range and predation by introduced mammals rats and cats (although no specific predation threats are mentioned in Tonga). The CR, Hawksbill turtle (*Eretmochelys imbricata*) and Leatherback (*Dermochelys imbricata*), the EN Green turtle (*Chelonia mydas*) and VU Olive Ridley (*Lepidochelys olivacea*) are known to nest on the Ha'apai Group, eggs as well as nesting turtles are reported to be taken⁸.

Two molluscs the *Eua globosa* and *Samoana cramptoni* both endemic to the island of Eua are classified as CR- Possibly extinct. No live snails have been seen since 1970 and 1933 respectively. Loss of habitat due to deforestation is identified as the main cause for these severe declines.

The endemic Tongan megapode *Megapodius pritchardii* is classified as EN. Once widespread, remnant populations are found on Niuafo'ou. The main threat to this species was biological resource use- the results of a study in 1993 showed that over 50% of eggs were harvested (although this has declined since 1993). A possible cause for low successes in hatching could be changes in soil temperatures and geothermal activity affecting incubation. Adults are known to be hunted on a small scale on Niuafo'ou which is inhabited. Predation by feral cats and dogs is prevalent; pigs may compete with chicks for food and destroy foraging habitat. A Conservation Strategy for the Polynesian Megapode on Niuafo'ou (Lloyd et al 2011⁹) was developed in 2011 by the World Pheasant Association and the Tonga Community Development Trust. The strategy outlines the actions that have to be undertaken for conservation of this species. Actions are focused on community-based sustainable management of egg harvesting and enhanced environmental education. Eggs were buried at volcanically heated sites on the inhabited islands of Late (60 eggs) and Fonualei (35 eggs), the translocation is reported to have failed on Late. Surveys are planned as part of the **GEF-PAS Island Biodiversity Project**- of Niuafo'ou to obtain further information on status and habitat use of Tongan megapode and of Late and Fonualei Islands to assess the fate of the introduced populations.

Three bird species are classified as VU on Tonga. The Tongan ground dove (*Gallicolumba stairi*) is found on several islands a healthy population on Late and others on Fonualei, a few smaller islands in Vava'u, and formerly, or perhaps still, on a few islands in the Ha'apai and Nomuka groups. The native bristle-thighed curlew (*Numenius tahitiensis*) has a wide Pacific native range and no known threats have been recorded on Tonga. Parkinson's Petrel (*Procellaria parkinsoni*) is native to Colombia; Cook Islands; Costa Rica; Ecuador; French Polynesia; Mexico; New Zealand; Nicaragua; Niue; Panama; Peru and Tonga. No threats have been recorded in Tonga.

⁷ Allison, A., Hamilton, A. & Tallwin, O. 2012. *Tachygyna microlepis*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2.

⁸ Sulieti Havea & Kenneth T. MacKay, 2009. Marine Turtle Hunting in the Ha'apai Group, Tonga. Marine Turtle Newsletter 123:15-17 < <http://www.seaturtle.org/mtn/archives/mtn123/mtn123p15.shtml>>

⁹ Lloyd, H., Torres-Sovero, C. and Faka'osi, S. 2011. Conservation Strategy for the Polynesian Megapode *Megapodius pritchardii* on Niuafo'ou, Tonga. World Pheasant Association, Newcastle, UK and Tonga Community Development Trust, Tongatapu, Tonga. 41pp.

The NT Tongan whistler (*Pachycephala jacquinoti*) is a single island endemic of the Vava'u group of islands where they are common and widespread. The Vava'u group contains some of the remaining habitats for breeding seabirds in Tonga. However, predation by introduced mammals, black rat (*Rattus rattus*), Pacific rat (*Rattus exulans*) are likely threats, these two rats are known to occur on the 16 inhabited islands of the Vava'u group including Maninita where an eradication project was undertaken in 2002. Habitat destruction due to browsing and trampling by introduced ungulates and habitat loss due to deforestation are other threats.

The endemic CR tree *Aglaia heterotricha*, was last collected in 1952 on the island of 'Eua and is thought to be possibly extinct. Three plant species the cycad (*Cycas seemannii*), *A. saltatorum* and the endemic conifer (*Podocarpus pallidus*), are classified as VU. The endemic conifer is known only from the island of 'Eua. Threats to this species are unknown. *C. seemannii* is native to Fiji; New Caledonia; Tonga; Vanuatu. Habitat loss is a threat; no specific threats have been recorded on Tonga. *A. saltatorum* native to several Pacific nations like Fiji, Solomon Islands, Wallis and Futuna, Vanuatu and Tonga is known to be impacted by habitat loss; no specific threats have been recorded on Tonga. The NT mangrove species *Rhizophora samoensis* is native to the eastern Pacific and Australasia - Fiji, New Caledonia, Tonga, Samoa, and American Samoa. Loss of mangrove habitat is a threat. This and other mangrove species occur as a narrow band on the seaward side of lagoons on Tonga and Samoa. Although legislation exists in Tonga that controls the use of mangroves, this is not always applied.

The National Threatened terrestrial plant species list includes over 60 species of cultural, medicinal and value as timber species. Only three of this list has been assessed in the IUCN Red List but have not been listed under Tonga. They are all classified as LC. The classification of these species on the National list is as follows 12 CR, 19 EN, 45 VU and 9 of unknown category 'A'. Please see **INF Tonga Species 1.3** for details. It must be noted that some of the species on this list have been identified as alien and potentially invasive species in Tonga. Examples are Apele Tonga (*Annona squamosa*), Fisi'uli (*Bidens pilosa*), Alu (*Epipremnum pinnatum*).

The National Threatened marine species list includes 50 species (both inshore and offshore fish) and four species from the estuarine habitat. 20 of the 59 species listed have been assessed in the IUCN Red List but have not been listed under Tonga. Of these two are CR, two as EN, four NT, four LR, seven LC and one DD. The classification of these species on the National List is as follows: the 10 coral species are all listed as 'Rare', 20 species are list as CR (they include marine turtles and several molluscs), 20 species are listed as EN, four as 'Low Abundance' and five as VU. Please see **INF Tonga Species 1.3** for details. Also included in the list are introduced clams that are used in aquaculture.

Priority Conservation Areas of Tonga

The Programme of Work on Protected Areas (PoWPA) Action Plan¹⁰ was submitted to the CBD in 2011 for Tonga. According to the plan (based on data from the WDPA), as of 2010, 14.5% of Tonga's

¹⁰ PoWPA Action Plan <<http://www.cbd.int/protected/implementation/actionplans/country/?country=to>>

terrestrial surface and 2.5% territorial Waters are protected. The PoWPA plan states that *'Based on ecological gap analysis and other assessments conducted the realistic national targets for terrestrial and marine areas for target 11 are 5% marine and 17% terrestrial by 2020'*.

Target 11 is a reference to Aichi Target 11¹¹ which states that *"By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes"*.

The World Database on Protected Areas (WDPA)¹² provides the most comprehensive dataset on protected areas worldwide. The WDPA lists 22 'protected areas' for Tonga. The Tonga NBSAPs lists 19 protected areas including six Park and Reef Reserves, two sites of historical importance, one Faunal Reserve, one Marine Reserve, one Nature Reserve, one Sanctuary, one Multiple Use Conservation Area, four National Parks and two 'Other Areas'. Both the lists are not entirely compatible. Additionally, key biodiversity areas have been designated by other institutions for conservation purposes such as BirdLife International's Endemic Bird Areas (EBAs) and Important Bird Areas (IBAs) and World Wildlife Fund's (WWF) Ecoregions.

The lists of these 'designated areas' have been compiled in an annotated inventory (see **INF 2.1 Tonga Conservation Areas**). Information on any assigned codes (WDPA code, IBA and EBA code), IUCN Protected Area category, Lat/long information, area, designation type, a description of the site, significant biodiversity and any known threats and a comment on any relevant socio-economic information). Following is a brief summary of some of the key designated areas.

National Parks

Four National Parks have been designated by Tonga, the terrestrial Mt Talau, Tofua, Kao and 'Eua. Kao National Park which is a Marine Protected Area (MPA) and no specific records were found of significant biodiversity.

Tofua is the largest island of the Ha'apai group (close to 50 sq kms) and has one of the only remnants of primary forest in Tonga. It is a steep active volcano that features a caldera lake of 7 sq kms. A large number of introduced (potentially invasive) and invasive plants have been recorded in Tofua, these species are a potential threat to native plant species, resulting in habitat alteration resulting in habitat degradation and loss and decline in native species.

Mt. Talau is a flat topped mountain 131 meters high. Significant species that occur on this site include the banded iguana, the Tongan Whistler and the flying fox (*Pteropus tonganus*). There is no specific information available on biodiversity threats.

¹¹ Aichi Targets < <http://www.cbd.int/sp/targets/>>

¹² World Database on Protected Areas (WDPA) <<http://www.wdpa.org/>>

'Eua National Park includes the remaining rain forest of this area. It covers an 800 meter wide band of tropical rainforest, bordered on the west by sheer cliffs that drop down to numerous caves and chasms. This area is home to several threatened plant species. The spread of invasive alien plants (understory plants and lianas) is a threat to the ecological integrity of this area.

Special Management Areas

Equal fishing rights on Tongan waters to all Tongans were proclaimed in the mid-1800s. Due to the general decline in coastal fisheries resources on which the communities relied on for food and income, a new Fisheries law was enacted in 2002 which included provisions for the creation of Special Management Areas (SMAs).

An SMA grants a community management control of its inshore resources; in effect, providing a community with the basic tools and skills for better management initiatives. The main objectives of a management plan are to 1) enforce the authority to exclude outsiders from entering an SMA, 2) establish marine parks, and 3) implement restrictions on harvested resources, including, size limits and catch amounts.

Six local communities (Ha'afeva, O'ua, 'Atata, Felemea, Ovaka, 'Eueiki) have been designated as Coastal Communities with Special Management Areas (SMAs), these communities therefore take the leading role in managing their coastal fisheries resources with assistance from the Fisheries Division.

Some of the conditions enforced by these communities include 1. No person shall harvest any marine organism for the aquarium industry which includes hard coral, soft coral, small invertebrates and aquarium fish; 2. No person shall be allowed to: • Harvest any ark clam less than 45mm in length. • Harvest any green snail species. • Harvest any *Trochus* species. • Gut any Curry fish species at shore; 3. No person shall undertake fishing of any nature for giant clam or lobster in this Protection Zone unless authorized.

The WDPA lists three Multiuse Conservation Areas- Eueiki Multi/Multiple Use Conservation Area, Felemea Multi/Multiple Use Conservation Area and O'ua Multi/Multiple Use Conservation Area. These areas may be synonymous with the Community Managed Species Management Areas listed above. Clarification has been sought.

Global Ecoregion and Terrestrial Ecoregion

WWF has designated the South Pacific Islands Forests as a Global 200 Ecoregion. The conservation status of this Global Ecoregion is listed as 'Critically Endangered'. It is made up of nine terrestrial ecoregions: Cook Islands tropical moist forests; Fiji tropical dry forests; Fiji tropical moist forests; Tuamotu tropical moist forests; **Tongan tropical moist forests**; Society Islands tropical moist forests; Samoan tropical moist forests; Marquesas tropical moist forests; and Tubuai tropical moist forests.

The conservation status of this Terrestrial ecoregion is listed as 'Critically Endangered'. It includes Tongatapu, the Vava'u, and Ha'apai Groups, as well as Niue. Please refer to the inventory of native species and invasive alien species of Tonga for species lists.

Principal threats to this ecoregion are habitat destruction, biological resource use and invasive alien species. Habitat destruction due to land use change (for agriculture) and establishment of plantations; habitat alteration due to the spread of invasive alien plants that compete with and displace native species are the main causes. Introduced *Casuarina equisetifolia* (introduced most probably when the Polynesians arrived) and several other alien and invasive plants both shrubs and lianas introduced by the European settlers are dominating some ecosystems. *Clidemia hirta*, *Lantana camara*, *Psidium guajava* and *Epiprenum* vine are examples. Introduced *Paspalum vaginatum* is the dominant grass cover in the inland margins of the swamp.

There is a high potential of introduced mammals (*Rattus* spp.), introduced by early Polynesian settlers, having major impacts on breeding seabirds and native passerines. Rats are currently found on the 45 inhabited islands of Tonga and effort has to be made to prevent their invasion to the uninhabited islands which can serve as reservoirs of native species. Captive breeding of Niuafou megapode, red shining parrot (*Prosopeia tabuensis*), and blue-crowned lorikeet (*Vini australis*) has begun as have efforts to establish populations of these species on uninhabited islands.

Endemic Bird Areas (EBAs) & Important Bird Areas (IBAs)

Two EBAs have been designated in Tonga in areas where the single island endemics the Tongan megapode and the Tongan Whistler occur (Niuafou (secondary area) and Tonga (secondary area). Seven IBAs have been proposed, these are areas where significant seabird colonies and Pacific restricted species are known to occur. The islands of Late and Fonualei the sites of translocation of the Tonga megapode are also considered. Birdlife International Data Zone¹³ provides datasheets on each of its site that outline a description of the site, the species that occur on it, its biodiversity significance as well as threats and conservation action.

Lists of threatened species that are known to occur on some of these designated areas are included (see **INF 2.1 Tonga- Conservation Areas-Threatened Species**). For the terrestrial areas besides the information available on the EBAs and IBAs there is a lack of information from credible sources on the occurrence of other threatened taxa such as plants and reptiles on these sites. This information needs to be developed. For the marine areas there is general information available at the generic and family level but scant information exists at the species level except for clams.

Alien and Invasive Species of Tonga

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

¹³ BirdLife International Data Zone < <http://www.birdlife.org/datazone/home>>

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.

The indigenous and endemic fauna and flora of Tonga underwent alteration with the arrival of Polynesian settlers more than 3000 years ago. The settlers brought with them herbaceous food crops, trees and animals like the Polynesian rat and the pig. The second wave of introductions of alien species occurred with the arrival of European settlers- more plants and trees for food resource, and ornamentals and weeds and animals like domestic goats, the black rat, Norway rat and birds like the European starling, jungle myna and rock pigeon. Ecosystem alteration, predation and other impacts led to native species extinctions, further leading to ecological disruptions such as alteration of dispersal guilds leading to more decline in native species populations and the integrity of ecosystems¹⁴

A comprehensive Desk-top review was undertaken to compile an annotated inventory of introduced and invasive species recorded in Tonga (**see INF 3.4 Tonga-Introduced-Invasive –Species**). Information included species names and higher taxonomy, common names, species organism type, biome and habitat type, pathways of introduction and spread, and links to risk assessments conducted for these species for the Pacific Region.

The four main sources used were the IUCN ISSG Global Invasive Species Database (GISD), Pacific Island Ecosystems at Risk (PIER), CAB International Invasive species Compendium (ISC) and the Global Biodiversity Information Facility (GBIF). Additional searches were conducted on Biological Abstracts Database, Google Scholar and other reports. Alien and invasive species from Tonga

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. Island level occurrence data was also extracted from the GISD. An inventory of species from Tonga that are on the GISD is provided (**see INF 3.1 Tonga-GISD**).

¹⁴ Fall, P. L. and T. D. Drezner 2011. "Plant Dispersal, Introduced Species, and Vegetation Change in the South Pacific Kingdom of Tonga." Pacific Science 65(2): 143-156.

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. Information on the occurrence of these species at least at the Island Group level is available from PIER. An inventory of species from Tonga that are on PIER is provided (**see INF 3.2 Tonga-PIER**).

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. CABI ISC does not provide detailed occurrence information at the island level. An inventory of species from Tonga that are on CABI ISC is provided (**see INF 3.3 Tonga-CABIISC**).

GBIF promotes and facilitates the mobilization, access, discovery and use of primary data about the occurrence of organisms. GBIF does not tag species as 'native' or 'alien' or if the species is 'invasive' or provide any island level occurrence information. GBIF stores data from herbariums and collections. GBIF data for Tonga was extracted and species names were matched with lists compiled from GISD, PIER and CABI ISC for confirmation. An inventory of species from Tonga that are on CABI ISC is provided (**see INF 3.4 Tonga-GBIF**).

Searches from Journal articles, reports and other documents did not yield any significant numbers of new species. One species Giant sensitive plant (*Mimosa diplotricha*) was documented from an alert on the Tonga Government website as a 'new' introduction. There were no records of this species in the four main sources used.

The annotated introduced and invasive species inventory for Tonga lists 393 species. Majority of the species listed belong to Kingdom Plantae, predominated by species belonging to Family Fabacea and Poacea. Most of the plants are herbaceous followed by grasses.

A majority of the introduced/invasive species are Terrestrial species followed by Freshwater and Marine. Habitat type has been recorded for a majority of the species listed. Most of the plant species listed are invaders of disturbed areas, agricultural and managed areas, wastelands and forest edges.

Information on the biostatus of the species was extracted from the databases without any additional interpretation. Information on pathways of spread has been recorded. These records are a general statement of how the species is dispersed and is not location specific

Risk assessments have been conducted for a majority of the plant species and links have been provided to the risk assessment sheets on the PIER database. Most of the species have achieved high scores and are classified as 'high risk' species.

Pathways of introduction and spread

The agricultural, forestry and fisheries sector play a vital role in the Tongan economy contributing up-to 90% of the exports and over 19% of the Gross Domestic Product (GDP). The agriculture and forestry sector have shown positive growth. While the Fisheries sector has shown positive growth there are concerns of a slowdown. Re-opening of Tongan waters to foreign fishing vessels that are licensed to fish, proposed increase in the size of vessels, increased farming of marine species with economic potential, and the development of aquaculture are some of the areas targeted for improvement. Expansion of the tourism industry and reactivating fisheries are two of several gaps identified for action.

Activities in the agriculture, forestry and fisheries sector have implication on the conservation of biodiversity. These activities may even facilitate the introduction of alien species that have the potential to become invasive. Introduction of potentially invasive species for aquaculture is a concern. Increased entry of fishing vessels from foreign location as well as inter-island movement are a potential pathway for alien and invasive species introductions in ballast water and as hull fouling organisms. Over 2000 yachts are recorded to visit the Vava'u islands of Tonga each year. Over 46,000 visitors are recorded as having arrived by air to Tonga in 2011. With increased tourism and arrival of visitors biosecurity at the borders both air and sea becomes critical.

A sortable list of species and corresponding pathways has been compiled from the GISD for the four major countries (Australia, New Zealand, Fiji and Hawaii (United States of America) that are the origin of much of the air and sea movement/links to Tonga. Both long distance pathway methods and short distance pathways (annotated as 'local') have been listed for each of the four countries (**see INF-4-Pathways**). Please note that this is not a comprehensive list of all known invasive or potentially invasive species and pathways in the selected four countries. This dataset has been compiled from the GISD. Also included is a list of known invasive species that are featured in the GISD and their corresponding pathways.

Pathways of introduction and spread have been recorded for a majority of introduced and invasive species present in Tonga listed in **INF 3.5**. While this information is a general listing of the known pathways of introduction and spread of these species; a conclusion cannot be drawn on which pathways are critical (to inform management) for Tonga. However, some observations can be made based on historical information. Species have been introduced to Tonga for food purposes and medicine, as ornamental species, as commensal animals with settlers, for the purpose of acclimatization (settlers bringing in species that reminded them of home).

Biodiversity Conservation and Invasive Alien Species Management Projects in Tonga

A review was undertaken to compile a list of biodiversity conservation and IAS management projects active in Tonga and undertaken in the recent past (**see INF-5-Tonga-Biodiversity-IAS-Projects**). The search involved contact with key persons as well as a Desk-top review.

27 individual activities have been recorded, most of them being related to biodiversity conservation. Five activities include the development of the NBSAPs, the first and fourth National Report to the CBD as well as the development of the Thematic Report on Protected Areas and the PoWPA Action Plan all part of Tonga's commitment to the CBD.

Ten activities have been recorded related to IAS management. This includes the GEF- PAS Pacific Invasive Project, two related to the conservation of the Tongan megapode, three training/seminar events (Eradication of rodents and cats, Pest diagnostics and ballast water management awareness seminar). One project was undertaken to eradicate rats from a group of three small islands (Maninita and two islets) in 2002. However, it has been reported that rats have been sighted on Maninita, it is unknown if there has been reinvasion or if the eradication exercise was a failure.

Conclusion

Biodiversity data and information are crucial to well-informed decision making in the implementation of biodiversity conservation action, yet these data and information are not readily available. One of the problems is the complexity of biodiversity data and information in terms of bio-status and distribution. Also, these data and information are dispersed, sometimes outdated and are not available in ready to use and compatible formats.

Baseline information on the status and distribution of biodiversity and natural resources serve as a benchmark for monitoring and the development of biodiversity indicators and trends. 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. These data and information are necessary for reporting and planning future action.

The results of this comprehensive review provide a baseline for biodiversity data and information for Tonga. Based on the information collated we can conclude that species most under threat occur in the marine biome. Biological resource use (overfishing and overharvesting) is the primary threat type. Invasive alien plants are the predominant biological invaders. However there is limited information on evidence of impacts. Coral reefs and allied ecosystems in the marine biome and forests in the terrestrial biome are most under threat.

Following are some observations related to the collation of data and information

Threatened species information:

- The primary source of this information is the IUCN Red List of Threatened Species. These species are conservation assessed but this assessment is on the global status of the species. If native species are not conservation assessed they are not listed.
- Some taxa include comprehensive and up-to-date information such as 'bird species'. However there is limited information for plant species one example is the CR endemic *Aglaia heterotricha*.

- The Tonga NBSAPs and Fourth National report has listed over 140 terrestrial plant and marine inshore and offshore species as ‘Threatened’, the basis for this ranking or additional information is unavailable.

Conservation sites

- The WDPA is a significant source of protected areas information. There were some errors spotted in this list. The National list of protected areas has been listed in the NBSAPs (2006), the Fourth National report to the CBD states that there have been no additions to this list. Not all these sites are listed on the WDPA and given an IUCN protected area category

Introduced and Invasive Species information

- While the four resources provided information on the known introduced and invasive species in Tonga, there is very limited information on evidence of impacts and extent of spread. No interpretation has been made on the status of these species and the biostatus listed in the source information has been used
- Information on habitat types and pathways have been recorded for the list of species in general as Tonga specific information is largely unavailable

A list of islands of Tonga has been compiled from dispersed sources (see **INF-6 Tonga-Islands**). It is hoped that this list will be reviewed and will form the backbone for recording of site, species and threat information

Following are suggestions based on the work undertaken to complete this review.

1. It is critical to develop a National Biodiversity Database for Tonga that provides a framework to document data and information on species, ecosystems and designated/protected areas, and threats to these species and areas.
 2. The design and functionality of this database should be such that it facilitates the development of biodiversity indicators, trends in the status of species and ecosystems
 3. The design and functionality of the database should be such that it allows all CBD and other multilateral environment agreements country focal points to report with ease
 4. It is critical to keep this data and information updated on a regular basis so management action is prioritized and implemented at the earliest helping to mitigate severe impacts
 5. Data and information generated by researchers and scientists who work in Tonga should be retained by the relevant Government agency so that it may be included in national datasets
 6. More research and studies should be encouraged to evaluate the impact of invasive alien species and other threats on biodiversity and ecosystems in Tonga.
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Glossary

Glossary	
CBD	Convention on Biological Diversity
CR	Critically Endangered
EBA	Endemic Bird Area
EN	Endangered
ENSO	El Niño–Southern Oscillation
EX	Extinct
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEF-PAS	GEF –Pacific Alliance for Sustainability
IAS	Invasive Alien Species
IBA	Important Bird Area
IBPoW	Island Biodiversity Programme of Work
ISSG	Invasive Species Specialist Group
IUCN	International Union for Conservation of Nature
KBA	Key Biodiversity Area
LC	Least Concern
LR	Lower Risk
MPA	Marine Protected Area
NBSAP	National Biodiversity Strategy and Action Plan
NT	Near Threatened
PoWPA	Programme of Work on Protected Areas
SIDs	Small Island States
SPREP	Secretariat of the Pacific Region Environment Programme
SSC	Species Survival Commission
UNEP	United Nations Environment Programme
VU	Vulnerable
WDPA	World Database on Protected Areas

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A file folder has been provided with all the source information used in the development of this report (see **INF-7-Tonga-Information**)

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