Ridges to Reefs Conservation Plan for Choiseul Province, Solomon Islands

Geoff Lipsett-Moore, Richard Hamilton, Nate Peterson, Edward Game, Willie Atu, Jimmy Kereseka, John Pita, Peter Ramohia and Catherine Siota

Published by: The Nature Conservancy, Asia-Pacific Resource Centre

Contact Details:
Geoff Lipsett-Moore: The Nature Conservancy, 51 Edmondstone Street, South Brisbane. Qld. 4101. Australia
email: glipsett-moore@tnc.org

William Atu: The Nature Conservancy, PO Box 759, Honiara, Solomon islands.
e-mail: watu@tnc.org

Suggested Citation: Geoff Lipsett-Moore, Richard Hamilton, Nate Peterson, Edward Game, Willie Atu, Jimmy Kereseka, John Pita, Peter Ramohia and Catherine Siota (2010). Ridges to Reefs Conservation Plan for Choiseul Province, Solomon Islands. TNC Pacific Islands Countries Report No. 2/10. 53 pp

© 2010, The Nature Conservancy
All Rights Reserved.
Reproduction for any purpose is prohibited without prior permission

Available from:
Asia-Pacific Resource Centre
The Nature Conservancy
51 Edmondstone Street
South Brisbane, Queensland 4101
Australia
Or via the worldwide web at:
http://conserveonline.org/workspaces/pacific.island.countries.publications/documents/choiseul

LAURU LAND CONFERENCE OF

TRIBAL COMMUNITY TRUST BOARD INC.

P.O. BOX 26 Taro Post Office, Choiseul Bay, Choiseul Province, Solomon Islands

CHOISEUL PROVINCE

LAURU ISLANDS

TO LEAD IS TO SERVE

The Nature Conservancy

Protecting nature. Preserving life.™

WWF®

Foreword

The land and seas surrounding Lauru are the life-blood of our people, and our long term survival and prosperity is integrally linked to the ecological health of our small island home. Our ancestors' were acutely aware of this, and they developed many intricate customs and traditions relating to the ownership and use of Lauru's natural resources. Although many of our worthy traditions and customs persist, today our island of Lauru is faced with a growing number of threats. Rapid population growth and our entry into the global cash economy have dramatically increased pressure on our natural resources.

In the past two decades commercial logging has changed the physical and social landscape of Lauru, and as we look to the future we must prepare ourselves for the growing threat of climate change, a global challenge that must be tackled at local, provincial, national and global scales. As Christians we are obligated to be good stewards of Gods creations, and today more than ever, we the people of Lauru must make informed decisions about how to conserve and sustainably develop our natural environment, to ensure that our children can enjoy the cultural, social and economic treasures that have defined our people for a millennium.

The stakeholder driven ridges to reefs conservation planning process that is documented in this report represents a positive and important step towards ensuring our children have a bright future. This conservation plan represents the first comprehensive attempt to pull together all of our available knowledge, both scientific and local, on the marine and terrestrial biodiversity of Lauru, as well as the threats and opportunities for conservation that exist.

When the chiefs and leaders of Lauru saw the preliminary findings of this report at the Lauru Land Conference of Tribal Communities annual conference at Soranamola in October 2009, they made a bold commitment to establish a Lauru Ridges to Reefs Protected Areas Network that will safeguard our remarkable cultural and natural heritage. Implementing the Lauru Protected Area Network will require establishing marine and terrestrial protected areas across each ward of Lauru, and this ridges to reefs conservation plan will be an important tool in guiding this process.

On behalf of the people of Lauru I thank all of those who were involved in completing this report. In many ways the completion of this report is the beginning of the hard work not the end, and I urge all of us to work together to achieve the shared vision of a Lauru Ridges to Reefs Protected Areas Network.

Honourable Reverend Chief Leslie Boseto
President of the Lauru Land Conference of Tribal Communities

Acknowledgements

This report was made possible through generous funding and support of the Early Action Grants and The Nature Conservancy (TNC). The report represents a synthesis of the expertise, knowledge and views of Choiseul's leaders, government, scientific experts, NGO's and authorities. The TNC Team wishes to thank all those present at the workshops (Table 1) without whose contribution, this assessment would not have been possible. A special thanks to Hon. Reverend Chief Leslie Boseto, President of Lauru Land Conference of Tribal Communities, Hon. Jackson Kiloe, Premier of Choiseul Province, Luke Pitakoe, Secretary of the Lauru Land Conference of Tribal Communities and the people of Choiseul for their vision and support.

Table 1: List of participants

First name	Second name	Community/Organisation
Willie	Atu	The Nature Conservancy
Rose	Babaua	Ministry of Environment, Conservation and Meteorology
Marcon	Bakolae	Vurango community
Rence	Dako	Sirobesi community
Scott	Dereveke	Vurango community
Joseph	Gamatia	Sepa community
Eddie	Game	The Nature Conservancy
Julian	Gataso	Nukiki community
Richard	Hamilton	The Nature Conservancy
Cornelius	Joi	Loimuni community
Paul	Kaegabatu	Sariana community
Eric	Katovai	University of Queensland
Francis	Kavakesa	Voru voru community
Jimmy	Kereseka	LLCTC/The Nature Conservancy
Richard	Kopana	Voza community
Atkin	Kuma	Vurango community
Geoff	Lippsett-Moore	The Nature Conservancy
Leadley	Medoko	Voza community
Thompson	Miabule	Choiseul Province Fisheries Division
Mesach	P.	Susuka community
Geoffrey	Pakipota	Choiseul Province Planning Division
John	Palataru	Voza community
Dario	Palavakava	Vurango community
Alma	Panisi	Live and Learn
Nate	Peterson	The Nature Conservancy
Patrick	Pikacha	University of Queensland
John	Pita	The Nature Conservancy
Luke	Pitakoe	Lauru Land Conference of Tribal Communities
Philip	Poloso	Vurango community
Peter	Poqeava	Molevaqa community
Myknee	Qusa	World Wildlife Foundation
Peter	Rex	Ministry of Fisheries and Marine Resources
Catherine	Siota	The Nature Conservancy

B.	Sipele	Soranamola community
John	Sonagolomo	Sirovanga community
Gregory	Suvaka	Chivoko community
Nelson	Tanito Kere	Choiseul Fisheries Division
Rodney	Telovae	Moli community
Hon. Peter	Tobire	Wagina community
Eagan	Velo	Chivoko community
Joshua	Vorekale	Kuma community
John	Zale	Kio community
Michael	Zazu	Lauru Land Conference of Tribal Communities
Romano	Zesapa	Kadova community
Franklin	Zilivole	Boe community

Acronyms

CBD	Convention for Biological Diversity
GEF	Global Environment Facility
GIS	Geographic Information System
IUCN	International Union for Conservation of Nature
IMARS	Institute for Marine Remote Sensing
LLCTC	Lauru Land Conference of Tribal Communities
LMMA	Locally Managed Marine Area
LPAN	Lauru Ridges to Reefs Protected Area Network
MECM	Ministry of Environment, Conservation and Meteorology
MFMR	Ministry of Fisheries and Marine Resources
MPA	Marine Protected Area
NGO	Non-Governmental Organization
PoWPA	Program of Work on Protected Areas
SINBSAP	Solomon Islands National Biodiversity Strategic Action Plan
TNC	The Nature Conservancy
WWF	Worldwide Fund for Nature/ World Wildlife Fund

Executive Summary

This Ridges to Reefs conservation plan is the culmination of the views of many. It harmonizes the local knowledge of the Lauru people with a modern conservation planning approach. It recognizes that what we do on the land has a profound effect on our streams, rivers and nearshore areas. The Lauru people have many traditions and customs pertaining to the management of their natural resources. But today some of these traditions have been lost, and the long term sustainability of Lauru is threatened by rapid population growth, expanding logging and mining activities and the looming threats of climate change. It was recognized by the community leaders of Lauru and the Choiseul Provincial Government that there was a need to plan wisely and protect key resources to ensure a bright future.

In 2008 the Lauru Land Conference of Tribal Communities (LLCTC) asked The Nature Conservancy to assist Lauru with conservation planning for the future. Subsequently, in May 2009 a participatory mapping workshop was held in Taro. Community leaders from across the Province attended and some 25 conservation features were identified and mapped. These features represent important biological and cultural resources that would benefit from protection, such as; turtle nesting beaches, fish spawning aggregations, megapode nesting areas, seagrass and other aquatic resources. Participatory mapping was also used to identify threats to biodiversity (i.e. logging, mining and areas susceptible to climate change) and to map areas of conservation opportunity, such as sites that are proposed but not yet gazetted as protected areas, and sites already managed by communities for some natural resources.

These data were then digitized into a form suitable for inclusion in a conservation planning analysis. In line with the Solomon Islands' commitment under the Convention of Biological Diversity (CBD 2006), the target representation of conservation features for a Choiseul wide protected area network was set at a base of 10% of total area of each feature, with a 20% climate change scenario also generated. Sites that are of critical importance were given elevated targets: 50% of total area for fish spawning aggregations and 95% for nesting beaches of endangered turtles. The planning region we used encompassed all lands, waters and seas of Choiseul Province, out to the 200 meter depth contour, the approximate extent of the area used by the communities of Choiseul. The biodiversity of Choiseul Province was represented by three groups of conservation features: existing available data on terrestrial habitats, marine habitats, and locally identified conservation features. Terrestrial and aquatic habitats were divided into 89 classes based on vegetation type and geology. Marine habitats were defined by 47 coral reef types (IMARs) and stratified into four expert-derived bioregions giving a total of 114 marine conservation features. These features combined with the 25 features identified by the LLCTC were the primary inputs for the analysis. Marxan decision support software was then used to develop 10% and 20% representative ridges to reefs options.

In October 2009, TNC staff presented the preliminary findings of the Choiseul conservation planning exercise at the LLCTC conference that was held at Soranamola. Following the presentations LLCTC participants provided their unanimous support for two recommendations put forward by TNC and the LLCTC environmental committee: (1) Establish a Lauru Protected Areas Network (LPAN) and (2) That each ward in Choiseul (there are 12) establishes at least one marine protected area and one terrestrial protected area within the next two years. It was agreed by the LLCTC that the implementation of the LPAN will remain a community driven process that is guided by the Choiseul Ridges to Reef Conservation Plan.

Table of Contents

List of Figures

List of Tables

Introduction

The Choiseul ridges to reefs conservation plan was facilitated and compiled by The Nature Conservancy (TNC) in response to requests from the Lauru Land Conference of Tribal Communities (LLCTC) and the Choiseul Provincial Government. These requests came about from an understanding that the future sustainability and prosperity of the Choiseul people is integrally linked to its natural ecosystems, and the development of a Choiseul conservation plan that takes biodiversity, threats and opportunities into account will enable the Lauru people to make wise and informed choices about their future.

In its simplest form, developing a conservation plan involves comparing the distribution of biodiversity with the distribution of protected areas and finding where species and ecosystems are left unprotected or under protected. To address these problems in a systematic way, the concept of ecological representation was developed. This refers to the need for protected areas to represent, or sample, the full variety of biodiversity of different biological realms (freshwater, marine and terrestrial through all the ecoregions) and biological scales (ecosystems, species and within-species variation) (Noss, 1995). A ridges to reefs approach recognizes that what we do on the land has a profound effect on streams, rivers and nearshore areas. Many island ecosystem components provide vital goods and services, such as protection against extreme weather events, while also providing habitat for marine animals and reef fish. Thus the conservation of island biodiversity represents a cost-effective and practical way for islands to ensure sustainability and adapt to threats such as climate change.

This report captures the full scope of the Choiseul Ridges to Reefs Conservation Plan from its genesis to completion. Chapter 1 provides the physical, biodiversity, threat, cultural and social context for Solomon Islands and Choiseul. Chapter 2 provides the insight into conservation in Choiseul from traditional to contemporary practices. Chapter 3 provides the conservation planning process and outcomes and Chapter 4 provides recommendations and next steps.

The completion of the Choiseul conservation plan provides a roadmap to guide future conservation efforts throughout Choiseul. It is hoped that it will assist in enabling the leaders of Choiseul to implement the Lauru Ridges to Reefs Protected Area Network (LPAN), the first such network ever proposed in Solomon Islands. The development of this ridges to reefs conservation plan also provides a pilot study to the Ministry of Environment, Conservation and Meteorology (MECM) with regards to a conservation planning process and approach that could be effectively applied to the whole of Solomon Islands. Finally, it provides constructive progress regarding Solomon Islands commitment to the Convention on Biodiversity (CBD) and the completion of the identification of terrestrial and marine priorities as part of the Program of Work on Protected Areas (PoWPA).

1.1 Solomon Islands

1.1.1 Physical and Cultural

Solomon Islands form an arc of deep water oceanic islands that lie within the Solomon Sea. One of the larger South Pacific nations, Solomon Islands extend for over 1,700 kilometres between Bougainville in the north-west and Vanuatu in the south-east, with main islands lying between latitudes 5-12^{o} S and longitudes 152-163^{o} E (Macmillan, 1996). The Solomon Islands archipelago is located within the Pacific's Ring of Fire, and volcanic activity and major folding and faulting between the Pacific, Australian and Asian tectonic plates have created a country of unusual and spectacular landscapes (Hunnam et al., 2001). Fluctuating sea levels and periods of highly localised tectonic uplifting and folding events stabilised around 6,000 years before present (Nunn, 1994; 1998), leaving behind a diversity of island formations, with dormant and active volcanoes, raised limestone reefs, lagoons and atolls, all dominant features of Solomon Islands. The six major islands of the Solomon nation are Guadalcanal, New Georgia, Malaita, Isabel, Choiseul and Makira (Figure 1). All are elongate steeply rising islands, with peaks of up to 2,400m. They are rugged naturally forested islands, surrounded by fringing coral reefs and lagoon systems.

The first wave of migrants to settle in this region occurred about 35,000 years ago when settlers from Papua New Guinea moved to the northern islands in the Bismarck Archipelago. Midden deposits on New Ireland provide the earliest evidence in the world of human colonisation of oceanic islands, and some of the earliest evidence of marine fishing technologies (Allen et al., 1989). A second wave of human migration occurred approximately 5,000 years ago, when Austronesian speaking people moved throughout the entire Bismarck archipelago and Solomon Islands. The Austronesian people, famous for their decorated Lapita pottery, were expert seafarers and fishers and rapidly colonised the Melanesian islands, before moving east of Fiji to colonise Tonga and Samoa and become the first settlers and ancestors of present day Polynesia (Kirch, 2000). This rapid second phase of colonisation was made possible by the geological stabilisation of this area, with newly formed lateral erosion plains and river basins providing suitable areas for agricultural developments, and extensive lagoon systems providing rich supplies of marine resources. Today Solomon Islands supports a great diversity of cultures, with over 87 Austronesian and non-Austronesian languages spoken by its 500,000 inhabitants.

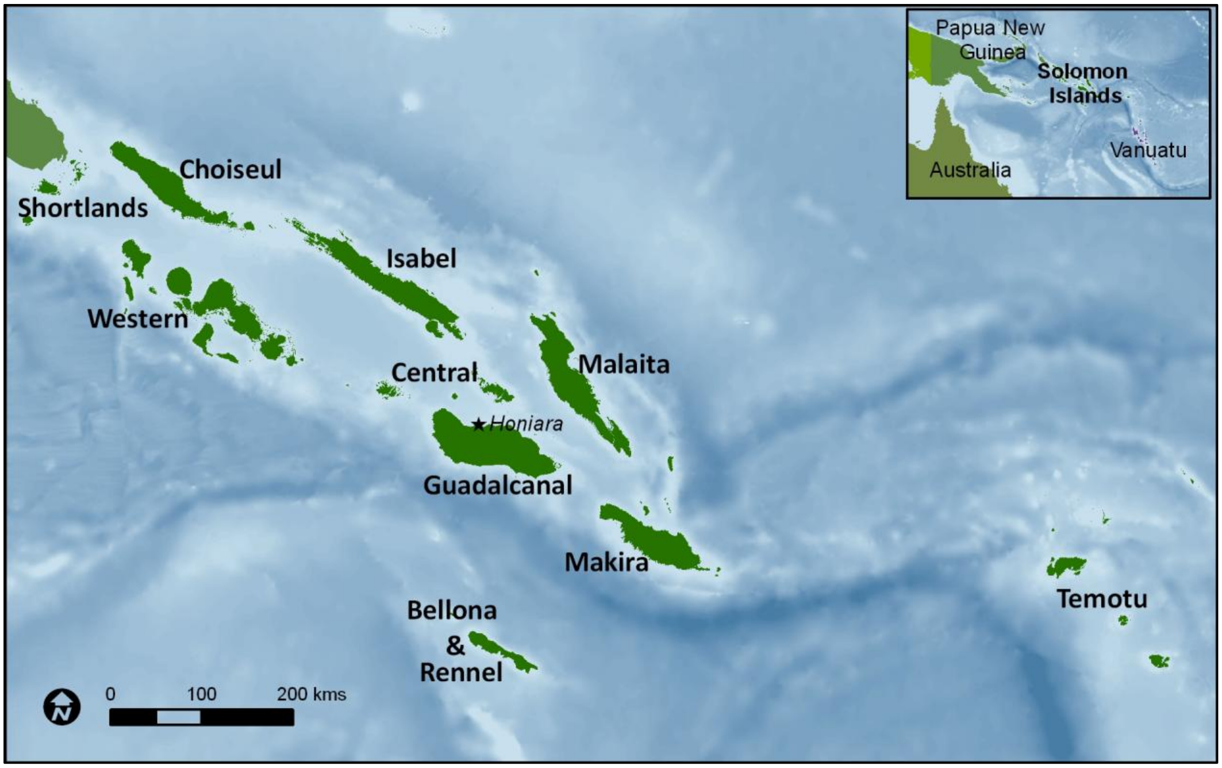

Figure 1: Provinces of Solomon Islands

1.1.2 Biodiversity

Solomon Islands has the second highest terrestrial biodiversity of anywhere in the Pacific, surpassed only by Papua New Guinea (Morrision et al., 2007). Solomon Islands Rain Forests Terrestrial Ecoregion AA0119[1] (Olsen et al., 2001) have high vertebrate endemism, including single-island endemics, restricted-range mammals, and 69 bird species found nowhere else in the world. The Solomon Islands has an estimated 5,599 described species including: 2,597 described plant species, 245 birds, 75 mammals, 87 reptiles, 19 amphibians, 777 fish and 1,799 invertebrate species (IUCN, 2008).

Solomon Islands also occupies the eastern portion of the global centre of marine diversity, known as the Coral Triangle, which includes all or part of the Philippines, Indonesia, Malaysia, Timor Leste, Papua New Guinea and Solomon Islands (Figure 2). The Coral Triangle comprises 76% of the world's corals and 37% of the world's coral reef fish species in an area that covers less than 2% of the planet's oceans (Veron et al., 2009). The Solomon Islands marine environment presents numerous opportunities for marine conservation, as throughout the nation marine biodiversity is high, marine habitats are in good condition and current levels of threats are low relative to other areas in the western Coral Triangle (Green et al., 2006).

[1] http://www.worldwildlife.org/wildworld/profiles/terrestrial/aa/aa0119_full.html

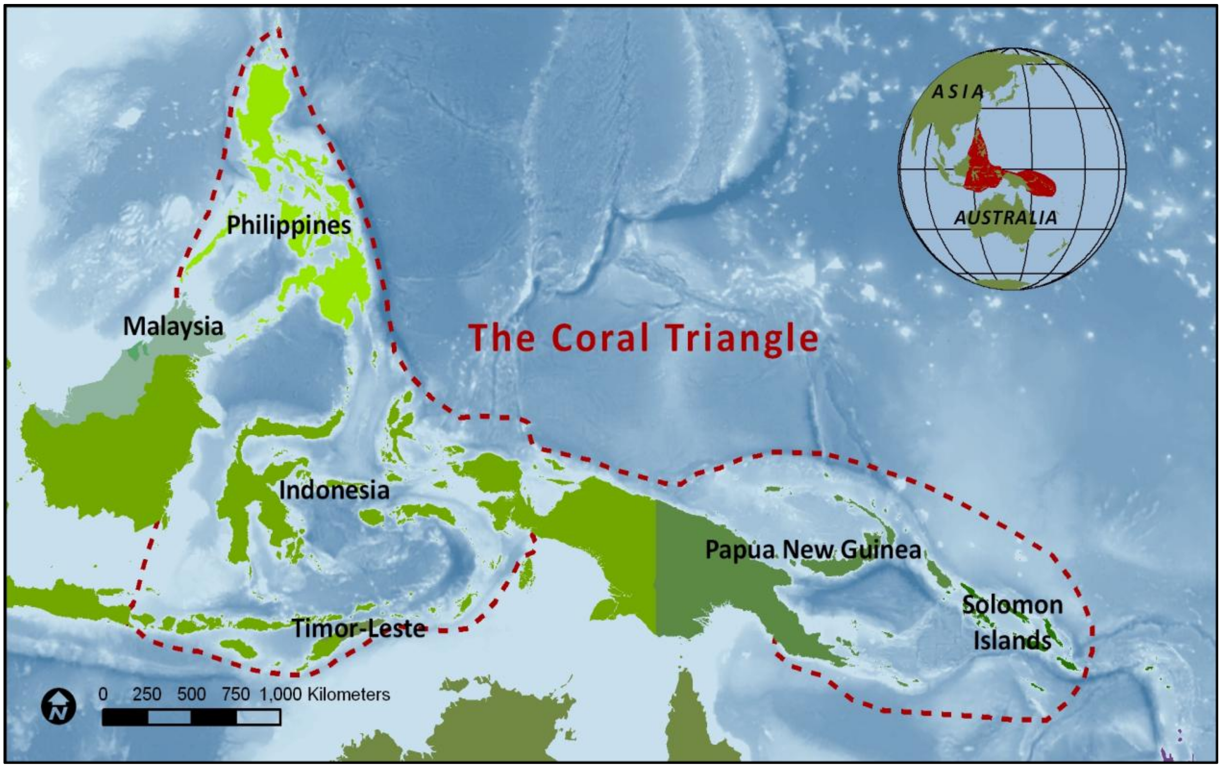

Figure 2: The Coral Triangle (Veron et al. 2009)

1.1.3 Threats

Less that 1% of Solomon Islands land and sea areas are currently protected. Of the existing protected areas most are marine and are managed by local communities and NGOs, although the Government has supported a few of them. Major threats to Solomon Islands biodiversity include: the ongoing threat of logging, mining, oil palm and other industrial agriculture and unsustainable fishing practices. In many regions of Solomon Islands valuable marco invertebrates are severely overexploited, while large vulnerable reef fishes are in serious decline in some provinces (Ramohia, 2006; Hamilton, 2003a). These threats are further compounded by the increasing demand on natural resources (e.g. clearing for subsistence agriculture and local overfishing) and by a rapidly expanding human population (2.8%/annum)[2].

Forest cover in Solomon Islands has decreased dramatically from 80% in the 1990s to 60% today, indicating a significant loss in biodiversity. The need to protect these forests is imperative to ensure that biodiversity of Solomon Islands is maintained. The current status of species in Solomon Islands include: two extinct, ten critically endangered, 20 endangered, 184 vulnerable, 196 near threatened species (IUCN, 2008). These numbers are expected to rapidly increase over the next decade if the existing protected area system isn't immediately expanded and strengthened.

Solomon Islands are also especially vulnerable to climate change, since island species populations tend to be small, localized, and highly specialized, and thus can readily driven to

[2] http://www.spc.int/prism/sbtest/Social/Popcen/Census1999.htm

extinction by invasive species and expanding threatening processes. The main threats from climate change to island ecosystems are the observed and projected rise in sea level and the potential increase in the frequency of storms (Solomon Islands National Government 2001, UNFCCC 2007). Global average sea level rise at the end of the 21st century (2090-2099) is projected to range between 0.18 and 0.59 metres (IPCC, 2007) although recent predictions are as high as 7 metres[3]. Coral reefs, which provide many ecosystem services to island people, are also highly sensitive to temperature and chemical changes in seawater as a consequence of Climate Change and increased carbon dioxide (CO^2) in the atmosphere. The current climate change predictions indicate major present and future changes for island biodiversity and people.

1.1.4 National framework for conservation

The national framework for conservation in Solomon Islands is provided under the Convention on Biodiversity (CBD) that Solomon Islands are a signatory to. The formation of the Ministry of Environment, Conservation and Meteorology (MECM) by Solomon Islands Government in 2007 provides the leadership necessary to oversee the work pertaining to conservation of biological diversity in the country. The development of the Solomon Islands National Biodiversity Action Plan (SINBSAP) is a response to the CBD commitment and also provides constructive direction (SINBSAP, 2008). The SINBSAP outlines the framework to ensure long term sustainability of biodiversity in Solomon Islands. Responsibilities for achieving the goals of the SINBSAP will not only rest with the government but also with NGOs, Provincial authorities, communities and resources owners.

1.2 Choiseul Province

1.2.1 Physical and cultural

Choiseul Province, or Lauru as it is known locally, is one of the nine provinces of Solomon Islands (Figure 1). It lies between the island of Bougainville (part of Papua New Guinea) and Santa Isabel in the west of Solomon Islands. It consists mainly of Choiseul Island with an area of 3,106 km^2, two small islands: Wagina (82 km^2) and Rob Roy (67 km^2), with over 300 small islets less than 1 km^2 each. 95.5% of Choiseul is under tribal ownership, with the remainder being alienated land. Wagina Island makes up the largest area of alienated land in Choiseul Province.

Lauru is a multi-cultural society. It's population is made up predominantly of indigenous Melanesians. The most recent people to call Choiseul home are Micronesians from the Phoenix Islands (part of Kiribati), who were relocated to the island of Wagina by the British government in 1963. There are ten languages spoken in Choiseul, with Solomon Island Pijin the most widely spoken language. A 2005/2006 household and income and expenditure survey estimated the Choiseul population to be 31,259, with 54% of the population being under 20 years of age. Population growth rate in Choiseul over the past two decades has been very high; 4.4% a year compared with the national average of 2.8 % (Choiseul Province Medium Term Development Plan, 2009-2011).

[3] http://www.wmo.ch/pages/prog/wcrp/documents/WCRPnews_20080221.pdf

Although one of the larger island in the Solomon Archipelago, Choiseul is considered very remote due to a lack of basic infrastructure such as roads, wharfs, shipping and air services, telecommunications and banking facilities. This lack of basic infrastructure has constrained economic development in the province and also hampers the delivery of basic health and educational services (Choiseul Province Medium Term Development Plan, 2009-2011). The most common (yet very expensive) means of travel around Choiseul's coastlines is via small dinghies that are typically powered by a 25 or 40 HP outboard engine, and a journey from the eastern to western end of Choiseul can take up to 10 hours.

Choiseul communities have limited income earning opportunities and they are heavily dependent on their natural resources for survival and as a means of generating cash. Over 90% of households in Choiseul have subsistence gardens and over 86% are engaged in subsistence capture of finfish (National Census, 1999). More than 80% of households are also involved in small scale copra production, and high-value, non-perishable marine export products such as beche-de-mer (dried sea cucumber), trochus and shark fin are particularly sought after commodities. Other sources of income include logging royalties, small scale timber production, remittances from family members working in urban centres in Solomon Islands and the limited sale of vegetables and finfish.

1.2.2 Biodiversity

Choiseul contains some of the largest remaining stands of lowland rainforest in the Pacific (McClatchey et al. 2005), and these forests support a greater biodiversity than any other province in the Solomon Archipelago (Diamond and Mayr 1976, Morrison et al. 2007, Keppel et al. 2010). Choiseul also had some of the highest coral and fish diversity of any of the provinces surveyed in the 2004 Solomon Islands REA (Green et al., 2006), and has remained virtually unaffected by coral bleaching events and crown of thorn starfish outbreaks that have detrimentally affected nearby regions such as the Autonomous Region of Bougainville and New Ireland Province in Papua New Guinea, in the past decade (Hamilton, personal obs; Hamilton et al. 2009).

1.2.3 Threats

Forestry is the only major commercial activity in Choiseul and there are more than ten logging companies currently in operation, and fifteen licensed saw mills. The province is currently the third largest log producer in the country, and it is the last major island in Solomon Islands that has significant remaining stands of lowland forest that are suitable for logging. There are no mines in Choiseul; however exploratory mining is currently being conducted in east Choiseul by the Sumitomo Mining Company (Choiseul Province Medium Term Development Plan, 2009-2011).

No commercial fisheries operate in Choiseul waters and currently there is only one operational fisheries centre in Choiseul that purchases fish off local fishers. Lack of markets coupled with the extended distances to local markets means that in many communities in Choiseul fishing for reef fish remains predominantly for "kaikai no mo" (for food only). A 2004 marine assessment of the Solomon Islands revealed that food fish populations were healthy in Choiseul province, a pattern that was not seen in some of the other major provinces in Solomon Islands that have higher human populations and historically have had higher levels of artisanal and commercial fishing (Green et al., 2006). In contrast, valuable marine invertebrates in Choiseul were severely over exploited, a trend that mirrored all other surveyed regions in the Solomon Islands (Ramohia, 2006).

The very high level of dependency that the Choiseul population has on natural ecosystems and the resources that they provide also make these communities extremely vulnerable to natural disasters and impacts of climate change. This was made starkly apparent on the 2nd of April 2007, when an earthquake of magnitude 8.1 struck the western region of Solomon Islands, unleashing a tsunami with a wave height of 2-10m that caused severe damage along the coastal areas of Western and Choiseul Provinces. The 2007 tsunami affected almost half of Choiseul's population, resulting in loss of life and the widespread destruction of homes, schools and property (Choiseul Province Medium Term Development Plan, 2009-2011). The tsunami also impacted detrimentally on food security, destroying subsistence gardens and reducing the abundance of food fishes in some areas of South Choiseul (Hamilton et al., 2007). Unanticipated flow on effects of the tsunami include the contamination of water supplies in large coastal villages such as Sasamungga due to a proportion of the coastal community relocating further inland (up stream) and contaminating streams. This movement is due to fear of future tsunamis and a therefore a reluctance to resettle on the coast (Choiseul Province Medium Term Development Plan, 2009-2011).

2 Conservation in Choiseul

2.1 Traditional management

In Choiseul virtually all land and shallow seas come under traditional ownership, often referred to as customary tenure. Customary tenure is a situation in which identifiable groups of people have informal or formal rights to land and sea areas, where their rights to use and access resources are, in principle, excludable, transferable, and enforceable, either on a conditional or permanent basis (Ruddle, 1996). Many communities in Choiseul continue to retain strong control over their traditional land and sea areas, and this provides an existing culturally recognized ownership structure around which community based conservation incentives can be based.

In the past Choiseul communities had numerous traditions and customs relating to the access and management of their natural resources, and today some of these practices persist. One of the most common forms of customary management is when communities ban the harvest of trochus and beche-de-mer on a reef for a period of months or years. Closures are declared by the chiefs and church leaders, and once closed reefs are considered tambu (sacred or off limits) until reopened by the leaders. In Choiseul fishers often adhere closely to closures out of respect and also out of fear, as it is widely believed that it would be very bad luck to break the tambu.

When these customary closures are lifted the valuable macro invertebrates are normally intensively harvested over several days in order to raise cash for important community events such as the building of a church or a school building. It is important to note that in most cases these customary closures represent stockpiling of valuable community resources, as opposed to the western concept of biodiversity conservation (Hamilton, 2003b).

2.2 Contemporary conservation

The first international environmental NGO[4] to work in Choiseul Province was The Nature Conservancy (TNC). TNC began working in Solomon Islands in 1992, with its initial work being to facilitate the establishment of the Arnavon Islands Marine Conservation Area (ACMCA). The ACMCA consists of 15,800 hectares of protected islands and sea, and it is located between Choiseul and Isabel Province. It supports one of the largest remaining rookeries of hawksbill turtles in the world. The ACMCA was established in partnership with the Katupika and Wagina communities (Choiseul Province), Kia community (Isabel Province), Choiseul and Isabel provincial government and the national government of Solomon Islands.

In 2000 TNC began to expand its program in Choiseul beyond the Arnavons. It did this by forming a partnership with the Lauru Land Conference of Tribal Communities (LLCTC). The LLCTC is a grassroots ecumenical non-government organization that has strong community support throughout Choiseul. From 2000 onwards TNC personnel attended the LLCTC annual

[4] WWF and Live and Learn have also been conducting conservation programs in Choiseul Province in the past decade

conference and gave environmental presentations, and in 2003 a Memorandum of Understanding was signed between TNC and the LLCTC, where both parties formally announced their intentions to work together on issues of common interest such as conservation, natural resource management and sustainable development within the Province of Choiseul. In the same year TNC staff also began engaging and working with Provincial fisheries staff on marine awareness-raising initiatives in Choiseul Province.

By 2005 this partnership resulted in the establishment of an environmental office within the LLCTC headquarters (located near Taro), the formation of a LLCTC Environmental Committee and employment of a full time LLCTC/TNC Environmental Community Conservation Officer. The LLCTC/TNC Environmental Community Conservation Officer is the primary point of contact for local communities. Since 2005 the environmental program has focused predominantly on marine conservation, and TNC, LLCTC and provincial fisheries have worked to assist nine local communities in establishing Locally Marine Managed Areas (LMMAs) on their traditional reefs (Figure 7). The establishment of these nine community based MPAs have been community driven initiatives.

2.3 Choiseul Engagement Process

In Choiseul the process of engagement has been as follows:

- Communities that are interested in conserving a proportion of their customary marine estates write to the LLCTC/TNC Environmental office asking for assistance in establishing a protected area. Frequently the community will already have areas of interest in mind (i.e. an island and surrounding reefs), and in such cases, all of the traditional owners that have a primary claim to this area will sign the letter stating that the proposed conservation area is free from tenure dispute.

- The LLCTC/TNC Environmental officer then visits the community that is interested in conservation. The environmental officer provides conservation awareness and advice, explains the role of LLCTC and TNC, and makes a preliminary assessment of the biodiversity value of the area. The environmental officer also makes an assessment of how ready a community is to engage in conservation, taking into account any cultural or political factors that may affect the success or failure of the proposed area.

- If communities and partners decide to proceed, a baseline survey is conducted for the area of interest and surrounding areas[5]. This typically involves a team of 6-10 individuals (made up of TNC, LLCTC, Choiseul Provincial fisheries officers and other NGO staff i.e. WWF staff) who conduct scientific assessments on the status of coral, reef fish and macro invertebrates in the area.

[5] In many cases communities establish LMMAs before baseline studies are undertaken

- On completion of the survey the assessment team provides immediate feedback to the community. Advice is given on the suitability of the proposed area for meeting its objectives (as determined by the community) given the size, habitat connectivity and general condition of a proposed area relative to other surrounding areas.

- The community then takes the time it needs to reach a consensus of what area to conserve based on their preferences and the advice they have received. At times feedback on the results of scientific surveys has resulted in communities abandoning a proposed area and choosing new areas that support higher biodiversity, or extending the boundaries of a MPA so that it encompasses a broader range of connected habitats. Once a consensus is reached then the Chief will declare that the area is closed, and community members and neighbouring communities are informed of the closure through Church services[6]. To date all of the existing LMMAs (Figure 7) have been established as permanent closures.

- The LLCTC/TNC environmental office builds ongoing interest in conservation efforts by a range of activities including; facilitating exchanges, assisting communities to become part of the Solomon Islands LMMA network, community monitoring programs and through feedback at the LLCTC annual meetings.

2.4 Recognition of the need for Province wide conservation planning

By 2008 there was a ground swell of interest and enthusiasm for establishing both marine and terrestrial conservation areas in Choiseul. Other NGO's including WWF and Live and Learn were also actively involved in initiatives within the Province. This enthusiasm was self propagating, being fed by stories of communities success; in particular about how the establishment of LMMAs had quickly led to resource recovery within the LMMA boundaries, as well as resulting in better catch rates in nearby open areas. The LLCTC Environmental office was receiving many more requests for assistance than it could manage. It was decided that a better knowledge of the biodiversity, threats and opportunities in Choiseul were required, so that implementation of future conservation areas by the LLCTC and partners could be carried out in a more strategic and meaningful manner.

2.5 Stakeholders conservation planning workshop

To initiate this process LLCTC, TNC and the Choiseul Provincial Government held a stakeholders conservation planning workshop in Taro from the 19th – 21st of May 2009. This workshop brought together stakeholders from each ward of Choiseul, Choiseul Provincial Government staff and representatives from the Ministry of Fisheries and Marine Resources and the Ministry of Environment, Conservation and Meteorology. TNC staff with expertise in conservation

[6] If tenure disputes arise after the establishment of a protected area, conservation activities are suspended and the dispute is mediated by LLCTC. Once the dispute is resolved conservation activities can resume.

planning, GIS, climate change and Choiseul's marine ecology attended, along with representatives from other environmental organisations such as WWF and Live and Learn.

On the first day of the workshop facilitators outlined the need to plan for sustainability and climate change, and also explained the types of information that are required for this process. On the second day participatory mapping of the marine and terrestrial biodiversity in Choiseul was conducted. This involved stakeholders identifying areas of land and sea that are of high conservation or cultural value to them (Figure 3). The meeting was divided into three groups, covering the western, middle and eastern section of Choiseul. Large format colour base maps illustrating existing terrestrial (vegetation) and reef data, rivers, roads and major communities at 1:70,000 scale were provided to each group and conservation features and threats were delineated and labelled by the community leaders using participatory mapping. These base maps were then returned to Brisbane and all line features digitized to create GIS files for all community based features. This resulted in the mapping of 78 categories (conservation features, threats, and opportunities). Twenty-five of these categories were deemed suitable for inclusion in the analysis (Figure 4, Appendix 1) as well as threats (Appendix 2). Categories that were too general (e.g. corals, bush rope, bamboo) were not used. On the third day the threats to biodiversity (i.e. sea level rise, proposed logging and mining activities, fisheries) and opportunities (i.e. existing protected or managed areas) were also identified through participatory mapping.

Figure 3: Participatory Mapping - Community leaders map important conservation features across Lauru

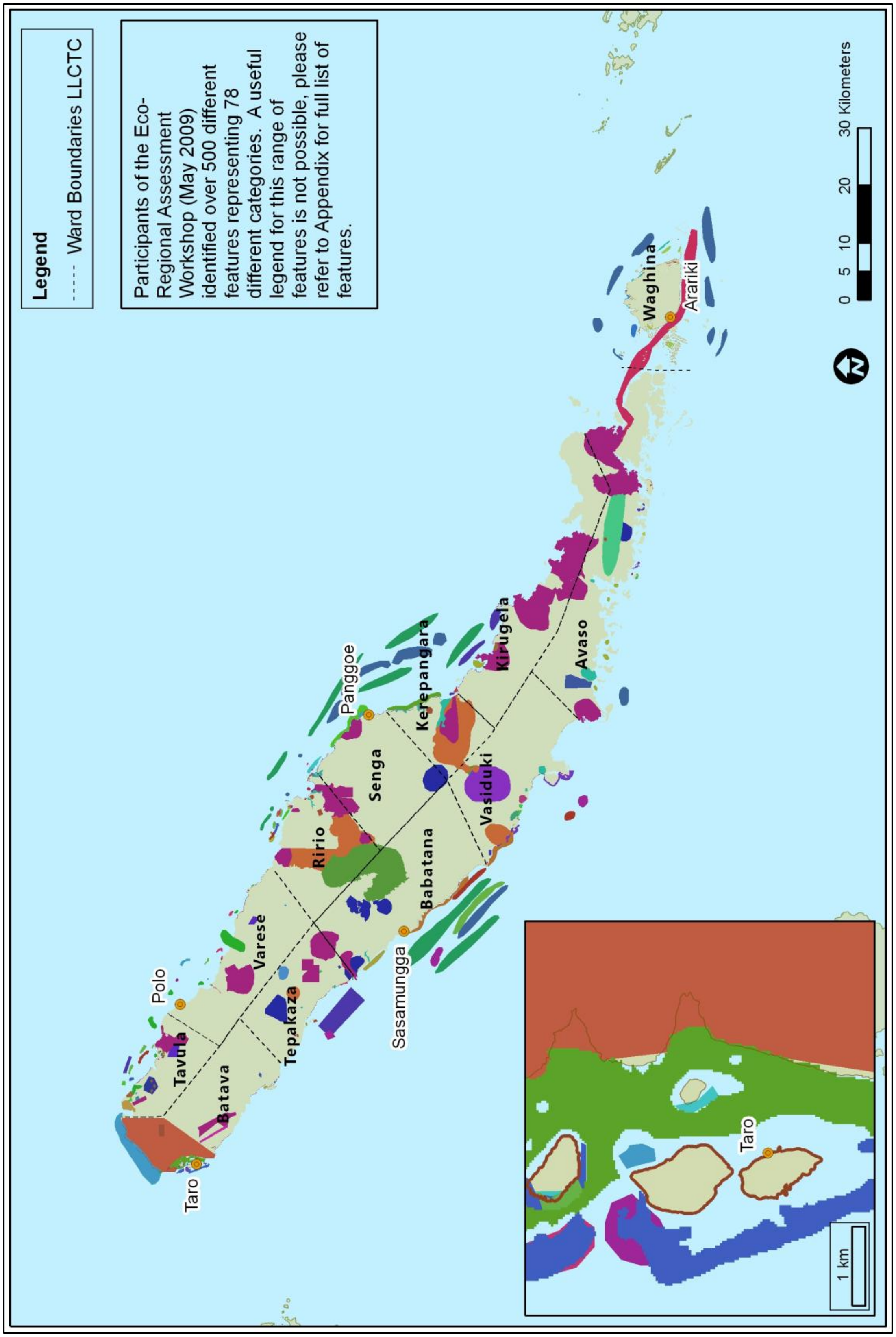

Figure 4: Local features identified by participants at LLCTC meeting in May 2009. These include conservation features, threats, and opportunities

3 Conservation planning

3.1 Introduction

The Solomon Islands are a signatory to the Convention on Biodiversity (CBD) which requires that member Nations set aside at least 10% of their country in protected areas to slow the global loss of biodiversity. The CBD Program of Work on Protected Areas (PoWPA) was adopted by the 7th CBD Conference of Parties in 2004. It is a global action plan to address the impediments to the establishment of at least 10% of each country as protected areas. In 2004 this ambitious program included 92 activities. In 2005-2007 UNDP-GEF redefined PoWPA to a set of 13 priority PoWPA activities. One of the 13 priority activities is Activity 1.1.5: *Complete protected area system gap analyses at national and regional levels based on the requirements for representative systems of protected areas that adequately conserve terrestrial, marine and inland water biodiversity and ecosystems.*

Solomon Islands have no formal protected areas criteria with the exception of several themes in the 2008 SINBSAP:

- Theme 3: Solomon Islands government is fully committed to a National Protected Area System by developing appropriate legislation and Protected Area design.

- Theme 10: To ensure that pressures, impacts and mitigation measures of climate change are adequately supported and addressed to conserve the country's biodiversity.

3.1.1 Conservation Criteria for Ridges to Reefs Protected Area Network

In the absence of any formal criteria for the Solomon Islands, we used the following draft criteria, based broadly on Nationally agreed criteria for forests in Australia (Commonwealth of Australia 1997), but modified to accommodate the immediate need to consider climate change impacts. These draft criteria provide a starting point for the development of a comprehensive, adequate representative and resilient protected area system for Solomon Islands. In addition, adopting a ridges to reefs approach, recognizes that what we do on the land has a profound effect on our streams, rivers and near shore areas and seeks to minimize these impacts.

3.1.1.1 Biodiversity

- 10% of the original extent of each ecosystem type (terrestrial and marine)

- All remaining occurrences of rare and endangered ecosystems should be reserved or protected by other means as far as is practicable. A rare ecosystem is one where its geographic distribution involves a total range of generally less than 500 ha.

- Replication - protected areas should be replicated across the geographic range of the ecosystem to decrease the likelihood that chance events such as wildfire or disease will cause the ecosystem to decline.

- Species and other elements of biodiversity - The protected area network should seek to maximize the area of high quality habitat for all known elements of biodiversity wherever practicable, but with particular reference to:
  - the special needs of rare, vulnerable or endangered species;
  - special groups of organisms, for example species with complex habitat requirements, or migratory or mobile species;
  - areas of high species diversity, natural refugia for flora and fauna, and centres of endemism; and
  - those species whose distributions and habitat requirements are not well correlated with any particular ecosystem.

3.1.1.2 Climate Change

The Protected Area Network should seek to ensure the resilience of ecosystems to the impacts of rapid climate change by:

- Increasing CBD Target to 20% to improve adequacy in anticipation of climate change. Protected areas act as an insurance policy for vulnerable communities. They provide essential ecosystem services such as food and freshwater security and the first line of defence against the climate change impacts such as sea level rise (e.g. barrier reefs, mangroves and fore dunes). They also provide the co-benefit of conserving biodiversity.

- Conservation targets should be elevated 95% for conservation features most vulnerable to the impacts of climate change (e.g. turtle nesting beaches).

- Using a ridges to reefs approach recognizes that what we do on the land has a profound effect on our steams, rivers and near shore areas and seeks to minimize these impacts. This reinforces the resilience of nearshore ecosystems such as mangroves and reefs.

3.1.2 This Analysis

The following ridges to reefs conservation assessment and products, represents a synthesis of the best available spatial and locally derived data. In its simplest form, a gap analysis involves comparing the distribution of biodiversity with the distribution of protected areas and finding where species and ecosystems are left unprotected or under protected (Dudley and Parrish, 2006). To address these problems in a systematic way, the concept of ecological representation was developed. This refers to the need for protected areas to represent, or sample, the full variety of biodiversity of different biological realms (freshwater, marine and terrestrial through all the ecoregions) and biological scales (ecosystems, species and within-species variation) (Noss, 1995).

3.1.3 Marxan decision support

Conservation planning requires the effective representation or sampling of many different conservation features, all with very different spatial distributions. It also requires the consideration of many threats and opportunities for the protection and effective management of those conservation features. In order to make the choices regarding which areas are better to protect, you need a fundamental unit of choice, or planning unit. Across the Choiseul study area we generated a planning unit layer that consisted of 15,788 - 50 ha hexagons (Figure 5). This allows us to compare one area with another across Choiseul so that we can determine those areas that best capture the biodiversity we seek to protect. Determining conservation priority areas that efficiently sample the biodiversity of Choiseul requires the selection of those planning units that satisfy a number of ecological criteria (outlined above in section 3.1.1). In this case, our biodiversity targets for each conservation feature and the effective consideration of the cost layer which incorporates those areas where it would be less appropriate to protect.

We used Marxan to assist us with the many decisions required to determine the most important areas to protect and manage in order to meet the 10% and 20% targets. Marxan is a decision support tool developed specifically to assist with complex conservation planning problems (Ball and Possingham 2000, Possingham et al. 2000). Specifically, we used Zonae Cogito a more user friendly version of Marxan (Watts et al. 2010). Marxan and its variants have been used to assist with 100's of conservation planning initiatives around the world. It is designed to help synthesize and automate the selection process for large amounts of different data so that many different scenarios can be developed and explored. In order to deal with often conflicting biodiversity, threat and opportunity data we need to have well defined targets. These conservation targets are then sought in a way that the conservation priorities developed result in minimal impact on community interests. Conservation priorities are preferentially selected in areas where communities have expressed an interest in conservation.

The key inputs used in the Marxan runs were:

- Planning Units: 15,788 50 ha hexagons (Figure 5)
- Stratification of Marine Targets (Figure 6)
- Terrestrial Conservation Features: 89
- Marine Conservation Features: 114
- Local Conservation Features: 25
- Conservation Targets: 10% and 20% with rare and vulnerable features to 50% or 95% (Appendix 1)
- Cost surface based on boundary length
- 100 runs
- Number of iterations/run: 10,000,000
- Boundary Length Modifier: 0.35
- Penalty Cost: 5 (Set equally across all conservation targets which means all targets were weighted equally)
- Temperature decreases: 10,000
- Adaptive annealing “on”
- Using simulated annealing

A more detailed description of the key inputs is detailed in following section. For a complete description on the use of Marxan see Game and Grantham (2008).

3.2 Methods

3.2.1 Planning Area, stratification, planning units

The planning area includes all the islands of Choiseul Province and all near shore, reef and shelf waters out to the 200m depth contour (derived from GEBCO bathymetry data)[7].

Planning units provide the individual unit of choice for selection. We generated a planning unit layer that consisted of 15,788 - 50 ha hexagons across the entire study area (Figure 5). The 50 ha size is approximately the size of the smallest protected areas in Choiseul. It is also a fine enough scale to allow the development of refined areas while simultaneously keeping the number of planning units constrained to a number where the processing time in Marxan was manageable.

The stratification provides the overarching template within which each target is sought. This ensures that representation, geographic spread and replication are effectively incorporated in the analyses. The marine areas were stratified into four regions: northeast, northwest, southeast and southwest (Figure 6) to capture the variation in reef structure, currents and seasonal variation in prevailing winds (based on expert opinion Hamilton and Ramohia pers. comm.). Terrestrial area was not stratified as it forms one largely homogenous unit.

[7] http://www.gebco.net/

Figure 5: Planning Units

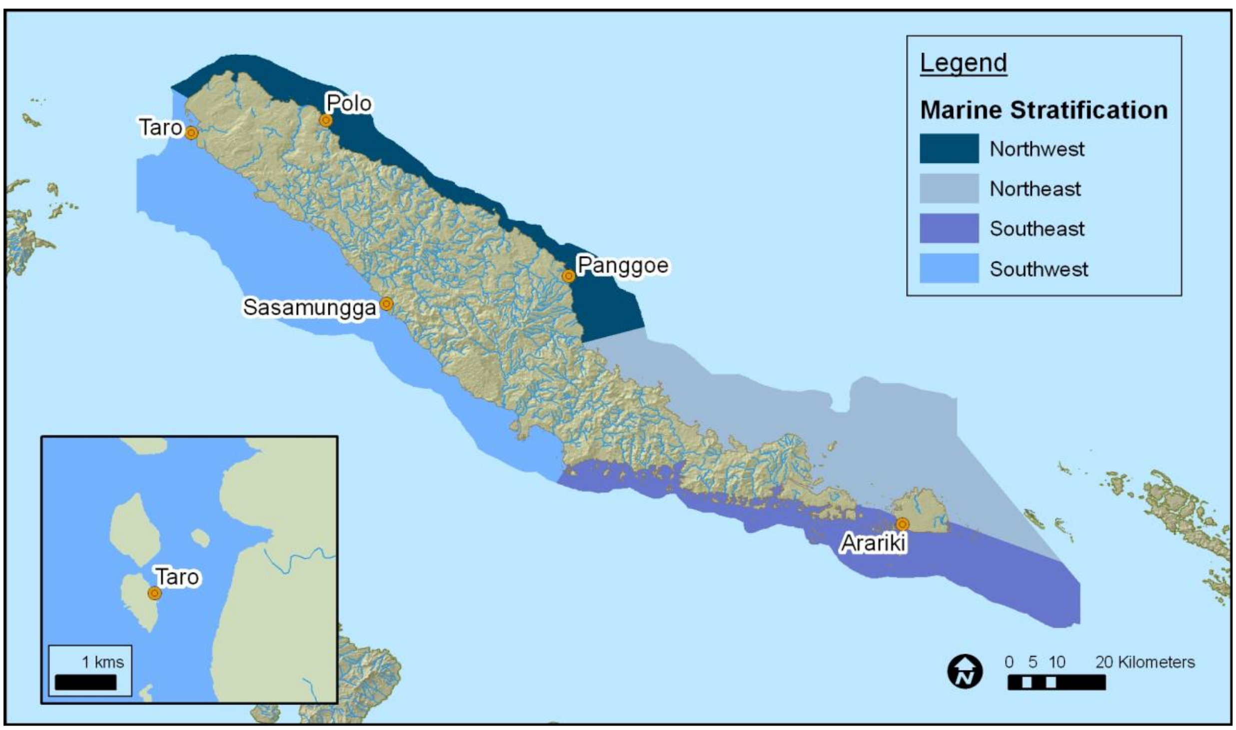

Figure 6: Marine Stratification

3.2.2 Existing Protected Areas

Less than 1% of Choiseul's land and sea is currently or is proposed under some form of protection or management. To date there are nine Locally Managed Marine Areas (1,618 ha); five existing managed or protected areas (1,408 ha); and six proposed Forest Protection Areas (4,887 ha) (Table 2, Figure 7). The management designation in the terrestrial protected areas is unknown, the LMMA's are all No Take areas and the marine managed areas have periodic closures which are put in place to allow stocks of trochus and Bech-de-mer the chance to recover. This totals to 7,866 ha of proposed, protected, or managed areas or 1% of the study area.

Table 2: Existing Protected Areas

Name	Designation	ZONING	Hectares
Zinoa	Locally Managed Marine Area	No Take	145
Parama	Locally Managed Marine Area	No Take	348
Redman	Locally Managed Marine Area	No Take	109
Chivoko	Locally Managed Marine Area	No Take	83
Rabakela	Locally Managed Marine Area	No Take	22
Tabubiru	Locally Managed Marine Area	No Take	78
Muzo	Locally Managed Marine Area	No Take	495
Moli	Locally Managed Marine Area	No Take	137
Vacho Islands	Locally Managed Marine Area	No Take	201
		Sub-Total	**1,618**
Katurasele Managed Area	Managed Area - Existing	Unknown	339
Tuzu Managed Area	Managed Area - Existing	Unknown	132
Tandanai Managed Area	Managed Area - Existing	Unknown	374
Chivako Forest Protection Area	Protected Area - Existing	Unknown	516
Managed Area (no name)	Managed Area – Existing	Unknwon	47
		Sub-Total	**1,408**
Vuri Forest Protection Area	Protected Area - Proposed	Unknown	613
Sirebe Forest Protection Area	Protected Area - Proposed	Unknown	559
Padezaka – Forest Protection Area	Protected Area - Proposed	Unknown	448
Kubongava Forest Protection Area	Protected Area - Proposed	Unknown	897
Baukoalo Forest Protection Area	Protected Area - Proposed	Unknown	1,262
Boeboe Forest Protection Area	Protected Area - Proposed	Unknown	1,108
		Sub-Total	**4,887**
		Grand Total	**7,913**

Table 3: Total area figures for Choiseul Province and study area

Total land area for Choiseul Province	330,148 ha
Total sea area for Choiseul (to the 200m depth contour)	437,184 ha
Total land and sea	767,332 ha

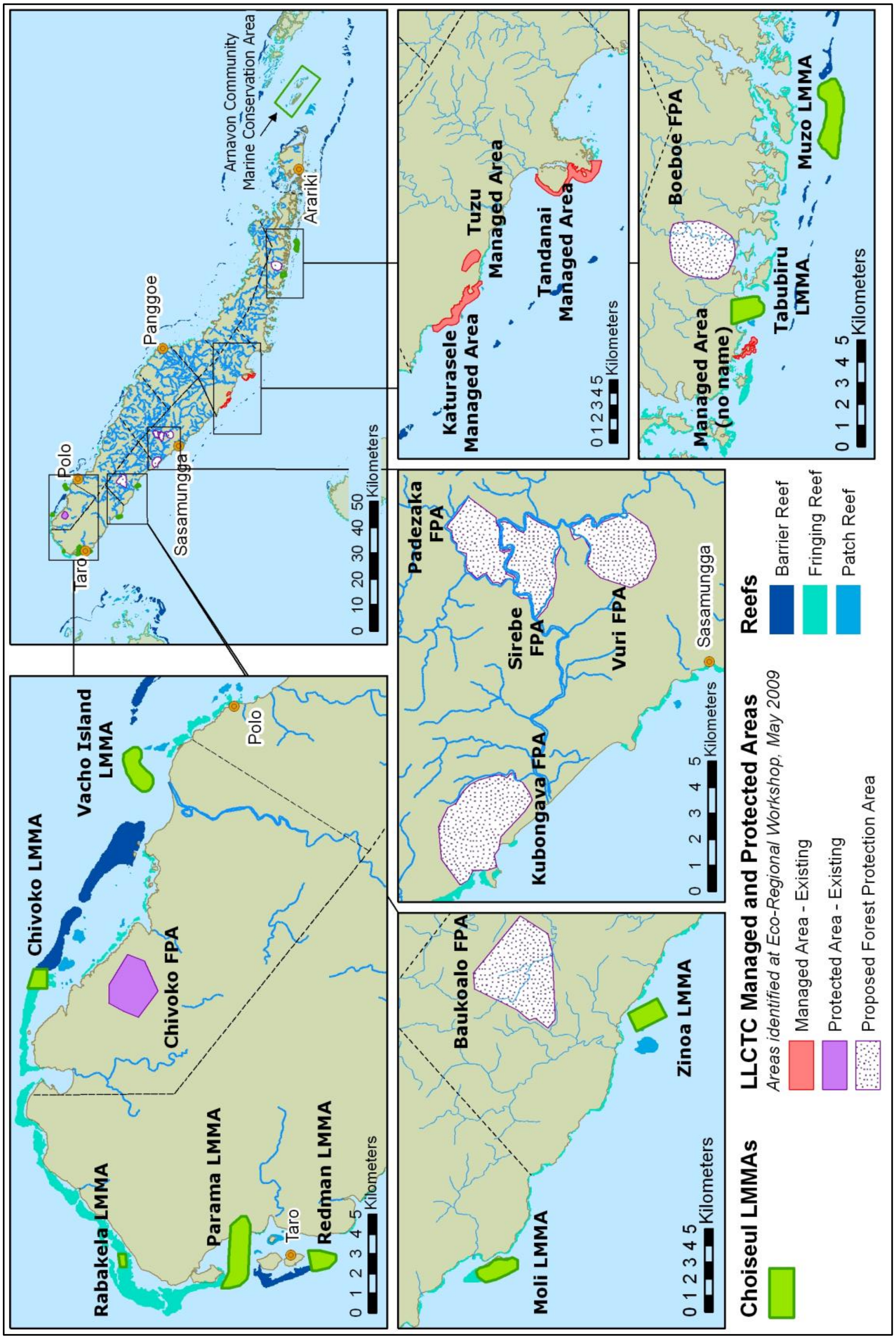

Figure 7: Existing LMMAs and LLCTC Managed or Protected Areas

3.2.3 Conservation Features

We compiled the best available spatial data sets for Choiseul Province that represent marine and terrestrial features, as well as data on threats (e.g. logging and mining). Terrestrial conservation features were sourced from a vegetation classification supplied by the Solomon Islands Ministry of Forestry. Additional spatial data illustrating, roads, rivers, ward boundaries, and village locations was supplied by the Solomon Islands Ministry of Lands in early 2009. A full list of conservation features is detailed in Appendix 1.

3.2.3.1 Marine Conservation Features

A total of 47 marine conservation features were detailed in the Millennium Coral Reef Mapping Project data set (Andréfouët et al., 2005), including coastal shelf, reef and bay complexes (see Figure 8, Appendix 1). The Millennium Coral Reef Mapping Project reef classification is derived from remotely sensed satellite data and processed by Serge Andrefouët and his team at the Institute for Marine Remote Sensing, University of South Florida. These data are freely available and offer the most detailed and complete reef classification. We also obtained data on turtle nesting beaches (based on expert opinion and unpublished data; Peter Ramohia, John Pita and Catherine Siota pers. comm., and LLCTC participatory mapping).

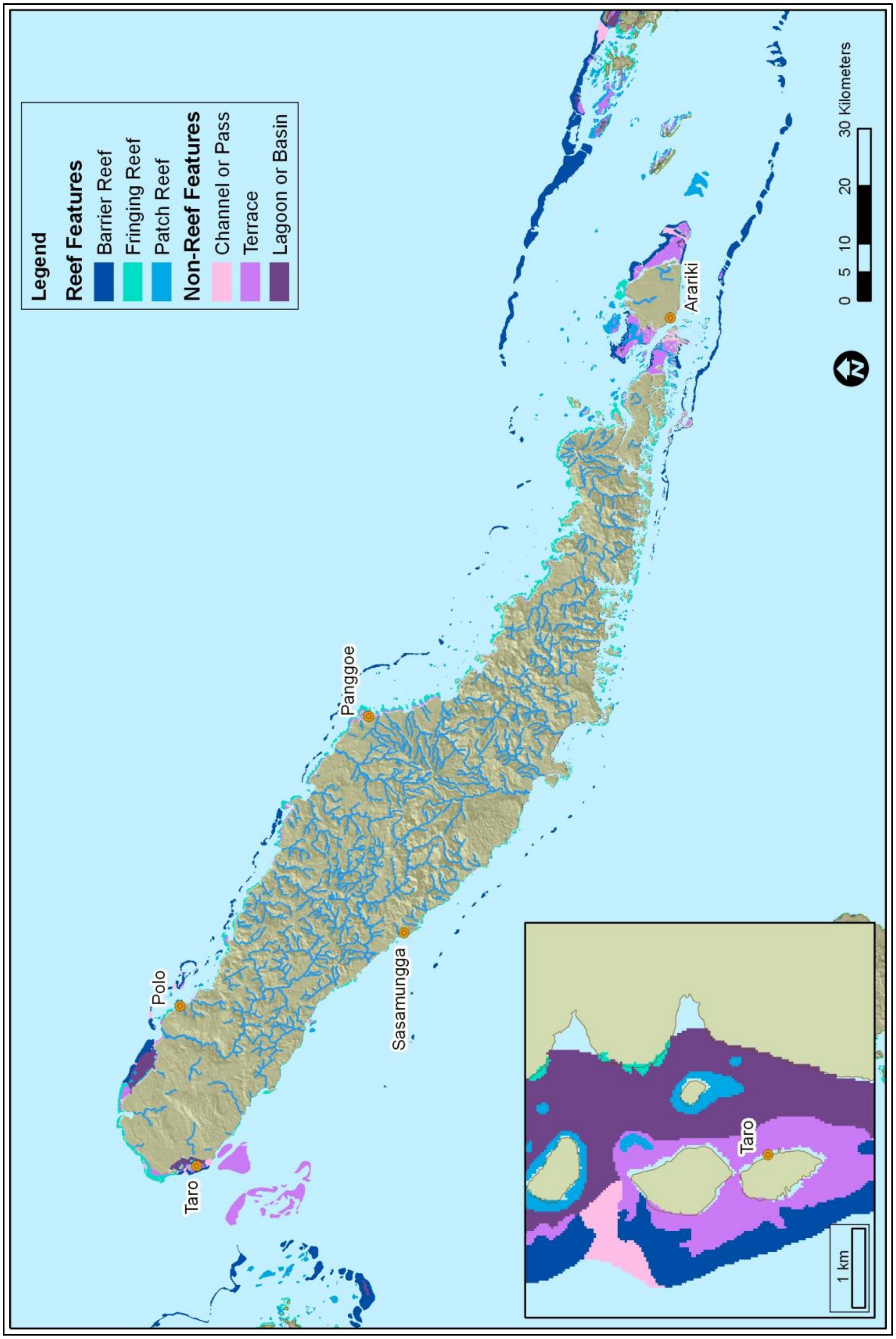

Figure 8: Marine features. Note that only general reef features are shown here. Full classification includes 47 reef types (Appendix 1)

3.2.3.2 Terrestrial Conservation Features

Mueller-Dombois and Fosberg (1998) outlined seven broad natural vegetation types in the Solomon Islands, including: coastal strand vegetation, mangrove forests, freshwater swamp forests, two types of lowland rain forests, seasonally dry forest and grassland (only on Guadalcanal), and montane rain forest.

The vegetation map used in this analysis was based on available forestry mapping. A total of 24 vegetation types and three non vegetation types were delineated within the mapping including: mangrove, swamp, fresh water mixed forests, lowland forest, iron wood (*Hibiscus tileaceous*) forest, hill mixed forest, upper mountain forest, and degraded forests (Table 3,Figure 9).

Choiseul is a structurally and geologically complex island. It has been intensely faulted and has a prominent fracture patterns. The underlying basement rocks are pre-Tertiary metamorphics which originated as basaltic or andesitic lavas and pyroclastics and also significant areas of limestone (Wall and Hansell, 1976).

Vegetation reflects the complex underlying patterns of geology, hydrology and soils (Cox and Moore 2000). Unfortunately, the available vegetation layer does not reflect the complexities of the lithology and geology in Choiseul. In order to better represent the terrestrial biodiversity in Choiseul, we unioned a 1:200,000 geology classification with the existing forestry data.

A 1:200,000 geology map for Choiseul Province, compiled from 1:50,000 map sheets (1977-79) was scanned, attributed and converted to a shape file for the analysis. The initial geology classification included 22 classes: two swamp classes, three alluvium classes, eight Limestone or calcite formations, three mixed formations, two volcanics, one ultramafic, one schist and two basalts. This classification was simplified (Table 4) based on expert opinion (Malcolm Cox QUT pers. com.) to produce five broad geology types (Figure 10). These were then unioned with the vegetation data layer to give a refined vegetation classification of 89 vegetation types that would more reasonably reflect vegetation and geology (Appendix 1).

Table 4: Vegetation Types

Number	Vegetation Type
1	Upper Mountain Forest
2	Hill Campnospemna dominated forest
3	Hill mixed forest of small canopy sizes
4	Hill mixed forest of medium canopy sizes
5	Hill mixed forest of various canopy sizes
6	*Hibiscus tilicius* dominated forest of small canopy sizes
7	*Hibiscus tilicius* dominated forest of medium to various canopy sizes
8	*Hibiscus tilicius* dominated forest of various canopy sizes
9	Fresh water Campnosperma dominated lowland forest
10	Fresh water mixed forest of small canopy sizes
11	Fresh water mixed forest of medium canopy sizes
12	Fresh water mixed forest of various canopy sizes
13	Fresh water mixed Lowland Forest of various canopy sizes
14	Fresh water Terminalia dominated of small canopy sizes
15	Fresh water Terminalia dominated of medium canopy sizes
16	Fresh water Terminalia dominated of various canopy sizes
17	Fresh water pandanus dominated forest
18	Lowland mixed forest of medium canopy sizes
19	Lowland mixed forest of various canopy sizes
20	Herbaceous swamp, mixed species composition
21	Saline mangrove forest
22	Hill degraded forest
23	Fresh water degraded forest
24	Lowland degraded forest
25	Braided River courses
26	Cloud obscured
27	Non forest areas

Table 5: Geology Types. Values in Geology Type I are from the source map and have been grouped into Geology Type II.

No.	Geology Type I	No.	Geology Type II
1	Freshwater Swamp	1	Mud, silt, sandy-silt
2	Mangrove Swamp		
3	Alluvium		
4	Alluvium (coralline debris)	2	Reef rocks and rubble (limestone)
5	Backreef and lagoonal facies		
6	Reef limestone		
7	Nukiki Limestone Formation: Backreef and lagoonal facies		
8	Nukiki Limestone Formation: Raised reef limestone		
9	Mount Vuasa Limestone Member		
10	Maetambe Volcanics, Komboro Volcanics	3	Volcanic rocks and rubble (iron rich)
11	Alluvium (basaltic debris)		
12	Voza Lavas: Basalts, sheared		
13	Voza Lavas: Basalts, massive and pillowed		
14	Pemba Formation: Mbani Calcisiltite Member	4	Hard sedimentary rocks
15	Pemba Formation: Sui Calcarenite Member		
16	Calcisiltites within Tpp-Pemba Formation		
17	Vaghena Formation		
18	Undifferntiated siltstones, sandstones, and conglomerates		
19	Koloe and Sanggighae Breccia Members		
20	Oaka Metamicrogabbro	5	Metamorphic rocks
21	Siruka Ultramafics		
22	Choiseul Schists		

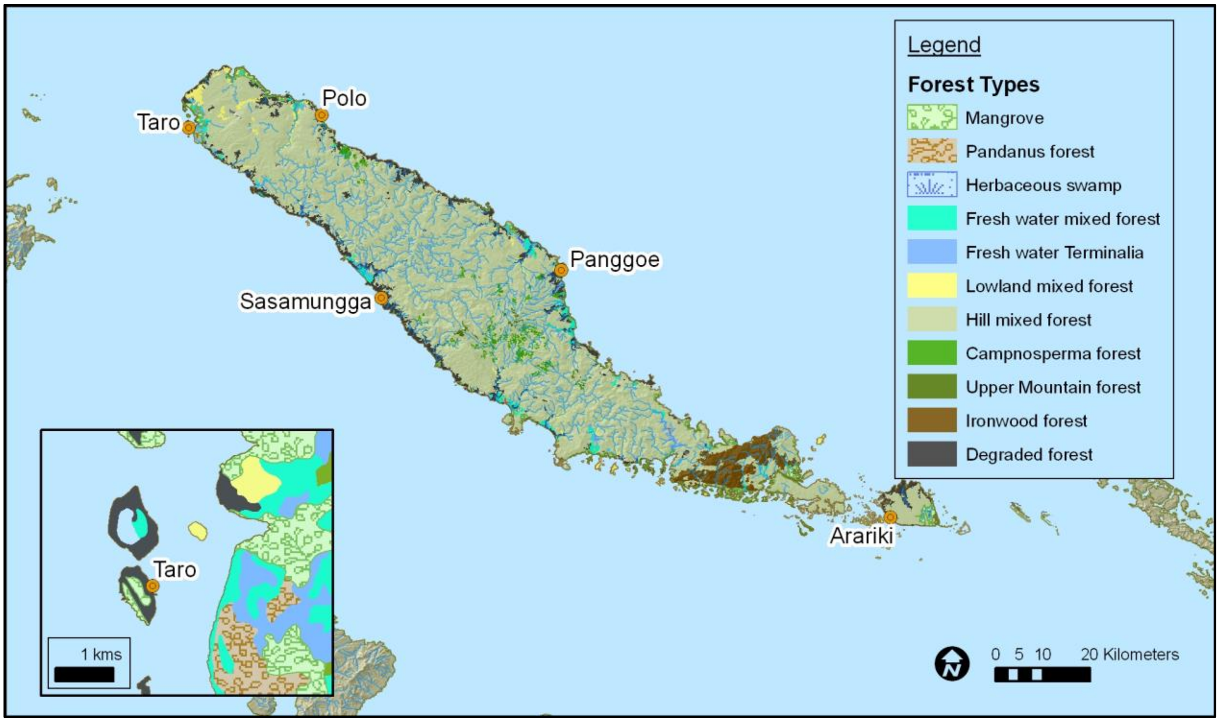

Figure 9: Broad vegetation types

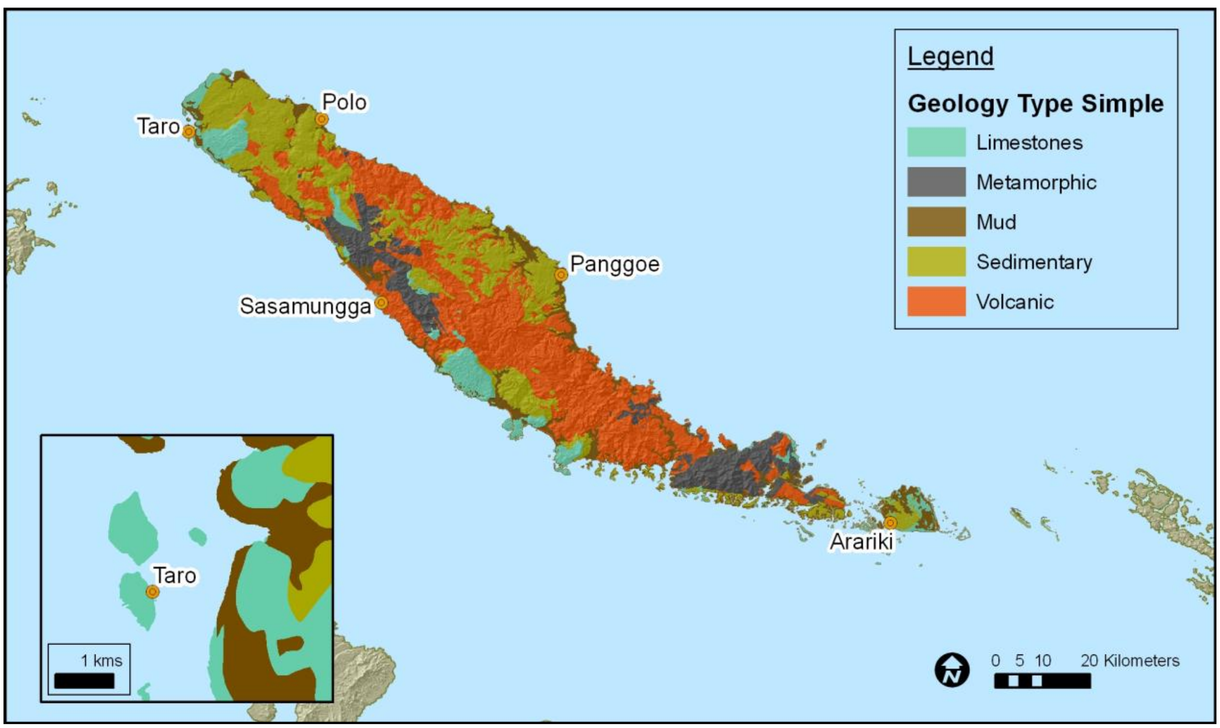

Figure 10: Simplified Geology

3.2.3.3 Discounting

Forests were discounted to reflect their relative quality/condition in terms of their ability to support biodiversity. A number of assumptions were made regarding the condition of the forest based on different known management regimes. It was assumed:

- Intact forests provide the highest quality habitat for supporting biodiversity
- Logged forests provide less suitable habitat for biodiversity, and
- Plantation forests provide the least suitable habitat for biodiversity.

The aim here was to approximate current forest condition to provide a meaningful gradient from undisturbed forest to disturbed forests and to clearly delineate those areas unsuitable for protection from those that are more suitable for protection. Within the existing schema we assigned the following discounting (Table 6) for forests based on logging activity (within vegetation data). Classes detailed below are based on available logging history data and modified based on local knowledge.

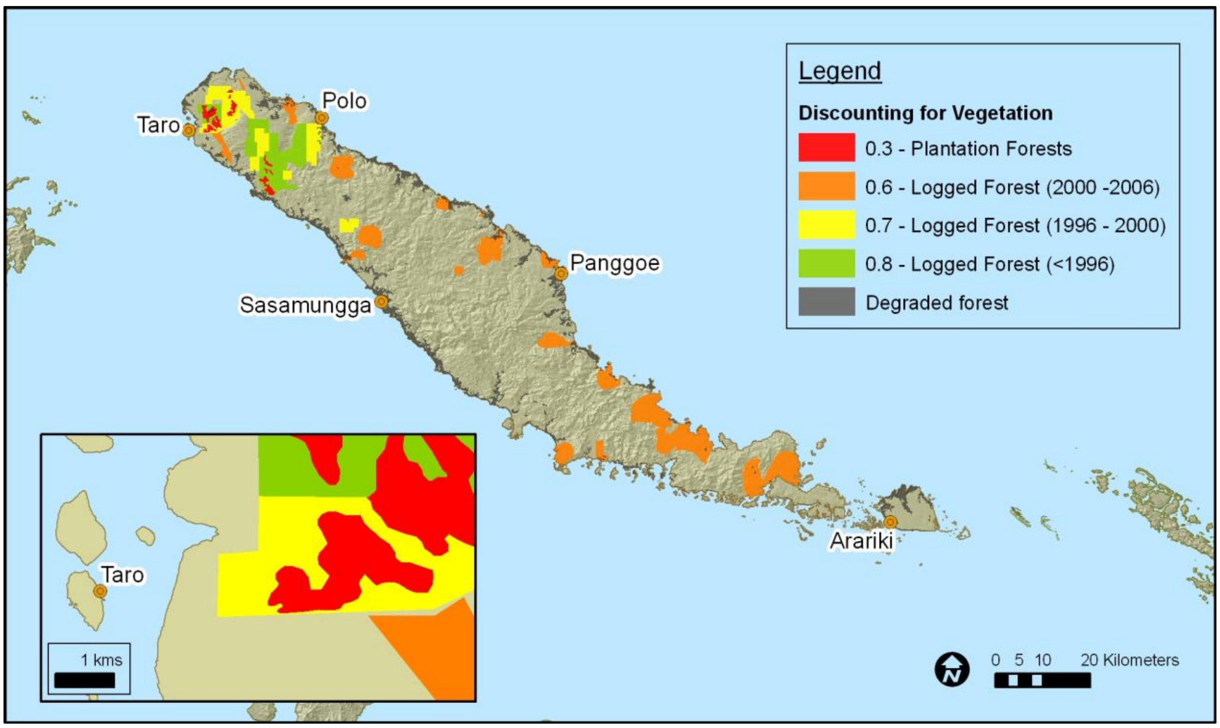

Figure 11: Discount rate for vegetation types. Note that Degraded forest was not discounted, but rather was not given a target in the Marxan analysis.

Table 6: Discount rates for logged areas

Land Use Intensity Class	Status 2009
Unlogged Forest	1.0
Logged Forest 2000-2006	0.6
Logged Forest 1996-2000	0.7
Logged Forest <1996	0.8
Plantation Forests	0.3

3.2.4 Conservation Targets

Conservation targets were set according to the Conservation Criteria outlined in Section 3.1.1 (page 14) for all conservation features. A simple 10% and 20% targets based on original extent were assigned to all conservation features (terrestrial, marine and community). However, for conservation features that were vulnerable to sea level rise (i.e. turtle nesting beaches) or of crucial importance to local communities such as such as transient fish spawning aggregations and megapode nesting areas, targets were increased to 95% (Appendix 1). Broadly delineated community features (dolphins, sharks, etc) and non conservation features such as degraded forests and non forest areas were not used as targets (Appendix 1).

3.2.5 Cost Surface

The cost of including each planning unit in the protected area network was determined simply by the area of each planning unit in hectares, minus the proportion of the planning unit with conditions highly conducive to rapid inclusion in the protected area network. These include sites that are proposed but not yet gazetted protected areas, sites already managed by communities for natural resources, and sites where communities have previously indicated their support for the establishment of a protected area. Sites already formally declared protected areas were considered a non-negotiable part of the Lauru Protected Areas Network.

3.3 Results

3.3.1 10% Target Option

Based on the criteria detailed above we developed a 10% option for Choiseul Province. This Marxan scenario represents a summary of 100 different but equally valid scenarios to meet the 10% goal. It identifies priority areas for protection and management based on a 10% target for all conservation features (Figure 12). The different colours provide a gradient from those areas most required in order to meet the 10% representation target (blue), to those areas least required to meet a 10% representation target (yellow). Another way of describing this is:

- Blue Areas - represent the core areas that you would need in any protected areas network (i.e. little flexibility). These areas occur in 90 out of 100 different scenarios.
- Red areas - represent important areas, but you have some flexibility in terms of which areas to choose. These areas occur in 60 out of 100 different scenarios, and
- Yellow areas - are still important, but you have the most choice and most flexibility regarding which planning units to include in your protected area network. These areas might occur in 10-20 out of 100 different scenarios.

3.3.2 20% Target Option

Based on the criteria detailed above, we also developed 20% option for Choiseul Province (Figure 13). The 20% scenario adopts a precautionary approach and recognises the uncertainty around the impacts of climate change and equally how biodiversity will respond to those changes. By increasing the adequacy of the protected areas network, we increase:
the first lines of defence against sea level rise (mangroves, fringing reefs, etc),
intact catchments and fresh water ecosystems to improve freshwater security
greater areas for all marine and terrestrial targets to improve food security, and
provides the added benefit for biodiversity by increasing the adequacy of the protected areas network for species and ecosystems.

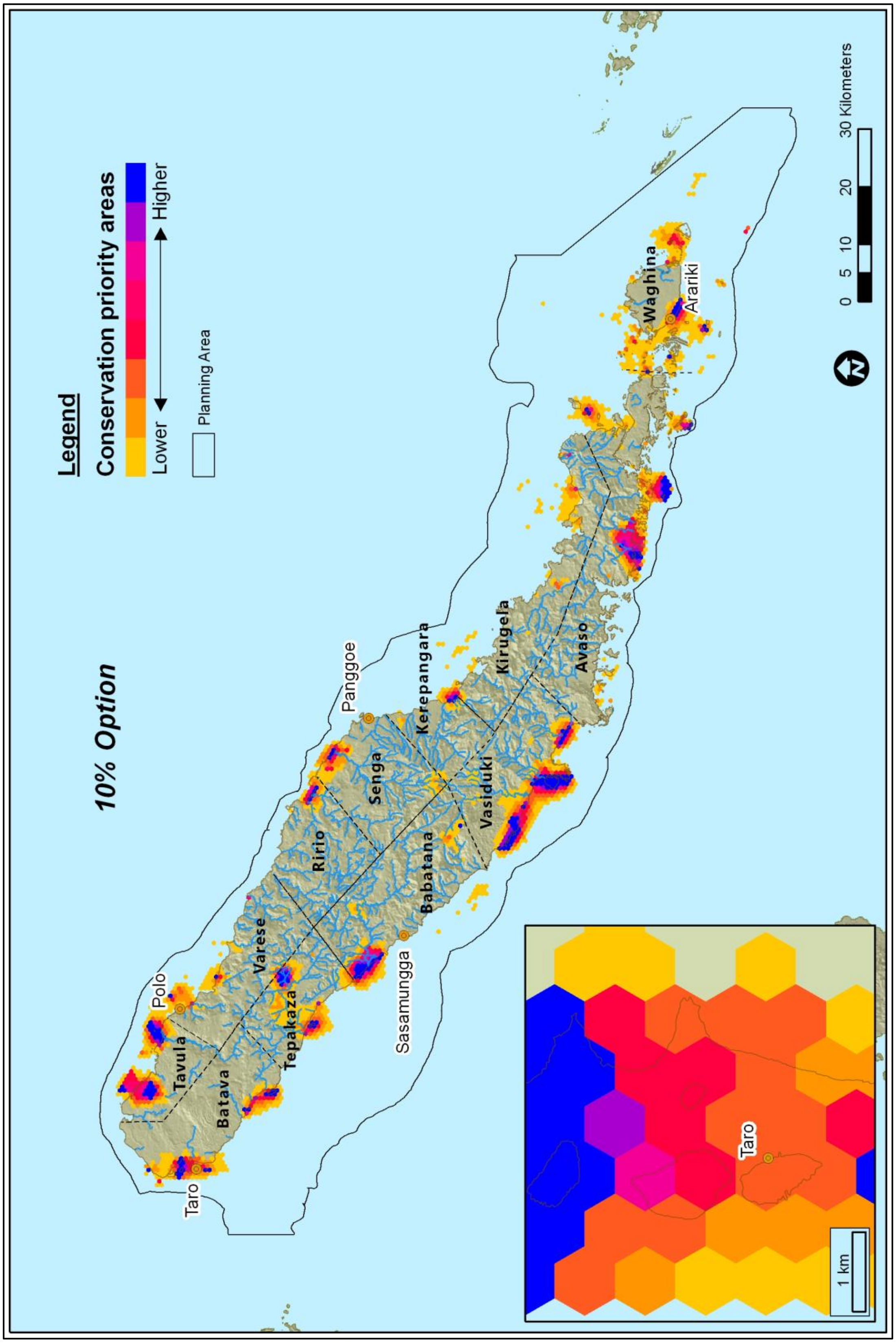

Figure 12: Conservation priority areas - 10 % Option

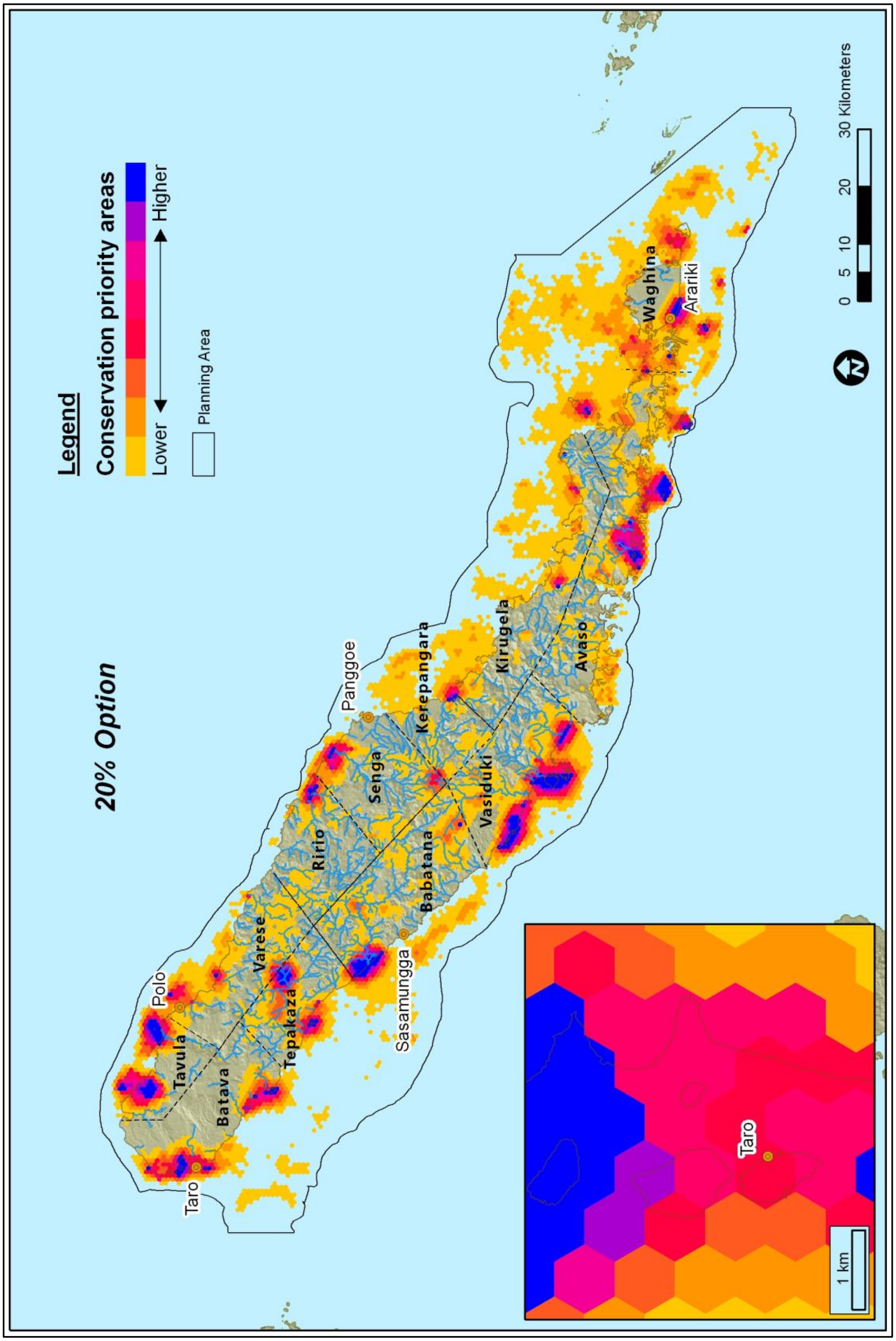

Figure 13: Conservation priority areas - 20 % Option

3.4 Discussion

This report is a living document and represents the first attempt to conduct a stakeholder driven provincial wide conservation planning process in Solomon Islands. It is unique in many ways: Firstly, the planning exercise in Choiseul was undertaken in response to a request from the LLCTC, who represent all of the indigenous leaders of Choiseul. Secondly, it drew heavily on the local knowledge of multiple stakeholders and the best available scientific knowledge. Thirdly, it utilized powerful state of the art software (Marxan) to analyse large and complex data sets and to harmonize local and scientific knowledge to identify conservation priority areas across Choiseul Province.

With the recent commitments of the LLCTC to establishing a LPAN, this conservation plan should be seen by all stakeholders as a tool that can help guide each ward of Choiseul in establishing new marine and terrestrial protected areas. The areas of conservation priority identified in the 10% and 20% Marxan solutions presented in this report should **not** be viewed as the only options for conservation; rather they represent the targets that, if conserved and managed, would most rapidly achieve a LPAN that covered 10 or 20% of the biodiversity of Choiseul Province.

The conservation priority areas identified in this report are based on best available data at the time, and there are limits to these data sets and this analysis. Primary limitations include:

- Some of the data sets (e.g. vegetation) were older data or sampled limited areas (e.g. species data). These data can always be improved and refined and new data should be incorporated as it becomes available.
- We only addressed a subset of simple conservation criteria in this analysis. As the Solomon Islands national government moves towards developing a national set of conservation criteria for Solomon Islands, these new criteria need to be incorporated and addressed in future analyses. These might include: climate change adaptation, climate change mitigation and evaluating conservation priority areas regarding options for payments for ecosystem services.
- At the time of the stakeholder meeting no representatives from Kirugela ward were available. Equally, at the stakeholder workshop equal gender representation was not achieved. Missing local knowledge and gender related local knowledge could be readily incorporated in a future analysis.

Nevertheless, the identified conservation priority areas represent a very important starting point for discussion and further investigation. As new information becomes available and if closer investigation reveals that some areas which are identified as high priorities in this plan are unsuitable for community based conservation, the LPAN will almost definitely take a different shape.

This is to be expected, and in no way detracts from the value of the plan or the ambitious goals of the LLCTC. The implementation of a Lauru Reefs to Ridges Protected Areas Network will act as an insurance policy for the people of Lauru. As well as safeguarding the unique terrestrial and marine biodiversity of Choiseul, it will also help secure long term food and fresh water security and prosperity in the face of growing threats such as rapid population growth and climate change (Dudley et al., 2010).

4 Recommendations and Next Steps

In October 2009 TNC staff presented the preliminary findings of the Choiseul conservation planning exercise to the LLCTC conference that was held at Soranamola (Figure 14). Following the presentations LLCTC participants provided their unanimous support for two recommendations put forward by TNC and the LLCTC environmental committee:

1. Establish a Lauru Ridges to Reefs Protected Areas Network
2. That each of the 12 wards in Choiseul establishes at least one marine protected area and one terrestrial protected area within the next two years

It was agreed by the LLCTC that the implementation of the Lauru Reefs to Ridges Protected Areas Network will remain a community driven process that is guided by the Choiseul Conservation plan.

Figure 14: LLCTC Annual Conference at Soranamola

The completion of the Choiseul Ridges to Reefs Conservation Plan provides a roadmap to guide future conservation efforts throughout Choiseul. It provides a starting point for discussion with leaders and, if effectively implemented, will provide the first Ridges to Reefs Protected Area Network in Solomon Islands.

Figure 15: Choiseul Crested Pigeon - *Microgoura meeki* (©Alexander Lang); Choiseul Provincial Flag.

The development of this Ridge to Reefs Conservation Plan also provides a pilot study to the Ministry of Environment, Conservation and Meteorology with regards to a conservation planning process that could be effectively applied to the whole of Solomon Islands.

Interestingly, the Choiseul Conservation Plan through the stakeholder consultation process has potentially identified a living population of a unique endemic species, thought to be extinct on Choiseul - the Choiseul Crested Pigeon (*Micouruna meeki*) or traditionally known as the kukuru-ni-lua, Kuvojo or Dumoko. This bird is the emblem at the centre of the Choiseul Provincial Flag (Figure 15*).* No birds have been recorded since 1929. Verifying local knowledge that indicates that this bird is still alive should be a high priority. If this bird is found to still be alive its remaining populations should be protected.

Finally, the Choiseul Ridges to Reefs Conservation Plan provides strategic direction regarding conservation priority areas for the Choiseul government, leaders and people. However, this is only the first step in the process of establishing a Lauru Protected Area Network. It recognizes that there are many steps and decisions that need to be made before determining the final boundaries of protected or managed areas. All of these decisions are ultimately at the discretion of the traditional owners of the land and sea. The next step in establishing the Lauru Protected Area Network, is to develop an effective and efficient process to work with the traditional land and sea owners to establish the protected areas for each ward, and to move constructively forward to realize the Lauru Protected Area Network for the benefit of present and future generations.

5 References

Allen, J.C., Gosden, & White, J.P. (1989). Human Pleistocene adaptations in the tropical island Pacific: recent evidence from New Ireland, a Greater Australian outlier. *Antiquity* **63**: 548-561.

Andréfouët, S., F. E. Muller-Karger, J. A. Robinson, C. J. Kranenburg, D. Torres-Pulliza, S. A. Spraggins, and B. Murch. 2005. Global assessment of modern coral reef extent and diversity for regional science and management applications: a view from space. in Y. Suzuki, T. Nakamori, M. Hidaka, H. Kayanne, B. E. Casareto, K. Nadaoka, H. Yamano, M. Tsuchiya, and K. Yamazato, editors. 10th International Coral Reef Symposium. Japanese Coral Reef Society, Okinawa, Japan. CDROM. Pages 1732-1745.

Ball, I. R. and H. P. Possingham, (2000) MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual pdf (267KB)

Choiseul Province Medium Term Development Plan, 2009-2011. Choiseul Provincial Government, Solomon Islands.

Commonwealth of Australia (1997) Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia.

Cox, B. and Moore, P. D. (2000) Biogeography: An Ecological and Evolutionary Approach, 6th edition Blackwell Publishing, Australia.

Diamond, J. M. and E. Mayr. (1976). Species-area relation for birds of the Solomo Archipelago. Proceedings of the National Academy of Sciences of the United States of America 73:262-266.

Dudley, N. and Parrish, J. [Eds] (2006). *Closing the Gap: Creating ecologically representative protected area systems*. Convention on Biological Diversity, Montreal, Canada. CND technical Series no 24. vi +108 pp.

Dudley, N. Stolten, S. Belokurov, A. Krueger L. Lopoukhine N., MacKinnon K, Sandwith T. and Sekhran N (eds) (2010); Natural Solutions: Protected Areas helping people cope with climate change, IUCN-WCPA, TNC, UNDP, WCS, the World Bank and WWF, Gland Switzerland, Washington DC and New York, USA.

Game, E. T. and H. S. Grantham. (2008); Marxan user manual; for Marxan version 1.8.10. The University of Queensland and Pacific Marine Analysis and Research Association Brisbane.

Green A., Lokani P., Atu W., Ramohia P., Thomas P. and Almany J. (eds). (2006). Solomon Islands Marine Assessment: Technical report of survey conducted May 13 to June 17, 2004. TNC Pacific Island Countries Report No 1/06.

Hamilton R. (2003a). The role of indigenous knowledge in depleting a limited resource - A case study of the Bumphead Parrotfish (*Bolbometopon muricatum*) artisanal fishery in Roviana Lagoon, Western Province, Solomon Islands. Putting fishers' knowledge to work conference proceedings, Canada: Fisheries Centre Research Reports, University of British Colombia. p 68-77.

Hamilton, R. (2003b). A report on the current status of exploited reef fish aggregations in the Solomon Islands and Papua New Guinea – Choiseul, Ysabel, Bougainville and Manus Provinces. *Western Pacific Fisher Survey Series:* Society for the Conservation of Reef Fish Aggregations. Volume 1. (confidential appendix).

Hamilton, R., A. Green and J. Almany eds. (2009). Rapid Ecological Assessment: Northern Bismarck Sea, Papua New Guinea. Technical report of survey conducted August 13 to September 7, 2006. TNC Pacific Island Countries Report No. 1/09.

Hamiton, R., P. Ramohia, A. Hughes, C. Siota, N. Kere, M. Giningele, J. Kereseka, F. Taniveke, N. Tanito, W. Atu and Tanavalu L. (2007). Post-Tsunami Assessment of Zinoa Marine Conservation Area, South Choiseul, Solomon Islands. TNC Pacific Island Countries Report No. 4/07.

Hunnam, P., Jenkins, A., Kile, N. & Shearman, P. (2001). *Marine resource management and conservation planing: Bismarck-Solomon Seas ecoregion: Papua New Guinea Solomon Islands.* World Wide Fund for Nature, South Pacific program. Oceanic Printers, Suva, Fiji Islands.

IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IUCN, 2008. Solomon Islands: Summary of species on the 2008 IUCN Red List of Threatened Species. http://www.iucnredlist.org

Keppel, G., Y. M. Buckley, and H. P. Possingham. (2010). Drivers of lowland rain forest community assembly, species diversity and forest structure on islands in the tropical South Pacific. Journal of Ecology 98:87-95.

Kirch, P.V. (2000). *On the road of the winds*. Berkeley, University of California Press.

Macmillan (1996). *The Book of the World*. Macmillan, USA.

McClatchey, W. C., M. Q. Sirikolo, H. Boe, E. Biliki, and F. Vothoc. (2005). A proposed PABITRA study area on Lauru Island, Western Solomon Islands. Pacific Science 59:213-239.

Morrison, C., P. Pickacha, T. Pitakia, and D. Boseto. (2007). Herpetofauna, community education and logging on Choiseul Island, Solomon Islands: implications for conservation. Pacific Conservation Biology 13:250-258.

Mueller-Dombois, D. and F.R. Fosberg. (1998). Vegetation of the tropical Pacific islands. Springer-Verlag, New York.

National Census (1999). Report on 1999 Population and Housing Census. Honiara, Solomon Islands: Statistics Office, Solomon Islands Government.

Noss, R (1995). Maintaining Ecological Integrity in Representative Reserve Networks, WWF Canada and WWF US, Toronto and Washington DC

Olson, D.M, Dinerstein, E, Wikramanayake E.D., Burgess N.D. , Powell, G.V.N, Emma C. Underwood, Jennifer A. D'amico, Illanga Itoua, Holly E. Strand, John C. Morrison, Colby J. Loucks, Thomas F. Allnutt, Taylor H. Ricketts, Yumiko Kura, John F. Lamoreux, Wesley W. Wettengel, Prashant Hedao, and Kenneth R. Kassem (2001) Terrestrial Ecoregions of the World: A New Map of Life on Earth BioScience 933 Vol. 51 (11) 933-938

Possingham, H. P., I. R. Ball and S. Andelman (2000) Mathematical methods for identifying representative reserve networks. In: S. Ferson and M. Burgman (eds) Quantitative methods for conservation biology. Springer-Verlag, New York, pp. 291-305. pdf (223KB)

Ramohia P. (2006). Fisheries Resources: Commercially Important Macroinvertebrates. In: Green A., Lokani P., Atu W., Ramohia P., Thomas P. and Almany J. (eds). (2006). Solomon Islands Marine Assessment: Technical report of survey conducted May 13 to June 17, 2004. TNC Pacific Island Countries Report No 1/06.

Ruddle, K. (1996) Traditional management of reef fishing. In: *Reef Fisheries*, ed. N. V. C Polunin & C. M. Roberts, pp. 315—35. London, UK: Chapman and Hall.

Solomon Islands National Government (2001) Solomon Islands Initial National Communications under the United Nations Framework on Climate Change.

SINBSAP (2008) Solomon Islands National Biodiversity Strategy and Action plan - Solomon Island Government.

UNFCCC (2007): Vulnerability and Adaptation to Climate Change in Small Island Developing States: Background paper for the expert meeting on adaptation for Small Island developing States.
http://unfccc.int/files/adaptation/adverse_effects_and_response_measures_art_48/application/pdf/200702_sids_adaptation_bg.pdf

Wall J R D and Hansell J R F (1976) Land resources of the Solomon Islands Volume 6 Choiseul and the Shortland Islands; Land Resource Study 18; Land Resources Division, Ministry of Overseas Development Tolworth Tower, Surbiton, Surrey, England.

Watts, M.E., R.R. Stewart, D. Segan, L. Kircher, and H.P. Possingham. 2010. Using the Zonae Cogito Decision Support System, a Manual. pdf (1288KB)

Veron, J.E.N, Devantier, L.M., Turak, E., Green A.L., Stuart Kininmonth, S, Mary Stafford-Smith M and Peterson, N. (2009) Delineating the Coral Triangle. Galaxea, Journal of Coral Reef Studies 11: 91-100

6 Appendices

Appendix 1

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
North west Marine Stratification							
100,010	Shelf	Target	51,064	0.1	5,106	0.2	10,213
100,020	Island lagoon - deep lagoon	Target	1,471	0.1	147	0.2	294
100,080	Outer Barrier Reef Complex - forereef	Target	498	0.1	50	0.2	100
100,090	Outer Barrier Reef Complex - pass	Target	253	0.1	25	0.2	51
100,100	Outer Barrier Reef Complex - reef flat	Target	788	0.1	79	0.2	158
100,110	Outer Barrier Reef Complex - shallow terrace	Target	47	0.1	5	0.2	9
100,120	Outer Barrier Reef Complex - shallow terrace	Target	261	0.1	26	0.2	52
100,130	Outer Barrier Reef Complex - subtidal reef flat	Target	1,629	0.1	163	0.2	326
100,250	Intra-lagoon patch-reef complex - forereef	Target	36	0.1	4	0.2	7
100,260	Intra-lagoon patch-reef complex - reef flat	Target	49	0.1	5	0.2	10
100,270	Intra-lagoon patch-reef complex - subtidal reef flat	Target	4	0.1	0	0.2	1
100,280	Barrier land - land on reef	Non Target	11	0	-	0	-
100,300	Intra-seas patch-reef complex - forereef	Target	74	0.1	7	0.2	15
100,310	Intra-seas patch-reef complex - reef flat	Target	91	0.1	9	0.2	18
100,320	Intra-seas patch-reef complex - shallow terrace	Target	4	0.1	0	0.2	1
100,330	Intra-seas patch-reef complex - subtidal reef flat	Target	144	0.1	14	0.2	29
100,400	Ocean exposed fringing - forereef	Target	298	0.1	30	0.2	60
100,410	Ocean exposed fringing - pass	Target	83	0.1	8	0.2	17
100,420	Ocean exposed fringing - reef flat	Target	629	0.1	63	0.2	126
100,430	Ocean exposed fringing - shallow terrace	Target	409	0.1	41	0.2	82

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
100,440	Intra-seas exposed fringing - forereef	Target	412	0.1	41	0.2	82
100,450	Intra-seas exposed fringing - reef flat	Target	1,792	0.1	179	0.2	358
100,460	Intra-seas exposed fringing - shallow terrace	Target	955	0.1	95	0.2	191
100,480	Diffuse fringing - diffuse fringing	Target	110	0.1	11	0.2	22
North east Marine Stratification							
200,010	Shelf	Target	130,809	0.1	13,081	0.2	26,162
200,030	Island lagoon - shallow lagoon with constructions	Target	461	0.1	46	0.2	92
200,050	Outer Barrier Reef Complex - deep drowned	Target	1,002	0.1	100	0.2	200
200,130	Outer Barrier Reef Complex - subtidal reef flat	Target	823	0.1	82	0.2	165
200,170	Coastal Barrier Reef Complex - channel	Target	20	0.1	2	0.2	4
200,180	Coastal Barrier Reef Complex - enclosed basin	Target	25	0.1	3	0.2	5
200,190	Coastal Barrier Reef Complex - enclosed lagoon	Target	38	0.1	4	0.2	8
200,200	Coastal Barrier Reef Complex - forereef	Target	906	0.1	91	0.2	181
200,210	Coastal Barrier Reef Complex - pass	Target	226	0.1	23	0.2	45
200,220	Coastal Barrier Reef Complex - reef flat	Target	877	0.1	88	0.2	175
200,230	Coastal Barrier Reef Complex - shallow terrace	Target	2,460	0.1	246	0.2	492
200,240	Coastal/fringing patch - subtidal reef flat	Target	21	0.1	2	0.2	4
200,260	Intra-lagoon patch-reef complex - reef flat	Target	99	0.1	10	0.2	20
200,270	Intra-lagoon patch-reef complex - subtidal reef flat	Target	11	0.1	1	0.2	2
200,280	Barrier land - land on reef	Non Target	49	0	-	0	-
200,290	Intra-seas patch-reef complex - deep terrace	Target	337	0.1	34	0.2	67
200,300	Intra-seas patch-reef complex - forereef	Target	260	0.1	26	0.2	52
200,310	Intra-seas patch-reef complex - reef flat	Target	454	0.1	45	0.2	91
200,320	Intra-seas patch-reef complex - shallow terrace	Target	186	0.1	19	0.2	37

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
200,330	Intra-seas patch-reef complex - subtidal reef flat	Target	559	0.1	56	0.2	112
200,350	Shelf patch-reef complex - forereef	Target	112	0.1	11	0.2	22
200,360	Shelf patch-reef complex - reef flat	Target	155	0.1	16	0.2	31
200,370	Shelf patch-reef complex - shallow terrace	Target	52	0.1	5	0.2	10
200,380	Shelf patch-reef complex - subtidal reef flat	Target	476	0.1	48	0.2	95
200,400	Ocean exposed fringing - forereef	Target	1,137	0.1	114	0.2	227
200,420	Ocean exposed fringing - reef flat	Target	1,581	0.1	158	0.2	316
200,430	Ocean exposed fringing - shallow terrace	Target	202	0.1	20	0.2	40
200,440	Intra-seas exposed fringing - forereef	Target	414	0.1	41	0.2	83
200,450	Intra-seas exposed fringing - reef flat	Target	396	0.1	40	0.2	79
200,460	Intra-seas exposed fringing - shallow terrace	Target	122	0.1	12	0.2	24
200,470	Bay exposed fringing - bay exposed fringing	Target	36	0.1	4	0.2	7
200,480	Diffuse fringing - diffuse fringing	Target	120	0.1	12	0.2	24
200,490	Fringing of coastal barrier complex - diffuse fringing	Target	91	0.1	9	0.2	18
South east Marine Stratification							
300,010	Shelf	Target	79,404	0.1	7,940	0.2	15,881
300,030	Island lagoon - shallow lagoon with constructions	Target	263	0.1	26	0.2	53
300,040	Outer Barrier Reef Complex - barrier reef pinnacle/patch	Target	11	0.1	1	0.2	2
300,050	Outer Barrier Reef Complex - deep drowned reef flat	Target	528	0.1	53	0.2	106
300,070	Outer Barrier Reef Complex - enclosed basin	Target	13	0.1	1	0.2	3
300,080	Outer Barrier Reef Complex - forereef	Target	106	0.1	11	0.2	21
300,100	Outer Barrier Reef Complex - reef flat	Target	27	0.1	3	0.2	5
300,110	Outer Barrier Reef Complex - shallow terrace	Target	124	0.1	12	0.2	25

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
300,130	Outer Barrier Reef Complex - subtidal reef flat	Target	3,011	0.1	301	0.2	602
300,140	Multiple Barrier Complex - inner terrace	Target	39	0.1	4	0.2	8
300,150	Multiple Barrier Complex - outer terrace	Target	25	0.1	2	0.2	5
300,160	Multiple Barrier Complex - subtidal reef flat	Target	245	0.1	24	0.2	49
300,170	Coastal Barrier Reef Complex - channel	Target	12	0.1	1	0.2	2
300,190	Coastal Barrier Reef Complex - enclosed lagoon	Target	63	0.1	6	0.2	13
300,200	Coastal Barrier Reef Complex - forereef	Target	321	0.1	32	0.2	64
300,210	Coastal Barrier Reef Complex - pass	Target	447	0.1	45	0.2	89
300,220	Coastal Barrier Reef Complex - reef flat	Target	353	0.1	35	0.2	71
300,230	Coastal Barrier Reef Complex - shallow terrace	Target	2,245	0.1	225	0.2	449
300,240	Coastal/fringing patch - subtidal reef flat	Target	11	0.1	1	0.2	2
300,270	Intra-lagoon patch-reef complex - subtidal reef flat	Target	1	0.1	0	0.2	0
300,280	Barrier land - land on reef	Non Target	267	0	-	0	-
300,290	Intra-seas patch-reef complex - deep terrace with constructions	Target	600	0.1	60	0.2	120
300,300	Intra-seas patch-reef complex - forereef	Target	235	0.1	23	0.2	47
300,310	Intra-seas patch-reef complex - reef flat	Target	312	0.1	31	0.2	62
300,320	Intra-seas patch-reef complex - shallow terrace	Target	8	0.1	1	0.2	2
300,330	Intra-seas patch-reef complex - subtidal reef flat	Target	241	0.1	24	0.2	48
300,360	Shelf patch-reef complex - reef flat	Target	46	0.1	5	0.2	9
300,380	Shelf patch-reef complex - subtidal reef flat	Target	172	0.1	17	0.2	34
300,400	Ocean exposed fringing - forereef	Target	67	0.1	7	0.2	13
300,420	Ocean exposed fringing - reef flat	Target	831	0.1	83	0.2	166
300,430	Ocean exposed fringing - shallow terrace	Target	52	0.1	5	0.2	10

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
300,440	Intra-seas exposed fringing - forereef	Target	171	0.1	17	0.2	34
300,450	Intra-seas exposed fringing - reef flat	Target	545	0.1	54	0.2	109
300,460	Intra-seas exposed fringing - shallow terrace	Target	2	0.1	0	0.2	0
300,470	Bay exposed fringing - bay exposed fringing	Target	540	0.1	54	0.2	108
300,480	Diffuse fringing - diffuse fringing	Target	222	0.1	22	0.2	44
300,490	Fringing of coastal barrier complex - diffuse fringing	Target	65	0.1	7	0.2	13
South west Marine Stratification							
400,010	Shelf	Target	130,957	0.1	13,096	0.2	26,191
400,020	Island lagoon - deep lagoon	Target	595	0.1	59	0.2	119
400,060	Outer Barrier Reef Complex - deep terrace	Target	79	0.1	8	0.2	16
400,080	Outer Barrier Reef Complex - forereef	Target	113	0.1	11	0.2	23
400,090	Outer Barrier Reef Complex - pass	Target	190	0.1	19	0.2	38
400,100	Outer Barrier Reef Complex - reef flat	Target	266	0.1	27	0.2	53
400,110	Outer Barrier Reef Complex - shallow terrace	Target	159	0.1	16	0.2	32
400,130	Outer Barrier Reef Complex - subtidal reef flat	Target	322	0.1	32	0.2	64
400,250	Intra-lagoon patch-reef complex - forereef	Target	29	0.1	3	0.2	6
400,260	Intra-lagoon patch-reef complex - reef flat	Target	28	0.1	3	0.2	6
400,270	Intra-lagoon patch-reef complex - subtidal reef flat	Target	5	0.1	0	0.2	1
400,280	Barrier land - land on reef	Non Target	24	0	-	0	-
400,340	Shelf patch-reef complex - deep terrace	Target	5,238	0.1	524	0.2	1,048
400,350	Shelf patch-reef complex - forereef	Target	26	0.1	3	0.2	5
400,360	Shelf patch-reef complex - reef flat	Target	55	0.1	6	0.2	11
400,370	Shelf patch-reef complex - shallow terrace	Target	20	0.1	2	0.2	4
400,380	Shelf patch-reef complex - subtidal reef flat	Target	151	0.1	15	0.2	30

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
400,390	Ocean exposed fringing - enclosed lagoon or basin	Target	3	0.1	0	0.2	1
400,400	Ocean exposed fringing - forereef	Target	256	0.1	26	0.2	51
400,410	Ocean exposed fringing - pass	Target	13	0.1	1	0.2	3
400,420	Ocean exposed fringing - reef flat	Target	1,161	0.1	116	0.2	232
400,430	Ocean exposed fringing - shallow terrace	Target	176	0.1	18	0.2	35
400,450	Intra-seas exposed fringing - reef flat	Target	3	0.1	0	0.2	1
400,480	Diffuse fringing - diffuse fringing	Target	59	0.1	6	0.2	12
Terrestrial Features							
500,050	Hill mixed forest of various canopy sizes - -	Target	6	0.1	1	0.2	1
500,200	Lowland mixed forest of various canopy sizes - -	Target	175	0.1	17	0.2	35
500,210	Hill degraded forest - -	Non Target	1	0	-	0	-
500,240	Saline mangrove forest - -	Target	25	0.1	2	0.2	5
501,020	Hill Campnosperna dorminated forest - Mud	Target	15	0.1	1	0.2	3
501,030	Hill mixed forest of small canopy sizes - Mud	Target	46	0.1	5	0.2	9
501,040	Hill mixed forest of medium canopy sizes - Mud	Target	352	0.1	35	0.2	70
501,050	Hill mixed forest of various canopy sizes - Mud	Target	6,431	0.1	643	0.2	1,286
501,060	Hibiscus tilicius dorminated forest of small canopy sizes - Mud	Target	2	0.1	0	0.2	0
501,070	Hibiscus tilicius dorminated forest of medium to various canopy sizes - Mud	Target	118	0.1	12	0.2	24
501,090	Fresh water Campnosperna dorminated lowland forest - Mud	Target	20	0.1	2	0.2	4
501,100	Fresh water mixed forest of small canopy sizes - Mud	Target	939	0.1	94	0.2	188
501,110	Fresh water mixed forest of medium canopy sizes - Mud	Target	538	0.1	54	0.2	108
501,120	Fresh water mixed forest of various canopy sizes - Mud	Target	2,494	0.1	249	0.2	499

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
501,130	Fresh water mixed Lowland Forest of various canopy sizes - Mud	Target	608	0.1	61	0.2	122
501,140	Fresh water Terminalia dorminated of small canopy sizes - Mud	Target	16	0.1	2	0.2	3
501,150	Fresh water Terminalia dorminated of medium canopy sizes - Mud	Target	1,234	0.1	123	0.2	247
501,160	Fresh water Terminalia dorminated of various canopy sizes - Mud	Target	1,160	0.1	116	0.2	232
501,170	Fresh water pandanus dorminated forest - Mud	Target	610	0.1	61	0.2	122
501,180	Herbaceous swamp, mixed species composition - Mud	Target	33	0.1	3	0.2	7
501,190	Lowland mixed forest of medium canopy sizes - Mud	Target	288	0.1	29	0.2	58
501,200	Lowland mixed forest of various canopy sizes - Mud	Target	2,284	0.1	228	0.2	457
501,210	Hill degraded forest - Mud	Non Target	1,784	0	-	0	-
501,220	Fresh water degraded forest - Mud	Non Target	161	0	-	0	-
501,230	Lowland degraded forest - Mud	Non Target	5,676	0	-	0	-
501,240	Saline mangrove forest - Mud	Target	4,545	0.1	455	0.2	909
501,250	Braided River courses - Mud	Non Target	45	0	-	0	-
501,270	Non forest areas - Mud	Non Target	3	0	-	0	-
502,010	Upper Mountain Forest - Limestones	Target	119	0.1	12	0.2	24
502,020	Hill Campnosperna dorminated forest - Limestones	Target	11	0.1	1	0.2	2
502,030	Hill mixed forest of small canopy sizes - Limestones	Target	2,056	0.1	206	0.2	411
502,040	Hill mixed forest of medium canopy sizes - Limestones	Target	1,289	0.1	129	0.2	258
502,050	Hill mixed forest of various canopy sizes - Limestones	Target	18,046	0.1	1,805	0.2	3,609
502,070	Hibiscus tilicius dorminated forest of medium to various canopy sizes - Limestones	Target	93	0.1	9	0.2	19
502,100	Fresh water mixed forest of small canopy sizes - Limestones	Target	81	0.1	8	0.2	16

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
502,110	Fresh water mixed forest of medium canopy sizes - Limestones	Target	93	0.1	9	0.2	19
502,120	Fresh water mixed forest of various canopy sizes - Limestones	Target	181	0.1	18	0.2	36
502,130	Fresh water mixed Lowland Forest of various canopy sizes - Limestones	Target	50	0.1	5	0.2	10
502,150	Fresh water Terminalia dorminated of medium canopy sizes - Limestones	Target	93	0.1	9	0.2	19
502,160	Fresh water Terminalia dorminated of various canopy sizes - Limestones	Target	203	0.1	20	0.2	41
502,170	Fresh water pandanus dorminated forest - Limestones	Target	71	0.1	7	0.2	14
502,190	Lowland mixed forest of medium canopy sizes - Limestones	Target	468	0.1	47	0.2	94
502,200	Lowland mixed forest of various canopy sizes - Limestones	Target	1,460	0.1	146	0.2	292
502,210	Hill degraded forest - Limestones	Non Target	974	0	-	0	-
502,230	Lowland degraded forest - Limestones	Non Target	1,521	0	-	0	-
502,240	Saline mangrove forest - Limestones	Target	837	0.1	84	0.2	167
502,260	Cloud obscured - Limestones	Non Target	34	0	-	0	-
502,270	Non forest areas - Limestones	Non Target	41	0	-	0	-
503,020	Hill Campnosperna dorminated forest - Sedimentary	Target	558	0.1	56	0.2	112
503,030	Hill mixed forest of small canopy sizes - Sedimentary	Target	608	0.1	61	0.2	122
503,040	Hill mixed forest of medium canopy sizes - Sedimentary	Target	12,875	0.1	1,288	0.2	2,575
503,050	Hill mixed forest of various canopy sizes - Sedimentary	Target	69,098	0.1	6,910	0.2	13,820
503,070	Hibiscus tilicius dorminated forest of medium to various canopy sizes - Sedimentary	Target	255	0.1	26	0.2	51
503,100	Fresh water mixed forest of small canopy sizes - Sedimentary	Target	61	0.1	6	0.2	12

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
503,110	Fresh water mixed forest of medium canopy sizes - Sedimentary	Target	107	0.1	11	0.2	21
503,120	Fresh water mixed forest of various canopy sizes - Sedimentary	Target	350	0.1	35	0.2	70
503,130	Fresh water mixed Lowland Forest of various canopy sizes - Sedimentary	Target	83	0.1	8	0.2	17
503,150	Fresh water Terminalia dorminated of medium canopy sizes - Sedimentary	Target	184	0.1	18	0.2	37
503,160	Fresh water Terminalia dorminated of various canopy sizes - Sedimentary	Target	159	0.1	16	0.2	32
503,170	Fresh water pandanus dorminated forest - Sedimentary	Target	52	0.1	5	0.2	10
503,180	Herbaceous swamp, mixed species composition - Sedimentary	Target	1	0.1	0	0.2	0
503,190	Lowland mixed forest of medium canopy sizes - Sedimentary	Target	476	0.1	48	0.2	95
503,200	Lowland mixed forest of various canopy sizes - Sedimentary	Target	1,623	0.1	162	0.2	325
503,210	Hill degraded forest - Sedimentary	Non Target	4,379	0	-	0	-
503,220	Fresh water degraded forest - Sedimentary	Non Target	12	0	-	0	-
503,230	Lowland degraded forest - Sedimentary	Non Target	952	0	-	0	-
503,240	Saline mangrove forest - Sedimentary	Target	835	0.1	84	0.2	167
503,260	Cloud obscured - Sedimentary	Non Target	276	0	-	0	-
503,270	Non forest areas - Sedimentary	Non Target	1	0	-	0	-
504,010	Upper Mountain Forest - Volcanic	Target	630	0.1	63	0.2	126
504,020	Hill Campnosperna dorminated forest - Volcanic	Target	4,955	0.1	496	0.2	991
504,030	Hill mixed forest of small canopy sizes - Volcanic	Target	297	0.1	30	0.2	59
504,040	Hill mixed forest of medium canopy sizes - Volcanic	Target	12,498	0.1	1,250	0.2	2,500

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
504,050	Hill mixed forest of various canopy sizes - Volcanic	Target	110,679	0.1	11,068	0.2	22,136
504,060	Hibiscus tilicius dorminated forest of small canopy sizes - Volcanic	Target	6	0.1	1	0.2	1
504,070	Hibiscus tilicius dorminated forest of medium to various canopy sizes - Volcanic	Target	287	0.1	29	0.2	57
504,100	Fresh water mixed forest of small canopy sizes - Volcanic	Target	143	0.1	14	0.2	29
504,110	Fresh water mixed forest of medium canopy sizes - Volcanic	Target	67	0.1	7	0.2	13
504,120	Fresh water mixed forest of various canopy sizes - Volcanic	Target	395	0.1	39	0.2	79
504,130	Fresh water mixed Lowland Forest of various canopy sizes - Volcanic	Target	85	0.1	9	0.2	17
504,140	Fresh water Terminalia dorminated of small canopy sizes - Volcanic	Target	3	0.1	0	0.2	1
504,150	Fresh water Terminalia dorminated of medium canopy sizes - Volcanic	Target	377	0.1	38	0.2	75
504,160	Fresh water Terminalia dorminated of various canopy sizes - Volcanic	Target	240	0.1	24	0.2	48
504,170	Fresh water pandanus dorminated forest - Volcanic	Target	22	0.1	2	0.2	4
504,190	Lowland mixed forest of medium canopy sizes - Volcanic	Target	144	0.1	14	0.2	29
504,200	Lowland mixed forest of various canopy sizes - Volcanic	Target	728	0.1	73	0.2	146
504,210	Hill degraded forest - Volcanic	Non Target	5,573	0	-	0	-
504,220	Fresh water degraded forest - Volcanic	Non Target	155	0	-	0	-
504,230	Lowland degraded forest - Volcanic	Non Target	1,220	0	-	0	-
504,240	Saline mangrove forest - Volcanic	Target	245	0.1	24	0.2	49
504,250	Braided River courses - Volcanic	Non Target	15	0	-	0	-
504,260	Cloud obscured - Volcanic	Non Target	214	0	-	0	-
504,270	Non forest areas - Volcanic	Non Target	18	0	-	0	-

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
505,020	Hill Campnosperna dorminated forest - Metamorphic	Target	218	0.1	22	0.2	44
505,030	Hill mixed forest of small canopy sizes - Metamorphic	Target	82	0.1	8	0.2	16
505,040	Hill mixed forest of medium canopy sizes - Metamorphic	Target	3,179	0.1	318	0.2	636
505,050	Hill mixed forest of various canopy sizes - Metamorphic	Target	24,011	0.1	2,401	0.2	4,802
505,060	Hibiscus tilicius dorminated forest of small canopy sizes - Metamorphic	Target	180	0.1	18	0.2	36
505,070	Hibiscus tilicius dorminated forest of medium to various canopy sizes - Metamorphic	Target	11,901	0.1	1,190	0.2	2,380
505,080	Hibiscus tilicius dorminated forest of various canopy sizes - Metamorphic	Target	10	0.1	1	0.2	2
505,100	Fresh water mixed forest of small canopy sizes - Metamorphic	Target	10	0.1	1	0.2	2
505,110	Fresh water mixed forest of medium canopy sizes - Metamorphic	Target	36	0.1	4	0.2	7
505,120	Fresh water mixed forest of various canopy sizes - Metamorphic	Target	123	0.1	12	0.2	25
505,130	Fresh water mixed Lowland Forest of various canopy sizes - Metamorphic	Target	10	0.1	1	0.2	2
505,150	Fresh water Terminalia dorminated of medium canopy sizes - Metamorphic	Target	49	0.1	5	0.2	10
505,160	Fresh water Terminalia dorminated of various canopy sizes - Metamorphic	Target	41	0.1	4	0.2	8
505,170	Fresh water pandanus dorminated forest - Metamorphic	Target	19	0.1	2	0.2	4
505,190	Lowland mixed forest of medium canopy sizes - Metamorphic	Target	72	0.1	7	0.2	14
505,200	Lowland mixed forest of various canopy sizes - Metamorphic	Target	191	0.1	19	0.2	38
505,210	Hill degraded forest - Metamorphic	Non Target	170	0	-	0	-

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
505,220	Fresh water degraded forest - Metamorphic	Non Target	2	0	-	0	-
505,230	Lowland degraded forest - Metamorphic	Non Target	56	0	-	0	-
505,240	Saline mangrove forest - Metamorphic	Target	195	0.1	19	0.2	39
505,250	Braided River courses - Metamorphic	Target	3	0.1	0	0.2	1
505,260	Cloud obscured - Metamorphic	Non Target	92	0	-	0	-
999,999	Unknown - -	Non Target	226	0	-	0	-
LLCTC Features							
600,020	Protected Area - Existing	Lock in	546	0.1	55	0.2	109
600,030	Protected Area - Proposed	Positive Cost Input	6,484	0	-	0	-
600,040	Tambu sites	Non Target	629	0	-	0	-
600,050	Culturally important areas	Positive Cost Input	48	0	-	0	-
600,060	Supportive community	Positive Cost Input	1,711	0	-	0	-
600,070	Turtle Nesting Beaches	Target 95	171	0.95	163	0.95	163
600,080	Turtle Feeding Areas	Target	368	0.1	37	0.2	74
600,090	Green Turtle Feeding Area	Target	221	0.1	22	0.2	44
600,100	Dugong Feeding Areas	Target	364	0.1	36	0.2	73
600,110	Seagrass	Target	1,040	0.1	104	0.2	208
600,120	Nursery areas	Target	462	0.1	46	0.2	92
600,130	Fish spawning areas	Target 50	373	0.5	186	0.5	186
600,140	Baitfish Grounds	Target	571	0.1	57	0.2	114
600,150	Tuna	Target	12,353	0.1	1,235	0.2	2,471
600,160	Beche-de-mer	Non Target	7,608	0	-	0	-
600,170	Trochus	Non Target	8,428	0	-	0	-

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
600,180	Coconut Crab	Non Target	2,795	0	-	0	-
600,190	Mud Crab	Non Target	3,112	0	-	0	-
600,200	Mud clam/shell	Non Target	261	0	-	0	-
600,210	Clam Shell	Non Target	6,624	0	-	0	-
600,220	Cray Fish	Non Target	8,194	0	-	0	-
600,240	Gold Lip	Target	6,127	0.1	613	0.2	1,225
600,250	Topa	Target	5,077	0.1	508	0.2	1,015
600,260	Open Maus	Non Target	2,885	0	-	0	-
600,270	Prawns	Non Target	29	0	-	0	-
600,280	Snapper	Non Target	10,065	0	-	0	-
600,290	Seaweed	Non Target	527	0	-	0	-
600,300	Sharks	Non Target	5,917	0	-	0	-
600,310	Crocodile	Non Target	4,329	0	-	0	-
600,320	Dolphin	Non Target	4,073	0	-	0	-
600,330	Tumi (White bait)	Target	141	0.1	14	0.2	28
600,340	Buma	Target	1,366	0.1	137	0.2	273
600,350	Palio (Fish) Giant Trevally Spawning	Target	418	0.1	42	0.2	84
600,370	Bori (fish)	Target	4,222	0.1	422	0.2	844
600,380	Gato (fish)	Target	130	0.1	13	0.2	26
600,390	Milk Fish (vulm)	Target	1	0.1	0	0.2	0
600,400	Dumoko	Target 95	360	0.95	342	0.95	342
600,410	Mepapode	Target 95	8,533	0.95	8,106	0.95	8,106
600,420	Hornbill	Non Target	10,034	0	-	0	-
600,430	Nesting Area's for Birds	Target	2	0.1	0	0.2	0

SP_ID	Description	Utility	Hectares	10% Scenario		20% Scenario	
				%	Hectares	%	Hectares
600,440	Bird	Non Target	10,071	0	-	0	-
600,450	Flying Fox	Target	9,759	0.1	976	0.2	1,952
600,460	Possum	Non Target	8,602	0	-	0	-
600,470	Pig	Non Target	5,548	0	-	0	-
600,480	Frogs	Target	8,510	0.1	851	0.2	1,702
600,500	Mangroves	Non Target	2,777	0	-	0	-
600,510	Swamps	Non Target	149	0	-	0	-
600,520	Waterfall	Non Target	29	0	-	0	-
600,530	Rivers and Stream	Non Target	8,631	0	-	0	-
600,540	Lakes	Target	19	0.1	2	0.2	4
600,550	Coral	Non Target	6,708	0	-	0	-
600,560	Caves	Target	8,626	0.1	863	0.2	1,725
600,570	Sago Palm	Non Target	8,543	0	-	0	-
600,580	Canoe/nut trees (Nali Nut)	Non Target	8,552	0	-	0	-
600,600	Ironwood Trees	Target	4,447	0.1	445	0.2	889
600,620	Lawyer Cane	Non Target	9,558	0	-	0	-
600,630	Bush Rope	Non Target	8,510	0	-	0	-
600,640	Bamboo	Non Target	15	0	-	0	-
600,650	Jugha	Non Target	38	0	-	0	-

Appendix 2

Code	Threat Description
	Climate Change
Th1	Coastal Areas Flooded (e.g. Sago swamps flooded, Fresh water lost, Turtle nesting beaches lost
Th2	Vulnerable Communities already affected
Th3	Areas of Coral Bleaching
Th4	Reef disturbance by sand
	Other threats
Th5	Areas Licensed for logging but not yet logged
Th10	Logging
Th11	Mining
Th12	Crown of thorns
Th13	Industrial Agriculture – Oil Palm, Plantation, etc.