Fiji National Biodiversity Threat Assessment: Ranking Major Threats Impacting Fiji's Biodiversity

Dr Mark O'BRIEN, Ms Nunia MOKO, Dr Dick WATLING, Ms Melania SEGAIDINA, and Dr Clare MORRISON

In Partnership with:

Acknowledgements

This work was funded by the IUCN Program as part of the implementation of the BIODEV2030 project. The methodology and the overall study approach were conducted in agreement with the representatives of IUCN and BIODEV2030. Florence Curet, Neil Cox, Antonin Vergez and Tavenisa Luisa provided valuable project support and feedback. Francis Saladrau, Conservation Officer at NatureFiji-MareqetiViti provided support for the expert consultations and workshops and administrative support for the overall project.

We thank the biodiversity experts and other stakeholders for sharing their time, knowledge and expertise with us. The robust data sets would not have been possible without their contribution.

The Ministry of Environment and the Ministry of Forestry provided valuable feedback on the results of the analyses.

Abbreviations and Acronyms

AFD	French Development Agency
AOH	Area of Habitat
AZE	Alliance for Zero Extinction
DPSIR	Drivers-Pressure-State-Impact-Response Framework
ECAL	Environment and Climate Adaptation Levy
FAC	Fiji Agriculture Census
IBA	Important Bird Area
IUCN-CMP	International Union for the Conservation of Nature and the Conservation Measures Partnership
IUCN ORO	International Union for the Conservation of Nature – Oceania Regional Office
KBA	Key Biodiversity Area
NBSAP	National Biodiversity Strategy and Action Plan
NFMV	NatureFiji-MareqetiViti
NGO	Non-Governmental Organisation
OECM	Other Effective Area-Based Conservation Measures
SIDS	Small Island Developing States
SOE	Fiji's State of the Environment Report (2020)
STAR	Species Threat Abatement and Restoration metric
SUMA	Special, Unique Marine Area
UNEP-WCMC	United Nations Environment Programme World Conservation Monitoring Centre
6NR	6th National Report to the Convention on Biological Diversity

Executive summary

This scientific assessment of the state of biodiversity and the different threats affecting biodiversity at the national level in Fiji was conducted to enable the identification of key economic sectors associated with the primary threats to Fiji's biodiversity.

The methodological approach to this assessment consisted of three components: (1) a review of the literature and relevant policy documents, (2) the analysis and use of the STAR metric data and other IUCN data, and (3) expert elicitation. The original project proposal was assessed using the terrestrial biodiversity due to the nature of the data included in Red List of Species of the STAR analysis. As Fiji is an island nation with extensive marine biodiversity, the literature review and the expert elicitation also considered the main threats to marine biodiversity.

The main threats identified in the literature were invasive species, agriculture and habitat loss for terrestrial biodiversity, all three of which are anthropogenic pressures; and overfishing and coastal habitat modification for marine biodiversity.

The results of the original STAR analyses identified invasive species, habitat modification and logging as the main threats to biodiversity in Fiji. The modified analysis using additional terrestrial threatened species confirmed the threats posed by invasive species and logging and highlighted the significant threat posed by agriculture.

The results of the expert elicitation were similar to those from the literature review and STAR analyses for terrestrial biodiversity with the top threats including invasive species and agriculture. Our findings suggest that these primary threats form components of the same overarching threat – namely the loss, reduction of quality, and fragmentation of the native forest habitat in which the majority of Fiji's endemic biodiversity is restricted. As one of the objectives of this project is to reverse or slow down the IUCN Red List Index for Fiji, we clearly need to address the loss/fragmentation of native forest. The top threats to marine biodiversity identified by the experts were biological resource use, climate change, commercial coastal development and pollution.

The STAR scores for the original Amphibians, Bird and Mammals suggest that, in Fiji at least the threat abatement component is at least 3 times the Restoration component. Threat abatement should be prioritised in Fiji to reduce species extinction risk, although there remain considerable benefits in combining threat abatement with targeted restoration projects at the local scale – both within and adjacent to native forest areas.

Based on the results of this assessment, the three main threats to biodiversity in Fiji at the national level are:

Major threat 1: Loss of forest cover and fragmentation, primarily associated with land clearing for agriculture and various other means;

Major threat 2: invasive species – from a range of activities associated with forest loss, habitat fragmentation and efficient modes of transport for the terrestrial and marine environment, and

Major threat 3: biological resource use – mainly relating to the marine environment.

This report concludes that the sectors associated with the greatest direct impact or effect on Fiji's biodiversity are Agriculture and Fisheries. Addressing the primary threats caused by these sectors will have a significant impact on biodiversity in Fiji and is likely to modify the downward trajectory of Fiji's Red List Index.

Contents

List of Figures

List of Tables

List of Boxes

1. Introduction: Background, purpose, and approach of the assessment in Fiji

The health of the ecosystems on which we depend and on which all other species depend is degrading today at an unprecedented rate. This situation weakens livelihoods, food security, health and quality of life worldwide, and poses economic and financial risks. This is particularly significant for countries and people that are heavily dependent on natural resources and biodiversity for subsistence needs.

To try and halt this loss of biodiversity and promote more sustainable and resilient economies, IUCN is collaborating with Expertise France and WWF-France to catalyze the BIODEV2030 initiative. Funded by the French Development Agency (AFD), the project strives to mainstream biodiversity into key economic sectors in 16 pilot countries, among which Fiji represents Oceania. The objectives of BIODEV2030 and its approach are well aligned with Fiji's *National Development Plan 2017-2036* (see box 1) and the project outputs shall support its implementation.

This two-year project shall create the conditions for a national dialogue involving stakeholders around strategic economic sectors, relevant to the national economy and biodiversity. This dialogue will aim to initiate and facilitate tangible voluntary national and sectoral commitments to reduce pressures on biodiversity over the next decade. Such voluntary contributions will be a big step towards building ambitious common goals to halt the decline in biodiversity by 2030 and restore biodiversity by 2050.

As the initial step to BIODEV 2030 implementation in Fiji, IUCN ORO recruited NatureFiji-MareqetiViti to conduct the national biodiversity assessment at the national and local levels. This assessment is consistent with Fiji's national policies, *State of the Environment 2020, National Biodiversity Strategy and Action Plan for Fiji 2020 - 2025* and the *Sixth National Report to the Convention on Biodiversity* whose aims include (i) assessing the current state of Fiji's environment (including biodiversity), (ii) identifying the key drivers and pressures that affect Fiji's state of the environment, and (iii) providing recommendations to address key environmental challenges.

BOX 1: NATIONAL DEVELOPMENT PLAN 2017 - 2036

Launched in 2017, the National Development Plan (NDP) outlines both a 20-year Development Plan (2017-2036) and a comprehensive 5-year Development Plan (2017-2021). These plans work together, as the 5-year Development Plan provides a detailed action agenda with specific targets and policies that are aligned to the long-term transformational 20-year Development Plan.

Inclusive growth will help address remaining poverty and reduce inequalities while accelerating progress in gender equality. The NDP stresses the importance of sustained economic expansion supported by private sector investment and trade, and the enhanced provision of social services and public goods. It sets a strategy for Fiji to become a regional hub of the South Pacific for business, including by improving transport and digital connectivity, and developing a skilled workforce and productive jobs, which will contribute to regional cooperation and integration. Rural development based on the sustainable use of natural resources in agriculture, fisheries and mining is also on the agenda.

The outcome of a nation-wide consultation process with a whole-of-society approach, the NDP is aligned with, and outlines strategies to achieve Fiji's global commitments, including the 2030 Agenda for Sustainable Development and the Paris Agreement on climate change. The integrated nature of development and the need for multi-sectoral solutions are recognised and addressed. Critical cross-cutting issues such as climate change, green growth, the environment, gender equality, disability and governance are mainstreamed in the NDP.

Source: Government of Fiji (2017).

1.1. Purpose of the assessment

The overall goal of this project is to provide a scientific overview and assessment of the threats to biodiversity posed by different economic sectors in Fiji based on existing literature and reports, scientific data and interviews with experts and key stakeholders. More specifically, the project will:

1) Assess the state of biodiversity in Fiji,
2) Identify, classify and rank the threats to Fiji's biodiversity from anthropogenic activities,
3) Identify economic sectors associated with the primary threats to Fiji's biodiversity for engagement with the BIODEV 2030 project in Fiji.

The chosen methodology approach is comprised of three components: (1) a review of the literature and relevant policy documents, (2) the analysis and use of the STAR metric data and other IUCN data, and (3) expert elicitation.

2. Methodology and data

2.1. Project Framework & Definitions

2.1.1. Project framework

The project framework, the associated methodologies, results and outputs are summarised in Figure 1 below.

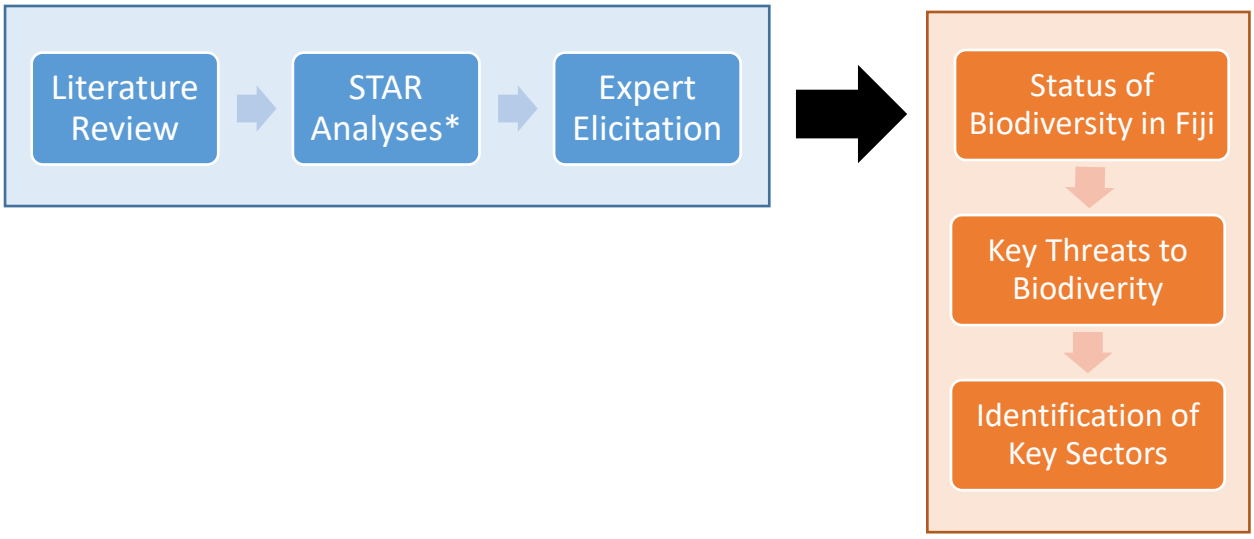


FIGURE 1: Methodological approach (blue) and outputs (orange) of the National Biodiversity Threat Assessment for Fiji (STAR = Species Threat Abatement and Restoration metric). * Combination of STAR analysis results provided by IUCN and modified STAR analyses conducted by NFMV.

First, we conducted an online search for peer-reviewed literature, policy documents, IUCN Red List data, other scientific data and sectoral reports relating to biodiversity and threatening processes in Fiji (see section 2.2.1 for details). This information guided the development of the expert questionnaire and aided in the identification of key biodiversity experts. Second, we reanalysed the STAR metric data provided by IUCN and identified important additional species to include in the national biodiversity threat assessment for Fiji (see section 2.2.2 for details). Third we conducted an expert elicitation workshop with biodiversity experts working on a range of taxonomic groups and ecosystems in Fiji, followed by an online survey of the experts (see section 2.2.3 for details). Finally, we related the key threats identified through the previous steps to their causes and the economic sectors associated with these threats in the context of Fiji. A virtual national stakeholder workshop was conducted to present on the results of the report and gather feedback on the key threats identified and the economic sectors associated with these threats (Appendix 4).

2.1.2. Biodiversity

Biodiversity is defined in Article 2 of the text of the Convention on Biological Diversity as being "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."

Biodiversity exists at different, interrelated levels of organisation.

1) genetic diversity (or intraspecific diversity) is defined by the variability of genes within the same species, whether between individuals or populations.
2) species diversity (or interspecific diversity) which corresponds to the diversity of living species, the basic unit of systematics, by their number, nature and abundance.
3) ecosystem diversity which corresponds to the diversity of ecosystems present on Earth which form the biosphere.

Due to time limitations associated with project, we have focused our assessment at the species diversity level but include some assessment at the ecosystem level.

2.1.3. Threats

There are different types of threats that may impact biodiversity: stress, direct threats, and contributing factors (Salafsky et al. 2003, 2008). We used the International Union for the Conservation of Nature and Conservation Measures Partnership (IUCN-CMP), Threats Classification Scheme, Version 3.2, which focuses on a complete set of direct threats to species or taxonomic groups, for our biodiversity threat assessment. The system is hierarchical and has three different levels, from coarse to fine scale. Each Level 1 entry (e.g. threat "2. Agriculture & aquaculture") is subdivided into several Level 2 entries (e.g. threat "2.1 Annual & perennial non-woody crops", "2.2 Wood & pulp plantations", "2.3 Livestock farming and ranching" and "2.4 Marine & freshwater aquaculture"). Some of these in turn are subdivided into Level 3 entries (e.g. "2.1.1 Shifting agriculture"). The classifications are designed to be comprehensive, consistent and exclusive for the first and second levels. The third level is at a much finer scale. While our assessment included Level 1 and Level 2 threats, we focused on Level 2 threats as these are the most relevant at the national and local scale within Fiji. The Level 1 threats were used to group finer-scale threats but were generally considered too generic for this assessment.

2.2. Data Collection

2.2.1. Biodiversity Status & Trends Review

The documents and data used for the review component of the national biodiversity assessment were collected through online searches of scientific databases, government agency websites, online data repositories, NGO and regional organisation websites, and from local and internationally-based Fiji biodiversity experts. The documentary and data sources were loosely divided into government documents/policies, peer-reviewed literature, reports, and scientific data held by experts of the consultancy team and other experts.

2.2.2. Biodiversity Threat Assessment – National Level

Review of the initial amphibian, bird and mammal STAR species proposed by IUCN

General STAR methods (see Mair et al. 2021 for more details)

The "**Species Threat Abatement and Restoration**" (**STAR**) metric, evaluates the potential benefit for threatened species of actions to reduce threats and restore habitat. Like the Red List Index, STAR is derived from existing data in the IUCN Red List. As such, STAR is designed to explain which potential actions (threat reduction and/or habitat restoration) could affect the Red List Index.

STAR is spatially explicit, enabling identification of threat abatement and habitat restoration opportunities in particular places, which if implemented, could reduce species extinction risk to levels that would exist without ongoing human impact. STAR assumes that for the great majority of species complete alleviation of threats would reduce extinction risk through halting decline and/or permitting sufficient recovery in population and distribution, such that the species could be down listed to the IUCN Red List category of Least Concern.

For each species, a global **STAR threat-abatement** (**STAR$_T$**) score is calculated. Using weighting ratios, this varies from zero for Least Concern species to 100 for Near Threatened, 200 for Vulnerable, 300 for Endangered and 400 for Critically Endangered. The sum of STAR$_T$ values across all species represents the global threat-abatement effort needed for all species to become Least Concern.

BOX 2: EXAMPLES SHOWING HOW THE 'LOCAL' $STAR_T$ SCORE IS DERIVED.

Black-faced Shrikebill, *Clytorhynchus nigrogularis*, is listed as Near-threatened in the IUCN Red List. Its global STAR-T (above) is 100. It is endemic to Fiji – so the $STAR_T$ for Fiji is also 100.

Samoan Flying-fox *Pteropus samoensis*, is also listed as Near-threatened in the IUCN Red List. Its global $STAR_T$ is also 100. However, it occurs in Fiji, Samoa and American Samoa. The Area of Occupied Habitat (AOH) in Fiji represents 92% of its Global AOH – and so the $STAR_T$ score for Fiji is 92.

$STAR_T$ scores can be disaggregated spatially, based on the area of habitat currently available for each species in a particular location. This shows the potential contribution of conservation actions in that location to reducing the extinction risk for all species globally.

The extent of current and restorable Area of Habitat (AOH) for species was determined using 5 km resolution species' AOH rasters. Species current AOH were calculated using the European Space Agency "Climate Change Initiative" (ESA CCI) land use and cover maps from 2015, with 300 x 300 m pixel size. The ESA CCI original 37 land cover classes were reclassified into ten major classes (forests, wetlands, arid ecosystems, natural grasslands, shrublands, croplands, cultivated grasslands, rock and ice, and urban areas), and then matched to the habitat classes from IUCN Red List assessments. Species' range maps were then overlaid with land cover and digital elevation maps to map the area of habitat within each species' range, constrained by the species' elevation range (from the IUCN Red List). Species' range maps are coded for presence and origin; the current AOH parts of species' ranges where the species was recorded as Extinct were excluded, and only parts of each species' range where the species was recorded as Native, Reintroduced or Assisted Colonisation were included.

The local $STAR_T$ score can be further disaggregated by threat ($T_{t,i}$ see equation below), based on the known contribution of each threat to the species' risk of extinction. This quantifies how actions that abate a specific threat at a particular location (or country) contribute to the global abatement of extinction risk for all species.

$$T_{t,i} = \sum_{s}^{N_s} P_{s,i} W_s C_{s,t}$$

Where:

$\mathbf{P_{s,i}}$ is the current Area of Habitat (AOH) of each species (s) within location (i), expressed as a percentage of the global species' current AOH;

$\mathbf{W_s}$ is the IUCN Red List category weight of species s (NT= 1, VU = 2, EN = 3 and CR= 4);

$\mathbf{C_{s,t}}$ is the relative contribution of threat t to the extinction risk of species s calculated as the percentage population decline from that threat at global scale (and note at site *i*);

$\mathbf{N_s}$ is the total number of species at location (i).

BOX 3: DERIVATION OF $STAR_T$ THREAT SCORES.

The IUCN Red List records five separate threats for Black-faced Shrikebill, Agriculture & Aquaculture, Biological Resource Use, and three species under the Invasive and other problematic species. The Impact score for all five of these threats is listed as Low Impact, 5. Each threat is equal – so the $STAR_T$ score for each of these threats, based on this species, is 25 (5 threats x 5). Note that when summing – the Invasive threat has 3 sets of 20 scores – and so Invasives scores 60 overall for this species.

For Samoan Flying Fox, six IUCN CMP Level 2 threats are listed, three of these under the Agriculture & Aquaculture threat, two under Biological Resource Use, and one under climate change. The impact scores for Agriculture are 6, 6 and 5 (= 17), for Biological Resource Use are 8 and 6 (= 14), and for Climate Change is 9 – the total threat score comes to 40. The $STAR_T$ scores for these threats are 42.5 (17*100/40), 35 (14*100/40) and 22.5 (9*100/40), respectively.

The STAR metric also includes a **habitat restoration component** to reflect the potential benefits to species of restoring lost habitat. The STAR restoration component is calculated for each species and is based on the area of habitat (AOH) that has been lost and is potentially restorable. The STAR restoration score (**$STAR_R$**) quantifies the potential contribution that habitat restoration activities could make to reducing species' extinction risk. For a particular species at a particular location (or country), the STAR restoration ($STAR_R$) score ($R_{t,i}$ see equation below) reflects the proportion that restorable habitat at the location represents of the

global area of remaining habitat for that species. Importantly, a multiplier is applied to $STAR_R$ scores to reflect the slower and lower success rate in delivering benefits to species from restored habitat compared with conserved existing habitat.

$$R_{t,i} = \sum_{s}^{N_s} H_{s,i} W_s C_{s,t} M_{s,i}$$

Where:

$\mathbf{H_{s,i}}$ is the extent of restorable AOH for species s at location i, expressed as a percentage of the global species' current AOH.

M*i* is a multiplier appropriate to the habitat at location i to discount restoration scores. We use a global multiplier of 0.29 based on the median rate of recovery from a global meta-analysis assuming that restoration has been underway for ten years (the period of the post-2020 outcome goals).

The original area of habitat (original AOH) represented the extent of original ecosystem types before human impact (i.e. the land cover before conversion to croplands, pasturelands or urban areas). ESA CCI land use and cover maps from 1992 were used to inform back-casting of the extent of original ecosystem types. Species range maps were then overlaid with this back-cast land cover and with digital elevation maps to map the original area of habitat within each species range. For the purposes of this analysis, the extent of species original AOH was constrained to within individual species' range maps according to the IUCN Red List; these range maps largely reflect current range limits due to a lack of consistent information across all species on their historical, recently extirpated range. As with current AOH, for original AOH only parts of each species' range where the species was recorded as Native, Reintroduced or Assisted Colonisation according to the origin coding of the IUCN Red List assessments. However, for original AOH, parts of species' ranges where the species was recorded as Extinct were included, for all species for which this information was available. Species restorable AOH was then calculated as the difference between original and current AOH.

BOX 4: DERIVATION OF $STAR_R$ SCORES.

Analysis of the data indicates that the AOH that is lost and potentially restorable for Black-faced Shrikebill represents an extra 47% of habitat over and above the area that is considered currently to be occupied. The $STAR_R$ score for the Shrikebill is, therefore, 47*0.29 – or 13.5.

For Samoan flying Fox – the area of AOH within Fiji that has been lost, and is potentially restorable, represents an additional 38% over and above the 91% of the total AOH of this species in Fiji. Again, the $STAR_R$ score for the Flying Fox is, therefore, 38*0.29 – or 11.

The STAR scores have been calculated and mapped at global scale using species' extinction risk categories and threat classification data downloaded for amphibians, birds and mammals from the IUCN Red List website on 16 September 2020. A total of 5,364 species (2,054 amphibians, 1,962 birds and 1,348 mammals) were included in the Global analysis based on the availability of the necessary data (Mair et al 2021).

A total of 31 amphibian, bird and mammal species (from the IUCN Red List) were selected by IUCN for inclusion in the Fiji national biodiversity assessment based on STAR assessments. The STAR data selected by IUCN were extracted on 16 September 2020 based on IUCN Red List 2020-2. After reviewing these STAR species, and the Red List 2021-1, we added four endemic species to the list (one mammal and three birds) that should have been included in the original data analysed and removed three species (all seabird species that do not regularly occur in Fiji) (Appendix 1). The final number of amphibians, bird and mammal species for evaluation was 32 (see Appendix 1 for species list). As all four species added to the list are endemic to Fiji, their AOH score is 100%. All four species have a narrow current, and former, range. There is no evidence of range contraction for two of these species (Rotuma Myzomela and Ogea Monarch), both of which occur across the islands to which they are restricted. We consider some restoration potential for Natewa Silktail, and restoration potential for Fiji Flying fox being similar to that for other Taveuni island-endemics.

Identification of other terrestrial taxa in Fiji for inclusion in the national threat assessment (non-STAR taxonomic groups)

One immediate concern about the initial STAR analysis was that it was undertaken using a small proportion of the species in country, from a small subset of taxa. Extrapolating up from this to represent the principal threats to Fijis biodiversity as a whole seemed dangerous, without undertaking some checks.

We were aware that, for Fiji, there is reasonably extensive coverage of other terrestrial fauna, namely Reptiles (31 Fijian species are included on the IUCN Red List, of which 18 are Globally Threatened or Near Threatened) and gastropods (200 Fijian species are on the Red List of which 72 are Globally Threatened or Near Threatened). In addition, we felt that the flora of Fiji should be represented. A total of 208 species of *Magnoliopsida*, 9 *Pinopsida*, 70 *Liliopsida* and 1 *Cycadopsida* occur in Fiji and are on the IUCN Red List of threatened species v.2021-1. These include 65, 4, 18 and 1 species, respectively, classed as either Globally Threatened or Near Threatened (see Appendix 1 for additional species). Not all species within these taxa have been assessed through the IUCN Red List – but each are well represented. These additional species were assessed using the slightly modified methodology described briefly below.

The STAR analysis uses Area of Habitat (AOH) and expresses the importance of each species to Fiji's biodiversity based on the percent of the total (global) AOH that occurs in Fiji. For many of the reptile, mollusc and plant species, there are no readily available AOH data available. Consequently, we used the number of countries that a species occurs in as a surrogate of AOH to weight the impact of each species on Fiji's biodiversity. This weight is equal to 1/(No. of countries) expressed as a percentage.

Using this approach, endemic species score 100, species in two countries score 50 and species in 10 countries score 10 and so on. That percentage is then multiplied by the IUCN Red List score (NT = 1, VU = 2, EN = 3, CR = 4) as previously described.

Box 5. Derivation of $STAR_T$ scores for species where AOH was not available.

The Fiji Crested Iguana *Brachylophus vitiensis* is classed as Critically Endangered. This gives it a score of 4. It is endemic to Fiji – and so 100% of its range is in the country. Accordingly, the $STAR_T$ score (here the global score is equal to the in Fiji score) for this species is 400.

The cycad *Cycas seemannii* is classed as Vulnerable. As above, this gives it a score of 2. In addition to Fiji, it occurs in 3 countries - New Caledonia, Tonga and Vanuatu. So, Fiji represents 25% (1/4) of the number of countries that it occurs in. The $STAR_T$ score for this species in Fiji is, therefore, 25*2 = 50.

The threat scores were calculated using exactly the same approach as Box 3 (above).

This information allows us to evaluate the importance of a wider range of species of Fiji's national biodiversity and how they capture the key threats for the national biodiversity in general. Note that endemic species score 100% using both methods, and that over 90% of the

reptiles, molluscs and plant species on Fiji's Globally Threatened and Near Threatened species lists are endemic.

Consideration of marine taxa for inclusion in the national threat assessment

Fiji is a small island state (land area = 18,274 km^2, EEZ = 1,356,662 km^2), with a large proportion of its biodiversity found in estuarine, coastal and marine habitats. We felt that the omission of these species from the STAR analysis will result in a bias towards the identification of threatening processes and sectors focused primarily on terrestrial biodiversity rather than those most significantly impacting biodiversity at the national level. A number of the bird species, listed in the original STAR analysis, use the coastal and/or marine environment. However, many of the threats, as listed on the IUCN Red List, to these species are land-based – occurring at their nesting grounds. Most of these species do not breed in Fiji, using the coastal or marine areas during the non-breeding, or migratory times of year. The identified threats were not, primarily, marine-based. As a result, we included all Globally Threatened and Near Threatened marine species that are present in Fiji and are listed on the IUCN Red List. As before, the AOH for these species was not available, so we used the inverse of the number of countries that the species were listed as present on the IUCN Red List (as explained in Box 5 above). As marine biodiversity is a key component of Fiji's national biodiversity, we compared the findings from this data with the Special Unique Marine Areas report (SUMA report, Sykes et al. 2018), IUCN Red List data and consultations with experts to identify the main threats to marine biodiversity and the key economic sectors associated with these threats (see sections 2.2.3, 3.2.1, 3.3, 4.3).

2.2.3. Expert elicitation workshop and questionnaire

We conducted an online expert elicitation workshop on 25 June 2021 with 16 biodiversity experts and on 29 June 2021 with six staff of the Ministry of Forestry to verify the results of the STAR analysis, help fill the identified taxonomic and ecosystem gaps and enable a comprehensive national evaluation of the threats to Fiji's biodiversity. The experts included individuals and those from key organisations involved in biodiversity conservation and management in Fiji, including academic institutions, conservation NGOs, government agencies and environmental consultants (see Appendix 2). They included experts with experience working with range of taxonomic groups (e.g. amphibians, reptiles, mammals, birds, plants, fish, corals) and in different ecosystems (terrestrial, freshwater, marine).

The workshop began with a summary of the overall project aims, the STAR approach used and key patterns emerging from the STAR data. This overview, while potentially influencing the

expert assessments, was necessary to enable the experts to understand the nature of the project, become familiar with the methodology and understand what was required from them to complete their national biodiversity assessment. The project summary was then followed by a group discussion of the data presented, key threats for different taxonomic groups and the issue of marine species assessments. At the end of the workshop, experts were sent a questionnaire (Appendix 3) and asked to identify and rank key threats to biodiversity within their taxonomic and ecosystem-based areas of expertise. A further 11 individuals who could not make the virtual session were sent video recordings of the workshop and a copy of the questionnaire to fill out. With the exception of three experts who worked together to evaluate the threats to bat species, all experts conducted their national biodiversity assessments independently.

Given the COVID-19 outbreak that hit Fiji in June and the subsequent lockdown of much of Viti Levu (mainland), we were unable to include other stakeholders (e.g. private business, local communities, agriculture sector) during this process as these groups would require a face-to-face approach to engagement. This is particularly important for local communities which require extensive community consultation over a long timeframe and do not have access to online communication platforms due to limited computing and internet capacity.

Analysis of expert data

The data from experts were segregated into target groups (species or taxon, see Table 1) and ecosystems (Table 1) to calculate the number of times a threat (Level 2) was cited by experts for each target group and ecosystem (see Section 4.3.3.1).

TABLE 1: TARGET GROUPS FOR EXPERT ASSESSMENTS: MAMMALS, BIRDS, AMPHIBIANS, REPTILES, FRESHWATER FISH, PLANTS, TERRESTRIAL INVERTEBRATES, MARINE INVERTEBRATES AND MARINE VERTEBRATES. NUMBERS IN PARENTHESES INDICATE THE NUMBER OF EXPERTS FOR EACH TAXONOMIC GROUP/ECOSYSTEM THAT RESPONDED TO THE STUDY.

Target Group	Target Ecosystem
1. Mammals (2)	1. Natural terrestrial ecosystems (23)
2. Birds (6)	2. Agroecosystems (1)
3. Amphibians (6)	3. Freshwater ecosystems (4)
4. Reptiles (3)	4. Marine ecosystems (12)
5. Freshwater fish (4)	5. Other (0)
6. Plants (6)	
7. Terrestrial invertebrates (0)	
8. Marine invertebrates (e.g. coral) (6)	
9. Marine vertebrates (e.g. fish) (6)	

The value of contribution to biodiversity loss was ranked from 1 (weak) to 5 (strong) (Table 2). The contribution of each threat (Level 2) towards biodiversity loss for each target group and ecosystem was also derived from these data. The sum of "contribution to biodiversity loss" was calculated for each target group and ecosystem to allow for a ranking of expert statements.

TABLE 2: RANKING VALUES FOR THE CONTRIBUTION OF THREATS TOWARDS BIODIVERSITY LOSS OR IRREVERSIBILITY OF THE THREAT.

CONTRIBUTION TO BIODIVERSITY LOSS/ IRREVERSIBILITY	
1	WEAK
2	MEDIUM
3	STRONG
4	VERY STRONG

Calculating the contribution of "forest loss" to biodiversity loss.

The threat of commercial logging and wood harvesting of native trees is historic in Fiji. Level 2 threats were further aggregated into "Loss of forest" (derived from threats otherwise allocated – see Table 3) and mapped against other "non-loss of forest" threats.

TABLE 3: LIST OF LEVEL 2 THREATS ON THE CLASSIFICATION LEVEL (IUCN-CMP) COMBINED AS "LOSS OF FOREST" IN THE ANALYSIS OF THE EXPERT DATA.

2.1 Annual & perennial non-timber crops
2.2 Wood & pulp plantations
2.3 Livestock farming & ranching
3.2 Mining & quarrying
3.3 Renewable energy
4.1 Roads & railways
4.2 Utility & service lines
5.3 Logging & wood harvesting
7.1 Fire & fire suppression
7.2 Dams & water management/use
11.1 Habitat shifting & alteration

3. Fiji's Biodiversity Status and Trends

3.1. The scope of the assessment

Fiji is an archipelago comprised of over 332 islands located in the Western Pacific Ocean (17°42' 48.1356" S and 178° 3'54.1188" E). The total land area in Fiji is estimated to be 18,333 km^2 and it has an EEZ of 1,356,662 km^2. Only 100 of the islands are inhabited and the two main islands, Viti Levu and Vanua Levu, whose areas are 10,429 km^2 and 5556 km^2, respectively, account for 85% of the total landmass and are inhabited by 93% of the total population of 884,887 (FBS, 2017). Around 56% (10,266.48 km^2) of the land is occupied by forests and 23% (4216.59 km^2) by agriculture (SOE 2020).

Fiji has a tropical maritime climate and rainfall is highly variable and mainly orographic precipitation under the influence of the prevailing south-east trade winds. Rainfall variability depends on the height of the mountains, which determine the weather the windward and leeward sides of the country experience during the wet season from November to April and dry season from May to October (SOE 2020).

3.2. Biodiversity status and trends - Ecosystem approach

3.2.1. Ecoregions and Ecosystems

Fiji, spread over 332 islands, possesses an endemic-rich biodiversity. The country falls within the Polynesia-Micronesia Biodiversity Hotspot, which is one of the 36 biodiversity hotspots in the world. In this section we describe the major ecosystems present in Fiji divided into terrestrial, freshwater and marine areas.

A. TERRESTRIAL REALM

Natural systems

Natural terrestrial habitats in Fiji can be categorised into nine vegetation classes based on Mueller-Dombois and Fosberg's (1998) description of the major vegetation types found in Fiji.

1) ***Broad-leaf lowland rain forest*** is found in the wet zone of the high islands of Viti Levu and Vanua Levu and extends from near sea level to an altitude of 600 m, with a mean annual rainfall of 2,000–3,000 mm. These forests are predominantly a mixed assemblage of 20-30 m tall trees, largely dominated by primary Fijian species on steep lands. The canopy matrix includes angiosperm species, such as *Calophyllum vitiense* and *Endospermum macrophyllum*, along with *Canarium vitiense, Cleistocalyx spp., Garcinia vitiense, Heritiera ornithocephala, Myristica castaneifolia, Palaquium*

hornei, Parinari insularum, and *Syzygium* spp. Gymnosperms are also present in the forests, such as Kauri (*Agathis vitiense*), *Dacrydium elatum*, and *Nageia vitiensis.*

2) ***Upland rain forest*** occurs mostly in areas above 600 m in both the wet and dry zones, the latter toward the interior of the large islands. These areas receive a mean annual rainfall of 2,000–3,750 mm. The physiognomy of upland rainforests differs from that of lowland forests in being lower-statured, with crowns lower on their trunks. Temperatures are cooler and rainfall is generally higher, differentiating the wet zone and the intermediate zone. Thus, a wet-zone forest with more than 3750 mm annual rainfall can be distinguished from an intermediate-zone forest with 2000 mm to 3750 mm rainfall.
3) ***Cloud forests*** are mainly enshrouded in clouds and are restricted to mountaintops and ridges above 600 m near the coast and higher than 900 m inland with more than 9,000 mm of annual rainfall. Stunting is related to cooler temperatures, higher winds, and lower light levels that reduce photosynthesis, along with excess moisture levels that accelerate nutrient leaching and decrease soil aeration. At the height of about 1200 m elevation, unique trees include *Ardisia brackenridgei, Dysoxylum lenticellare, Fagraea vitiensis,* and *Weinmannia sp.*, which are found along with shrubs, such as *Pipturus argenteus, Randia vitiensis* and *Scaevola floribunda*. At lower altitudes of 800 m, species mostly occurring in the lowland forests are found, such as *Alstonia vitiensis, Bischofia javanica, Calophyllum neo-ebudicum, Heritiera ornithocephala, Palaquium hornei* and *Parinari insularum*.
4) ***Dry forests*** are only known to occur in parts of the dry zone of Viti Levu and Vanua Levu and some of the western islands and much of which have been destroyed primarily by fire but contributed to by persistent grazing. Rainfall is very low in the dry season but can receive similar rainfall as wet forests during the rainy season resulting in a mean annual range of 1,750–2,250 mm.
5) ***Talasiga vegetation*** is dry-zone vegetation found in fire-degraded environments and spreads from sea level to 1,000 m. It receives a mean annual rainfall of 1,500–2,500 mm. Talasiga (sunburnt) vegetation covers about a third of both Viti Levu and Vanua Levu. It refers to once-forested dry lowlands, which have now been degraded by fire and over-grazing into a mosaic of pyrophytic grasslands and savannahs. Large grass-reedlands of *Miscanthus floridulus* and *Pennisetum polystachyon* dominate some areas, but in areas of severe soil nutrient impoverishment, low-growing plants of the

indigenous ferns *Pteridium aquilinum var. esculentum* and *Dicranopteris linearis* form the primary vegetation cover.

6) ***Freshwater wetland vegetation*** occurs commonly only in the wet zone of Viti Levu in poorly drained alluvial sites along coastal flatland along the Rewa and Navua Rivers but elsewhere there are limited areas of marsh which are today dominated by exotic ferns, grasses, and sedges. The wetland forests include native species, such as*Inocarpus fragifer,, Barringtonia racemosa, Fagraea berteroana, Metroxylon vitiense* and *Glochidion cordatum,* and invasive introduced species, such as *Annona glabra,* and *Psidium guajava.*

7) ***Mangrove forests*** are associated with river estuaries and are found along the coastline. The richest mangroves in Fiji occur at the mouths of major river deltas around mud-covered stream banks in the tidal zone. There are eight mangrove species in Fiji. *Rhizophora stylosa, R. samoensis (*and their hybrid *R. x. selala) which* form a scrubby seaward fringe, being replaced inland by basin forests of *Bruguiera gymnorrhiza,* and more landward elements of *Excoecaria agallocha, Lumnitzera littorea, Xylocarpus granatum and X. moluccensis*.

8) ***Coastal strand vegetation*** changes from creepers and herbs to shrubs and trees. These forests are dominated by pure stands of *Casuarina equisetifolia* or *Pandanus tectorius,* which is supplanted inland by a mixed littoral forest that includes *Barringtonia asiatica, Calophyllum inophyllum, Cocos nucifera, Cordia subcordata, Hibiscus tiliaceus, Hernandia nymphaeifolia, Terminalia catappa, Thespesia populnea,* and *Tournefortia argentea*. The coastal dunes of Sigakota are dominated by native species, such as *Calophyllum inophyllum, Dysoxylum mollissimum,* and *Syzygium richii.*

9) ***Small island vegetation*** is a combination of coastal strand vegetation, mangrove forest, and talasiga vegetation. These islands receive a mean annual rainfall of approximately 2,000 mm.

Agricultural systems

According to the most recent Fiji Agriculture Census (2020), 194, 768.6 ha (1947.7 km^2) of Fiji's land is under some form of agriculture: Temporary crops or short term crops (22.8%), fallow for one year or more (6.4%), permanent crops – no pastures (14.3%), permanent crops with pastures (17.5%), temporary meadows and pastures (10.3%), permanent meadows and pastures (14.0%), others (14.8%) (Ministry of Agriculture, 2020). The major area under harvested crops is occupied by yaqona (kava), and production has been increasing due to an

increase in demand locally and internationally along with an increase in lucrative pricing (price of 1 kg yaqona increased from $30.00 to $120.00 since 2016 although it had since fallen to less than $80.00) (SOE 2020). The area harvested for yaqona increased over 49% between 2015 and 2016 (SOE 2020). Most recently the area harvested for yaqona was 12, 305.1 ha (42.1% of the area harvested for temporary crops in Fiji) (Ministry of Agriculture 2020).

This is followed by those areas used to produce cassava, dalo, and copra. Sugar cane is another nationally important crop grown in the drier areas of Viti Levu and Vanua Levu, where the official 'cane perimeter' is over 110,000 ha but currently less than 50% of it is planted with cane with much of it abandoned. There has been a continuous decline since 2003 in the area being harvested for sugar cane due to the expiration/non-renewal of native land leases for cane plantations and Fiji's decreasing share of the global sugar market because of decreasing international subsidies (SOE 2020). Sugarcane was not listed in the Fiji Agriculture Census (2020) data even though it was given as an example of a "permanent crop", hence it is not clear if the current 194,768.6 ha of agricultural land includes or is addition to the 110,000 ha (1,100 km^2) of official "cane perimeter".

Fiji's farmland (194,768.6 ha) is dominated by farmers having traditional ownership (54.1%), followed by native lease (23.7%), freehold land (13.9%), lease from state (6%), occupied land with informal agreement (2.1%), occupied land without any legal agreement (0.2%), and others (0.04%) (Ministry of Agriculture 2020).

Plantation Forests

Fiji has very successfully established significant hardwood and softwood plantation sectors which currently make up about 11% of Fiji forest cover (Figure 2, Government of Fiji 2010). Caribbean Pine *Pinus caribaea* was found to grow very well on areas of anthropogenic open reed-grasslands (Talasiga) and although exotic, were nonetheless both productive and ecologically beneficial in halting a degrading pedological trend. Currently approximately 50,000 ha is grown by Fiji Pine and on private woodlots owned by landowners. Approximately the same area of mahogany *Swietenia macrophylla* has been planted, but in contrast to the pine, Fiji Hardwood Corporation's 14 plantations were established through conversion of native forest.

Fiji has no shortage of potential for reforestation of degraded forest areas and abandoned sugar cane areas in the sloping foothills of agricultural land.

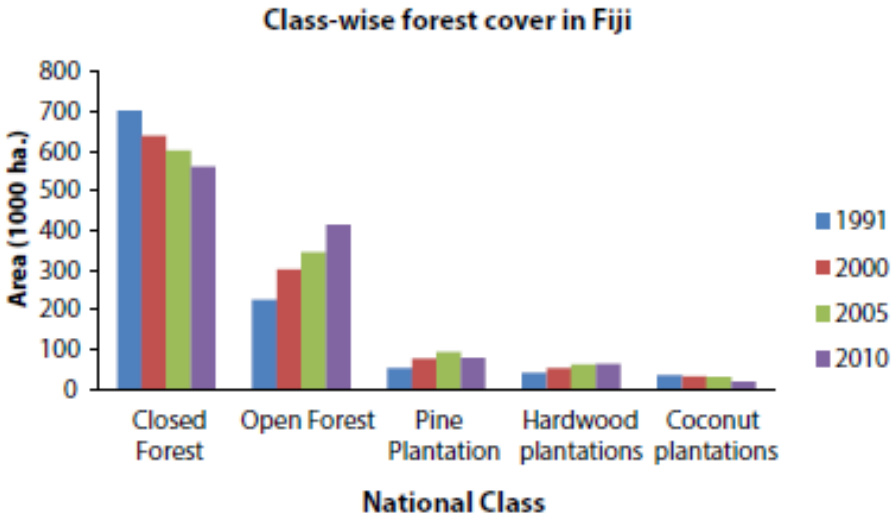


FIGURE 2: National class-wise trend in forest cover of Fiji. Source: Global Forest Resource Assessment (2015)

B. FRESHWATER REALM

Freshwater systems in Fiji are made up of rivers, creeks, streams, springs, lakes, peat swamps, ponds, and dams. Despite the high rainfall levels across the country, freshwater wetlands occupy only a very small proportion of the land surface (ca. 0.3%) (Gray 1993). The few freshwater lakes in Fiji are largely in mountainous regions, and the largest, Tagimoucia Crater Lake (16 ha) is found at 820 m on Taveuni Island (Manghubai et al. 2018).

Over 80% of Viti Levu is drained by Fiji's four largest rivers - Rewa, Ba, Navua, and Sigatoka. Rivers in Vanua Levu are generally short with the longest being the Dreketi River (55 km). These rivers and their tributaries provide an important water source for rural and urban populations and the upland regions host a number of endemic species. The Monasavu Dam in the Viti Levu central highlands is Fiji's largest storage reservoir (SOPAC 2012).

Fiji has a high diversity of freshwater fish and invertebrate species. There are 166 known freshwater fish species including 13 species endemic to Fiji (Copeland et al. 2016). Freshwater macroinvertebrate species richness is high, comprising 61 families, many of which are endemic to Fiji (e.g., damselflies (*Nesobasis* spp.), spring snails (*Fluviopupa* spp.), aquatic gastropods (*Acochlidium fijiense*, *Fijidoma maculata*) (Haynes 1988; Haynes & Kenchington 1991; Rashni 2014; Zielske & Haase 2014).

C. COASTAL & MARINE REALM

Fiji has an estimated area of 4550 km^2 of coral reefs surrounding over 330 islands and more than 500 islets and cays, in the form of fringing, line, patch, atoll, and barrier reefs (Mangubhai

et al. 2018). Extensive mangrove, seagrass and salt marsh habitats remain in good condition along more remote shores and river estuaries. Deepwater habitats include trenches, basins, canyons, seamounts, rift valleys, ridges, plateaus, spreading ridges, and hydrothermal vents (IHO 2008).

Mangroves

Fiji has the third largest mangrove resource in the Pacific Islands after Papua New Guinea (372,770 ha) and the Solomon Islands (64,200 ha) (Mangrove Management Committee 2013). The Forest Resource Assessment and Conservation (2017) recorded Fiji's mangrove cover to be 45,940 ha from Viti Levu, Vanua Levu, and Taveuni. The assessment was updated in 2019 to 47,440 ha which covered Cicia, Gau, Lakeba, Matuku, Moala, Ovalau, Viti Levu, and Vanua Levu (SOE 2020).

Confusion on the critical issue of the extent of Fiji's mangrove area, as initially raised by MMC (2013), is the most recent estimate of Fiji's mangrove resource which raises the area to 65,243 ha (Cameron *et al*. (2021)). There are eight mangrove species recorded from Fiji.

Seagrass Beds

The distribution of seagrass in Fiji is poorly documented (Prasad 2010) with the 2004 estimated 16.5 km^2 area of Waycott et al. (2004) considered a significant underestimate (G. Brodie as cited in Mangubhaii et al. 2018). Fiji has five recorded species (*Halophilia decipiens*, *H. ovalis*, *Halodule uninervis, H. pinifolia, Syringodium isoetifolium*) and one subspecies (*H. ovalis* sp. *bullosa*) (Prasad 2010). Data on faunal biodiversity within seagrass meadows are also severely lacking for Fiji.

3.2.2 Biodiversity status and trends - Species approach: Flora and Fauna

A. MAMMALS

There are 11 species of mammals in Fiji of which bats are the only native species (one endemic species, one endemic sub-species, four native). Introduced mammals in Fiji include three rat species and two mongoose species. There are also feral pigs, horses, cattle, deer, cats and dogs. Five species of mammals, all bats, in Fiji are globally threatened (Table 4).

TABLE 4: GLOBALLY THREATENED MAMMALS OF FIJI (IUCN 2021, http://www.iucnredlist.org)

Status	Common name	Scientific name	Trend
CR	Fiji flying fox	*Mirimiri acrodonta*	Decreasing
EN	Fiji mastiff bat Pacific sheath-tailed bat	*Chaerephon bregullae* *Emballonura semicaudata*	Decreasing Decreasing
VU	Fiji blossom bat	*Notopteris macdonaldi*	Decreasing
NT	Samoan flying fox	*Pteropus samoensis*	Decreasing

B. BIRDS (AVIFAUNA)

A total of 108 bird species breed or are regular migrants to Fiji or Fiji waters, 36 of these are country endemic species. Ten species are globally threatened (Critically Endangered, Endangered or Vulnerable) while there are a further 14 species which are considered globally as Near Threatened. Together these comprise 25% of Fiji's avifauna and all but three of these species are considered to be decreasing in number (Table 5).

TABLE 5: GLOBALLY THREATENED BIRDS OF FIJI (BIRDLIFE INTERNATIONAL 2021), INCLUDING THE TREND STATUS (FROM HTTP://WWW.IUCNREDLIST.ORG). NOTE: THE GLOBALLY THREATENED LIST EXCLUDES TWO PETRELS - WHITE-NECKED AND BLACK PETREL AND THE FAR EASTERN CURLEW WHICH ARE CONSIDERED AS VAGRANTS IN FIJI OR FIJI WATERS.

Status	Common name	Scientific name	Trend
CR	Red-Throated Lorikeet Fiji Petrel	*Charmosyna amabilis* *Pseudobulweria macgillivrayi*	Decreasing Decreasing
EN	Long-Legged Thicketbird Polynesian Storm-petrel*[1] Far Eastern Curlew*[1] Phoenix Petrel*[2]	*Megalurulus rufus* *Nesofregetta fuliginosa* *Numenius madagascariensis* *Pterodroma alba*	Stable Decreasing Decreasing Decreasing
VU	Shy Ground-dove Pink-billed parrotfinch Natewa Silktail Rotuma Myzomela Crimson Shining Parrot Collared Petrel White-necked Petrel Black Petrel*[1]	*Alopecoenas stairi* *Erythrura kleinschmidti* *Lamprolia klinesmithi* *Myzomela chermesina* *Prosopeia splendens* *Pterodroma brevipes* *Pterodroma cervicalis* *Procellaria parkinsoni*	Decreasing Decreasing Decreasing Stable Decreasing Decreasing Increasing Stable

	Cook's Petrel *[2]	*Pterodroma cookii*	Increasing
NT	Whistling Dove	*Chrysoena viridis*	Decreasing
	Mottled Petrel	*Pterodroma inexpectata*	Decreasing
	Sooty Shearwater	*Ardenna grisea*	Decreasing
	Flesh-footed Shearwater*[2]	*Ardenna carneipes*	Decreasing
	Tahiti Petrel	*Pseudobulweria rostrata*	Decreasing
	Bristle-thighed Curlew	*Numenius tahitiensis*	Decreasing
	Bar-tailed Godwit	*Limosa lapponica*	Decreasing
	Masked Shining Parrot	*Prosopeia personata*	Decreasing
	Taveuni Silktail	*Lamprolia victoriae*	Decreasing
	Taveuni Streaked Fantail	*Rhipidura rufilateralis*	Decreasing
	Kadavu Fantail	*Rhipidura personata*	Decreasing
	Azure-crested Flycatcher	*Myiagra azureocapilla*	Decreasing
	Ogea Monarch	*Mayrornis versicolor*	Stable
	Black-throated Shrikebill	*Clytorhynchus nigrogularis*	Decreasing

*[1] – These species were not considered for the STAR analysis as they are considered to be vagrants to Fiji.
*[2] – these species were considered for the initial STAR analysis but were rejected as they, too, were considered to be vagrants to Fiji.

C. AMPHIBIANS

There are two endemic species of frog in Fiji - the Fiji Ground Frog (*Cornufer vitianus*) and the Fiji Tree Frog (*C. vitiensis*). The Cane Toad (*Rhinella marina*) is an introduced species and spread all across Fiji. The two-amphibian species in Fiji are both listed as globally Near threatened (Table 6).

TABLE 6: GLOBALLY THREATENED AMPHIBIANS OF FIJI (IUCN 2021, http://www.iucnredlist.org)

Status	Common name	Scientific name	Trend
NT	Fiji ground frog	*Cornufer vitianus*	Decreasing
	Fiji tree frog	*Cornufer vitiensis*	Decreasing

D. REPTILES

There are 33 species of terrestrial reptile in Fiji including five species of (terrestrial dwelling) snake (including the banded sea krait), five iguana species, 14 skinks and 10 geckoes. Most of these species are endemic to Fiji including the Fiji Burrowing Snake (*Ogmodon vitianus*) which represents an endemic genus, eight skinks, two geckoes and four species of iguanas. In addition to the terrestrial reptile species, there are also five marine turtles and three marine snakes found in Fiji waters. Thirteen reptile species in Fiji are listed as globally threatened (Table 7). Some species are extirpated from Viti Levu and Vanua Levu and other islands where the introduced mongoose is naturalised (Clause et al. 2018; Morrison et al. 2004; Osbourne et al. 2013).

TABLE 7: GLOBALLY THREATENED TERRESTRIAL REPTILES OF FIJI (IUCN 2021, http://www.iucnredlist.org)

Status	Common name	Scientific name	Trend
CR	Fiji crested iguana	*Brachylophus vitiensis*	Decreasing
	Ono-i-Lau ground skink	*Leiolopisma alazon*	Decreasing
EN	Fiji banded iguana	*Brachylophus bulabula*	Decreasing
	Lau banded iguana	*Brachylophus fasciatus*	Decreasing
	Gau iguana	*Brachylophus gau*	Decreasing
	Viti Levu mountain skink	*Emoia campbelli*	Decreasing
	Vanualevu slender tree skink	*Emoia mokosariniveikau*	Decreasing
	Fiji barred tree skink	*Emoia trossula*	Decreasing
	Fiji burrowing snake	*Ogmodon vitianus*	Decreasing
VU	Fiji copper-headed skink	*Emoia parkeri*	Decreasing
	Rotuman forest gecko	*Lepidodactylus gardineri*	Unknown
	Fiji forest gecko	*Lepidodactylus manni*	Unknown
NT	Fiji green tree skink	*Emoia concolor*	Unknown

E. TERRESTRIAL MOLLUSCS

There are over 230 molluscs (land snails) recorded from Fiji (Brodie & Barker 2011). Of these 90% are native (found in Fiji and elsewhere) and 78% are endemic to Fiji. Twenty-two species are introduced of which four are of uncertain origin in the Pacific (Brodie & Barker 2011). Seventy-two species are listed as globally threatened (Table 8).

TABLE 8: GLOBALLY THREATENED TERRESTRIAL LAND SNAILS OF FIJI (IUCN 2021, http://www.iucnredlist.org)

Status	Scientific name	Trend
CR	*Delos gardineri, Gonatorhaphe lauensis, Lauopa mbalavuana, Maafu thaumasius, Omphalotropis ingens, Ouagapia ratusukuni, Placostylus koroensis, Placostylus mbengensis, Priceconcha tuvuthaensis, Sinployea angularis, Sinployea navutuenis, Succinea rotumana, Thaumatodon corrugata, Thaumatodon spirrhymatum, Trochomorpha kambarae, Trochomorpha moalensis, Trochomorpha planoconus, Trochomorpha tuvuthae, Vatusila kondoi, Vatusila nayauana*	Unknown for all
EN	*Ba humbugi, Fijiopoma liberata, Gonatorhaphe intercostata Gonatorhaphe stricta, Macropalaina pomatiaeformis, Omphalotropis subsoluta, Ouagapia perryi, Palaina taviensis Placostylus graeffei, Placostylus guanensis, Placostylus hoyti Placostylus kantavuensis, Placostylus ochrostoma, Placostylus seemanni, Sinployea princei, Sinployea rotumana Thaumatodon subdaedalea, Trochomorpha albostriata, Trochomorpha tavinniensis, Trochomorpha transarata*	Majority unknown, some stable or decreasing
VU	*Diancta macrostoma, Fijianella calciphila, Fijianella cornucopia, Fijianella laddi, Fijiopoma diatreta, Lagivala minusculus, Lagivala vivus, Microcharopa mimula, Omphalotropis costulata, Omphalotropis longula,*	Majority unknown, some stable or decreasing

	Omphalotropis rosea, Palaina godeffroyana, Palaina subregularis, Placostylus elobatus, Placostylus malleatus Sinployea adposita, Sinployea godeffroyana, Sinployea inermis, Sinployea lauenis, Sinployea monstrosa, Sinployea recursa, Thaumatodon laddi, Trochomorpha abrochroa, Trochomorpha accurata, Zyzzyxdonta alata	
NT	*Moussonia fuscula, Omphalotropis circumlineata, Omphalotropis zelriolata, Palaina martensi, Trochomorpha corallina, Trochomorpha fessonia, Trochomorpha luedersi*	Unknown for all

F. FISH

i - Freshwater Fish

A total of 166 species of freshwater fish have been recorded for Fiji of which 13 are endemic species. About 10 species are introduced to Fiji's freshwater systems of which the tilapia (*Oreochromis mossambica*) is most dominant invasive freshwater fish species. No freshwater fish species are currently listed as threatened by IUCN while 14 species are listed as Data Deficient.

ii - Marine Fish

Over 2000 species of fish are recorded from Fiji's coastal and marine areas (SOE 2020, Government of Fiji 2017). Only 45 species are listed as globally threatened on the IUCN Red List (Table 9) including 27 shark and ray species and 18 other fish.

TABLE 9: GLOBALLY THREATENED MARINE FISH OF FIJI (IUCN 2021, http://www.iucnredlist.org)

Status	Common name	Scientific name	Trend
CR	Whitetip shark	*Carcharhinus longimanus*	Decreasing
EN		*Chilinus undulatus*	All Decreasing
	Pelagic thresher shark	*Alopias pelagicus*	
	Grey reef shark	*Carcharhinus amblyrhynchos*	
	Basking shark	*Cetorhinus maximus*	
	Shortfin mako	*Isurus oxyrinchus*	
	Pacific Manta ray	*Mobula birostris*	
	Giant devil ray	*Mobula mobular*	
	Box ray	*Mobula tarapacana*	
	Smoothtail devilray	*Mobula thurstoni*	
	Whale shark	*Rhincodon typus*	
	Zebra shark	*Stegostoma tigrinum*	
VU	Spotted seahorse	*Hippocampus kuda*	All Decreasing
	Thorny seahorse	*Hippocampus histrix*	
	Camouflage grouper	*Epinephelous polyphekadion*	
	Ocean sunfish	*Mola mola*	
	Squaretail coral grouper	*Plectropomus areolatus*	
	Blue marlin	*Makaira nigricans*	
	Brown-marbled grouper	*Epinephelus fuscogattatus*	

	Harlequin filefish Bigeye tuna Red-striped coral goby Ocellated eagle ray False thresher shark Atlantic thresher shark Blacktip reef shark Great white shark Seal shark Coastal manta ray Sharptooth lemon shark Smooth hammerhead shark Whitetip reef shark Porcupine ray Whitetail stingray	*Oxymonocanthus longirostris* *Thunnus obesus* *Gobiodon axillaris* *Aetobatus ocellatus* *Alopias superciliosus* *Alopias vulpinus* *Carcharhinus melanopterus* *Carcharodon carcharias* *Dalatias licha* *Mobula alfredi* *Negaprion acutidens* *Sphyrna zygaena* *Triaenodon obesus* *Urogymnus asperrimus* *Urogymnus granulatus*	
NT	 Rasp coral goby Narrow-barred Spanish mackerel Albacore tuna Yellowfin tuna Striped Marlin Bignose shark Bull shark Tiger shark Blue shark	*Cahetodon trifascialis* *Gobiodon brochus* *Scomberomorus commerson* *Thunnus alalunga* *Thunnus albacares* *Kajikia audux* *Carcharhinus altimus* *Carcharhinus leucas* *Galeocerdo cuvier* *Prionace glauca*	All Decreasing

G. PLANTS

Fiji's National Biodiversity Strategy and Action Plan (2017–2024) reports that there are 1518 species of plants found in Fiji's forests of which 50.1% are endemic. Fifty-five species are currently listed as globally threatened by IUCN (Table 10).

TABLE 10: GLOBALLY THREATENED PLANTS OF FIJI (IUCN 2021, http://www.iucnredlist.org)

Status	***Scientific name***	**Trend**
CR	*Acmopyle sahniana, Balaka diffusa, Balaka microcarpa, Balaka streptostachys, Cyphosperma naboutinense, Cyphosperma tanga Cyrtandra denhamii, Gardenia candida, Guettarda wayaensis Hibiscus bennettii, Hibiscus bragliae, Hibiscus macverryi Hibiscus storckii, Meryta tenuifolia, Metrosideros ochrantha Psychotria volii, Pterocymbium oceanicum*	All are unknown or decreasing
EN	*Acacia mathuataensis, Acsmithia vitiense, Agathis macrophylla Balaka macrocarpa, Burckella richii, Croton metallicus Dacrydium nausoriense, Heterospathe longipes, Heterospathe phillipsii, Homalium laurifolium, Manilkara vitiensis, Metroxylon vitiense, Neoveitchia storckii, Neuburgia alata, Santalum yasi, Schefflera euthytricha*	All are unknown or decreasing

VU	*Barringtonia seaturae, Buchanania vitiensis, Cycas seemannii Cyphosperma trichospadix, Cyrtandra kandavuensis, Diospyros phlebodes, Elaeocarpus ampliflorus, Endospermum robbieanum Excoecaria acuminata, Excoecaria acuminata, Hydriastele vitiensis, Maesa pickeringii, Melicope evansensis, Melochia parhamii, Pritchardia thurstonii*	All are unknown or decreasing
NT	*Astronidium storckii, Dendrobium prasinum, Dendrobium tokai Fagraea gracilipes, Physokentia petiolata, Physokentia thurstonii Podocarpus affinis*	All are unknown or decreasing

3.3.3 Areas of Conservation Importance

3.3.3.1 Key Biodiversity Areas

Key Biodiversity Areas (KBAs) are nationally identified sites that significantly contribute to the global preservation of biodiversity, in terrestrial, freshwater and marine ecosystems. Identifying KBAs is an important approach to address biodiversity conservation at the site level, i.e. at the level of individual protected areas, concessions and KBAs. The concept was first based on birds and has now been extended to cover a wider range of taxa and conservation initiatives (IUCN, 2016). The identification of KBAs builds on the existing network (IUCN, 2016), which includes among others: (i) Important Bird and Biodiversity Areas (IBBA) and (ii) Alliance for Zero Extinction (AZE) sites.

A. TERRESTRIAL AREAS

Fiji has 14 terrestrial Important Bird Areas (IBA, Masibalavu & Dutson 2006), some of which have legal protection where they overlap with government managed forest reserves and nature reserves and 14 marine associated sites, making 28 in total (http://datazone.birdlife.org/country/fiji/ibas). It also has four Alliance for Zero Extinction sites (AZEs) of which two have no protection while two have partial protection (SOE 2020).

There are 39 terrestrial Key Biodiversity Areas (including all IBAs, AZEs, Figure 3) in Fiji (http://www.keybiodiversityareas.org/sites/search).

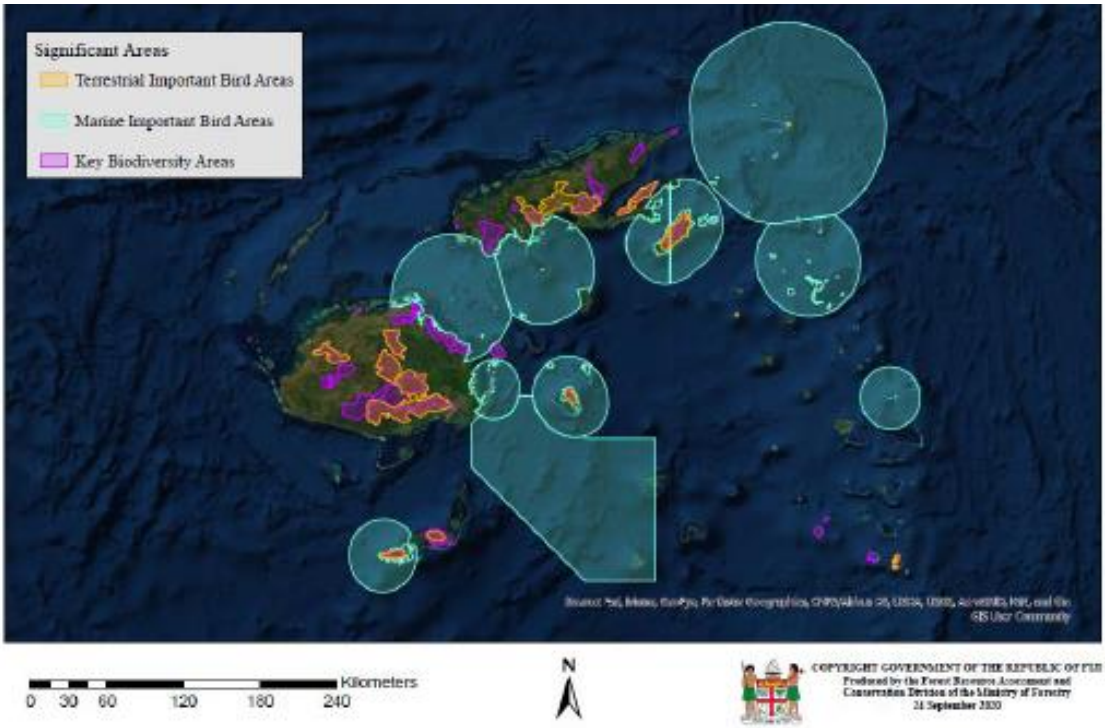


FIGURE 3: KEY BIODIVERSITY AREAS (PURPLE), TERRESTRIAL IMPORTANT BIRD AREAS (ORANGE BORDER) AND MARINE IMPORTANT BIRD AREAS (BLUE) IN FIJI (Source: Government of Fiji (2020) - Fiji Sixth National Report to CBD)

B. MARINE AREAS

In 2016, Fiji's nearshore and offshore marine areas were evaluated against a set of criteria to identify Special, Unique Marine Areas or SUMAs (see Sykes et al. 2018 for details of the process and results). In total, 98 sites were identified by the 2016 expert workshop as Special, Unique Marine Areas (SUMAs) (Figure 4 and Table 11). This large number of sites reflects the variety of marine habitats within the Fiji Islands, reefs, and surrounding oceans.

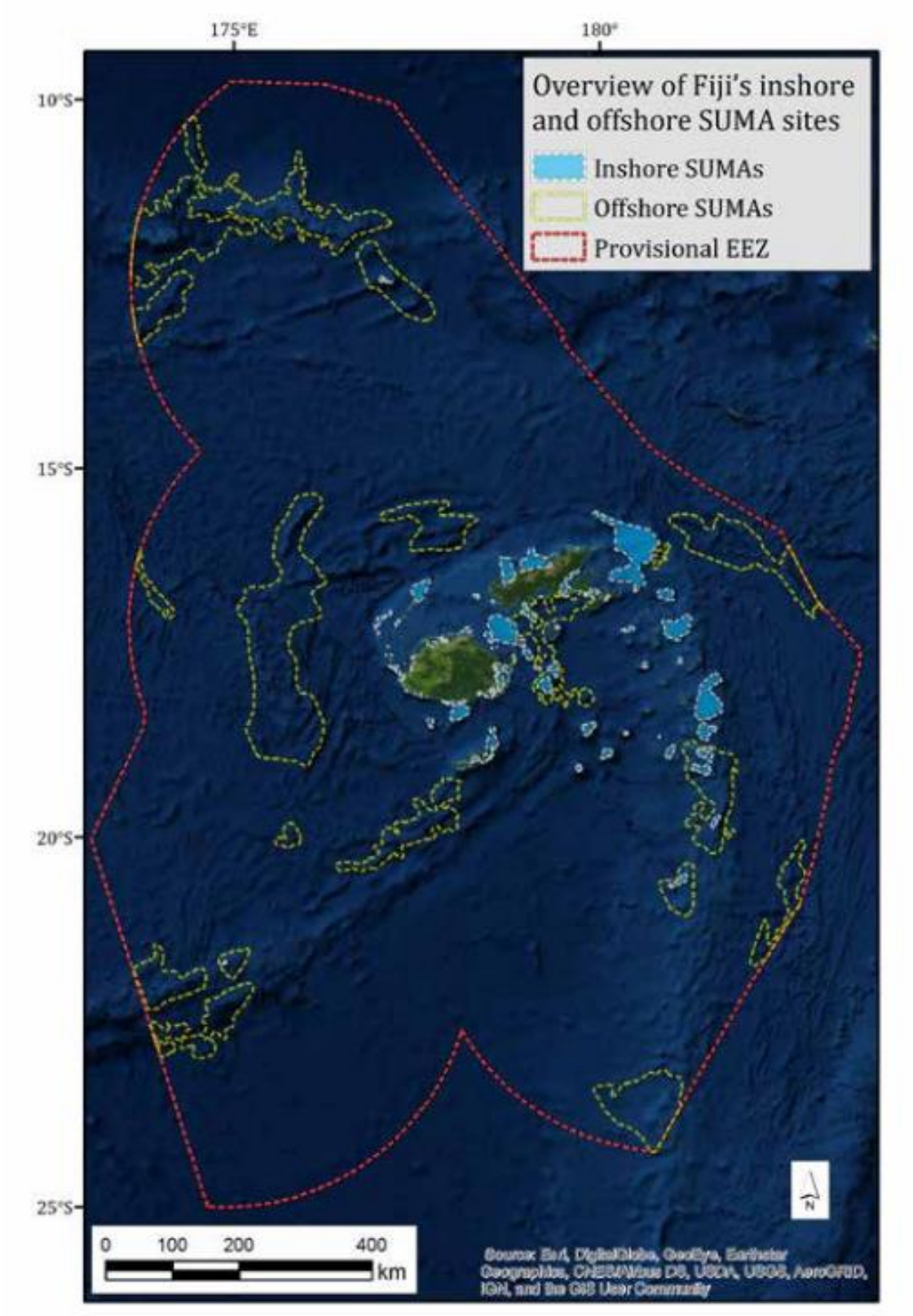


FIGURE 4: INSHORE AND OFFSHORE SPECIAL, UNIQUE MARINE AREAS (SUMAS) (SOURCE: SYKES ET AL. 2018)

TABLE 11: NUMBER OF SPECIAL, UNIQUE MARINE AREAS (SUMAS) IN EACH GEOGRAPHIC REGION WITHIN FIJI (Source: Sykes et al. 2018)

Geographic Cluster	Number of sites
Yasawa Islands	4
Mamanuca Islands	7
South Viti Levu (Beqa, Vatulele, Kadavu)	5
North Viti Levu	7
West Viti Levu	7
East Viti Levu	8
Vatu-i-Ra	3
Lomaiviti	8
North Vanua Levu	3
South Vanua Levu	4
Taveuni and Ringgold Islands	4
Lau	16
Remote Offshore (Rotuma and Conway)	2
Deep Water / Open Ocean North of Fiji	4
Deep Water / Open Ocean West of Fiji	4
Deep Water / Open Ocean South of Fiji	5
Deep Water / Open Ocean East of Fiji	7
Total number of SUMA sites	98

3.3.3. 2 Protected Areas

A. TERRESTRIAL PROTECTED AREAS

Fiji has 23 terrestrial protected areas that includes one national park, water catchments, sanctuaries, and managed areas. The protected areas are managed by National Trust of Fiji, Ministry of Forestry, local communities, and private enterprises. The terrestrial protected areas cover around 50,000 ha, which is 2.7% of the total land area of Fiji (SOE 2020) but it does not reflect a systematic and scientific identification and protection of areas of national biodiversity and ecosystem significance, and there is no applicable national legislation for this purpose. The Sovi Basin Protected Area, the largest of all protected areas, is the prime (remaining) intact patch of tropical lowland rainforest of 16,344 hectares[1]. This protected area is present in the

[1] The Sovi Basin Protected Area Management Plan 2013 states the total area is 16,344 hectares.

Waidina sub-catchment, which is an important area from the point of view of landscape conservation (see Box 6).

BOX 5: SOVI BASIN PROTECTED AREA

The Sovi Basin, Waimaro is the largest remaining area of intact, undisturbed forest in Fiji. Covering an area of 16,344 hectares, the Sovi Basin Protected Area (SBPA) is Fiji's largest terrestrial protected area, owned by nine landowning units (mataqali) who reside in five separate villages within the provinces of Naitasiri and Namosi on Viti Levu. In 2012 – 23 years after it was first recognised as an important conservation site - the SBPA Landowners approved a 99-year lease for the SBPA to the National Trust of Fiji (NTF) – under the facilitation of the TLTB (iTaukei Land Trust Board). The management of the SBPA is now undertaken by the NTF and the SBPA Landowners. Below is a summary of the events leading up to the legal protection of the site.

- Sovi Basin was first identified as an important conservation site in 1989.
- In 1996, on behalf of the landowners, TLTB "accepted in-principle the concept of environmental conservation and sustainable development of Sovi Basin".
- Little progress from 1996-2004 as foreign NGOs set development agendas.
- SBWG (Sovi Basin Working Group) set up in 2004 comprising Provincial Councils, TLTB, Ministry of Forestry, NTF, Ministry of Environment, University of the South Pacific (USP), Conservation International and Landowners.
- In depth landowner consultations in 2004-2005 to determine landowner issues and obtain consent.
- Short-term lease (20,421 hectares) – 5 years issued by TLTB (2005-2010).
- Community Education fund during the short-term lease – 208 awards with $43,000 allocated.
- Major biodiversity surveys led by USP 2003-2006.
- Set up of a Trust Fund to finance the lease and the management of the Sovi Protected Area 2005-2008.
- Fiji Water makes major donation to provide the Trust Fund with all the funds required.
- 2010-11 Final landowner consent for a 99-year lease (16,344 hectares) to the National Trust acquired.
- 2011 (July) iTLTB makes a lease offer to the National Trust for Fiji which was accepted and settled financially
- 2011 (August). Government of Fiji halted the processing of the lease document to enable the excision of the Wainivadu valley for a Tailings Dam for the Namosi JV copper mine. A decade later, Namosi JV has yet to submit its EIA which is the necessary documentation for their plans and an assessment of the need for excision.

Some of the other key protected areas are presented in Figure 5 and Table 12 below.

TABLE 12: TERRESTRIAL PROTECTED AREAS OF FIJI (SOURCE: NATIONAL TRUST OF FIJI (2011) AS CITED IN GOVERNMENT OF FIJI (2020) – STATE OF THE ENVIRONMENT REPORT). IUCN Category Ia = Strict nature reserve, II = National Park, VI = Protected areas with sustainable use of resources.

Terrestrial Sites	Institutional Arrangement	IUCN Category	Year of Establishment	Area (ha)
Protected Areas – legally established – regarded as secure				
Sigatoka Sand Dunes National Park	Cabinet Decree	II	1988	240
JH Garrick Memorial Park	Freehold owned by National Trust	II	1986	428
Ravilevu	Nature Reserve (Forestry Decree) Vuo, Draunibuto-Labiko and Vunamoli have no ecological significance	I	1959	4020
Naqarabuluti		I	1958	279
Nadarivatu		I	1956	93
Tomanivi		I (II)	1958	1322
Vuo		I (II)	1960	1.2
Draunibota, Labiko		I (II)	1959	2.16
Vunamoli		I (II)	1968	20.2
Namenalala Island	99-year lease by Native Lands Trust Board (NLTB) with conservation conditions	II	1984	43
Yadua Taba Island		Ia	2004	50
Waisali Reserve		II	1991	120
Monasavu Catchment	99-year lease by NLTB (conditions not known)	VI	2004	c. 1000
Navua Gorge – Ramsar Site	25-year lease by NLTB with conservation conditions	II	1997	c. 640
Sovi Basin Reserve	5-year 'temporary lease'	II	2006	20,421
Other Protected Areas (without legal security)				
Taveuni Forest Reserve	Forest Reserve (Forestry Decree)	VI	1914	11,160
Wabu Forest Reserve		I (II)		c. 1200
Colo-i-suva Amenity Park		II	1952	91
Bouma National Heritage Park	Memorandum of Understanding – 99 years. NLTB, DoF, NZ Govt.; Landowner managed	II (VI)	1990	1417
Koroyanitu National Heritage Park	Landowner managed	II (VI)	1989	1200
Total				**43,748**

Source: National Trust of Fiji (2011)

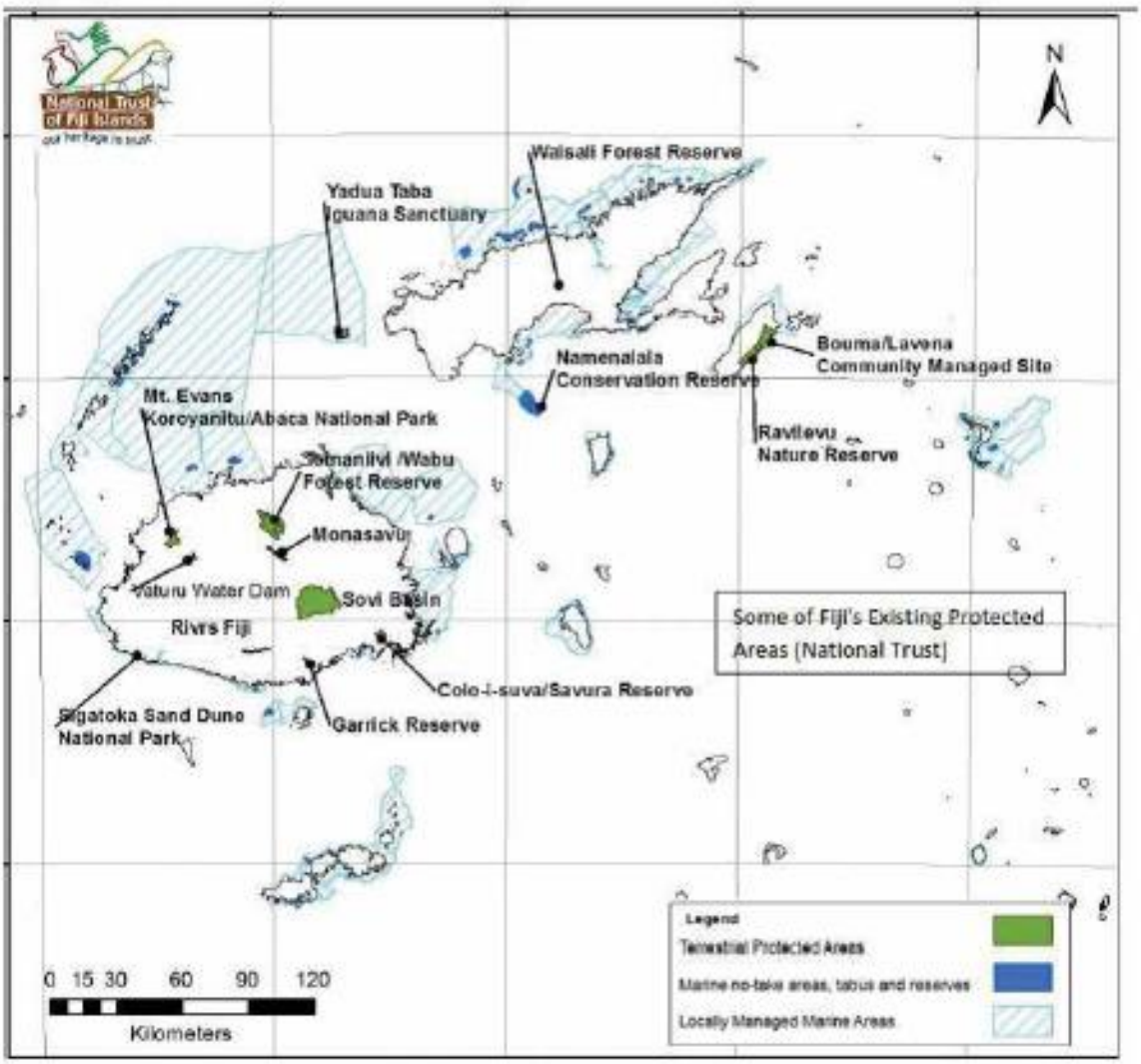


FIGURE 5: TERRESTRIAL PROTECTED AREAS OF FIJI (Source: National Trust of Fiji)

The Ministry of Forestry manages several ecologically important protected areas – Tomaniivi, Ravilevu, Wabu, Vago-Savura – under the Forest Decree provisions for Forest Reserves and Nature Reserves[2] (Figure 6).

[2] The Nature Reserve provisions in the Forest Decree are not acceptable to the iTLTB for conservation and protected area purposes on native land, while the Forest Reserve legislation is for silvicultural purposes.

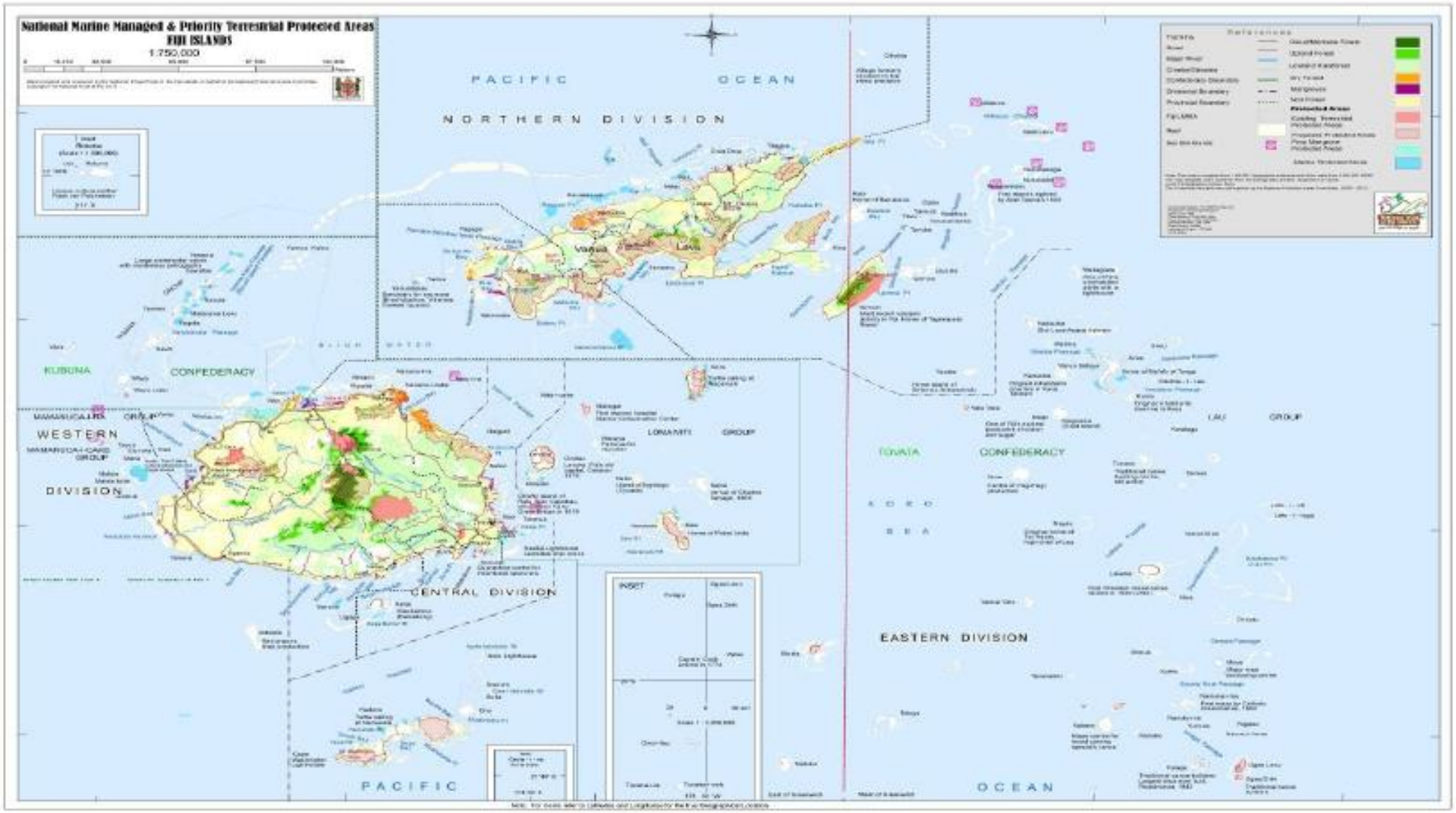


FIGURE 6: PRIORITY AND PROPOSED TERRESTRIAL AREAS AND MANAGED MARINE AREAS FOR FIJI. Source: National Trust of Fiji.

B. MARINE PROTECTED AREAS

Marine Protected Areas (MPAs), also known as Locally Managed Marine Areas (LMMAs), are the most successful and a traditional form of conservation of marine areas and their biodiversity. The network of LMMA in Fiji is known as Fiji's Locally Managed Marine Areas (FLMMA). Currently, there are 149 LMMAs governed by local communities covering 1.77 million hectares of the marine area (more than 50% of the country's inshore marine area) (Day et al. 2015, Figure 7).

The iTaukei communities hold 'customary marine tenure' over Fiji's inshore waters and the management of harvest and resources is through traditional knowledge. These customary fishing rights over the areas are known as 'qoliqoli' and extend from the foreshore to slightly beyond the fringing reefs. Fiji's qoliqoli is unique in the sense that it has arguably the most systemically recorded and demarcated customary-held marine tenure areas and the customary rights are held on a communal basis and registered to customary groups (Sloan & Chand 2016). While primarily established to protect the fishing areas and resources within traditionally-owned areas for sustainable use, FLMMA sites contribute to the conservation of marine biodiversity within Fiji.

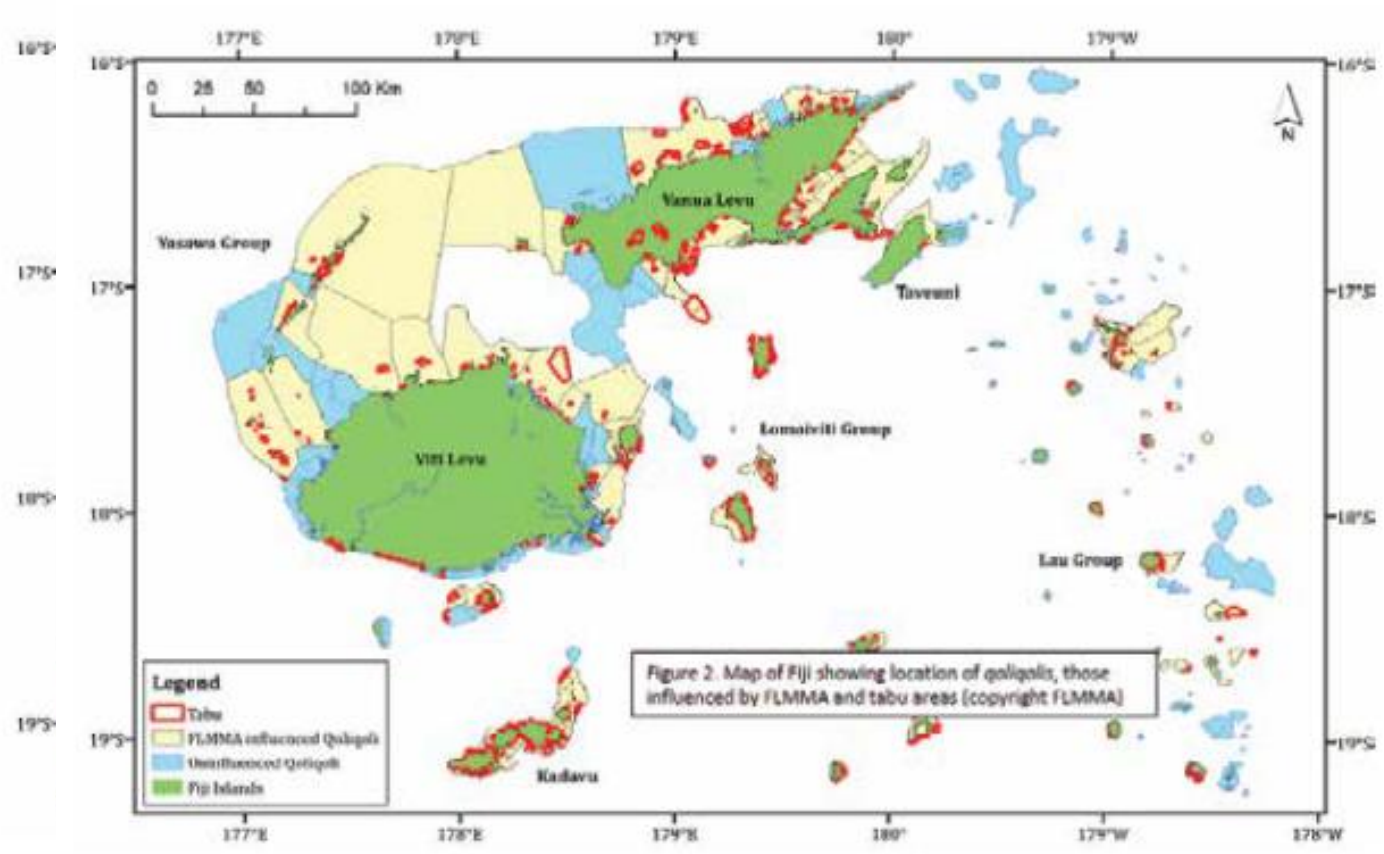


FIGURE 7: LOCATION OF IQOLIQOLI SITES IN FIJI INCLUDING TABU ZONES (NO TAKE, IN RED) AND THOSE IN THE FLMMA NETWORK. (Source: National Trust of Fiji, SOE 2020).

4. Biodiversity Threat Assessment

4.1. National Level Assessment – Literature Review

The literature review examined the threats to native biodiversity in terrestrial and marine ecosystems in Fiji with a focus on natural systems (i.e. not agroecosystems or plantation forests for logging). The three biggest threats reported in the literature for terrestrial species were invasive species, agricultural practices and habitat loss, all three of which are anthropogenic pressures. Fiji's NBSAP (2017-2024) ranks the top 10 threats to endemic species by threat type and also identifies the three top threats as invasive species (85 endemic species affected, 33% of all endemic species), agriculture (81 species, 31%) and habitat loss (24 species, 9%). The Fiji SOE (2020) cites SPREP (2016) and lists Invasive species, Agriculture, Habitat loss, Development, Climate, Exploitation, Mining, Fire, Human disturbance and Pollution as key threats to Fiji's endemic and threatened species. Invasive species were identified as the major threat to Fiji's biodiversity.

Main threats to forests and flora

The Fiji SOE (2020) identifies land use change with forests being cleared to generate revenue from timber sales, conversion to agricultural land or extraction of fuelwood as the main threats to Fiji's forests and flora. More specifically, the main threats include (note: not listed as rank order):

A) Forest conversion to root crop production and pasture – indiscriminate clearing of forests for commercial and semi-commercial agriculture is a key cause of deforestation. Increasing market prices for yaqona have led to rapid growth in yaqona cultivation and expansion of agriculture into previously forested areas, including upland areas with Taveuni being a key area. Livestock farming on Viti Levu and Vanua Levu has resulted in the conversion of forest areas to pasture for cattle ranching and livestock grazing within some forest areas.

B) Conventional logging – market demand for timber is a major driver of logging. Rapid re-logging of native forests exacerbates forest degradation, particularly in the absence of restocking or restoration/reforestation activities.

C) Mining – is a key economic sector for Fiji and has led to extensive deforestation in the area of mine activities.

D) Extraction of forest resources – Extraction of fuelwood, subsistence timber harvesting and extraction of other forest products is a traditional practice in Fiji. Little research

has examined the extraction practices involved and the impacts on forest biodiversity in Fiji.

E) Forest fires – Fire is an integral component of traditional swidden agricultural systems and in the dry and intermediate zone has been responsible for the conversion of much of these areas to non-forested habitats since the arrival of Fiji's first inhabitants. Fire remains the most serious impediment to natural regeneration or reforestation of these areas, while fire continues to be a serious agency of deforestation in the wet zone. Agricultural techniques in rural communities in Fiji have changed due to market demands and this has resulted in a switch to a more intensive management, seeing the clearing, burning and conversion of more forested land for agriculture.

F) Invasive species - Some invasive species that have documented impacts on native flora include rats (seed predation), goats (plant predation causing the loss of forest cover), and invasive plants such as *Pinanga coronata* (Dyer et al. 2019; Dyer et al. 2018; Dyer 2017; Lenz et al. in press). Other invasive plant species include *Spathodea campanulata, Samanea saman, Gmelina arborea, Piper aduncum, Sphagneticola trilobata, Lantana camara, Leucaena leucocephala, Merremia peltata* and *Mikania micrantha*, which may have varying ecological roles, particularly in Fiji's open habitats and its Talasiga landscape

G) De-reservation of protected areas – recent political pressure has resulted in some forest reserves originally established under the Forestry Act being reverted to native land ownership. It is important to note that Forest Reserves, under the Forest Decree 1992, were established for silvicultural uses (Clarke and Taylor 2008). Most were planted up as mahogany plantations not for trial or research purposes but for commerce - these were the reserves that were de-reserved. The Nadala-Nadarivatu Forest Reserve was the main species trial area for Ministry of Forestry and some remnants of these trials still survive. Forest Reserves were never intended to be biodiversity protected areas until recently. Fiji needs to undertake a systematic and scientific identification and protection of areas of national significance, and there is no applicable national legislation for this purpose – which is an issue that will need to be addressed if there are to be more terrestrial protected areas established.

Mangrove forests are primarily threatened by coastal infrastructure development (industrial zones, residential units, tourism, sea-walls for flood protection), conversion of mangrove

forests for aquaculture and dredge disposal. Overharvesting for fuelwood for commercial and subsistence purposes persists as a minor concern.

Fiji's REDD + project's study on Drivers of Deforestation and Forest Degradation identified six direct drivers (MoF 2019): Forest conversion to agriculture; Poorly planned infrastructure development; Conventional logging; Natural disasters; Invasive species; and Mining.

Main threats to fauna

Terrestrial and freshwater species

The main threats to native fauna species reported in the literature are invasive or introduced species and loss of habitat. The main drivers for habitat loss are described in the previous section. Some of the main invasive species threats include (note: not listed in rank order):

A) Indian mongoose (*Herpestes auropunctatus* and *H. fuscus*) and feral cats – have been reported as being responsible for the extirpation and population declines of several ground dwelling species including iguanas, skinks, frogs and birds.
B) Cane toad (*Rhinella marina*) – Cane toads are a major threat to the native frog species in terms of competition for resources. As they are toxic at all life-stages they also pose a threat to many predatory species including raptors and snakes.
C) Rats, cats and pigs – these species pose a serious threat to sea and land birds through direct predation of eggs, chicks or adults or nest/burrow destruction.
D) Free ranging horses, cattle and goats – these herbivores/browsers can seriously impact native forest regeneration and restoration by selective grazing and the spread of invasive species such as rain tree, *Gmelina arborea* and guava.
E) Tilapia (*Oreochromis* spp.) – tilapia was introduced for aquaculture but have managed to escape (or were deliberately introduced) into natural waterways. Tilapia is believed to consume the fingerlings of native species and severely impact populations of local amphiodromous species.
F) Other species – include invasive birds such as the Red-vented bulbul, which aggressively outcompete native passerines for resources and the spread of invasive plants such as *Piper aduncum* prickly solanum and guava. Land snails, mealy bugs and ants pose threats to native forest and crop species. The Green Iguana (*Iguana iguana*) is another threat to Fiji's four native iguanas and through sheer potential numbers and size remains a huge threat to the ecological integrity of Fiji's native flora.

In addition, other threats to freshwater ecosystems and species reported in the literature include those that have a significant effect on surface water quality (note: not listed in rank order):

A) Mining and gravel extraction – the mining and quarrying of minerals in Fiji is dominated by crushed aggregate, gravel, and sand, used for construction materials, and to a lesser extent limestone, which is used for agricultural purposes. Most regulated river extraction is considered highly unsustainable and has significant environmental impacts. Excessive gravel extraction through dredging leads to water turbidity and changed surface water conditions leading to sharp declines in freshwater vertebrates and invertebrates affecting biodiversity and food security for rural communities (Smith et al., 2018).
B) Riverbank erosion - sedimentation due to riverbank clearing caused by logging within stream buffer zones or land clearing for agriculture leads to changed water conditions and affects stream foodwebs and biodiversity.
C) Pesticide/fertilizer runoff in agricultural zones – leads to changed water conditions and affects stream foodwebs and biodiversity.
D) Diversion of flows for water supply or hydropower generation – affect amphidromous species that need to migrate between freshwater and saltwater habitats, and can lead to the loss of forest habitat in impoundments.
E) Drainage and clearing for agriculture – has led to the almost complete loss of the endemic and endangered Fiji sago palm forests once widespread in the alluvial plains of the wet zone of Viti Levu.

Marine species and habitats

The main threats to marine species in nearshore areas and coral reef systems can be divided into those caused by anthropogenic activities, including climate change, and those posed by natural events such as extreme weather.

The main anthropogenic threats to Fiji's reefs and nearshore areas are (note: not listed in rank order):

A) Overfishing – The majority of Fiji's population lives near the coast and is highly dependent on fisheries, particularly coastal fisheries of both vertebrate and invertebrate species, for local economic and subsistence needs. Exploitation has increasingly intensified for both inshore and offshore fisheries in recent years and, coupled with decades of poor or neglected management, has resulted in many coastal fisheries being

fully exploited, especially close to urban centres. Fiji is also involved in the aquarium trade and exports ornamental fish, hard and soft corals and live rock (Mangubhai et al. 2018), most of which is collected from the wild.

B) Coastal habitat modification – coastal development for tourism, residential and industrial development

C) Removal of beach rock and coral for building and infrastructure (e.g. roads) – in addition to the loss of coral habitat from the marine ecosystem, this practice has altered/modified the integrity of the surrounding fringing reefs affecting their ability to minimise coastal erosion (Mimura & Nunn 1998).

D) Predator and disease outbreaks – predators such as crown of thorns starfish (*Acansther planci*) and *Drupella* snails and diseases such as ulcerative white-spot syndrome have a significant impact on corals.

E) Climate change – including sea-level rise, storm surge and coral bleaching. Fiji's coasts are susceptible to exposure to sea-level rise and storm surge events which will likely worsen with future climate change. Fiji is subject to almost annual localised mild coral bleaching. Minor bleaching was observed in 1989, 1998, 1999, 2002 and 2005 with most coral populations recovering by 2011. During the 2000 La Nina, coral bleaching resulted in losses of 40-80% of scleractinian corals in Fiji (Mangubhai et al. 2018)

F) Sediment and nutrient runoff from human-altered water catchments (e.g. through agriculture, forestry and mining). Along the Coral Coast of Viti Levu, nutrient levels (nitrate and phosphate) in sea and river water exceed levels considered harmful to coral reefs (Mosely & Aalbersberg 2003; Goundar et al. 2014). Fertilizers, herbicides and pesticides are widely used in the agriculture industry throughout Fiji but there is little to no regulation of their use. Wood and chemical waste from sawmills containing copper, chromium and arsenic are another source of pollution (Mangubahi et al. 2018). The absence of appropriate disposal facilities and management has led to many of these hazardous chemicals making their way into coastal ecosystems (Department of Environment 2010).

G) Improper waste disposal and pollution - Marine pollution is a long standing and growing issue in Fiji and includes the entry of chemicals, industrial waste, sewage, nutrients, and pesticides into the ocean. Pollution studies in Fiji generally concentrate on Suva Harbour and the peninsula and report excessive levels of lead, copper, zinc, iron, arsenic, organochlorine pesticides and polychlorinated biphenyls attributed to a range of industrial and commercial activities including industrial areas, shipyards, oil

storage depots, food-processing, and urban wastewater (Chand et al. 2011; Gangaiya et al. 2001; Morrison et al. 1996; Park et al. 2013).

Natural disasters can cause mechanical or structural damage such as that caused by hurricanes and cyclones. Reports after Cyclone Winston in February 2016 showed damage to corals 20-30 m below the surface (Mangubhai, 2016). Recovery from some of these disturbances can take decades depending on the frequency of the events, scale and intensity of damage caused and compounding factors such as pollution or overfishing.

4.2. National Level Assessment - STAR Metric Scores

4.2.1. Terrestrial Species.

We calculated the STAR metric based on the updated selection of 32 Amphibian, Bird and Mammal species identified (see Appendix 1 for details of species included, Table 13 for summary).

TABLE 13. TAXONOMIC GROUPS AND IUCN RED LIST CATEGORIES FOR SPECIES IN THE STAR ANALYSIS FOR FIJI. NT = NEAR THREATENED, VU = VULNERABLE, EN = ENDANGERED, CR = CRITICALLY ENDANGERED. $STAR_T$ = STAR THREAT ABATEMENT SCORE, $STAR_R$ = STAR RESTORATION SCORE

Taxonomic Group	Sum	NT	VU	EN	CR	Endemic (as a %)	$STAR_T$	$STAR_R$
Amphibians	2	2				100	200	29
Birds	25	13	9	1	2	60	2958	359
Mammals	5	1	1	2	1	20	853	1000
Total	32	16	10	3	3	53	4011	1388

COMPARISON OF $STAR_T$ WITH $STAR_R$ DATA.

$STAR_T$ – the threat abatement component of STAR represents ca.75% of the total STAR score for these species in Fiji (see Figure 8). This indicates that the IUCN Red List data for these species suggests that conservation measures in Fiji should focus on reducing the threats to species in their current habitats. This does not mean that restoring habitats within which the species are no longer present is not recommended – rather that it should be undertaken in concert with threat abatement at, or adjacent to, native forest sites.

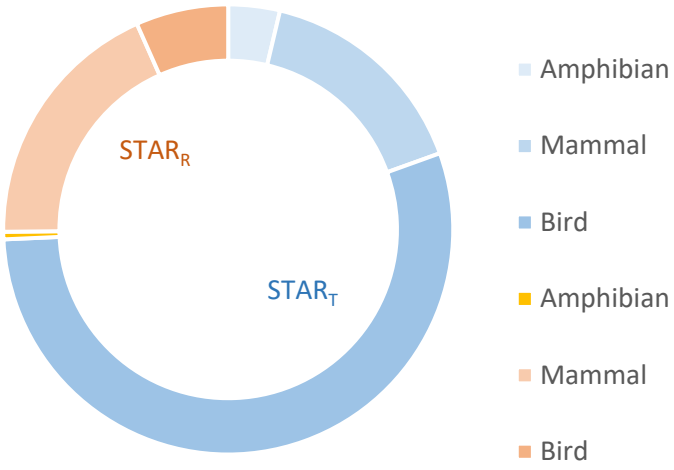


FIGURE 8. STAR THREAT ABATEMENT AND STAR RESTORATION SCORES SUMMED FOR THE 32 SPECIES OF AMPHIBIAN, BIRD AND MAMMAL USED IN THE INITIAL ANALYSES FOR THIS STUDY.

If we calculate the STAR scores for each of the major Level 2 threat types, then we find that the main threat to Fiji's biodiversity is 8.1. Invasive alien species (IAS). This is followed by the 11.1 a Climate Change threat, habitat shifting and alteration, 2.1. Agriculture, Annual & Perennial non-timber crops and 5.3 Biological Resource Use, Logging and wood-harvesting (Figure 9). For each of these, the Threat Abatement score greatly exceeds the equivalent Restoration score.

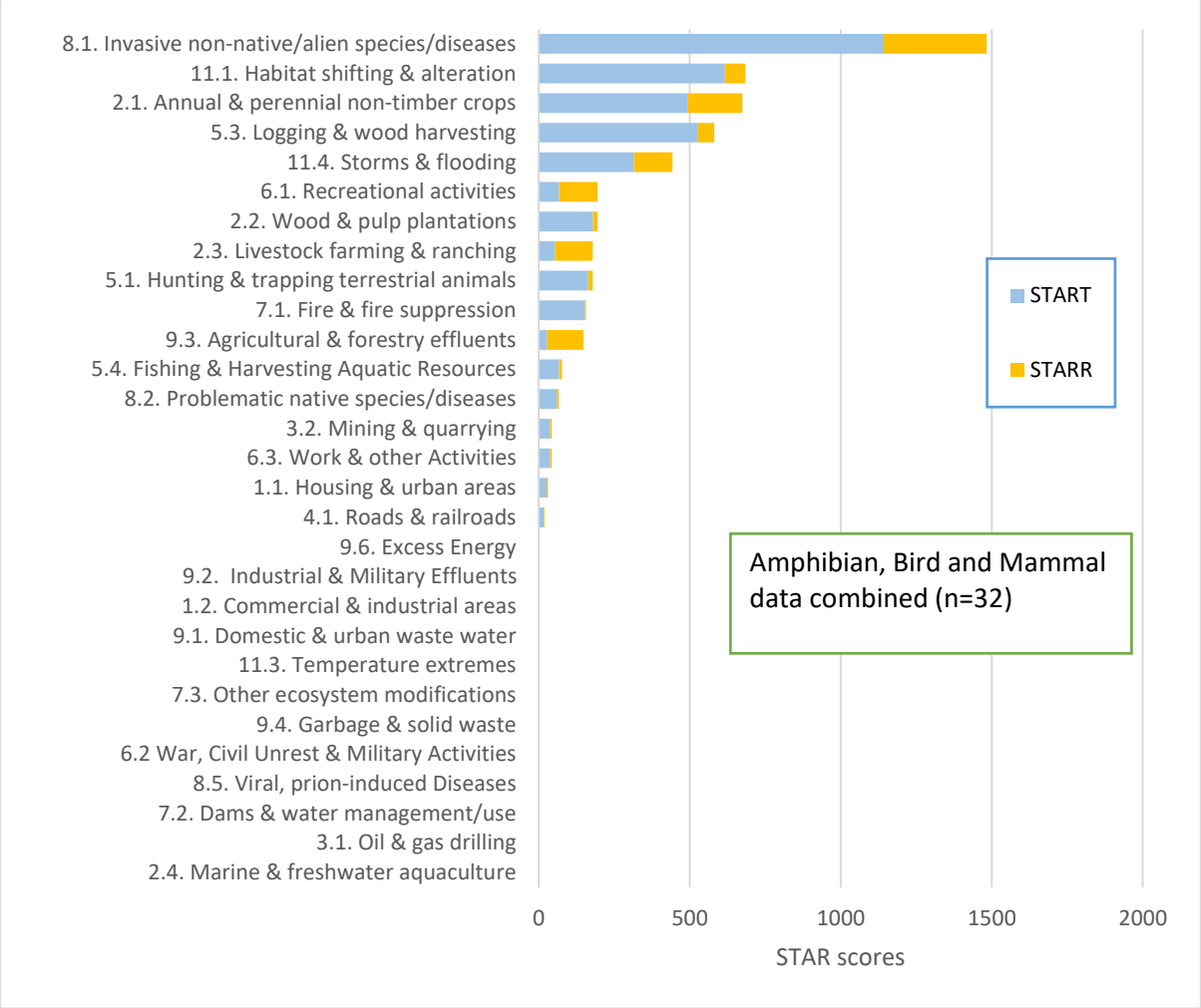
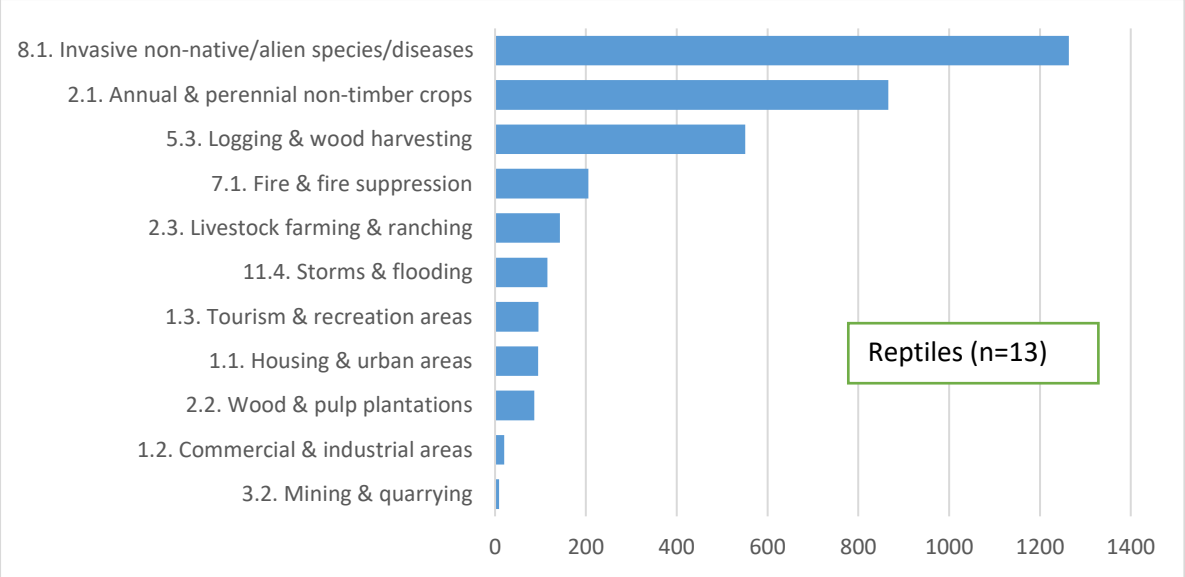


FIGURE 9: SUMMARY OF KEY THREATS TO AMPHIBIAN, BIRD AND MAMMAL STAR SPECIES IN FIJI. BLUE BARS REPRESENT THE RESULTS OF THE STAR THREAT ABATEMENT SCORES, ORANGE BARS REPRESENT THE RESULTS OF THE STAR RESTORATION SCORES.

If we use the modified AOH metric explained in section 2.2.2, we can calculate $STAR_R$ scores for the 13 reptiles and 72 molluscs that are present in Fiji and listed on the IUCN Red List. These can also be used to assess the major threats to these species – using the STAR assessment as explained in section 2.2. It is clear that for both these terrestrial fauna groups the threats are similar to those recorded for Amphibians, Birds and Mammals using the original AOH metric (Figure 10).



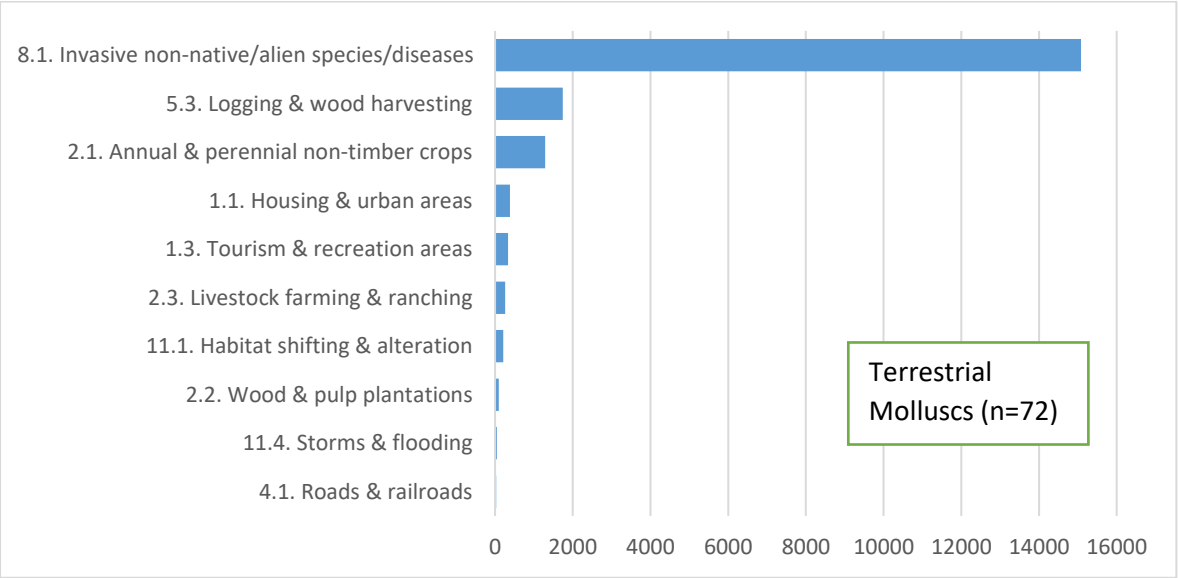


FIGURE 10 THE $STAR_R$ SCORES FOR MAJOR THREATS – WHEN ASSESSING REPTILES OR TERRESTRIAL MOLLUSCS THAT OCCUR IN FIJI AND ARE ON THE IUCN RED LIST. THE NUMBER ON THE HORIZONTAL AXIS IS THE OVERALL STAR THREAT ABATEMENT SCORE FOR THE TAXONOMIC GROUP.

The threat scores on the IUCN Red List data for the 85 endemic and threatened plants (mainly tree, palm and orchid species) highlighted the threat posed by Annual & Perennial non-timber crops (Figure 11), a threat that was less important in the original (and more limited) STAR analysis.

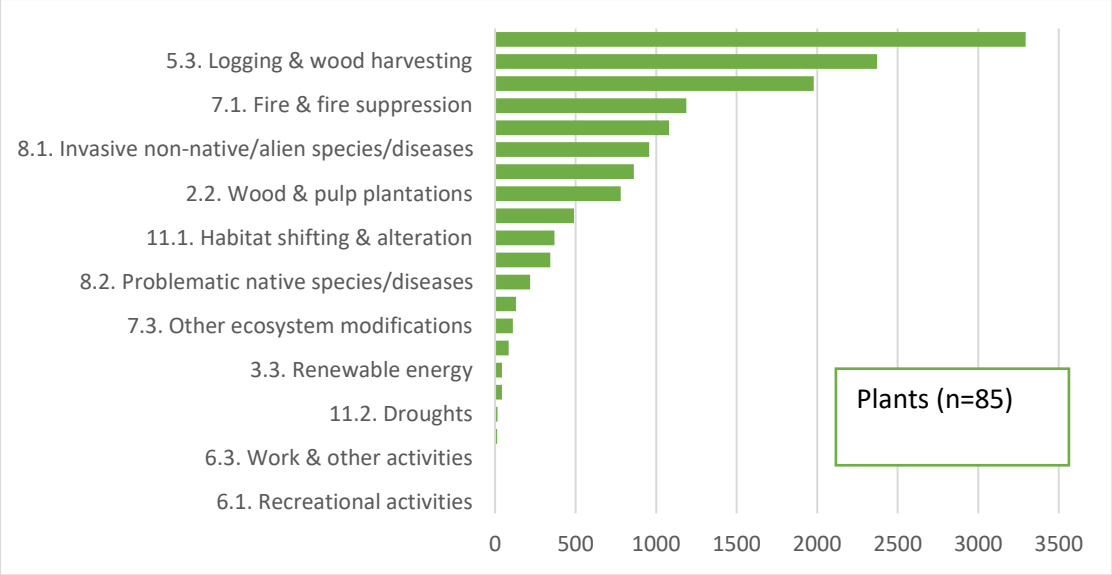


FIGURE 11: SUMMARY OF KEY THREATS TO PLANTS IN FIJI USING THE STAR ANALYSIS. THE NUMBER ON THE HORIZONTAL AXIS IS THE OVERALL STAR THREAT ABATEMENT SCORE FOR THE TAXONOMIC GROUP.

There are two ways of reviewing the relative importance of the key threats – as detailed above. In Figure 12 we have added the scores for each taxon to each other to provide an overall score, and a rank order, for the overall threats to terrestrial taxa in the country.

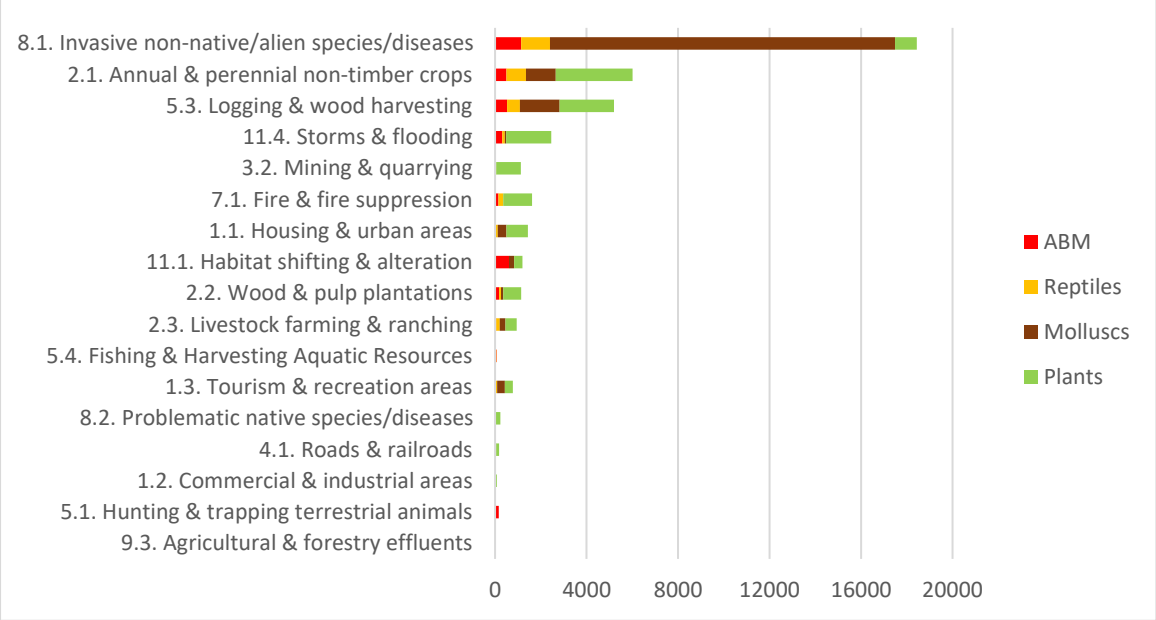


FIGURE 12: SUMMARY OF KEY THREATS TO GLOBALLY THREATENED AND NEAR THREATENED SPECIES IN FIJI. ABM = AMPHIBIAN, BIRD AND MAMMAL SPECIES. THE NUMBER ON THE HORIZONTAL AXIS IS THE OVERALL STAR THREAT ABATEMENT SCORE FOR THE TAXONOMIC GROUP.

This would be ideal where all taxa have been assessed – and so the data are based on all taxa. We know this not to be the case – many plants have not been through the IUCN Red List process to date, similarly various groups within the Molluscs (notably the Partulid snails) have

not yet been accepted into the IUCN Red List. So, an alternative approach would be to present the data highlighting the top ranked threats for each taxonomic group, as they stand, and comparing across the taxa. This is presented in Table 14 below.

TABLE 14. THE PRIORITY THREATS FOR EACH TERRESTRIAL TAXONOMIC GROUP, USING THE STAR$_T$ ANALYSIS. DATA FOR EACH GROUP ARE PRESENTED SEPARATELY ABOVE. ABM = AMPHIBIANS, BIRDS AND MAMMALS.

Threat classification level (IUCN-CMP)		ABM	Reptiles	Molluscs	Plants
Level 1.	Level 2				
1. Residential and commercial development	1.1 Housing and urban areas				
	1.2 Commercial and industrial areas				
	1.3 Tourism and recreation areas				
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops				
	2.2 Wood & pulp plantations				
	2.3 Livestock farming & ranching				
	2.4 Marine & freshwater aquaculture				
3. Energy production & mining	3.1 Oil & gas drilling				
	3.2 Mining & quarrying				
	3.3 Renewable energy				
4. Transportation & service corridors	4.1 Roads & railways				
	4.2 Utility & service lines				
	4.3 Shipping lanes				
	4.4 Flight paths				
5. Biological resource use	5.1 Hunting & trapping terrestrial animals				
	5.2 Gathering terrestrial plants				
	5.3 Logging & wood harvesting				
	5.4 Fishing & harvesting aquatic resources				
6. Human intrusions & disturbances	6.1 Recreational activities				
	6.2 War, civil unrest & military exercises				
	6.3 Work & other activities				
7. Natural system modifications	7.1 Fire & fire suppression				
	7.2 Dames & water management/use				
	7.3 Other ecosystem modifications				
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases				
	8.2 Problematic native species/diseases				
	8.3 Introduced genetic material				
	8.4 Species/diseases of unknown origin				
	8.5 Viral/prion-induced diseases				
	8.6 Diseases of unknown cause				
9. Pollution	9.1 Domestic & urban waste water				
	9.2 Industrial & military effluents				
	9.3 Agricultural & forestry effluents				
	9.4 Garbage & solid waste				
	9.5 Air-borne pollutants				
	9.6 Excess energy				
10. Geological events	10.1 Volcanoes				
	10.2 Earthquakes/tsunamis				
	10.3 Avalanches / landslides				
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration				
	11.2 Droughts				
	11.3 Temperature extremes				
	11.4 Storms & flooding				
	11.5 Other impacts				
12. Other options	12.1 Other threats				

The Red Cells indicate one of the top three threats, the Orange Cells are the 4-6th most severe threats while the dark blue cells represent the 7-10th most severe threats within each taxonomic group. Pale blue cells are other threats that are listed but outside the top 10 threats for the group.

Table 14 shows quite clearly that three threats are highly ranked across all six taxonomic groups – Logging & Wood Harvesting, Annual & Perennial non-timber crops and Invasive non-native, species/diseases.

4.2.2. Marine Species.

We attempted to repeat the same process with the various marine taxa that are listed as present in Fiji Waters in the IUCN Red List.

The first key message to note is that the global distribution of IUCN Red List species that occur in the marine environment in Fiji is markedly different from the global distribution of IUCN Red List species from the terrestrial environment (see Figure 13 below).

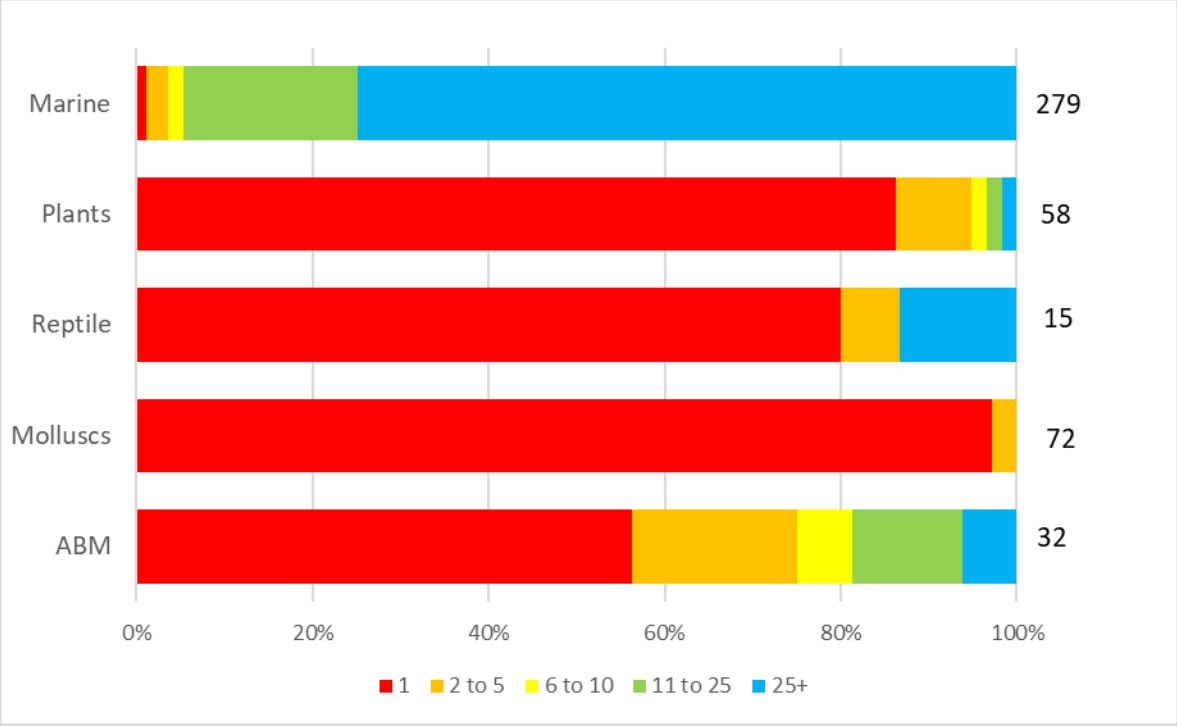


FIGURE 13 THE CONTRASTING PROPORTION OF ENDEMIC SPECIES AND WIDE-RANGING SPECIES IN THE TERRESTRIAL AND MARINE ENVIRONMENT IN FIJI. THE COLOURS REPRESENT THE NUMBER OF COUNTRIES THAT THE IUCN RED LIST RECORDS EACH SPECIES TO BE PRESENT IN. THE NUMBERS ON THE RIGHT-HAND SIDE OF THE GRAPH ARE THE NUMBER OF RED LIST GLOBALLY THREATENED AND NEAR-THREATENED SPECIES IN EACH TAXONOMIC GROUP IN FIJI THAT WERE INCLUDED IN THE STAR ASSESSMENT.

It can be seen that 55% of the amphibian, bird and mammal species, 80% of the reptiles, 85% of the plants and >90% of the terrestrial molluscs that are Globally Threatened or Near Threatened on the IUCN Red List and present in Fiji are endemic to the Fiji Islands. By contrast

less than 2% of the marine species are endemic. By contrast, 75% of the marine species occur in 25 or more countries, compared with just 15% of reptiles and less than 10% of plants, molluscs or amphibian, birds and mammals.

There is no, easily available, AOH data for marine taxonomic groups so we have used the country-based workaround, as explained above in Box 5. Clearly, here an endemic species scores 100 in Fiji while a species that occurs in 25 countries scores just 4 (1/25) – so the majority of marine species contribute relatively little to the overall STAR score for Fiji.

In Figure 14 we present the principal threats to three sets of marine taxonomic groups, Vertebrates (including teleost fish, sharks and rays, cetaceans and turtles), Corals and other Invertebrates (including sea cucumbers and deep vent snails).

Note that, in all three taxonomic groups the Biological Resource Use, Fishing and harvesting aquatic resources, threat is either the first or the second most important threat. Note also that the scale of the horizontal axis differs between groups. For Marine Vertebrates and Corals, the scale is low, relative to the Marine Invertebrates (not coral) score and also compared with the terrestrial taxonomic groups. This reflects that both Marine Vertebrates and Coral species tend to occur in a high number of countries compared with the other groups. Note also that, within the Marine Invertebrates (not coral) group that the Energy Production and mining, Mining and Quarrying, threat is markedly higher than other threats in that group and any of the combined threats in the other marine taxonomic groups. This is a function of the one marine taxonomic groups that is restricted range and present in Fiji and one or two other countries – the deep vent, marine molluscs – or punk-rock snails. In addition to the species STAR scores being high, these species are only associated with the one threat – the mining and quarrying threat – associated with deep-sea mining.

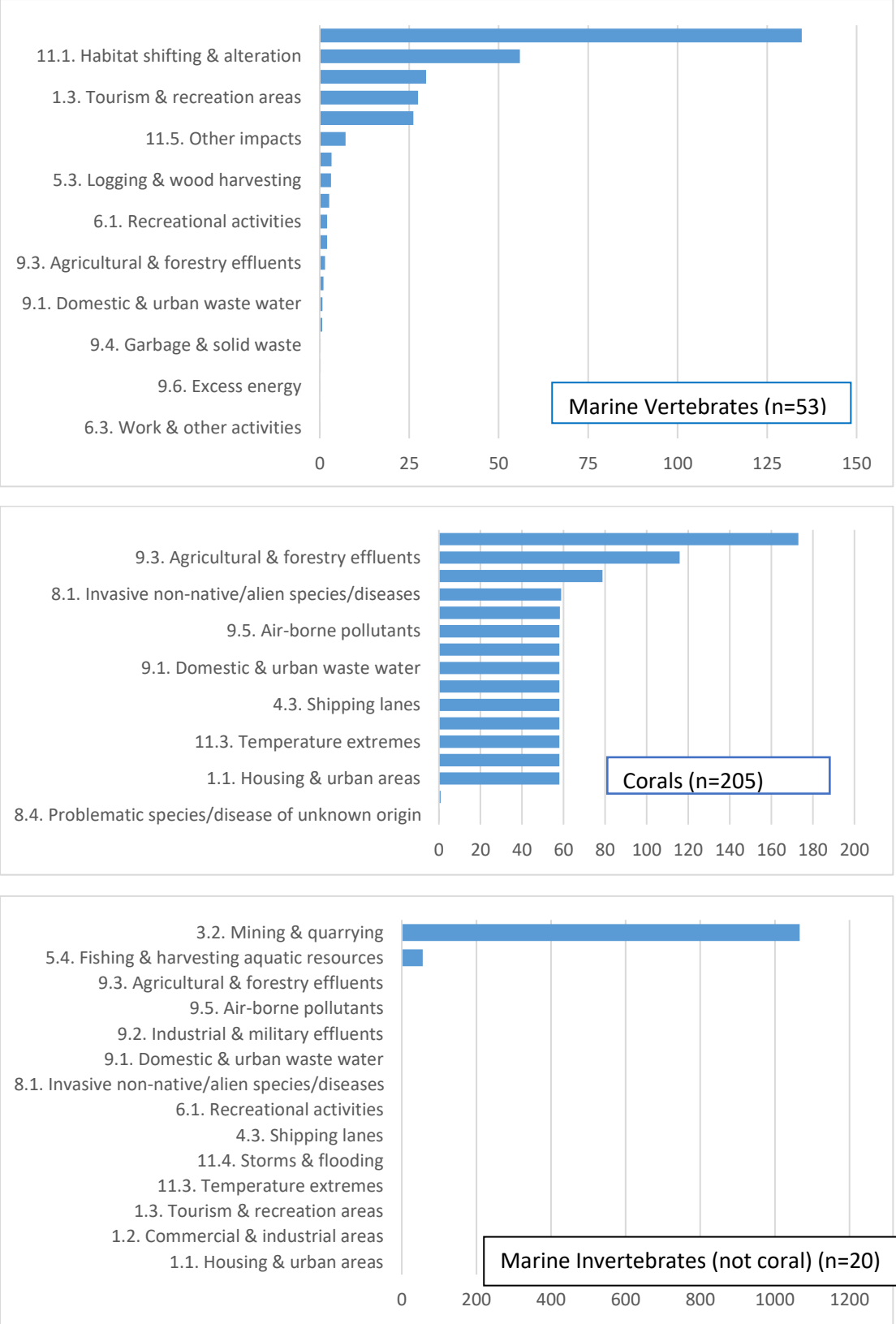


FIGURE 14. SUMMARY OF KEY THREATS TO MARINE TAXONOMIC GROUPS IN FIJI USING THE STAR ANALYSIS. THE NUMBER ON THE HORIZONTAL AXIS IS THE OVERALL STAR THREAT ABATEMENT SCORE FOR THE TAXONOMIC GROUP.

Using our alternative approach used for highlighting the top ranked threats for terrestrial species, we compared the main threats to marine species across the different taxonomic groups (Table 15).

The Red Cells in Table 15 indicate one of the top three threats, the Orange Cells are the 4-6th most severe threats while the dark blue cells represent the 7-10th most severe threats within each taxonomic group. Pale blue cells are other threats that are listed but outside the top 10 threats for the group. Table 15 shows quite clearly that the main threat across all taxonomic groups is 5.4 Fishing and harvesting of aquatic resources.

TABLE 15. THE PRIORITY THREATS FOR EACH MARINE TAXONOMIC GROUP, USING THE STAR$_T$ ANALYSIS. DATA FOR EACH GROUP ARE PRESENTED SEPARATELY ABOVE.

Threat classification level (IUCN-CMP)		**Vertebrates**	**Corals**	**Other In-vertebrates**
Level 1.	Level 2			
1. Residential and commercial development	1.1 Housing and urban areas			
	1.2 Commercial and industrial areas			
	1.3 Tourism and recreation areas			
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops			
	2.2 Wood & pulp plantations			
	2.3 Livestock farming & ranching			
	2.4 Marine & freshwater aquaculture			
3. Energy production & mining	3.1 Oil & gas drilling			
	3.2 Mining & quarrying			
	3.3 Renewable energy			
4. Transportation & service corridors	4.1 Roads & railways			
	4.2 Utility & service lines			
	4.3 Shipping lanes			
	4.4 Flight paths			
5. Biological resource use	5.1 Hunting & trapping terrestrial animals			
	5.2 Gathering terrestrial plants			
	5.3 Logging & wood harvesting			
	5.4 Fishing & harvesting aquatic resources			
6. Human intrusions & disturbances	6.1 Recreational activities			
	6.2 War, civil unrest & military exercises			
	6.3 Work & other activities			
7. Natural system modifications	7.1 Fire & fire suppression			
	7.2 Dames & water management/use			
	7.3 Other ecosystem modifications			
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases			
	8.2 Problematic native species/diseases			
	8.3 Introduced genetic material			
	8.4 Species/diseases of unknown origin			
	8.5 Viral/prion-induced diseases			
	8.6 Diseases of unknown cause			
9. Pollution	9.1 Domestic & urban waste water			
	9.2 Industrial & military effluents			
	9.3 Agricultural & forestry effluents			
	9.4 Garbage & solid waste			
	9.5 Air-borne pollutants			
	9.6 Excess energy			
10. Geological events	10.1 Volcanoes			
	10.2 Earthquakes/tsunamis			
	10.3 Avalanches / landslides			
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration			
	11.2 Droughts			
	11.3 Temperature extremes			
	11.4 Storms & flooding			
	11.5 Other impacts			
12. Other options	12.1 Other threats			

4.3. National Level Assessment - Expert-based Threat Assessment Tool (EbTAT)

4.3.1 – Expert assessors

Of the 53 species experts identified and invited to participate in the assessment, 20 individuals attended the two sessions and 24 individuals responded to the questionnaire. Individuals who responded to the questionnaire were those with expertise in the areas of mammals, birds, amphibians, reptiles, freshwater fish, plants, marine invertebrates and marine vertebrates (see Appendix 2 for list of experts) (Figure 15). Thirteen of the 24 questionnaire respondents had previously contributed or currently contribute to IUCN species assessments or have reviewed assessments.

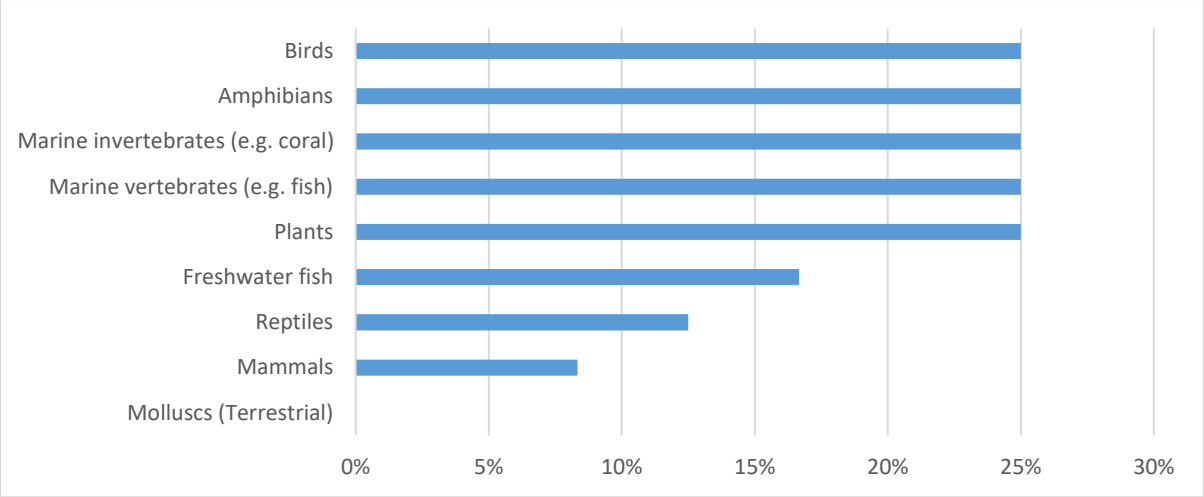


FIGURE 15: RANGE OF EXPERTISE AMONGST THE 24 FIJI SPECIES EXPERTS INTERVIEWED TO REVIEW THE RESULTS OF THE STAR ANALYSIS AND THE MODIFIED "COUNTRY APPROACH" ON AMPHIBIANS, MAMMALS, BIRDS, PLANTS, FRESHWATER FISH, MARINE INVERTEBRATES AND MARINE VERTEBRATES AND PROVIDE FEEDBACK ON THE QUESTIONNAIRE.

4.3.2 – Overall national expert threat assessment

The results of the expert assessments follow the same format as for the STAR metric scores presented in section 4.2. The taxonomic groups presented below are amphibians, birds, mammals, reptiles and plants for the natural terrestrial ecosystem; freshwater fish for the freshwater ecosystem and marine vertebrates and invertebrates for the marine ecosystem. Two hundred and fifty-two statements on Level 2 threats to the taxonomic groups mentioned above were extracted from the 24 respondents.

LEVEL 2 THREATS TO FIJI'S AMPHIBIANS, BIRDS AND MAMMALS

Seventy-two expert statements were recorded for Level 2 threat types to (combined) amphibians, birds and mammals whereby the most commonly cited threat was 8.1 Invasive

non-native/alien species/diseases (24%) followed by 2.1 Annual & perennial non-timber crops (14%) and 5.3 Logging & wood harvesting (10%) (Figure 16).

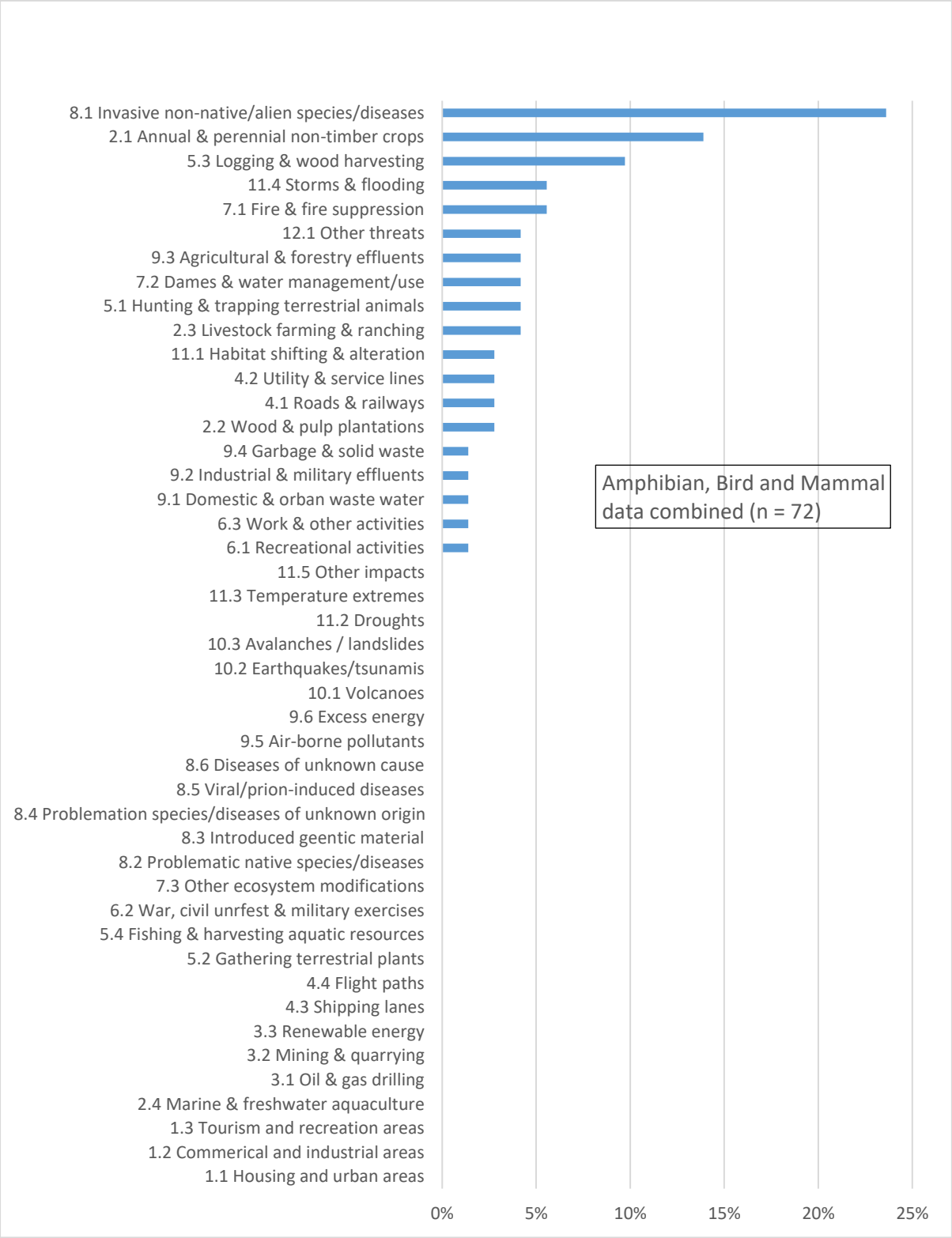
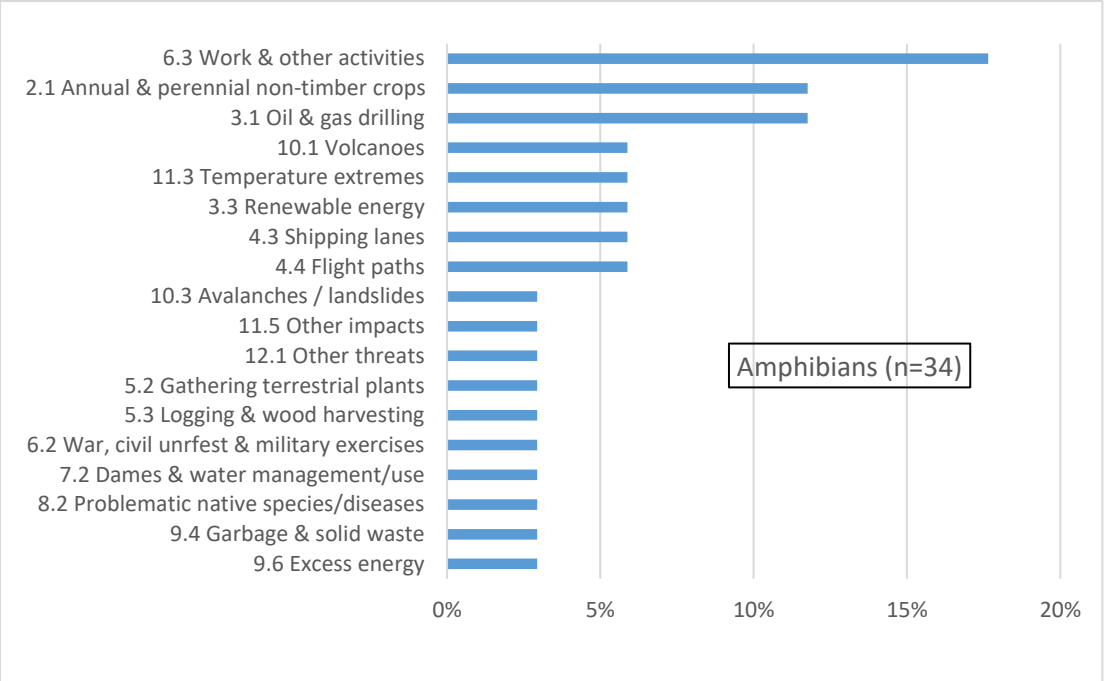
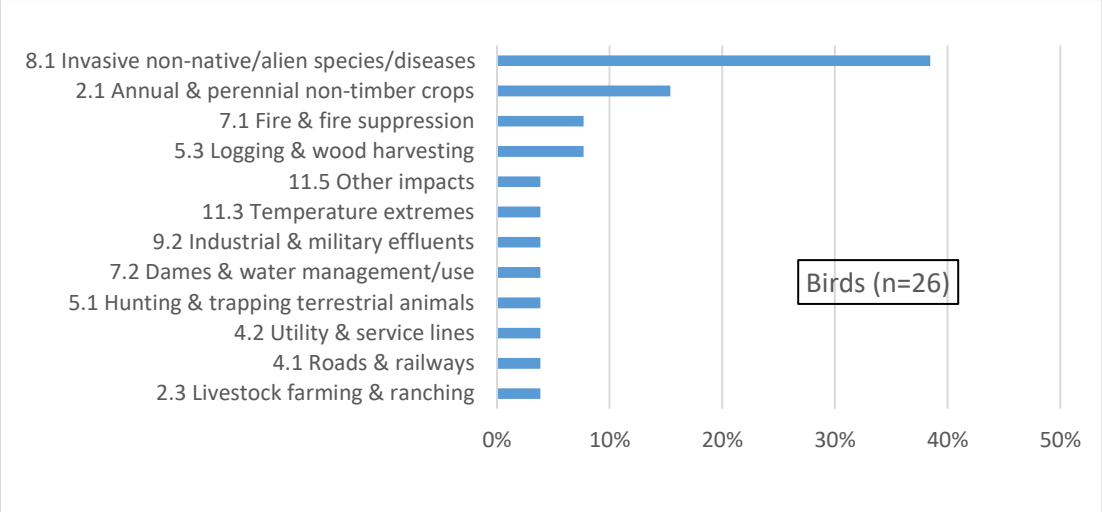


FIGURE 16: SUM OF KEY THREATS TO AMPHIBIAN, BIRD AND MAMMAL SPECIES IN FIJI. N = 72 STATEMENTS BY EXPERTS WHO CONTRIBUTED TO THE ASSESSMENT OF AMPHIBIANS, BIRDS AND MAMMALS. THE NUMBER ON THE HORIZONTAL AXIS IS THE PERCENTAGE OF THE TOTAL NUMBER OF STATEMENTS MADE.

When amphibians (number of expert statements, n = 34), birds (n = 26) and mammals (n = 13) are considered separately, the Level 2 threats are ranked differently for the different groups (Figure 17, below) whereby:

1. Level 2 threats to amphibians cited are: Human intrusions and disturbance (6.3 Work & other activities, 18%), followed by 2.1 Annual & perennial non-timber crops, and 3.1 Oil & gas drilling (12% each).
2. Level 2 threats to birds cited are: 8.1 Invasive non-native/alien species/diseases (38%), followed by 2.1 Annual & perennial non-timber crops (15%), then 5.3 Logging & wood harvesting and 7.1 Fire & fire suppression (8% each).
3. Level 2 threats to mammals cited are: 11.4 Storms & flooding (15%) and 2.1 Annual & perennial non-timber crops (15%)the first threat is relevant most particularly to Fiji's cave-dwelling bats, all three of which are listed as threatened on the IUCN Red List (Table 4).





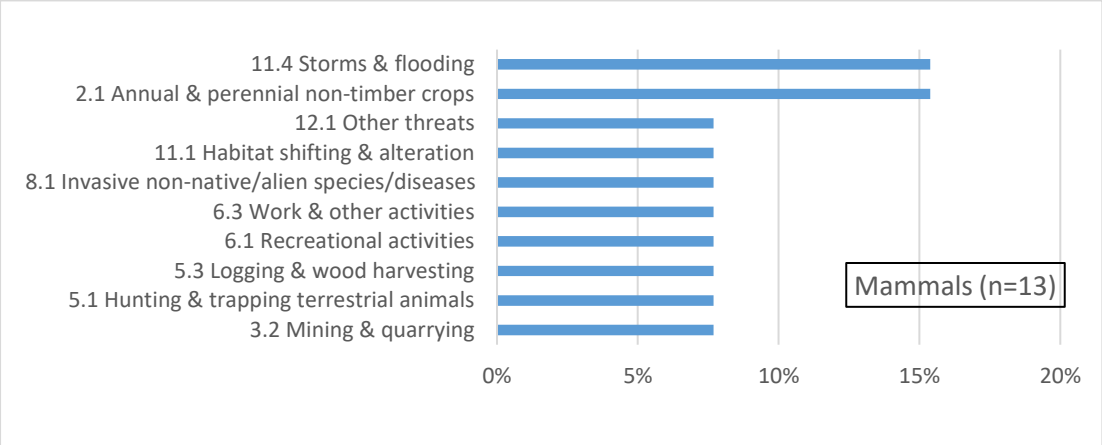
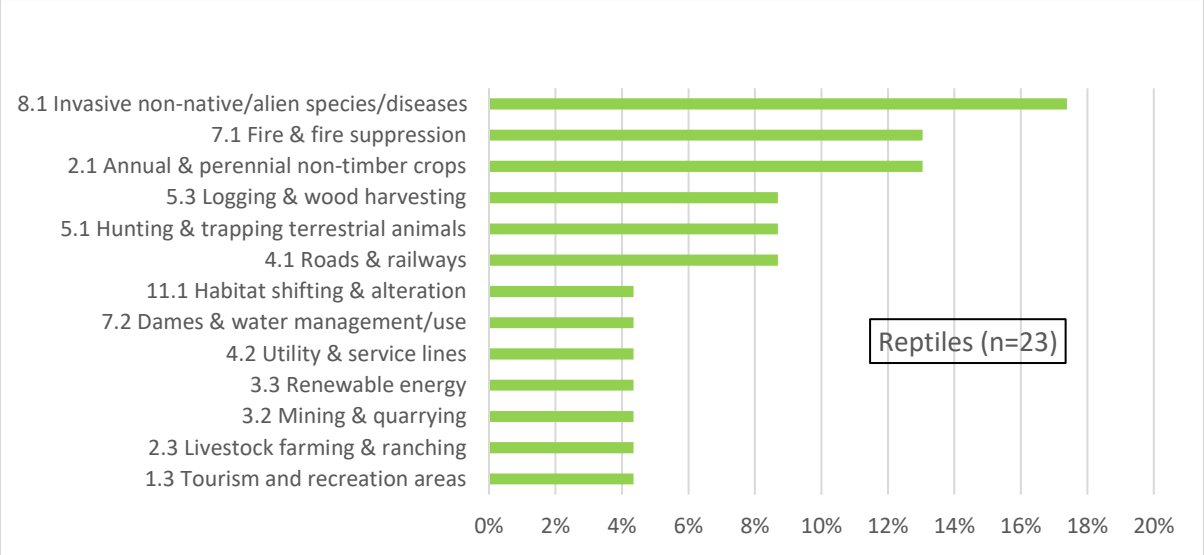
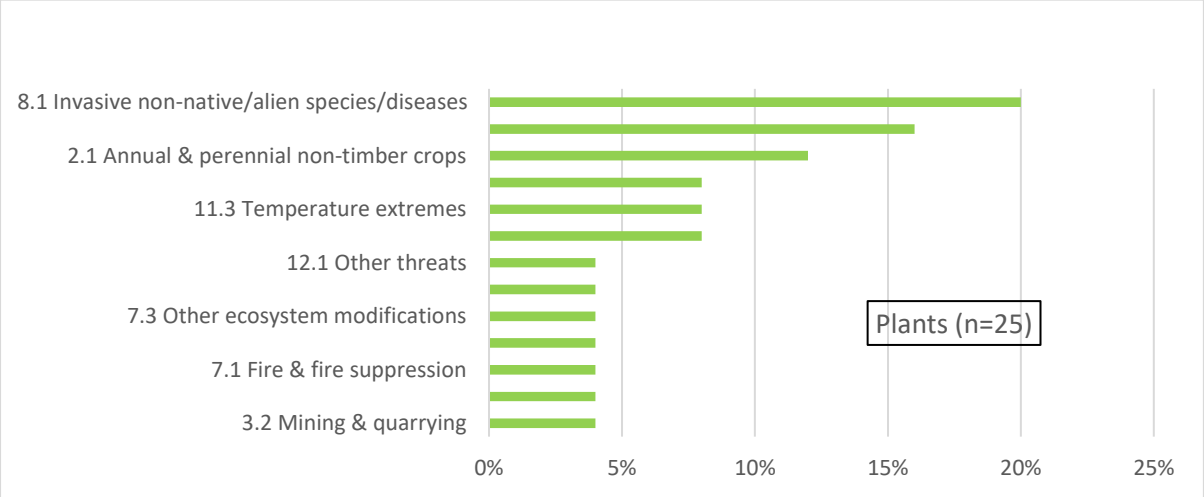


FIGURE 17: SUM OF KEY THREATS TO AMPHIBIANS, BIRDS AND MAMMALS WHEREBY N = NUMBER OF EXPERT STATEMENTS RECORDED FOR THE LEVEL 2 THREAT TO THE TAXON. THREATS WITH ZERO (0) VALUES HAVE BEEN REMOVED FROM THIS FIGURE. THE NUMBER ON THE HORIZONTAL AXIS IS THE PERCENTAGE OF THE TOTAL NUMBER OF STATEMENTS MADE (AMPHIBIANS: N=34; BIRDS: N=26; MAMMALS: N=13).

LEVEL 2 THREATS TO FIJI'S REPTILES, PLANTS AND FRESHWATER FISH

Eighty threat statements were recorded for Fiji's reptiles, plants and freshwater fish (Figure 18). Invasive alien species (8.1 Invasive non-native/alien species/diseases) were the most cited Level 2 threat to these taxa.





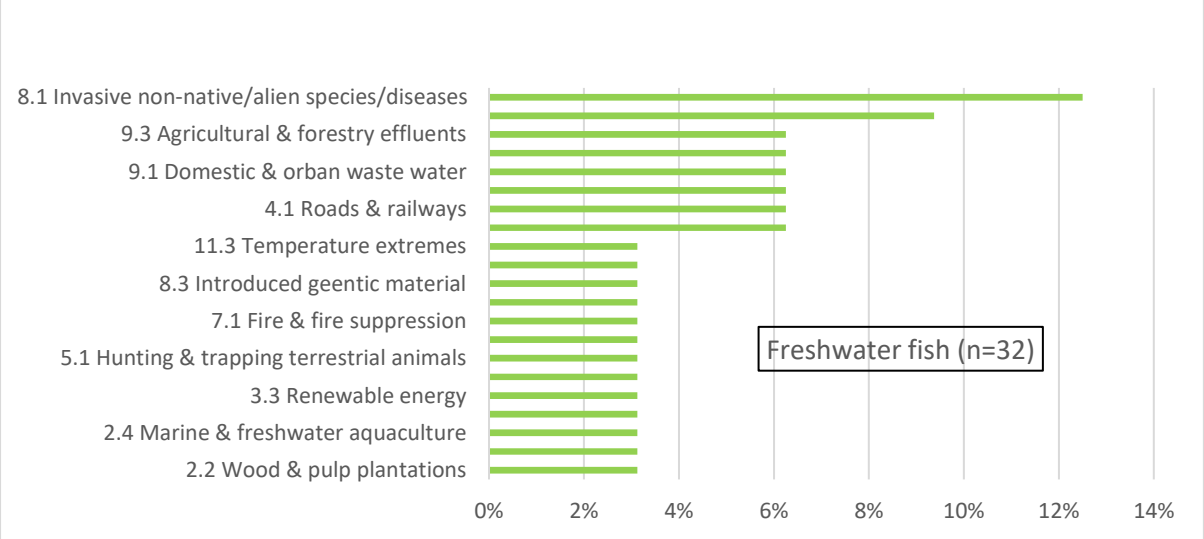


FIGURE 18: LEVEL 2 THREATS TO FIJI'S REPTILES, PLANTS AND FRESHWATER FISH AS CITED BY EXPERTS CONSULTED. N= NUMBER OF EXPERT STATEMENTS RECORDED FOR THE LEVEL 2 THREAT TO THE TAXON. THREATS WITH ZERO (0) VALUES HAVE BEEN REMOVED FROM THIS FIGURE. THE NUMBER ON THE HORIZONTAL AXIS IS THE PERCENTAGE OF THE TOTAL NUMBER OF STATEMENTS MADE (REPTILES: N=23; PLANTS: N=25; FRESHWATER FISH: N=32).

As with the comparison of threats approach across the different taxa used for the $STAR_T$ analysis (section 4.2), we also compared the main threats across all terrestrial taxa based on the expert assessments (Table 16). The Red Cells indicate one of the top 3 threats, the Orange Cells the 4-6th most severe threats while the dark blue cells represent the 7-10th most severe threats within each taxonomic group. Pale blue cells are other threats that are listed but outside the top 10 threats

Table 16 shows that two threats are highly ranked across all three taxonomic groups - 2.1 Annual & perennial non-timber crops and 8.1 Invasive non-native species/diseases.

In Table 17 we compare the results of the expert assessments with the $STAR_T$ results and the literature review. The table shows consistency between the results of the STAR metric and the expert assessments in that 2.1 Annual & perennial non-timber crops, 5.3 Logging & wood harvesting and 8.1 Invasive non-native species/diseases are highly ranked threats across the terrestrial taxonomic groups. The literature lists rather than ranks the threats and there is overlap with the $STAR_T$ results and the expert data.

TABLE 16. THE THREAT FOR EACH TERRESTRIAL TAXONOMIC GROUP BASED ON EXPERT ASSESSMENTS. DATA FOR EACH GROUPS ARE PRESENTED SEPARATELY ABOVE.

Threat classification level (IUCN-CMP)		**ABM**	**Reptiles**	**Plants**
Level 1.	Level 2			
1. Residential and commercial development	1.1 Housing and urban areas			
	1.2 Commercial and industrial areas			
	1.3 Tourism and recreation areas			
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops			
	2.2 Wood & pulp plantations			
	2.3 Livestock farming & ranching			
	2.4 Marine & freshwater aquaculture			
3. Energy production & mining	3.1 Oil & gas drilling			
	3.2 Mining & quarrying			
	3.3 Renewable energy			
4. Transportation & service corridors	4.1 Roads & railways			
	4.2 Utility & service lines			
	4.3 Shipping lanes			
	4.4 Flight paths			
5. Biological resource use	5.1 Hunting & trapping terrestrial animals			
	5.2 Gathering terrestrial plants			
	5.3 Logging & wood harvesting			
	5.4 Fishing & harvesting aquatic resources			
6. Human intrusions & disturbances	6.1 Recreational activities			
	6.2 War, civil unrest & military exercises			
	6.3 Work & other activities			
7. Natural system modifications	7.1 Fire & fire suppression			
	7.2 Dams & water management/use			
	7.3 Other ecosystem modifications			
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases			
	8.2 Problematic native species/diseases			
	8.3 Introduced genetic material			
	8.4 Species/diseases of unknown origin			
	8.5 Viral/prion-induced diseases			
	8.6 Diseases of unknown cause			
9. Pollution	9.1 Domestic & urban waste water			
	9.2 Industrial & military effluents			
	9.3 Agricultural & forestry effluents			
	9.4 Garbage & solid waste			
	9.5 Air-borne pollutants			
	9.6 Excess energy			
10. Geological events	10.1 Volcanoes			
	10.2 Earthquakes/tsunamis			
	10.3 Avalanches / landslides			
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration			
	11.2 Droughts			
	11.3 Temperature extremes			
	11.4 Storms & flooding			
	11.5 Other impacts			
12. Other options	12.1 Other threats			

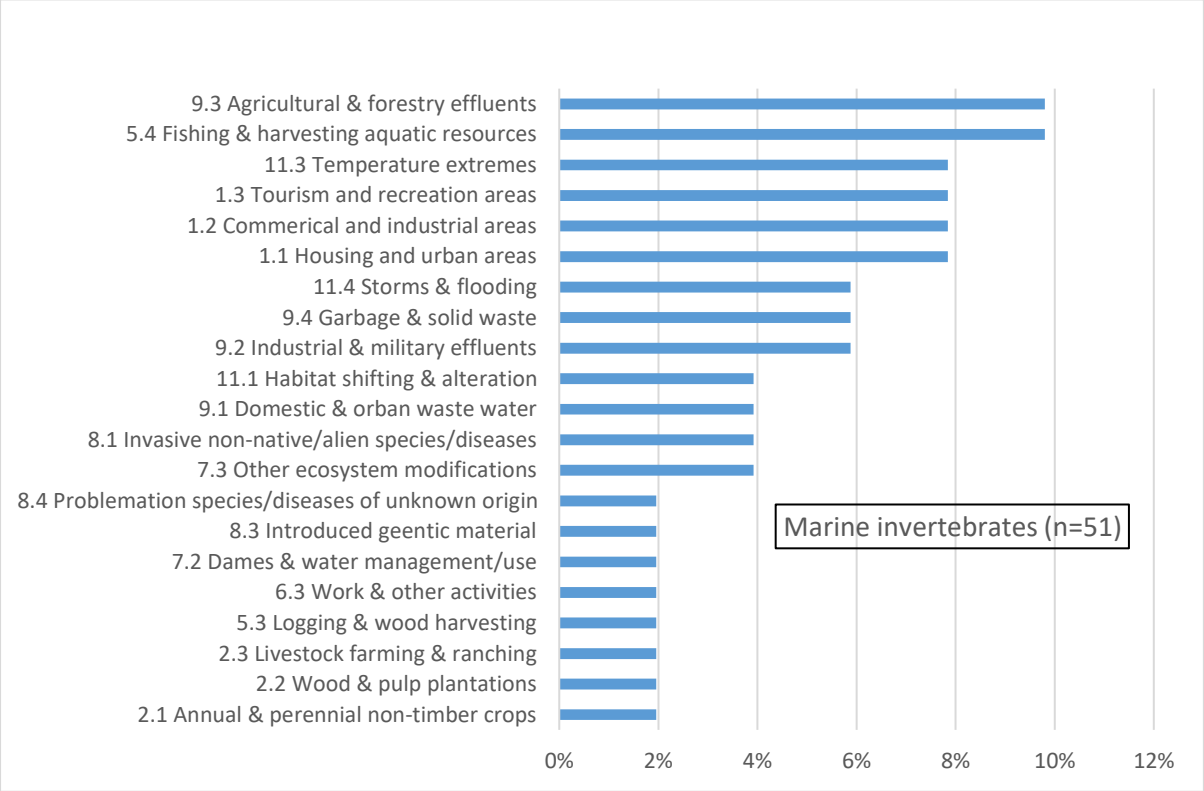
TABLE 17: COMPARING PRIORITY IUCN-CMP THREATS FOR EACH TERRESTRIAL TAXONOMIC GROUP USING THE STAR$_T$ ANALYSIS (LEFT), EXPERT DATA (MIDDLE) AND LITERATURE REVIEW (RIGHT, NOT-RANKED)

		STAR METRIC				EXPERT DATA			LITERATURE (TERRESTRIAL, FRESHWATER SPECIES)
Threat classification level (IUCN-CMP)		**ABM**	**Reptiles**	**Molluscs**	**Plants**	**ABM**	**Reptiles**	**Plants**	
Level 1.	Level 2								
1. Residential and commercial development	1.1 Housing and urban areas								
	1.2 Commercial and industrial areas								
	1.3 Tourism and recreation areas								
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops								Forest conversion to root crop production and pasture River bank erosion (sedimentation due to agricultural activities) Pesticide/fertilizer runoff in agricultural zones Drainage and clearing for agriculture
	2.2 Wood & pulp plantations								
	2.3 Livestock farming & ranching								
	2.4 Marine & freshwater aquaculture								
3. Energy production & mining	3.1 Oil & gas drilling								
	3.2 Mining & quarrying								Mining Gravel extraction
	3.3 Renewable energy								
4. Transportation & service corridors	4.1 Roads & railways								
	4.2 Utility & service lines								
	4.3 Shipping lanes								
	4.4 Flight paths								
5. Biological resource use	5.1 Hunting & trapping terrestrial animals								Conventional logging Extraction of forest resources River bank erosion (sedimentation due to agricultural activities)
	5.2 Gathering terrestrial plants								
	5.3 Logging & wood harvesting								
	5.4 Fishing & harvesting aquatic resources								
6. Human intrusions & disturbances	6.1 Recreational activities								
	6.2 War, civil unrest & military exercises								
	6.3 Work & other activities								
7. Natural system modifications	7.1 Fire & fire suppression								Forest fires Diversion of flows for water supply or hydropower generation
	7.2 Dams & water management/use								
	7.3 Other ecosystem modifications								
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases								Invasive species
	8.2 Problematic native species/diseases								
	8.3 Introduced genetic material								
	8.4 Species/diseases of unknown origin								
	8.5 Viral/prion-induced diseases								

	8.6 Diseases of unknown cause								
9. Pollution	9.1 Domestic & urban waste water								Pesticide/fertilizer runoff in agricultural zones
	9.2 Industrial & military effluents								
	9.3 Agricultural & forestry effluents								
	9.4 Garbage & solid waste								
	9.5 Air-borne pollutants								
	9.6 Excess energy								
10. Geological events	10.1 Volcanoes								
	10.2 Earthquakes/tsunamis								
	10.3 Avalanches / landslides								
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration								
	11.2 Droughts								
	11.3 Temperature extremes								
	11.4 Storms & flooding								
	11.5 Other impacts								
12. Other options	12.1 Other threats								Dereservation of protected areas Poorly planned infrastructure development

LEVEL 2 THREATS TO FIJI'S MARINE INVERTEBRATES AND VERTEBRATES

Ninety-nine expert statements were recorded for Fiji's marine invertebrates (51 statements) and vertebrates (48 statements). For both marine invertebrates and vertebrates, Pollution - 9.3 Agricultural & forestry effluents and Biological resource use (5.4 Fishing & harvesting aquatic resources (~10%) are the most cited threat followed by Climate change (11.3 Temperature extremes) and Residential & commercial development (1.3 Tourism & recreation areas) (Figure 19).



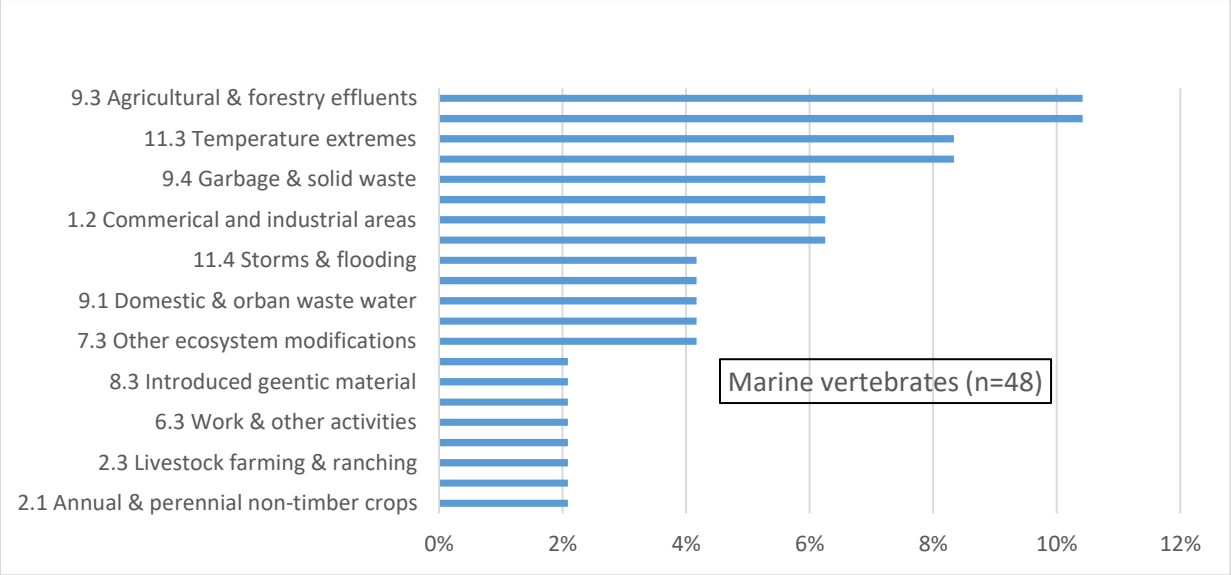


FIGURE 19: LEVEL 2 THREATS TO FIJI'S MARINE INVERTEBRATES AND MARINE INVERTEBRATES AT CITED BY EXPERTS. N= NUMBER OF EXPERT STATEMENTS RECORDED FOR THE LEVEL 2 THREAT TO THE TAXONOMIC GROUP. THREATS WITH ZERO (0) VALUES HAVE BEEN REMOVED FROM THIS GRAPH.

As with the comparison of threats approach across the different taxa used for the $STAR_T$ analysis (section 4.2), we also compared the main threats across all marine taxa based on the expert assessments (Table 19). The Red Cells indicate one of the top 3 threats, the Orange Cells the 4-6th most severe threats while the dark blue cells represent the 7-10th most severe threats within each taxonomic group. Pale blue cells are other threats that are listed but outside the top 10 threats

Table 19 shows that four threats are ranked highly across the two taxonomic groups: 1.3 Tourism and recreation areas, 5.4 Fishing & harvesting aquatic resources, 9.3 Agricultural & forestry effluents and 11.3 Temperature extremes.

In Table 20 we compare the results of the expert assessments with the $STAR_T$ results and the literature. The table shows that while there is inconsistency at Level 2 threats across all the taxa and the two datasets, there is consistency at Level 1 threats, identifying 5. Biological resource use and 1. Residential and commercial development as highly ranked threats for Fiji's marine taxa. The literature data is not ranked, but it shows overlap with the $STAR_T$ and expert results.

TABLE 18: THE SUM OF CONTRIBUTION OF THREAT FOR EACH TAXA, BASED ON EXPERT RESPONSES. DATA FOR EACH GROUP ARE PRESENTED SEPARATELY ABOVE.

Threat classification level (IUCN-CMP)		**Marine invertebrates**	**Marine vertebrates**
Level 1.	Level 2		
1. Residential and commercial development	1.1 Housing and urban areas		
	1.2 Commercial and industrial areas		
	1.3 Tourism and recreation areas		
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops		
	2.2 Wood & pulp plantations		
	2.3 Livestock farming & ranching		
	2.4 Marine & freshwater aquaculture		
3. Energy production & mining	3.1 Oil & gas drilling		
	3.2 Mining & quarrying		
	3.3 Renewable energy		
4. Transportation & service corridors	4.1 Roads & railways		
	4.2 Utility & service lines		
	4.3 Shipping lanes		
	4.4 Flight paths		
5. Biological resource use	5.1 Hunting & trapping terrestrial animals		
	5.2 Gathering terrestrial plants		
	5.3 Logging & wood harvesting		
	5.4 Fishing & harvesting aquatic resources		
6. Human intrusions & disturbances	6.1 Recreational activities		
	6.2 War, civil unrest & military exercises		
	6.3 Work & other activities		
7. Natural system modifications	7.1 Fire & fire suppression		
	7.2 Dams & water management/use		
	7.3 Other ecosystem modifications		
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases		
	8.2 Problematic native species/diseases		
	8.3 Introduced genetic material		
	8.4 Species/diseases of unknown origin		
	8.5 Viral/prion-induced diseases		
	8.6 Diseases of unknown cause		
9. Pollution	9.1 Domestic & urban waste water		
	9.2 Industrial & military effluents		
	9.3 Agricultural & forestry effluents		
	9.4 Garbage & solid waste		
	9.5 Air-borne pollutants		
	9.6 Excess energy		
10. Geological events	10.1 Volcanoes		
	10.2 Earthquakes/tsunamis		
	10.3 Avalanches / landslides		
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration		
	11.2 Droughts		
	11.3 Temperature extremes		
	11.4 Storms & flooding		
	11.5 Other impacts		
12. Other options	12.1 Other threats		

TABLE 19: COMPARING PRIORITY IUCN-CMP THREATS FOR EACH MARINE TAXONOMIC GROUP USING THE $STAR_T$ ANALYSIS (LEFT), EXPERT DATA (MIDDLE) AND LITERATURE REVIEW (RIGHT, NOT-RANKED)

		$STAR_T$ ANALYSIS			**EXPERT DATA**		**LITERATURE**
Threat classification level (IUCN-CMP)		**Vertebrates**	**Corals**	**Other In-vertebrates**	**Marine invertebrates**	**Marine vertebrates**	
Level 1.	Level 2						
1. Residential and commercial development	1.1 Housing and urban areas						Coastal habitat modification Removal of beach rock and coral for building and infrastructure (e.g. roads)
	1.2 Commercial and industrial areas						
	1.3 Tourism and recreation areas						
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops						Sediment and nutrient runoff from human-altered water catchments (e.g. through agriculture, forestry and mining).
	2.2 Wood & pulp plantations						
	2.3 Livestock farming & ranching						
	2.4 Marine & freshwater aquaculture						
3. Energy production & mining	3.1 Oil & gas drilling						Sediment and nutrient runoff from human-altered water catchments (e.g. through agriculture, forestry and mining).
	3.2 Mining & quarrying						
	3.3 Renewable energy						
4. Transportation & service corridors	4.1 Roads & railways						Removal of beach rock and coral for building and infrastructure (e.g. roads)
	4.2 Utility & service lines						
	4.3 Shipping lanes						
	4.4 Flight paths						
5. Biological resource use	5.1 Hunting & trapping terrestrial animals						Overfishing Sediment and nutrient runoff from human-altered water catchments (e.g. through agriculture, forestry and mining).
	5.2 Gathering terrestrial plants						
	5.3 Logging & wood harvesting						
	5.4 Fishing & harvesting aquatic resources						
6. Human intrusions & disturbances	6.1 Recreational activities						
	6.2 War, civil unrest & military exercises						

	6.3 Work & other activities						
7. Natural system modifications	7.1 Fire & fire suppression						Removal of beach rock and coral for building and infrastructure (e.g. roads)
	7.2 Dams & water management/use						
	7.3 Other ecosystem modifications						
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases						Predator and disease outbreaks
	8.2 Problematic native species/diseases						
	8.3 Introduced genetic material						
	8.4 Species/diseases of unknown origin						
	8.5 Viral/prion-induced diseases						
	8.6 Diseases of unknown cause						
9. Pollution	9.1 Domestic & urban waste water						Sediment and nutrient runoff from human-altered water catchments (e.g. through agriculture, forestry and mining). Improper waste disposal and pollution
	9.2 Industrial & military effluents						
	9.3 Agricultural & forestry effluents						
	9.4 Garbage & solid waste						
	9.5 Air-borne pollutants						
	9.6 Excess energy						
10. Geological events	10.1 Volcanoes						
	10.2 Earthquakes/tsunamis						
	10.3 Avalanches / landslides						
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration						Climate change Natural disasters
	11.2 Droughts						
	11.3 Temperature extremes						
	11.4 Storms & flooding						
	11.5 Other impacts						
12. Other options	12.1 Other threats						

RANKING OF EXPERT STATEMENTS ON THREATS' CONTRIBUTIONS TO LOSS OF FIJI'S BIODIVERSITY

The ranking of expert statements on threats to Fiji's biodiversity were based on the sum of "contribution to biodiversity loss" for each Level 2 threat (see Table 2) documented for each taxon/ group (Figure 20 for amphibians, birds and mammals combined).

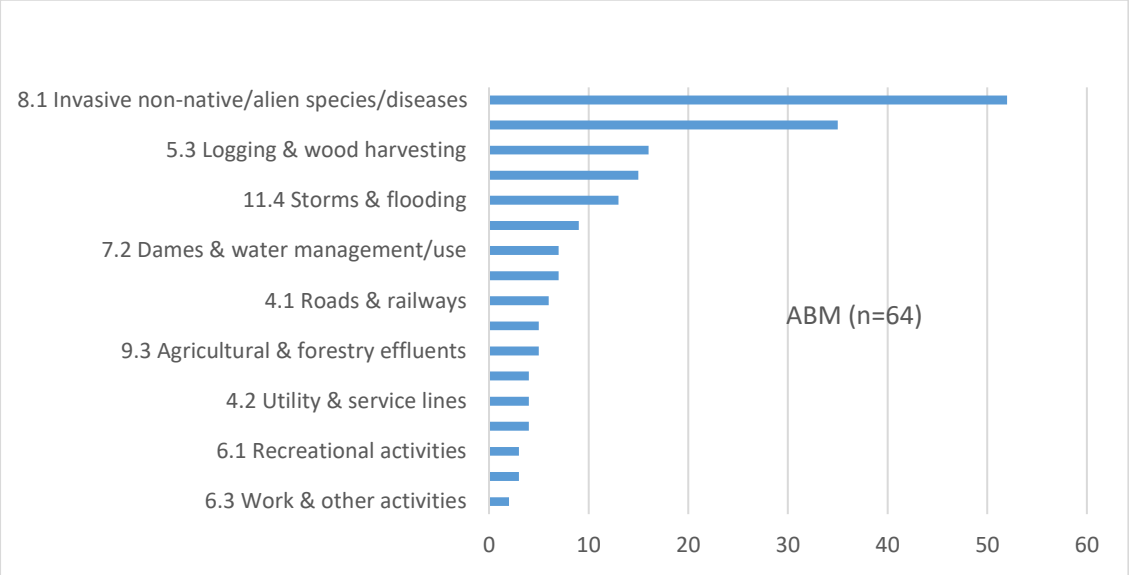
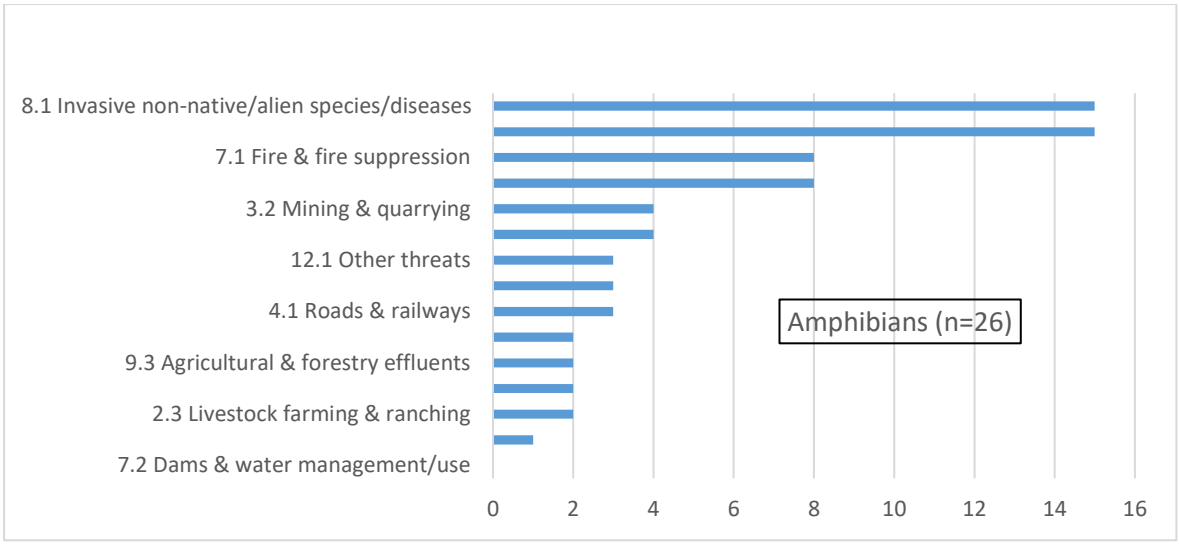
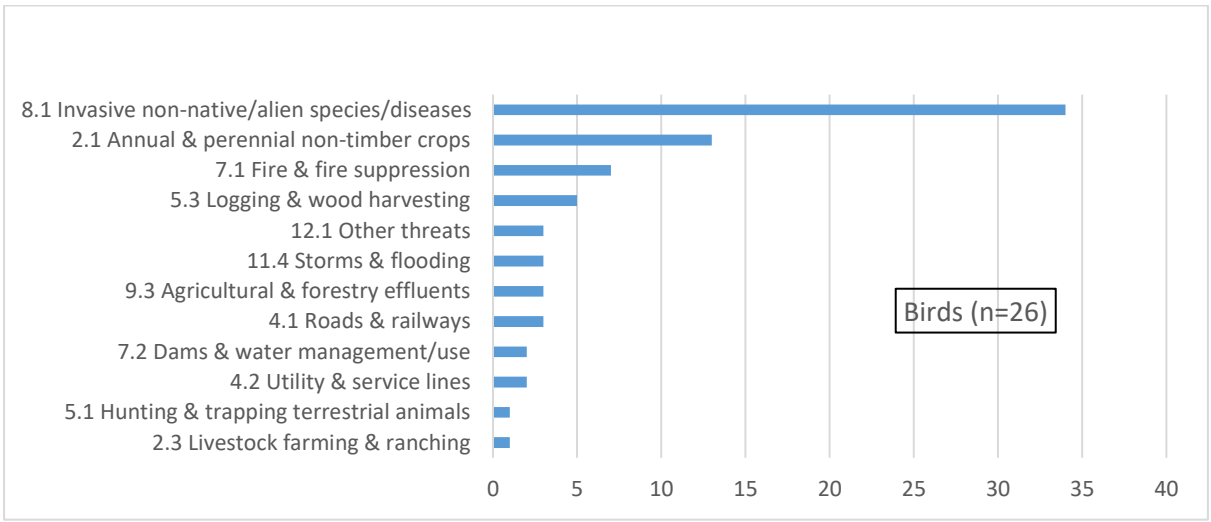


FIGURE 20. SUM OF "CONTRIBUTION TO BIODIVERSITY LOSS" OF LEVEL 2 THREATS (IUCN-CMP CLASSIFICATION) FOR AMPHIBIANS, BIRDS AND MAMMALS - COMBINED. N = NUMBER OF EXPERT STATEMENTS.

Note that 8.1 Invasive non-native/alien species/diseases is ranked as the strongest contributor to loss of amphibians, birds and mammals (combined), followed by 5.3 Logging & wood harvesting and 11.4 Storms & flooding.

When amphibians, birds and mammals are presented separately (Figure 21), invasive alien species are still ranked as a strong contributor towards amphibian and bird loss, whilst 11.4 Storms & flooding and 2.1 Annual & perennial non-timber crops are ranked as high contributors of mammalian loss (Figure 17), which is relevant most particularly to Fiji's cave-dwelling bats, all three of which are listed as threatened on the IUCN Red List (Table 4).





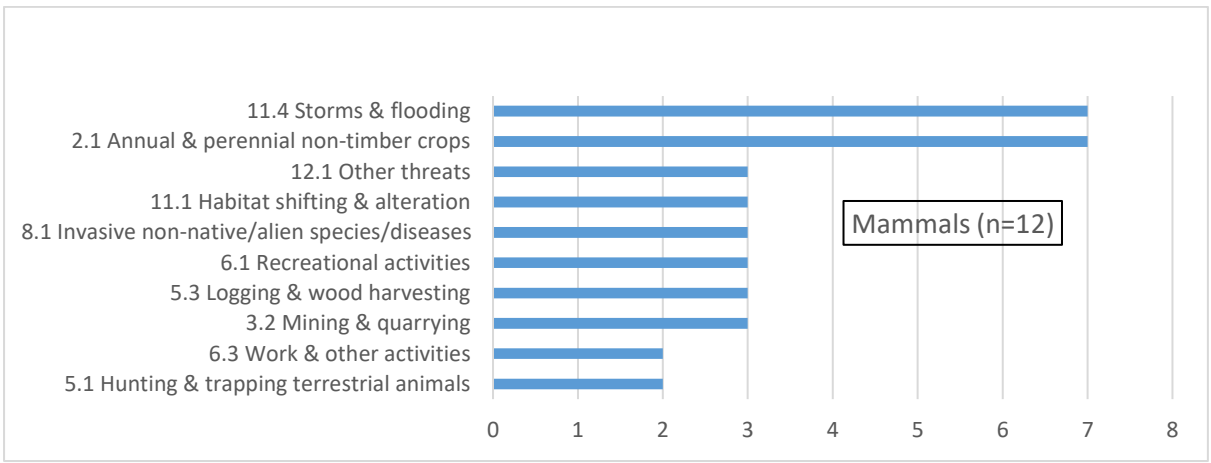


FIGURE 21. SUM OF "CONTRIBUTION TO BIODIVERSITY LOSS" OF LEVEL 2 THREATS (IUCN-CMP CLASSIFICATION) FOR AMPHIBIANS, BIRDS AND MAMMALS. N = NUMBER OF EXPERT STATEMENTS.

For reptiles and plants, 8.1 Invasive non-native/alien species/diseases is ranked as the highest contributor to loss biodiversity followed by 7.1 Fire & fire suppression (reptiles) and 5.3 Logging & wood harvesting (plants) (Figure 22).

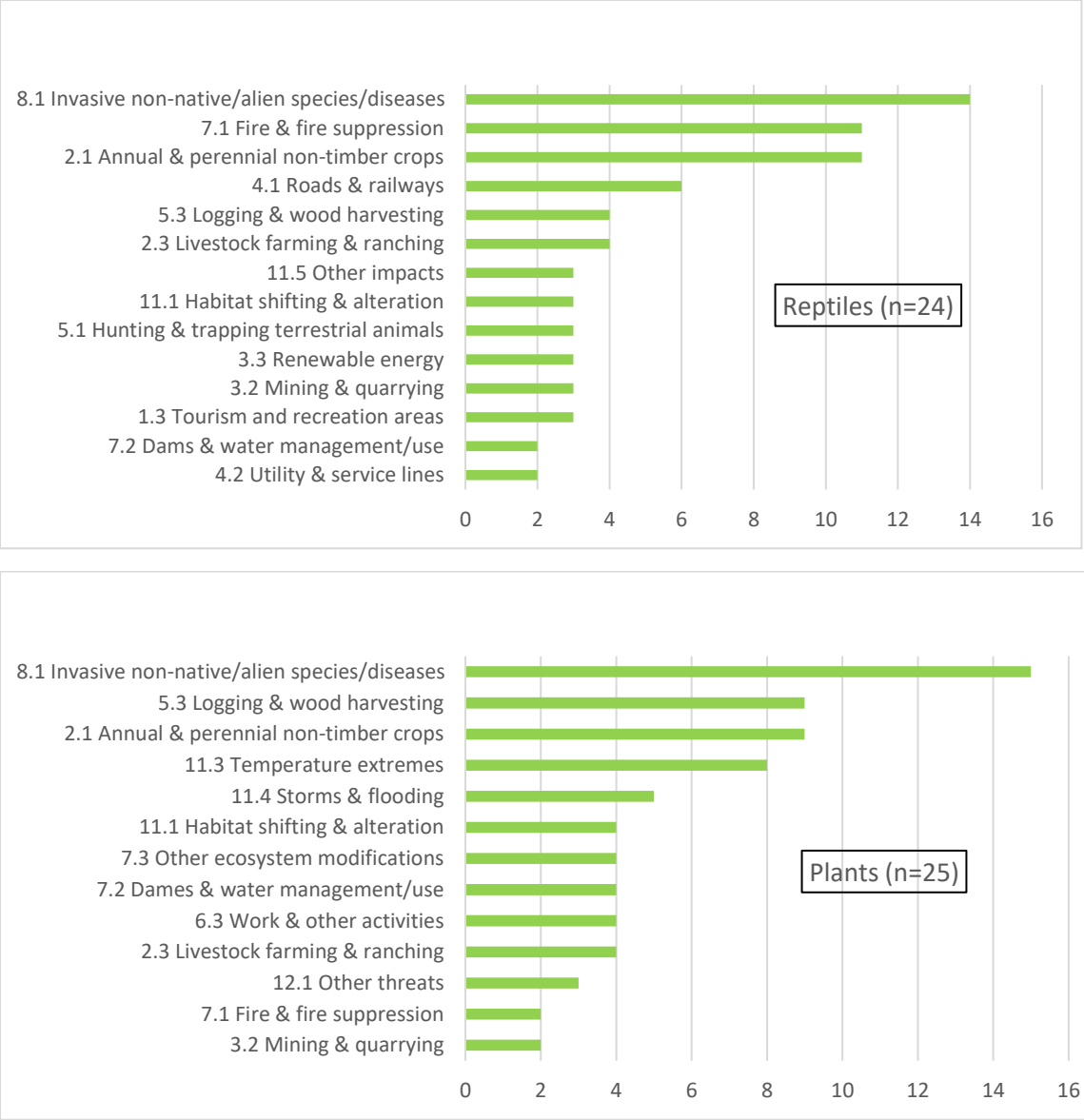


FIGURE 22. SUM OF "CONTRIBUTION TO BIODIVERSITY LOSS" OF LEVEL 2 THREATS (IUCN-CMP CLASSIFICATION) FOR REPTILES AND PLANTS. N = NUMBER OF EXPERT STATEMENTS.

Consistent with the STAR metric and the expert data (Table 18), Table 21 shows that 2.1 Annual & perennial non-timber crops and 8.1 Invasive non-native species/diseases are highly ranked as threats across all the terrestrial taxonomic groups.

TABLE 20: THE SUM OF CONTRIBUTION OF THREAT FOR EACH TAXA, BASED ON EXPERT RESPONSES. DATA FOR EACH GROUP ARE PRESENTED SEPARATELY ABOVE.

Threat classification level (IUCN-CMP)		ABM	Reptiles	Plants
Level 1.	Level 2			
1. Residential and commercial development	1.1 Housing and urban areas			
	1.2 Commercial and industrial areas			
	1.3 Tourism and recreation areas			
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops			
	2.2 Wood & pulp plantations			
	2.3 Livestock farming & ranching			
	2.4 Marine & freshwater aquaculture			
3. Energy production & mining	3.1 Oil & gas drilling			
	3.2 Mining & quarrying			
	3.3 Renewable energy			
4. Transportation & service corridors	4.1 Roads & railways			
	4.2 Utility & service lines			
	4.3 Shipping lanes			
	4.4 Flight paths			
5. Biological resource use	5.1 Hunting & trapping terrestrial animals			
	5.2 Gathering terrestrial plants			
	5.3 Logging & wood harvesting			
	5.4 Fishing & harvesting aquatic resources			
6. Human intrusions & disturbances	6.1 Recreational activities			
	6.2 War, civil unrest & military exercises			
	6.3 Work & other activities			
7. Natural system modifications	7.1 Fire & fire suppression			
	7.2 Dams & water management/use			
	7.3 Other ecosystem modifications			
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases			
	8.2 Problematic native species/diseases			
	8.3 Introduced genetic material			
	8.4 Species/diseases of unknown origin			
	8.5 Viral/prion-induced diseases			
	8.6 Diseases of unknown cause			
9. Pollution	9.1 Domestic & urban waste water			
	9.2 Industrial & military effluents			
	9.3 Agricultural & forestry effluents			
	9.4 Garbage & solid waste			
	9.5 Air-borne pollutants			
	9.6 Excess energy			
10. Geological events	10.1 Volcanoes			
	10.2 Earthquakes/tsunamis			
	10.3 Avalanches / landslides			
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration			
	11.2 Droughts			
	11.3 Temperature extremes			
	11.4 Storms & flooding			
	11.5 Other impacts			
12. Other options	12.1 Other threats			

The red cells indicate one of the top 3 most severe threats, the orange cells the 4-6th most severe threats while the dark blue cells represent the 7-10th most severe threats within each taxonomic

group. Pale blue cells are other threats that are listed but outside the top 10 most severe threats for the group.

RANKING OF EXPERT STATEMENTS ON THREATS' CONTRIBUTIONS TO LOSS OF FIJI'S MARINE INVERTEBRATE AND MARINE VERTEBRATE SPECIES

Fifty-one and 48 expert (threat) statements (Level 2 – IUCN-CMP classification) were recorded for marine invertebrates and marine vertebrates, respectively. These were ranked according to the "Contribution to biodiversity loss" (Figure 23).

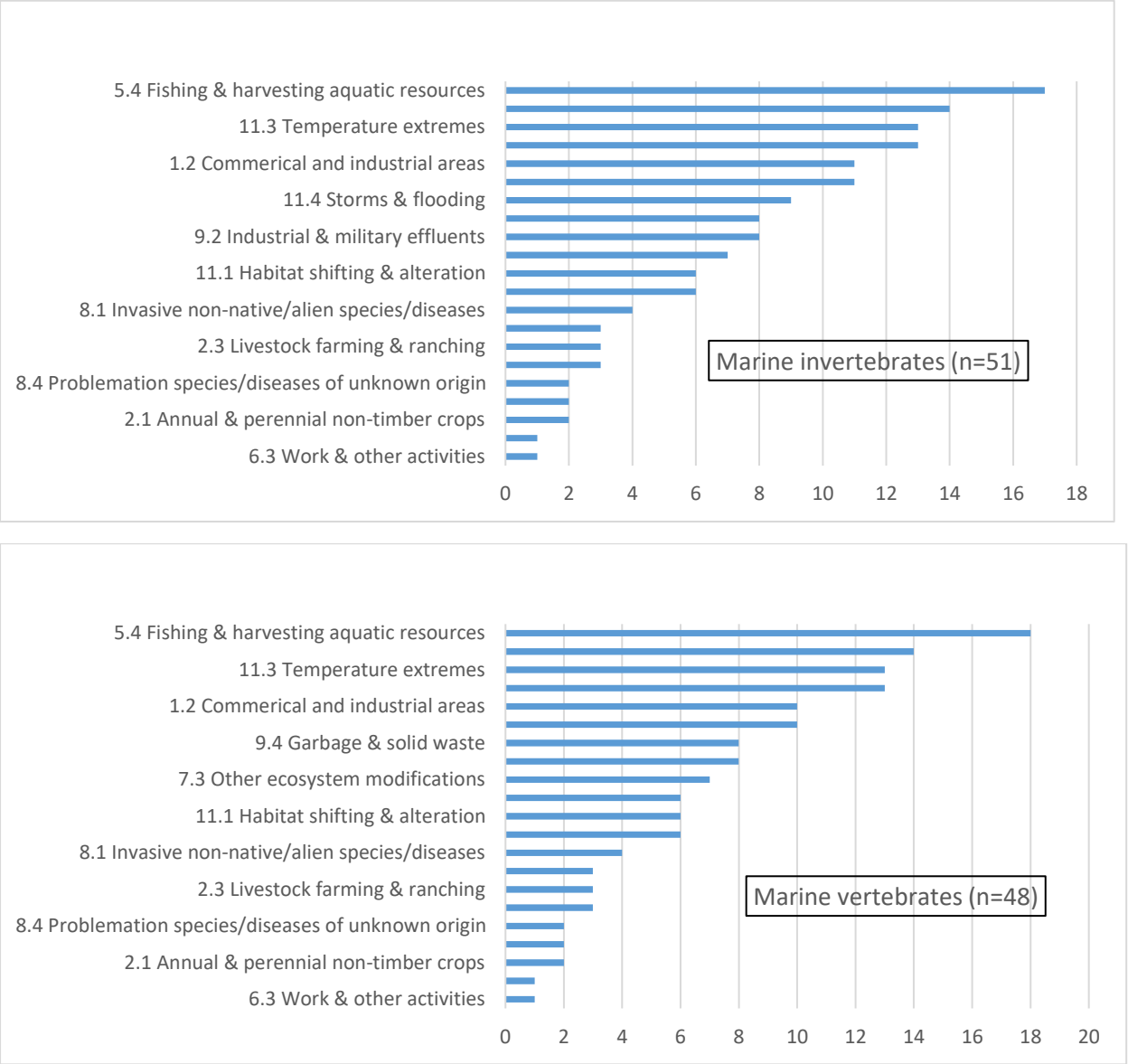


FIGURE 23. SUM OF "CONTRIBUTION TO BIODIVERSITY LOSS" OF LEVEL 2 THREATS (IUCN-CMP CLASSIFICATION) FOR MARINE VERTEBRATES AND INVERTEBRATES. N = NUMBER OF EXPERT STATEMENTS.

The results for ranking of threats (Level 2 – IUCN-CMP classification) to Fiji's marine invertebrates and marine vertebrates (according to "Contribution to biodiversity loss) are

similar for the two taxonomic groups with 5.4 Fishing & harvesting aquatic resources recorded as the strongest contributor (Table 22).

TABLE 21. THE SUM OF CONTRIBUTION OF THREATS FOR EACH TAXA, BASED ON EXPERT RESPONSES. DATA FOR EACH GROUP ARE PRESENTED SEPARATELY ABOVE.

Threat classification level (IUCN-CMP)		**Marine invertebrates**	**Marine vertebrates**
Level 1.	Level 2		
1. Residential and commercial development	1.1 Housing and urban areas		
	1.2 Commercial and industrial areas		
	1.3 Tourism and recreation areas		
2. Agriculture & Aquaculture	2.1 Annual & perennial non-timber crops		
	2.2 Wood & pulp plantations		
	2.3 Livestock farming & ranching		
	2.4 Marine & freshwater aquaculture		
3. Energy production & mining	3.1 Oil & gas drilling		
	3.2 Mining & quarrying		
	3.3 Renewable energy		
4. Transportation & service corridors	4.1 Roads & railways		
	4.2 Utility & service lines		
	4.3 Shipping lanes		
	4.4 Flight paths		
5. Biological resource use	5.1 Hunting & trapping terrestrial animals		
	5.2 Gathering terrestrial plants		
	5.3 Logging & wood harvesting		
	5.4 Fishing & harvesting aquatic resources		
6. Human intrusions & disturbances	6.1 Recreational activities		
	6.2 War, civil unrest & military exercises		
	6.3 Work & other activities		
7. Natural system modifications	7.1 Fire & fire suppression		
	7.2 Dams & water management/use		
	7.3 Other ecosystem modifications		
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases		
	8.2 Problematic native species/diseases		
	8.3 Introduced genetic material		
	8.4 Species/diseases of unknown origin		
	8.5 Viral/prion-induced diseases		
	8.6 Diseases of unknown cause		
9. Pollution	9.1 Domestic & urban waste water		
	9.2 Industrial & military effluents		
	9.3 Agricultural & forestry effluents		
	9.4 Garbage & solid waste		
	9.5 Air-borne pollutants		
	9.6 Excess energy		
10. Geological events	10.1 Volcanoes		
	10.2 Earthquakes/tsunamis		
	10.3 Avalanches / landslides		
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration		
	11.2 Droughts		
	11.3 Temperature extremes		
	11.4 Storms & flooding		
	11.5 Other impacts		
12. Other options	12.1 Other threats		

The red cells indicate one of the top 3 most severe threats, the orange cells the 4-6th most severe threats while the dark blue cells represent the 7-10th most severe threats within each taxonomic group. Pale blue cells are other threats that are listed but outside the top 10 threats for the group.

Comparing priority threats for each marine taxonomic group, using the START$_T$ analysis and expert data, we find Level 1 threats: 1. Residential and commercial development and 5. Biological resource use as strong contributors to marine biodiversity loss. Pollution and Climate change also rank as strong contributors.

RANKING OF EXPERT STATEMENTS ON THREATS TO FIJI'S NATURAL TERRESTRIAL AND MARINE ECOSYSTEMS USING "CONTRIBUTION TO BIODIVERSITY LOSS"

Expert statements on the "Contribution to biodiversity loss" of each threat level to Fiji's natural terrestrial and marine ecosystems were ranked following the analysis of expert statements on threats to Fiji's biodiversity. One hundred and thirteen statements were recorded for Fiji's natural terrestrial environment. Invasive alien species (8.1 Invasive non-native/alien species/diseases) was ranked as the strongest threat to Fiji's natural terrestrial environment followed by 2.1 Annual & perennial non-timber crops and 5.3 Logging & wood harvesting (Figure 24).

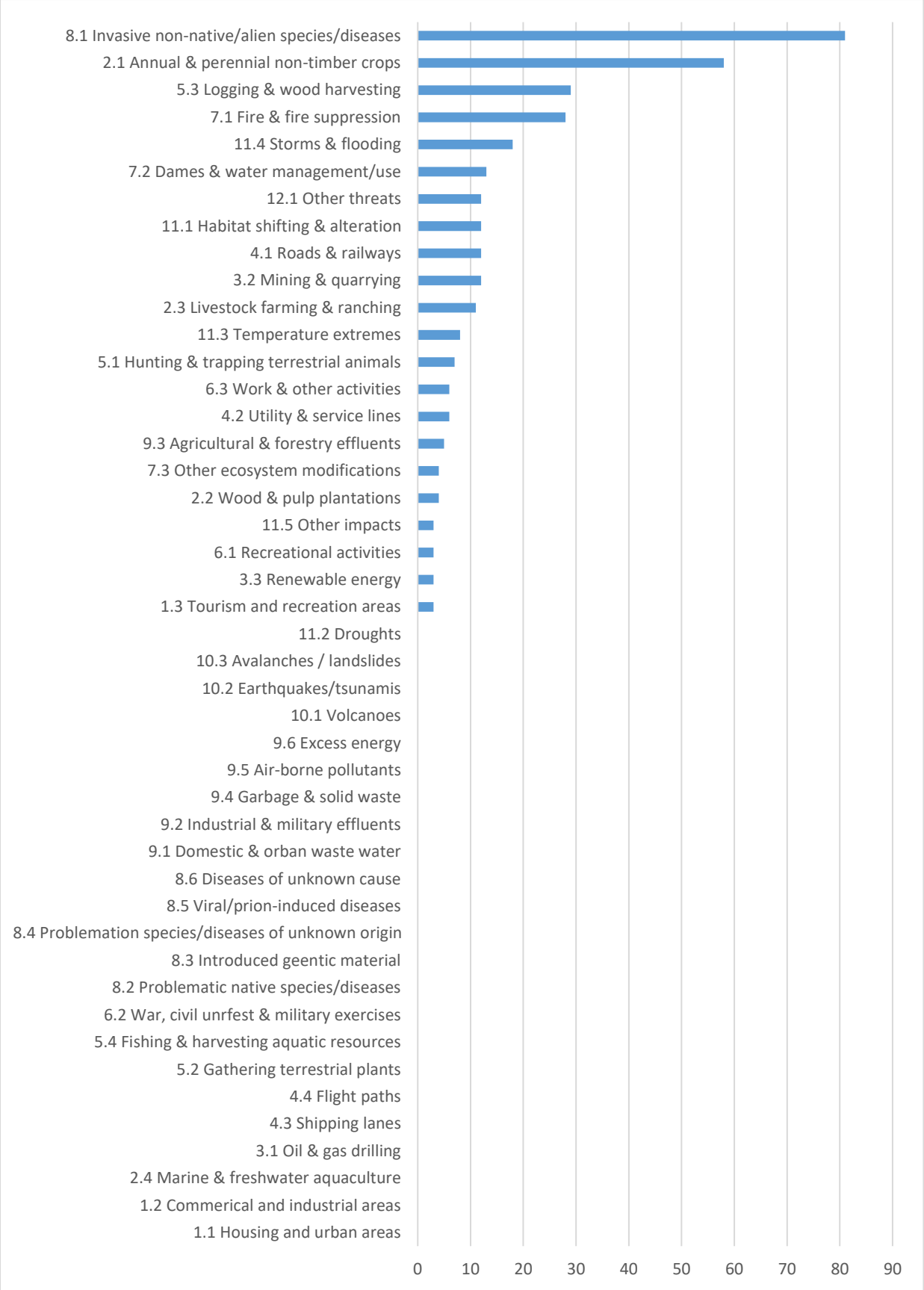


FIGURE 24: SUM OF "CONTRIBUTION TO BIODIVERSITY LOSS" OF LEVEL 2 THREATS (IUCN-CMP CLASSIFICATION) FOR FIJI'S NATURAL TERRESTRIAL ECOSYSTEMS. N = NUMBER OF EXPERT STATEMENTS (N = 113 IN TOTAL)

Ninety-eight expert statements were recorded for the sum of "contribution (of threat) to biodiversity loss: for the marine ecosystem" where 5.4 Fishing & harvesting aquatic resources was ranked as the strongest contributor followed by 9.3 Agricultural & forestry effluents then 11.3 Temperature extremes (Figure 25).

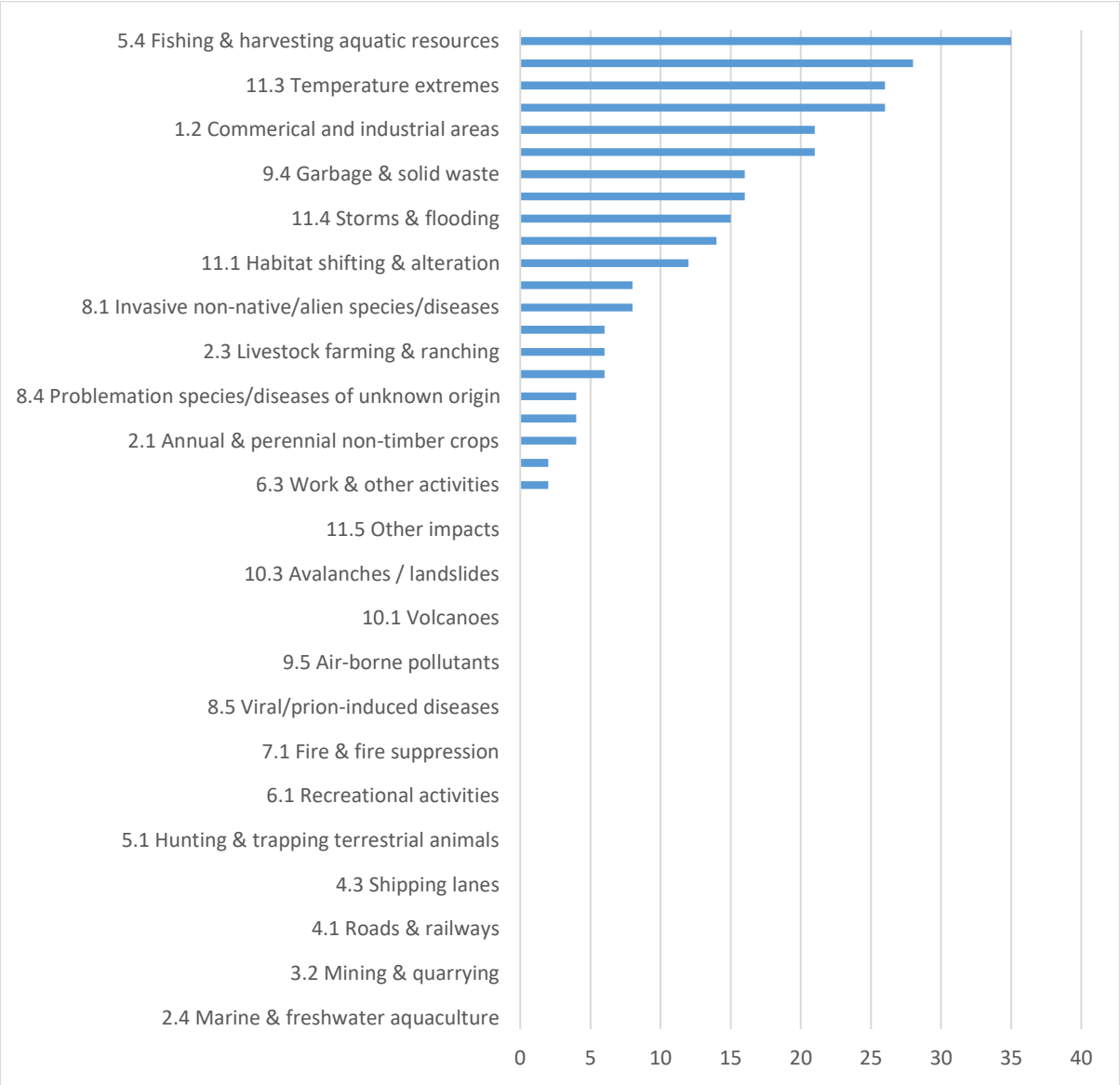
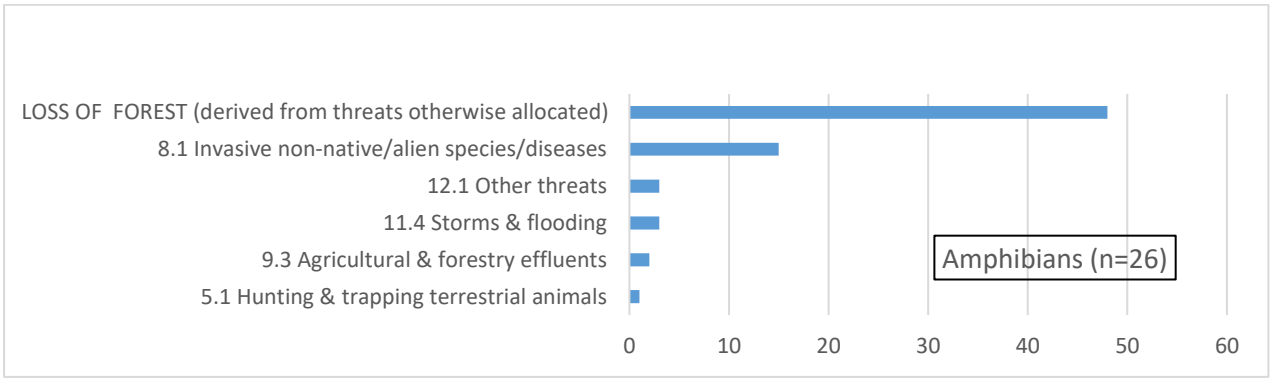


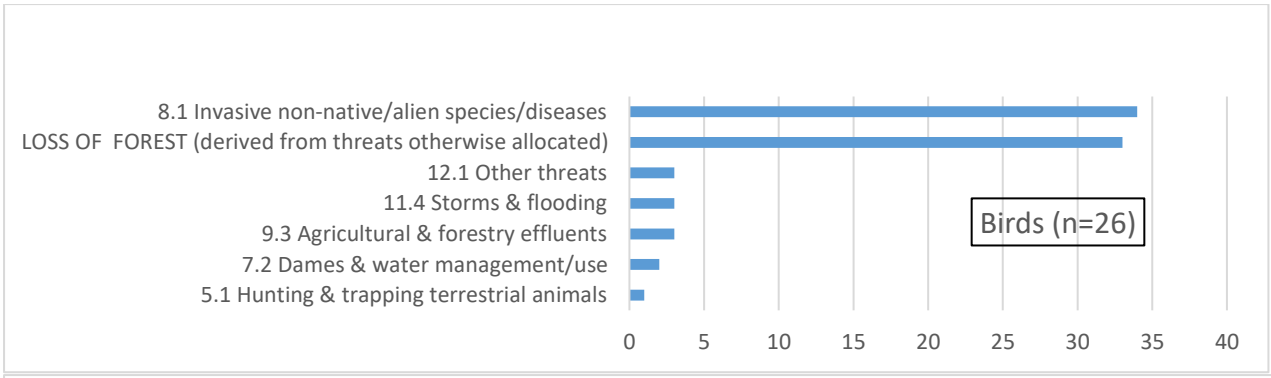
FIGURE 25: SUM OF "CONTRIBUTION TO BIODIVERSITY LOSS" OF LEVEL 2 THREATS (IUCN-CMP CLASSIFICATION) FOR FIJI'S MARINE ECOSYSTEMS. N = NUMBER OF EXPERT STATEMENTS (N = 98 IN TOTAL)

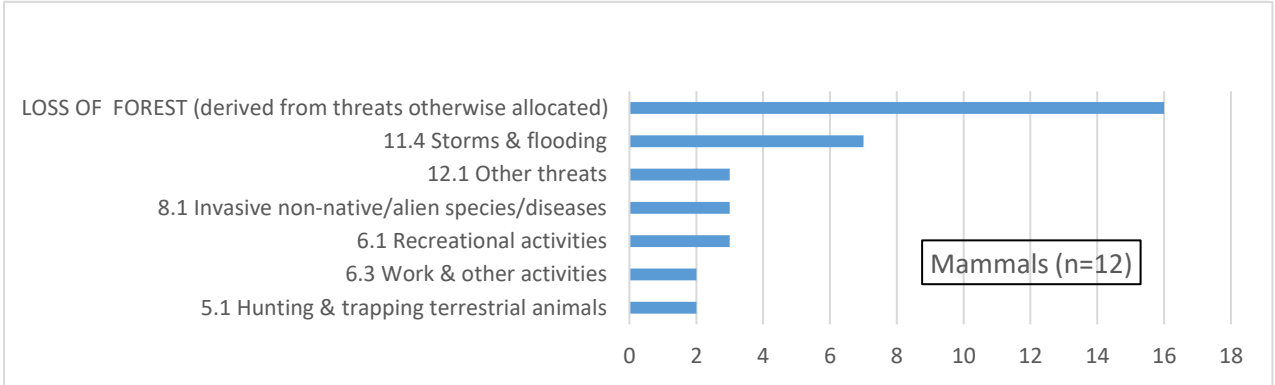
CONSIDERATION OF "LOSS OF FOREST" AS A THREAT TO FIJI'S TERRESTRIAL BIODIVERSITY

Harvesting of native forest in Fiji is a largely historic threat to Fiji's biodiversity – cumulative, emerging loss of forest through various means – small holder farms, livestock farming, construction of roads, placement of communications towers and transmission lines into areas of high biodiversity is considered to be the most significant current threats. To consider forest loss, eleven (11) Level 2 threats that are known to contribute to forest loss were aggregated (Table 3, section 2.2.3)

Forest loss as a threat was considered only for the terrestrial biodiversity: amphibians, birds, mammals, reptiles and plants; and for expert data only. The sum of "contribution to biodiversity loss" of threats was used for this exercise. The total expert statements for each taxa were 26 (amphibians), 26 (birds), 12 (mammals), 24 (reptiles) and 25 (plants). Statements that scored zero have not been included in Figure 26 presented below.







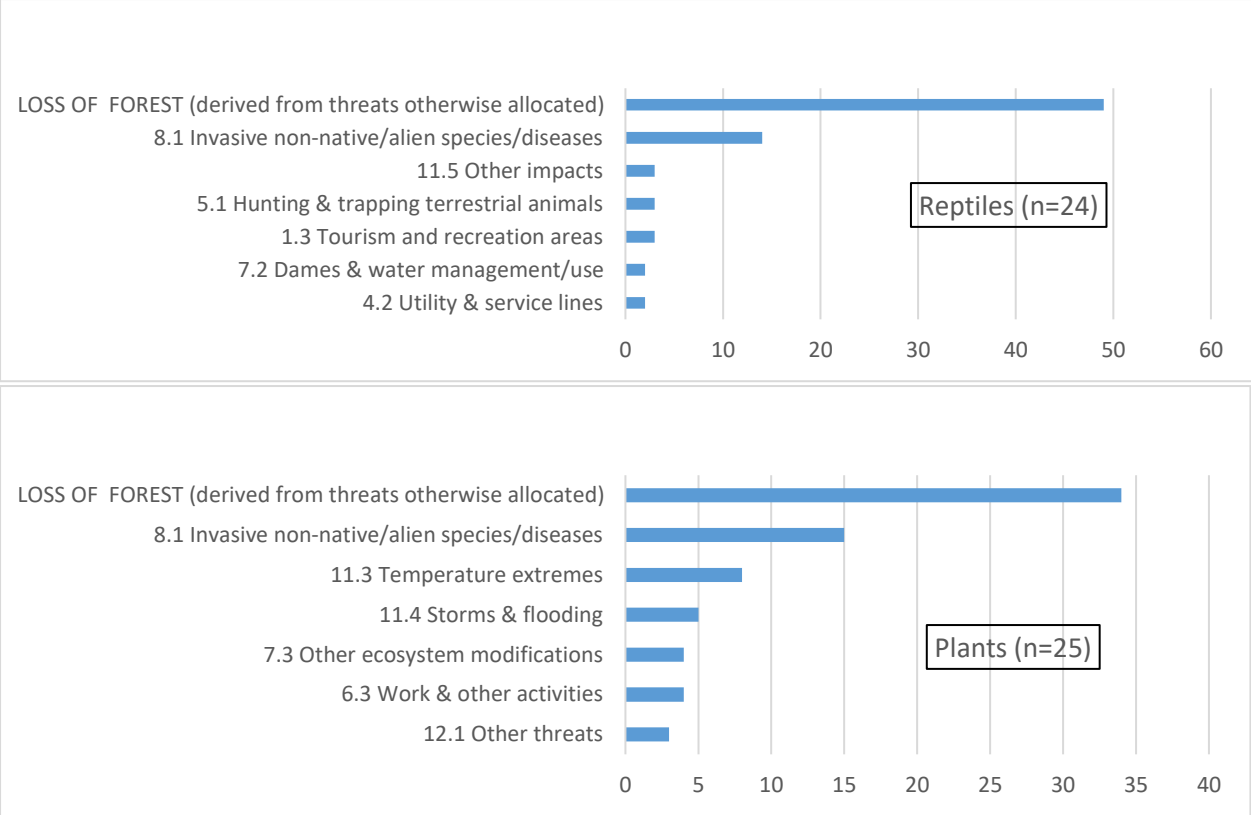


FIGURE 26: COMPARISON OF THE THREAT POSED BY 'FOREST LOSS' TO OTHER THREATS IDENTIFIED BY THE EXPERTS FOR AMPHIBIANS, BIRDS, MAMMALS, REPTILES AND PLANTS. N = NUMBER OF EXPERT STATEMENTS.

Except for birds where invasive alien species is considered to be the most significant threat, loss of forest ranks highly for amphibians, mammals, reptiles and plants.

TABLE 22: THE SUM OF CONTRIBUTION OF THREAT (IUCN-CMP) FOR EACH TAXA, BASED ON EXPERT RESPONSES (TABLE 20), AGGREGATION OF "LOSS OF FOREST THREATS" AND THE LITERATURE

		EXPERT DATA				AGGREGATED "LOSS OF FOREST" ON EXPERT DATA					LITERATURE (TERRESTRIAL, FRESHWATER SPECIES)
Threat classification level (IUCN-CMP)		**ABM**	**Reptiles**	**Plants**		**Amphibians**	**Birds**	**Mammals**	**Reptiles**	**Plants**	
Aggregated "Loss of forest" threats	2.1 Annual & perennial non-timber crops										Forest conversion to root crop production and pasture River bank erosion (sedimentation due to agricultural activities) Pesticide/fertilizer runoff in agricultural zones Drainage and clearing for agriculture
	2.2 Wood & pulp plantations										
	2.3 Livestock farming & ranching										
	3.2 Mining & quarrying										Mining Gravel extraction
	3.3 Renewable energy										
	4.1 Roads & railways										
	4.2 Utility & service lines										
	5.3 Logging & wood harvesting										Conventional logging Extraction of forest resources River bank erosion (sedimentation due to agricultural activities)
	7.1 Fire & fire suppression										Forest fires Diversion of flows for water supply or hydropower generation
	7.2 Dams & water management/use										
Level 1.	**Level 2**										
1. Residential and commercial development	1.1 Housing and urban areas										
	1.2 Commercial and industrial areas										
	1.3 Tourism and recreation areas										
2. Agriculture & Aquaculture	2.4 Marine & freshwater aquaculture										

3. Energy production & mining	3.1 Oil & gas drilling										
4. Transportation & service corridors	4.3 Shipping lanes										
	4.4 Flight paths										
5. Biological resource use	5.1 Hunting & trapping terrestrial animals										Conventional logging Extraction of forest resources River bank erosion (sedimentation due to agricultural activities)
	5.2 Gathering terrestrial plants										
	5.3 Logging & wood harvesting										
	5.4 Fishing & harvesting aquatic resources										
6. Human intrusions & disturbances	6.1 Recreational activities										
	6.2 War, civil unrest & military exercises										
	6.3 Work & other activities										
7. Natural system modifications	7.1 Fire & fire suppression										Forest fires Diversion of flows for water supply or hydropower generation
	7.2 Dams & water management/use										
	7.3 Other ecosystem modifications										
8. Invasive species and other problems, genes and diseases	8.1 Invasive non-native species/diseases										Invasive species
	8.2 Problematic native species/diseases										
	8.3 Introduced genetic material										
	8.4 Species/diseases of unknown origin										
	8.5 Viral/prion-induced diseases										

	8.6 Diseases of unknown cause										
9. Pollution	9.1 Domestic & urban waste water										Pesticide/fertilizer runoff in agricultural zones
	9.2 Industrial & military effluents										
	9.3 Agricultural & forestry effluents										
	9.4 Garbage & solid waste										
	9.5 Air-borne pollutants										
	9.6 Excess energy										
10. Geological events	10.1 Volcanoes										
	10.2 Earthquakes/tsunamis										
	10.3 Avalanches / landslides										
11. Climate change and extreme weather conditions	11.1 Habitat shifting & alteration										
	11.2 Droughts										
	11.3 Temperature extremes										
	11.4 Storms & flooding										
	11.5 Other impacts										
12. Other options	12.1 Other threats										Dereservation of protected areas Poorly planned infrasctructure development

5. Discussion and Recommendations

This exercise was undertaken to (1) assess the state of biodiversity in Fiji, (2) identify, classify and rank the threats from anthropogenic activities to Fiji's biodiversity and (3) identify the economic sectors associated with the primary threats to Fiji's biodiversity for engagement with the BIODEV2030 PROJECT in Fiji.

Using a combination of 1) a review of the literature and relevant policy documents, 2) analysis through the STAR metric and other IUCN data (national modified approach) and 3) expert elicitation, we present the state of biodiversity in Fiji under the ecosystem and species approach (Section 3) and our findings on the primary threats to biodiversity in Fiji (Section 4).

The results of the three methodological approaches used demonstrate that there are three highly ranked threats across the terrestrial taxonomic groups: 2.1 Annual & perennial non-timber crops, 5.3 Logging & wood harvesting, and 8.1 Invasive non-native species/diseases.

Our findings suggest that these primary threats form components of the same overarching threat – namely the loss, reduction of quality, and fragmentation of the native forest habitats in which the majority of Fiji's endemic biodiversity is restricted. Addressing the loss/fragmentation of native forests would be the most effective means to fulfil the objective of this project: to reverse, or slow down the IUCN Red List Index for Fiji.

Fiji is an island nation with extensive marine ecosystems and associated species richness. While many of these species are widespread throughout the Pacific region, resulting in relatively low endemism and, consequently, relatively minor contributions to the IUCN Red List Index for Fiji, they form a significant component of Fiji's national biodiversity. As a result, it is important that these species are included in national assessments of the major threats facing Fiji's biodiversity. Our results demonstrate that the key threats to Fiji's marine ecosystems and biodiversity are associated with 9.3 Agricultural & forestry effluents, which in turn is a consequence of forest loss/fragmentation, as well as 5.4 Fishing & harvesting aquatic resources.

These results were communicated to stakeholders on 17th August 2021 (Appendix 4), where there was no objection to the results and the recommendations. These have been reflected in the sections below.

5.1. Major Threat 1 – Loss of forest and fragmentation

5.1.1 Forest and Timber Harvesting

We consider that commercial "Logging and wood-harvesting" (IUCN-CMP Threat Level 2) of native forest is essentially an historic threat to Fiji. It is possibly a future threat, but logging is not currently a significant threat as, currently, logging is targeted at plantation forests which are of minor importance for native terrestrial biodiversity. Fiji has successfully established significant hardwood and softwood plantation sectors. Historically, Fiji Hardwood Corporation's 14 plantations were established through conversion of native forest. By contrast, Caribbean Pine Pinus caribaea was found to grow very well on areas of anthropogenic open reed-grasslands (Talasiga) and although exotic, were nonetheless both productive and ecologically beneficial in halting a degrading pedological trend. The SOE (2020) reports that since 2011, the majority of log production has come from Pine plantations with limited impact on native forests.

The IUCN-CMP Level 2 threat category of "Logging and wood-harvesting" does not sufficiently cover "loss of forest" and habitat fragmentation to reflect loss of forest through various other means including small holder farms, livestock farming, construction of roads, transmission lines and telecommunication sites in areas of high biodiversity which are significant current threats. To consider "Loss of forest" as a contributor to biodiversity loss, we aggregated the IUCN-CMP Level 2 threats (Table 3) for the expert data. Forest loss (through various means) is ranked highly for amphibians, birds, mammals, reptiles and plants (Figure 17, Table 22).

5.1.2 Agricultural expansion for cash crops

Fiji's SOE (2020), and the other literature reviewed, identifies but does not rank forest conversion to root crop production and pasture (agriculture) as a threat to Fiji's terrestrial biodiversity. By contrast, both the STAR metric and expert data (Table 17) highly rank the threat of 2.1 Annual & perennial non-timber crops (agriculture) to terrestrial biodiversity.

Fiji's agriculture sector has undergone extensive research that has resulted in policies and initiatives to support it. A review of agriculture policy papers in the Fiji 2020 Agriculture Sector Policy Agenda states: "*It is not the policy that is lacking, but the implementation of the policy. The government's law did not adjust to policy changes and there are existing acts in agriculture development that are no longer relevant. In a country characterized by a mix farming system, a combination of trade liberalization, import substitution, government*

intervention and private sector intervention would work as long there is a community-based national program that is sustainable" (Ministry of Agriculture 2014).

The mission statement of the Ministry of Agriculture's 5-year Strategic Development Plan [SDP] (2019 – 2023) is to create an enabling environment that accelerates sustainability, economic opportunities, climatic viability, food and nutrition security for all Fijians. Aligned to Fiji's 5-year and 20-year National Development Plan (2017 - 2036) and the Sustainable Development Goals, the Agriculture SDP has five (5) key strategic priorities:

1. Improve food and nutrition security for all Fijians;
2. Increase farmer household income for sustainable livelihoods;
3. Increase adoption of sustainable resource management and climate smart agriculture;
4. Establish and improve commercial agriculture; and
5. Improve quality public sector performance and service delivery.

PROSPECT 1

In 2017, the Environment and Climate Adaptation Levy (ECAL), a tax on prescribed services, items and income was introduced under the Environmental Levy (Budget Amendment) Act 2017. The purpose of ECAL is to help fund critical work to protect Fiji's natural environment, reduce carbon footprint, and adapt the economy, communities and infrastructure to the worsening impacts of climate change. In 2019, the Fiji Revenue and Customs Service reported on the expenditure of ECAL where 1% of FJD $105.5 million was spent on Environmental conservation projects and 3.4% on sustainable resource management projects (Figure 27).

Infrastructure development, water management, agricultural development, and rural development projects accounted for 65.1%, 18.9%, 3.2% and 0.9% respectively.

	Project	ECAL Funds Used		Project	ECAL Funds Used
1	National Disaster Database	$ 157,311	29	Supply and Installation of 5000 Solar Home Systems	$ 1,908,595
2	Disaster Relief and Rehabilitation Fund	$ 1,000,000	30	Supply of Solar Home System Replacement Component Ongoing	$ 85,608
3	Disaster Risk and Climate Change Adaptation	$ 991,537	31	Maintenance of Irrigation Schemes	$ 616,556
4	Upgrade of Outer Island Stations	$ 111,898	32	Drainage and Flood Protection	$ 1,851,630
5	Upgrade of Nadi Radar Antenna	$ 339,140	33	Watershed Management	$ 879,196
6	Installation of Water Level Rainfall Telemetry Instruments	$ 184,458	34	Coastal Erosion Protection Works	$ 161,233
7	Community Access Roads, Footpaths and Footbridges	$ 959,390	35	Maintenance of Drainage - Non - Municipal Councils	$ 1,252,521
8	Upgrade of Informal Settlements	$ 186,241	36	Drainage for Rural Residential Areas	$ 439,272
9	Upgrade of Town Wide Informal Settlements	$ 1,118,189	37	Drainage Farmlands	$ 1,137,193
10	Food Security Program	$ 662,077	38	Improvement and Upgrade of Wastewater Distribution System	$ 3,628,354
11	Agricultural Research and Development	$ 1,016,355	39	Rural Water Supply Programme	$ 6,701,885
12	FDB Subsidy: Interest on Agricultural Loans to Fijian	$ 1,952,065	40	Rainwater Harvesting Systems – Government to Reimburse 70% for Residential Households	$ 3,323,633
13	Coastal Fisheries Development	$ 568,548	41	Subsidy Naboro Landfill	$ 559,168
14	Aqua Culture Development	$ 246,995	42	Environment Programme - Northern and Western Division	$ 51,798
15	Food Security Program - Aquaculture	$ 83,459	43	Compliance and Enforcement of EIA	$ 3,645
16	Reducing Emissions from Deforestation and Forest Degradation(REDD+)	$ 377,480	44	Environment Management Act	$ 6,726
17	Research and Development of Wood and Non Wood Species	$ 102,089	45	Litter Awareness	$ 50,039
18	Reforestation of Degraded Forest	$ 630,068	46	Phase Out of Methyl Bromide	$ 27,530
19	Reforestation of Indigenous Species	$ 236,600	47	National Waste Management Strategy	$ 189,362
20	Ground Water Assessment and Development-Small Islands (32)	$ 191,868	48	Hydrochloroflorocarbon Phase Out Management Plan	$ 29,801
21	Ground Water Assessment and Development-Large Islands (29)	$ 1,099,574	49	Implementation of National Biodiversity Strategies Action Plans and Cartagena Protocol	$ 29,071
22	Environmental Monitoring of Mines and Quarrys	$ 71,438	50	3R Awareness Programme	$ 25,123
23	Renewable Energy Development Projects	$ 153,875	51	Construction of Naboro Landfill - Stage 2	$ 74,409
24	Energy Conservation Implementation	$ 54,816	52	Upgrading and Replacement of Bridges - Bridge Renewals	$ 20,034,042
25	Energy Conservation Assessment	$ 43,686	53	Jetties and Crossing Maintenance and Renewals	$ 1,589,530
26	Upgrade of Gau and Cicia Biofuel Mills	$ 322,316	54	Upgrading of Rural Roads (Access)	$ 19,792,207
27	Supply and Installation of 2635 Solar Home Systems Ongoing	$ 473,323	55	New Capital Resilience Programme	$ 799,365
28	Supply & Upgrade of 700 Type I Solar Home Systems	$ 467,453	56	Rehabilitation and Construction of Schools and Public Buildings	$ 26,450,531
				TOTAL	FJ $105.5 million

Keys									
Disaster Relief and Response	Meteorology Services	Rural Development	Urban Development	Agricultural Development	Sustainable Resource Management	Energy Conservation	Water Management	Environmental Conservation	Infrastructure Development

FIGURE 27: PROJECTS FUNDED BY ENVIRONMENT AND CLIMATE ADAPTATION LEVY (ECAL) AS AT 30 APRIL 2019. SOURCE: MINISTRY OF ECONOMY 2019

RECOMMENDATION

We suggest a review of the spend of ECAL to more effectively deliver benefits to communities who manage priority areas for biodiversity on land in Fiji.

PROSPECT 2

The Fiji Agriculture Census Report (2020) reports that "temporary crops" dominate Fiji's agricultural landscape (76.7% of 194,768.6HA) and 54.1% of land that is farmed is of traditional land ownership (Ministry of Agriculture 2020) – this is land that is registered in the Native Land Trust Act [Cap 134] as "native reserve", typically for communal use by the landowning unit. Monitoring and evaluation is challenging for mataqali land under native reserve as it is not bound by legal lease arrangements and subsequently not subject to environment impact assessments. This contrasts with native land that is under lease arrangements through either the Itaukei Lands Trust Board or government, as required by the Fiji Environment Management Act 2005.

RECOMMENDATION

Establishing more effective monitoring of ‘native reserve’ land in order to minimise the damage to, and promote the conservation of native forest habitats.

PROSPECT 3

The impact of small holder farms, indiscriminate expansion of yaqona (kava) farms (see Box 6), access roads, hydropower and utilities into native forest is little understood and not sufficiently monitored or documented. It is, however, acknowledged as a significant threat to Fiji’s terrestrial biodiversity and habitats through habitat fragmentation.

The over-riding issue is that the native forest is not valued – and so is sacrificed for other more immediately ‘valued’ services. That lack of value runs from local communities right through to the higher echelons of government. Decisions are made that assume that forest loss is the most economical, least impacting and the most economic form of land use change. We need to address how we value native forest and how to minimise the damage to native forest while, at the same time, not disadvantage the owners of that native forest so that they are willing to support conservation of their forests.

Fiji has committed to designating 16% of land mass as terrestrial protected areas (Government of Fiji 2020). As the world agrees to a 30% Protected Area (including Other Effective Area-Based Conservation Measures OECM) target by 2030, Fiji needs to radically update its approach to contributing to this target. Currently protected terrestrial areas in Fiji account for only 3% of Fiji’s total land mass(source?), , but even this small area is far from ‘risk free’ protected. This situation remains despite significant investments through the Global Environment Facility through the Program of Protected Areas (POWPA), Global Environment Facility – Protected Area Systems (GEF-PAS), Ridge to Reef (R2R) from 2005 to 2020.

BOX 6: THE ISSUE OF YAQONA (KAVA)

Yaqona (*Piper methysticum*) is a crop that was traditionally grown for subsistence use. Reflecting the recent increased demand for yaqona in local and overseas markets, the sector has rapidly transitioned to a more commercial industry with significant government support. Between 2015-2018, yaqona was exported to 41 countries and Fiji earned over FJ$30 million in yaqona export earnings in 2019 alone. The Government is now aiming to provide assistance to about 10,000 yaqona farmers by the end of 2022 in recognition of the significant foreign exchange earnings it brings in for the economy.

As a result of this increased commercial production, yaqona cultivation is currently seen as a significant threat to remaining native forests in Fiji. The area covered by yaqona cultivation increased at a rate of 15% per year from 2014 to 2018 (SOE, 2020) in response to the Government's Yaqona Farming Program.

Currently, we do not know the extent that yaqona cultivation has penetrated forested areas – there are no formal statistics nor maps of the extent of yaqona cultivation in the country. In addition to the extent of the sectors, there are several other key elements that remain unknown.

How much damage does yaqona cultivation do, and is it reversible?

To what extent is yaqona cultivation dependent on other factors? There is a clear spread of yaqona cultivation along tracks built for other purposes – as such access for agricultural development but also other projects is the driver, as fuelled by significant price rises, in part from export markets. Yaqona grows best fully exposed to sunlight and as such forest destruction is complete at the site.

What contribution does the yaqona cultivated in native forested areas make to the overall industry? No data are available for this.

Can the negative connotations of native habitat destruction be used to limit these activities?

Yaqona cultivation can be a lucrative, legitimate and easily undertaken land use opportunity for rural landowners whose cash-generating opportunities are otherwise limited. Landowners will rightly consider conservation as just another land use, and as such government needs to facilitate a framework which makes conservation an acceptable alternative.

The existing protected area policy, legislation and enforcement is insufficiently robust to protect against loss of forest. For this we need an effective protected area network alongside the increased valuation of native forest habitats. A network which provides risk-free protection of Fiji's natural heritage for:

- the benefit of future generations of Fijians;
- for its unique genetic resources of value to the international community; and,
- the well-being and satisfaction of the native landowners

RECOMMENDATION:

One of two areas where we need to focus the development efforts is through a recommitment to effectively fund a Protected Area network in accordance with the NBSAP commitments that the government has made to the CBD. We need to:

i. Provide increased protection for a minimum of the 16% of terrestrial land, primarily native forest to enable Fiji to ensure the "risk-free" protection of national and global biodiversity thereby maximising the benefits to the species that impact on the IUCN Red List index. The suite of KBAs goes some way to further address this, together with justification, but now needs updating.

ii. Address how to effectively deliver forest conservation as a 'land use' that landowners' value more than other potential uses and developments.

Address how to deliver benefits to the landowners such that they are fully supportive of measures needed for the effective conservation of the land whether it is full protection, threatened species management or the reduction/ elimination of invasive species

PROSPECT 4

Through the national program on REDD+ and the 30 million trees by 2030 campaign, the Ministry of Forestry is working with stakeholders to reforest Fiji with native trees, fruit trees and exotic timber species (where applicable). Against these investments, we have recorded continued forest loss in and around Fiji's high conservation value forests.

RECOMMENDATION:

The second area where we need to focus the development efforts is to greatly improve our understanding of the principle threats to Fiji's native biodiversity from the range of issues currently identified. Much of the discussion, including the threat information on Fiji's species in the IUCN Red List threats category, is based more on speculation than quantitative evidence. There is a real need to better understand the requirements of species under threat. Immediate, high priority, concerns that need addressing are -

1. What are the current drivers of forest loss/fragmentation? The IUCN threats attempt to identify this – but each in isolation, no one threat taken individually is causing significant damage – it is the accumulation of these multiple threats that is of concern. This is a development imperative, but advances in conservation are not commensurate with the threats.

2. At what scale does forest fragmentation impact on various species? This will differ between taxa but is vitally important if we are to establish effective areas for the protection of biodiversity.
3. Are the threats from invasive species compounded by the fragmentation and 'opening up' of native forest habitats?

PROSPECT 5

The IUCN Red List of threatened species and a country's Red List Index are used in sustainability frameworks across different business sectors (IUCN 2016). In 2011, the UNEP-WCMC found that the Red List Categories were used in over half of the 37 standards and certification schemes in eight sectors assessed (Juff-Bignoli 2014). Some of these sectors include agriculture (12 standards), biotrade (2 standards), carbon (3 standards), finance (5 standards), fisheries and aquaculture (5 standards e.g. the Aquaculture Stewardship Council) forestry (4 standards e.g. the Forest Stewardship Council), mining (2 standards, e.g. the Responsible Jewellery Council), lending (e.g. the Asian Development Bank Safeguard) and tourism (3 standards) (UNEP-WCMC 2011, Juff-Bignoli 2014).

RECOMMENDATION

There is a need to develop a threatened species management capacity commensurate with the need. Currently NGOs lead in funding and implementation of a small number of initiatives, but there is a need for government, NGOs and academic institutions to identify and address the gaps in our current knowledge to enable the country to most effectively managed its threatened species. This in turn will enable us to update Fiji specific data on the IUCN Red List through investment in research with academic institutions, knowledge and capacity building, and so more effectively address the standards that sectors use in their certification schemes

PROSPECT 6

The Red List Index is an effective metric for measuring how a country conserves its biodiversity. We have shown that, within SIDs, this metric is weighted strongly toward the endemic, terrestrial fauna and flora – and is not an effective measure of the nation's marine issues, many of the species of which are wide-ranging.

RECOMMENDATION:

Alternative ways of addressing this have been suggested, and might include -.

i. A regional Red List Index, addressed by nations in partnership, may be a more effective way of presenting changes in the marine biodiversity.
ii. A red list for ecosystems, focused on marine ecosystems, may be a more effective way of targeting unique marine environments at the national level.

iii. An index that combines the globally threatened species with a sustainable resource use component may provide a more pragmatic approach.

Oceanic states, such as Fiji, will need to understand how best to develop a metric to address this component considering the importance and diversity of Fiji's marine biodiversity.

5.2. Major Threat 2 – Invasive species (from a range of activities)

The threat of invasive species in a SIDS environment is immense. The first priority is to stop the invasive species from arriving. If the species has arrived, then an attempt to eradicate them should be undertaken as soon as possible – the longer this is left the more expensive the operation becomes. When invasive species have become established then there is evidence that habitat fragmentation/disturbance increases the impact that those species can have.

Habitat fragmentation (through access roads, agricultural expansion), improved transport technologies and better access to some remote forests and islands of Fiji (as described above) have contributed to the vulnerability of native fauna and flora to invasive alien species. Island restoration and invasive species monitoring and management in Fiji have shown that endangered species and ecosystems recover after the removal of introduced predators such as rats, feral cats, and goats (see Box 7) but require substantial logistical and financial support. In the last decade, two new species (the ivory cane palm *Pinanga coronata* and the green iguana *Iguana iguana*) have been recognised as serious invasive. The response, to date, has been ineffective in controlling their spread, let alone addressing eradication needs (Lenz *et al*., in press).

BOX 7: RESTORATION OF MONURIKI ISLAND TO SAFEGUARD UNIQUE SPECIES

Monuriki Island is 40 ha island off the west coast of Viti Levu. Its traditional landowners are the Mataqali Navunaivi, Yanuya Village. It is the 12th island with successful restoration (eradication of introduced mammals and predators) in Fiji. Below is a summary timeline of the activities, efforts and stakeholders associated with this achievement.

2009 - Feasibility assessment showed that rats and goats posed severe threats to the breeding of seabirds, including wedge-tailed shearwaters, and the Critically endangered Fijian Crested Iguana (*Brachylophus vitiensis*)
2010 - First batch of wild iguanas captured for captive breeding at Kula Eco Park (with permission from island custodians)
2011 - Eradication of feral goats and rats
2012 - Final batch of crested iguanas captured for captive breeding.
2015 - 32 offspring of captured wild iguanas (1-3 yr old) released into the wild on restored Monuriki Island.
2017 - 48 offspring of captured wild iguanas released into the wild on Monuriki.
2018 - Monitoring of shearwaters and iguana populations and invasive species; assessment of captive bred iguanas in the wild. Wild iguanas (non-captive breeding) encountered indicating successful in-situ breeding after predator and goat eradication.
2019 - Release of more captive-bred iguanas into the wild on Monuriki.

This project would not have been successful without the collaboration of the following organisations and individuals: National Trust of Fiji, BirdLife International, NatureFiji-MareqetiViti, Nadroga/Navosa Provincial Council, Kula EcoPark, Fiji Department of Environment, Fiji Police Force, Biosecurity Authority of Fiji, Mamanuca Environment Society, Pacific Invasives Initiative, San Diego Zoo, Ross Wharfe, Luke Robertson, New Zealand Department of Conservation, skilled hunters, David & Lucile Packard Foundation, UK Darwin Initiative, Critical Ecosystem Partnership Fund, Aage V. Jensen Foundation, European Community and the landowners of Monuriki and Kadomo Mataqali Vuna-i-vi and Mataqali Namatua, Taukei Yanuya, and the village of Yanuya (Koro ko Yanuya).

RECOMMENDATIONS

1. A more robust response to eradicate newly identified/ naturalised invasive species needs to be established.
2. In addition, inter-island biosecurity, consistent post-eradication biosecurity protocols and monitoring to keep biodiversity-rich sites free of invasive species is critical.
3. Many of the threats from invasive species are due to the loss of habitat and activities mentioned in 5.1.

5.3. Major Threat 3 – Biological resource use (mainly threat to marine)

Biological resource use was ranked highly as a threat for both the terrestrial (Table 17: "5.3 Logging and wood harvesting) and the marine species and ecosystems (Table 19). Much of this related to near-shore subsistence or local commercial fisheries (caught to sell at local markets) rather than large-scale commercial offshore fisheries. Within the last 12 months, Fiji's marine resources and achievements for sustainable resource use have been challenged by the impacts of the COVID-19 pandemic. For example, a public campaign, the 4FJ campaign, to establish a seasonal ban on the harvest of groupers, was initiated in 2014. This campaign resulted in government issuing a legal ban for a 4-month period every year (Box 8). However, as the COVID pandemic impacted on Fiji communities in 2020, the government ban was reduced from 4 to 2 months (Fiji Sun 2020).

On the 10th of October 2020, Fiji government through the Minister of Forestry, Mr Osea Naiqamu launched "Plant One Million Coral Initiative" with the theme "Build, Restore Fiji's Natural Assets for A Resilient Future" programme. The Ministry has identified areas around the country whose coral reefs need immediate restoration and will be working closely with its coastal communities and stakeholders as corals play a significant role in the marine ecosystems. This is also aligned to the government commitment at the Convention on Biological Diversity (CBD) and the Sustainable Development Goals (SDG).

BOX 8: 4FJ CAMPAIGN TO REVIVE FIJI'S RAPIDLY DECLINING GROUPER FISH STOCK

Launched in 2014, the 4FJ (For Fiji) campaign was established with support from the Fiji Ministry of Fisheries to reduce fishing pressure on rapidly declining grouper fisheries in Fiji. The campaign recruited "champions" (sports figures, community leaders, church leaders) to pledge to not eat groupers during the spawning season (June – September each year).

In 2018, after targeted campaigning to receive more than 15,000 public 4FJ pledges through media outreach, community visits and private sector engagements, the movement came to fruition as the Ministry of Fisheries legally banned the harvesting and sale of groupers during their peak breeding months (June through to September).

The 4FJ campaign has launched the 4FJ Fish Smart – the next chapter in this campaign to build citizen commitment to observing the seasonal ban of groupers.

Source: https://4fjmovement.org/inside-the-movement-launch

RECOMMENDATIONS

1. Monitor the effectiveness of the 4FJ awareness-raising campaign as an effective conservation measure and if appropriate expand to other taxa.
2. Continue to engage with local communities, fishermen and the Fiji Locally Managed Marine Areas (FLMMA) network to promote sustainable coastal fisheries.

5.4. Study Limitations and Knowledge Gaps

There are several limitations of this study that could lead to bias and/or confounding arguments affecting our findings.

5.4.1. The 'reductionist' approach inherent in the IUCN threats listing.

Outcomes can be linked to a range of different IUCN threats – forest fragmentation/loss can be linked to agricultural expansion, harvesting of timber, increase in pollution flow, increase in roads/development, even spread of invasive species. The key is to identify the outcome and determine a solution.

5.4.2. The incompleteness of the species list used for assessment.

a. We attempted to get around this by expanding the suite of taxonomic groups included in the analysis – but this required the use of a surrogate measure for AOH.

b. Even within the taxonomic groups we used there were gaps in coverage – Partulid snail data for Fiji has not, to date, been included in the list. The plant species included are only a fraction of all plant species in Fiji, in particular there is a bias away from the 'relatively unknown' cloud forest endemic plants.

d. The threat component within IUCN Red List is often not uppermost in expert's minds when they undertake the assessment. Every single coral, for instance, has exactly the same suite of threats with exactly the same impact scores. Is this realistic?

e. Taxonomy changes – the bird list includes four species that were not identified as separate species even 10 years ago. The taxonomy of corals as used in the IUCN Red List is considered to be out-of-date and may have 'over-lumped' species groups –revisions may identify that species have much more restricted ranges.

f. Some of the species in Fiji are listed as Data Deficient on the IUCN Red List, as a result they were not included in the analyses as they did not come under a threatened category. For example, there are 14 freshwater fish that are listed as DD. Given that these are mainly

endemic species with relatively restricted ranges, they would have contributed useful information to the assessment.

5.4.3. The lack of representation of the Marine biodiversity component needs to be addressed.

1. It is clear that the marine biodiversity component is unlikely to be prioritised, at the national level, IF the primary objective is reversal of the IUCN Red List Index for Fiji. There needs, therefore, to be a review/assessment of how marine biodiversity are incorporated into assessments of biodiversity at the national level within SIDS.
2. The primary marine biodiversity threat common to the range of taxa came down to biological resource use – and so there continues to be a need to focus on sustainable resource management (continuing the approach that has been followed for at least 3 decades in Fiji)). This indicates that progress is most likely to be achieved in partnership with the Ministry of Fisheries. There are many positive examples where these approaches are in place, FLMMA, 4FJ, MPAs, etc. We need to capture the success, or otherwise, of these various initiatives – from the biodiversity perspective – and modify the processes, as necessary.

5.4.4. Lack of accurate data on the geographic extent of threats

While agriculture has been highlighted as a significant threat to Fiji's native biodiversity, it is difficult to assess quantitatively the extent of this threat due to a paucity of robust data on the geographic extent and expansion of agriculture across the country including into/surrounding formal and informal protected areas. There are no accurate GIS maps/layers publicly available for the area of land under agriculture or the extent and location of the remaining native forest types.

5.5. Summary of Recommendations

Major Threat 1 – Loss of forest and fragmentation

1. Prospect 1: ECAL - we suggest a review of the spend of ECAL to deliver benefits more effectively to communities who manage priority areas for biodiversity on land in Fiji.
2. Prospect 2: Working with indigenous landowners - Establish more effective monitoring of 'native reserve' land in order to minimise the damage to and promote the conservation of native forest habitats.
3. Prospect 3: Protected Areas - The two areas that we need to focus the development efforts are:

a. A recommitment to effectively fund a Protected Area network in accordance with the NBSAP commitments that the government has made to the CBD. We need to:
    i. Provide increased protection for a minimum of the 16% of terrestrial land, primarily native forest to enable Fiji to ensure the "risk-free" protection of national and global biodiversity thereby maximising the benefits to the species that impact on the IUCN Red List index. The suite of KBAs goes some way to further address this, together with justification, but now needs updating.
    ii. Address how to effectively deliver forest conservation as a 'land use' that landowners value more than other potential uses and developments.
b. Address how to deliver benefits to the landowners such that they are fully supportive of measures needed for the effective conservation of the land whether it is full protection, threatened species management or the reduction/ elimination of invasive species

4. Prospect 4: Understanding the principle threats to Fiji's native biodiversity - Immediate, high priority, concerns that need addressing are –
    a. What are the current drivers of forest loss/fragmentation? The IUCN threats attempt to identify this – but each in isolation, no one threat taken individually is causing significant damage – it is the accumulation of these multiple threats that is of concern. This is a development imperative, but advances in conservation are not commensurate with the threats.
    b. At what scale does forest fragmentation impact on various species? This will differ between taxa but is vitally important if we are to establish effective areas for the protection of biodiversity.
    c. Are the threats from invasive species compounded by the fragmentation and 'opening up' of native forest habitats?
5. Prospect 5: National capacity to update the IUCN Red List of Threatened Species - There is a need to develop a threatened species management capacity commensurate with the need. Currently NGOs lead in funding and implementation of a small number of initiatives, but there is a need for government, NGOs and academic institutions to identify and address the gaps in our current knowledge to enable the country to most effectively managed its threatened species. This in turn will enable us to update Fiji specific data on the IUCN Red List through investment in research with academic institutions, knowledge and capacity

building, and so more effectively address the standards that sectors use in their certification schemes.

6. Prospect 6: The Red List Index - Alternative ways of addressing this have been suggested, and might include -.
    a. A regional Red List Index, addressed by nations in partnership, may be a more effective way of presenting changes in the marine biodiversity.
    b. A red list for ecosystems, focused on marine ecosystems, may be a more effective way of targeting unique marine environments at the national level.
    c. An index that combines the globally threatened species with a sustainable resource use component may provide a more pragmatic approach.

Oceanic states, such as Fiji, will need to understand how best to develop a metric to address this component considering the importance and diversity of Fiji's marine biodiversity.

Major Threat 2 – Invasive species (from a range of activities)

1. A more robust response to eradicate newly identified/ naturalised invasive species needs to be established.
2. In addition, inter-island biosecurity, consistent post-eradication biosecurity protocols and monitoring to keep biodiversity-rich sites free of invasive species is critical.
3. Many of the threats from invasive species are due to the loss of habitat and activities mentioned in 5.1.1.

Major Threat 3 – Biological resource use (mainly threat to marine)

1. Monitor the effectiveness of the 4FJ awareness-raising campaign as an effective conservation measure and if appropriate expand to other taxa.

2. Continue to engage with local communities, fishermen and the Fiji Locally Managed Marine Areas (FLMMA) network to promote sustainable coastal fisheries.

Study Limitations and Knowledge Gaps

The study had its limitations and there were knowledge gaps that were too huge to address within the study period. These have been described in detail in Section 5.4

6. Conclusion

For an oceanic country like Fiji, the protection of forest biodiversity is critical and will contribute to sustainable agricultural and fisheries development and so ensure food security for all, thus meeting Fiji's national economic and social priorities.

The current threats to biodiversity have been known for a long time, but individually are small and piece-meal. They are now getting to a stage where the cumulative impact of these threats is exacerbated by a protected area policy and legislation that is insufficiently robust to ensure the all-important insurance against loss of forest and that is an effective protected area network. A network which provides risk-free protection of Fiji's natural heritage for:

- the benefit of future generations of Fijians;
- for its unique genetic resources of value to the international community; and,
- the well-being and satisfaction of the native landowners.

How do we ensure that the native forest habitat is valued both for its ecosystem services and its biodiversity in a way that establishes forest conservation as a viable landuse option?

The cornerstone of the Fiji Forest Policy is a form of rural landuse planning, sometimes referred to as Permanent Forest Estates, which considers the multiple roles of the forest to ensure sustainable forest management and shared benefits across multiple stakeholders to maintain ecosystem services and reduce the risk of encroachment through other land use such as agriculture and forest-removing activities.

This report concludes that the sectors associated with the greatest direct impact or effect on Fiji's biodiversity are Agriculture and Fisheries. Addressing the primary threats caused by these sectors will have a significant impact on biodiversity in Fiji and is likely to modify the downward trajectory of Fiji's Red List Index. It is important to note that the threats are not limited to these two economic sectors; and that there are other sectors may provide alternative solutions to the threats that have been identified here.

6.1. Sector 1 - Agriculture

Land degradation through historical agricultural activities and more recent expansion of crops such as taro and yaqona onto marginal lands is worsening in Fiji, therefore increasing vulnerabilities to extreme weather events (Ministry of Forestry 2019) as well as reducing the resilience to introduced species.

The Fiji Agriculture Census 2020 (FAC2020) documents that of the 194,768.61 ha of land farmed in Fiji, 54.1% is farmed by members of indigenous landowners or mataqali. Only 23.7% are under a lease arrangement with indigenous landowners through the Itaukei Land Trust Board; 13.9% is freehold land and 6% is leased from the state. The data for the FAC2020 was collected before Fiji's had its first COVID-19 case in 2020. In July 2020 the Prime Minister of Fiji announced that 115,000 Fijians had lost their jobs or had had their hours cut as a result of COVID-19 (Bainimarama 2020). This first wave saw many laid-off workers, particularly indigenous Fijians, return to their traditional villages focussing on agriculture, particularly kava as an alternative livelihood.

The Ministry of Agriculture has launched several programs to address food security and revive the economy through agriculture in response to the economic impact of COVID-19 in Fiji (Ministry of Agriculture 2021), but it is not clear if these activities will focus on lands under the agricultural lease only, or if it will be extended to non-leased land (native reserve land) farmed and managed by indigenous landowners (some of whose farms are located within Fiji's biodiversity rich areas).

Fiji is now experiencing its second wave community-transmissions of COVID-19, with even more severe impacts on the economy. Loss of forest due to agricultural expansion in non-leased or "native-reserve" land is predicted to increase.

There needs to be a focus on education and community engagement of stakeholders in the Agriculture sector (Figure 27) – going beyond engaging only usual or traditional stakeholders, to include those in the non-formal agriculture sector in Fiji. Education and engagement should happen not only at ministerial level, but at all levels including the landowning communities, commercial producers, sector representatives (e.g. Sugar Cane Growers Council, Fiji Kava Council), the Itaukei Lands Trust Board and organisations that provide regional support (e.g. PHAMA Plus).

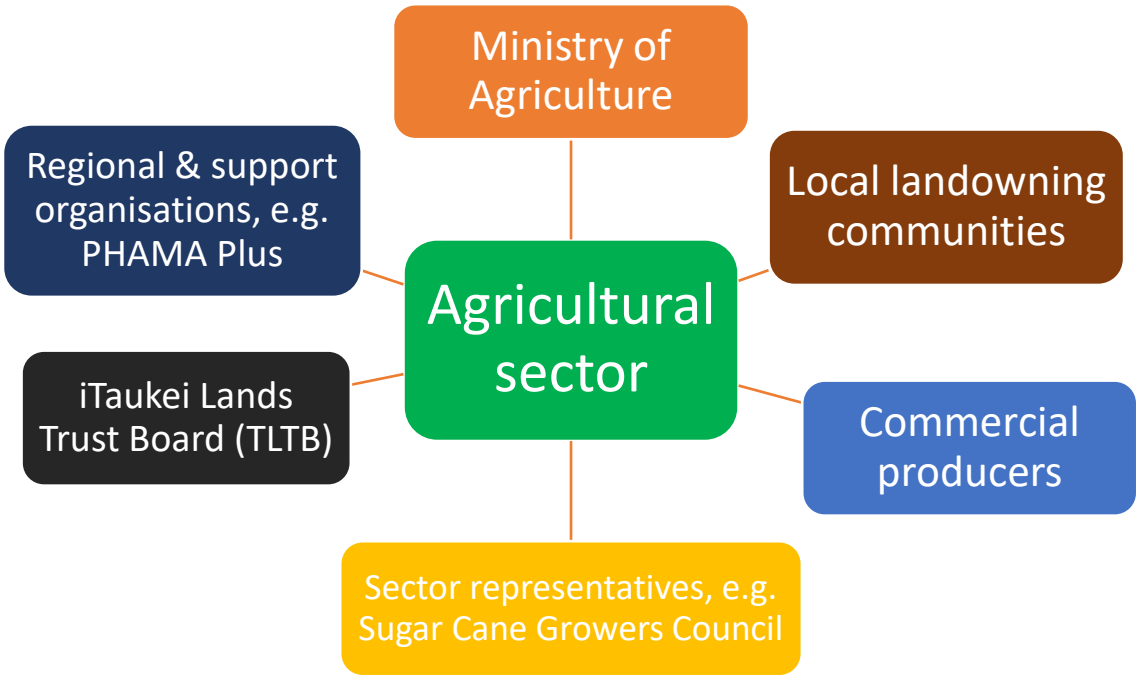


FIGURE 28: AGRICULTURAL SECTOR (PRELIMINARY) LIST OF STAKEHOLDERS

6.2. Sector 2 – Coastal fisheries

Fiji has committed to a 30% target for marine protected areas and 100% effectively managed locally managed marine areas (Government of Fiji 2020). In 2016 the Fiji National Marine Ecosystem Service Valuation (MESV) report valued Fiji's marine ecosystem services at FJD$2.5B, out of which $228.2M is the combined value of the role Fiji's coral reef and mangroves play in coastal protection, contribution to global carbon storage and the value of subsistence fishing per year to coastal communities.

Fiji's Ministry of Fisheries collaborates with non-governmental organisations, civil society organisations and academic institutions to address the management Fiji's coastal fisheries. Through consistent research, the fisheries sector has trialled and implemented various initiatives to diversify, add-value and reduce the pressure on Fiji's inshore fisheries (Government of Fiji 2020). Some initiatives include the One Million Planting programme which is aligned to the government international commitment to the Convention on Biological Diversity (CBD) and the Sustainable Development Goals (SDG).

Fed by scientific data, campaigns such as the 4FJ movement have raised considerable awareness to the general public on the plight of groupers in Fiji.

Despite the existence of sound policies, legislations, programs, campaigns and advocacy, Fiji's marine species continue to be at risk through coastal fisheries and coastal development.

Engaging the Coastal fisheries sector does not only involve the Ministry of Fisheries, but also the many stakeholders: Local iqoliqoli customary users, commercial fishers, sector representatives (e.g. Fiji fishing industry association), conservation NGOs and FLMMA (Figure 28).

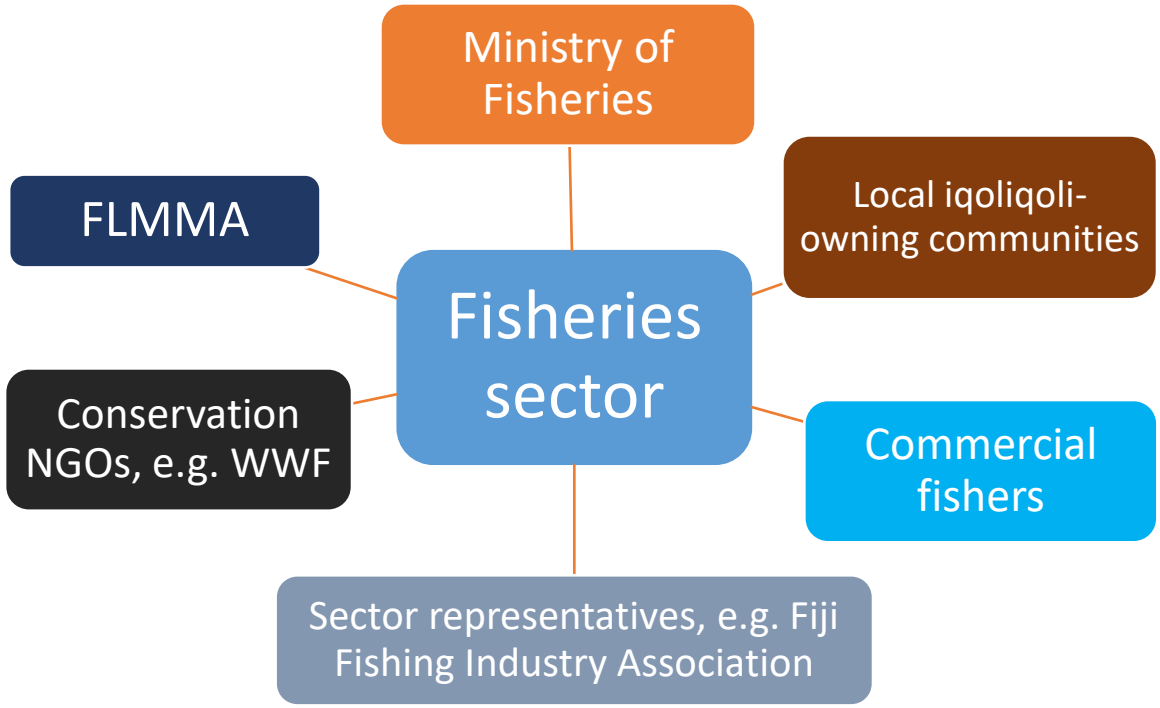


FIGURE 29: COASTAL FISHERIES SECTOR (PRELIMINARY) LIST OF STAKEHOLDERS

7. Bibliography

Bainimarama, V. (2020) Hon. PM Bainimarama's statement at the Global Leaders' Day at the ILO Global Summit on COVID-19 and the World of Work.(website link)

Cameron C, A Maharaj, B Kennedy, S Tuiwawa, N Goldwater, K Soapi, CE Lovelock 2021. Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. Environmental Challenges 2: 100018 https://doi.org/10.1016/j.envc.2020.100018

Chand, V., Prasad, S., & Prasad, R. (2011). Distribution and chemical fractionation of arsenic in surficial sediments of the Lami coastal environment in Fiji. *The South Pacific Journal of Natural and Applied Sciences, 28*(1), 78–81.

Clause, A. G., Thomas-Moko, N., Rasalato, S. and R. N. Fisher (2018) "All is not lost: Herpetofauna "extinctions" in the Fiji Islands" *Pacific Science* 72(3): 321-328

Copeland, L. K. F., Boseto, D. T., & Jenkins, A. P. (2016). Freshwater ichthyofauna of the Pacific-Asia biodiversity transect (PABITRA) gateway in Viti Levu, Fiji. *Pacific Conservation Biology*, *22*(3), 236–241.

Day, J. C., Laffoley, D. and Zischka, K. 2015.'Marine protected area management', in G. L. Worboys, M. Lockwood, A. Kothari, S. Feary and I. Pulsford (eds) Protected Area Governance and Management.

Dyer M.J., Keppel G., Tuiwawa M., Vido S. & H.J. Boehmer (2018): Invasive alien palm *Pinanga coronata* threatens native tree ferns in an oceanic island rainforest. – *Australian Journal of Botany* 66, pp. 647-656. (https://doi.org/10.1071/BT18088)

Dyer, M. J. B. (2017) Distribution of the invasive palm *Pinanga coronata* and its effects on native tree ferns in the Colo-i-Suva area, Viti Levu, Fiji. *The University of the South Pacific, Faculty of Science, Technology & Environment (FSTE) & The University of South Australia (UniSA*), pp. 14

Dyer, M. J. B.; Keppel, G.; Watling, D.; Tuiwawa, M.; Vido, S. & H. J. Boehmer 2019. Using expert knowledge and field surveys to guide management of an invasive alien palm in a Pacific Island lowland rainforest. In: C.R. Veitch, (ed.), *Island Invasives: Stepping Up To The Challenge. Proceedings of the 14th Ecology and Management of Alien Plant Invasions (EMAPI) World Congress 2017*. Gland, Switzerland: IUCN & Dundee, Scotland.

FBS (2017). Fiji Bureau of Statistics, National Census 2017. https://www.statsfiji.gov.fj/

Fiji Sun (2020). Seasonal ban on Kawakawa and Donu lifted. https://fijisun.com.fj/2020/08/09/seasonal-ban-on-kawakawa-and-donu-lifted/. Accessed on 23rd July 2021.

Fiji Sun (2021). Breeding season start for kawakawa and donu start. https://fijisun.com.fj/2021/06/01/breeding-season-for-kawakawa-and-donu-starts/ Accessed on 23rd July 2021.

Gangaiya, P., Tabudravu, J., South, R., & Sotheeswaran, S. (2001). Heavy metal contamination of the Lami coastal environment, Fiji. *South Pacific Journal of Natural Sciences*, *19*, 24–29.

Goundar, M. S., Morrison, R. J., & Togamana, C. (2014). Phosphorous requirements of some selected soil types in the Fiji sugarcane belt. *South Pacific Journal of Natural and Applied Sciences*, *32*, 1–10.

Government of Fiji (2010). Fiji's Fourth Report to the Fourth National Report to the United Nations Convention on Biological Diversity 2010.

Government of Fiji (2017). 5-Year & 20-Year National Development Plan – Transforming Fiji. Ministry of Economy, Republic of Fiji. https://www.fiji.gov.fj/getattachment/15b0ba03-825e-47f7-bf69-094ad33004dd/5-Year-20-Year-NATIONAL-DEVELOPMENT-PLAN.aspx

Government of Fiji (2020). *Fiji Sixth National Report to CBD*. Ministry of Environment, Suva, Fiji.

Government of Fiji (2020). *Fiji's State of Environment Report 2020*. Suva, Fiji.

Gray, A. J. (1993). Fiji. In D. A. Scott (Ed.), *A directory of wetlands in Oceania* (pp. 72–98). Slimbridge and Kuala Lumpur: The International Waterfowl and Wetlands Research Bureau and Asian Wetlands Bureau.

Haynes, A. (1988). A population study of the Fijian freshwater thiarid gastropod *Fiji Doma maculat*a (Mousson). *Archiv für Hydrobiologie*, *113*, 27–39.

Haynes, A., & Kenchington, W. (1991). *Acochlidium fijiensis* sp. nov. (Gastropoda: Opisthobranchia: Acochlidiacea) from Fiji. *The Veliger*, *34*(2), 166–171.

IHO, 2008. Standardization of Undersea Feature Names: Guidelines Proposal form Terminology

IUCN (2016) Guidelines for the Appropriate Use of the IUCN Red List for Business. Version 1.0 (October 2016).

Juffe-Bignoli, D. (2014) *Biodiversity for Business: A Guide to Using Knowledge Products Delivered through IUCN*. IUCN, Gland, Switzerland.

Keppel G., Peters, S., Taoi, J., Raituku, N., and Thomas-Moko, N. (2021) "The threat by the invasive African tulip tree, *Spathodea campanulata* P.Beauv., for the critically endangered Fijian tree, *Pterocymbium oceanicum* A.C.Sm.; revisiting an assessment based on expert knowledge after extensive field surveys" *Pacific Conservation Biology* https://doi.org/10.1071/PC20068

Lenz M-I, Galvin S, Keppel G, Gopaul S, Kowasch M, Dyer M, Watling D, Lodhar S, Hanson G, Erasmi S, Boehmer H, (2021). Where to invade next: inaction on biological invasions threatens sustainability in a small island developing state of the tropical South Pacific ? In: P.S. Low, (ed), Sustainable Development: Asia-Pacific Perspectives. Cambridge University Press, Cambridge. ISBN 0521897173, 9780521897174Mangubhai, S. (2016). *Impact of Tropical Cyclone Winston on coral reefs in the Vatu-i-Ra seascape*. *Report No. 01/16.* Suva: Wildlife Conservation Society.

Mangubhai S, Sykes H, Lovell E, Brodie G, Jupiter S, Lal R, Lee S, Loganimoce EM, Morris C, Nand Y, Qauqau I, Rashni B (2018). Fiji: Coastal and marine ecosystems. In C. Sheppard (ed.) World Seas: An Environmental Evaluation Volume II: The Indian Ocean to the Pacific. Elsevier.

Mimura, N., & Nunn, P. D. (1998). Trends in beach erosion and shoreline protection in rural Fiji. *Journal of Coastal Research*, *14*(1), 37–46.

Ministry of Agriculture (2014). Fiji 2020 Agriculture Sector Policy Agenda

Ministry of Agriculture (2021). Press releases. https://agriculture.gov.fj/pressrelease.php?page=2 Accessed on 23rd July 2021

Ministry of Agriculture (2020). 2020 Fiji Agriculture Census. Volume 1: General Table & Descriptive Analysis Report. Parliamentry Paper No. 59/2021. Government of Fiji.

https://www.fiji.gov.fj/getattachment/e71b8d61-ce72-48fc-bca2-eeeff2d8739b/Environment-Climate-Adaptation-Levy.aspx (Accessed on 31 July 2021)

Ministry of Economy (2018). ECAL in Action. How Your Environment and Climate Change Adaptation Levy is Building a Better, Stronger Fiji. Bulletin 01/2018.

Ministry of Forestry (2019). Emission Reductions Program Document (ER-PD). Forest Carbon Partnership Facility (FCPF) Carbon Fund, World Bank.

Ministry of Fisheries (2018a). Fish Guide on the 4-Month Ban on Fishing, Sale and Export of Kawakawa & Donu https://www.fisheries.gov.fj/images/Publications/KawakawaDonuFishGuideA4_MID.pdf. Accessed on 23rd July 2021.

Ministry of Fisheries (2018b). Public notice: 4-month ban (June thru September) on fishing, sale and export of all species of grouper (Kawakawa) and coral trout (Donu). https://www.fisheries.gov.fj/images/Publications/FishPosterA2_MID.pdf Accessed on 23rd July 2021.

MMC (2013). Mangrove Management Plan for Fiji 2013. – Mangrove Management Committee – prepared by MESCAL (DRAFT), Suva. http://macbio-pacific.info/wp-content/uploads/2017/08/Mangrove-Management-Plan-Draft-Final-_NN.pdf

Morrison, R. J., Harrison, N., & Gangaiya, P. (1996). Organochlorine contaminants in the estuarine and coastal marine environments of the Fiji Islands. *Environmental Pollution*, *93*(2), 159–167.

Morrison, C., Naikatini, A., Thomas, N., Rounds, I., Thaman, B. & Niukula, J. (2004). Rediscovery of an endangered frog *Platymantis vitianus*, on mainland Fiji: implications for conservation and management. *Pacific Conservation Biology* 10: 237-24

Mosley, L. M., & Aalbersberg, W. G. L. (2003). Nutrient levels in sea and river water along the 'coral coast' of Viti Levu, Fiji. *South Pacific Journal of Natural and Applied Sciences*, *21*, 35–40.

Mueller-Dombois, D., & Fosberg, F. R. (1998). *Vegetation of the tropical Pacific Islands*. New York: Springer.

Osborne, T., Naikatini, A., Morrison, C. & Thomas, N. (2013). The distribution of the Fiji frogs *Platymantis* spp.: new records and ramifications. *Pacific Conservation Biology* 19: 175-183.

Park, E.-K., Wilson, D., Choi, H.-J., Wilson, C. T., & Ueno, S. (2013). Hazardous metal pollution in the Republic of Fiji and the need to elicit human exposure. *Environmental Health and Toxicology*, *28*, 1–3.

Prasad, B. (2010). Natural resource inventory report of the Fiji Islands (2010). In *Volume 2: Marine resources inventory of the Fiji Islands*. Suva: University of the South Pacific.

Rashni, B. (2014). *Effect of catchment forest cover on macroinvertebrate community structure in streams of Fiji* (MSc thesis). Suva: The University of the South Pacific.

Salafsky, N., D. Salzer, AJ Stattersfield, C. Hilton-Taylor, R. Neugarten, SHM Butchart, B. Collen, N. Cox, LL Maste r, S. O'Connor, and D. Wilkie. (2008). A standard lexicon for biodiversity conservation: Unified classifications of threats and actions. Conservation Biology 22: 897–911.

Salafsky, N., D. Salzer, J. Ervin, T. Boucher, and W. Ostlie. (2003). Conventions for defining, naming, measuring, combining, and mapping threats in conservation: an initial proposal for a standard system. Conservation Measures Partnership, Washington, DC

Sloan, J. and Chand, K. (2016). An analysis of property rights in the Fijian qoliqoli. *Marine Policy*: 76–81.

Smith Robert, Gary Lee, Akuila Tawake, Epeli Waqavonovono, Ken Chambers, Tevita Bukarau, Christine Prasad, Donato Roqica, Isireli Nagata, Timaima Nainoca, Ville Peltovuori, Priya Devi, Josefa Caniogo, Mihaela Stojkoska, Lacina Pakoun, Caroline Ngonze and Daniel M. Franks (2018). Baseline Assessment of Development Minerals in Fiji. United Nations Development Programme, Kadavu House, Suva, Fiji

SOPAC. (2012). *Catalogue of rivers*. Noumea: Secretariat of the Pacific Community.

Sykes H, Le Grand J, Davey K, Kirmani SN, Mangubhai S, Yakub N, Wendt H, Gauna M, Fernandes L (2018) Biophysically special, unique marine areas of Fiji. MACBIO (GIZ, IUCN, SPREP), Wildlife Conservation Society and Fiji's Protected Area Committee (PAC); Suva.

UNEP-WMC (2011). *Review of the biodiversity requirements of standards and certification schemes: A snapshot of current practice*. Secretariat of the Convention on Biological Diversity, Montreal, Canada. Technical Series No 63, 30 pages.

Waycott, M., McKenzie, L. J., Mellors, J. E., Ellison, J. C., Sheaves, M. T., Collier, C., et al. (2011). Chapter 6: Vulnerability of mangroves, seagrasses and intertidal flats in the tropical Pacific to climate change. In Bell, J. D., Johnson, J. E., & Hobday, A. J. (Eds.), *Vulnerability of tropical pacific fisheries and aquaculture to climate change* (pp. 297–368, 925 pp.). Secretariat of the Pacific Community.

Zielske, S., & Haase, M. (2014). New insights into tateid gastropods and their radiation on Fiji based on anatomical and molecular methods (Caenogastropoda: Truncatelloidea *Zoological Journal of the Linnean Society*, *172*, 71–102.

APPENDIX 1: LIST OF SPECIES

APPENDIX 1.1 Amphibian/ Bird/ Mammal List

Scientific Name	Red List Category	$STAR_T$ score
Alopecoenas stairi	Vulnerable	177.3
Ardenna bulleri	Vulnerable	4.8
Chaerephon bregullae	Endangered	14.2
Charmosyna amabilis	Critically Endangered	400.0
Chrysoena viridis	Near Threatened	100.0
Clytorhynchus nigrogularis	Near Threatened	100.0
Cornufer vitianus*	Near Threatened	100.0
Cornufer vitiensis*	Near Threatened	100.0
Emballonura semicaudata*	Endangered	194.7
Erythrura kleinschmidti	Vulnerable	200.0
Lamprolia klinesmithi	Vulnerable	200.0
Lamprolia victoriae	Near Threatened	100.0
Limosa lapponica	Near Threatened	0.1
Mayrornis versicolor	Near Threatened	100.0
Megalurulus rufus	Endangered	300.0
Mirimiri acrodonta*	Critically Endangered	400.0
Myiagra azureocapilla	Near Threatened	100.0
Myzomela chermesina	Vulnerable	200.0
Notopteris macdonaldi*	Vulnerable	152.4
Numenius tahitiensis	Near Threatened	1.4
Prosopeia personata	Near Threatened	100.0
Prosopeia splendens	Vulnerable	200.0
Pseudobulweria macgillivrayi	Critically Endangered	400.0
Pseudobulweria rostrata	Near Threatened	3.2
Pterodroma brevipes	Vulnerable	57.8
Pterodroma cervicalis	Vulnerable	6.8
Pterodroma inexpectata	Near Threatened	0.1
Pterodroma leucoptera	Vulnerable	6.5
Pteropus samoensis*	Near Threatened	91.6
Rhipidura personata	Near Threatened	100.0
Rhipidura rufilateralis	Near Threatened	100.0
Tringa brevipes	Near Threatened	0.4

*Mammals; **Amphibians

APPENDIX 1.2 Reptiles

Scientific Name	Red List Category	$STAR_T$ score
Brachylophus bulabula	Endangered	300
Brachylophus fasciatus	Endangered	300
Brachylophus gau	Endangered	300
Brachylophus vitiensis	Critically Endangered	400
Emoia campbelli	Endangered	300
Emoia concolor	Near Threatened	100
Emoia mokosariniveikau	Endangered	300
Emoia parkeri	Vulnerable	200
Emoia trossula	Endangered	150
Leiolopisma alazon	Critically Endangered	400
Lepidodactylus gardineri	Vulnerable	200
Lepidodactylus manni	Vulnerable	200
Ogmodon vitianus	Endangered	300

APPENDIX 1.3 Molluscs

Scientific Name	Red List Category	$STAR_T$ score
Ba humbugi	Endangered	300
Delos gardineri	Critically Endangered	400
Diancta macrostoma	Vulnerable	200
Fijianella calciphila	Vulnerable	200
Fijianella cornucopia	Vulnerable	200
Fijianella laddi	Vulnerable	200
Fijiopoma diatreta	Vulnerable	200
Fijiopoma liberata	Endangered	300
Gonatorhaphe intercostata	Endangered	300
Gonatorhaphe lauensis	Critically Endangered	400
Gonatorhaphe stricta	Endangered	300
Lagivala minusculus	Vulnerable	200
Lagivala vivus	Vulnerable	200
Lauopa mbalavuana	Critically Endangered	400
Maafu thaumasius	Critically Endangered	400
Macropalaina pomatiaeformis	Endangered	300
Microcharopa mimula	Vulnerable	200
Moussonia fuscula	Near Threatened	100
Omphalotropis circumlineata	Near Threatened	100
Omphalotropis costulata	Vulnerable	200
Omphalotropis ingens	Critically Endangered	400
Omphalotropis longula	Vulnerable	200
Omphalotropis rosea	Vulnerable	200
Omphalotropis subsoluta	Endangered	300
Omphalotropis zelriolata	Near Threatened	33.33333333

Ouagapia perryi	Endangered	150
Ouagapia ratusukuni	Critically Endangered	400
Palaina godeffroyana	Vulnerable	200
Palaina martensi	Near Threatened	100
Palaina subregularis	Vulnerable	200
Palaina taviensis	Endangered	300
Placostylus elobatus	Vulnerable	200
Placostylus graeffei	Endangered	300
Placostylus guanensis	Endangered	300
Placostylus hoyti	Endangered	300
Placostylus kantavuensis	Endangered	300
Placostylus koroensis	Critically Endangered	400
Placostylus malleatus	Vulnerable	200
Placostylus mbengensis	Critically Endangered	400
Placostylus ochrostoma	Endangered	300
Placostylus seemanni	Endangered	300
Priceconcha tuvuthaensis	Critically Endangered	400
Sinployea adposita	Vulnerable	200
Sinployea angularis	Critically Endangered	400
Sinployea godeffroyana	Vulnerable	200
Sinployea inermis	Vulnerable	200
Sinployea lauenis	Vulnerable	200
Sinployea monstrosa	Vulnerable	200
Sinployea navutuenis	Critically Endangered	400
Sinployea princei	Endangered	300
Sinployea recursa	Vulnerable	200
Sinployea rotumana	Endangered	300
Succinea rotumana	Critically Endangered	400
Thaumatodon corrugata	Critically Endangered	400
Thaumatodon laddi	Vulnerable	200
Thaumatodon spirrhymatum	Critically Endangered	400
Thaumatodon subdaedalea	Endangered	300
Trochomorpha abrochroa	Vulnerable	200
Trochomorpha accurata	Vulnerable	200
Trochomorpha albostriata	Endangered	300
Trochomorpha corallina	Near Threatened	100
Trochomorpha fessonia	Near Threatened	100
Trochomorpha kambarae	Critically Endangered	400
Trochomorpha luedersi	Near Threatened	100
Trochomorpha moalensis	Critically Endangered	400
Trochomorpha planoconus	Critically Endangered	400
Trochomorpha tavinniensis	Endangered	300
Trochomorpha transarata	Endangered	300
Trochomorpha tuvuthae	Critically Endangered	400

Vatusila kondoi	Critically Endangered	400
Vatusila nayauana	Critically Endangered	400
Zyzzyxdonta alata	Vulnerable	200

APPENDIX 1.4. Terrestrial Plants.

Scientific Name	Red List Category	$STAR_T$ score
Acacia mathuataensis	Endangered	300
Acmopyle sahniana	Critically Endangered	400
Acsmithia vitiense	Endangered	300
Agathis macrophylla	Endangered	100
Astronidium storckii	Near Threatened	100
Balaka diffusa	Critically Endangered	400
Balaka macrocarpa	Endangered	300
Balaka microcarpa	Critically Endangered	400
Balaka streptostachys	Critically Endangered	400
Barringtonia seaturae	Vulnerable	200
Buchanania vitiensis	Vulnerable	200
Burckella richii	Endangered	150
Croton metallicus	Endangered	300
Cycas seemannii	Vulnerable	50
Cyphosperma naboutinense	Critically Endangered	400
Cyphosperma tanga	Critically Endangered	400
Cyphosperma trichospadix	Vulnerable	200
Cyrtandra denhamii	Critically Endangered	400
Cyrtandra kandavuensis	Vulnerable	200
Dacrydium nausoriense	Endangered	300
Dendrobium prasinum	Near Threatened	100
Dendrobium tokai	Near Threatened	100
Dioscorea nummularia	Near Threatened	14.28571429
Diospyros phlebodes	Vulnerable	200
Elaeocarpus ampliflorus	Vulnerable	200
Endospermum robbieanum	Vulnerable	200
Excoecaria acuminata	Vulnerable	200
Excoecaria acuminata	Vulnerable	200
Fagraea gracilipes	Near Threatened	100
Gardenia candida	Critically Endangered	400
Guettarda wayaensis	Critically Endangered	400
Heterospathe longipes	Endangered	300
Heterospathe phillipsii	Endangered	300
Hibiscus bennettii	Critically Endangered	400
Hibiscus bragliae	Critically Endangered	400
Hibiscus macverryi	Critically Endangered	400
Hibiscus storckii	Critically Endangered	400
Homalium laurifolium	Endangered	300
Hydriastele vitiensis	Vulnerable	200
Intsia bijuga	Near Threatened	3.846153846
Maesa pickeringii	Vulnerable	200
Manilkara vitiensis	Endangered	300

Melicope evansensis	Vulnerable	200
Melochia parhamii	Vulnerable	200
Meryta tenuifolia	Critically Endangered	400
Metrosideros ochrantha	Critically Endangered	400
Metroxylon vitiense	Endangered	300
Neoveitchia storckii	Endangered	300
Neuburgia alata	Endangered	300
Physokentia petiolata	Near Threatened	100
Physokentia thurstonii	Near Threatened	100
Podocarpus affinis	Near Threatened	100
Pritchardia thurstonii	Vulnerable	100
Psychotria volii	Critically Endangered	400
Pterocymbium oceanicum	Critically Endangered	400
Rhizophora samoensis	Near Threatened	6.666666667
Santalum yasi	Endangered	150
Schefflera euthytricha	Endangered	300

APPENDIX 1.5. Corals

Scientific Name	Red List Category	$STAR_T$ score
Acanthastrea bowerbanki	Vulnerable	8.695652174
Acanthastrea brevis	Vulnerable	5.405405405
Acanthastrea hemprichii	Vulnerable	5.405405405
Acanthastrea hillae	Near Threatened	2.173913043
Acanthastrea ishigakiensis	Vulnerable	4.347826087
Acanthastrea regularis	Vulnerable	14.28571429
Acanthastrea rotundoflora	Near Threatened	3.333333333
Acanthastrea subechinata	Near Threatened	4.761904762
Acropora abrolhosensis	Vulnerable	13.33333333
Acropora aculeus	Vulnerable	4.545454545
Acropora acuminata	Vulnerable	4.347826087
Acropora anthocercis	Vulnerable	4.87804878
Acropora aspera	Vulnerable	5.405405405
Acropora austera	Near Threatened	1.923076923
Acropora carduus	Near Threatened	4.166666667
Acropora caroliniana	Vulnerable	18.18181818
Acropora dendrum	Vulnerable	7.142857143
Acropora digitifera	Near Threatened	1.724137931
Acropora divaricata	Near Threatened	1.923076923
Acropora donei	Vulnerable	6.666666667
Acropora echinata	Vulnerable	6.451612903
Acropora florida	Near Threatened	2.380952381
Acropora formosa	Near Threatened	1.5625
Acropora glauca	Near Threatened	4.166666667
Acropora globiceps	Vulnerable	6.666666667
Acropora granulosa	Near Threatened	2
Acropora horrida	Vulnerable	3.225806452
Acropora humilis	Near Threatened	1.754385965
Acropora hyacinthus	Near Threatened	1.754385965
Acropora kirstyae	Vulnerable	10
Acropora listeri	Vulnerable	4.444444444
Acropora lokani	Vulnerable	15.38461538
Acropora loripes	Near Threatened	1.818181818
Acropora lovelli	Vulnerable	7.142857143
Acropora lutkeni	Near Threatened	2.43902439
Acropora microclados	Vulnerable	5.714285714
Acropora millepora	Near Threatened	2.5
Acropora monticulosa	Near Threatened	2.43902439
Acropora nana	Near Threatened	2.777777778
Acropora nasuta	Near Threatened	1.538461538
Acropora palmerae	Vulnerable	5.882352941
Acropora paniculata	Vulnerable	5.714285714

Acropora pharaonis	Vulnerable	5.714285714
Acropora polystoma	Vulnerable	4.87804878
Acropora retusa	Vulnerable	5.405405405
Acropora secale	Near Threatened	1.785714286
Acropora selago	Near Threatened	2.083333333
Acropora solitaryensis	Vulnerable	7.692307692
Acropora speciosa	Vulnerable	8
Acropora spicifera	Vulnerable	6.666666667
Acropora tenuis	Near Threatened	1.612903226
Acropora vaughani	Vulnerable	4.651162791
Acropora verweyi	Vulnerable	4.761904762
Alveopora allingi	Vulnerable	3.636363636
Alveopora catalai	Near Threatened	4
Alveopora fenestrata	Vulnerable	4.761904762
Alveopora marionensis	Vulnerable	10
Alveopora spongiosa	Near Threatened	1.694915254
Alveopora verrilliana	Vulnerable	4.87804878
Anacropora matthai	Vulnerable	15.38461538
Anacropora puertogalerae	Vulnerable	8
Astreopora cucullata	Vulnerable	5.555555556
Astreopora expansa	Near Threatened	2.222222222
Astreopora macrostoma	Near Threatened	4.545454545
Barabattoia laddi	Vulnerable	8.695652174
Blastomussa wellsi	Near Threatened	3.333333333
Catalaphyllia jardinei	Vulnerable	6.060606061
Caulastrea curvata	Vulnerable	11.11111111
Caulastrea tumida	Near Threatened	2.857142857
Ctenactis albitentaculata	Near Threatened	5
Cynarina lacrymalis	Near Threatened	2.127659574
Cyphastrea agassizi	Vulnerable	9.523809524
Cyphastrea ocellina	Vulnerable	10.52631579
Diploastrea heliopora	Near Threatened	1.886792453
Echinomorpha nishihirai	Near Threatened	7.142857143
Echinopora horrida	Near Threatened	5
Echinopora mammiformis	Near Threatened	2.631578947
Echinopora pacificus	Near Threatened	5
Euphyllia cristata	Vulnerable	6.666666667
Euphyllia divisa	Near Threatened	7.142857143
Euphyllia glabrescens	Near Threatened	1.818181818
Euphyllia yaeyamaensis	Near Threatened	4.761904762
Favia helianthoides	Near Threatened	2.173913043
Favia laxa	Near Threatened	2.631578947
Favia lizardensis	Near Threatened	2.325581395
Favia maritima	Near Threatened	2.173913043

Favia matthaii	Near Threatened	1.612903226
Favia rosaria	Vulnerable	22.22222222
Favia rotundata	Near Threatened	3.03030303
Favia stelligera	Near Threatened	1.666666667
Favia veroni	Near Threatened	2.777777778
Favites abdita	Near Threatened	1.5625
Favites bestae	Near Threatened	4.761904762
Favites chinensis	Near Threatened	1.851851852
Favites complanata	Near Threatened	1.612903226
Favites flexuosa	Near Threatened	1.666666667
Favites halicora	Near Threatened	2.040816327
Favites paraflexuosa	Near Threatened	3.225806452
Favites russelli	Near Threatened	1.818181818
Favites vasta	Near Threatened	3.225806452
Fungia fungites	Near Threatened	1.754385965
Galaxea astreata	Vulnerable	3.846153846
Galaxea fascicularis	Near Threatened	1.612903226
Goniastrea favulus	Near Threatened	2.777777778
Goniastrea minuta	Near Threatened	3.703703704
Goniastrea palauensis	Near Threatened	2.222222222
Goniastrea ramosa	Vulnerable	22.22222222
Goniopora columna	Near Threatened	1.851851852
Goniopora lobata	Near Threatened	1.851851852
Goniopora minor	Near Threatened	1.785714286
Goniopora stokesi	Near Threatened	2.173913043
Heliopora coerulea	Vulnerable	3.174603175
Hydnophora exesa	Near Threatened	1.587301587
Hydnophora microconos	Near Threatened	1.515151515
Isopora crateriformis	Vulnerable	9.090909091
Isopora cuneata	Vulnerable	4.87804878
Isopora palifera	Near Threatened	2.127659574
Leptastrea bewickensis	Near Threatened	4.761904762
Leptastrea bottae	Near Threatened	2.040816327
Leptastrea inaequalis	Near Threatened	2.325581395
Leptoria irregularis	Vulnerable	10.52631579
Leptoria phrygia	Near Threatened	1.538461538
Leptoseris incrustans	Vulnerable	3.921568627
Leptoseris yabei	Vulnerable	5.555555556
Lobophyllia diminuta	Vulnerable	8.695652174
Lobophyllia pachysepta	Near Threatened	4
Micromussa amakusensis	Near Threatened	3.225806452
Montastrea annuligera	Near Threatened	2.127659574
Montastrea magnistellata	Near Threatened	2
Montastrea multipunctata	Vulnerable	9.090909091

Montastrea salebrosa	Vulnerable	12.5
Montastrea valenciennesi	Near Threatened	2.564102564
Montipora altasepta	Vulnerable	10.52631579
Montipora angulata	Vulnerable	6.666666667
Montipora australiensis	Vulnerable	6.060606061
Montipora calcarea	Vulnerable	5.405405405
Montipora caliculata	Vulnerable	4.761904762
Montipora capitata	Near Threatened	3.846153846
Montipora capricornis	Vulnerable	9.090909091
Montipora cebuensis	Vulnerable	9.523809524
Montipora confusa	Near Threatened	8.333333333
Montipora corbettensis	Vulnerable	9.090909091
Montipora crassituberculata	Vulnerable	7.692307692
Montipora efflorescens	Near Threatened	1.587301587
Montipora effusa	Near Threatened	2.702702703
Montipora foliosa	Near Threatened	1.515151515
Montipora foveolata	Near Threatened	2.222222222
Montipora incrassata	Near Threatened	3.571428571
Montipora lobulata	Vulnerable	7.142857143
Montipora nodosa	Near Threatened	2.564102564
Montipora peltiformis	Near Threatened	2.325581395
Montipora samarensis	Vulnerable	10
Montipora undata	Near Threatened	2.702702703
Montipora venosa	Near Threatened	1.515151515
Oulophyllia bennettae	Near Threatened	2.702702703
Oulophyllia crispa	Near Threatened	1.818181818
Pachyseris gemmae	Near Threatened	10
Pachyseris rugosa	Vulnerable	4.444444444
Paraclavarina triangularis	Near Threatened	4.761904762
Pavona bipartita	Vulnerable	4.255319149
Pavona cactus	Vulnerable	3.076923077
Pavona decussata	Vulnerable	3.125
Pavona minuta	Near Threatened	3.448275862
Pavona venosa	Vulnerable	3.571428571
Pectinia alcicornis	Vulnerable	8
Pectinia elongata	Near Threatened	5.882352941
Pectinia lactuca	Vulnerable	5.405405405
Pectinia paeonia	Near Threatened	3.448275862
Physogyra lichtensteini	Vulnerable	3.703703704
Platygyra acuta	Near Threatened	3.03030303
Platygyra lamellina	Near Threatened	1.724137931
Platygyra ryukyuensis	Near Threatened	2.777777778
Plerogyra simplex	Near Threatened	3.448275862
Plerogyra sinuosa	Near Threatened	1.818181818

Pocillopora elegans	Vulnerable	5.882352941
Pocillopora eydouxi	Near Threatened	1.470588235
Podabacia motuporensis	Near Threatened	3.448275862
Polyphyllia novaehiberniae	Near Threatened	5.263157895
Porites annae	Near Threatened	3.448275862
Porites attenuata	Vulnerable	10
Porites cylindrica	Near Threatened	2.173913043
Porites deformis	Near Threatened	5
Porites horizontalata	Vulnerable	6.896551724
Porites lobata	Near Threatened	1.315789474
Porites murrayensis	Near Threatened	2.040816327
Porites nigrescens	Vulnerable	3.773584906
Porites stephensoni	Near Threatened	2.941176471
Psammocora contigua	Near Threatened	1.538461538
Psammocora digitata	Near Threatened	2.222222222
Psammocora vaughani	Near Threatened	5.882352941
Pseudosiderastrea tayami	Near Threatened	1.960784314
Scolymia vitiensis	Near Threatened	2.631578947
Seriatopora aculeata	Vulnerable	13.33333333
Seriatopora caliendrum	Near Threatened	1.923076923
Seriatopora stellata	Near Threatened	4
Stylophora pistillata	Near Threatened	1.587301587
Symphyllia hassi	Vulnerable	9.523809524
Tubipora musica	Near Threatened	1.587301587
Turbinaria heronensis	Vulnerable	33.33333333
Turbinaria mesenterina	Vulnerable	3.125
Turbinaria patula	Vulnerable	9.090909091
Turbinaria peltata	Vulnerable	3.703703704
Turbinaria radicalis	Near Threatened	6.666666667
Turbinaria reniformis	Vulnerable	3.125
Turbinaria stellulata	Vulnerable	4.081632653

APPENDIX 1.6. Marine Vertebrates

Scientific Name	**Red List Category**	**$STAR_T$ score**
Aetobatus narinari	Vulnerable	4.166666667
Aetobatus ocellatus	Vulnerable	4.166666667
Alopias pelagicus	Endangered	3.797468354
Alopias superciliosus	Vulnerable	1.25
Alopias vulpinus	Vulnerable	1.219512195
Balaenoptera bonaerensis	Near Threatened	3.571428571
Balaenoptera musculus	Endangered	3.846153846
Balaenoptera physalus	Vulnerable	2.941176471
Carcharhinus altimus	Near Threatened	2.857142857
Carcharhinus amblyrhynchos	Endangered	4.838709677

Carcharhinus leucas	Near Threatened	3.448275862
Carcharhinus longimanus	Critically Endangered	3.007518797
Carcharhinus melanopterus	Vulnerable	2.898550725
Carcharodon carcharias	Vulnerable	2.06185567
Caretta caretta	Vulnerable	1.904761905
Cetorhinus maximus	Endangered	2.222222222
Chaetodon trifascialis	Near Threatened	1.612903226
Cheilinus undulatus	Endangered	5.172413793
Chelonia mydas	Endangered	2.97029703
Dalatias licha	Vulnerable	6.666666667
Dermochelys coriacea	Vulnerable	1.515151515
Epinephelus fuscoguttatus	Vulnerable	3.50877193
Epinephelus polyphekadion	Vulnerable	3.571428571
Eretmochelys imbricata	Critically Endangered	5.263157895
Galeocerdo cuvier	Near Threatened	0.892857143
Gobiodon axillaris	Vulnerable	11.76470588
Gobiodon brochus	Near Threatened	16.66666667
Hippocampus histrix	Vulnerable	4.87804878
Hippocampus kuda	Vulnerable	7.142857143
Isurus oxyrinchus	Endangered	1.910828025
Kajikia audax	Near Threatened	1.315789474
Makaira nigricans	Vulnerable	1.834862385
Mobula alfredi	Vulnerable	2.941176471
Mobula birostris	Endangered	2.158273381
Mobula mobular	Endangered	1.960784314
Mobula tarapacana	Endangered	2.142857143
Mobula thurstoni	Endangered	2.040816327
Mola mola	Vulnerable	1.19760479
Negaprion acutidens	Vulnerable	18.18181818
Oxymonacanthus longirostris	Vulnerable	4.347826087
Physeter macrocephalus	Vulnerable	1.492537313
Plectropomus areolatus	Vulnerable	4.651162791
Prionace glauca	Near Threatened	0.568181818
Pseudorca crassidens	Near Threatened	0.657894737
Rhincodon typus	Endangered	2.43902439
Scomberomorus commerson	Near Threatened	1.724137931
Siganus uspi	Near Threatened	100
Sphyrna zygaena	Vulnerable	1.62601626
Stegostoma tigrinum	Endangered	7.894736842
Taeniura lymma	Near Threatened	2.222222222
Thunnus alalunga	Near Threatened	0.709219858
Thunnus albacares	Near Threatened	0.769230769
Thunnus obesus	Vulnerable	1.526717557
Triaenodon obesus	Vulnerable	3.225806452

Urogymnus asperrimus	Vulnerable	6.896551724
Urogymnus granulatus	Vulnerable	12.5

APPENDIX 1.7. Marine Invertebrates other than corals

Scientific Name	Red List Category	$STAR_T$ score
Actinopyga echinites	Vulnerable	3.846153846
Actinopyga mauritiana	Vulnerable	4.444444444
Actinopyga miliaris	Vulnerable	3.846153846
Alviniconcha boucheti	Endangered	100
Alviniconcha kojimai	Endangered	100
Bathymodiolus brevior	Vulnerable	100
Bathymodiolus elongatus	Vulnerable	200
Bruceiella globulus	Vulnerable	100
Desbruyeresia cancellata	Vulnerable	100
Desbruyeresia spinosa	Vulnerable	66.66666667
Holothuria fuscogilva	Vulnerable	3.125
Holothuria lessoni	Endangered	8.108108108
Holothuria nobilis	Endangered	5.555555556
Holothuria scabra	Endangered	5.769230769
Holothuria whitmaei	Endangered	9.677419355
Ifremeria nautilei	Endangered	100
Millepora murrayi	Near Threatened	4.347826087
Phymorhynchus hyfifluxi	Vulnerable	200
Stichopus herrmanni	Vulnerable	5.405405405
Thelenota ananas	Endangered	5.357142857

APPENDIX 2: EXPERTS CONTACTED AND CONSULTED

LIST OF EXPERTS CONTACTED AND CONSULTED FOR THE PROJECT: FIJI NATIONAL BIODIVERSITY THREAT ASSESSMENT: RANKING MAJOR THREATS IMPACTING FIJI'S BIODIVERSITY

	Organisation and Position	**Interviewee**	**Contact details**	**Species workshop group**	**Specialist**	**Emailed?**	**No response (0) Confirmed for Friday (1) Receive video recording ((2)**	**Accepted invite**	**Email sent (video and documents)**	**Feedback received (Questionnaire)**	**Feedback received (other)**	**RedList Assessment assessors/ reviewers (ALL)**	**RedList Assessment assessors/ reviewers (Experts that provided feedback)**
1	South Pacific Regional Herbarium, USP, Curator	Marika Tuiwawa	marika.tuiwawa@usp.ac.fj	Terrestrial - plants	1	y	0						
2	Marine Collection, USP, Curator	Kelly Brown	kelly.brown@usp.ac.fj	Marine	1	y	1	1	1	1			
3	University of the South Pacific	Monal Lal	mlal1@usc.edu.au	Marine	1	y	1	1	1	1			
4	University of the South Pacific	Alivereti Naikatini	alivereti.naikatini@usp.ac.fj		1		1	1	1	1		1	1
5	University of the South Pacific	Tamara Osbourne-Naikatini	tamara.osborne@usp.ac.fj		1		1	1	1	1			1
6	Institute of Applied Sciences	Gilianne Brodie (Deputy Director)	gilianne.brodie@usp.ac.fj	Terrestrial/ Marine – gastropods	1	y	0		1		1	1	

	Organisation and Position	**Interviewee**	**Contact details**	**Species workshop group**	**Specialist**	**Emailed?**	**No response (0) Confirmed for Friday (1) Receive video recording ((2)**	**Accepted invite**	**Email sent (video and documents)**	**Feedback received (Questionnaire)**	**Feedback received (other)**	**RedList Assessment assessors/ reviewers (ALL)**	**RedList Assessment assessors/ reviewers (Experts that provided feedback)**
7		Lekima Copeland	lekima.copeland@gmail.com	Freshwater vertebrates	1	y	0		1				
8		David Boseto	lekima.copeland@gmail.com	Freshwater vertebrates	1	y	0		1		1		
9		Patricia Kailoa	pkailola@gmail.com	Freshwater vertebrates	1	y	0		1		1		
10		Bindiya Rashni	diyarash@gmail.com	Freshwater invertebrates	1	y	0		1		1		
11		Aaron Jenkins	a.jenkins@ecu.edu.au	Freshwater vertebrates	1	y	0		1		1		
12	Conservation International	Isaac Rounds (Forester)	irounds@conservation.org	Terrestrial - plants	1	y	2		1		1	1	
13	Marine Ecology Consulting Limited	Helen Sykes (Principal)	Helen@marineecologyfiji.com	Marine	1	y	1	1	1	1			
14	USGS	Robert Fisher	rfisher@usgs.gov	Terrestrial	1	y	0		1		1	1	
15		Stacie Hathaway	sahathaway@usgs.gov	Terrestrial	1	y	0		1				
16	San Diego ZOO	Kim Gray	KGray@sandiegozoo.org	Terrestrial	1	y	0		1	1		1	1
17	Taronga Zoo	Peter Harlow	peter.harlow.sydney@gmail.com	Terrestrial	1	y	0		1		1	1	
18	National Trust of Fiji	Jone Niukula (Heritage Officer)	jniukula@nationaltrust.org.fj	Terrestrial	1	y	0	1	1		1	1	

	Organisation and Position	**Interviewee**	**Contact details**	**Species workshop group**	**Specialist**	**Emailed?**	**No response (0) Confirmed for Friday (1) Receive video recording ((2)**	**Accepted invite**	**Email sent (video and documents)**	**Feedback received (Questionnaire)**	**Feedback received (other)**	**RedList Assessment assessors/ reviewers (ALL)**	**RedList Assessment assessors/ reviewers (Experts that provided feedback)**
19		Siteri Tikoca (PhD candidate – bats)	stikoca@gmail.com	Terrestrial	1	y	1		1	1		1	1
20	USP – School of Geography	Sarah Pene (Lecturer)	sarah.pene@usp.ac.fj	Terrestrial	1	y	2		1	1			
21	Wildlife Conservation Society	Stacy Jupiter (Regional Director)	sjupiter@wcs.org	Marine	1	y	2		1	1			
22	University of South Australia	Gunnar Keppel	Gunnar.Keppel@unisa.edu.au	Terrestrial	1	y	1	1	1	1		1	1
23	Griffith University	Clare Morrison	c.morrison@griffith.edu.au	Terrestrial	1	y	1	1	1	1		1	1
24	ECF	Dick Watling	watling@environmentfiji.com	Terrestrial	1	y	1	1	1	1		1	1
25	BirdLife International	Mark O'Brien	mark.obrien@birdlife.org	Terrestrial	1	y	1	1	1	1		1	1
26	NatureFiji-MareqetiViti	Nunia Thomas-Moko	nuniat@naturefiji.org	Terrestrial	1	y	1	1	1	1		1	1
27	NatureFiji-MareqetiViti	Jake Taoi	jake@naturefiji.org	Terrestrial	1	y	1		1	1		1	1
28	NatureFiji-MareqetiViti	Ana Lutua	analutua@naturefiji.org	Terrestrial	1	y	1		1	1		1	1

	Organisation and Position	**Interviewee**	**Contact details**	**Species workshop group**	**Specialist**	**Emailed?**	**No response (0) Confirmed for Friday (1) Receive video recording ((2)**	**Accepted invite**	**Email sent (video and documents)**	**Feedback received (Questionnaire)**	**Feedback received (other)**	**RedList Assessment assessors/ reviewers (ALL)**	**RedList Assessment assessors/ reviewers (Experts that provided feedback)**
29	NatureFiji-MareqetiViti	Jone Raituva	jone@naturefiji.org	Terrestrial	1	y	1	1	1		1		
30	NatureFiji-MareqetiViti	Ana Nasiga	ananasiga@naturefiji.org	Terrestrial	1	y	1		1	1			
31	NatureFiji-MareqetiViti	Melania Segaidina	melania@naturefiji.org	Terrestrial	1	y	1		1	1		1	
32	NatureFiji-MareqetiViti	Semaema Vakaciriwaqa	semaema@naturefiji.org	Terrestrial		y	1	1	1	1		1	
33	IUCN - Red List Authoriy for Bats	Dave Waldien	dwaldien@gmail.com	Terrestrial	1	y	1	1	1	1		1	1
34	WildLife Conservation Society	Sangeeta Manugbhai (Country Director, Fiji)	smangubhai@wcs.org	Marine	1	y	2		1	1			
35	BirdLife International	Steve Cranwell (Invasive Species Program manager)	steve.cranwell@birdlife.org	Terrestrial/ Marine	1	y	2		1	1			
36	WWF	Francis Areki	fareki@wwfpacific.org	Marine/ Terrestrial	1	y	1	1	1				
37	IUCN	Hans Wendt (Marine Program)	Hans.Wendt@iucn.org	Marine	1	y	1		1	1			

	Organisation and Position	**Interviewee**	**Contact details**	**Species workshop group**	**Specialist**	**Emailed?**	**No response (0) Confirmed for Friday (1) Receive video recording ((2)**	**Accepted invite**	**Email sent (video and documents)**	**Feedback received (Questionnaire)**	**Feedback received (other)**	**RedList Assessment assessors/ reviewers (ALL)**	**RedList Assessment assessors/ reviewers (Experts that provided feedback)**
38	FLMMA	Margaret Vakalalabure (Coordinator)	mvakalalabure@fijilmma.org.fj	Marine	1	y	1		1				
39	**Ministry of Forestry**												
40	Conservator of Forests	Sanjana Lal (Conservator of Forests)	lal.sanjana@gmail.com	Terrestrial	1	y	2	1	1				
41	Executive Director Forest Operations and Extension Services	Manasa Luvunakoro	mluvunakoro@gmail.com		1	y	2	1	1				
42	Director of Operations-Central/Eastern	George Vuki	george.vuki@govnet.gov.fj		1	y	2	1	1				
43	Assistant Director-Central/Eastern	Arieta Tupou	arieta.tupou.govnet.gov.fj		1	y	2	1	1				
44	Director Operations-North	Moape Drikalu	drikalu.moape@gmail.com		1	y	2	1	1				
45	Assistant Director North	Uraia Racule	raculepaula@yahoo.com		1	y	2	1	1				

	Organisation and Position	**Interviewee**	**Contact details**	**Species workshop group**	**Specialist**	**Emailed?**	**No response (0) Confirmed for Friday (1) Receive video recording ((2)**	**Accepted invite**	**Email sent (video and documents)**	**Feedback received (Questionnaire)**	**Feedback received (other)**	**RedList Assessment assessors/ reviewers (ALL)**	**RedList Assessment assessors/ reviewers (Experts that provided feedback)**
46	Director Operations-West	Maleli Nakasava	avesidina@gmail.com		1	y	2	1	1			1	
47	Assistant Director West				1	y	2	1	1				
48	Forest Resource Assessment and Conservation	Deborah Sue	deb deborahlsue@gmail.com		1	y	2	1	1				
49	Director Silviculture Research and Development	Jale Tauraga	jale.tauraga@govnet.gov.fj / jtauraga@gmail.com		1	y	2	1	1	1		1	1
50	Director Timber Utilisation Research and Product Development	Tevita Bulai	tevita.bulai@govnet.gov.fj / bulaitevita@gmail.com		1	y	2	1	1				
51	Training and Education	Sailosi Kinivuwai	sailosi.kinivuwai@govnet.gov.fj / skinivuwai@gmail.com		1	y	2	1	1				
52	Fiji Ministry of Fisheries	Saras Sharma	saras.sharma@govnet.gov.fj	Marine	1	y							
53	Extension Central Division	Nanise Tuqiri	nanise.tuqiri@govnet.gov.fj							1			
										24	10	20	13

APPENDIX 3: QUESTIONNAIRE FOR SPECIES EXPERTS ON THE RESULTS OF FIJI'S STAR METRIC ANALYSIS

Mainstreaming biodiversity through sector-based commitments emerging from multi-stakeholder dialogue in pilot countries

Assessing the State of Biodiversity and Main Loss Drivers at National and Local Levels in Fiji

Questionnaire for experts on the results of the Fiji STAR metric analysis

Name : ……

Organisation and expertise : ……

Target group(s):	**Indicate all that apply**	**Target ecosystems :**	**Indicate all that apply**
Mammals		Natural terrestrial ecosystems	
Birds		Agroecosystems	
Amphibians		Freshwater ecosystems	
Freshwater fish		Marine ecosystems	
Plants		Other –	
Terrestrial Invertebrates			
Marine invertebrates (e.g. coral)			
Marine vertebrates (e.g. fish)			

Table 1: Clarification of information needed for your expert evaluation of the threats to biodiversity in Fiji – guide to filling in Question 1 (in Page 2).

Threat	**Specific threat details**	**Scale of threats (Global, Regional or Local)**	**Contribution to biodiversity loss (Weak, medium, strong or very strong)**	**Irreversibility (Weak, medium, strong or very strong)**	**Observations**
List the threats that in your opinion have an impact on the biodiversity of your target group(s) *Use IUCN-CMP classifications (see pages 3 and 4).*	*Provide details of the threats – e.g. species affected, changes over time, details of threatening processes*	*Is this threat specific to Fiji or is it regional (Pacific) or global*	*Indicate the perceived contribution of each threat to the decline of the species in your target group(s), expressed as very strong, strong, medium or weak*	*Indicate the perceived degree to which the effects of each threat to your target taxonomic group(s) can be restored. Expressed as :* *very high = not reversible* *high = reversible but not affordable* *medium = reversible but reasonable commitment of resources* *low = easily reversible at a relatively low cost*	*Any other observations you would like to make about each threat*

Question 1 : *Please fill out the table below in regards to the specific threats to biodiversity in Fiji based on your knoweldge and expertise. Use the explanations in the table above and the list of threats according to IUCN-CMP classification on the next page.*

N°	Threat	Specific threat details	Scale of threats (Global, Regional or Local)	Contribution to biodiversity loss (Weak, medium, strong or very strong)	Irreversibility (Weak, medium, strong or very strong)	Observations
1						
2						
3						
4						
5						
6						

Question 2: Do you agree with the STAR assessments for your particular group or ecosystems? _____

Question 3: If you do not agree, please state why.

_____
_____
_____
_____

Level 1 Threats

Threat Classification Level (IUCN-CMP)
1. Residential and commercial development
2. Agriculture & Aquaculture
3. Energy production and mining
4. Transportation and service corridors
5. Biological resource use
6. Human intrustions and disturbance
7. Natural system modification
8. Invasive species and other problematic species, genes and diseases
9. Pollution
10. Geological events
11. Climate change and severe weather
12. Other options

Level 2 Threats

Threat classification level (IUCN-CMP)	
1. Residential and commercial development	
	1.1 Housing and urban areas
	1.2 Commerical and industrial areas
	1.3 Tourism and recreation areas
2. Agriculture & Aquaculture	
	2.1 Annual & perennial non-timber crops
	2.2 Wood & pulp plantations
	2.3 Livestock farming & ranching
	2.4 Marine & freshwater aquaculture
3. Energy production & mining	
	3.1 Oil & gas drilling
	3.2 Mining & quarrying
	3.3 Renewable energy
4. Transportation & service corridors	
	4.1 Roads & railways
	4.2 Utility & service lines
	4.3 Shipping lanes
	4.4 Flight paths
5. Biological resource use	
	5.1 Hunting & trapping terrestrial animals
	5.2 Gathering terrestrial plants
	5.3 Logging & wood harvesting
	5.4 Fishing & harvesting aquatic resources
6. Human intrustions & disturbances	
	6.1 Recreational activities
	6.2 War, civil unrfest & military exercises
	6.3 Work & other activities

Threat classification level (IUCN-CMP)	
7. Natural system modifications	
	7.1 Fire & fire suppression
	7.2 Dames & water management/use
	7.3 Other ecosystem modifications
8. Invasive species and other problems, genes and diseases	
	8.1 Invasive non-native/alien species/diseases
	8.2 Problematic native species/diseases
	8.3 Introduced geentic material
	8.4 Problemation species/diseases of unknown origin
	8.5 Viral/prion-induced diseases
	8.6 Diseases of unknown cause
9. Pollution	
	9.1 Domestic & orban waste water
	9.2 Industrial & military effluents
	9.3 Agircultural & forestry effluents
	9.4 Garbage & solid waste
	9.5 Air-borne pollutants
	9.6 Excess energy
10. Geological events	
	10.1 Volcanoes
	10.2 Earthquakes/tsunamis
	10.3 Avalanches / landslides
11. Climate change and extreme weather conditions	
	11.1 Habitat shifting & alteration
	11.2 Droughts
	11.3 Temperature extremes
	11.4 Storms & flooding
	11.5 Other impacts
12. Other options	
	12.1 Other threats

APPENDIX 4: STAKEHOLDERS CONSULTATION VIRTUAL WORKSHOP – NOTES AND SUMMARY OF RECOMMENDATIONS

APPENDIX 4: STAKEHOLDERS CONSULTATION VIRTUAL WORKSHOP – NOTES AND SUMMARY OF RECOMMENDATIONS

Assessing Fiji's State of Biodiversity and Main Loss Drivers– virtual workshop
"Ranking Major Threats Impacting Fiji's Biodiversity".
August 17th (Tuesday)
1300 – 1600 Fiji Time
Stakeholder Consultation
Feedback Notes

Session 1: Welcome Remark *Regional Director IUCN ORO – Mr Mason Smith*
Key message ● 3 main threats to Fiji's biodiversity at the national level: loss of forest cover due to agricultural practices and various other means ,invasive species - associated with forest loss and habitat fragmentation and biological resource use. ● Ensure the pilot project is implemented at the regional level. Loss of Biodiversity

Session 2: Opening Remark of the Workshop

Permanent Secretary for Environment – Mr Joshua Wycliffe

Key messages

- Biological Diversity is an asset to Fiji. Should be treated as assets.
- Obligation does not only include the duty of protecting our biological diversity but also the heartfelt tie we must have with biodiversity.
- BIODEV 2030 is a 2-year project that creates a national platform for strategic engagements in order to protect/save our biological diversity
- Protecting our environment is protecting ourselves, protecting our world and all things around us.

Session 3: Objectives of the Workshop

Fiji Country Project Officer BIODEV 2030 – Ms Tavenisa Luisa

Key messages

- Provide an opportunity for your views, review of the draft report, analyze the findings and results and assess sectors impacting Fiji's biodiversity and provide feedback.
- Goal of the report: halt biodiversity loss by 2030 and restore biodiversity by 2050 while promoting more sustainable and resilient economies.
- Strategy: through resource mobilisation and multi-stakeholder dialogue.

Session 4: Presentation on the Background of BIODEV 2030

Fiji Country Project Officer BIODEV 2030 – Ms Tavenisa Luisa

Key message

- Project has been run in 16 countries around the world. Fiji is the only country representing the Oceania on this project
- What is learnt , will be shared on different platforms.
- Consultants have identified the threats to biodiversity and the drivers of these threats.
- This is a pilot project where it is action oriented. There might be ups and downs expected.
- Species are declining putting Fiji;s development and survival at risk. We need to act on the declining species in Fiji.
- Hon. Prime Minister Voreqe Bainimarama has endorsed the leaders pledge on environment protection.
- Project launched in March 2021, April recruiting of consultants, May - June development of draft report completed.
- 2-3 sectors identified in the draft report. Report to be finalised hopefully by the end of the month.

- Report to be presented in the IUCN Conservation Congress in September.
- Project also supporting the National Biodiversity Strategy Action Plan.

Session 7: *Question and Answer session* Moderator: Tavenisa Luisa Rapporteurs:		
Q1	Question: Guava trees to be a part of the benefit in degraded land, with the current situation we have. Are there any other invasive species that can provide some kind of environmental protection? Posed by: Isoa Korovulavula	Response: Invasive Alien Species identified in the report are species that contribute to forest degradation and other environmental threats. Answered by: Nunia

Q2	**Question:** Have we considered that degraded habitats are an accelerator for impacts of invasive species? Posed by: Steve Cranwell	**Response**: Steve is correct – and this is something that needs to be looked at in the next phase of the project. We have not thought about how we can address invasive species in one single species because of the nature of the system. The scientific basis for which we make our decisions on invasive alien species does not exist. E.g. African Tulip Tree, while it is communicated as an IAS, there has not been an ecological study to confirm it – as this species is probably the best species for reforestation of the degraded grasslands in Fiji. Answered by: Mark (Birdlife) and Dick
Q3	Question: Agriculture has been identified as one of the main drivers, while this is true, could we re-look at the contributing factors that make agriculture as a major sector in biodiversity loss. We need to consider the fact that we need agriculture for food security. The Ministry is challenged by the fact that alot of the on-the-	Response: This project provides an opportunity to look at agriculture with the partnership of various stakeholders. (Note figure 28 of the report) – this is why local landowning communities are highlighted as a key stakeholder – because of the subsistence farming and the practice of shifting cultivation and slash and burn.

	ground practice is unsustainable. Need to consider that there are 3 categories of Farmers: Commercial farmers – where there is a high use of fertilizers Semi-commercial farmers Subsistence farmers – these are the farmers that are practicing shifting cultivation, and clearance of forest areas. Posed by: Solomoni Nagaunavou (Ministry of Agriculture)	Answered by: Nunia Thomas-Moko Profile farmers and strategise based on the profiles. Suggested by: Isoa Koroiwaqa
Q4	Question: Thank you Nunia and team for the presentation, nothing surprising there in terms of threats to biodiversity. You also have identified stakeholders that we should bring on board to address species decline. Has the team also identified some keys activities relating to species	Response: It is the encroachment, particularly into marginal land. Does the forum here have any suggestions on specific activities that they think are contributing to forest loss or the loss of forest through agricultural activities? Answered by: Nunia

	decline with respect to the major threats to biodiversity identified during the study? Posed by: Issac Rounds	Response: One of the aspects – not looking at biodiversity per se, but at the institutional arrangements that we have, perhaps they are not sustainable. The point brought up by Solo is important – take into account the land tenure system, the lease arrangements. Overarching legislations and systems need to be arrange in a manner that allows for conservation to happen. Answered by: Isoa Korovulavula

Session 9 – Feedback presentations

Group 1: Marine

Issues raised: Look at the issues in a more "marine-oriented" way rather than a "biodiversity" way. Issues affecting the maritime rather than terrestrial areas. The issue of sustainability. This reflects that marine is not treated in the manner the style it is designed.

Key messages (summary)

In summary, the participants concurred with the results of the study. The Marine group's discussion did not cover the marine sector per se, but covered issues from the terrestrial sector that affect marine. This is perhaps a reflection of the fact that the marine sector is not well covered under the STAR analysis, and needs to be looked at separately.

Group 2: Forestry

Issues raised: Major threats:

COVID 19 – driver of forest loss. Urban- Rural drift: people moving back home to their villages.

The return in investment would probably be greater than if they worked a 9-5 job.

They are returning to their villages to earn an income. For some, this may be a long-term move – because of the improved price of Kava rather than go back to their formal employment. This is a less stressful way of earning money for them.

Can we make “kava” positive for biodiversity?

National campaign on sustainable land use/farming practice

Institutional arrangements – *need to be looked at - contradictory policies that allow for unsustainable development and land use practices, encroachment etc.*

Invasive Alien Species:

Addressing the threats of IAS seems to be really fragmented at the national level. There needs to be more holistic and collaborative approach to addressing the threats of IAS - especially those already present in Fiji and preventing their spread to uninfested areas/islands.

The GEF6 IAS Project (being implemented by BAF) aims to improve the chances of the long-term survival of terrestrial endemic and threatened species on Taveuni/Qamea Island and surrounding islets (due to Giant Invasive Iguana presence) by building national and local capacity to prevent, detect, control and manage Invasive Alien Species (IAS). All stakeholders are invited to collaborate through this project as we seek to develop capacities at the national level including a national coordinating body working on IAS.

Key messages (summary):

Urban-rural drift may become a long term threat as individuals move back to their villages and invest in agricultural activities that promote the clearing of forest. This will become a significant threat to biodiversity.

The TLTB has developed a Landuse Master Plan for ITaukei Lands and Leases demarcating areas that can be used for agriculture and other activities – need to look into how this can be engaged in the program.

We need to look at opportunities where we incentivize the farmers, but intervening at the market end (Biodiversity-friendly "green" kava). Some of the current programs – agroforestry etc, does not work if the farmers are not incentivized.

Institutional arrangements need to be looked at – there are contradictory policies that allow for encroachment into forest reserves and high conservation value forests to occur.

Group 3: Agriculture

Issues raised: No change however there is the concern for habitats in terms of biodiversity threat by invasive alien species in terms of the agricultural sector. Reversing invasive alien species loss in terms of biodiversity. What makes agriculture a driver of biodiversity loss?

There is a huge challenge ahead on the engagements of the sectors and their stakeholders to address biodiversity loss.

Need clarification around the IAS focus. The group of threats need to be recognised as drivers, especially IAS. What can be done now? IAS – ecosystem jeopardy.

Two sectors: How do we make best use of the collaboration with Agriculture and Fisheries to address the threat of IAS?

Transport is a sector that needs to be considered because of IAS.

Agriculture- what are the contributing factors that are making agriculture a major threat?

Government supporting sustainable agriculture but it entirely depends on the farmers on how they practice sustainable farming

Relook at the land use plans and make up a national land use plans

Agricultural activity in Fiji is a market demand driven e.g Kava and TC Winston. Ginger and Dalo usually need machinery, especially for commercial farming.

Key messages (summary):

Consider the Transport Sector.

Look at more than 2 sectors – Do the 2 sectors adequately address the imminent threat of IAS, is this enough to address biodiversity loss? Forest loss has been long term and ongoing. In the meantime, there is the imminent threat of IAS across all landscapes and sectors.

Agriculture- what are the contributing factors that are making agriculture a major threat?