KINGDOM OF TONGA

Special Management Area Report 2020

MINISTRY OF FISHERIES

KINGDOM OF TONGA

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We hope that this work will be beneficial to Tonga in the years to come.

The research vessel S.V. Chaveta with Patrick Smallhorn-West, James Smallhorn-West and Stefano Freddi conducting surveys in Vava’u. Sketch by Dominique Serafini, former comic artist for Equipe Cousteau

Preface

In 2016 a partnership was developed between the Tongan Ministry of Fisheries and James Cook University in Townsville, Australia. Its aim was to implement the first stage of a Tongan national coral reef monitoring project, and to provide an overview of the current status of Tonga’s Special Management Area (SMA) program. Since 2002 the Ministry of Fisheries has been heavily focused on expanding the SMA program, and communities throughout Tonga have been enthusiastic about introducing local marine management. As a result of this momentum, the Ministry has focused primarily on implementation. However, this came at the cost of monitoring, and until now there was very little information available on whether the SMA program was achieving its target objectives. Until this information was available, it has not been possible to fully demonstrate the efficacy of Tonga’s SMA program.

This document provides the missing details on the current ecological status and impacts of Tonga’s SMA program. It provides a broad overview of the program on a national scale, including detailed reports on each SMA community and impact assessments of the oldest SMA communities.

The Ministry of Fisheries is happy to share the results of this work with the hope of improving the future conditions of coastal resources in the Kingdom of Tonga.

Dr. Tuikolongahau Halafihi

CEO

Ministry of Fisheries

Nuku’alofa, Tonga

‘I he 2016 na’e fokotu’utu’u ai ha fengaue’aki vaofi ‘a e Potungaue Toutai ‘a Tonga, mo e ‘Univesiti Jame’s Cook ‘o Townsville, ‘Aositelelia. Ko e taumu’a ‘o e fengaue’aki ko eni ke fakahoko ‘a e poloseki ki hono tokangaekina ‘o e feo ‘I he hakau fakalukufua ‘o Tonga, pea mo hono ‘omai ‘a e tu’unga lolotonga ‘oku ‘iai ‘a e Polokalama Feitu’u Pule’I Makehe. Talu mei he 2002 ‘a hono fokotu’utu’u mo fakahoko ‘e he Potungaue Toutai ‘a e Polokalama Feitu’u Pule Makehe (pule’i fakakolo ‘a e toutai), pea mo faka’au ke to e tokolahi ange ‘a e ngaahi kolo matatahi ‘I Tonga ‘oku nau kau ki hono Pule’I fakakolo ‘a e toutai. ‘I he lolotonga ni, ‘oku fakatefito ‘a e ngaue ‘a e Potungaue ki hono fakahoko ‘a e ngaahi palani ngaue ‘o e polokalama, ka neongo ia ‘oku ‘iai ‘a hono ngaahi pole tautautefito ki hono muimui’i ‘a e tu’unga ‘oku ‘iai. Ko e taha ia ‘uhinga ‘oku ‘ikai lahi fe’unga ha ngaahi fakamatala pe fakamo’oni ke fakapapau’i ‘oku a’usia ‘e he polokalama ‘a ‘ene ngaahi taumu’a, ka ‘e toki malava ke fakapapau’i ‘I hano ma’u ha ngaahi fakamatala lahi fe’unga mo taau ke fakahaa’i ‘aki ‘a e lelei ‘o e polokalama Feitu’u Pule’I Makehe ‘I Tonga.

Ko e pepa ko eni ‘oku ne ‘oatu ‘a e ngaahi fakamatala fakaikiiki felave’i pea mo e tu’unga lolotonga ‘oku ‘iai ‘a e Polokalama Feitu’u Pule’i Makehe, ‘o tatau pe ki he me’amo’ui ‘i tahi pea mo ‘ene felave’i ki he kakai. ‘Oku ne ‘omai ‘a e tu’unga fakalukufua ‘oku ‘iai ‘a e polokalama ‘I he fonua, ‘o kau ai mo e ngaahi lipooti mei he ngaahi kolo Feitu’u Pule’I Makehe takitaha ‘o fakafehoanaki ki he ngaahi kolo matatahi na’a nau kamata’I mai ‘a e polokalama.

‘Oku fiefia ‘a e Potungaue Toutai ke vahevahe ‘a e ola ‘o e ngaue koeni, ‘i he tui mo e faka’amu ki hano to e fakatupulekina ‘i he kaha’u ‘a e ngaahi me’amo’ui ‘I he feitu’u mamaha ‘I Tonga.

Faka’apa’apa Atu

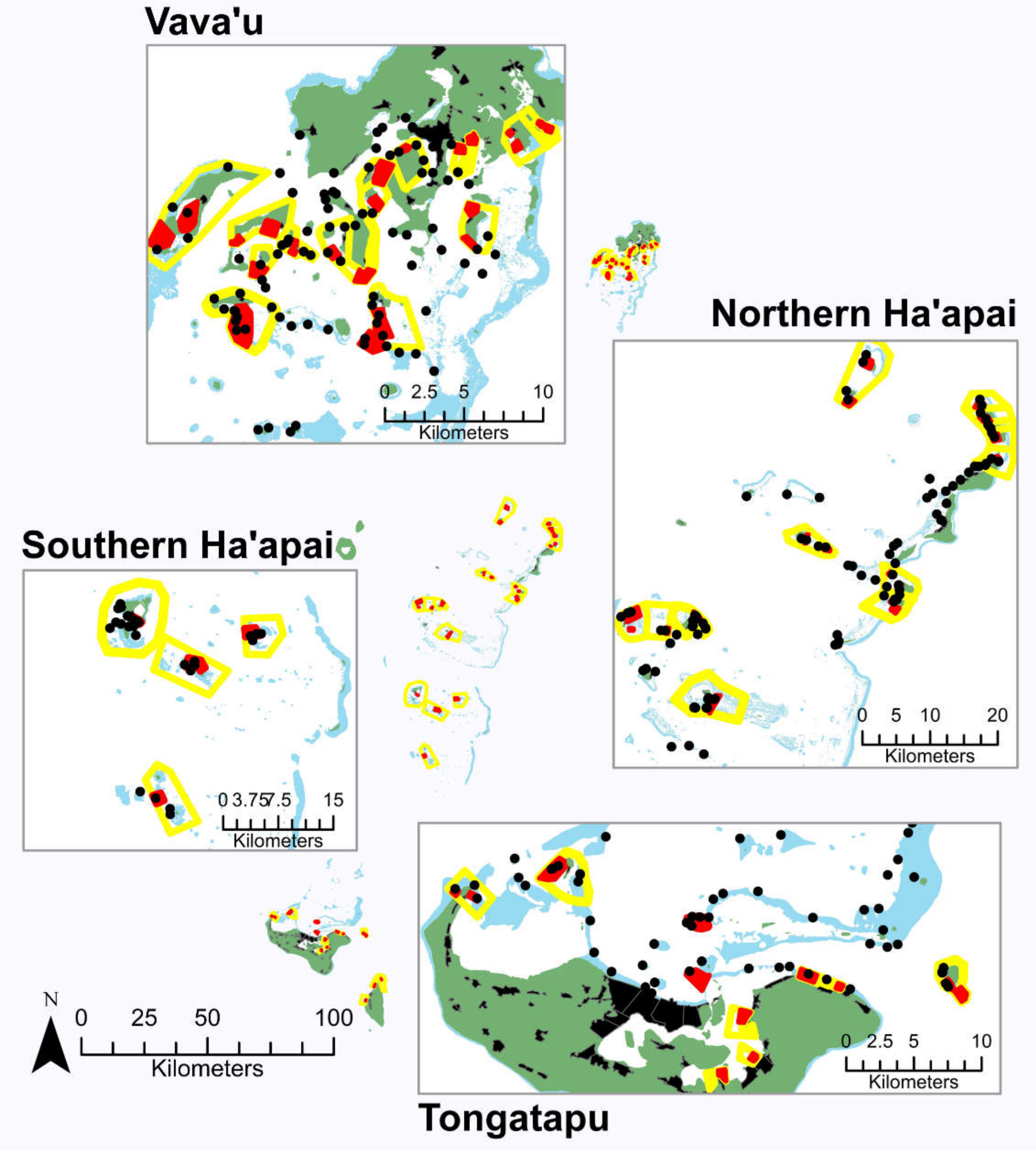
Dr. Tuikolongahau Halafihi

CEO

Potungaue Toutai

Nuku’alofa, Tonga

Map



Map of the Kingdom of Tonga outlining the current extent of both the Special Management Area program and the ecological surveys used for this study. Yellow outlines are Special Management Areas, where only registered members of the community can fish. Red outlines are Fish Habitat Reserves, which are permanent no-fishing zones. Black circles represent survey sites, green represents land and black outlines on land villages.

Overview

This report provides a detailed synthesis of the current ecological status of Tonga's Special Management Area (SMA) program. From 2016 to 2019, a total of 383 sites were surveyed across Tonga's coral reef ecosystem to determine the health of the countries marine environment and the impacts of their new approach to marine management. A one to two page overview of 49 individual SMAs is included in this report.

At the outset, we wish to acknowledge the detailed understanding that Tongan coastal communities have for their marine ecosystems. While our surveys are extensive, the marine environment of Tonga is vast, and we understand that the data we report on each SMA does not encapsulate their full breadth of diversity. However, the surveys conducted for this project nonetheless constitute the largest database currently in existence on Tonga's coral reefs and the SMA program, providing a national overview of the current status of the program from 2016-2019.

The SMA program is Tonga's version of community-based or local marine management, whereby communities are given the responsibility of looking after their own marine resources both for themselves and for future generations. Since its inception in 2002 it has grown incredibly fast, with almost all coastal communities in the country now either within an SMA or requesting one. Special Management Areas are divided into two parts: i) the SMA itself, in which only registered members of that community are allowed to fish, and ii) the Fish Habitat Reserve (FHR), with is a permanent no-fishing zone within each SMA. Throughout this report SMAs are always colored yellow and FHRs red.

Impact assessments on the eight oldest SMAs demonstrate that recovery of fish abundance and diversity is occurring within some FHRs, but not elsewhere within the SMAs, showing i) recovery of reef ecosystems is occurring in Tonga thanks to community management and the presence of no-fishing areas (FHRs), and, ii) the level of fishing within the SMA areas (outside of the FHRs) may still be too high for fish stocks to recover. Therefore additional regulations, such as size and catch limits, or limiting certain practices (e.g. night time spearfishing) may be necessary in order to realize one of the key objectives of the SMA program, which is "**to revive the health and status of coastal fisheries resources in Tonga for current and future generations**".

This document is divided into nine sections:

Section 1. Overview of the Special Management Area program. This includes i) What is an SMA?, ii) History of the SMA program and iii) Monitoring Tonga's coral reefs and SMAs.

Section 2. Overall status of Tonga's coral reefs. Current status of Tonga's coral reefs across Tongatapu, Ha'apai and Vava'u and the main findings of the ecological surveys.

Section 3. Ecosystem health scores for all 49 SMAs. Overall scores, from one to five, calculated for each SMA included in the report. This score provides a summary of the detailed findings outlined for each SMA in sections five and six.

Section 4. Impact of Tonga's eight oldest SMAs. Overview of the methods and results of the impact assessment conducted for the eight oldest SMAs.

Section 5. Tonga's eight oldest SMAs. Detailed description of the marine ecosystem within the eight older SMA communities in Tonga.

Section 6. Tonga's new SMAs. Detailed baseline data on the newest 41 SMA communities, or proposed SMA communities in Tonga at the time of writing. The descriptions of these communities marine life does not include an impact assessment, as at the time the surveys were conducted these SMA's were still too young for effects to be expected.

Section 7. Key questions, limitations and recommendations. This section summarizes the main findings of the report and addresses key questions about the results. It then lists limitations of the SMA program and recommendations for improving marine management in Tonga.

Section 8. Concluding remarks.

Section 9. Appendices

A fisher in the Lofanga SMA

Fakama'opo'opo

'Oku 'oatu 'i he lipooti ko eni 'a e ngaahi fakamatala felave'i mo e tu'unga lolotonga 'a e Polokalama Feitu'u Pule'i Makehe. Mei he 2016 ki he 2019, ko e feitu'u fakakatoa 'e 383 na'e savea'i honau hakau 'i Tonga 'o fakataumu'a ke 'ilo 'a e tu'unga mo'uilelei fakalukufua 'oku 'iai 'i he fonua pea mo hono fakahoko 'a e founga pule'i fo'ou 'a e toutai, 'iloa ko e polokalama Feitu'u Pule'i Makehe. Ko e peesi 'e taha ki he ua 'oku 'oatu ai 'a e fakamatala felave'i mo e kolo Feitu'u Pule'i Makehe 'e 47 'oku fakakau 'i he lipooti ni.

'Oku 'oatu foki heni mo e ngaahi fakamatala fakaikiiki fekau'aki mo e mahino 'oku ma'u 'e he ngaahi kolo matatahi 'i Tonga, felave'i mo e 'atakai 'o 'oseni. Ko e 'atakai 'o e potu tahi 'o Tonga 'oku lahi, pea na'e fakahoko e savea 'i he founga fakalukufua ke mahino ko e fakamatala 'oku lipooti fekau'aki mo e kolo Feitu'u Pule'i Makehe takitaha 'oku 'ikai fakangatangata fakatatau ki he fo'i 'elia 'oku nau pule'i. Ka neongo ia, ko e ola na'e ma'u mei he savea na'e fakahoko, na'e malava ke fakama'opo'opo fakataha ia mo e ngaahi fakamatala 'i Tonga felave'i mo e feo mo e polokalama Feitu'u Pule'i Makehe. Koia ai, ko hono vahevahe atu 'a e fakamatala ko eni 'oku 'oatu ia felave'i mo e tu'unga lolotonga fakalukufua 'a e Polokalama Feitu'u Pule'i Makehe mei he 2016 ki he 2019.

Ko e Polokalama Feitu'u Pule'i Makehe, ko e fakalea ia 'e taha 'a hono pule'i fakakolo 'a e toutai 'i Tonga, 'a ia 'oku foaki 'a e mafai 'o e Pule'anga ki he ngaahi kolo takitaha ke nau pule'i mo tokangaekina 'a e toutai 'i honau matafanga 'o 'ikai ngata pe he to'utangata ko eni, kae pehe ki he kaha'u foki. Talu mei hono fokotu'u he 2002, mo e faka'au ke manakoa 'a e kau mai 'o e ngaahi kolo matatahi 'i he fonua ki he polokalama. Ko e Polokalama Feitu'u Pule'i Makehe 'oku vahevahe ia ki he konga 'e ua: i) ko e fo'i 'elia Feitu'u Pule'i Makehe 'ata'ata pe, 'a ia 'oku ngofua ki he tokotaha toutai kuo 'osi lesisita 'i he kolo ke ne toutai ai, ii) ko e Feitu'u Malu'i mo e Nofo'anga 'o e Ika, pe 'oku 'iloa ko e 'Elia Tapu 'a ia 'oku tapu 'aupito ke fakahoko ha toutai pe ngaue felave'i mo e toutai 'i loto ai. Ko e 'elia ko eni 'i loto 'i he 'elia Feitu'u Pule'i Makehe takitaha. 'I he pepa ko eni, koe 'elia Feitu'u Pule'i Makehe 'oku faka'ilonga lanu engeenga pea lanu kulokula leva 'a e 'elia Feitu'u Malu'i mo e Nofo'anga 'o e Ika.

Ko e ola mei hono sivi 'o e tu'unga fakalakalaka 'o e ngaahi kolo Feitu'u Pule'i Makehe motu'a taha 'e valu, 'oku ne fakamahino mai tu'unga 'oku 'iai 'a e tupulekina 'o e tokolahi 'o e me'amo'ui pea mo 'enau kalasi kehekehe 'i loto 'i he Feitu'u Malu'i mo e Nofo'anga 'o e Ika, 'o 'ikai ha to e feitu'u 'i loto 'i he Feitu'u Pule'i Makehe. Ko e ola ko eni 'oku mahu'inga 'i he 'uhinga 'e ua: i) ko e tupulekina 'o e feo 'oku hoko 'i Tonga makatu'unga mei hono pule'i fakakolo 'o e toutai pea mo e fakataputapu 'o e toutai 'i loto 'i he Feitu'u Malu'i mo e Nofo'anga 'o e Ika, ii) ko e tu'unga 'oku 'iai 'a e toutai 'i loto 'i he Feitu'u Pule'i Makehe (ka 'oku 'ikai ko e Feitu'u Malu'i mo e Nofo'anga 'o e Ika) 'oku kei fakavalevale fakatatau ki he lahi 'o e me'amo'ui kenau fakatupu. Koia ai 'oku fema'u ke to e tanaki ha ngaahi tu'utu'uni pe lao ki hono fakangatangata 'o e toutai tautautefito ki he lalahi mo e lahi ola toutai, pe ko hono ta'ofi ha ngaahi founga toutai (e.g. ama uku) kae lava ke a'usia kakato 'e he polokalama Feitu'u Pule'i Makehe 'a e taha 'a hono ngaahi taumu'a, 'a ia 'oku pehe hono fakalea **"ke fakatupulekina 'a e tu'unga mo'uilelei 'oku 'iai 'a e me'amo'ui mo e ngaahi nofo'anga ika 'i he feitu'u mamaha 'i Tonga, ma'ae to'utangata ko eni kae pehe ki he kaha'u foki".**

A note on translations...

Neongo 'a hono tohi 'a e lipooti ni 'i he lea fakapilitania, ka 'oku 'oatu 'i he lea fakaTonga, 'a e ngaahi konga mahu'inga 'i he lipooti. Ko e Konga 5 mo e 6 'oku 'oatu 'i he lea fakapilitania pea mo e fakaTonga foki. Ko e ngaahi fika mo e fakatata ma'u'anga fakamatala 'i he Konga 1 mo e 7 'i he lipooti ni 'oku 'oatu 'i he lea fakaTonga 'i he Konga C 'o e ngaahi ma'u'anga fakamatala kehe (Appendix C).

Ko e pepa ma'u'anga fakamatala ko eni 'oku vahevahe ia ki he konga 'e ono:

Konga 1. Polokalama Feitu'u Pule'i Makehe. Ko e konga ko eni 'oku ne 'omai 'a e puipuitu'a 'o e Polokalama Feitu'u Pule'i Makehe. Kau ai 'a e i) Ko e ha 'a e Feitu'u Pule'i Makehe, ii) Hisitolia 'o e Polokalama Feitu'u Pule'i Makehe, iii) Muimui'i: Angafe hono tala 'oku fakalakalaka e Polokalama Feitu'u Pule'i Makehe?

Konga 2. Tu'unga fakalukufua 'o e feo/hakau mo e Polokalama Feitu'u Pule'i Makehe 'i Tonga. Ko e konga ko eni 'oku ne 'oatu 'a e fakatata mahino 'o e tu'unga lolotonga 'oku 'iai 'a e feo/hakau 'i Tonga, ko e tu'unga fakalakalaka 'o e ngaahi kolo Feitu'u Pule'i Makehe mo ene Feitu'u Malu'i mo e Nofo'anga 'o e Ika motu'a taha 'e valu, ko e poini 'i hono fakamaaka 'o e tupulekina 'o e me'amo'ui 'i he ngaahi kolo Feitu'u Pule'i Makehe motu'a taha 'e valu, pea mo e poini 'i hono fakamaaka 'o e tu'unga mo'uilelei 'o e 'atakai 'o tahi 'i he ngaahi kolo Feitu'u Pule'i Makehe kotoa 'e 47.

Konga 3. Fakamaaka á e tuúnga moúilelei ó e átakai í he ngaahi kolo Feituú Puleí Makehe (SMA) é 49. Ko e tuúnga fakalukufua ó e ngaahi kolo SMA takitaha mei hono fakamaaka mei he taha (1) ki he nima (5) óku fakakau atu ia í he lipooti ko eni. Ko e fakamaaka ko eni óku ne óatu hono fakamaópoópo á e ngaahi fakamatala fakaikiiki fekauáki mo e ngaahi kolo SMA takitaha í he konga nima (5) mo e ono (6).

Konga 4. Ko e tuúnga ó e ngaahi kolo Feituú Puleí Makehe (SMA) motuá taha í Tonga. Ko e vakai fakalukufua ki he founga mo e ola naé ngaueáki ki hono vakaií/sivií á e tuúnga ó e ngaahi kolo SMA motuá taha í Tonga.

Konga 5. Kolo Feitu'u Pule'i Makehe motu'a taha 'e valu 'i Tonga. Ko e konga ko eni 'oku ne 'oatu 'a e fakamatala fakaikiiki 'a e 'atakai 'o e konga tahi 'o e ngaahi kolo Feitu'u Pule'i Makehe motu'a taha 'e valu 'i Tonga. 'Oku kau ai 'a hono sivi 'a e tu'unga fakalakalaka 'oku 'iai, fakahoa 'a e Feitu'u Pule'i Makehe/Feitu'u Malu'i mo e Nofo'anga 'o e Ika pea mo e ngaahi 'elia makehe na'e kau hono savea'i ke ne fakamahino pe 'oku tupulekina 'a e me'amo'ui mo e feo fakahoa ki he tokolahi kae pehe ki he'ene kalasi kehekehe 'i loto 'i he Feitu'u Pule'i Makehe mo e Feitu'u Malu'i mo e Nofo'anga 'o e Ika.

Konga 6. Ngaahi Feitu'u Pule'i Makehe fo'ou 'i Tonga. Ko e konga ko eni 'oku ne 'oatu 'a e fakamatala fakaikiiki fekau'aki mo e ngaahi kolo Feitu'u Pule'i Makehe fo'ou 'e 39, pe ko e ngaahi kolo fo'ou 'oku 'amanaki ke fokotu'u. Fakatokanga'i ange, ko e ngaahi fakamatala felave'i mo e tu'unga 'o e me'amo'ui mo hono 'atakai 'i he ngaahi potu tahi koeni, 'oku 'ikai kau ai 'a hono sivi 'o e tu'unga fakalakalaka, makatu'unga pe mei he te'eki 'iai ha taimi ke 'asi ha liliu 'i he 'uhinga pe ko e ngaahi kolo fo'ou nae toki fokotu'u.

Konga 7. Ngaahi tefito'i fehu'i, fakangatangata pea mo e fokotu'u fakakaukau. Ko e konga ko eni 'oku ne fakama'opo'opo 'a e ngaahi tefito'i fekumi 'o e lipooti pea mo hono tali ha ngaahi fehu'i 'e ngali 'ohake felave'i pea mo e ola 'o e fekumi. 'Oku lisi atu mo e ngaahi fakangatangata 'e 10 'o e Polokalama Feitu'u Pule'i Makehe pea mo e ngaahi fokotu'u fakakaukau 'e 9 ke to e lelei ange hono pule'i 'o e toutai 'i Tonga.

Konga 8. Fakama'opo'opo.

Konga 9. Ngaahi fakamatala nounou fekauáki mo e ola ngaue naé fakahoko.

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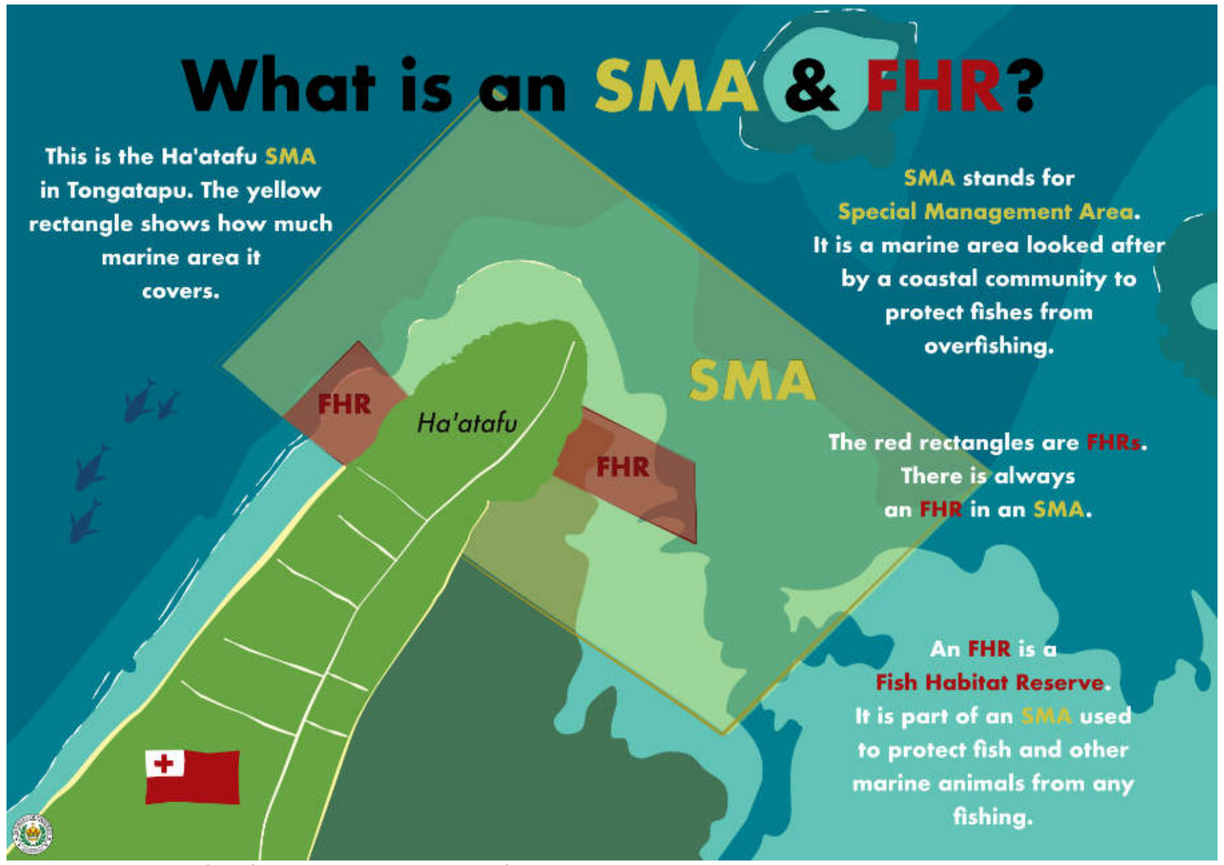
Fanueli Tonga'onevai, staff member of the Ministry of Fisheries in Ha'apai



*A Tongan translation of this figure is available in Appendix C

Community-based management can be defined as natural resource or biodiversity protection by, for and with the local community*. This means that communities are given the responsibility of proper management and use of resources within their environment. This is a social response as the government needs help from people who have a deep connection with their local environment. Community-based management can be a useful tool because local groups may know the area being managed better than anyone, and also are the ones most affected by change.

Special Management Areas are a management tool where specific and committed communities are given exclusive access to an area of the ocean that they are responsible for looking after not only for themselves, but also for future generations. Within each area, called a Special Management Area, or SMA, there must be a Fish Habitat Reserve, or FHR. The FHR is permanently closed to all fishing and is there in order to keep part of the ecosystem healthy, and allow the fish to recover. Under this scenario, resources may continue to be used by local communities, but at the same time maintained for future generations. Coastal community management committees (CCMCs) and coastal community management plans (CCMPs) are developed to assist communities in their management role.

*Western, D., & Wright, R. M. (1994). Natural connections: Perspectives in community-based conservation. Washington, DC: Island Press.& Syst. 9: 349–364

Box 1. Objectives of the SMA program*

The objectives of the SMA program in Tonga are to:

1. Control fishing activities
2. Restore fish stocks and habitat in no-fishing areas (FHRs)
3. Raise community awareness and involvement on fisheries conservation and management
4. Promote sustainable fishing practices
5. Improve the living standards in the community

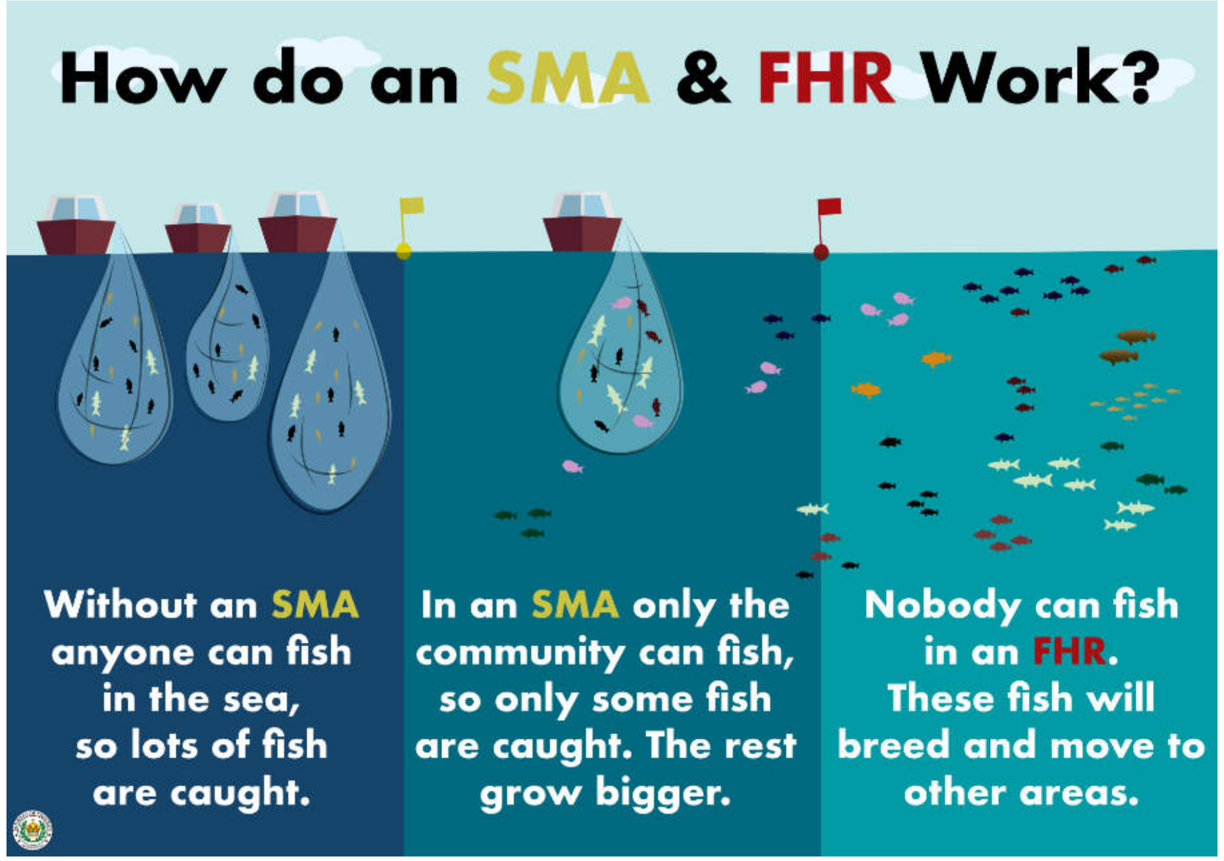
This can all be summarized in the long-term vision of the Special Management Area program, which is to "**revive the health and status of coastal fisheries resources in Tonga for current and future generations**"**.

*Tongan translation available in Appendix C
** Fisheries Division, Ministry of Agriculture & Food, F. and F. (2010). Community-Managed Special Management Areas in Tonga Brochure, 1–2.

Coastal Community Management Comittee for the Ha'ano Special Management Area

*A Tongan translation of this figure is available in Appendix C

Section 1. Background



**A Tongan translation of this figure is available in Appendix C*

Community consultations are a very important part of implementing any new SMA. First, communities must submit a letter of interest. This is followed by meeting with the Ministry of Fisheries to decide on the Coastal Community Management Committee (CCMC) and the boundaries of the SMA and FHR. Additional consultations are then performed with both the SMA community and other nearby communities, as well as key stakeholders. Finally, the SMA is gazetted through parliament and the boundary markers added.

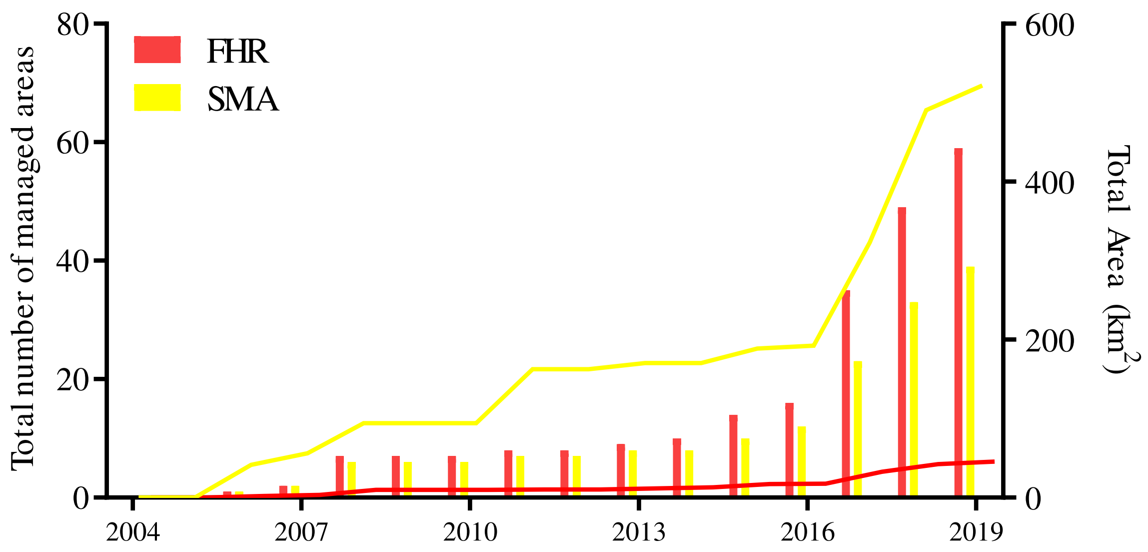
History of the Special Management Area program

Fisheries management in Tonga has been historically open access, meaning anyone can fish anywhere. While this might have worked well in the past, in modern times it has resulted in overfishing. In the early 2000s, growing support for letting local communities manage their own resources resulted in the Fisheries Management Act 2002. The first SMA, O'ua in the Ha'apai group, was designated in November 2006. While the program has since received funding from many domestic and international sources, it has largely been the Tongan Ministry of Fisheries that has driven its expansion. Tongans are therefore justifiably proud in the fact that the successful implementation of this "home grown" program has largely been by their own efforts.

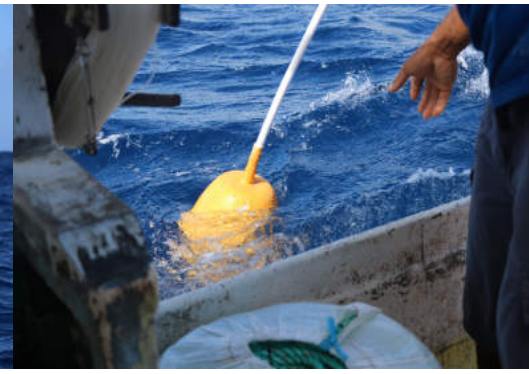
The SMA program has become so popular with Tongan communities that one consultant noted that it is "bursting at the seams". In the first decade the program grew slowly, but the gradual increase in awareness of the program lead to 31 new SMAs being established from 2016-2019, resulting in roughly half of all coastal communities in Tonga having an SMA. As of September 2019, an additional 46 SMA communities have either been confirmed, submitted to cabinet for approval, written a letter of interest, or been proposed, with the aim of including all coastal communities in the program by 2025.

So far, it is clear that the implementation of the SMA program in Tonga has been very successful, and should be seen as a good example of how local action can rapidly grow into change on a regional scale.

However, does the rapid growth of the SMA program actually tell us if the program is achieving its objectives?



Growth of the SMA program, with bars indicating the total numbers of SMAs and FHRs and lines representing the total area in km^2.



Deploying new boundary markers for the Felemea SMA

Section 1. Background

Why is monitoring important?

As discussed previously, so far it is clear that the implementation and expansion of the program has been very successful. The Ministry of Fisheries and the SMA communities have done a remarkable job at creating new SMAs.

But what does this actually tell us about whether the SMAs are "reviving the health and status of coastal fisheries resources for current and future generations"? In other words, even if many SMAs are put in, unless the fish come back, the job isn't finished. Implementation is only the first step towards a better future.

So how do we know if the SMA program is working?

This is the role of the marine monitoring program.

What is Monitoring?

Monitoring involves going out and collecting data on the health and status of coral reefs and coastal fisheries resources in Tonga. It also involves testing whether the ecosystem has changed because of management. Unless teffort is committed to examine the state of the ecosystem in Tonga, both inside and outside the SMAs and FHRs, then it is not possible to say whether the SMA program is achieving its main objectives. While some of the stated goals of the SMA program were not explicitly about improving fish stocks and ecosystem health, if these objectives are not achieved then interest in the program may erode. **Unless proper monitoring occurs, accurate conclusions cannot be made about the success of the SMA program.**

Monitoring SMAs involves carefully quantifying and evaluating the coral reefs and reef fish fisheries both inside and outside the SMAs and FHRs using a very strict survey design. This involves divers with a strong knowledge of local species and coral reef ecosystems quantifying the health of coral reef ecosystems at sites all around the country. This is done by counting many different fish species and their sizes, as well as the proportion of the reef that is covered by different organisms. Importantly, the same methods must be used at every site, which allows comparisons to be made between sites.

A diver swims along a transect and records the size, number and species of coral reef fish

Monitoring Tonga's coral reefs and SMAs

From 2016 – 2019 the Ministry of Fisheries, in partnership with James Cook University and the Australian Research Council Centre for Excellence in Coral Reef Studies, implemented a national coral reef monitoring program to examine the status of coral reefs in Tongatapu, Ha'apai and Vava'u. This initiative was funded by the National Geographic Society with the aim of mapping the entire countries coral reef ecosystem for the first time. This work has been combined with three other survey trips that took place from 2016 – 2019, using the same methodology, in order to provide the data for this report.

At each site, four to six 30 m belt transects were conducted between 2 to 12 m depth. Along each transect the size (cm) and number of all fish species was recorded. The proportion of reef that was covered by living coral or other types of substrate (e.g. algae, sponges etc.) was also recorded as percent cover. For full details of the survey methods see the references at the bottom of this page*

Surveys were conducted inside the FHRs and SMAs of 49 communities throughout Tonga. As of 2019 this represented every SMA in Tonga with the exception of those inside the Fanga'uta lagoon in Tongatapu and those in Eua. Importantly, surveys were also conducted around non-SMA communities and in other areas open to fishing in order to compare between FHR or SMA areas and areas that were still open to fishing. This allows conclusions to be made about whether the fisheries and coral reefs inside the FHRs or SMAs are improving because of management.

During these surveys a total of 1686 transects at 383 sites were comlpeted across Tonga's coral reefs and the size and identity of over 280,000 individual fish recorded as one of 510 separate species. While some areas are still incomplete (e.g. the Niua's and Eua), this is the largest dataset in existence on Tonga's nearshore marine environment.

*Ceccarelli, D. (2016). Vava ' u SMA Project Baseline Survey Technical Report, 1–74.

Smallhorn-West, P. F., Bridge, T. C. L., Malimali, S., Pressey, R. L., & Jones, G. P. (2018). Predicting impact to assess the efficacy of community-based marine reserve design. *Conservation Letters*, 1–8.

Stone, K., Menergink, K., Estep, A., Halafihi, T., Malimali, S., & Matoto, L. (2017). Vava'u Ocean Initiative Marine Expedition Interim Report.

Project	Departments	Funding	Surveyor	Island group	n. sites	Year
National monitoring project	Ministry of Fisheries	James Cook University ARC CoR CRS McIntyre Adventure/ Halaevalu Mata'aho Marine Discovery Centre National Geographic Society	Patrick Smallhorn-West	Tongatapu Ha'apai Vava'u	60 125 93	2018 2018 2017
ADB Vava'u Special Management Area baseline surveys (Ceccarelli, 2016)	Ministry of Fisheries Department of Environment VEPA	Asian Development Bank	Dr. Daniela Ceccarelli Karen Stone	Vava'u	36	2016
VEPA SMA baseline surveys	VEPA	VEPA	Karen Stone	Vava'u	12	2017-19
WAITT Institute field surveys (Stone et al. 2017)	Department of Environment VEPA	WAITT Institute	Heather Kramp Karen Stone	Ha'apai Vava'u	18 40	2017 2017

Section 2. Tonga’s Coral Reefs

Historically Tonga’s coral reefs have been largely understudied, with little information on their overall health. Data from 2016-2019 shows:

The coral reefs of Vava’u were in the poorest condition in the country. Mean live coral cover was <10%, and there was widespread evidence of large-scale damage from cyclones, coral bleaching, overfishing and poor water quality*. Urchin barrens and entirely dead reef (0% coral cover) were observed over large areas near the mouth of the estuarine lagoons. Similar conditions were observed in Tongatapu near the mouth of the Fanga’uta lagoon.

Average coral cover in Ha’apai was 21%, and 25% in Tongatapu. Within Ha’apai, the northern islands (Muitoa to Uiha) had evidence of recent large-scale bleaching along the sheltered, western sides of the islands. The exposed southern islands of Ha’apai (Nomuka, Mango and Fonoi) had very high coral cover and can be considered some of the healthiest reefs in the country. Coral cover in the Tongatapu bay adjacent to the capital was high, although these areas were heavily overfished.

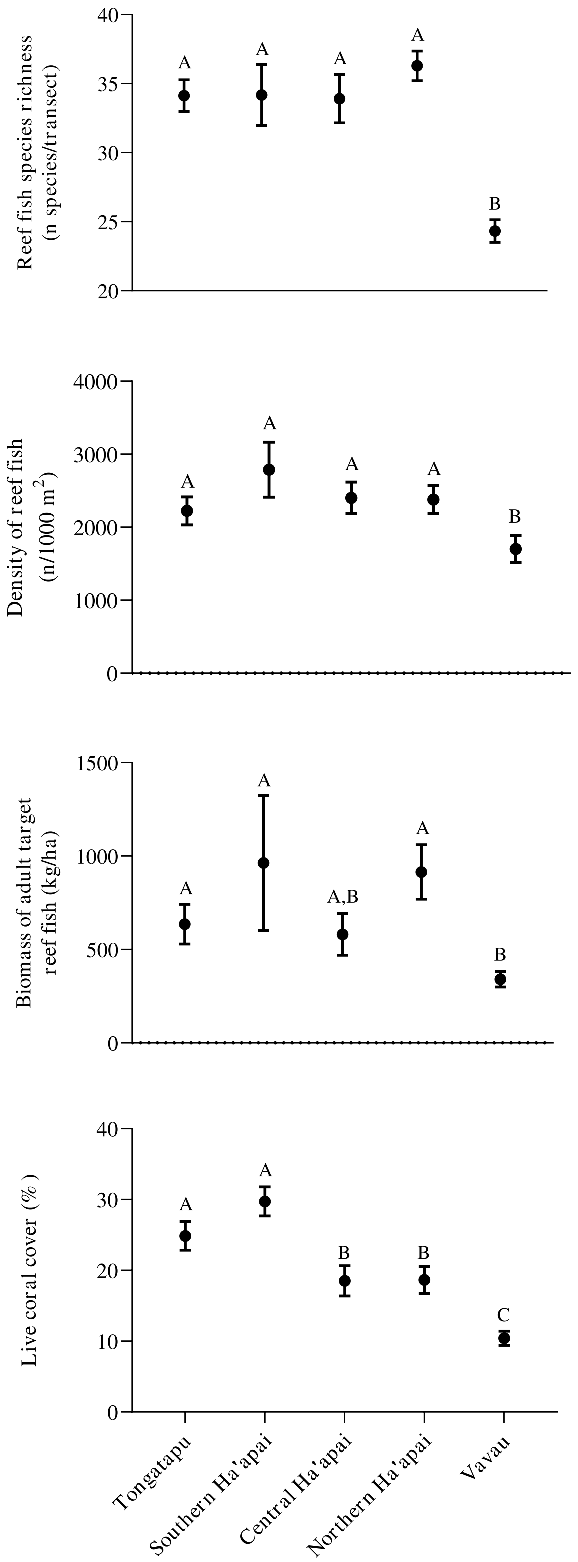
These surveys found two broad and consistent patterns in the health of Tonga’s coral reefs. First, large coral bleaching events have likely occurred in areas with low exposure to flushing by cool, oceanic waters (e.g. sheltered areas of Vava’u and Ha’apai). This may be exacerbated in Vava’u and minimized Tongatapu by a 2^{o}C temperature difference which has protected the reefs of Tongatapu. Secondly, poor water quality flowing from the lagoons of Vava’u and Tongatapu (e.g. Fanga’uta) appear to have resulted in widespread decimation of reefs, often with 0 % live coral cover, and possibly related outbreaks of *Diadema sp.* sea urchins.

The SMA program is an important first step towards improving the health of Tonga’s coral ecosystem by reducing overfishing. However, it is important to note that they are not a panacea. Coral bleaching and cyclones are both made worse by climate change and therefore it is imperative to work on changes at both the local and international level.

For additional details see:

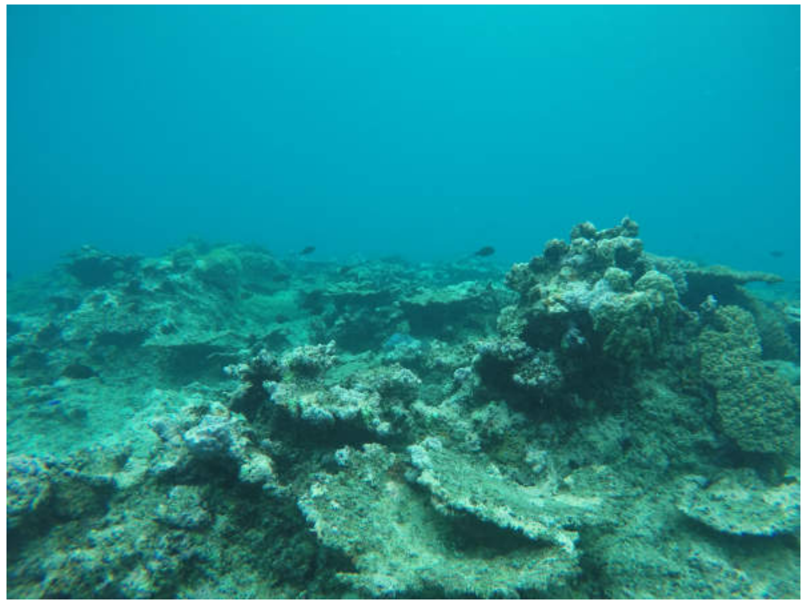
Smallhorn-West P, Gordon S, Stone K, Ceccarelli D, Malimali S, Halafihi T, Wyatt M, Bridge T, Pressey R, Jones G (in-review) Ecological status of Tonga’s coral reefs and associated fish resources: national trends and socio-environmental drivers

*While the Crown-of-Thorns starfish has been observed in Tonga, none of the surveys recorded them in large numbers.



Overall status of Tonga’s coral reefs and reef fish fishery. Because of it’s large latitudinal gradient, Ha’apai is split into south, central and north. Letters denote statistical groupings.

Healthy reefs around Mango island (left) and Nomuka island (right). The reefs surveyed in southern Ha’apai were the healthiest in the country.

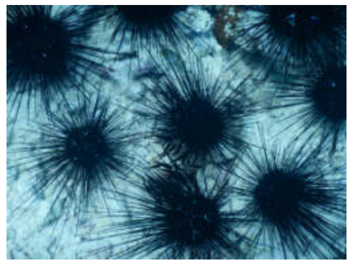


Top left: A recently bleached coral reef at Uoleva. This is clear because the reef still retains high complexity and the skeletons of most corals, but all are dead.

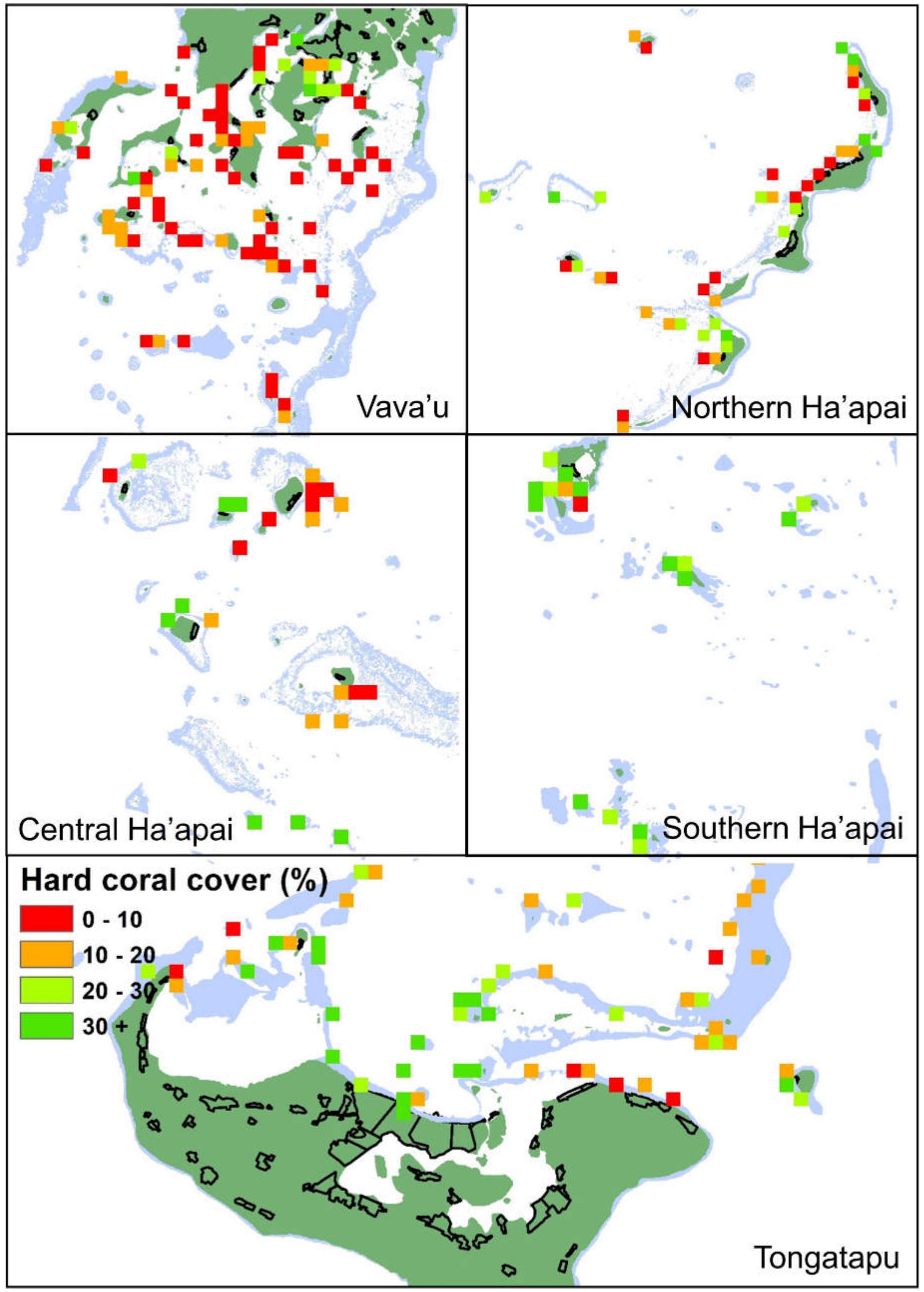
Top right: A reef recently affected by a cyclone at Ha’ano. This reef had many large dead table corals thrown all over the sand near the reef.

Bottom right: A dead reef near Ofu in Vava’u (0 % live coral cover). This reef was near the mouth of a large lagoon and there were many *Diadema* sp. sea urchins that appeared to be bioeroding the reef matrix.

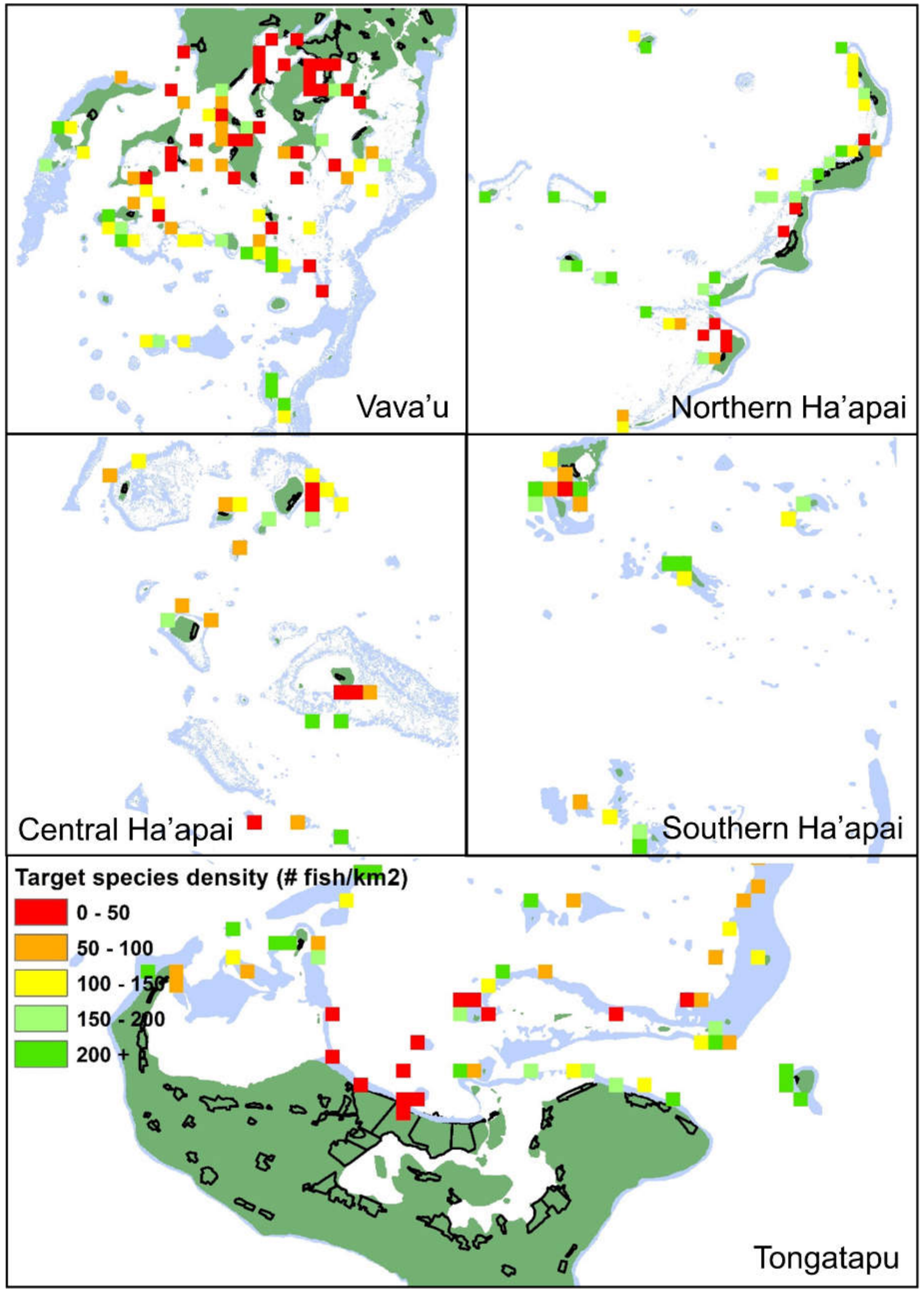
Bottom left: *Diadema sp.* sea urchins.



Live coral cover



Abundance of adult (< 20 cm) target reef fish



Section 3. Reef ecosystem health rating

Reef ecosystem health ratings for 49 Special Management Areas

An overal reef ecosystem health rating was calculated for all 49 SMAs included in this report. This rating is based on six variables of ecosystem health that were measured for all SMAs and FHRs, including the new ones for which only baseline data was available. Each community was given a rating out of 5 for each variable, and the total rating calculated as the average between all variables and rounded up to the nearest .5.

For all SMAs the following six variables were used to calculate the reef ecosystem health rating:

1. Adult food fish abundance inside the FHR
2. Reef fish diversity inside the FHR
3. Total live coral cover inside the FHR
4. Adult food fish abundance inside the SMA
5. Reef fish diversity inside the SMA
6. Total live coral cover inside the SMA

Considerations of rating

It is important to understand that many external factors beyond the control of each community will ultimately affect the condition of their coral reefs and fishery, and therefore this rating. National problems like water quality, and international problems like coral bleaching and cyclones will all affect a communities coral reefs. Therefore this score does not exclusively reflect the actions of each community, but also of the country and region as a whole and beyond.

For the 41 new SMA communities, as well as the older SMA communities for which there was no evidence of recovery, this score represents the current baseline status of their coral reefs, but does **NOT indicate any change to these conditions since the establishment of the SMA**

	Rating	FHR baseline fish Abundance # adult food fish/km2	FHR baseline fish Diversity # reef fish species	FHR baseline coral cover % live coral	SMA baseline fish Abundance # adult food fish/km2	SMA baseline fish Diversity # reef fish species	SMA baseline coral cover % live coral
Very low	1	0 - 50	< 30	0 - 10	0 - 50	< 30	0 - 10
Low	2	51 - 100	31 - 35	11 - 20	51 - 100	31 - 35	11 - 20
Medium	3	101 - 150	36 - 40	21 - 30	101 - 150	36 - 40	21 - 30
High	4	151 - 200	41 - 45	31 - 40	151 - 200	41 - 45	31 - 40
Very High	5	201+	45 +	40 +	201+	45 +	40 +

N/A Not Applicable

NO DATA No data was able to be collected for these areas

	Community	FHR baseline fish abundance	FHR baseline fish diversity	FHR baseline coral cover	SMA baseline fish abundance	SMA baseline fish diversity	SMA baseline coral cover	Total Rating
Old	Atata	Very High	High	High	Medium	Medium	High	4
	Eueiki Tongatapu	Very High	High	Medium	Very High	High	High	4.5
	Fafa	Very Low	Medium	Medium	N/A	N/A	N/A	2.5
	Felemea	Low	Medium	Low	Very Low	Low	Low	2
	Ha'afeva	Low	Low	Low	Low	Medium	Medium	2.5
	Nomuka	Very High	Very High	Very High	Low	Medium	Medium	4
	O'ua	Very High	Medium	Low	Very High	Medium	Low	3.5
	Ovaka	Medium	Low	Very Low	Low	Very Low	Very Low	2
New	Eueiki Vava'u	High	Very Low	Very Low	N/A	N/A	N/A	2
	Fakakakai	High	Very Low	Very Low	Medium	Low	Very Low	2
	Faleloa	Low	Medium	High	Low	Low	Medium	3
	Falevai	Very Low	Very Low	Very Low	Very Low	Medium	Low	1.5
	Fonoi	Low	Medium	Medium	Medium	Low	Medium	3
	Ha'ano	Medium	Low	Very Low	Medium	Very Low	Low	2
	Ha'atafu	Low	Very Low	Low	Very High	Low	Low	2.5
	Holeva	Very Low	Very Low	Low	Very Low	Very Low	Very Low	1.5
	Holopeka	NO DATA	NO DATA	NO DATA	Very Low	Medium	Medium	2.5
	Hunga	Medium	Very Low	Medium	Medium	Very Low	Very Low	2
	Kapa	Medium	Very Low	Very Low	Medium	Very Low	Very Low	2
	Kelefesia	Medium	Very Low	Medium	Very High	Low	Medium	3
	Koloa	Very Low	Very Low	High	Low	Very Low	Very Low	2
	Kolomotu'a	Very Low	Low	High	Very Low	Medium	Very High	3
	Kolonga	High	Very High	Very Low	Medium	Medium	Low	3
	Kotu	Low	Very Low	Medium	Low	Very Low	Low	2
	Koulo	NO DATA	NO DATA	NO DATA	High	Medium	Very Low	3
	Lape	NO DATA	NO DATA	NO DATA	Very Low	Very Low	Very Low	1
	Lofangai	Very High	Very High	Low	High	Medium	Very Low	3.5
	Makave	Very Low	Very Low	Low	Very Low	Very Low	Low	1.5
	Mango	Very High	Medium	Medium	Very High	Medium	High	4
	Manuka	NO DATA	NO DATA	NO DATA	High	Medium	Very Low	3
	Matamaka	Low	Very Low	Very Low	Very Low	Very Low	Low	1.5
	Matuku	Medium	Very High	Very High	Low	Very High	Very High	4.5
	Mounga'one	Very High	Very High	Medium	Very High	High	Low	4
	Muitoa	Medium	Very Low	Very High	Very High	High	High	4
	Nuapapu	Very Low	Very Low	Low	Low	Very Low	Low	1.5
	Ofu	Medium	Low	Very Low	Low	Very Low	Very Low	2
	Olo'ua	Very Low	Very Low	Low	Very Low	Very Low	Low	1.5
	Otea	N/A	N/A	N/A	Low	Very Low	Very Low	1.5
	Pangaimotu FHR TBU	Very High	High	High	N/A	N/A	N/A	4.5
	Pangaimotu SMA VAV	N/A	N/A	N/A	Very Low	Very Low	Very Low	1
	Pukotala	Very High	Low	Low	Medium	Very Low	High	3
	Talafo'ou	N/A	N/A	N/A	High	Low	Low	3
	Talihau	Very Low	Very Low	NO DATA	Very Low	Very Low	Low	1.5
	Taoa	N/A	Very Low	N/A	N/A	Very Low	Medium	2
	Taunga	Low	Very Low	Very Low	Medium	Very Low	Very Low	1.5
	Tefisi	Very Low	Very Low	Very Low	Very Low	Very Low	Low	1.5
	Uiha	Very Low	Medium	High	Very Low	Low	Medium	2.5
	Utulei	Low	Low	Medium	Very Low	Very Low	Medium	2
	Utungake	NO DATA	NO DATA	NO DATA	Low	Very Low	Medium	2

Section 4. Impact of Tonga's oldest SMAs

We examined the estimated recovery inside the oldest SMA and FHR areas in Tonga. At the time the surveys were completed (2016-2018) there were eight SMAs in the country that were old enough to expect the ecosystem to be starting to recover. Typical recovery times of coral reef fish can take at least two to three years for early signs of recovery and over 20 years for full recovery. Therefore only the eight SMA communities established prior to 2013/14 were examined for estimated ecosystem recovery. The 41 additional SMAs that were established after this date cannot assessed for recovery, and were treated only as baseline data.

Recovery was estimated by comparing surveys inside the SMAs and FHRs to specific areas open to fishing by everyone. The open areas used for comparison were carefully selected according to 11 socio-environmental variables, and statistically matched between open and managed areas to ensure only similar areas were compared. For example, a shallow fringing reef could only be compared to other shallow fringing reefs. Likewise, remote and exposed reefs were also only compared to other remote and exposed reefs.

For a comprehensive breakdown of the surveys, analysis and results, please see:

Smallhorn-West, P. F., Stone.K., Ceccarelli, D., Malimali, S., Halafihi, T., Bridge, T. C. L., Pressey, R. L., & Jones, G. P. (In review). Community management yields positive impacts for coastal fisheries resources and biodiversity conservation

This report includes the impacts of the older SMAs on two variables: the overall abundance of adult food fish and the species richness of reef fish.

Overall there was a strong impact of the FHRs on the diversity of reef fish and a moderate effect on the abundance of adult food fish, with more species of reef fish and higher abundances of adult fish overall inside the FHRs. This is the first evidence that demonstrates positive impacts for Tonga's SMA program.

While there has been strong recovery inside some FHRs, where fishing is not allowed, there is little evidence of recovery inside SMA areas, where the community is still allowed to fish. There was no evidence of any increase in adult food fish, and only marginal evidence for an increase in fish diversity inside the SMA areas themselves. However, these places are also important for community livelihoods and their sense of relationship with the ocean, and therefore even if the ecosystem has not recovered, mnaging these places is still important.

Overall, the best two performing FHRs in the country were for the communities of Atata and Nomuka, which both had recovery of adult food fish and reef fish diversity inside the FHRs.

In contrast, the Eueiki, Ha'afeva and O'ua FHRs were the poorest performing of all the older FHRs, with little evidence of any recovery.

Table. The variables used to match managed and open transects

Variable	Description
Depth	Depth (m), collected *in-situ*
Distance to land	Distance (m) from the nearest land source (Smallhorn-West et al., In review).
Distance to village	Distance (m) from the closest village (Smallhorn-West et al. In review).
Fishing pressure	Normalized (0-100) abundance of commercial and subsistence fishers (adjusted for catch) extrapolated across the coral reefs of Tonga. It constitutes a unit-less value of relative long-term fishing effort throughout the region (Smallhorn-West et al., In review).
Habitat	Exposed, semi-exposed or fringing, collected *in-situ.*
Island group	Ha'apai, Tongatapu or Vava'u.
Total live coral cover (%)	Collected either by the point intercept method or from photo quadrats.
Habitat rugosity	Estimate of habitat complexity collected *in-situ* on a five point scale from low and sparse relief (score = 1) to exceptionally complex with numerous caves and overhangs (score = 5)
Slope	Estimate of reef slope collected *in-situ* on a five point scale from < 10° (score = 1) to 90° (score = 5).
Surveyor	Dr. Daniela Ceccarelli, Heather Kramp, Patrick Smallhorn-West or Karen Stone.
Wave energy	Average daily wave energy (joules per m^2) (Smallhorn-West et al. In review).

Recovery ratings for Tonga's eight oldest Special Management Areas

To provide an overview of the overall change to fish stocks, a recovery rating was calculated for each of the eight older SMAs in Tonga. This rating is based on the two main recovery variables that were measured for each FHR and SMA. Each FHR and SMA was rated out of five for each variable, and the total score calculated as the average between both variables and rounded up to the nearest 0.5. If there was no effect then they were given a score of 1.0. Anything above 1.0 indicates that there was evidence of at least some recovery inside the FHR or SMA.

For the purpose of this report, recovery is defined as the *difference* between inside the FHR/SMA and matched areas open to fishing. This is different than baseline abundance, which is the raw value measured within the FHR/SMA.

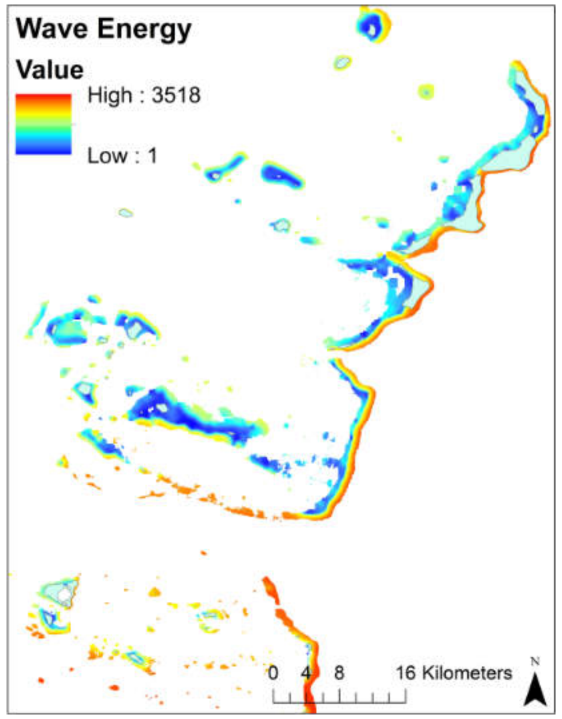
It is important to note that no recovery score was calculated for the 41 new SMAs as at the time the surveys were conducted these had been implemented too recently to record evidence of recovery.

		FHR recovery Abundance	FHR recovery Diversity
	Score	Effect size	Effect size
No Effect	1	0 - 0.2*	0 - 0.2*
Low	2	0.21- 0.4	0.21- 0.4
Medium	3	0.41- 0.6	0.41- 0.6
High	4	0.61- 0.8	0.61- 0.8
Very High	5	0.81+	0.81+

*Any non-significant value results in automatic score of one

*Cutoffs are based on standard definitions for Cohens D effect size

	Community	FHR recovery Abundance	FHR recovery Diversity	Recovery rating
FHR	Overall	Medium	Very High	4
	Atata	Medium	Very High	4
	Eueiki	No Effect	No Effect	1
	Fafa	Negative	Low	1.5
	Felemea	Low	No Effect	1.5
	Ha'afeva	No Effect	No Effect	1
	Nomuka	Low	Very High	3
	O'ua	No Effect	No Effect	1
	Ovaka	No Effect	Medium	2
SMA	Overall	No Effect	No Effect	1
	Atata	No Effect	No Effect	1
	Eueiki	No Effect	Low	1.5
	Felemea	No Effect	No Effect	1
	Ha'afeva	No Effect	No Effect	1
	Nomuka	No Effect	Low	1.5
	O'ua	Negative	Negative	1
	Ovaka	No Effect	No Effect	1



Right: Example of one of the variables used for matching SMA/FHR transects and areas open to fishing for the Ha'apai island group. This wave energy model (joules per m^2), along with 16 other socio-environmental layers, were made for all of Tonga's coral reef ecosystem as part of this project. Downloadable rater files are freely available at https://doi.pangaea.de/10.1594/PANGAEA.904800. For more information see:

Smallhorn-West, P. F., Gordon, S., Dempsey, A., Purkis, S., Malimali, S., Halafihi, Southgate, P., T., Bridge, T. C. L., Pressey, R. L., & Jones, G. P. (In review). Tongan socio-environmental layers for marine ecosystem management

Section 5. Tonga's eight oldest SMAs

What is included in each report?

In the pages that follow we provide details of the ecosystem state within the eight oldest Special Management Areas in Tonga. This includes not only estimated recovery due to management, but also overall ecosystem health. Following this we provide a baseline report for 41 new SMAs that only provides information on the current ecosystem state. Each older SMA is provided with a two page layout that can also be printed as a stand-alone leaflet or poster.

For each of the eight older SMAs in Tonga we provide:

A) A detailed map outlining the boundaries of the Special Management Area (yellow), where only registered members of each community are allowed to fish, and the Fish Habitat Reserve (red), which is permanently closed to all fishing activities. This map also includes the sites where the ecological surveys were completed. Circles are from the 2017/18 National monitoring program, squares from the 2017 Vava'u Ocean Expedition, diamonds from the Asian Development Bank 2016 Vava'u SMA baseline surveys and triangles from the 2017-2019 VEPA surveys.

B) Details of each SMA and its community including SMA area, FHR area, proportion of the SMA that is FHR, proportion of the SMA/FHR that is reef habitat and village population.

C) A short description of the main findings for each SMA

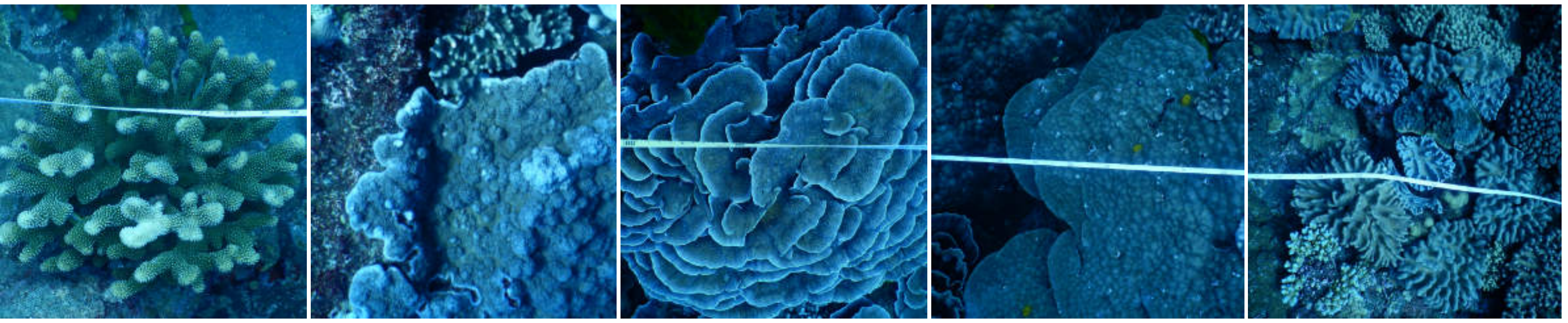
D) Figures that detail the abundance of adult food fish and diversity of fish inside the FHR and SMA, as well as the matched control sites. If there is strong evidence for a difference between the FHR or SMA and its matched control sites (in blue), then this shows that the FHR or SMA is having an effect (indicated by a star). Since multiple transects were completed at each site and inside each FHR or SMA, the column represents the average and the error bars around each column represent the variation between transects.

E) An image of the reefs inside the SMA or FHR.

F) Benthic cover – this is the amount (in total %) of different categories of reef substrate that was found on the transects inside the FHR and SMA*. The categories are:

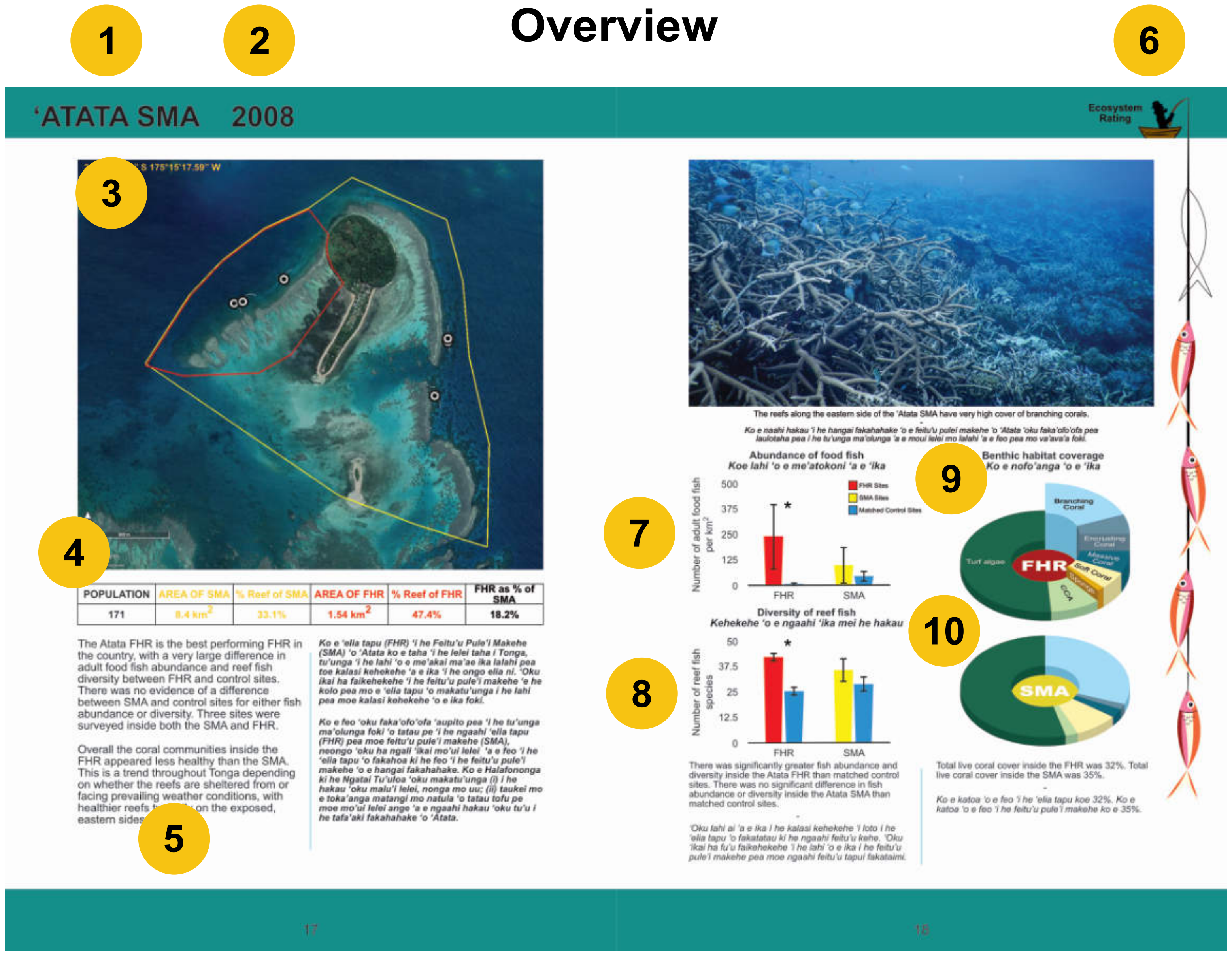
- Branching coral
- Encrusting coral
- Foliose coral
- Massive coral
- Soft coral
- Sponges
- Other invertebrates – sea urchins, sea stars, sea cucumbers etc.
- Crustose Coralline Algae (CCA) – This is a very important encrusting pink algae that helps reefs recover
- Macro algae
- Turf algae

*Sand and rubble categories were removed so the data only represents what was found on areas suitable for reef growth. This is because reef areas were the targets of the surveys and sandy areas were generally surveyed only when reef habitat was not available. If sand and rubble were included it would not accurately represent coverage of these habitat types. Benthic cover values therefore represent the percent cover of total reef habitat, which is available in the table, not percent cover of total area within the SMA/FHR.



From left to right: Examples from the benthic surveys of branching, encrusting, foliose, massive and soft corals respectively.

Overview



1. Community name
2. Year established
3. Map
4. Information table
5. Summary text
6. Ecosystem health rating
7. Abundance of adult food fish at FHR, SMA and matched control sites
8. Species richness of reef fish at FHR, SMA and matched control sites
9. Benthic cover inside FHR
10. Benthic cover inside SMA

'ATATA SMA 2008 TBU

POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
171	8.4 km^2	33.1%	1.54 km^2	47.4%	18.2%

The Atata FHR is the best performing FHR in the country, with a very large difference in adult food fish abundance and reef fish diversity between FHR and control sites. There was no evidence of a difference between SMA and control sites for either fish abundance or diversity. Three sites were surveyed inside both the SMA and FHR.

Adult food fish abundance was greatest at FHR site 3 (431.7 fish/km^2) and lowest at SMA site 1 (89.2 fish/km^2). Fish diversity was greatest at FHR site 1 (46.5 species) and lowest at SMA site 3 (35 species). Coral cover was lowest at the FHR site 1 (15.1%) and greatest at SMA site 3 (44.2%).

Overall the coral communities inside the FHR appeared less healthy than the SMA. This is a trend throughout Tonga depending on whether the reefs are sheltered from or facing prevailing weather conditions, with healthier reefs on the exposed, eastern sides.

Ko e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'o 'Atata, ko e 'Elia Tapu lelei taha ia 'i he fonua fakalukufua makatu'unga mei he lahi 'o e kalasi kehekehe 'o e ika lalahi mo tokolahi fakatatau ki hono fakahoa ki he ngaahi 'elia makehe ange na'e kau he savea. Na'e mahino 'a e 'ikai ke 'iai ha kehekehe 'i he Feitu'u Pule'i Makehe 'o 'Atata pea mo e ngaahi feitu'u makehe na'e kau he savea 'o tatau pe he tokolahi 'o e ika pe tu'unga kalasi kehekehe 'i he 'elia. Ko e ngaahi 'elia 'e tolu na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe mo e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika.

Ko e tu'unga 'o e lahi 'a e ika lalahi 'oku ngaue'aki ki he ma'u me'atokoni, na'e lahi ange 'i he 'elia 3 (431.7 ika/km^2) 'o e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika, pea si'isi'i ange 'i he 'elia 1 (89.2 ika/km^2) 'o e Feitu'u Pule'i Makehe. Ko e tu'unga kalasi kehekehe 'o e ika na'e lahi ange 'i he 'elia 1 (46.5 species) 'o e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika pea si'isi'i ange 'i he 'elia 3 (35 species) 'o e Feitu'u Pule'i Makehe. Ko e tu'unga 'oku 'iai 'a e feo 'oku si'isi'i ange 'i he 'elia 1 (15.1%) 'o e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika pea lahi ange 'i he 'elia 3 (44.2%) 'o e Feitu'u Pule'i Makehe.

Fakalukufua, 'oku mahino ko e kalasi kehekehe 'o e feo 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'oku si'isi'i fakahoa ki he Feitu'u Pule'i Makehe. Ko e taha eni he pole 'oku fehangahangai mo e ngaahi kolo Feitu'u Pule'i Makehe lahi taha 'i Tonga 'o makatu'unga 'i he fakakaukau 'oku fakatupunga mei he lahi malumalungia ha ngaahi feo mei he la'a pe ko e fakatupunga 'e he fakatamaki fakaenatula, 'o fakatatau ki he lahi ange tu'unga mo'uilelei 'o e feo ki he tafa'aki fakahahake.

The reefs along the eastern side of the 'Atata SMA have very high cover of branching corals.

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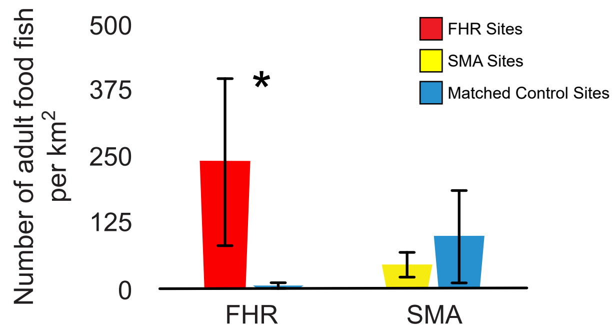
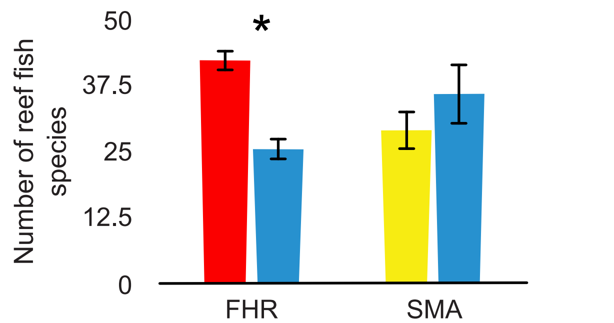
Ko e hakau 'i he tafa'aki fakahahake 'o e Feitu'u Pule'i Makehe 'o 'Atata 'oku lahi ai 'a e feo va'ava'a.

Abundance of food fish
Koe lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



There was greater fish abundance and diversity inside the Atata FHR than matched control sites. There was no difference in fish abundance or diversity inside the Atata SMA than matched control sites.

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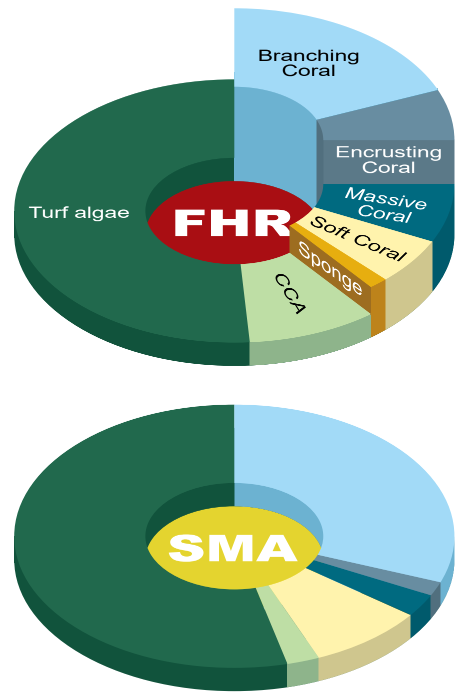
Na'e tokolahi ange mo kalasi kehekehe 'a e ika na'e ma'u 'i he savea 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'i hono fakahoa ki he ngaahi 'elia makehe na'e kau hono savea'i. Na'e 'ikai ke 'iai ha fu'u kehekehe 'i he tokolahi pe kalasi kehekehe 'o e ika 'i loto 'i he Feitu'u Pule'i Makehe 'o 'Atata 'i hono fakahoa ki he ngaahi 'elia makehe na'e kau hono savea'i

Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Total live coral cover inside the FHR was 32%. Total live coral cover inside the SMA was 35%.

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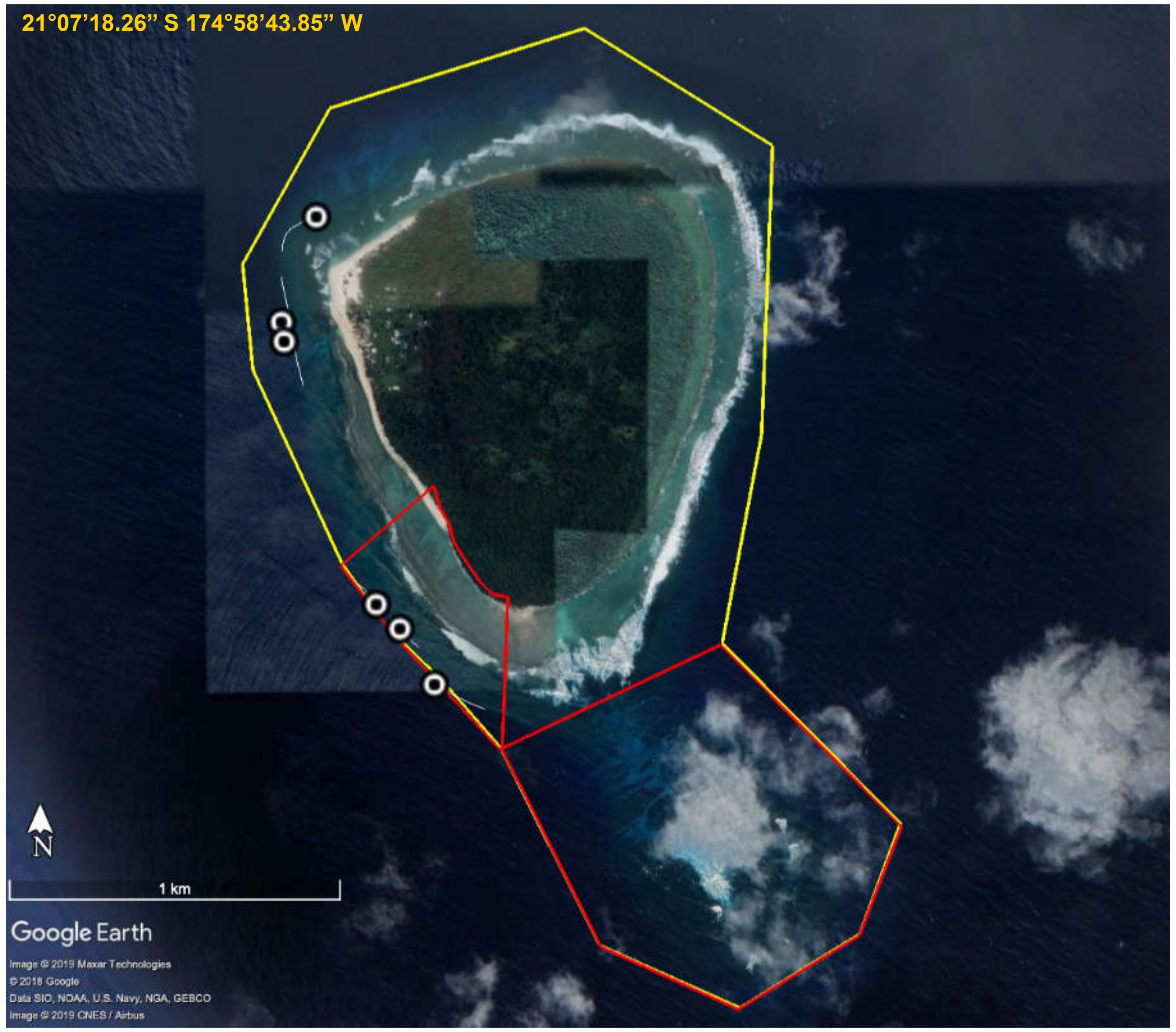
Ko e katoa 'o e feo 'i he 'elia tapu koe 32%. Ko e katoa 'o e feo 'i he feitu'u pule'i makehe ko e 35%.



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
76	3.75 km^2	27.2%	0.87 km^2	80.4%	23.2%

The coral reefs at all six sites surveyed around Eueiki are in clear oceanic waters exposed to high wave energy. These sites had consistently some of the greatest abundance of adult reef fish anywhere in the Kingdom. However, there was no evidence of either the FHR or SMA at ‘Eueiki having more adult food fish or fish diversity than nearby matched control sites, which also had many fish.

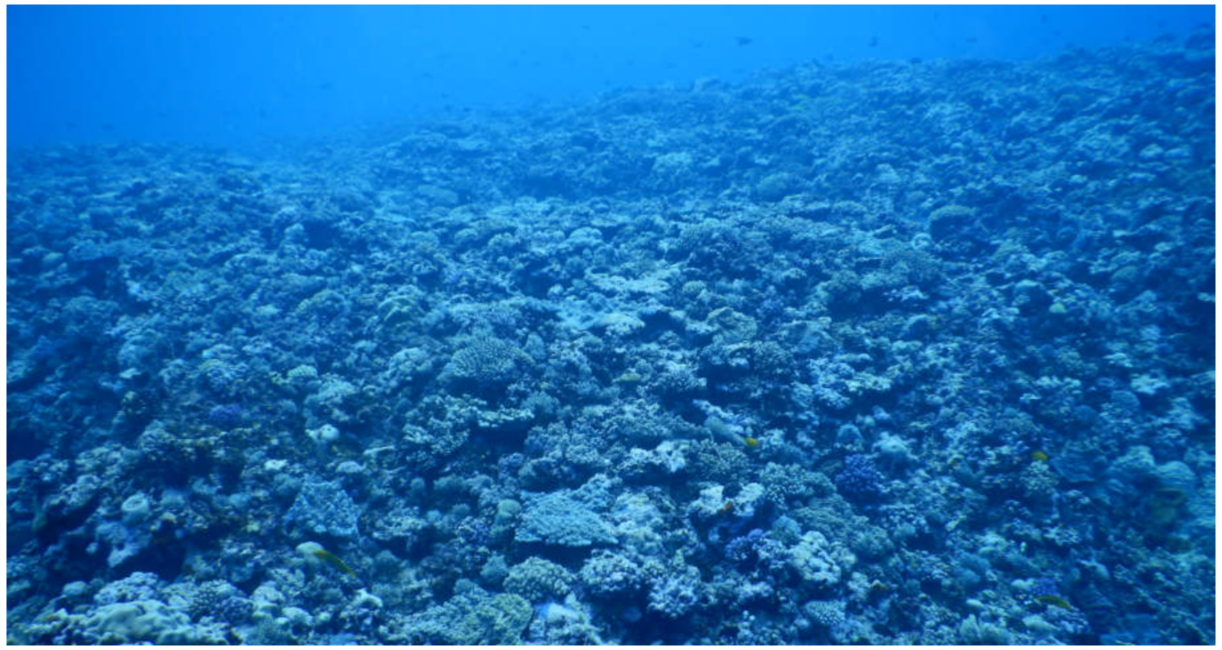
Adult food fish abundance was greatest at SMA site 1 (628.3 fish/km^2) and lowest at SMA site 2 (203.3 fish/km^2). Fish diversity was greatest at SMA site 1 (48.3 species) and lowest at FHR site 3 (34.5 species). Coral cover was lowest at the FHR site 3 (13.2%) and greatest at SMA site 1 (37.2%).

The clear and cool oceanic waters around ‘Eueiki are the likely reason why these reefs are in good condition, as this was also the case for nearby areas outside the FHR and SMA.

Ko e hakau feo ‘i he ngaahi ‘elia ‘e ono na’e savea’i ‘i ‘Eueiki, pea ‘oku nau ‘i he konga tahi ‘oku ma’a pea mo fehangahangai ma’u pe mo e ngaahi peau malohi. Ko e ngaahi ‘elia ko eni ‘oku lahi hono ma’u ai ‘a e ngaahi ika lalahi ‘i he taimi kotoa pe. Kaekehe, ‘oku mahino mei he ola ‘o e savea ‘oku ‘ikai ke fu’u ‘iai ha kehekehe ‘i he lahi mo e kalasi kehekehe ‘o e ika ‘o tatau pe i he Feitu’u Malu’i ‘o e Nofo’anga ‘o e Ika pe Feitu’u Pule’i Makehe fakahoa ki he ngaahi ‘elia makehe na’e kau hono savea’i. ‘I hono fakalea ‘e taha, ‘oku tatau pe lahi mo e kalasi kehekehe ‘o e ika ‘i he ngaahi ‘elia ni.

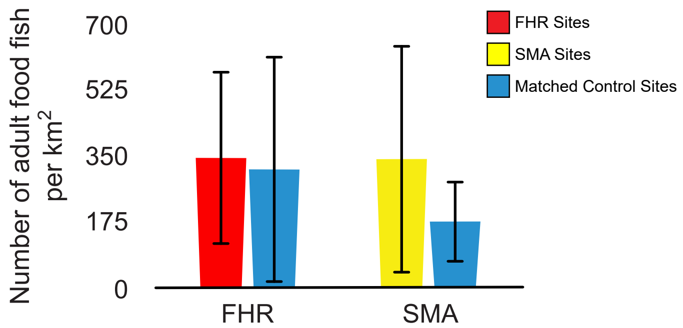
Ko e tu’unga na’e ‘iai ‘a e tokolahi ‘o e ika, na’e lahi ange ‘i he ‘elia 1 (628.3 ika/km^2) kae si’isi’i ange ‘i he ‘elia 2 (203.3 ika/km^2) ‘o e Feitu’u Pule’i Makehe. ‘I he kalasi kehekehe ‘o e ika, na’e lahi ange ‘i he ‘elia 1 (48.3 species) ‘o e Feitu’u Pule’i Makehe kae si’isi’i ange ‘i he ‘elia 3 (34.5 species) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika. ‘I he tu’unga mo’uilelei ‘o e feo, na’e si’isi’i ange ‘i he ‘elia 3 (13.2%) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika kae lahi ange ‘i he ‘elia 1 (37.2%) ‘o e Feitu’u Pule’i Makehe.

‘Oku ‘iai ‘a e tui ‘oku ‘i he tu’unga fakafiemalie ‘a e ngaahi hakau feo takatakai ‘i ‘Eueiki ‘o makatu’unga mei he ma’a mo e mokomoko lelei ‘a e potu tahi koia, kae pehe foki ki he ngaahi ‘elia ofi ‘i tu’a ‘i he Feitu’u Pule’i Makehe ‘o ‘Eueiki.

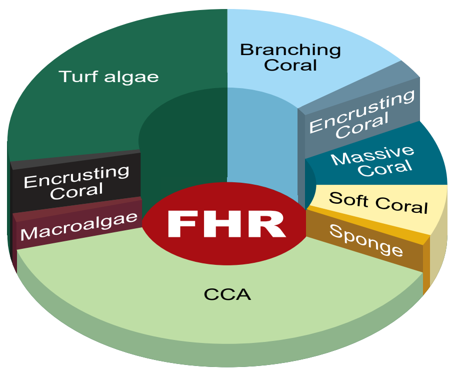


The healthy reefs around ‘Eueiki are likely because of cool and clean oceanic water.
-
Ko e mo’uilelei ‘a e hakau feo takatakai ‘i ‘Eueiki ‘oku makatu’unga mei he ma’a mo e mokomoko lelei ‘a e potu tahi koia.

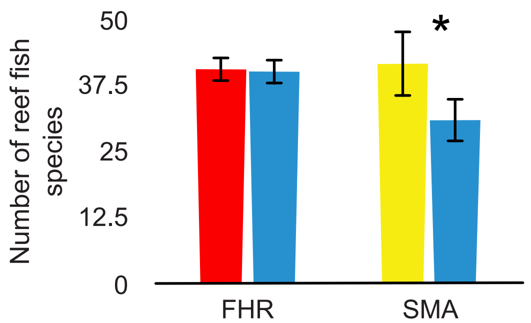
Abundance of food fish
Koe lahi ‘o e me’atokoni ‘a e ‘ika

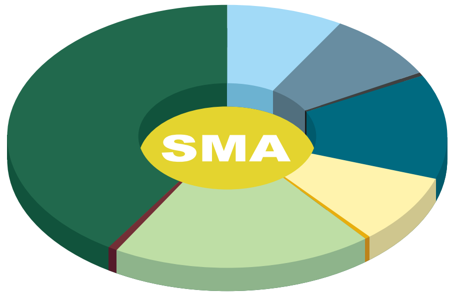


Benthic habitat coverage
Ko e nofo’anga ‘o e ‘ika



Diversity of reef fish
Kehekehe ‘o e ngaahi ‘ika mei he hakau





There was no difference in fish abundance or diversity inside the ‘Eueiki FHR or SMA than matched control sites.
-
Na’e ‘ikai ha fu’u kehekehe ‘i he lahi mo e kalasi kehekehe ‘o e ika ‘i loto ‘i he Feitu’u Pule’i Makehe ‘o ‘Euiki ‘i hono fakahoa ki he ngaahi ‘elia makehe ‘i tu’a na’e kau hono savea’i.

Total live coral cover inside the FHR was 69%. Total live coral cover inside the SMA was 58%.
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Ko e katoa ‘o e feo ‘i he ‘elia tapu koe 69%. Ko e katoa ‘o e feo ‘i he feitu’u pule’i makehe ko e 58%.

POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
20	-	-%	1.59 km^2	80%	-

The reefs around Fafa island are generally in poor to medium condition, with evidence of cyclone damage, coral bleaching and overfishing across all four sites surveyed. While there was no evidence of more food fish inside the FHR, there was a greater diversity of reef fish inside the FHR than matched control sites.

The greatest fish diversity was along the southern side, with an average of 42.5 species recorded at the southern sites and 31.8 species at the northern sites. The southern sites also had many more adult food fish than the northern sites (190 fish/km^2 vs. 5.8 fish/km^2). Coral cover was low at the south-western site (12.5%), but moderately high at all other sites (31–37%).

Given its proximity to Nuku'alofa, poaching may be a problem affecting the recovery of reef fish abundance inside the FHR. Discussion with staff members at the resort appeared to confirm this.

Ko e tu'unga mo'uilelei 'o e hakau feo takatakai 'i he motu ko Fafa, 'oku holo 'o fakatatau ki he ngaahi 'elia 'e fa na'e savea'i 'o mahino mei ai 'a e ngaahi maumau fakatupunga 'e he fakatamaki fakaenatula, feliuliuaki 'o e 'ea pea mo e toutai fakavalevale. Pea neongo 'oku ikai ke fu'u 'iai ha fakamo'oni pau ki he tu'unga 'oku 'iai 'a e lahi 'o e ika 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika, ka 'oku mahino 'a e lahi 'a e kalasi kehekehe 'o e ika 'i loto 'i he fo'i 'elia, fakahoa ki he ngaahi 'elia kehe 'i tu'a na'e kau hono savea'i.

'I he kalasi kehekehe 'o e ika, na'e lahi ange ki he tafa'aki faka-Tonga 'i he 'avalisi 'o e 42.5 pea 31.8 'i he tafa'aki faka-Tokelau. 'I he tafa'aki faka-Tonga aipe, na'e lahi ange ai 'a e ika lalahi 'oku ngaue'aki ki he ma'u me'atokoni 'i hono fakahoa ki he tafa'aki faka_Tokelau (190 ika/km^2 vs. 5.8 ika/km^2). Ka neongo ia, ko e tu'unga mo'uilelei 'o e hakau feo na'e mahino 'a 'ene holo 'i he tafa'aki Tonga – Hahake (12.5%) 'i hono fakahoa ki he toenga 'o e ngaahi 'elia (31-37%).

Na'e fakahoko ha fakatalanoa mo kinautolu 'a e kau ngaue 'i he resort koia 'i Fafa pea na'e mahino mei ai ko e palopalema 'oku fehangahangai mo e tupulekina 'o e me'amo'ui 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika, 'oku fakatupu mei hono toutai'i ta'e fakalao 'e he kakai mei tu'a 'o makatu'unga pe mei he vaofi koia 'a e motu ki Nuku'alofa.

The reef habitat around Fafa was dominated by fields of branching corals, although there was evidence of coral bleaching and cyclone damage.

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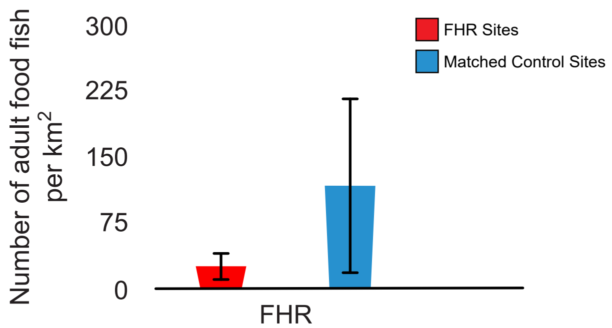
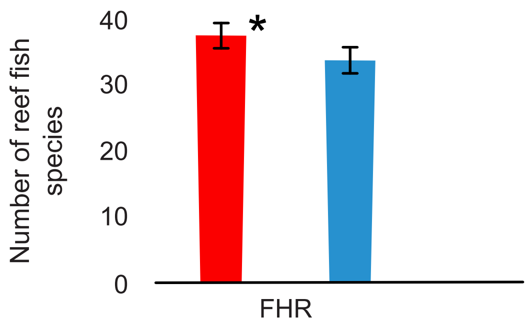
Ko e hakau takatakai 'o Fafa 'oku lahi taha ai 'a e fa'ahinga 'o e feo va'ava'a, neongo 'a e mate 'a feo kae pehe ki hono maumau'i 'e he fakatamaki fakaenatula.

Abundance of food fish
Koe lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



There was no difference in fish abundance inside the Fafa FHR than matched control sites. However, there was significantly greater diversity of reef fish within the FHR than matched control sites.

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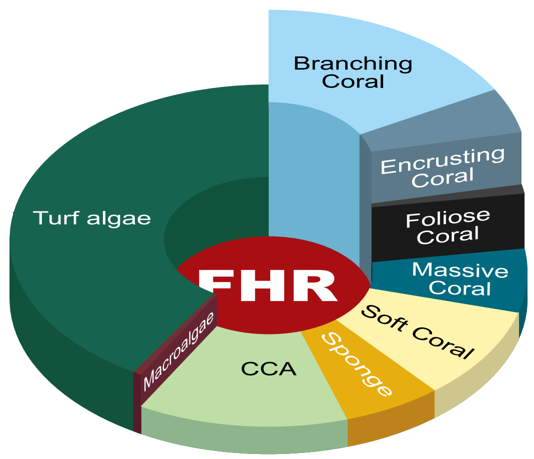
Na'e 'ikai 'iai ha fu'u kehekehe 'i he tokolahi 'o e ika 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika, fakahoa ki he ngaahi 'elia makehe ange 'i tu'a na'e kau hono savea'i. Kaekehe, na'e 'iai 'a e fakalakalaka 'i he tu'unga 'o e kalasi kehekehe 'o e ika 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika, fakatatau ki he ngaahi 'elia makehe ange.

Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Total live coral cover inside the FHR was 52%.

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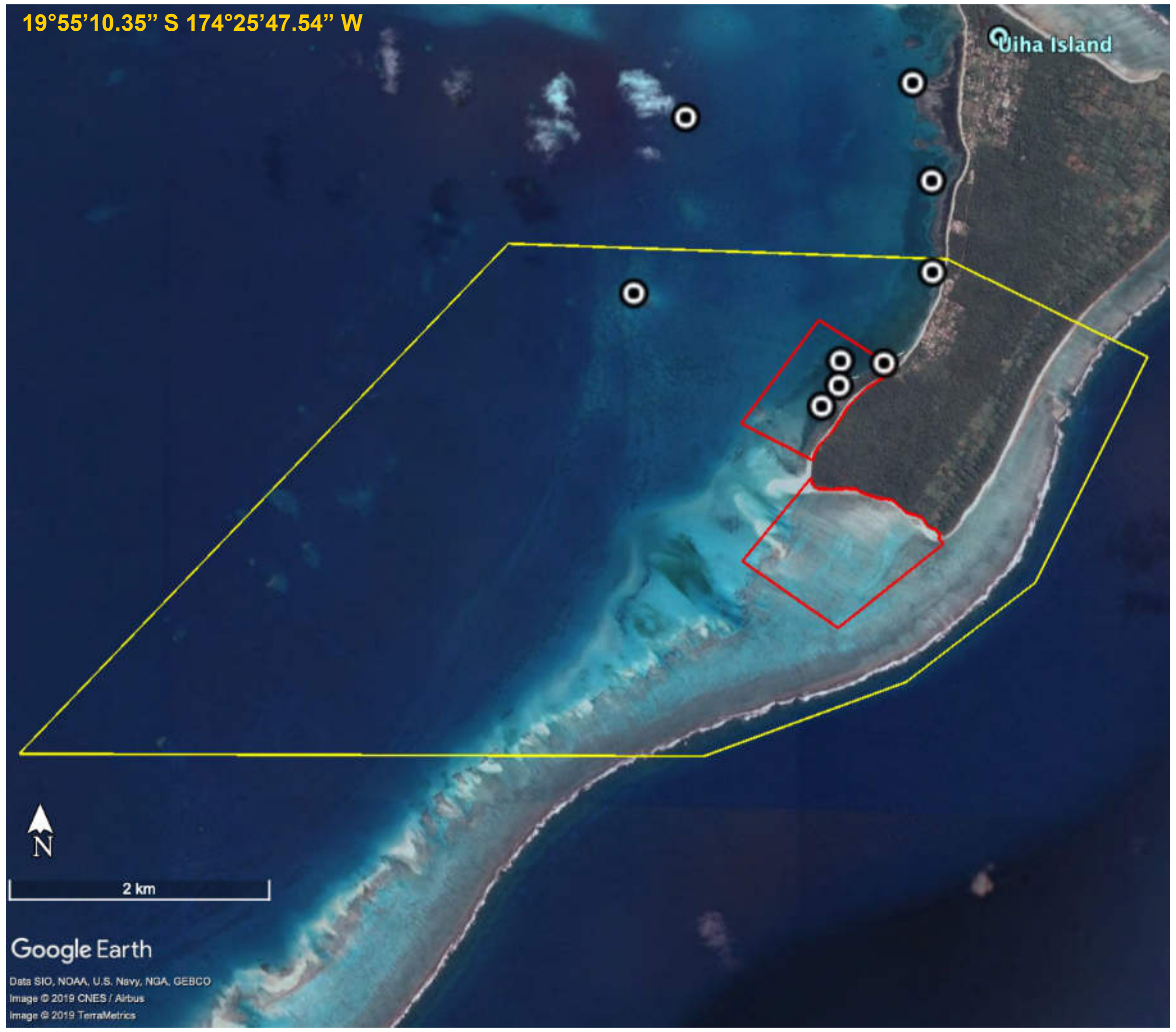
Ko e katoa 'o e feo 'i he 'elia tapu koe 52%.



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
175	17.1 km^2	22.7%	0.44 & 0.74 km^2	17%	6.9%

The fringing reefs around Felemea were generally in poor condition, with low coral cover and poor water quality. However, from the 6 sites surveyed across the SMA and FHR, it was clear that the FHR was having an important effect. Fish abundance was much greater inside the FHR than matched control sites, although no difference was observed for the SMA or for fish biodiversity from the FHR or SMA.

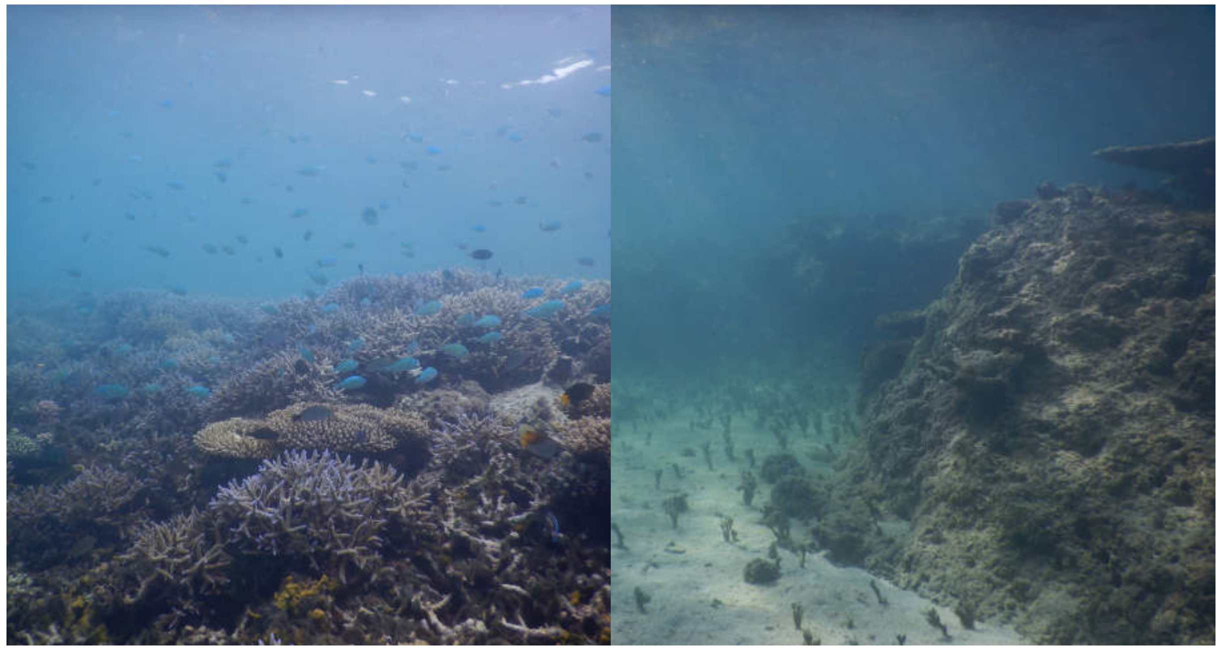
Adult food fish abundance was greatest at FHR site 1 (135 fish/km^2) and lowest at SMA site 1 (13.3 fish/km^2). Fish diversity was greatest at SMA site 1 (41.3 species) and lowest at SMA site 2 (29 species). Coral cover was lowest at the FHR site 2 (6.7%) and greatest at SMA site 1 (38.4%).

The Felemea community was exceptionally engaged in enforcement. The excellent job the community has done with their SMA is important for improving the health of their reefs. The southern FHR was in less than 50 cm of water and unable to be surveyed due to the shallow depth.

Ko e hakau takatakai koia ‘o Felemea ‘oku holo ‘a e tu’unga mo’uilelei ‘oku ‘iai pea ‘ikai ke fu’u ma’a ‘a e konga tahi koia. Kaekehe, ko e fo’i ‘elia ‘e 6 na’e fakahoko ai e savea ‘i loto ‘i he Feitu’u Pule Makehe pea mo e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika pea na’e mahino ‘a e ‘iai ‘a e fatongia mahu’inga ‘a e ‘elia tapu ‘aupito ki he Feitu’u Pule’i Makehe ‘o Felemea. Ko e tokolahi ‘o e ika na’e lahi ange ‘i loto ‘i he ‘elia tapu ‘aupito ‘i hono fakahoa ki he ngaahi ‘elia makehe ange ‘i tu’a na’e kau hono savea’i. Pea na’e ‘ikai ke fu’u ‘iai ha kehekehe ‘i he kalasi kehekehe ‘o e ika ‘i loto, fakatoloua ‘i he ‘elia tapu ‘aupito kae pehe ki he Feitu’u Pule’i Makehe.

Ko e tokolahi ‘o e ika lalahi ngaue’aki ki he ma’u me’atokoni na’e lahi ange ‘i loto ‘i he ‘elia 1 (135 ika/km^2) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika pea si’isi’i ange ‘i he ‘elia 1 (13.3 ika/km^2) ‘o e Feitu’u Pule’i Makehe. Pea ko e kalasi kehekehe ‘o e ika, na’e lahi ange ‘i he ‘elia 1 (41.3) pea si’isi’i ange ‘i he ‘elia 2 (38.4) ‘o e Feitu’u Pule’i Makehe. ‘I he tu’unga mo’uilelei ‘o e feo, na’e holo ‘i he ‘elia 2 (6.7%) ‘o e Feitu’u Pule’i Makehe kae lelei ange ‘i he ‘elia 1 (38.4%) ‘o e Feitu’u Pule’i Makehe.

‘I he tu’unga hono polisi’i/le’ohi ‘o e ‘elia Feitu’u Pule’i Makehe, na’e mahino ‘a e tokanga e kakai ‘o Felemea ko hono fakahoko e ngaue ko eni. Ko e taha eni he ngaue mahu’inga ‘aupito ‘i he polokalama ‘o fakataumu’a ke fakapapau’i ‘oku malu ‘enau ‘elia mo pea ke tupulekina e me’amo’ui mo e ngaahi nofoa’nga ika. Ka neongo ia, ko e tafa’aki faka-Tonga ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘oku si’isi’i ‘aki ‘a e 50cm ‘a e lololo pea na’e ‘ikai fakahoko ha savea ai makatu’unga pe mei he’ene fu’u mamaha.



The coral growth on the Felemea bommie inside the FHR was exceptional, with lots of branching corals and many adult food fish. The fringing reef inside the Felemea SMA and FHR was in poor condition, likely due to coral bleaching and cyclones.

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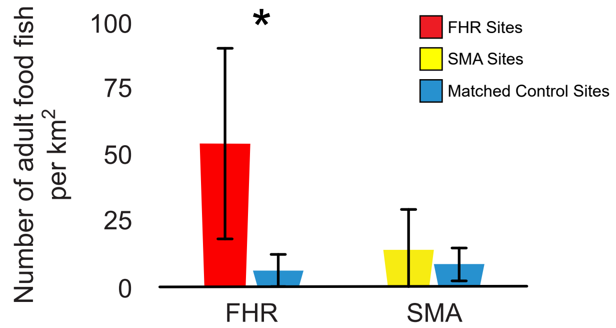
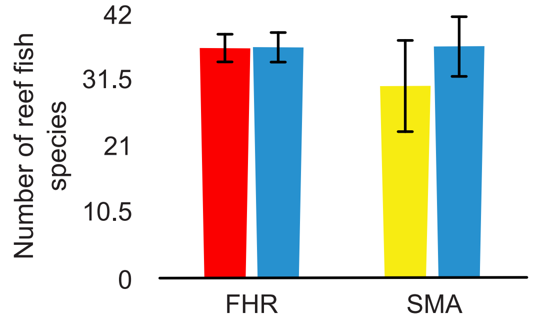
Ko e tu’unga na’e ‘iai ‘a e feo ‘i loto ‘i he Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika na’e fu’u lelei ‘aupito, he na’e lahi ai ‘a e feo va’ava’a pea mo e ika lalahi ‘oku ngaue’aki ki he ma’u me’atokoni. Ko e hakau feo ‘i loto ‘i he Feitu’u Pule’i Makehe mo e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘o Felemea, na’e holo ‘a e tu’unga ‘oku ‘iai, ‘o makatu’unga mei he fakatamaki fakaenatula pea mo e mate ‘a e feo ‘i he feliuliuaki ‘a e ‘ea.

Abundance of food fish
Koe lahi ‘o e me’atokoni ‘a e ‘ika



Diversity of reef fish
Kehekehe ‘o e ngaahi ‘ika mei he hakau



There was greater adult fish abundance inside the FHR than in matched control sites. There was no difference between the SMA and matched control sites or for reef fish biodiversity.

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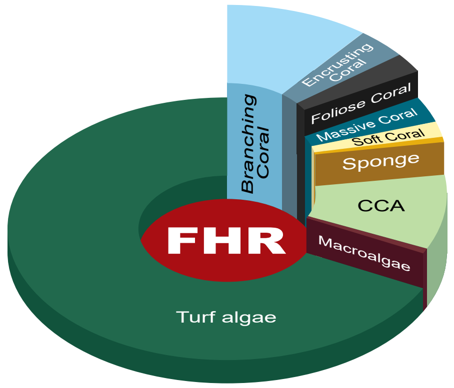
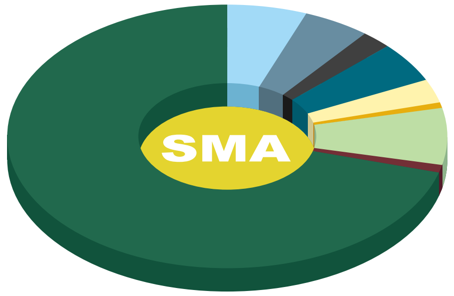
Na’e tokolahi ange ‘a e ika lalahi ‘i loto ‘i he Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘i hono fakahoa ki he ngaahi ‘elia makehe ‘i tu’a na’e kau hono savea’i. Pea na’e ‘ikai ha fu’u kehekehe ‘i he tokolahi pe kalasi ‘o e ika ‘i loto ‘i he Feitu’u Pule’i Makehe ‘i hono fakahoa ki he ngaahi ‘elia makehe ‘i tu’a na’e kau hono savea’i aipe.

Benthic habitat coverage
Ko e nofo’anga ‘o e ‘ika





Total live coral cover inside the FHR was 31%. Total live coral cover inside the SMA was 28%.

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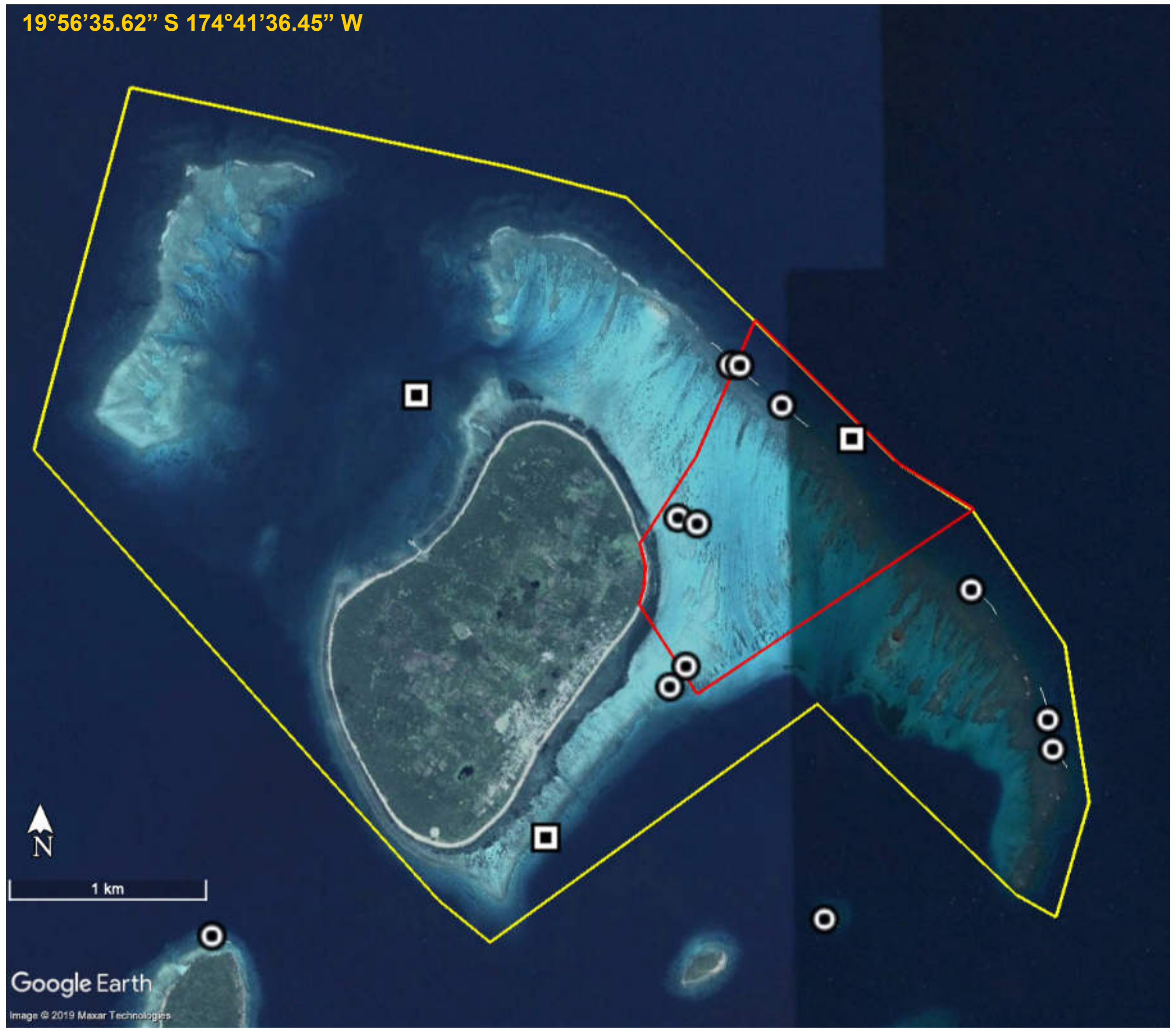
Ko e katoa ‘o e feo ‘i he ‘elia tapu koe 31%. Ko e katoa ‘o e feo ‘i he feitu’u pule’i makehe ko e 28%.



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
287	14.3 km^2	23.2%	1.39 km^2	33.5%	9.7%

Fifteen sites were surveyed inside Ha’afeva’s SMA and FHR by the 2017/18 national monitoring program and the 2017 Vava’u Ocean Initiative Marine Expedition. The seven sites surveyed along the outside edge of Ha’afeva’s SMA were in good condition, although there was no evidence that the SMA or FHR were having an effect for fish abundance or diversity.

Adult food fish abundance was greatest at FHR site 1 (163.3 fish/km^2) and lowest at SMA site 4 (6.6 fish/km^2). Fish diversity was greatest at SMA site 1 (51 species) and lowest at FHR site 6 (17.2 species). Coral cover was lowest at the FHR site 5 (4.1%) and greatest at SMA site 8 (33.4%).

The overall condition of these reefs is more likely because of their exposure to clean and clear oceanic conditions. In addition, when visiting the village it appeared that the sign depicting the area of the FHR and SMA was in poor condition.*

*For additional details on this SMA please read the 2017 Vava’u Ocean Initiative Marine Expedition Interim Report

Ko e fo’i ‘elia ‘e 15 ‘i loto ‘i he Feitu’u Pule’i Makehe mo e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘o Ha’afeva na’e kau hono savea’i lolotonga hono muimui’i/vakai’i fakalukufua ‘a e polokalama ‘i he ta’u 2017/2018 kae pehe ki he Vava’u Ocean Initiative Marine Expedition ‘i he ta’u 2017. Na’e mahino mei heni ‘a e fo’i ‘elia ‘e 7 ‘i he ngatangata’anga ‘o e hakau ‘i he Feitu’u Pule’i Makehe ‘o Ha’afeva, ‘a e fakafiemalie ‘a e tu’unga mo’uilelei ‘oku ‘iai ‘a e feo, neongo na’e ‘ikai ke fu’u ‘iai ha kehekehe ‘i he Feitu’u Pule’i Makehe pe Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika, ‘i he tokolahi pe kalasi kehekehe ‘o e ika.

Ko e tokolahi ‘o e ika lalahi ‘oku ngaue’aki ki he ma’u me’atokoni, na’e lahi ange ‘i he ‘elia 1 (163.3 ika/km^2) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika pea si’isi’i ange ‘i he ‘elia 4 (6.6 ika/km^2) ‘o e Feitu’u Pule’i Makehe. ‘I he kalasi kehekehe ‘o e ika, na’e lahi ange ‘i he ‘elia 1 (51) ‘o e Feitu’u Pule’i Makehe pea si’isi’i ange ‘i he ‘elia 6 (17.2) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika. ‘I he tu’unga mo’uilelei ‘o e feo, na’e holo ‘i he ‘elia 5 (4.1%) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika pea lelei ange ‘i he ‘elia 8 (33.4%) ‘o e Feitu’u Pule’i Makehe.

Ko e tu’unga fakalukufua ‘oku ‘iai ‘a e hakau ‘o hange ‘oku lave kiai ‘i ‘olunga, ‘oku makatu’unga mei he fehangahangai ‘a e hakau mo e konga tahi ‘oku ma’a pea ‘oku tu’u ‘ata ki he tahi mei tu’a. Kaekehe, ‘i he fepotalanoa’aki mo e kakai ‘o e kolo, na’e mahino ko e tu’unga ‘o e ‘elia Feitu’u Pule’i Makehe mo e Feitu’u Malu’i ‘o e ika na’e ‘i he tu’unga fakatu’utamaki.

The exposed northern reefs of the Ha’afeva SMA and FHR are in good condition, but this is likely because of environmental conditions and not the effect of management.

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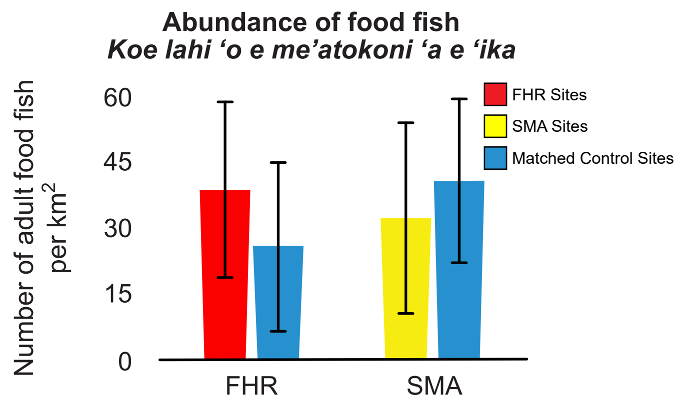
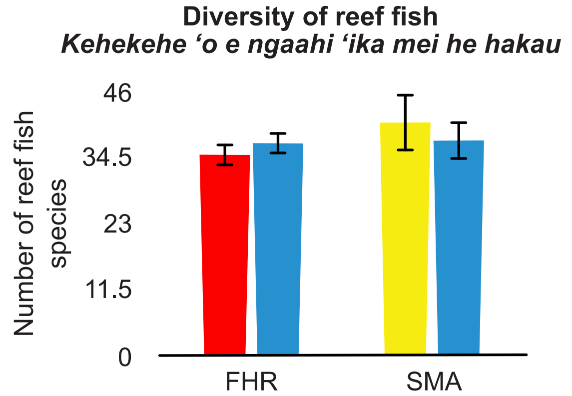
Ko e hakau feo ki he tafa’aki faka-Tokelau ‘o e Feitu’u Pule’i Makehe mo e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘o Ha’afeva, ‘oku ‘i he tu’unga fakafiemalie ‘a ‘ene mo’uilelei, ‘o ‘ikai ‘uhinga ko hono pule’i lelei ‘o e toutai, ka ko e tupulaki pe mei natula.





There was no difference in fish abundance or diversity inside the Ha’afeva FHR or SMA than matched control sites.

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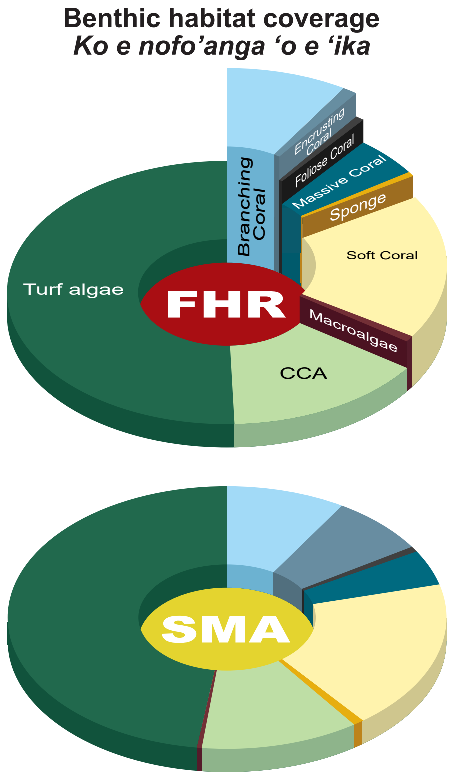
Na’e ‘ikai ke fu’u ‘iai ha kehekehe ‘i he tokolahi mo e kalasi kehekehe ‘o e ika, ‘i loto ‘i he Feitu’u Pule’i Makehe pe Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘o Ha’afeva ‘i hono fakahoa ki he ngaahi ‘elia makehe ‘i tu’a na’e kau hono savea’i.



Total live coral cover inside the FHR was 49%. Total live coral cover inside the SMA was 51%.

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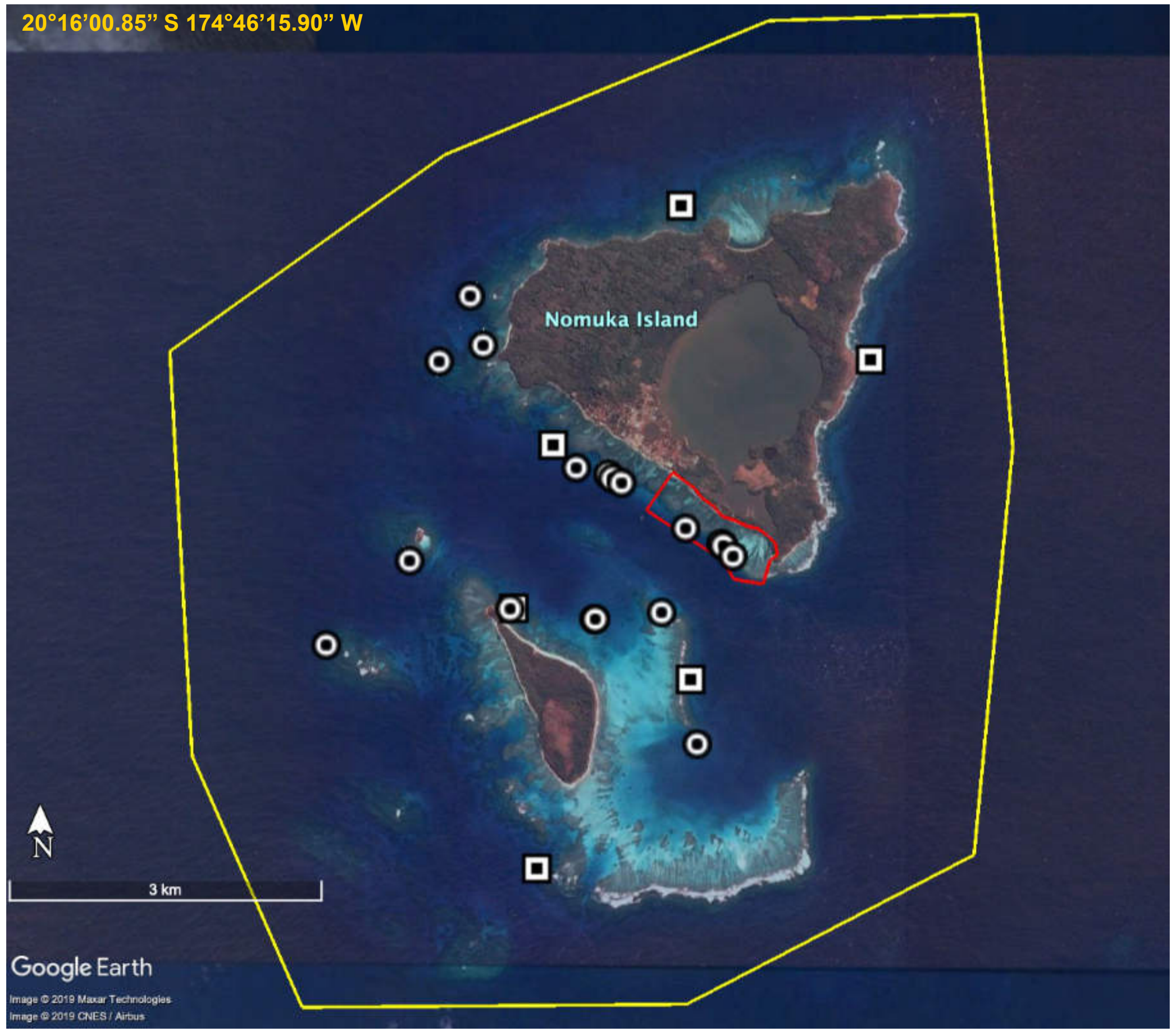
Ko e katoa ‘o e feo ‘i he ‘elia tapu koe 49%. Ko e katoa ‘o e feo ‘i he feitu’u pule’i makehe ko e 51%.

NOMUKA SMA 2011 HAP



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
362	68.2 km^2	18.6%	0.53 km^2	65.2%	0.8%

The Nomuka FHR is one of the best performing in the country, and 23 sites have been surveyed around Nomuka and Nomuka Iki by the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition. The reefs inside both the FHR and SMA are in very good condition, with some of the highest coral cover in the country and the most diverse assemblages of reef fish anywhere in the Kingdom. In addition, there was evidence of a strong effect of the FHR, with many more adult food fish, and greater fish diversity, inside the FHR than matched control sites. There was no evidence of an effect of the SMA areas, where the community can still fish.

Adult food fish abundance and coral cover were greatest at FHR site 1 (393.3 fish/km^2; 50.2%). Fish diversity was greatest at FHR site 4 (60 species). The lowest values for fish abundance, diversity and coral cover were in front of the village (79.7 fish/km^2, 15 species and 13.2%).

The strong effect of Nomuka's FHR is due to very good enforcement and strict monitoring by the community. In addition, the overall environmental conditions in southern Ha'apai are the best in the country for reef health. *

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report

Ko e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'o Nomuka, 'oku kau ia 'i he lelei taha 'a hono tu'unga 'i he fonua fakalukufua. Pea ko e foi 'elia 'e 23 na'e savea'i 'i Nomuka pea mo Nomukeiki 'i he 2017/2018 lolotonga hono muimui'i/vakai'i fakalukufua 'a e polokalama kae pehe ki he 2017 'e he Ocean Initiative Marine Expedition. Ko e hakau feo 'i loto 'i he Feitu'u Pule'i Makehe moe Feitu'u Malu'i 'o e Nofo'anga 'a e Ika, 'oku 'i he tu'unga fakafiemalie 'a 'ene mo'uilelei pea ko e taha ia he lelei taha 'i he fonua fakalukufua 'o tatau pe ki he tokolahi 'o e ika. Na'e fakapapau'i 'i he savea 'a e mahu'inga koia 'a e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'o makatu'unga 'i he lahi 'a e ika lalahi pea to e kalasi kehekehe 'i loto foki fakatatau ki hono fakahoa ki he ngaahi 'elia makehe 'i tu'a na'e kau hono savea'i. Pea na'e 'ikai ke fu'u 'iai ha kehekehe 'i he tupulaki 'a e me'amo'ui 'i loto 'i he Feitu'u Pule'i Makehe 'o Nomuka, tautautefito ki he feitu'u 'oku ngofua ke toutai ai e kakai.

Ko e tu'unga fakalakalaka 'oku 'iai 'a e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'o Nomuka, 'oku makatu'unga ia mei hono pule'i lelei, malu'i, polisi'i mo muimui'i lelei 'e he kakai 'o Nomuka. 'I he'ene pehe, 'oku mahino 'i he fakalukufua 'o e 'atakai 'o e potu tahi 'o Ha'apai, ko e tafa'aki faka-Tonga 'oku ne ma'u 'a e tu'unga mo'uilelei taha 'o e hakau feo.

The coral reefs inside the Nomuka FHR are very healthy, with high coral cover, lots of adult food fish and high reef fish diversity.

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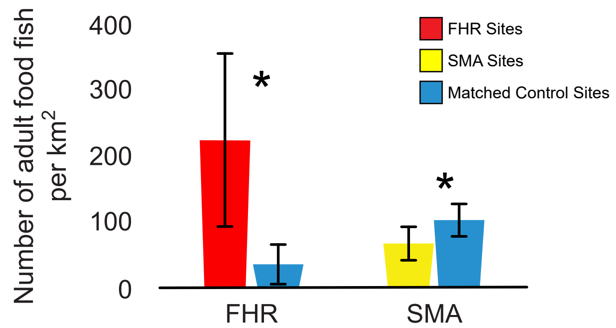
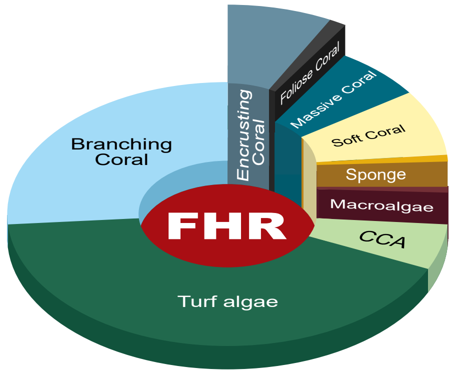
Ko e hakau feo 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'o Nomuka 'oku fu'u mo'uilelei 'aupito fakatatau ki he'ene tupulaki mo e lahi 'o e ika lalahi mo 'ene kalasi kehekehe 'oku nau nofo ai.

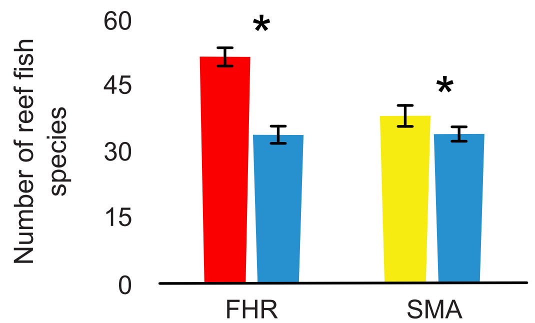
Abundance of food fish
Koe lahi 'o e me'atokoni 'a e 'ika

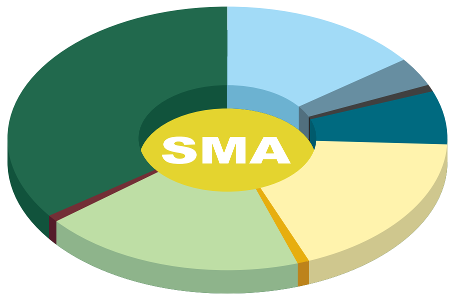


Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau





There was greater fish abundance and diversity inside the Nomuka FHR than matched control sites. There was no difference in fish abundance or diversity inside the Nomuka SMA than matched control sites.

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Na'e lahi ange ika lalahi mo kalasi kehekehe 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga ' a e Ika 'o Nomuka fakahoa ki he ngaahi 'elia makehe ange 'i tu'a na'e kau hono savea'i. Ka na'e ikai ke 'iai ha fu'u kehekehe 'i he lahi 'o e ika mo 'ene kalasi kehekehe 'i loto 'i he Feitu'u Pule'i Makehe 'o Nomuka fakahoa ki he ngaahi 'elia makehe na'e kau hono savea'i.

Total live coral cover inside the FHR was 56%. Total live coral cover inside the SMA was 62%.

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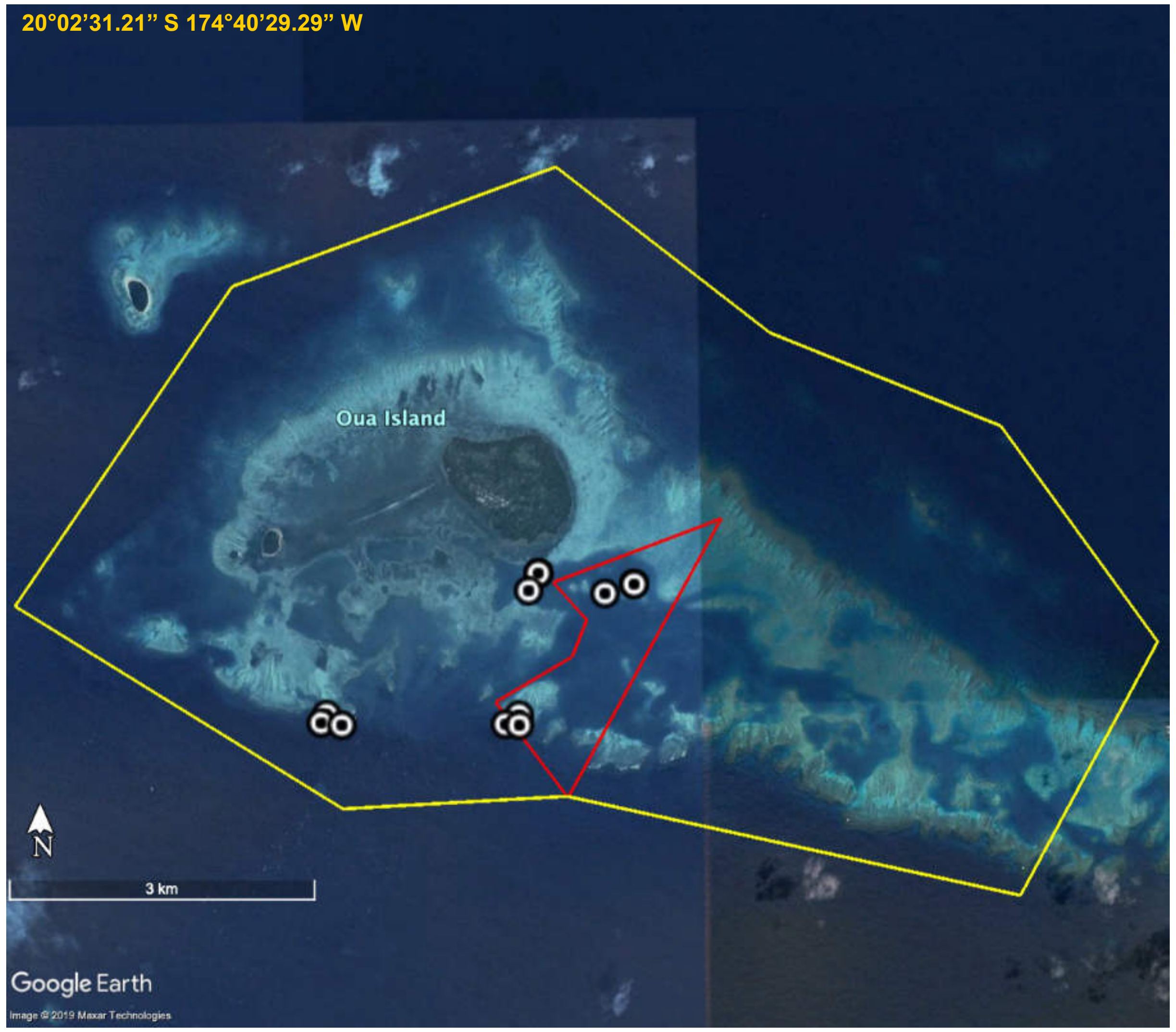
Ko e katoa 'o e feo 'i he 'elia tapu koe 56%. Ko e katoa 'o e feo 'i he feitu'u pule'i makehe ko e 62%.



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
76	41.68 km^2	29.2%	2.16 km^2	15.9%	5.2%

The coral reefs at the 6 outer slope sites of the O’ua SMA and FHR are in very good condition, with many adult food fish. However, there was no evidence of any difference between these areas and other areas open to fishing. The good condition of these reefs is likely the result of environmental conditions. The inner sites at Ou’a were in very poor condition, with high turbidity and algal cover.

Adult food fish abundance was greatest at FHR site 4 (370 fish/km^2) and lowest at SMA site 1 (0 fish/km^2). Fish diversity was greatest at SMA site 5 (47.5 species) and lowest at SMA site 3 (16.8 species). Coral cover was lowest at the FHR site 3 (2.9%) and greatest at SMA site 5 (21.8%).

The O’ua SMA is the oldest in the country, established in 2006. Because it is in such a remote location, fishing pressure may be very low, which may also be why there was no difference between the FHR and areas open to fishing.

Ko e hakau feo ‘i he Feitu’u Pule’i Makehe mo e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘o O’ua ‘oku fu’u tupulaki ‘aupito kae pehe ki he ika lalahi ‘oku ‘iai. Koia ai, ‘oku ‘ikai ke ‘iai ha fakamo’oni pau ‘oku ‘iai ha fu’u kehekehe ‘i he tu’unga ‘o e me’amo’ui moe nofo’anga ika ‘i he ngaahi ‘elia ni kae pehe ki he ngaahi ‘elia ‘oku ‘ata ki he toutai. Pea koe tupulaki ‘o e feo ‘oku ‘iai ‘a e tui ko e fakatupunga pe mei natula. Ka neongo ia, ko e konga ki loto ‘o e ‘elia ‘o O’ua ‘oku ‘i he tu’unga fakatu’utamaki fakatatau ki he ‘uli ‘o e tahi pea mo e tupu ‘o e limu ‘oku ne tamate’i ‘a e feo.

Ko e tu’unga ‘oku ‘iai ‘a e ika lalahi ‘oku lahi ange ‘i he ‘elia 4 (370 ika/km^2) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika kae si’isi’i ange ‘i he ‘elia 1 (0 ika/km^2) ‘o e Feitu’u Pule’i Makehe. ‘I he tu’unga ‘o e kalasi kehekehe ‘o e ika, na’e lahi ange ‘i he ‘elia 5 (47.5) ka e si’isi’i ange ‘i he ‘elia 3 (16.8) ‘o e Feitu’u Pule’i Makehe. Pea ki he tupulekina ‘o e feo, na’e si’isi’i ange ‘i he ‘elia 3 (2.9%) ‘o e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika pea lahi ange ‘i he ‘elia 5 (21.8%) ‘o e Feitu’u Pule’i Makehe.

Ko e Feitu’u Pule’i Makehe ‘o ‘O’ua, ko e fuofua feitu’u eni na’e fokotu’u ai ‘a e polokalama ‘i he ta’u 2006. Ko e fo’i motu tu’u tokotaha pe eni, pea ko e taha ia ‘uhinga ‘oku si’isi’i ai peai ‘a e ivi fakatoutai ‘oku fakahoko ai ‘o makatu’unga mei ai ‘a e ‘ikai ke fu’u ‘iai ha kehekehe ‘i he tu’unga ‘o e me’amo’ui moe nofo’anga ika ‘i loto i he ‘elia tapu ‘aupito mo e feitu’u ‘oku ngofua ai e toutai.

The coral reefs around O’ua are very healthy, with lots of food fish.

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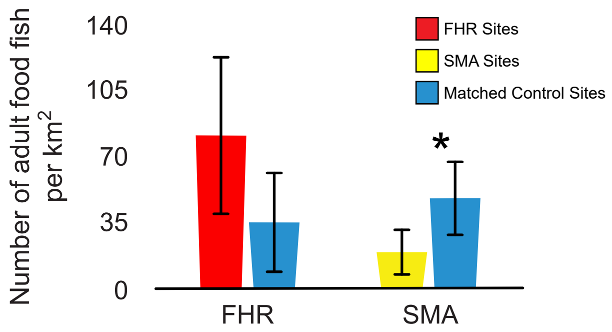
Ko e hakau feo takatakai ‘o ‘O’ua ‘oku fu’u mo’ui lelei, mo lahi ai ‘a e ika ‘oku ngaue’aki ki he ma’u me’atokoni.

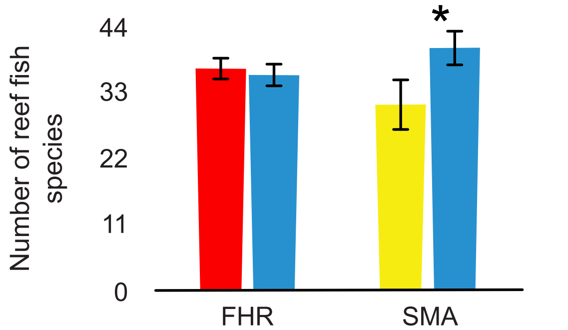
Abundance of food fish

Koe lahi ‘o e me’atokoni ‘a e ‘ika



Diversity of reef fish

Kehekehe ‘o e ngaahi ‘ika mei he hakau



There was no difference in fish abundance or diversity inside the O’ua FHR than matched control sites. There was signifincantly lower fish abundance and diversity inside the SMA than matched control sites.

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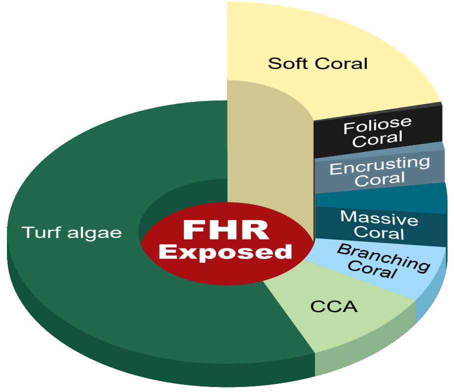
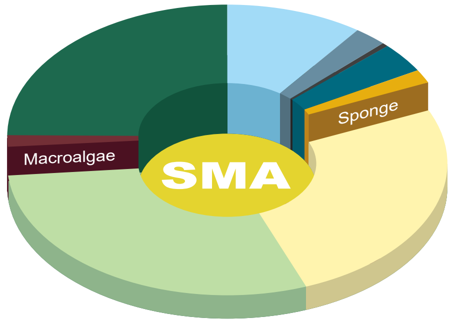
‘Oku ‘ikai ‘iai ha fu’u kehekehe ‘i he tu’unga ‘o e lahi mo e kalasi kehekehe ‘o e ika ‘i loto ‘i he Feitu’u Pule’i Makehe pe Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ‘o ‘O’ua fakatatau ki he ngaahi ‘elia makehe ‘i tu’a na’e kau hono savea’i.

Benthic habitat coverage

Ko e nofo’anga ‘o e ‘ika





Total live coral cover inside the FHR was 43%. Total live coral cover inside the SMA was 73%.

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Ko e katoa ‘o e feo ‘i he ‘elia tapu koe 43%. Ko e katoa ‘o e feo ‘i he feitu’u pule’i makehe ko e 73%.

POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
89	9.21 km^2	46.9%	2.6 km^2	15%	28.2%

The Ovaka SMA is the oldest SMA in Vava'u and has been surveyed by the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition in collaboration with VEPA. While several sites had very high abundances of reef fish, others had very few and overall there was no evidence of an effect of the FHR or SMA on adult fish abundance. There was however a strong effect of the FHR on reef fish diversity, with many more species inside the FHR than in areas open to fishing.

Adult food fish abundance was greatest at FHR site 4 (370 fish/km^2) and lowest at SMA site 1 (0 fish/km^2). Fish diversity was greatest at SMA site 5 (47.5 species) and lowest at SMA site 3 (16.8 species). Coral cover was lowest at the FHR site 3 (2.9%) and greatest at SMA site 5 (21.8%).*

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

Ko e Feitu'u Pule'i Makehe 'o Ovaka, ko e fuofua feitu'u ia na'e fokotu'u ai 'a e polokalama 'i Vava'u pea na'e fakahoko ai e savea lolotonga hono muimui'i/vakai'i fakalukufua 'a e polokalama 'i he 2017/18 pea mo e Ocean Initiative Marine Expedition 2017 'i he fengaue'aki vaofi mo e VEPA. Na'e mahino 'oku 'iai ngaahi 'elia 'oku lahi ai e ika, 'iai mo e ni'ihi 'oku si'isi'i pea 'i he vakai fakalukufua 'oku 'ikai ke fu'u 'iai ha fakamo'oni pau ke fakapapau'i 'oku 'iai ha ola mei he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika pe Feitu'u Pule'i Makehe 'o fakatatau ki he lahi 'o e ika lalahi. Kae kehe, 'oku 'iai 'a e ola 'oku 'asi mei he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'i he vakai ki he lahi 'o e kalasi kehekehe 'o e ika 'i loto 'i he 'elia ni fakatatau ki he ngaahi 'elia 'oku ngofua ki he toutai ai 'a e kakai 'o e kolo.

*Ko e tu'unga na'e 'iai 'a e ika lalahi 'oku ngaue'aki ki he ma'u me'atokoni na'e lahi ange 'i he 'elia 4 (370 ika/km^2) 'o e Feitu'u Malu'i 'o e Nofo'anga 'a e Ika pea si'isi'i ange 'i he 'elia 1 (0 ika/km^2) 'o e Feitu'u Pule'i Makehe. 'I he tu'unga 'o e kalasi kehekehe 'o e ika, na'e lahi ange 'i he 'elia 5 (47.5) pea si'isi'i ange 'i he 'elia 3 (16.8) 'o e Feitu'u Pule'i Makehe.**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition Interim 2017.*

The outer slopes of the Ovaka SMA have a high abundance of parrotfish and surgeonfish.

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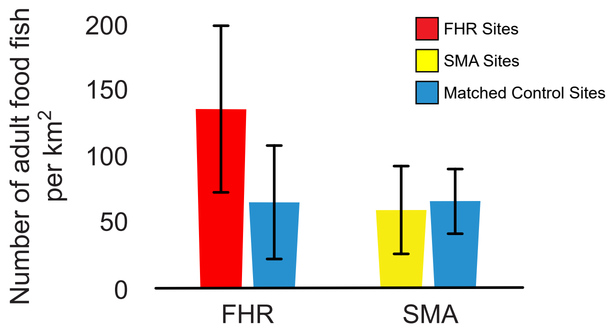
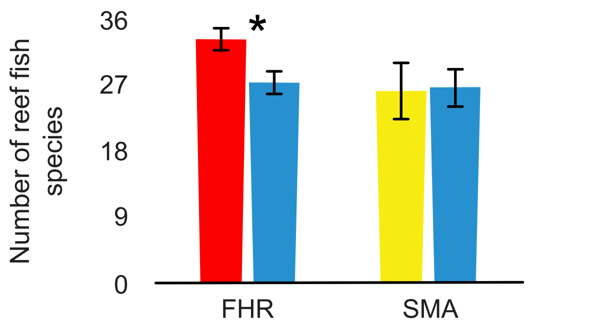
Ko e tafa'aki ki tu'a 'o e hakau 'o Ovaka, 'oku lahi ai 'a e kalasi 'o e ika ko e hohomo mo e 'ume.

Abundance of food fish
Koe lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



There was greater reef fish diversity inside the FHR than in matched control sites. There was no difference between the SMA or FHR and matched control sites or for reef fish abundance.

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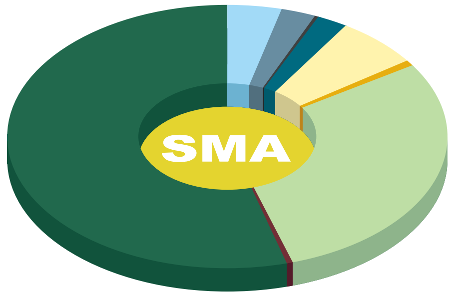
'I he kalasi kehekehe 'o e ika, na'e lahi ange 'i loto 'i he Feitu'u Malu'i 'o e Nofoanga 'a e Ika 'i hono fakahoa ki he ngaahi 'elia makehe ange 'i tu'a na'e kau hono savea'i. Pea na'e ikai 'iai ha fu'u kehekehe lahi 'o e ika 'o tatau pe 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika pea mo e Feitu'u Pule'i Makehe fakatatau ki he ngaahi ngaahi feitu'u makehe ange.

Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Total live coral cover inside the FHR was 34%. Total live coral cover inside the SMA was 45%.

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Ko e katoa 'o e feo 'i he 'elia tapu koe 34%. Ko e katoa 'o e feo 'i he feitu'u pule'i makehe ko e 45%.

What is included in each report?

In the pages that follow we provide details of the ecosystem state within the 41 new Special Management Areas in Tonga, established after 2013/14. It is important to note that this report does not include any information on estimated recovery within these areas as at the time of surveying they were all too young to be having an effect. Typical recovery times of coral reef fish can take at least three years for early signs of recovery and over 20 years for full recovery. Each SMA is provided with a one page layout that can also be printed as a stand-alone leaflet or poster.

We therefore provide only a baseline assessment of the current ecological state within these areas, which can be used in the future to examine changes due to management.

For each of the 41 new SMAs in Tonga we provide:

A) A detailed map outlining the boundaries of the Special Management Area (yellow), where only registered members of each community are allowed to fish, and the Fish Habitat Reserve (red), which is permanently closed to all fishing activities. This map also includes the sites where the ecological surveys were completed. Circles are from the 2017/18 national monitoring program, squares from the 2017 Vava’u Ocean Expedition, diamonds from the Asian Development Bank 2016 Vava’u SMA baseline surveys and triangles from the 2017-2019 VEPA surveys.

B) Details of each SMA and its community including SMA area, FHR area, proportion of the SMA that is FHR, proportion of the SMA/FHR that is reef habitat and village population.

C) A short description of the main findings for each SMA

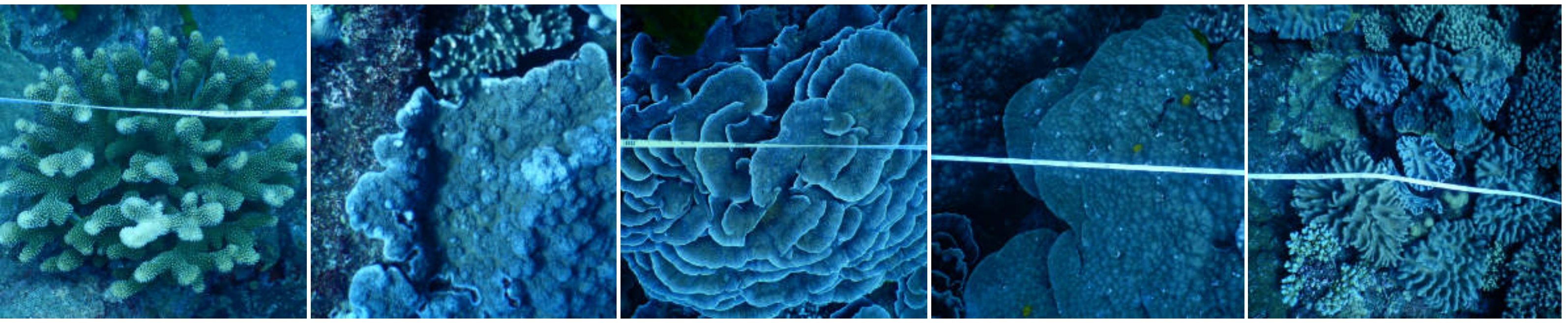
D) Figures that detail the baseline abundance of adult food fish and diversity of fish inside the FHR and SMA. Since multiple transects were completed at each site and inside each FHR or SMA, the column represents the average and the error bars around each column represent the variation between transects.

E) An image of the reefs inside the SMA or FHR.

F) Benthic cover – this is the amount (in total %) of different categories of reef substrate that was found on the transects inside the FHR and SMA*. The categories are:

- Branching coral
- Encrusting coral
- Foliose coral
- Massive coral
- Soft coral
- Sponges
- Other invertebrates – sea urchins, sea stars, sea cucumbers etc.
- Crustose Coralline Algae (CCA) – This is a very important encrusting pink algae that helps reefs recover
- Macro algae
- Turf algae

*Sand and rubble categories were removed so the data only represents substrata suitable for reef growth. This is because reef areas were the targets of the surveys and sandy areas were generally surveyed only when reef habitat was not available. If sand and rubble were included it would not accurately represent coverage of these habitat types. Benthic cover values therefore represent the percent cover of total reef habitat, which is available in the table, not percent cover of total area within the SMA/FHR.

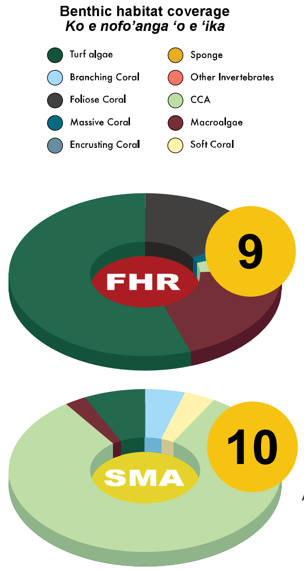


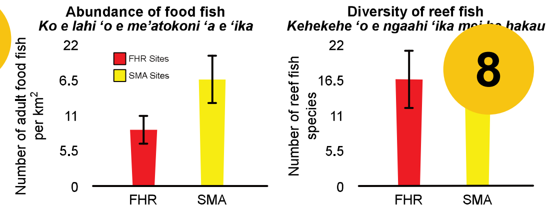
From left to right: Examples from the benthic surveys of branching, encrusting, foliose, massive and soft corals respectively.

Overview

HOLEVA SMA 2019

SMA SCORE





POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
125	1.5 km^2	32.7%	0.25 km^2	22.4%	16.7%

The Holeva SMA lies on the outermost north eastern edge of Vava’u, and is the most exposed SMA in Vava’u to open ocean swell. Two sites were surveyed by the Vava’u Environmental Protection Agency (VEPA). At both sites coral cover was low (FHR 19.7 %; SMA 4.8%), as well as the abundance (FHR 8.9 fish/km^2; SMA 16.7 fish/km^2) and diversity of reef fish (FHR 16.7 species; SMA 19.7 species).

Wave energy at these sites is very high throughout most of the year due to the easterly trade winds.

Ko e feitu’u puleí makehe (SMA) ‘o Ha’atafu ‘oku makehe ‘aupito tu’unga ‘i he’ene fakatou ma’u ‘a e konga ‘oku fehangahangai moe toka’anga matangi pea mo e konga ‘e taha ‘oku malu pea uu ‘ihe hangai fakahahake ‘o e tahi toafa ‘o e kolo ni. ‘Oku mahu’inga fakatou’osi ‘a e ongo ‘elia ni ke malu’i koe’uhi ko e fa’ahinga me’a mo’ui kehekehe ‘oku mo’ui ai.

Ko e feitu’u ‘oku tu’u ‘i he hangai fakahahake ‘oku mo’ui lelei ‘aupito ‘a e feo, pea lahi mo e ika ‘i he kalasi kehekehe pea ko e tu’unga ‘oku feo ‘oku fakafuofua ki he 20%. ‘I he tafa’aki ki he Tonga ‘o e feitu’u pule’i makehe (SMA) ‘oku mo’ui lelei ‘a e feo ‘o tatau pe moe tafa’aki fakahahake ‘oku 19%, ‘aia ‘oku lahi ‘ae ika foki ‘o tatau pe mo e ‘elia tapu (FHR) ‘aia ‘oku malu’i ai foki ‘ae ‘ika mo honau nofo’anga.

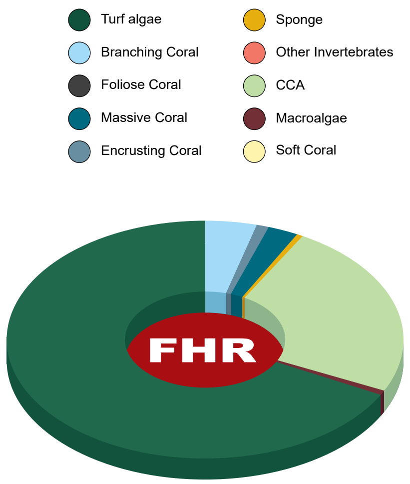
‘I he tafa’aki ki loto ‘o e tahi ‘i he ‘elia tapu ‘oku si’isi’i ai e tupu ‘a e feo ‘o fakafuofua pe ki he 7% pea toe si’i ange mo e lahi ‘o e ika pea mo e kalasi kehekehe. Ko e feitu’u ko’eni ‘oku ‘ikai fu’u ngaue pe tafe malohi ‘a e tahi o mahalo pe koe tupu me ihe ngaahi hakau ‘i he tafatatafa’aki. Koe ‘uli pe tafe e me’a kehekehe ki he feitu’u ni ‘oku hange ‘e ngali fakatu’utamaki ‘i he kahau ki he feitu’u ni.

Coral cover along the exposed side of Holeva was very low.
-
Koe ‘elia fakahihifo ‘o e ‘elia tapu ‘o Ha’atafu fakataha mo hono feo moe tahi ma’a mo masani ‘oku mahu’inga ke tauhi mo tokanga’i koe halafonionga ki he ngatai tu’uloa pea ke to e tokangai fakapotopoto ange ‘a e konga tahi toafa ‘i he ‘elia ni he ‘oku ‘ikai fu’u tafe lelei ‘a e tahi pea ngali si’isi’i ‘ae feo ‘oku mo’ui ai. ‘Oku fakafa’ei ke tau loto taha pea tau ngaue fakataha ma’u ai pe ki he Ngatai Tu’uloa. .

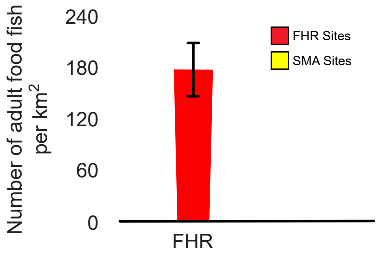
XX

1. **Community name**
2. **Map**
3. **Abundance of adult food fish in FHR and SMA**
4. **Information table**
5. **Summary text**
6. **Year established**
7. **Ecosystem health rating**
8. **Species richness of reef fish in FHR and SMA**
9. **Benthic cover inside FHR**
10. **Benthic cover inside SMA**

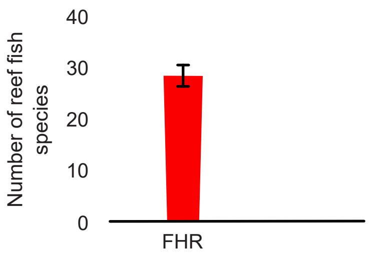
Benthic habitat coverage
Ko e nofo’anga ‘o e ‘ika



Abundance of food fish
Ko e lahi ‘o e me’atokoni ‘a e ‘ika



Diversity of reef fish
Kehekehe ‘o e ngaahi ‘ika mei he hakau



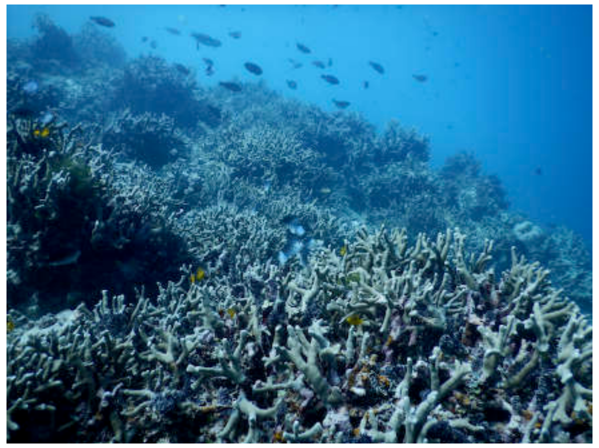
POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHRs as % of SMA
2	-	-%	1.19 km^2	23.4%	-

The Eueiki FHR is one of the outer most management areas in Vava’u and two sites were surveyed along its western side. The abundance of adult food fish was high (178.3 fish/km2), with many large adult snapper. However species richness was low (28.5 species). Coral cover was also very low, only 7%. This represents a similar trend throughout Vava’u, where coral cover was generally low at most sites.

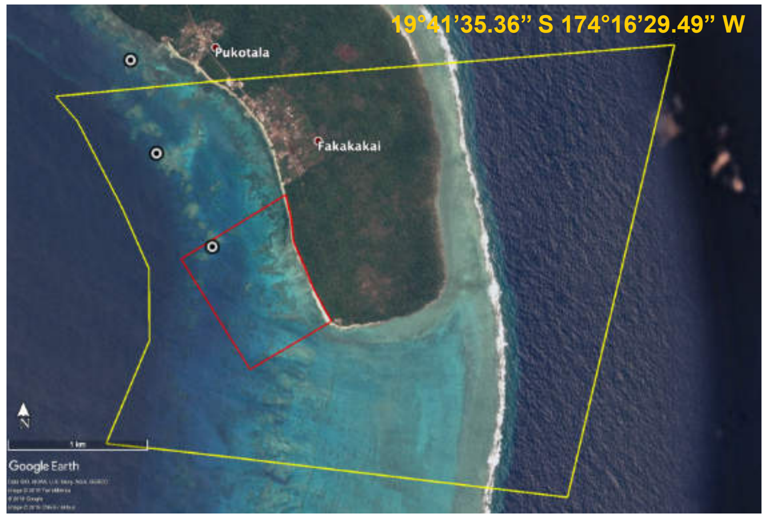
The Vava’u Environmental Protection Agency (VEPA) has been monitoring one site at Eueiki since 2014. They have reported on a large coral bleaching event along the north-west side of the island in 2015.

Ko e Feitu’u Pule’i Makehe ‘o ‘Eueiki ‘oku kau ia he ‘elia ‘oku fu’u pule’i lelei polisi’i talu hono fokotu’u ‘i Vava’u pea ko e foi ‘elia ‘e 2 na’e savea’i ‘i loto ‘i he tafa’aki faka-Hihifo. Ko e lahi ‘o e ika lalahi, na’e ‘i he tu’unga ma’olunga (178.3 ika/km2) tautautefito ki he kalasi ‘o e ika, ko e palu. Ka neongo ia, ‘i he tu’unga ‘o e kalasi kehekehe ‘o e ika, ‘oku holo (28.5) ‘o tatau pe ki he tu’unga ‘o e tupulaki ‘o e feo ‘oku holo ‘aki 7%. ‘Oku meimei ko e tu’unga eni ‘oku tofuhia ai ‘a e ngaahi feitu’u lahi ‘i Vava’u, ‘o holo ‘a e tu’unga ‘oku ‘iai ‘a e feo.

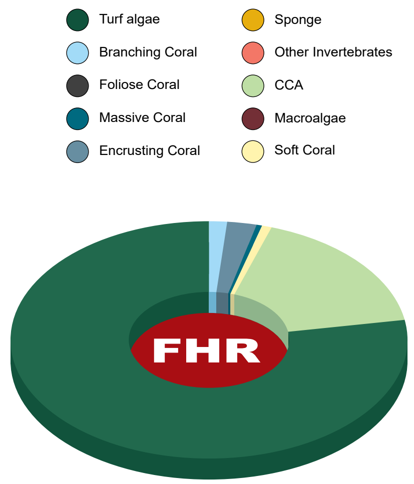
Ko e Vava’u Environmental Protection Agency (VEPA) ‘oku nau muimui’i/vakai’i ma’u pe ‘a e fo’i ‘elia ‘e taha ‘i ‘Eueiki talu mei he 2014. Pea ‘oku nau ‘osi lipooti ‘i he 2015 ‘a e lahi ‘o e mate ‘o e feo ‘i he tafa’aki faka-Tokelau Hihifo, fakatupunga mei he feliuliuaki ‘o e ‘ea..



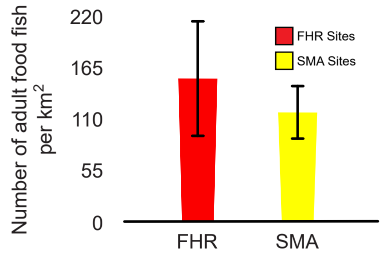
A large thicket of *Porites cylindrical* coral that has recovered since the 2015 bleaching event at the VEPA site.
-
Ko e taha ‘o e kalasi ‘o e feo (Porites cylindrical) ‘i he ‘elia ‘oku muimui’i ‘e he VEPA, ‘oku lolotonga fakaakeake mei he’ene mei mate, talu mei he 2015.



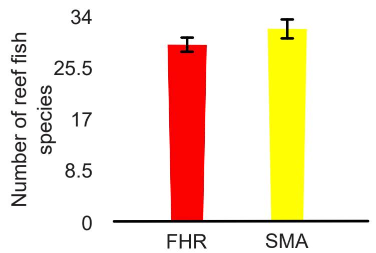
Benthic habitat coverage
Ko e nofo’anga ‘o e ‘ika

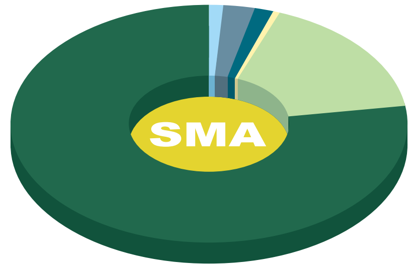


Abundance of food fish
Ko e lahi ‘o e me’atokoni ‘a e ‘ika



Diversity of reef fish
Kehekehe ‘o e ngaahi ‘ika mei he hakau

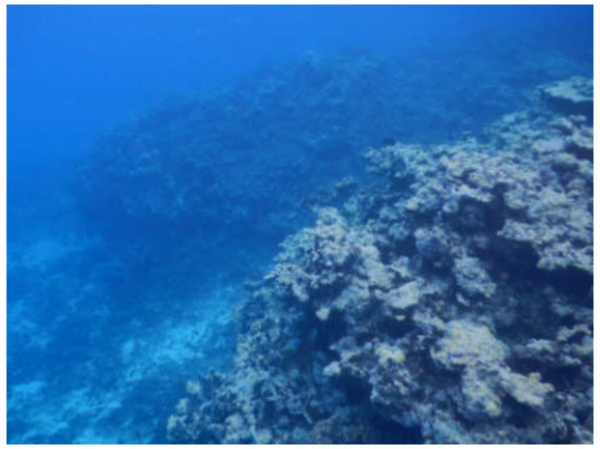




POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
145	10.74 km^2	17.2%	0.94 km^2	30.4%	8.75%

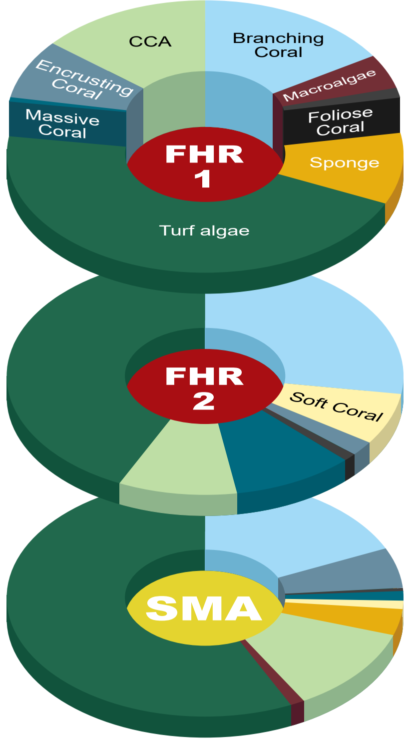
The Fakakakai SMA in northern Ha’apai had high fish abundance inside both the new SMA (118.5 fish/km2) and FHR (155 fish/km2). However, the coral reefs appeared to have been recently damaged by cyclones and coral bleaching, with very low coral cover (4.8%) at the two sites surveyed. This pattern was observed all along the western sides of the northern Ha’apai islands. Many large table corals littered the sandy areas near the reefs, which appear to have been broken off in a cyclone at some point in the past several years.

Ko e Feitu’u Pule’i Makehe ‘o Fakakakai ‘i he tafa’aki faka-Tokelau ‘o Ha’apai ‘oku lahi ai ‘a e tu’unga ‘o e ika ‘o tatau pe ‘i loto ‘i he Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika (155 ika/km2) pea mo e Feitu’u Pule’i Makehe (118.5 ika/km2) foki. Neongo ia, ko e hakau feo óku mahino á éne maumau ó fakatupunga é he saikolone mo e feliuliuaki á e éa pea óku í he tuúnga maúlalo á éne tupulekina (4.8%) í he feituú é ua (2) naé fakahoko ai e savea. Naé fakahoko savea ni í he tafaáki fakaHihifo ó e tafaáki fakaTokelau ó e ótu motu Haápai. Lahi ngaahi maka feo óku hake í he ngaahi matafanga óneóne ofi ki he hakau, ó fakamahino ko e maumaui é he saikolone í he ngaahi taú kuo maliu atu.

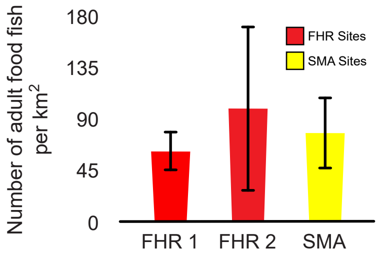


The reefs around Fakakakai appear to have been recently damaged from a cyclone, with many dead and broken table corals littering the ground.
-
Ko e hakau feo takatakai ‘o Fakakakai, ‘oku ‘ilonga ‘a e ngaahi maumau ko e toki fakatupunga ‘e he fakatamaki fakaenatula, ‘i he lahi ‘a e feo motumotu mo mate ‘oku laku holo ‘i he funga hakau.

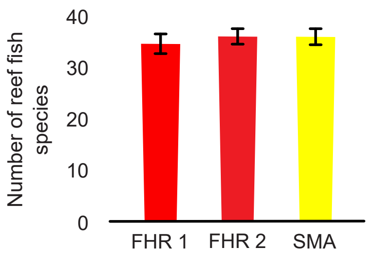
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau

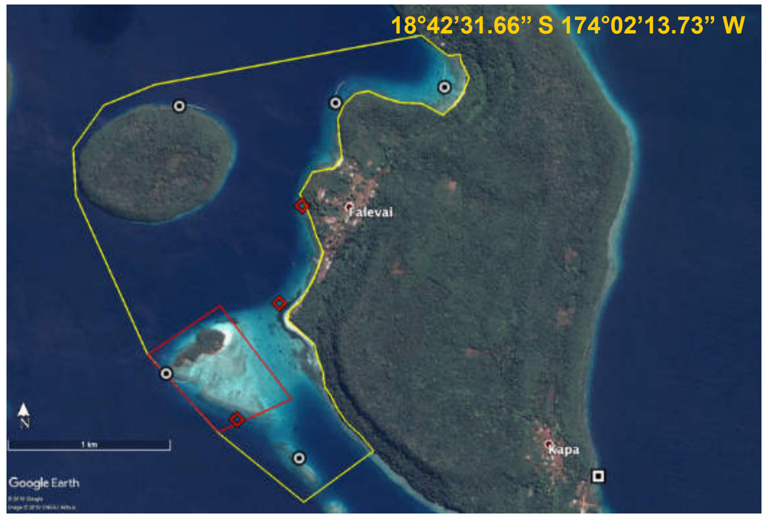


POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
368	15.83 km^2	17.4%	0.45 & 0.25 km^2	16.5%	4.4%

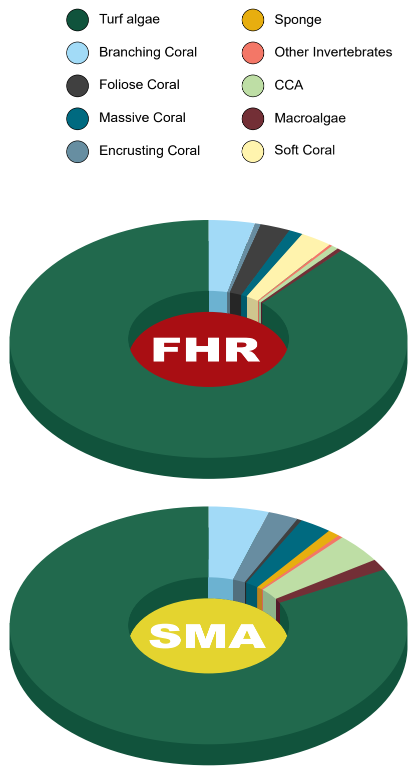
Five sites were surveyed within the Faleloa SMA, both close to the village and near the two resorts on the islands northern end. Fish abundance was greatest at the village SMA site (148.3 fish/km^2) and lowest in front of sandy beach resort (8.3 fish/km^2). Reef fish diversity was greatest at the shallow bommie in front of Matafonua resort (36.5 species) and lowest at the village SMA sites (29.2 species). The greatest coral cover was also at the shallow bommie in front of Matafonua resort (39.5%) and lowest at the village SMA sites (13.8 species).

Ko e 'elia 'e 5 na'e savea'i 'i he Feitu'u Pule'i Makehe 'o Faleloa, ofi ki he kolo kae pehe ki he ongo resort 'e ua 'i he tafa'aki faka-Tokelau. Ko e tu'unga 'o e ika na'e lahi ange 'i he 'elia ofi ki he kolo (148.3 ika/km^2) pea si'isi'i ange 'i he 'elia 'i mu'a 'i he Sandy Beach Resort (8.3 ika/km^2). 'I he kalasi kehekehe 'o e ika, na'e lahi ange ki he 'elia mamaha 'i mu'a 'i he Matafonua Resort (36.5) pea si'isi'i ange 'i he 'elia ofi ki he kolo (29.2). 'Ikai ngata ai, ko e tupulaki 'a e feo, na'e lelei ange 'i mu'a 'i he Matafonua Resort (39.5%) pea holo 'i he 'elia ofi ki he kolo (13.8%) aipe.

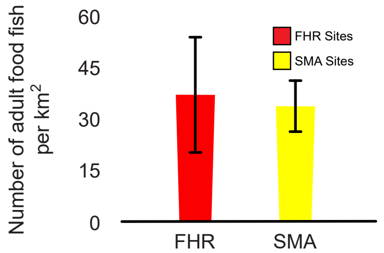
The bommie in front of Matafonua beach resort, with high coral cover and clear water.
-
Ko e 'elia mamaha 'i mu'a 'i he Matafonua Resort pea mo e tu'unga 'o e feo 'oku tupulaki 'aupito kae pehe ki he ma'a 'a e tahi.



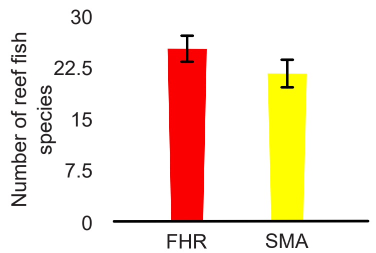
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
77	3.98 km^2	3.2%	0.36 km^2	41.8%	9%

Eight sites were surveyed within the Falevai SMA and FHR as part of both the 2017/18 national monitoring program as well as the Asian Development Bank Vava'u baseline SMA surveys. Overall the reefs within the Falevai SMA are in poor condition, with many signs of reef stress. The surveys around Port Maurelle anchorage had many signs of damage from anchoring yachts. However, the bommies around Nuku island to the south also were in very poor condition, with evidence of damage from cyclones.

Adult food fish density, total reef fish diversity and live coral cover were all greatest at A'a island (78.3 fish/km^2, 35.5 species, 16.7%) and lowest at the bommie past Nuku island towards Kapa (0 fish/km^2, 14.8 species, 4.1%).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e 'elia 'e 8 na'e savea'i 'i he Feitu'u Pule'i Makehe 'o Falevai lolotonga koia hono fakahoko 'a hono muimui'i fakalukufua 'a e polokalama 'i he 2017/18 kae pehe ki he savea na'e fakahoko 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia 'i he polokalama Feitu'u Pule'i Makehe 'i Vava'u. 'I he fakalukufua 'o e tu'unga 'o e feo, 'oku holo tu'unga mo'uilelei 'o e feo 'o makatu'unga 'i he ngaahi faka'ilonga 'oku fu'u lahi e toutai mo e ngaahi founga ngaue kehekehe 'oku fakahoko 'i he feitu'u ni. Pea ko e ola mei he savea takatakai 'i he taulanga Maurelle, na'e mahino ai 'a e lahi 'o e maumau 'o e hakau, fakatupunga mei he ngaahi li taula 'o e ngaahi vaka 'iote 'i he feitu'u ni. Kae kehe, ko e me'a tatau pe ki he tafa'aki faka-Tonga koia 'o e motu ko Nuku, 'a e holo 'a e feo 'o makatu'unga mei hono maumau'i 'e he saikolone mo e ngaahi fakatamaki fakaenatula.

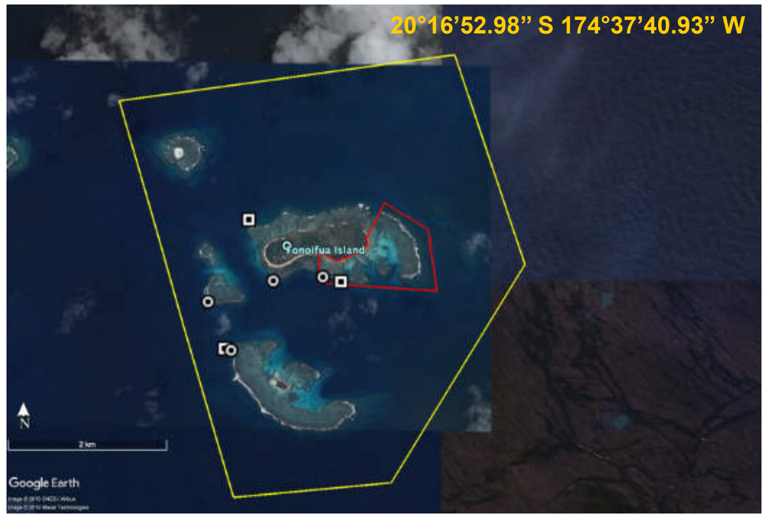
*Ko e lahi 'o e ika, ko 'enau kalasi kehekehe, pea mo e tupulaki 'a e feo na'a nau lahi ange 'i he motu ko A'a (78.3 ika/km^2, 35.5 species, 16.7 %) kae si'isi'i ange 'i he 'elia mamaha 'o e motu ko Nuku, tafa'aki ki Kapa (0 ika/km^2, 14.8 species, 4.1 %).**

**For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.*

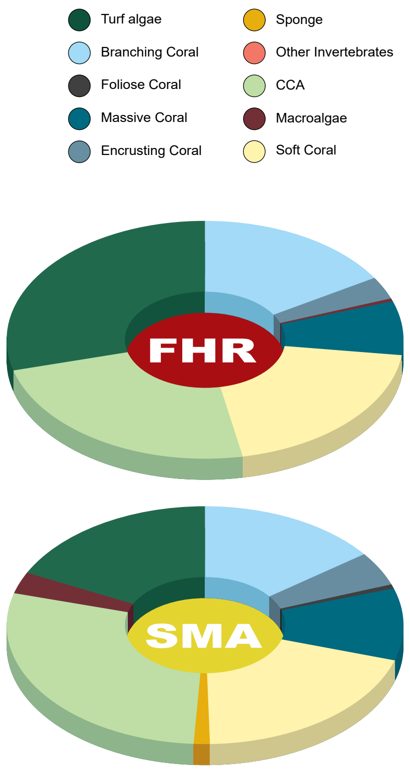
The coral reefs within the Falevai SMA were in poor condition, with very low coral cover throughout.
-
Ko e tu'unga 'o e feo 'i loto 'i he Feitu'u Pule'i Makehe 'o Falevai 'oku holo, pea 'oku holo aipe mo 'ene tu'unga tupulaki 'i he'ene tu'u fakalukufua.

FONOI SMA 2017 HAP

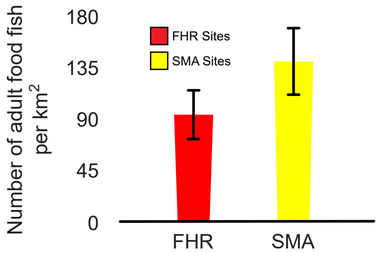
SMA SCORE



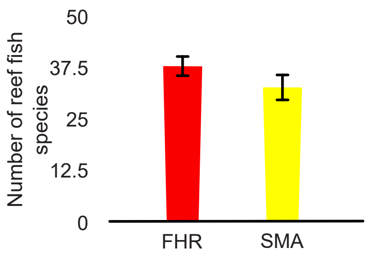
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
31	22.33 km^2	18%	1.91 km^2	23.4%	8.6%

Seven sites were surveyed within the Fonoi SMA by the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition, and these represent some of the healthiest coral reefs in Tonga. Southern Ha'apai has a combination of clean and clear oceanic currents and limited fishing pressure, both of which protect the reefs from degradation.

Within the Fonoi SMA, adult food fish abundance was greatest in the SMA area out front of the village (245 fish/km^2). Reef fish diversity was greatest at the farthest site within the FHR (43.8 species), but comparable at other sites. Coral cover was greatest along the outer reef sites (38.8%).*

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

Ko e fo'i 'elia 'e 7 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe 'o Fonoi 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'a e polokalama pea mo e 2017 aipe 'e he Vava'u Ocean Initiative Marine Expedition. Pea ko e ola 'o e savea na'e mahino ai ko e taha eni he ngaahi feitu'u 'i Tonga 'oku mo'uilelei ai 'a e feo. Ko e ngaahi hakau ki he tafa'aki faka-Tonga 'o Ha'apai, 'oku mahino 'a e ma'a 'o e tahi, pea mo e si'isi'i ivi fakatoutai 'iai pea ko e taha ia ngaahi 'uhinga 'oku ne pukepuke 'a e tu'unga fakatupulekina 'o e feo 'i he ngaahi feitu'u ni.

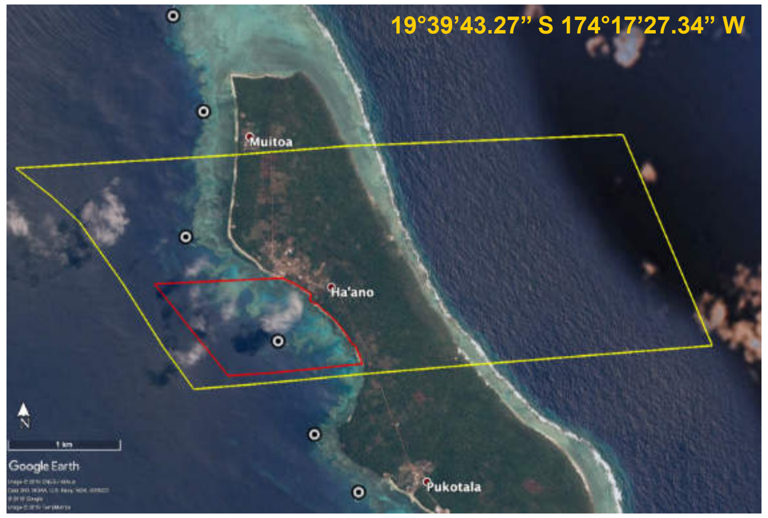
*'I loto 'i he Feitu'u Pule'i Makehe 'o Fonoi, na'e lahi ange 'a e ika lalahi 'i he 'elia ofi 'i mu'a pe 'i he kolo (245 ika/km^2), kae pehe foki ki he tu'unga 'o e kalasi kehekehe 'o e ika na'e lahi ange 'i he 'elia mama'o atu 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika (43.8), pea 'ikai ha fu'u kehekehe 'i he toenga 'o e ngaahi 'elia na'e kau hono savea'i. 'I he tu'unga 'o e tupulekina 'o e feo, na'e lahi ange ki he ki he ngaahi hakau mama'o atu mei he kolo (38.8%).**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition Interim 2017.*

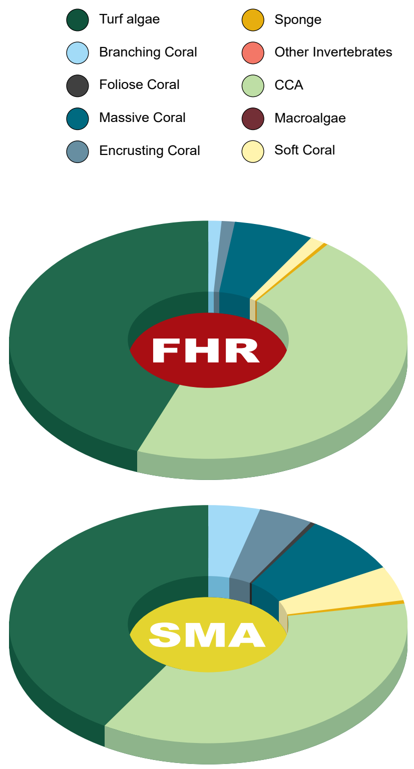
The coral reefs around Fonoi island in southern Ha'apai are some of the healthiest in the country, with clear water, low fishing pressure and high coral cover.
-
Ko e hakau feo takatakai 'i he motu ko Fonoi ki he tafa'aki faka-Tonga 'i Ha'apai, 'oku mahino 'ene mo'uilelei, ma'a e tahi, si'isi'i ivi fakatoutai 'iai pea 'oku tupulaki ke lahi ange foki.

HA'ANO SMA 2018 HAP

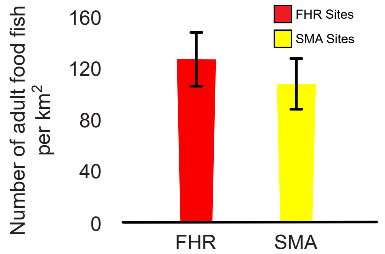
SMA SCORE



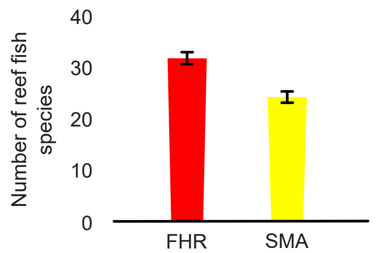
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
120	11.96 km^2	10%	0.87 km^2	36%	7.3%

Two sites were surveyed in 2018 inside the new Ha'ano SMA and FHR. Coral cover at these sites was generally low (12.6%), with recent evidence of cyclones and bleaching along much of the western side of the northern Ha'apai islands. Fish diversity at the SMA site was very low (24.5 species), while abundance was moderate (108.3 fish/km^2). In general, the reefs along the western side of the northern Ha'apai islands are shallow and fringing, changing between 5m and 12m into a sandy bottom with sharp overhangs.

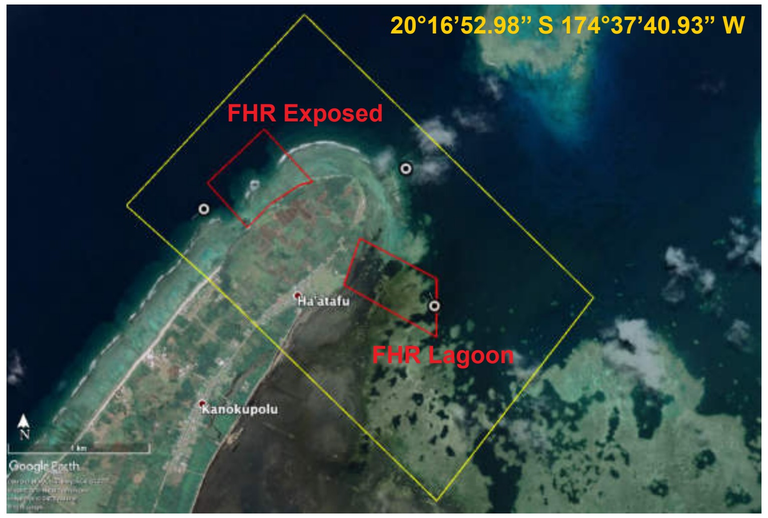
The sheltered condition of these reefs from open ocean swell and current may limit flushing by cooler water and exacerbate coral bleaching, driving the observed conditions.

Ko e 'elia 'e 2 na'e savea'i 'i he 2018 'i loto 'i he Feitu'u Pule'i Makehe 'o Ha'ano. 'I he tu'unga 'o e feo 'oku holo (12.6%) fakatatau ki he ngaahi ngaahi maumau fakatupunga 'e he saikolone pea mo e mate 'o e feo 'i he feliuliuaki 'o e 'ea tautautefito ki he tafa'aki faka-Hihifo 'o e konga tahi 'i he 'otu motu 'o Ha'apai. Ko e tu'unga 'o e kalasi kehekehe 'o e ika, 'oku holo 'aupito (24.5) 'i loto 'i he Feitu'u Pule'i Makehe, ka ko e tu'unga 'o e lahi, 'oku 'i loto pe 'i he fakafiemalie (108.3 ika/km^2). Koia ai, 'i he vakai fakalukufua ki he tu'unga 'o e hakau feo 'i he tafa'aki faka-Hihifo 'o e 'otu motu 'o Ha'apai ki he tafa'aki faka-Tokelau, 'oku 'ikai fu'u loloto 'a e feitu'u 'i he 'avalisi 'o e 5m – 12m pea 'oku lahi 'one'one pea mo masila 'a e ngaahi nagatangata'anga 'o e hakau feo.

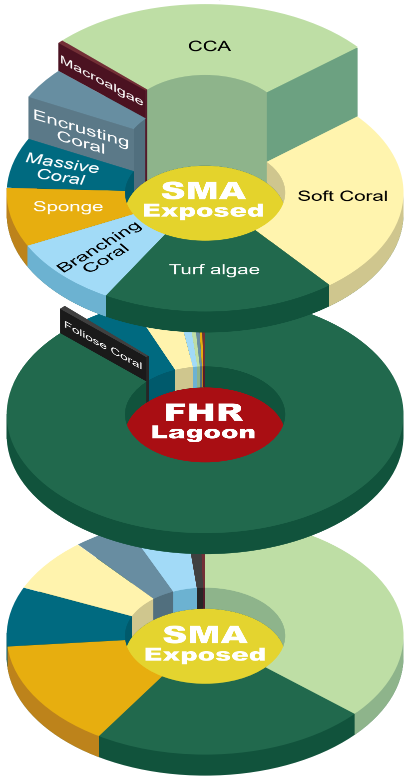
Makatu'unga mei he vavaofi 'a e ngaahi hakau mo 'ikai ke fu'u loko lava e konga tahi 'i he feitu'u ni ke vilo/fetongi mo e tahi mei tu'a 'oku ma'a mo mokomoko, ko e taha ia 'uhinga 'oku lahi ai mate 'a e feo fakatupunga 'e he feliuliuaki 'a e 'ea fakatatau ki he ola na'e ma'u 'e he savea.

Branching and massive corals inside the Ha'ano SMA.
-
Ko e fa'ahinga 'o e feo 'i loto 'i he Feitu'u Pule'i Makehe 'o Ha'ano.

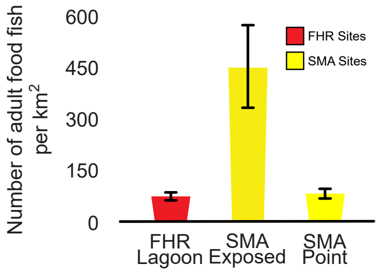
HA’ATAFU SMA 2017 TBU



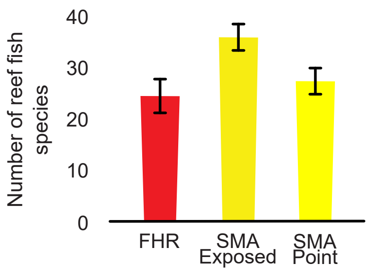
Benthic habitat coverage
Ko e nofo’anga ‘o e ‘ika



Abundance of food fish
Ko e lahi ‘o e me’atokoni ‘a e ‘ika



Diversity of reef fish
Kehekehe ‘o e ngaahi ‘ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
264	5.35 km^2	51.4%	0.24 & 0.24 km^2	58.2%	7.6%

The Ha’atafu SMA is special in having both a very exposed and a very sheltered side. Therefore there are two FHRs, one on the exposed western side and one on the sheltered eastern side in the lagoon near town. Both habitats are important to protect for different species.

The exposed side of Ha’atafu had the healthiest reef conditions, with greater fish abundance (460 fish/km^2) and diversity (36.5 species) and moderate coral cover (20.4%). While the northern tip of the Ha’atafu SMA had similar live coral cover to the exposed side (19.5%), the abundance of fish was very low (88.3 fish/km^2) and similar to the lagoon FHR (78.3 fish/km^2). The inner lagoon FHR had low coral cover (7%) and a low abundance and diversity of fish (25.3 species). This site was characterized by very turbid conditions, likely from the large reef flat nearby. Pollution and excess nutrients from run off are likely a significant threat at this site

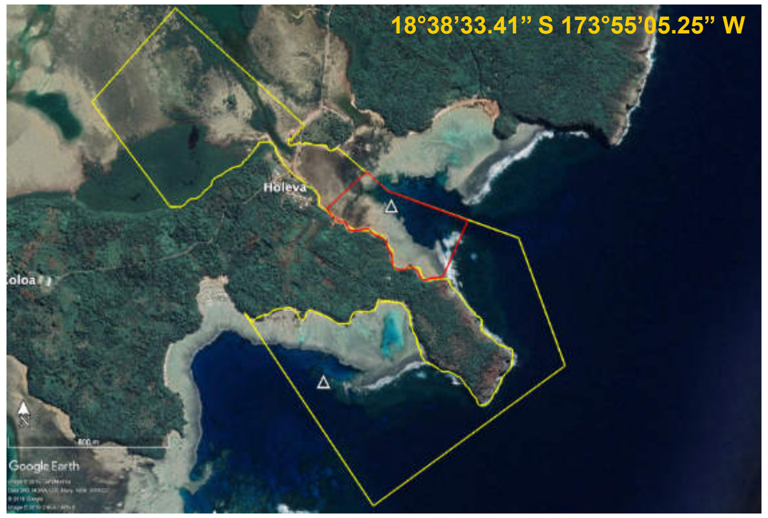
The exposed Ha’atafu FHR was changed to its present location in November 2019.

Ko e Feitu’u Pule’i Makehe ‘o Ha’atafu ‘oku makehe ange ‘i he ‘uhinga pe, ‘oku ne fakatou ma’u ‘a e tahi hanga ki tu’a pea moe tahi ‘i loto ‘i he konga tahi ‘oku nonga. Koia ai, ‘oku ua ‘a e Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika, taha ‘oku hanga ki tu’a ki he tafa’aki faka-Hihifo pea taha ‘oku ‘i loto ‘i he konga tahi oku nonga ki he tafa’aki faka-Hahake ofi ki he kolo. Ko e ngaahi nofo’anga ika ‘i he ongo feitu’u fakatoloua ‘oku mahu’inga ke malu’i, ‘i he ‘uhinga pe ko e kehekehe ‘a e me’amo’ui ‘oku nau nofo ai.

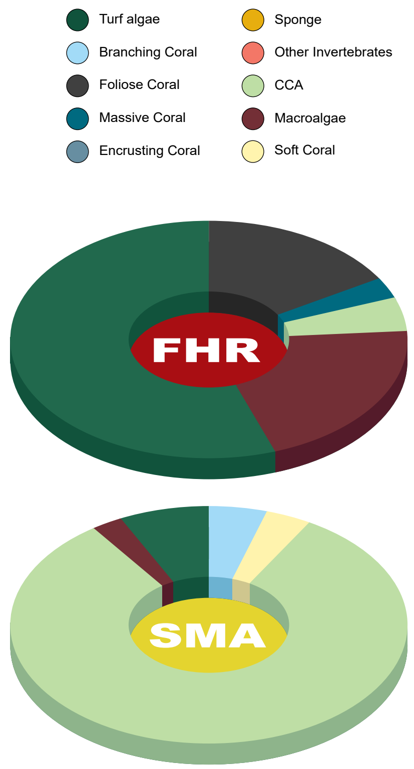
Ko e ngaahi nofo’anga ika ‘i he ongo feitu’u fakatoloua ‘oku mahu’inga ke malu’i, ‘i he ‘uhinga pe ko e kehekehe ‘a e me’amo’ui ‘oku nau nofo ai. Ko e ‘elia ‘oku hanga ki tu’a ‘o Ha’atafu ki he tafa’aki faka-Hihifo, ‘oku kau ‘i he hakau ‘oku mo’uilelei pea mo lahi ai e ika (460 ika/km^2) kae pehe foki ki he’enau kalasi kehekehe (36.5), pea mo e tupulaki ‘a e feo ‘oku ‘i he tu’unga fakafiemalie pe moia (20.4%). Kae kehe, neongo ‘a e tatau ‘a e tu’unga ‘o e tupulaki ‘a e feo ‘i he tuliki faka-Tokelau ‘o e Feitu’u Pule’i Makehe, pea mo e ‘elia ‘i he tafa’aki faka-Hihifo ‘oku hanga ki tu’a (19.5%), ka ko e lahi ‘o e ika ‘oku holo (88.3 ika/km^2) pea tatau pe ki he Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ki he tafa’aki faka-Hahake (78.3 ika/km^2) ‘o e tahi toafa. ‘I he Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika ki he tafa’aki faka-Hahake aipe, ‘oku holo tu’unga tupulekina ‘a e feo (7%) pea holo foki mo e lahi mo e kalasi kehekehe ‘o e ika (25.3). Ko e ‘elia ko eni ‘oku lahilahi ki he ‘uli/kele ‘a e tahi ‘iai ‘o makatu’unga mei he lahi ‘o e ‘uli, ko e tafe mai mei he funga fonua ‘i he taimi ‘oku ‘uha ai, pea ko e taha ia ‘a e palopalema ‘oku fehangahangai mo e ‘elia ko eni ‘i he tafa’aki faka-Hahake.

The exposed western FHR of Ha’atafu with moderate coral cover and clear water compared to the turbid lagoon site with little live coral cover.
-
Koe ‘elia fakahihifo ‘o e ‘elia tapu ‘o Ha’atafu fakataha mo hono feo moe tahi ma’a mo masani ‘oku mahu’inga ke tauhi mo tokanga’i koe halafonionga ki he ngatai tu’uloa pea ke to e tokangai fakapotopoto ange ‘a e konga tahi toafa ‘i he ‘elia ni he ‘oku ‘ikai fu’u tafe lelei ‘a e tahi pea ngali si’isi’i ‘ae feo ‘oku mo’ui ai. ‘Oku fakafa’ei ke tau loto taha pea tau ngaue fakataha ma’u ai pe ki he Ngatai Tu’uloa.

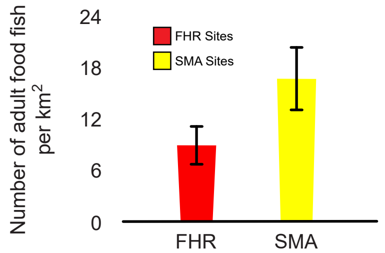
HOLEVA SMA 2019 VAV



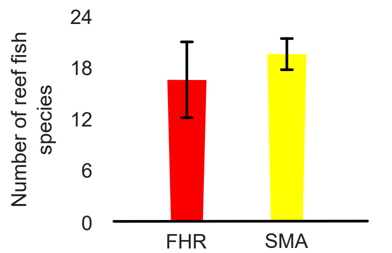
Benthic habitat coverage
Ko e nofo’anga ‘o e ‘ika



Abundance of food fish
Ko e lahi ‘o e me’atokoni ‘a e ‘ika



Diversity of reef fish
Kehekehe ‘o e ngaahi ‘ika mei he hakau



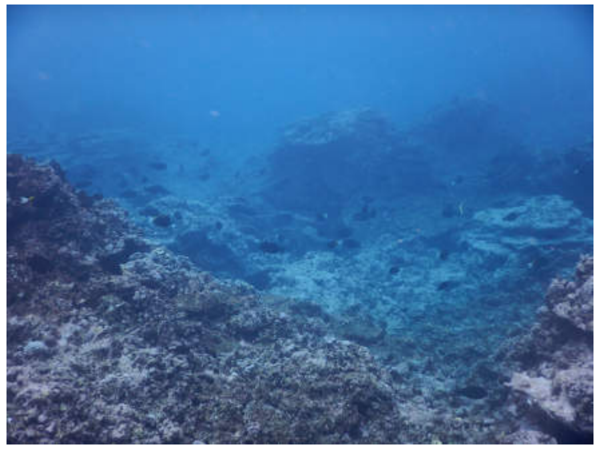
POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
125	1.5 km^2	32.7%	0.25 km^2	22.4%	16.7%

The Holeva SMA lies on the outermost north eastern edge of Vava’u, and is the most exposed SMA in Vava’u to open ocean swell. Two sites were surveyed by the Vava’u Environmental Protection Agency (VEPA). At both sites coral cover was low (FHR 19.7 %; SMA 4.8%), as well as the abundance (FHR 8.9 fish/km^2; SMA 16.7 fish/km^2) and diversity of reef fish (FHR 16.7 species; SMA 19.7 species).

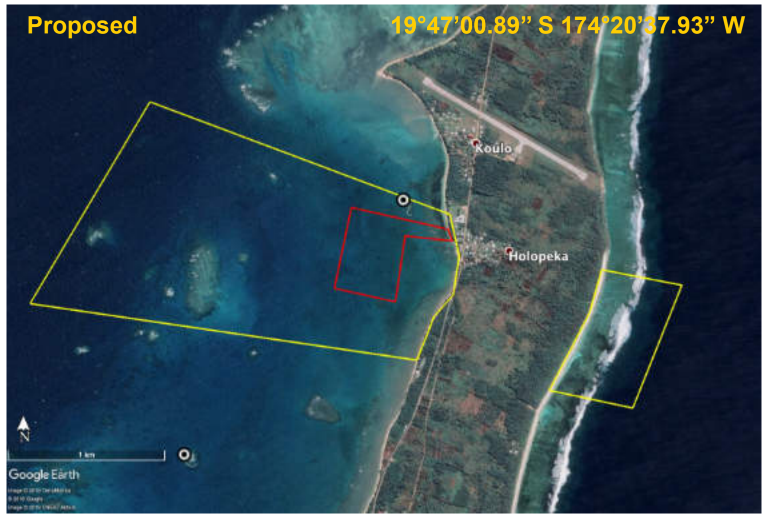
Wave energy at these sites is very high throughout most of the year due to the easterly trade winds.

Ko Holeva ko e Feitu’u Pule’i Makehe ia ‘oku tu’u ki he tafa’aki faka-Tokelau ‘o Vava’u, pea ko e taha ia ‘o e ngaahi Feitu’u Pulei Makehe ‘oku hanga ki he tahi ‘ata mei tu’a. Ko e fo’i ‘elia ‘e ua na’e savea’i ‘e he VEPA, pea na’e mahino ‘a e holo tu’unga ‘oku ‘iai ‘a e feo ‘i he ongo fo’i ‘elia ‘o tatau pe ‘i he Feitu’u Malu’i ‘o e Nofo’anga ‘a e Ika (19.7%) pea mo e Feitu’u Pule’i Makehe (4.8%). ‘Ikai koia pe, ka na’e holo mo e lahi ‘o e ika (FHR 8.9 ika/km^2; SMA 16.7 ika/km^2) kae pehe foki ki he tu’unga ‘enau kalasi kehekehe (FHR 16.7 species; SMA 19.7 species).

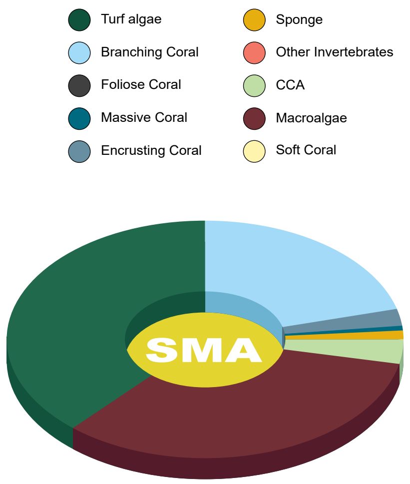
Ko e tu’unga ‘o e ‘au mo e peau ‘i he konga tahi ko eni ‘oku fu’u malohi ‘aupito, meimei ‘i he taimi kotoa pe ‘i he ‘uhinga pe ko ‘ene hanga ki he toka’anga ‘o e matangi mei he Hahake.



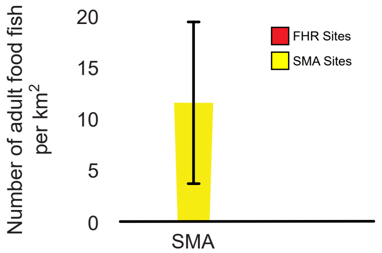
Coral cover along the exposed side of Holeva was very low.
-
Ko e tu’unga tupulekina ‘o e feo ‘i he tafa’aki ki tu’a ‘o Holeva ‘oku fu’u holo ‘aupito.



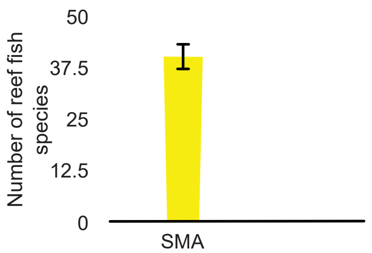
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHRs as % of SMA
119	3.16 km^2	22.1%	0.22 km^2	3.8%	7%

The Holopeka SMA is divided into two sections: the sheltered western section and the exposed eastern section. The sheltered western section has a large expanse of very shallow (>4 m) sandy habitat. One site along the shallow fringing reef of the SMA was surveyed as part of the 2017/18 national monitoring program.

Coral cover at this site was moderate and primarily thin branching corals (23.8%). While reef fish species richness was high (40.5 species), the abundance of adult food fish was very low (11.6 fish/km^2).

The Holopeka SMA is divided into two sections: the sheltered western section and the exposed eastern section. The sheltered western section has a large expanse of very shallow (>4 m) sandy habitat. One site along the shallow fringing reef of the SMA was surveyed as part of the 2017/18 national monitoring program.

Coral cover at this site was moderate and primarily thin branching corals (23.8%). While reef fish species richness was high (40.5 species), the abundance of adult food fish was very low (11.6 fish/km^2)

The Holopeka SMA had high cover of branching corals.

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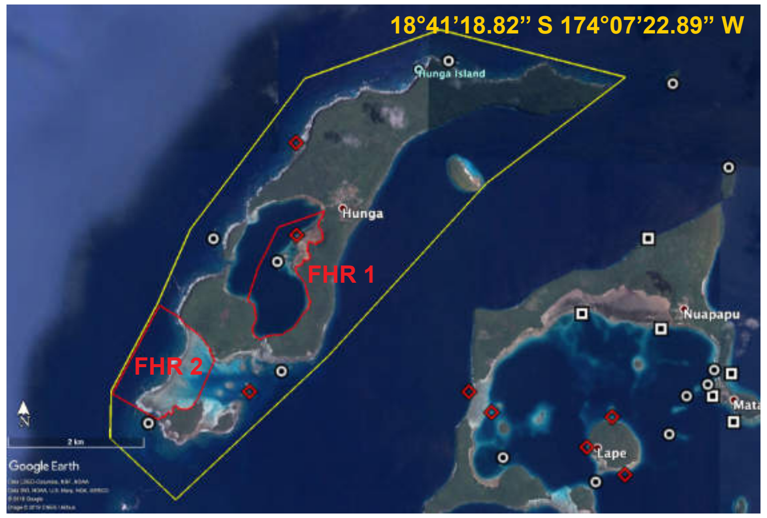
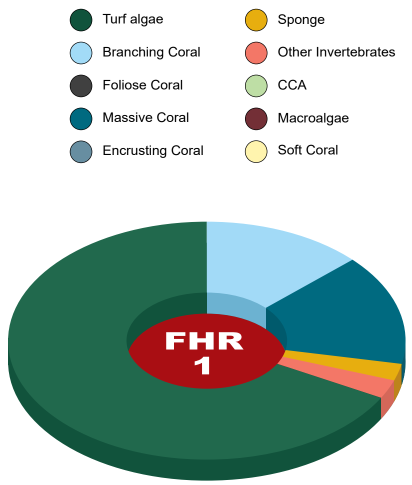
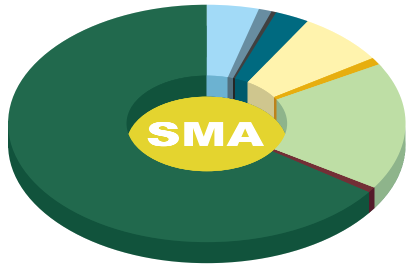
Koe 'elia fakahihifo 'o e 'elia tapu 'o Ha'atafu fakataha mo hono feo moe tahi ma'a mo masani 'oku mahu'inga.

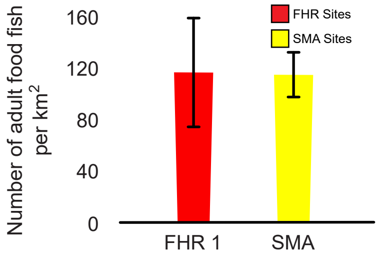


Benthic habitat coverage
Ko e nofo'anga 'o e 'ika

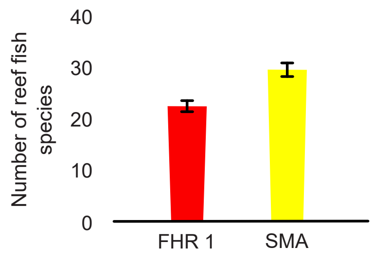




Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
174	20.73 km^2	24.6%	1.46 & 1.32 km^2	32.1%	13.4%

Hunga is the largest SMA in Vava'u and has two FHRs, one within the lagoon near the village and the second near the blue lagoon, along the southern section of the SMA. Combined, the two FHRs make Hunga have the second largest FHR area in the country, after Kotu in Ha'apai. Eight sites were surveyed in the Hunga SMA as part of the 2017/18 national monitoring program and the Asian Development Bank Vava'u SMA baseline surveys.

Live hard coral cover was greatest inside the lagoon (28.3%), where there were large stands of *Porites rus* and *Porites cylindrica* corals that grow well in sheltered conditions. Coral cover was lowest along the south western part of the SMA, particularly SMA site 2 (3.8%). Adult food fish abundance was greatest at SMA site 3 (201.6 fish/km^2), near the entrance to the lagoon and lowest at SMA site 5 (90 fish/km^2). Reef fish diversity was greatest at SMA site 2 (38.25 species) and lowest inside the Hunga lagoon (22.7 species).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e Feitu'u Pule'i Makehe 'o Hunga ko e 'elia lahi taha ia 'i he Polokalama 'i Vava'u pea mo e 'elia Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'e ua. Ko e taha 'i loto 'i he loto 'aa 'o e konga tahi ofi ki he kolo, pea mo e taha 'oku tu'u 'i tu'a 'i he tafa'aki faka-Tonga koia 'o e Feitu'u Pule'i Makehe. 'I hono fakataha'i 'a e ongo 'elia FHR 'o Hunga, ko e lahi taha ia 'i he FHR fakalukufua 'i he ngaahi Feitu'u Pule'i Makehe 'i Tonga. Ko e 'elia 'e 8 na'e savea'i 'i he Feitu'u Pule'i Makehe 'i he 2017/18n lolotonga hono muimui'i fakalukufua 'a e polokalama kae pehe ki he savea na'e fakahoko 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia.

*Ko e tupulaki 'o e feo na'e lahi ange 'i loto 'i he konga tahi loto'aa (28.%) 'i he 'uhinga pe ko e malu 'a e 'elia ni mei he ngaahi ha'aha'a 'o natula. Kae kehe, na'e holo tupulaki 'a e feo 'i he tafa'aki faka-Tonga Hihifo koia 'o e Feitu'u Pule'i Makehe 'i tu'a 'i he fo'i loto 'aa, tautautefito ki he 'elia 2 (3.8%) 'o e SMA. 'I he tu'unga 'o e lahi 'o e ika lalahi, na'e lahi ange 'i he 'elia 3 (201.6 ika/km^2) 'o e SMA, ofi ki he huu 'anga ki he fo'i loto 'aa pea si'isi'i ange 'i he 'elia 5 (90 ika/km^2) 'o e SMA ai pe. Ka 'i he tu'unga 'o e kalasi kehekehe 'a e ika, na'e lahi ange 'i e 'elia 2 (38.25) pea si'isi'i ange (22.7) 'i loto 'i he fo'i loto 'aa 'o e Feitu'u Pule'i Makehe 'o Hunga.**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he poloseki 'a e Pangike Fakalakalaka 'o 'Esia 'i Vava'u 2016.*

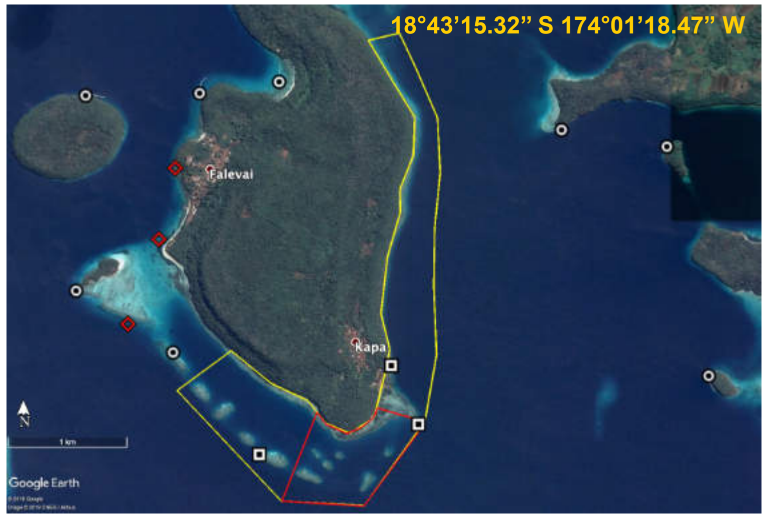

Large stands of *Porites rus* and *Porites cylindrica* occurred inside the Hunga Lagoon FHR. The exposed side of the Hunga SMA had a gradual sloping reef with variable coral cover.

-

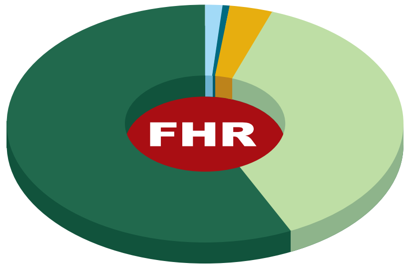
Ko e kalasi 'o e feo 'oku 'iloa ko e Porites rus mo e Porites cylindrical 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika 'i he fo'i loto 'aa 'i Hunga. Ko e hakau 'i he tafa'aki hanga ki tu'a 'o e Feitu'u Pule'i Makehe 'o Hunga 'oku meimei hifo ki lalo pea mo e tupulaki 'a e feo 'oku feto'aki pe.

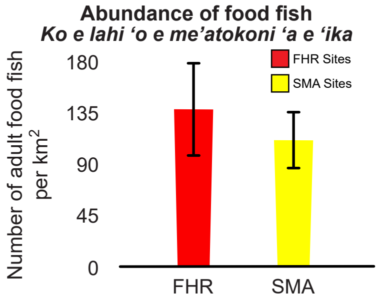
KAPA SMA 2019 VAV

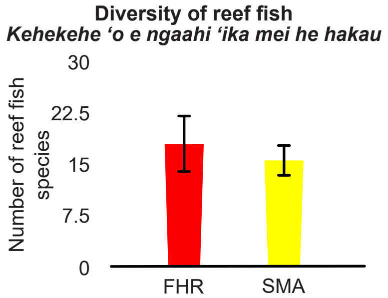
SMA SCORE

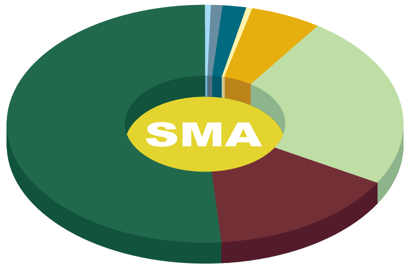


Benthic habitat coverage
Ko e nofo'anga 'o e 'ika









POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
40	2.33 km^2	7.4%	0.58 km^2	12.7%	24.9%

Three sites were surveyed within the Kapa SMA and FHR as part of the 2017 Vava'u Ocean Initiative Marine Expedition in partnership with VEPA. Coral cover was very low (3.1%) across all sites within the Kapa SMA and FHR, with dead coral observed as the dominant substrate. High numbers of Diadema sp. sea urchins were also observed at very high densities, a sign of poor water quality. Adult food fish density was moderate (93.3 to 139.4 fish/km^2) across all sites. Reef fish diversity was very low across all sites (13.8 to 18.2 species).*

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

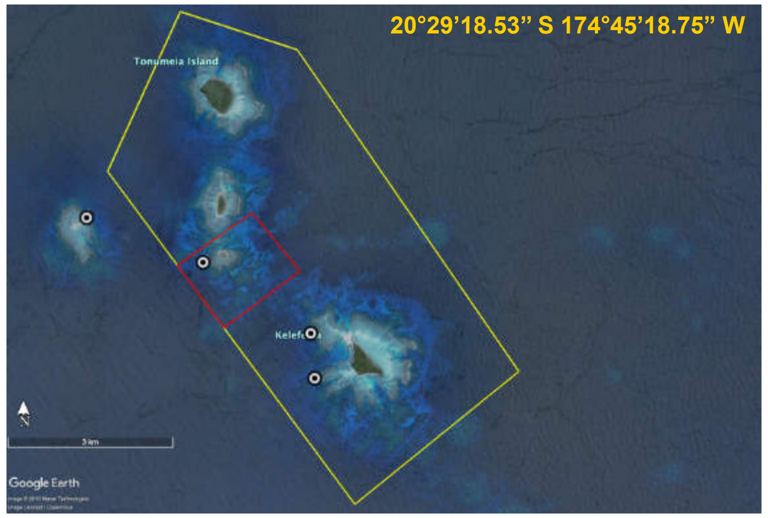
*Ko e fo'i 'elia 'e 3 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe 'o Kapa pea mo 'enau 'elia tapu (FHR) 'i he 2017 'e he Vava'u Ocean Initiative Marine Expedition 'i he fengaue'aki vaofi mo e VEPA. Ko e tupulekina 'o e feo na'e holo 'aupito tu'unga 'oku 'iai (3.1%) fakalukufua 'o e ngaahi 'elia na'e savea'i fakatatau ki he lahi 'o e feo 'oku mate. Ka 'i he tafa'aki 'o e me'amo'ui, na'e lahi 'asi 'a e kalasi 'o e tukumisi Diadema sp. pea ko e taha eni faka'ilonga 'a e holo 'a e tu'unga 'o e vai/tahi. Kae kehe, ko e lahi 'o e ika lalahi na'e 'i he tu'unga fakafiemalie pe (93.3 - 139.4 ika/km^2) 'i he ngaahi 'elia kotoa na'e savea'i pea ko e tu'unga 'o e kalasi kehekehe na'e holo (13.8 – 18.2).**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition Interim 2017.*

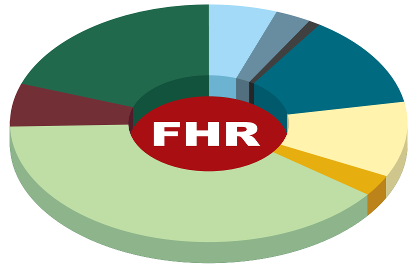
Coral cover at all sites in Kapa was very low, with large areas of dead reef.
-
Ko e tupulaki 'o e feo 'i he Feitu'u Pule'i Makehe 'o Kapa na'e fu'u holo 'aupito fakatatau ki he lahi 'o e feo 'oku mate.

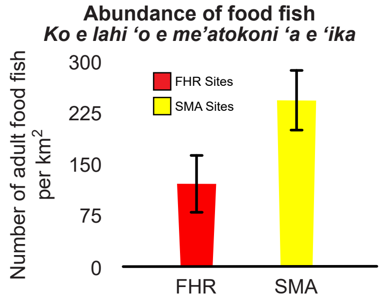
KELEFESIA SMA 2018 HAP

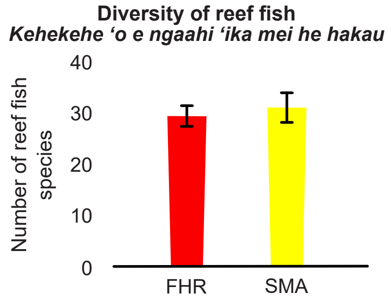
SMA SCORE

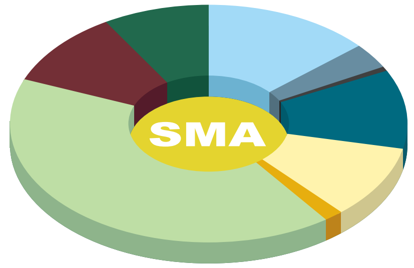


Benthic habitat coverage
Ko e nofo'anga 'o e 'ika









POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
2	32.72 km^2	27.1%	1.31 km^2	71.4%	4%

The Kelefesia SMA is the most remote management area in the Kingdom. While Kelefesia has a semi-permanent fishing camp, responsibility for management of this area lies with the Nomuka community to the north. The coral reef system inside the Kelefesia SMA is extensive, and overall in fairly healthy condition. It has likely been protected from bleaching events by cooler oceanic waters driven from the east by prevailing wind and wave conditions.

Adult food fish abundance was high throughout, and greatest at SMA site 1 (296.7 fish/km^2). Likewise, coral cover and reef fish diversity were moderate to high throughout, and greatest at SMA site 2 (31.1% and 36.3 species).

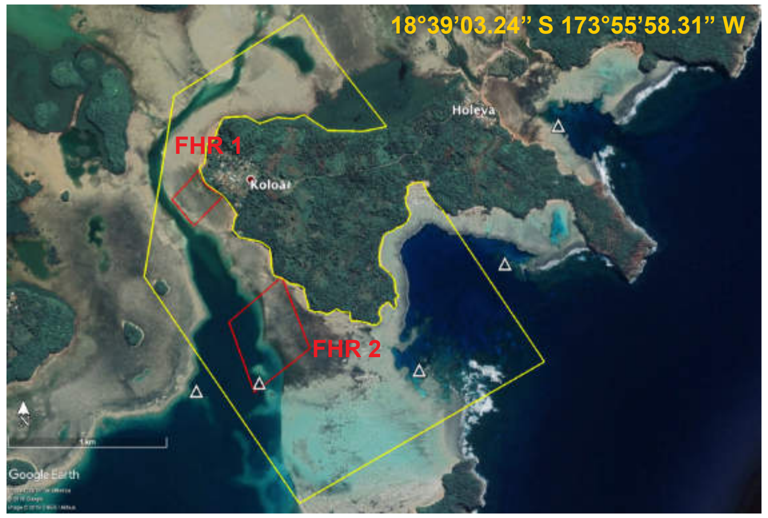
Ko e Feitu'u Pule'i Makehe 'o Tonumea mo Kelefesia ko e feitu'u 'oku pule'i fakakolo mama'o taha eni mei ha to e motu fakatatau ki he ngaahi SMA kehe 'oku kau ki he polokalama. Neongo 'oku 'ikai ke 'iai ha kakai 'e nofo he motu ni, ka 'oku mahino 'oku 'iai pe ngaahi nofo'anga fakataimi ki he kau toutai 'oku ngofua kenau toutai 'i he motu, pea 'oku 'i he malumalu ia 'o e kakai 'o Nomuka 'a hono pule'i 'o e Feitu'u Pule'i Makehe ko eni. Ko e tu'unga 'o e hakau 'o e motu ni 'oku lahi pea 'oku mahino 'oku 'i he tu'unga fakafiemalie pe 'ene mo'uilelei. 'Oku 'iai 'a e tui ko e feo 'o e feitu'u ni 'oku si'isi'i 'ene uesia mei he feliuliuaki 'o e 'ea 'i he 'uhinga pe ko e tu'u 'ataa 'a e motu 'i he ha'oha'onga 'o e fu'u moana pea 'oku ma'a mo mokomoko lelei ma'u pe tahi 'i he taimi kotoa pe.

Tu'unga 'o e ika lalahi 'oku ngaue'aki ki he ma'u m'eatokoni 'oku lahi kae tautautefito ki he 'elia 1 (296.7 ika/km^2) 'o e SMA. Tatau pe 'i he tu'unga 'o e feo 'oku tupulaki 'aupito kae pehe ki he kalasi kehekehe 'o e ika, tautautefito ki he 'elia 2 (31.1% and 36.3 kalasi kehekehe 'o e ika).

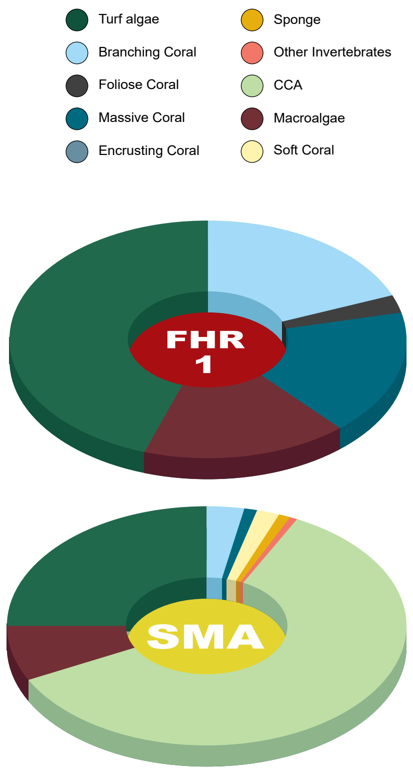
The coral reefs around the Kelefesia island group are part of the most remote SMA in the country.
-
Ko e hakau feo takatakai 'o Tonumea mo Kelefesia ko e Feitu'u Pule'i Makehe ia mama'o mei ha to e motu fakahoa ki he ngaahi Feitu'u Pule'i Makehe makehe ange.

KOLOA SMA 2017 VAV

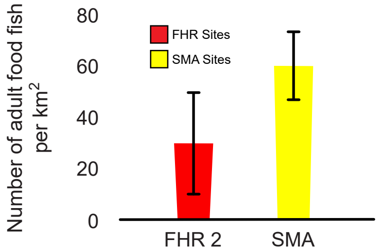
SMA SCORE



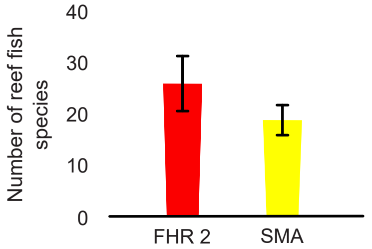
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
130	4.52 km^2	22.1%	0.2 & 0.06 km^2	0%	5.8%

Four sites were surveyed inside the Koloa SMA by the Vava'u Environmental Protection Agency (VEPA) in 2018. However, two of these sites were very shallow tidal areas not suitable for data collection. The inner area of the Koloa SMA is dominated by sand, macroalgae and cyanobacterial mats.

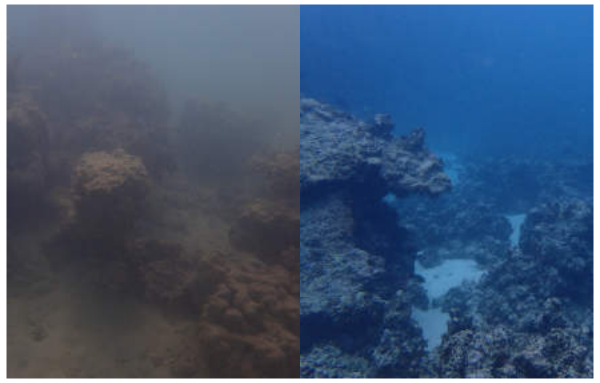
At both sites adult food fish abundance and reef fish diversity was low (inner site 30 fish/km^2 and 26.2 species; outer site 60 fish/km^2 and 19 species). Coral cover was high within the FHR (38.4%), with many branching and massive corals, but very low (4.02%) along the outer, exposed side of the SMA.

The FHR in front of the village was not surveyed, but will be very important for gleaning activities.

Ko e fo'i 'elia 'e 4 na'e savea'i 'i he Feitu'u Pule'i Makehe (SMA) 'o Koloa 'e he VEPA 'i he 2018. Kae kehe, ko e fo'i 'elia 'e 2 'i he ngaahi 'elia na'e savea'i na'e fu'u mamaha 'aupito ki hono fakahoko ai ha savea. Ko e konga ki loto 'i he SMA 'o Koloa 'oku lahi 'one'one, limu musie mo e kalasi kehekehe pe 'o e limu.

Ko e tu'unga 'o e ika lalahi na'e holo 'o tatau pe 'i he lahi pea mo e kalasi kehekehe 'o e ika 'i he konga ki loto (30 ika/km^2 mo e 26.2 kalasi kehekehe) mo 'i tu'a (60 ika/km^2 and 19 kalasi kehekehe) 'o e SMA. 'I he tu'unga 'o e feo, 'oku tupulaki 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika ('elia tapu) (38.4%), kae holo 'i he tafa'aki ki tu'a 'o e SMA.

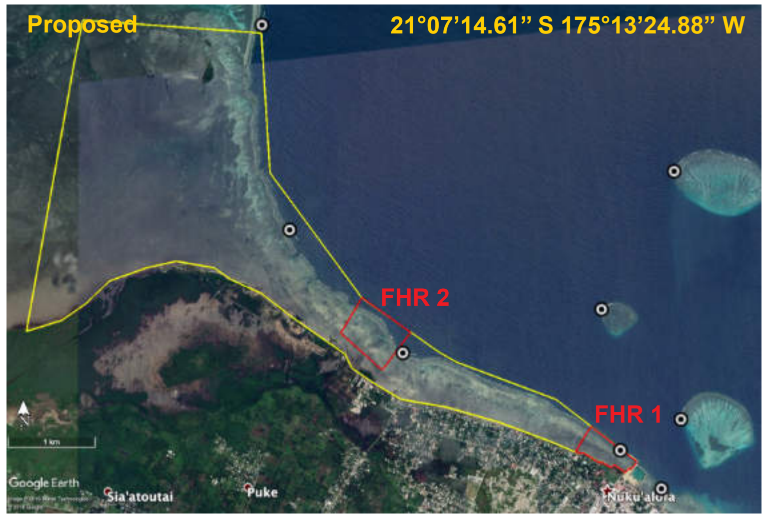
Ko e 'elia tapu 'i mu'a 'i he kolo, na'e ikai kau hono savea'i, ka 'oku fu'u mahu'inga 'aupito ki he toutai luelue/fangota 'a e kakai.



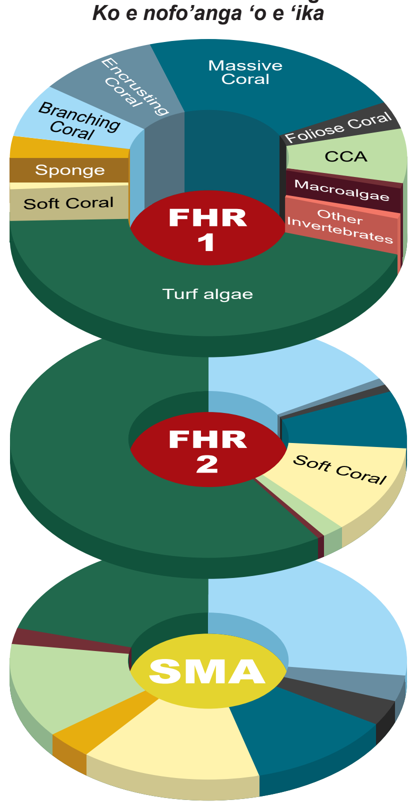
Coral cover at the lagoon FHR site was high and dominated by massive and branching corals which do well in turbid conditions. Although the water was clearer along the exposed reefs, coral cover here was still very low.
-
Ko e tupulaki 'o e feo 'i he 'elia tapu na'e lahi ange, neongo 'a e 'ikai ke fu'u ma'a 'a e tahi fakatatau ki he feo 'i he tafa'aki 'oku ma'a ange ai 'a e tahi na'e si'isi'i tupulaki 'a e feo.

KOLOMOTU'A SMA 2020 TBU

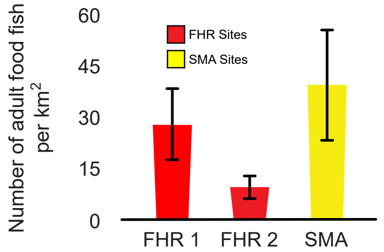
SMA SCORE



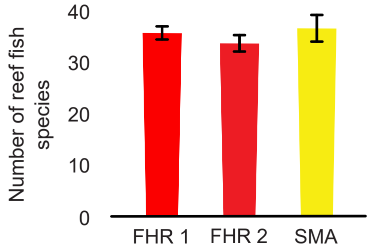
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
7397	3.08 km^2	71.4%	0.16 & 0.34 km^2	75.7%	16.2%

The proposed Kolomotu'a SMA is the closest SMA to the capital of Tonga, Nuku'alofa. There are two proposed FHRs, one near the Ministry of Fisheries in Sopu, and the other in front of the royal Palace.

Because of the high population density and distance to Nuku'alofa, the reefs around Kolomotu'a were very overfished at all three sites surveyed (10 to 40 fish/km^2). However, both reef fish diversity and coral cover were surprisingly high (diversity 33.8 to 36.8 species; coral cover 26.3 to 46%). These sites have some of the highest coral cover in the country.

The high coral cover of these reefs, despite overfishing, may be because of environmental conditions. The cooler waters in Tongatapu protect the reefs from coral bleaching, while the sheltered bay may protect them from cyclone damage.

Ko Kolomotu'a 'oku kau 'i he taha 'o e ngaahi kolo kuo fakahu 'enau tohi kole ki he Potungaue, 'o fakaha ai 'enau fie kau ki he polokalama. Pea ko e Feitu'u Pule'i Makehe ia 'e ofi taha ki he kolomu'a 'o Tonga, Nuku'alofa. Ko e 'elia tapu 'e 2 'oku fakaangaanga ke fokotu'u 'i he Feitu'u Pule'i Makehe koeni, 'aia ko e taha ke fokotu'u 'i mu'a 'i he konga tahi 'o e Potungaue Toutai 'i Sopu, pea taha 'i mu'a 'i he Palasi faka-Tu'i.

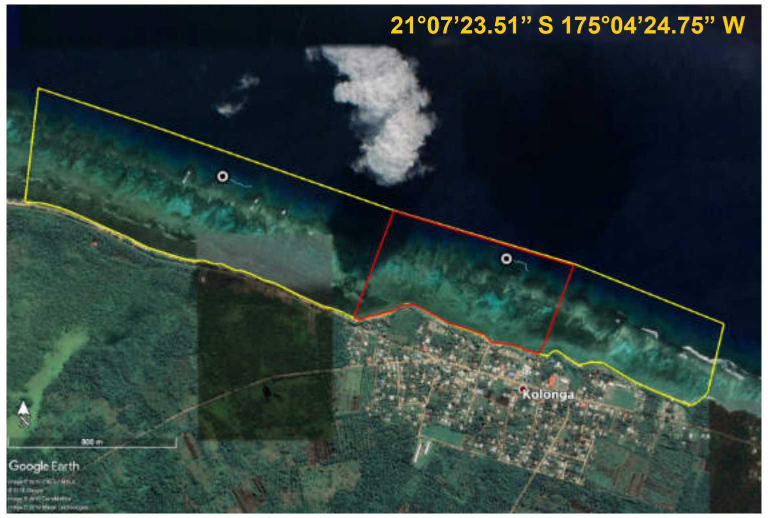
Na'e mahino mei he ngaahi 'elia 'e 3 na'e savea'i 'i he hakau takatakai 'o Kolomotu'a, 'a e holo 'a e tu'unga 'o e me'amo'ui (10 to 40 ika/km^2) 'o makatu'unga pe mei he fu'u tokolahi 'a e kakai 'oku nofo 'i he feitu'u ni, pea mo 'ene ofi ki Nuku'alofa. Ka neongo ia, ko e tu'unga 'o e tupulaki 'o e feo, mo e kalasi kehekehe 'o e ika na'e ma'olunga (33.8 – 36.8 kalasi kehekehe 'o e ika; 26.3 – 46% 'o e feo). Pea 'oku kau ngaahi feitu'u ni 'i he lelei taha 'o e tupulekina 'o e feo 'i he fakalukufua.

Ko e ma'olunga 'o e tu'unga 'a e tupulaki 'a e feo, neongo 'a e holo 'a e tu'unga 'o e m'eamo'ui, 'oku makatu'unga ia mei natula. 'Oku makatu'unga ia mei he mokomoko 'a e tahi 'i Tongatapu 'o 'ikai ke mate ai 'a e feo mei he feliuliuaki 'a e 'ea, pea to e malu foki mei he ngaahi hakau takai, mei he ngaahi fakatamaki fakaenatula.

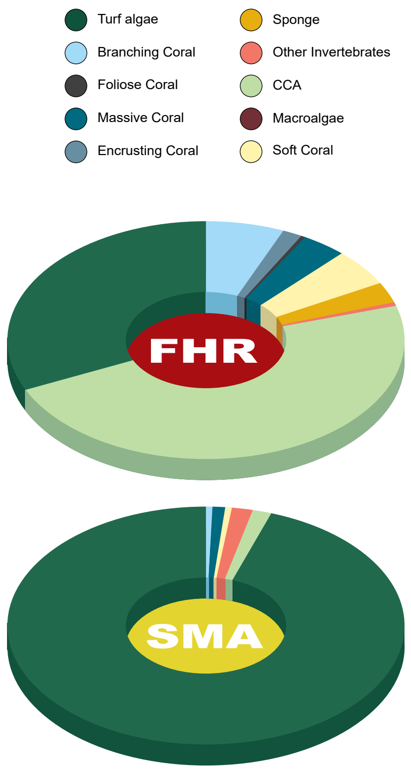
The reefs in front of Kolomotu'a had surprisingly high coral cover, likely protected from coral bleaching due to the cooler waters in Tongatapu and from cyclones by sheltered bay.
-
Ko e feo 'i mu'a 'i Kolomotu'a 'oku ma'olunga tu'unga tupulekina 'oku 'iai, 'o hange 'oku malu'i mei he feliuliuaki 'o e 'ea makatu'unga mei he mokomoko 'a e tahi pea to e malu 'a e hakau mei he ngaahi fakatamaki fakaenatula.

KOLONGA SMA 2015 TBU

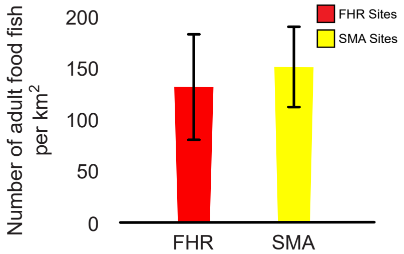
SMA SCORE



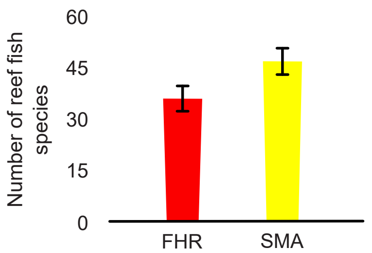
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau

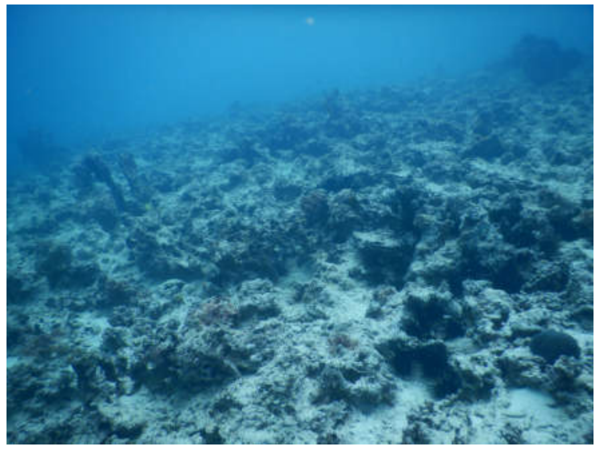


POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
1116	1.64 km^2	71.2%	0.4 km^2	85%	24.5%

Two sites were surveyed inside the Kolonga SMA, and an additional three along the coastline from the Fanga'uta lagoon. At all sites the reefs were in very poor condition, with large outbreaks of the *Diadema sp.* sea urchin. Coral cover was as low as 1%. The poor condition of the reefs here is likely because of runoff from the Fanga'uta lagoon, which has made many sea urchins grow. These destroy the reef with their feeding and kill any newly settled corals. This is a pattern that is also present near the lagoons in Vava'u and the Ofu SMA. It is very important for water quality to be improved at these locations.

The abundance of adult food fish was moderate (133.3 to 151.6 fish/km2), as was reef fish diversity (36 to 46.8 species).

The two Kolongoa FHRs were changed to the present FHR in November 2019.



Ko e 'elia 'e 2 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe 'o Kolonga, pea mo e taha 'i he konga tahi 'o Fanga'uta. Ko e tu'unga 'o e feo 'i he ngaahi 'elia ni 'oku holo 'aupito, pea lahi mo e 'asi 'o e vana. Ko e tupulekina 'o e feo 'oku holo 1% pea ko e holo ko eni 'o e feo 'oku ngalingali ko e makatu'unga mei he lahi 'o e tafe mai mei he konga tahi Fanga'uta, 'o fakatupunga 'a e lahi 'asi 'o e vana. Ko e lahi 'asi ko eni 'o e vana 'oku ne maumau'i e feo he 'oku nau ma'u me'atokoni mei ai kae tautautefito ki he fanga ki'i feo fo'ou 'oku toki tupu. Ko e tu'unga tatau eni 'oku 'asi 'i he ngaahi Feitu'u Pule'i Makehe 'i Vava'u 'o hange ko Ofu, pea 'oku fu'u mahu'inga 'aupito ke fai ha tokangaekina 'i hono fakapapau'i 'a e ma'a e tahi, kae malava ke 'iai ha fakalakalaka 'i he tu'unga 'o e feo 'i he ngaahi feitu'u ni.

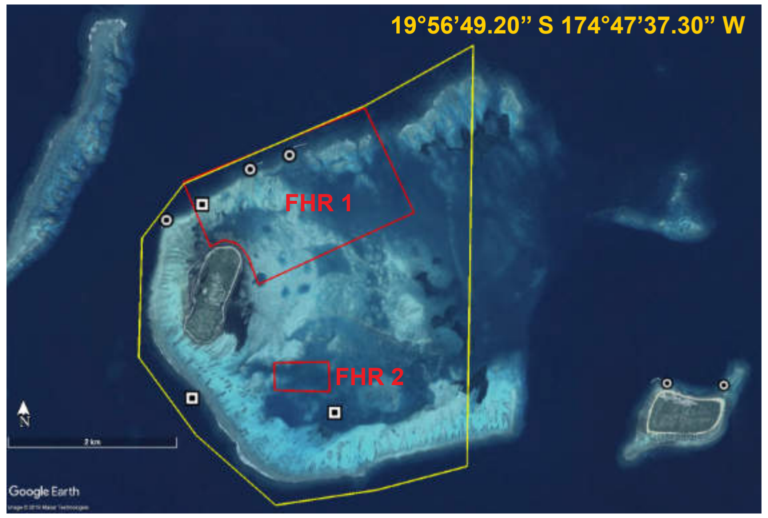
Ko e tu'unga 'o e ika lalahi na'e 'i he tu'unga fakafiemalie pe (133.3 - 151.6 ika/km2) kae pehe foki ki henau kalasi kehekehe (36 – 46.8).

The two Kolongoa FHRs were changed to the present FHR in November 2019.

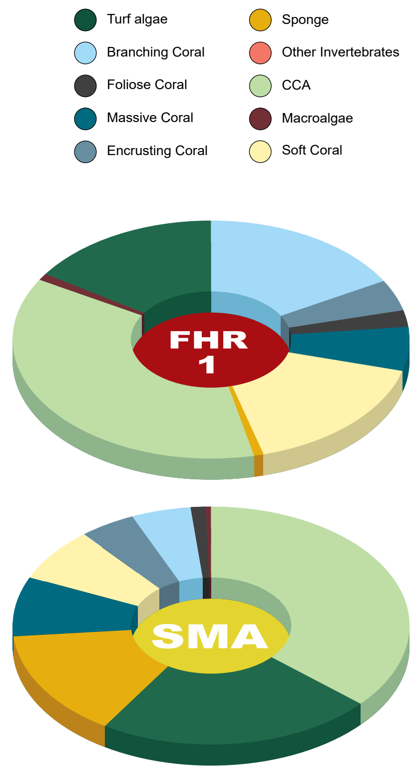
The coral reefs around Kolonga have been heavily damaged, likely from nutrient run of from Fanga'uta lagoon and large numbers of *Diadema sp.* sea urchins which have destroyed the reef.
-
Ko e hakau takai 'o Kolonga 'oku 'i he tu'unga fakatu'utamaki, makatu'unga mei he tafe mai 'o e tahi 'uli mei Fanga'uta kae pehe ki he fu'u tokolahi/lahi 'o e me'amo'ui ko e vana.

KOTU SMA 2015 HAP

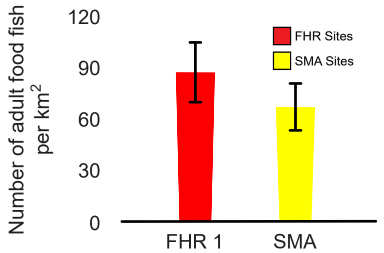
SMA SCORE



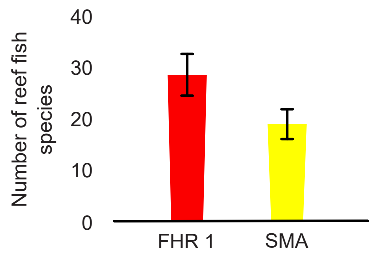
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau

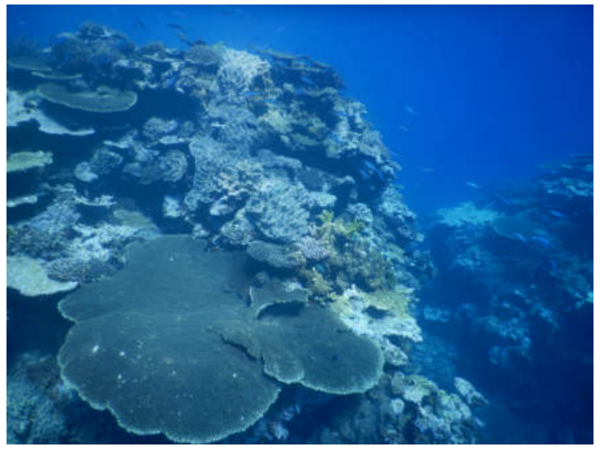


POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
127	16.86 km^2	31.7%	3.02 & 0.19 km^2	52.4%	19%

Six sites were surveyed in the Kotu SMA as part of the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition. The Kotu SMA is the westernmost SMA in the Ha'apai island group and has the largest FHR in the country.

Adult food fish abundance was greatest inside the exposed FHR (160.8 fish/km^2) and lowest in the lagoon (30.7 fish/km^2). Fish diversity was lowest at the south eastern exposed site (11.8 species) and highest inside the FHR (41.2 species). Coral cover was lowest in the lagoon (5.1%) and greatest inside the FHR (33.7%).*

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.



Ko e 'elia 'e 6 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe 'o Kotu 'i he 2079/18 lolotonga 'a hono muimui'i fakalukufua 'o e polokalama pea mo e Vava'u Ocean Initiative Marine Expedition 2017. Ko e Feitu'u Pule'i Makehe 'o Kotu 'oku 'i he tafa'aki faka-Hihifo 'o e vahefonua 'o Ha'apai pea 'oku 'iai 'a e 'elia tapu (FHR) lahi taha 'i he vahefonua.

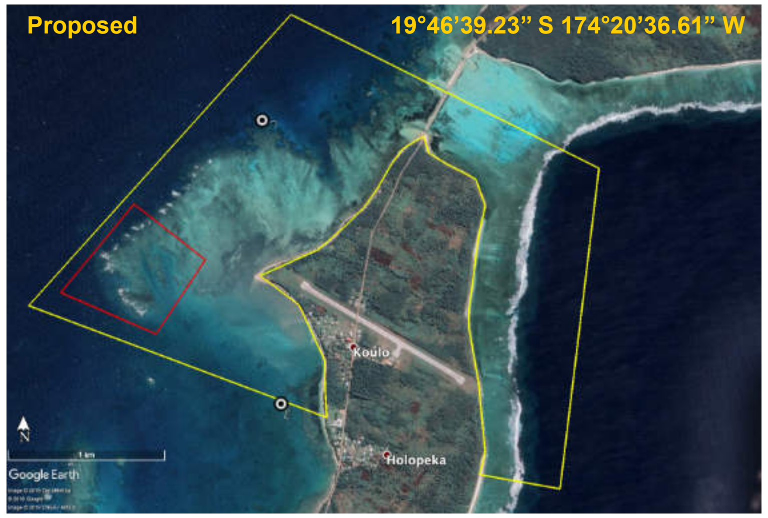
*Ko e tu'unga 'o e ika lalahi na'e lahi ange 'i loto 'i he 'elia tapu tafa'aki ki tu'a (160.8 ika/km^2) pea si'isi'i ange 'i he konga 'i loto 'o e Feitu'u Pule'i Makehe (30.7 ika/km^2). 'I he tu'unga 'enau kalasi kehekehe, na'e si'isi'i ange ki he tafa'aki faka-Tonga Hahake (11.8) pea lahi ange 'i loto 'i he 'elia tapu (41.2). Ko e tupulekina 'o e feo na'e si'isi'i ange 'i he konga 'i loto 'o e Feitu'u Pule'i Makehe (5.1 %) pea lahi ange 'i loto 'i he 'elia tapu (33.7%).**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition Interim 2017.*

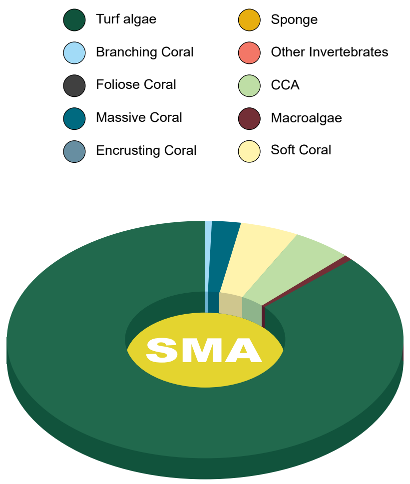
The Kotu FHR is the largest FHR in the Kingdom.
The outer edge of the FHR and SMA have a thriving coral reef community.
-
Ko e 'elia tapu (FHR) 'o Kotu, ko e 'elia tapu lahi taha ia 'i Tonga 'i he polokalama Feitu'u Pule'i Makehe. Ko e tafatafaki 'o e hakau 'i he 'elia tapu mo e Feitu'u Pule'i Makehe 'oku mo'ui lelei 'a e feo ai.

KOULO SMA 2020 HAP

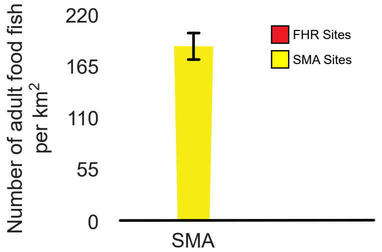
SMA SCORE



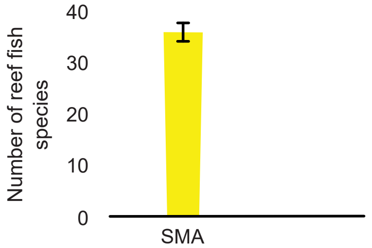
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
200	4.6 km^2	48.3%	0.39 km^2	61.5%	8.5%

The Koulo SMA is at the top of Lifuka island and has a channel where water flows from the exposed eastern edge to the sheltered western side of the island. Famously, in 1806 the Port-au-prince ship was destroyed in the sandy northern section of the Koulo SMA. It was discovered in 2012. The landing strip for the Ha'apai airport also goes very close to these reefs and airplanes routinely fly low over the SMA.

One site along the fringing reef of the SMA was surveyed as part of the 2017/18 national monitoring program. Coral cover at this site was very low (3.03%). Reef fish species richness was moderate (36 species), the abundance of adult food fish was high (186.6 fish/km^2).

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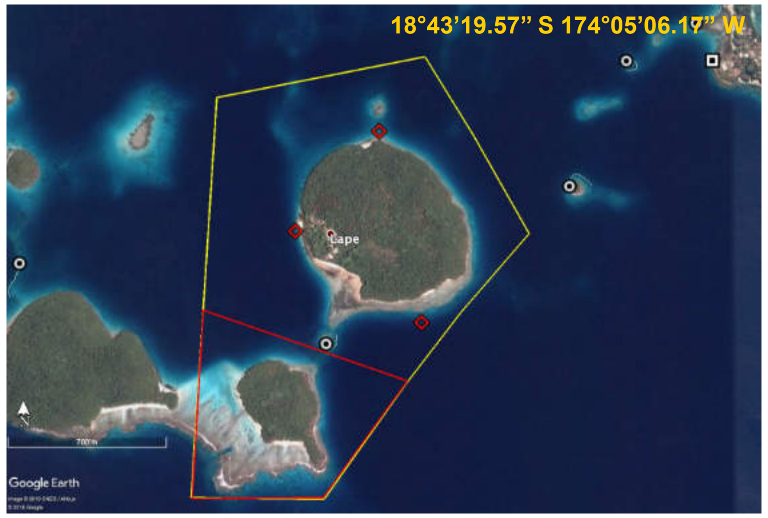
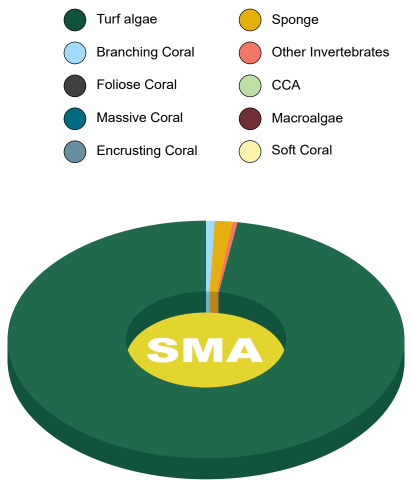
The fringing reef along the western edge of the Koulo SMA drops steeply into a sandy habitat at 10 to 15 m, near where the Port-au-prince shipwreck was discovered in 2012.
-
Koe 'elia fakahihifo 'o e 'elia tapu 'o Ha'atafu fakataha mo hono feo moe tahi ma'a mo masani 'oku mahu'inga ke tauhi mo tokanga'i koe halafonionga ki he ngatai tu'uloa.

LAPE SMA 2017 VAV

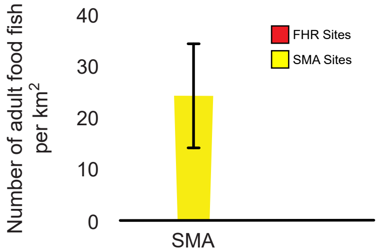
SMA SCORE



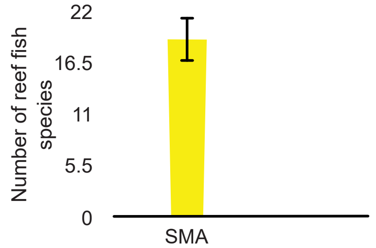
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
22	1.98 km^2	4.6%	0.58 km^2	19.2%	29.3%

Four sites were surveyed inside the Lape SMA as part of the 2017/18 national monitoring program and the 2016 Asian Development Bank baseline SMA surveys. However, no surveys were conducted inside the Lape FHR, which remains unsurveyed. Overall the area inside the Lape SMA is mostly sandy slope with very little habitat for coral growth. There was shallow fringing reef habitat along the southern edge of the island, although there was strong evidence of recent cyclone damage, with lots of coral rubble.

Coral cover was 0.5%. Adult food fish abundance was very low, ranging from 8.8 to 58.9 fish/km^2. Reef fish species richness was also very low, between 7.5 and 29.3 species.

The exposed southern side of the Lape FHR may be in better condition but it is data deficient*.

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e 'elia 'e 4 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe 'o Lape 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama pea mo e savea na'e fakahoko 'e he poloseki 'a e Pangike Fakalakalaka 'o 'Esia 'i he 2016. Ka neongo, na'e ikai ke fakahoko ha savea 'i loto i he 'elia tapu (FHR) 'o Lape. Ka 'i he vakai fakalukufua ki he 'i loto 'i he Feitu'u Pule'i Makehe 'o Lape, 'oku lahilahi 'a e ngaahi feitu'u 'oku 'one'one fakatatau ki he ngaahi feitu'u 'oku mo'ui ai e feo. 'Oku 'iai 'a e feitu'u 'oku mamaha ''i he hakau 'o e tafa'akj faka-Tonga 'o e motu, pea mo ha ngaahi maumau 'oku 'asi ai ko e fakatupunga mei he fakatamaki fakaenatula 'o fakatatau ki he lahi 'o e makamaka'i feo 'oku laku holo ai.

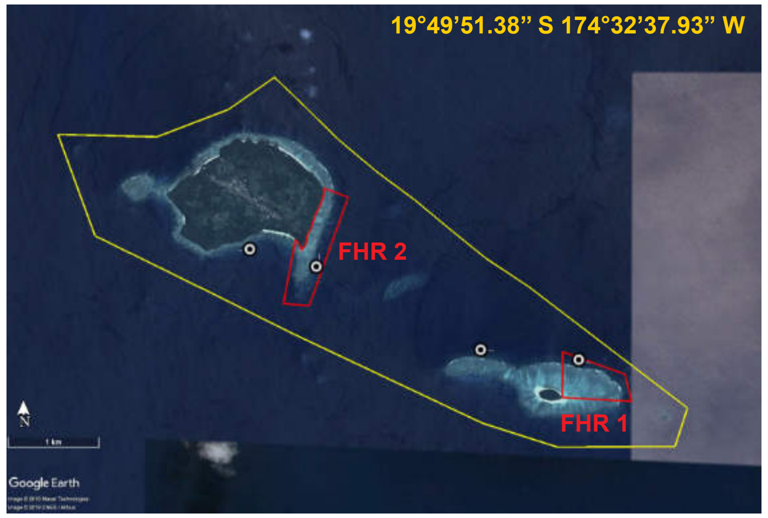
Ko e tu'unga tupulekina 'o e feo na'e 'i he 0.5% pea ko e ikai lalahi na'e si'isi'i ange 'i he 'avalisi 'o e 8.8 - 58.9 ika/km^2. 'I he tu'unga 'o e kalasi kehekehe 'o e ika na'e fu'u holo 'aupito 'i he 'avalisi 'o e 7.5 – 29.3.

*Ko e tafa'aki faka-Tonga 'o e 'elia tapu (FHR) 'oku 'i he tu'unga fakafiemalie 'a e tu'unga 'oku 'iai, ka 'oku 'ikai lahi fe'unga 'a e fakamatala tu'unnga 'oku 'iai.**

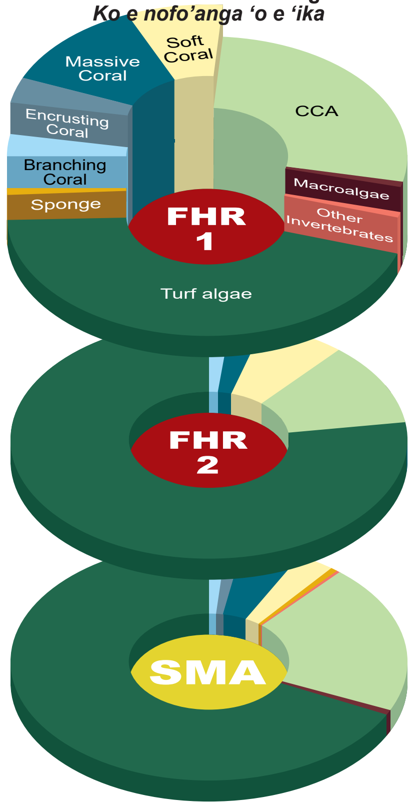
**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he poloseki 'a e Pangike Fakalakalaka 'o 'Esia 'i Vava'u 2016.*

The Lape SMA is dominated by sandy habitat with occasional coral outcrops. The FHR has not been surveyed.
-
Ko e Feitu'u Pule'i Makehe 'o Lape 'oku lahi 'one'one 'a e ngaahi nofo'anga ika. Pea ko e 'elia tapu (FHR) na'e ikai kau hono savea'i.

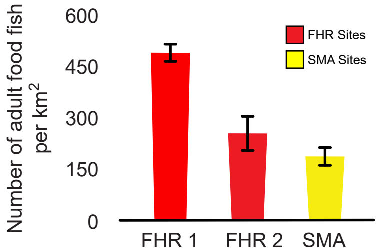
LOFANGA SMA 2018 HAP



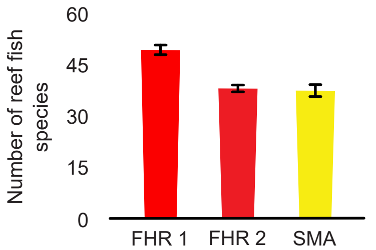
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
131	14.83 km^2	12.5%	0.36 & 0.45 km^2	63.4%	5.5%

The Lofanga SMA contains two FHRs, one on the nearby Hakauata reefs. All four sites were in good condition with healthy reef fish communities.

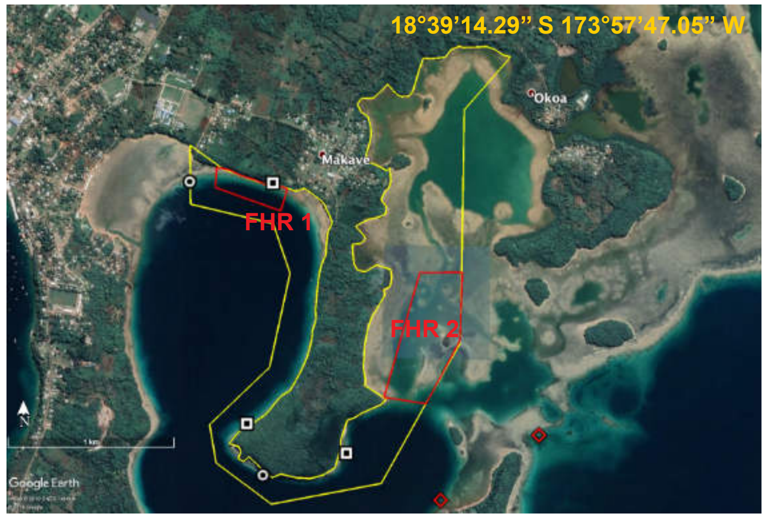
Adult food fish abundance inside the Lofangai FHR was 491.7 fish/km^2, one of the highest sites measured anywhere in the Kingdom. Reef fish diversity at this site was 49.8 species, also one of the highest recorded in the Kingdom. Coral cover ranged from very poor in the SMA near the village (4.3%) to moderate inside the FHR (20%).

Ko e Feitu'u Pule'i Makehe 'o Lofanga,'oku 'i loto 'a e 'elia tapu (FHR) 'e 2, pea ko e taha ai 'oku 'i he hakau 'o Hakauata. Ko e 'elia 'e 4 na'e savea'i pea ko e tu'unga fakalukufua 'o e me'amo'ui na'e kei 'i he tu'unga fakafiemalie.

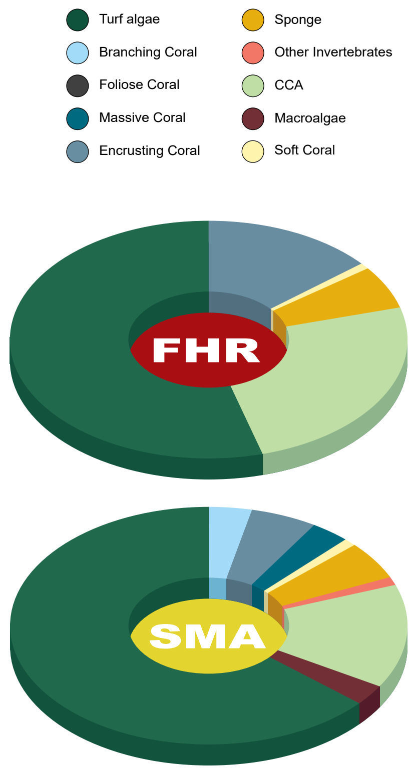
Ko e tokolahi 'o e ika lalahi 'i loto 'i he 'elia tapu (FHR) na'e 491.7 ika/km^2, pea ko e lahi taha ia 'i he ngaahi feitu'u kotoa na'e savea'i 'i he fonua fakalukufua. 'I he kalasi kehekehe 'o e ika, na'e 49.8 pea ko e to e lahi taha pe foki ia 'i he fakalukufua 'i he fonua. Ko e tupulekina 'o e feo, na'e 'i he 'avalisi 'o e holo (ofi ki he kolo) ki he fakafiemalie pe (20%) 'i loto 'i he 'elia tapu (FHR).

The gentle slope of the Lofangai FHR has some of the highest abundance and diversity of fish measured anywhere in the Kingdom.
-
Ko e hakau 'i loto 'i he 'elia tapu (FHR) 'oku 'iai 'a e lahi taha 'o e ika pea mo 'enau kalasi kehekehe 'i hono fakahoa ki he ngaahi feitu'u kehe 'i he fonua fakalukufua.

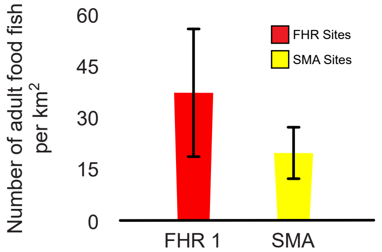
MAKAVE SMA 2019 VAV



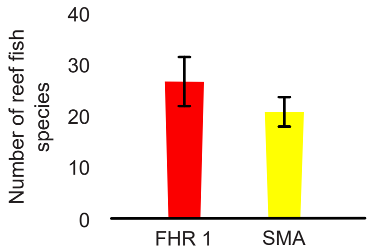
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
369	1.69 km^2	4.3%	0.1 & 0.25 km^2	3.7%	20.7%

Five sites were surveyed in the new Makave SMA as part of the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition. The reefs inside the Makave SMA are generally in very poor condition. There were many signs of *Diadema sp.* urchin outbreaks, likely from poor water quality from both the old harbour and the lagoon. These eat away at the reef matrix and destroy most of the corals. This was particularly severe at the southern edge of the peninsula, where live coral cover was 1.6%.

However, near the old harbour there were large stands of *Porites rus* and *Porites cylindrica*, which are both corals that do well in shallow and turbid water. Coral cover here was 21.5 % and reef fish diversity was 38.5 species. Adult food fish abundance was very low (5.3 to 40 fish/km^2), as was reef fish diversity everywhere except near the old harbour (5.4 to 27.5 species).

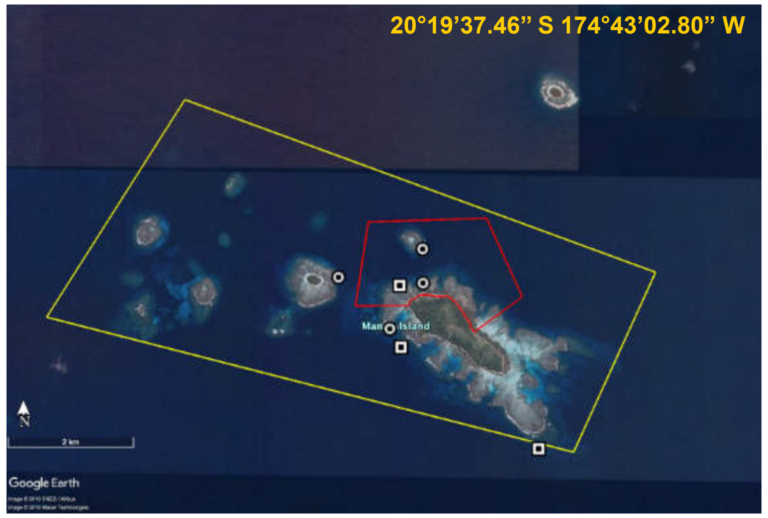
Ko e 'elia 'e 5 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) fo'ou 'o Makave 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama kae pehe ki he 2017 'e he Ocean Initiative Marine Expedition. Ko e hakau 'i loto 'i he SMA 'o Makave 'oku 'i he tu'unga fakatu'utamaki. 'Oku lahi 'asi ai 'a e kalasi 'o e vana pea ko e makatu'unga eni mei he 'uli 'o e tahi mei he tafe mai mei he fonua pea mo e loto taulaunga Neiafutahi. Ko e kalasi 'o e vana ko eni 'oku nau ma'u me'atokoni mei he feo pea mo maumau'i foki, pea ko e taha ia 'uhinga holo ai 'a e feo 'i he tafa'aki faka-Tonga (1.6%).

Ka neongo ia, 'i he ofi ki he taulanga Neiafutahi 'oku lahi 'asi ai 'a e kalasi 'o e feo ko e Porites rus mo e Porites cylindrical, 'i he 'uhinga pe ko e ongo kalasi pe eni 'e ua 'oku na malava 'o matu'uaki aki 'a e mamaha pea mo e 'uli 'o e tahi. Ko e tupulaki 'o e 'i he 'elia ni aipe na'e 21.5% pea mo e kalasi kehekehe 'o e ika na'e 38.5. Ko e tokolahi 'o e ikai lalahi na'e si'isi'i (5.3 to 40 ika/km^2), kae pehe ki he kalasi kehekehe 'o e ika'i he toenga ngaahi 'elia tukukehe ange feitu'u ofi ki he taulanga Neiafutahi (5.4 – 27.5).

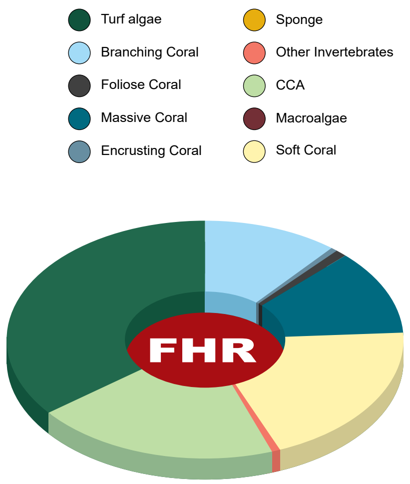
The shallow fringing reef near the old harbour in Neiafu has high coral cover of *Porites rus* and *Porites cylindrica*, which both do well in turbid shallow environments.
-
Ko e hakau mamaha ofi ki he taulanga Neiafutahi pea mo e kalasi 'o e feo ko e Porites rus mo e Porites cylindrical, 'a ia 'oku na malava lelei 'o matu'uaki 'a e 'uli mo e mamaha e tahi.

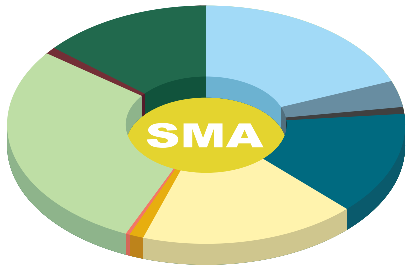
MANGO SMA 2017 HAP

SMA SCORE

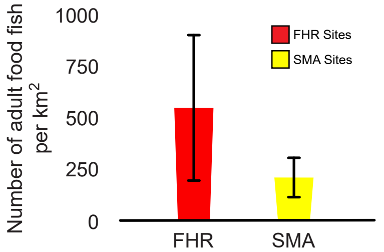


Benthic habitat coverage
Ko e nofo'anga 'o e 'ika

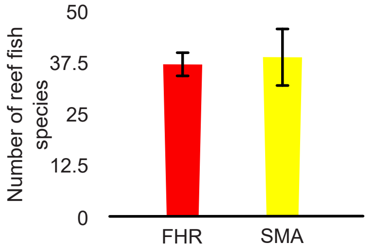




Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
30	39.75 km^2	17.9%	2.78 km^2	32.6%	7%

Seven sites were surveyed around the Mango SMA as part of the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition. The reefs of Southern Ha'apai are in the best condition of anywhere in Tonga. This is likely because of both environmental conditions and limited human pressure. These reefs have flushing from clean and cool oceanic water and are far from fishing pressure.

Adult food fish abundance at the outer FHR site was 905.8 fish/km^2, the highest recorded in the Kingdom. Reef fish diversity was greatest at the outer SMA site (46 species). Coral cover ranged from 23.5 to 48.3 %*.

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

Ko e 'elia 'e 7 na'e savea'i 'i he Feitu'u Pule'i Makehe (SMA) 'o Mango 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama kae pehe ki he 2017 'e he Vava'u Ocean Initiative Marine Expedition. Ko e hakau 'i he tafa'aki faka-Tonga 'o Ha'apai ko e lelei taha ia 'i Tonga fakalukufua. 'Oku makatu'unga eni mei he si'isi'i 'o e ivi fakatoutai 'i he feitu'u ni kae pehe foki ki he fakalakalaka mei natula. Ko e ngaahi hakau ko eni 'oku nau fehangahangai mo e tahi 'oku ma'a kae pehe ki he tahi mei tu'a 'oku mokomoko lelei pea mama'o mei he kau toutai.

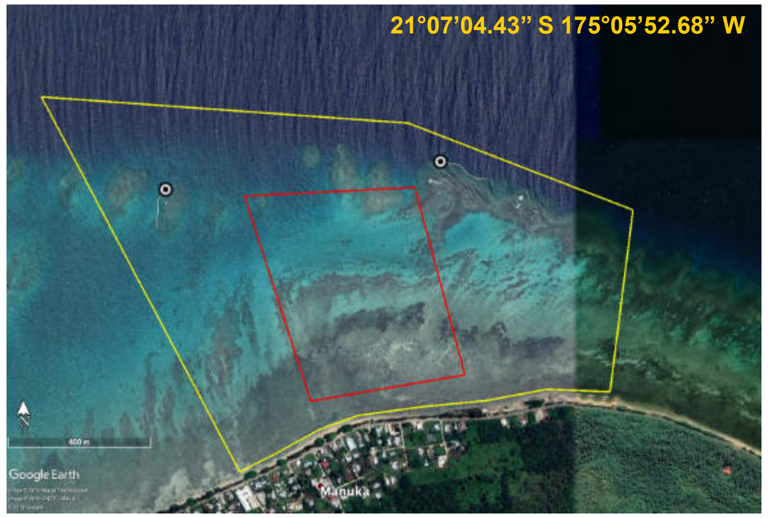
*Ko e tokolahi 'o e ika lalahi 'i tu'a 'i he 'elia tapu (FHR) na'e 905.8 ika/km^2 pea ko e lelei taha eni he fonua fakalukufua. Ko e kalasi kehekehe 'o e ika na'e lahi ange 'i he tafa'aki ki tu'a 'o e SMA (46), pea ko e tupulaki 'o e feo na'e 'i he 'avalisi 'o e 23.5% - 48.3%.**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition 2017.*

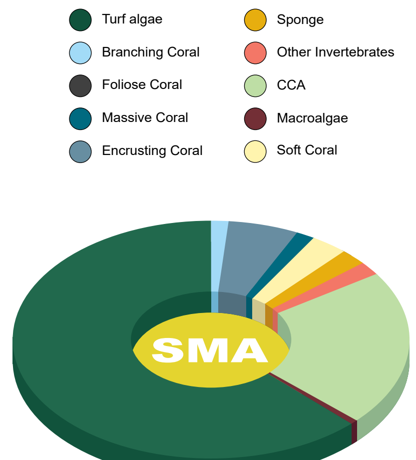
The Mango FHR has very healthy coral reefs, with the most adult food fish anywhere in the Kingdom and very high coral cover and reef fish diversity.
-
Ko e 'elia tapu (FHR) 'o Mango 'oku mo'uilelei 'a 'ene hakau, pea mo e ika lalahi taha 'i he fonua fakalukufua kae pehe ki he lahi 'a e tupulaki 'a e feo pea mo e kalasi kehekehe 'o e ika.

MANUKA SMA 2020 TBU

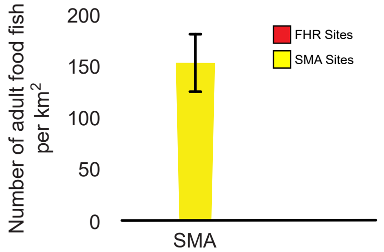
SMA SCORE



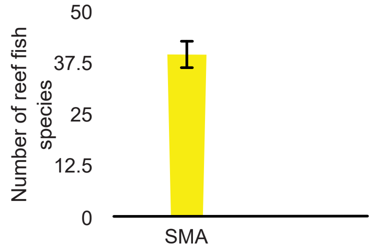
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
268	1.1 km^2	35.6%	0.26 km^2	10.8%	23.6%

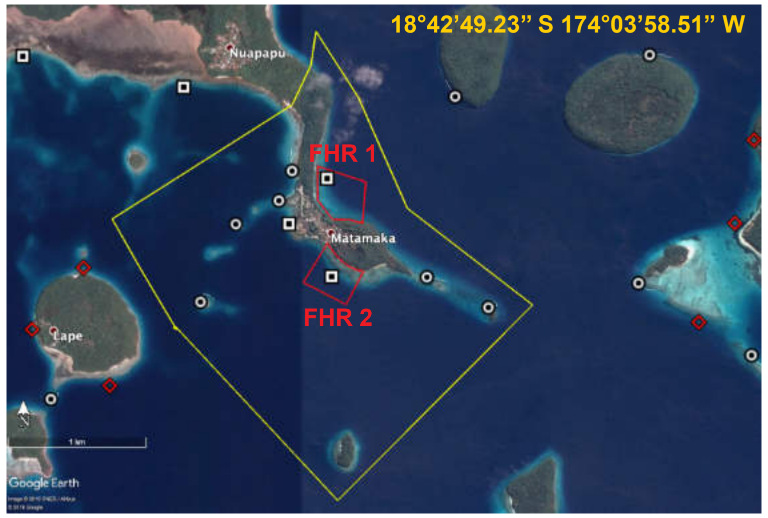
Two sites were surveyed inside the Manuka SMA. At both sites the reefs were in very poor condition, with large outbreaks of the *Diadema sp.* sea urchin. Coral cover was 6 to 11%. The poor condition of the reefs here is likely because of runoff from the Fanga'uta lagoon, which has made many sea urchins grow. These destroy the reef with their feeding and kill any newly settled corals. This is a pattern that is also present near the lagoons in Vava'u and the Ofu SMA. It is very important for water quality to be improved at these locations.

The abundance of adult food fish was moderate (128.3 to 180 fish/km^2), as was reef fish diversity (32.25 to 40 species).

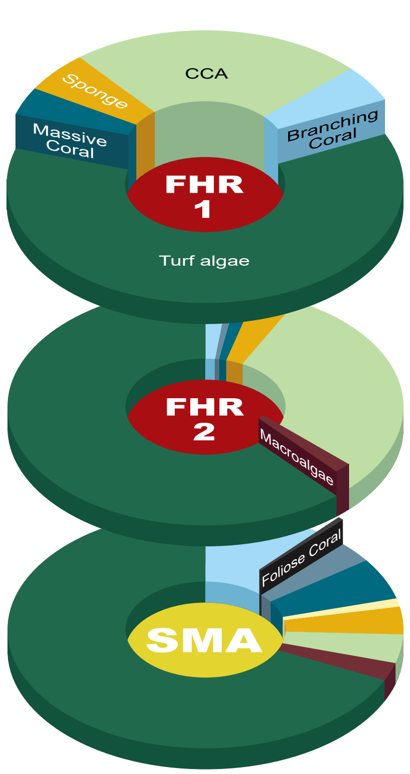
Ko e 'elia 'e 2 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o Manuka. 'I he ongo 'elia ni, ko e tu'unga 'o e hakau 'oku 'i he tu'unga fakatu'utamaki pea lahi moe 'asi 'o e kalasi 'o e vana. Ko e tupulaki 'o e feo na'e 'i he 'avalisi 'o e 6 – 11%. Ko e holo 'a e tu'unga 'o e hakau 'oku makatu'unga ia mei he tafe mai 'o e tahi 'uli mei Fanga'uta, 'o malava ke to e fakatupunga ai 'a e mo'ui tokolahi 'a e kalasi 'o e vana. Ko e kalasi 'o e vana ko eni 'oku nau maumau'i pe ma'u me'atokoni mei he feo. Ko e taha eni palopalema 'oku 'asi 'i Vava'u 'i he SMA 'o Ofu, pea mahino ai 'a e mahu'inga ke tokangaekina ke ma'a e tahi.

Ko e ika lalahi na'e 'i he tu'unga fakafiemalie pe 'ene tokolahi (128.3 to 180 ika/km^2), kae pehe ki he'enau kalasi kehekehe (32.25 – 40).

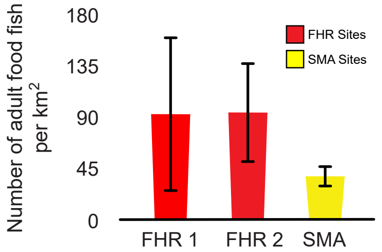
The coral reefs inside the Manuka SMA have been heavily damaged, likely from nutrient run of from Fanga'uta lagoon and large numbers of *Diadema sp.* sea urchins which have destroyed the reef.
-
Ko e hakau 'i loto 'i he SMA 'o Manuka 'oku fu'u lahi 'a e maumau 'oku hoko kiai, 'o makatu'unga mei he tafe mai 'a e tahi mei Fanga'uta mo e tupu tokolahi 'o e vana he 'oku ne maumau'i e feo.



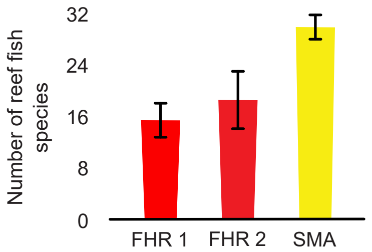
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
77	2.1 km^2	10.6%	0.1 & 0.1 km^2	27%	9.5%

Eight sites were surveyed inside the Matamaka SMA as part of the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition. Matamaka has to FHRs, on both sides of the peninsula.

The overall condition of the reefs inside the Matamaka SMA was variable. Coral cover ranged from 1.6% to 38.2%. Likewise, reef fish species richness ranged from 15.5 species in the southern FHR to 43 species on the outer bommies. Adult food fish abundance was generally low, between 0 and 93.3 fish/km2.*

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

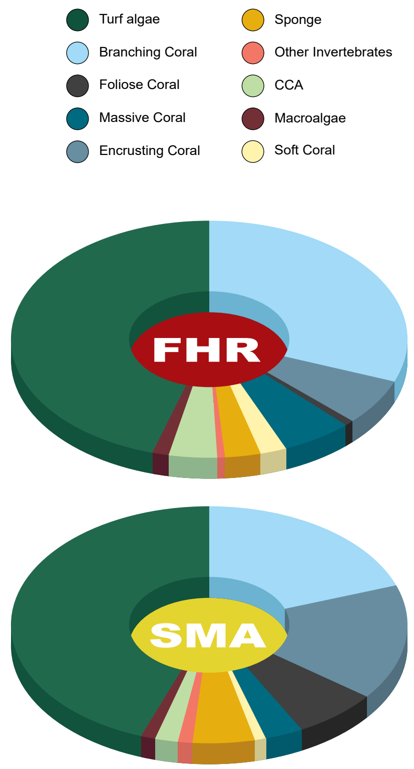
Ko e 'elia 'e 8 na'e savea'i 'i loto 'i he Feitu'u Pulei Makehe (SMA) 'o Matamaka 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama kae pehe ki he 2017 'e he Vava'u Ocean Initiative Marine Expedition. Ko e 'elia tapu (FHR) 'e 2 'i he SMA 'o Matamaka.

*Ko e tu'unga fakalukufua 'o e hakau 'i loto 'i he SMA 'o Matamaka 'oku kehekehe pe hono tu'unga. Ko e tupulekina 'o e feo 'oku 'i he 'avalisi 'o e 1.6 – 38.2%, pea ko e kalasi kehekehe 'o e ika 'oku 'i he 'avalisi 'o e 15.5 'i he tafa'aki faka-Tonga 'o e FHR ki he 43 'i he tafa'aki ki tu'a 'o e SMA. Pea ko e tu'unga 'o e ika lalahi na'e si'isi'i ange 'i he 'avalisi 'o e 0 – 93.3 ika/km2.**

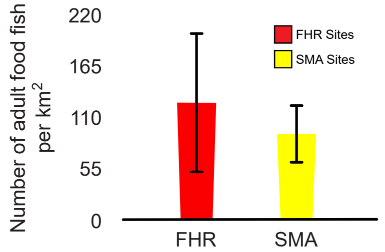
**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition 2017.*

A large outcrop of branching corals in the Matamaka SMA.
-
Ko e taha 'o e kalasi 'o e feo 'i he hakau koia 'o e SMA 'o Matamaka.

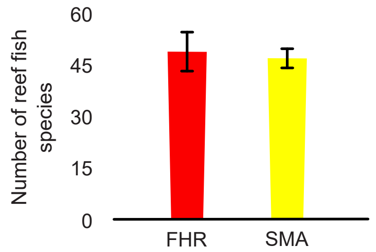
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
84	16.89 km^2	11.3%	0.55 km^2	24.2%	3.3%

The coral reefs inside the Matuku SMA and FHR were consistently in the very good condition. Coral cover was high at both of the two sites surveyed (43.7 and 45.5%). Likewise, reef fish diversity was also very high at both sites (47.3 and 49.5 species). Adult food fish abundance was moderate (93.3 to 127.5 fish/km2).

The overall good health of the reefs inside the Matuku SMA are likely due to environmental conditions. Clean oceanic currents will reduce the effects of coral bleaching and there was no immediate evidence of cyclone damage.

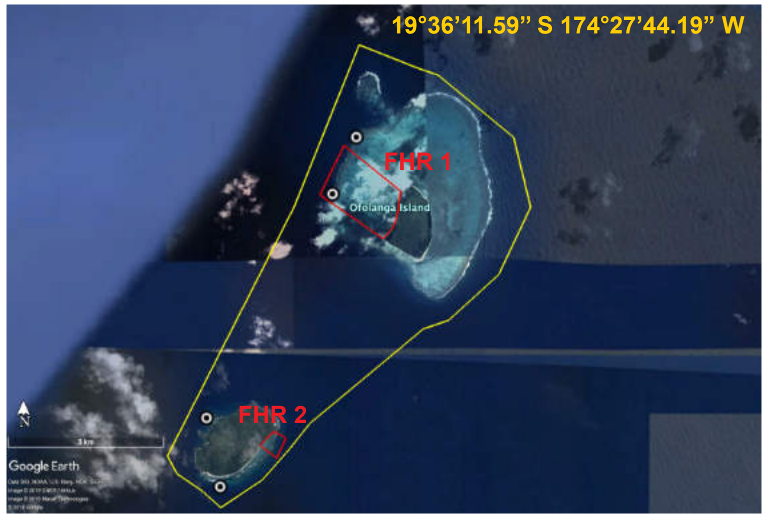
Ko e hakau 'i loto 'i he Feitu'u Pule'i Makehe (SMA) mo e 'elia tapu (FHR) 'o Matuku 'oku 'i he tu'unga fakafiemalie 'ene tupulekina. Ko e tupulaki 'o e feo, na'e lahi 'i he ongo 'elia 'e 2 na'e savea'i (43.7 – 45.5%). 'I he tu'unga 'o e kalasi kehekehe 'o e ika na'e to e lahi aipe 'i he ongo 'elia (47.3 – 49.5) pea ko e tu'unga 'o e ika lalahi na'e i he tu'unga fakafiemalie pe (93.3 to 127.5 ika/km2).

Ko e tu'unga mo'uilelei 'i he fakalukufua 'o e feo 'i he hakau 'o e SMA 'o Matuku 'oku 'iai 'a e tui ko e fakalakalaka pe mei natula. Makatu'unga eni mei he ma'a 'o e potu tahi pea mokomoko lelei kae pehe ki he 'ikai fu'u 'asi ha maumau fakatupunga mei he fakatamaki fakaenatula.

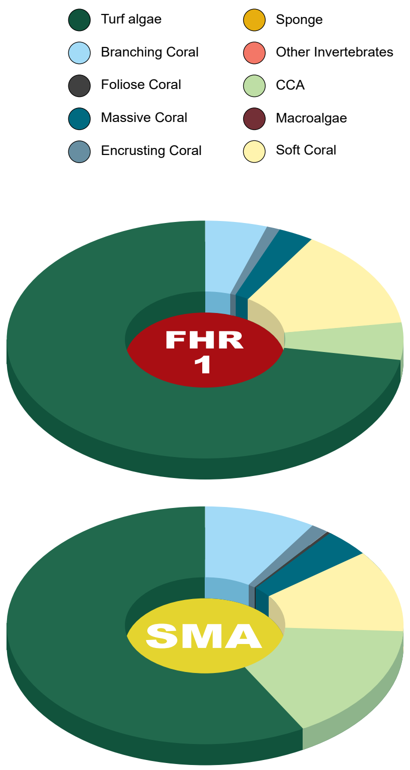
The reefs inside the Matuku SMA have both high coral cover and reef fish diversity.
-
Ko e hakau 'i loto 'i he SMA 'o Matuku, 'oku ne ma'u 'a e tu'unga fakalakalaka 'i he mo'ui lelei 'o e feo kae pehe foki ki he lahi 'o e kalasi kehekehe 'o e ika.

MOUNGA'ONE SMA 2018 HAP

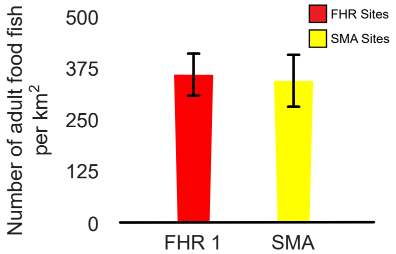
SMA SCORE



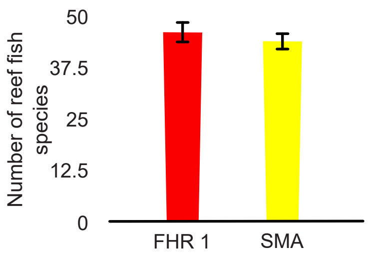
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
60	40.7 km^2	13.2%	1.8 & 1.2 km^2	19.5%	7.4%

There are two FHRs inside the Mounga'one SMA, which also covers Ofalanga Island. The reefs around both islands are in very good condition and have extensive reef habitat. This environment is characterized by high wave energy and clear and clean water. The extensive fringing reefs drop rapidly into deep water.

Adult food fish abundance was very high, particularly around Ofalanga (552.5 to 651.7 fish/km^2). Reef fish diversity was also very high (38 to 49.8 species). Coral cover was low around Mounga'one (9 to 12%) and higher around Ofalanga (21.9 to 38.7%).

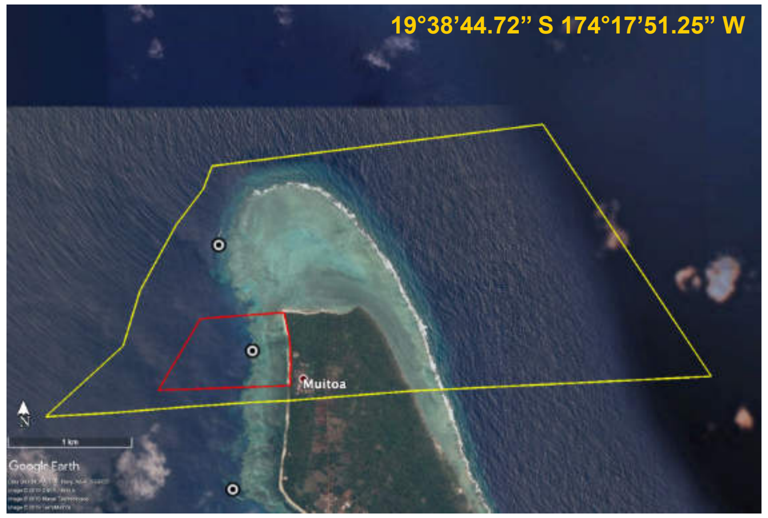
Ko e 'elia tapu (FHR) 'e 2 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o Mo'unga'one, 'o kau ai mo e motu ko Ofolanga. Ko e hakau takai 'i he ongo motu ni 'oku 'i he tu'unga fakafiemalie. Ko e tu'unga faka'atakai 'o e feitu'u ni 'oku 'iloa 'i he malohi hono ngaahi peau pea mo e ma'a 'o e konga tahi. Pea ko e hakau takai 'oku matu'aki hifo hangatonu pe ki he tahi loloto.

Ko e tu'unga 'o e ika lalahi 'oku lahi 'aupito 'o tautautefito ki he hakau takai 'o Ofolanga (552.5 to 651.7 ika/km^2). 'I he tu'unga 'o e kalasi kehekehe 'o e ika, 'oku lahi 'aupito moia (38 – 49.8), ka ko e tupulekina 'o e feo 'oku holo 'aupito 'i he hakau takai 'o Mo'unga'one (9 – 12%) kae lahi ange 'i he hakau takai 'o Ofolanga (21.9 – 38.7%).

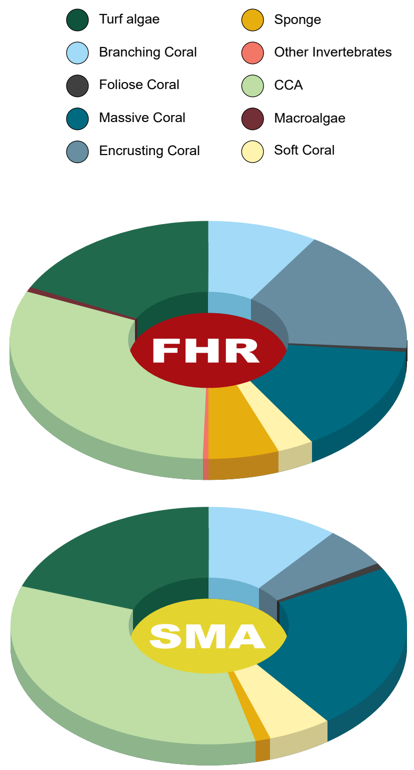
The coral reefs around Mounga'one and Ofalanga island are in very good condition, with extensive reef habitat and clear oceanic water.
-
Ko e tu'unga mo'uilelei 'o e feo 'i he hakau takai 'o Mo'unga'one mo Ofolanga 'i he lelei 'aupito, pea lahi ngaahi nofo'anga ika pea ma'a mo e tahi foki.

MUITOA SMA 2018 HAP

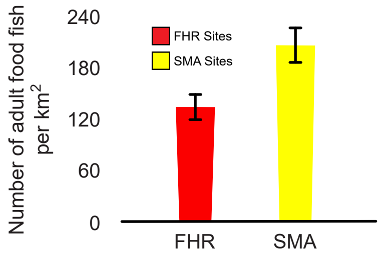
SMA SCORE



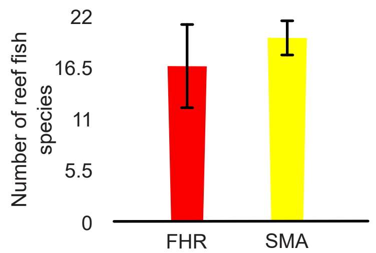
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



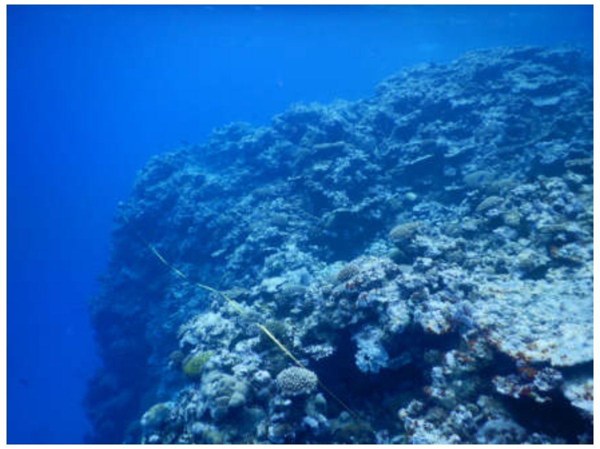
POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
50	10.81 km^2	12.3%	0.72 km^2	23%	6.7%

The Muitoa SMA is the northern most SMA in the Ha'apai ribbon islands. Two sites were surveyed along the inner edge of the reef. The outer edge of all the Ha'apai ribbon islands was too exposed for divers to survey.

Adult food fish abundance was moderate inside the FHR (136.7 fish/km^2) but very high inside the SMA (208.3 fish/km^2). Reef fish diversity was also high inside the SMA (42.25 species), but low inside the FHR (28 species). Coral cover was high at both sites inside the SMA and FHR (39.8 and 41.3%).

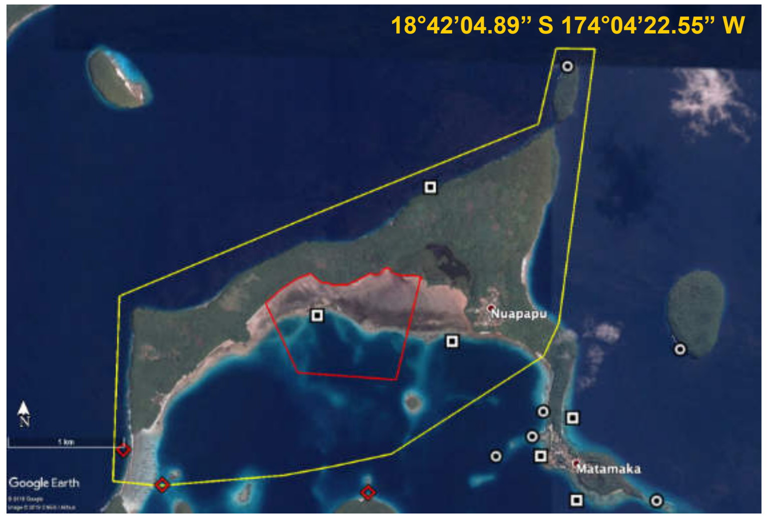
Ko e Feitu'u Pule'i Makehe (SMA) 'o Muitoa ko e SMA 'oku tu'u ki he tafa'aki faka-Tokelau 'o e 'otumotu Ha'apai. Ko e 'elia 'e 2 na'e savea'i 'i loto 'i he tafatafa'aki hakau, 'o 'ikai kau ai ngaahi tafa'aki ki tu'a he 'oku fu'u hanga ia ki tu'a ki he malu mo e hao 'o e kau uku na'a nau fakahoko e savea.

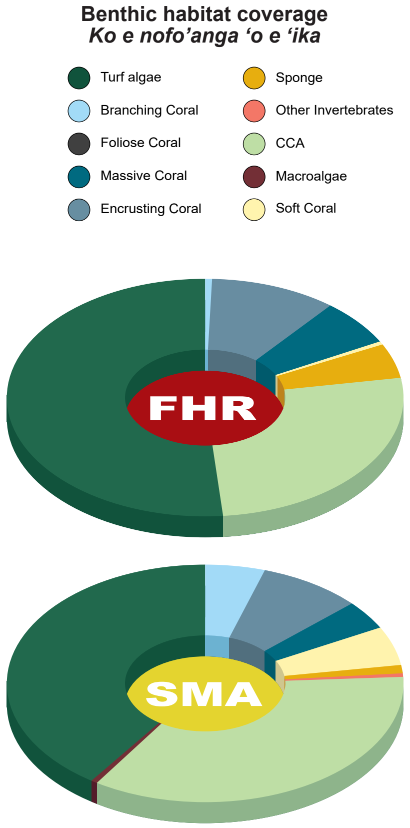
Ko e tu'unga 'o e ika lalahi na'e 'i he tu'unga fakafiemalie pe 'i loto 'i he 'elia tapu (FHR) (136.7 ika/km^2) kae lahi ange 'i loto 'i he SMA 'oku ngofua ki he toutai (208.3 ika/km^2). 'I he tu'unga 'o e kalasi kehekehe 'o e ika, na'e lahi ange 'i loto 'i he SMA aipe (42.25) kae si'isi'i ange 'i loto 'i he 'elia tapu (28). Pea ko e tupulaki 'o e feo na'e lahi ange fakatou'osi 'i he ongo 'elia 'o tatau pe 'i he 'elia tapu pea mo e SMA foki (39.8 mo e 41.3%).

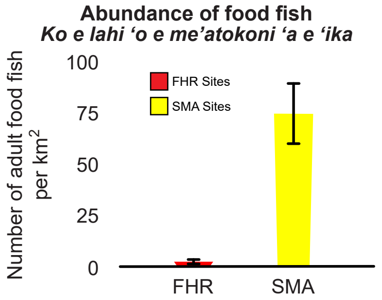


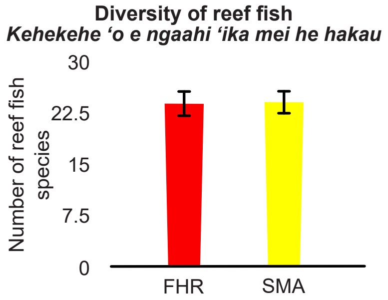
The Muitoa SMA is very exposed and stretches as a fringing reef before dropping steeply into deep water.
-
Ko e Feitu'u Pule'i Makehe (SMA) 'o Muitoa 'oku lahi hono hakau takai pea hifo hangatonu pe hono hakau ki lalo ki he tahi loloto.

SMA SCORE









POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
95	5.84 km^2	8.64%	0.92 km^2	11.1%	15.8%

Six sites were surveyed in the proposed Nuapapu SMA as part of the Asian Development Band 2016 baseline SMA surveys, the 2017 Vava'u Ocean Initiative Marine Expedition and the 2017/18 national monitoring program. The inner reef areas are sheltered and lagoonal, with scattered reefs. The outer reef is a shallow, narrow platform that drops off into deep water.

Adult food fish abundance was low inside the lagoon (2.2 to 40 fish/km^2) and greater on the outer reefs (95.5 to 165.5 fish/km^2), although still low. Reef fish species richness was very low within the lagoon (21.3 to 26.6 species) as well as on the outer reefs (15.8 to 33 species). Coral cover inside the lagoon was low to moderate with large expanses of sand (17.2 to 28%) and low along the outer western wall (1.7 to 16.9%)*.

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

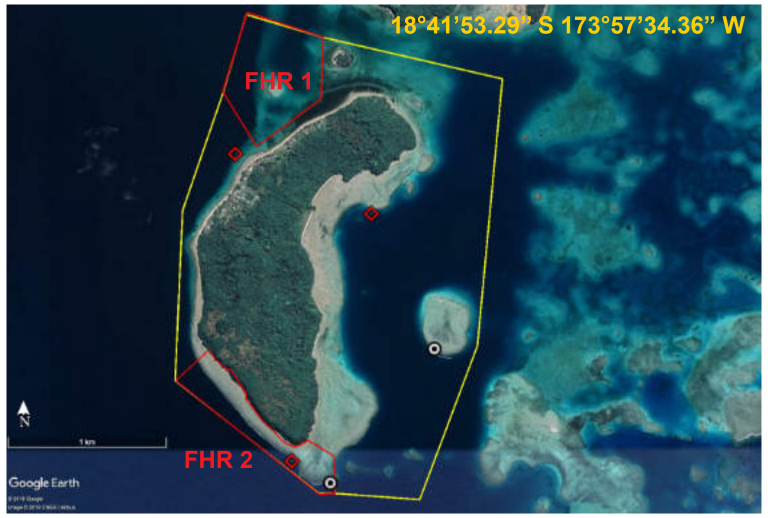
Ko e 'elia 'e 6 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o Nuapapu 'i he 2016 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia, 2017 'e he Vava'u Ocean Initiative Marine Expedition pea mo e 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama. Ko e konga ki loto 'o e hakau 'oku malu pea ki'i loloto pea takatakai 'e he ngaahi hakau feo kehekehe pea. Ko e konga ki tu'a 'o e hakau 'oku mamaha pea hifo aipe ki lalo ki he tahi loloto.

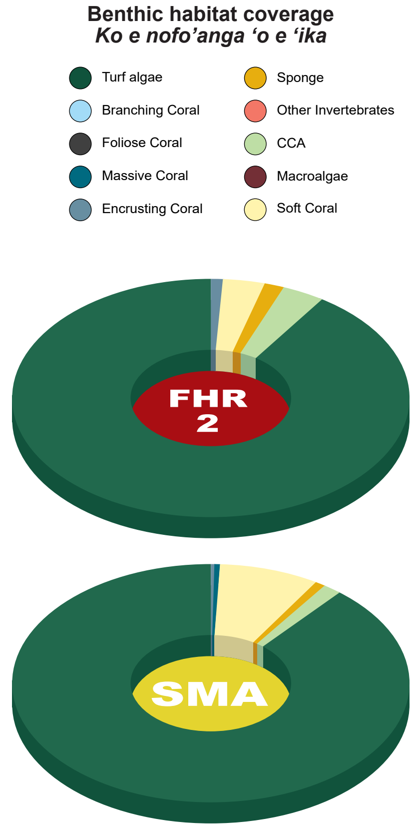
Ko e tu'unga 'o e ika lalahi na'e holo 'i he konga ki loto 'o e hakau (2.2 to 40 ika/km^2) pea lahi ange 'i he konga ki tu'a (95.5 to 165.5 ika/km^2), neongo 'oku kei si'isi'i pe 'i he tu'unga fakalukufua. 'I he kalasi kehekehe 'o e ika na'e holo 'aupito'i he konga ki loto 'o e hakau aipe (21.3 – 26.6) kae pehe ki he konga tu'a 'o e hakau (15.8 – 33). Ko e tupulaki 'o e feo 'i he konga ki loto 'o e hakau na'e holo pea lahi 'one'one 'a e ngaahi 'elia lahi (17.2 – 28%) pea to e holo aipe 'i he tafa'aki faka-Hihifo ki tu'a 'o e hakau (1.7 – 16.9%).*

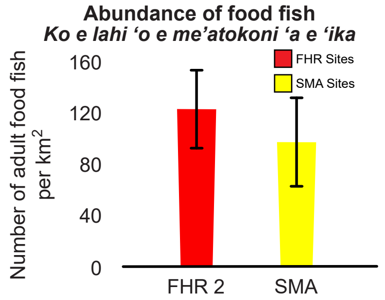
** Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition 2017.*

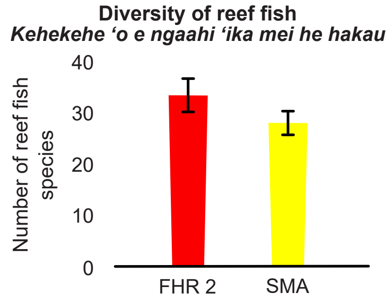
A shallow bommie inside the Nuapapu lagoon.
-
Ko e 'elia mamaha 'i he 'i loto 'i he hakau 'o Nuapapu.

SMA SCORE









POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
117	5.35 km^2	10.8%	0.29 & 0.38 km^2	20.3%	13.6%

Five sites were surveyed in the Ofu SMA as part of the 2017/18 national monitoring program and the Asian Development Bank 2016 baseline SMA surveys. The reefs in the Ofu SMA were in very poor condition, with large outbreaks of the *Diadema sp.* sea urchin. Coral cover was less than 1%, with very few live corals observed anywhere. The poor condition of the reefs here is likely because of runoff from lagoon, which has made many sea urchins grow. These destroy the reef with their feeding and kill any newly settled corals. This is a pattern that is also present near the Fanga'uta lagoon in Tongatapu. It is very important for water quality to be improved at these locations.

Adult food fish abundance was low to moderate (27.7 to 175.5 fish/km^2). Reef fish species richness was high at the outer sites (38.5 to 45.5 species), but low at the inner sites (23.6 to 25.8 species).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e 'elia 'e 5 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o Ofu 'i he 2017/18 lolotonga hono muimui'i fakalukufua tu'unga 'o e polokalama pea mo e 2016 'e he poloseki 'a e Pangike Fakalakalaka 'o 'Esia. Ko e hakau 'i loto SMA 'o Ofu 'oku 'i he tu'unga fakatu'utamaki, pea lahi mo e 'asi e kalasi 'o vana. Ko e tupulaki 'o e feo 'oku holo 'aki 'a e 1% pea si'isi'i ke ma'u ha feo mo'ui. Ko e tu'unga fakatu'utamaki ko eni 'oku 'iai 'a e hakau 'oku ngalingali ko e fakatupunga mei he lahi 'o e tafe mai 'o e tahi 'uli mei he loto taulanga Neiafu tahi, pea fakatupunga ai mo e lahi e 'asi 'o e kalasi 'o e vana. Ko e me'amo'ui ko eni (vana) 'oku nau maumau'i e feo pea nau ma'u me'atokoni mei ai 'o tamate'i aipe fanga ki'i feo iiki. Ko e natula tatau pe 'a e palopalema 'oku fehangahangai pea mo e ngaahi feitu'u ofi 'i Fanga'uta Tongatapu. 'Oku fu'u mahu'inga 'aupito ke fai hano to e tokangaekina 'a e ma'a 'o e tahi 'i he ngaahi feitu'u ni.

*Ko e tu'unga 'o e ika lalahi 'oku holo (27.7 - 175.5 ika/km^2). 'I he tu'unga 'o e kalasi kehekehe 'o e ika na'e lahi ange 'i he ngaahi konga ki tu'a 'o e hakau (38.5 – 45.5) pea si'isi'i ange 'i he konga ki loto 'o e hakau (23.6 – 25.8). **

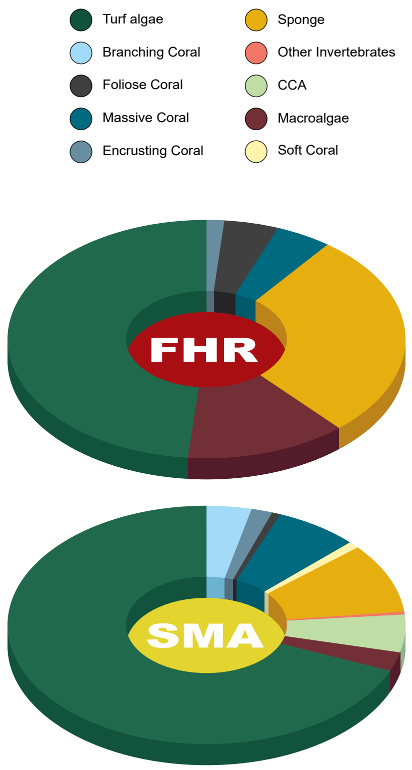
**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he poloseki 'a e Pangike Fakalakalaka 'o 'Esia 'i Vava'u 2016*

The coral reefs inside the Ofu SMA have been heavily damaged, likely from nutrient run of from the lagoon and large numbers of *Diadema sp.* sea urchins which have destroyed the reef.
-
Ko e hakau feo 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o Ofu 'oku 'i he tu'unga fakatu'utamaki, makatu'unga mei he lahi 'a e tafe mai 'o e tahi 'uli mei he loto taulanga Neiafutahi pea lahi mo e mo'ui 'a e kalasi 'o e vana, 'aia 'oku nau faka'auha'a e feo.

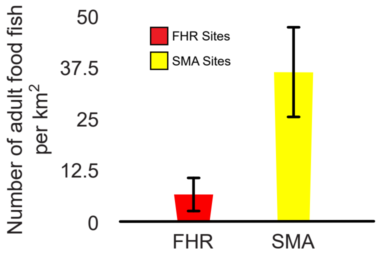
OLO'UA SMA 2020 VAV

SMA SCORE

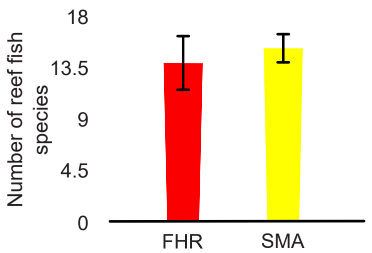
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
95	2.88 km^2	4.3%	0.42 km^2	1%	14.6%

Seven sites were surveyed within the proposed Olo'ua SMA as part of the 2016 Asian Development Bank baseline SMA surveys, the 2017/18 national monitoring program and VEPA baseline SMA monitoring. Similar to Ofu, the reefs in the Olo'ua SMA were in very poor condition, with large outbreaks of the *Diadema sp.* sea urchin. Coral cover in many places was less than 1%, with few live corals observed anywhere. However the 2019 VEPA surveys identified a healthy outcrop of coral about 40m wide in front of the village that may be acting as a fish nursery. This is in the proposed FHR.

The poor condition of the reefs here is likely because of runoff from lagoon, which has made many sea urchins grow. These destroy the reef with their feeding and kill any newly settled corals. This is a pattern that is also present near the Faga'uta lagoon in Tongatapu. It is very important for water quality to be improved at these locations.

Adult food fish abundance was very low (4.4 to 80 fish/km^2). Reef fish species richness was very low (10 to 24.5 species).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e 'elia 'e 7 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe fo'ou ko Olo'ua 'i he 2016 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia, 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama pea pehe ki he VEPA. 'Oku 'i he tu'unga tatau pea mo e tu'unga 'oku 'iai 'a e hakau 'o Ofu, lahi mo'ui 'a e kalasi 'o e vana, pea holo 'aki 'a e 1% 'a e tupulaki 'a e feo pea mo si'isi'i ke ma'u ha feo mo'ui. Kaekehe, 'i he 2019 na'e fakahoko ai 'e he VEPA ha to e savea 'o fakapapau'i ai 'oku tupulaki 'a e feo 'aki 'a e 40m 'i mu'a 'i he kolo pe, pea ngalingali 'e hoko 'elia ni ko e nofo'anga ki he ika. Ko e 'elia ko eni 'oku 'i loto ia 'i he 'elia 'oku fakaangaanga ke fokotu'u ko e 'elia tapu 'aupito.

Ko e tu'unga fakatu'utamaki 'oku 'iai 'a e feo 'oku makatu'unga aipe mei he tafe mai 'o e tahi 'uli mei he loto taulanga Neiafu tahi, 'o fakatupunga aipe 'a e tupu tokolahi 'a e kalasi 'o e vana. 'Aia 'oku nau maumau'i pe faka'auha e feo, 'i henau ma'u me'atokoni mei ai 'o tamate'i aipe fanga ki'i feo iiki. Ko e natula tatau pe 'a e palopalema 'oku hoko 'i he ngaahi feitu'u ofi ki Fanga'uta 'i Tongatapu. Mahu'inga 'aupito ke tokangaekina 'a e ma'a e tahi kae lava ke solova 'a e ngaahi palopalema 'oku fehangahangai mo e ngaahi feitu'u ni.

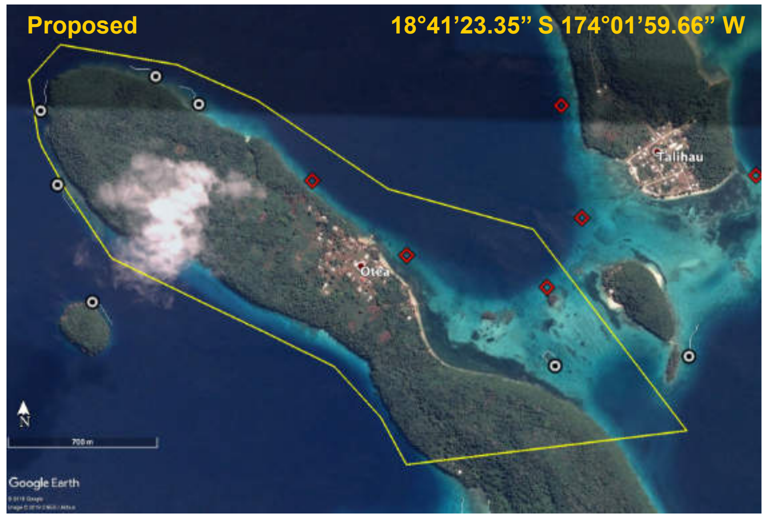
*Ko e tu'unga 'o e ika lalahi 'oku fu'u holo 'aupito (4.4 to 80 ika/km^2). Pea 'oku holo aipe mo e tu'unga 'oku 'iai 'a e kalasi kehekehe 'o e ika (10 – 24.5).**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he poloseki 'a e Pangike Fakalakalaka 'o 'Esia 'i Vava'u 2016.*

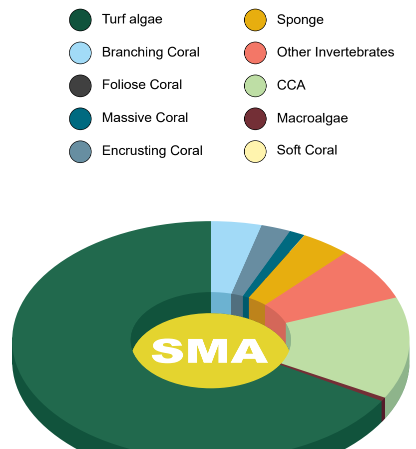
A healthy coral outcrop inside the Olo'ua SMA with many juvenile snapper.
-
Ko e taha 'o e konga hakau 'oku mo'uilelei 'i loto 'i he SMA 'o Olo'ua pea mo e fanga ki'i ika iiki.

OTEA SMA 2020 VAV

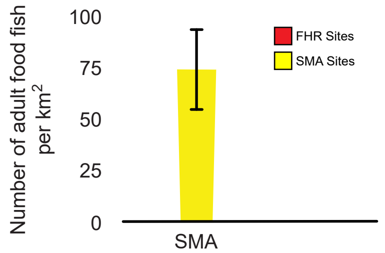
SMA SCORE



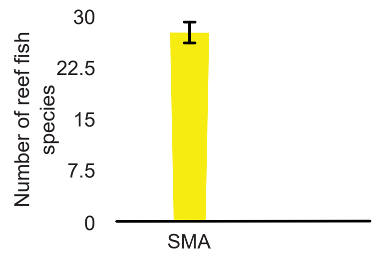
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
113	2.77 km^2	4.2%	-	-%	-

Eight sites were surveyed inside the proposed Otea SMA as part of the 2017/18 national monitoring program and the Asian Development Bank 2016 SMA baseline surveys. Shallow fringing reef habitat dominated the area in front of the village. This became deep walls towards the end of the point and around past Swallows Cave. The shallow area to the southeast, known as Japanese Gardens, was dominated by sandy habitat and many coral bommies. Crown of thorns starfish were also observed here.

Adult food fish abundance was low in front of the village (10 to 88.8 fish/km^2), but higher at the end of the point and past Swallows Cave (95-110 fish/km^2). Japanese Gardens also had moderate to high adult food fish abundance (161.7 fish/km^2). Reef fish diversity was low to moderate throughout the SMA (22 to 37.5 species). Coral cover was very low at all sites surveyed (3.3 to 13.7%).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

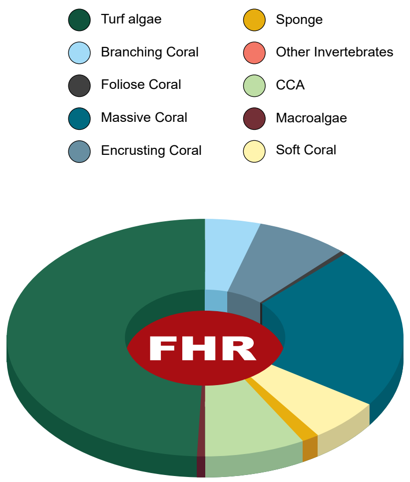
Ko e 'elia 'e 8 na'e savea'i 'i loto 'i he Feitu'u Pulei Makehe (SMA) 'oku fokotu'u 'e 'Otea ke hoko ko 'enau SMA 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama pea mo e 2016 'e he poloseki 'a e Pangike Fakalakalaka 'o 'Esia. Ko e konga 'i mu'a 'o e kolo 'oku mamaha 'a e hakau koia pea toki loloto atu ki he tafa'aki ki tu'a 'o a'u ki he 'Ana Pekepeka. Ko e 'elia mamaha ki he tafa'aki faka-Tonga Hahake 'oku 'iloa ko e Ngoue Siapani (Japanese Gardens), 'oku lahilahi ki he 'one'one moe feo iiki. Na'e malava ke 'asi e kalasi'o e mangamanga'atai (crown of thorns) lolotonga 'a e savea 'aia 'oku nau maumau'i pe faka'auha 'a e feo.

*Ko e tu'unga 'o e ika lalahi 'oku holo tautautefito ki he konga 'i mu'a 'o e kolo (10 to 88.8 ika/km^2), kae lahi ange 'i he ngaahi tafatafa'ki ki tu'a 'o 'au ki 'Ana Pekepeka (95-110 ika/km^2). 'I he Ngoue Siapani 'oku 'i he tu'unga fakafiemalie pe lahi 'a e ika lalahi (161.7 ika/km^2). Ka 'i he vakai ki he tu'unga 'o e kalasi kehekehe 'o e ika 'i he fakalukufua, na'e holo (22 – 37.5) pea holo foki mo e tupulaki 'a e feo 'i he ngaahi 'elia na'e savea'i (3.3 – 13.7%).**

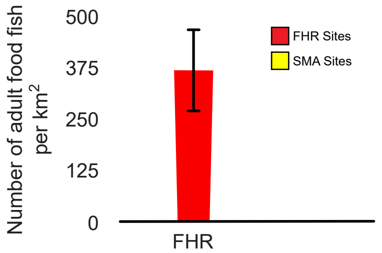
**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he poloseki 'a e Pangike Fakalakalaka 'o 'Esia 'i Vava'u 2016.*

All of the reefs surveyed inside the Otea SMA were in very poor condition.
-
'I he tu'unga fakalukufua 'o e feo 'i he ngaahi feitu'u na'e savea'i, na'e holo pea 'oku 'i he tu'unga fakatu'utamaki.

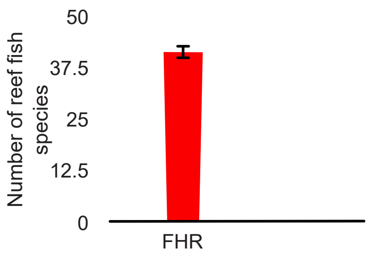
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
6	-	-%	1.4 km^2	43.4%	-

One site was surveyed along the outer edge of the Pangaimotu FHR, near the shipping channel. A minimum of four replicates are surveyed at each site. While the area closer to the Pangaimotu resort is mainly sandy bottom, the outer edge of the reef is a steep drop of into deeper water with high current flow. This is also a busy shipping channel.

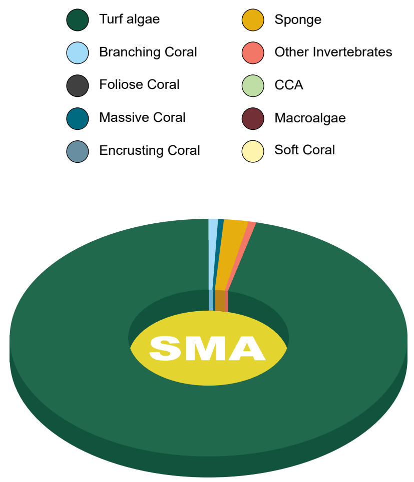
Adult food fish abundance was very high (368.3 fish/km^2), as was reef fish diversity (41.5 species) and live coral cover (34.5%).

Ko e 'elia 'e taha na'e savea'i 'i he tafa'aki ki tu'a 'o e Feitu'u Pule'i Makehe 'o Pangaimotu, ofi ki he 'alu 'anga vaka. Pea meimei ki he foi savea tu'o 4 na'e fakahoko 'i he ngaahi tafa'aki taha. Pea neongo 'a e lahilahi 'one'one 'a e 'elia 'i mu'a 'i he resort, ko e konga ki tu'a 'o e hakau 'i he 'elia ni 'oku hifo hangatonu ki lalo ki he feitu'u loloto pea 'oku malohi 'a e tafe 'a e 'au 'iai. 'Oku kau pe mo e 'elia ni he 'alu 'anga vaka foki.

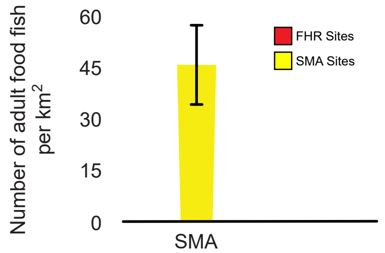
Ko e tu'unga 'o e ika lalahi na'e fu'u ma'olunga (368.3 ika/km^2), 'o tatau pe ki henau kalasi kehekehe (41.5) kae pehe k he tupulaki 'o e feo (34.5%).

The coral reef along the northern edge of the Pangaimotu FHR slopes steeply down into deeper water along the edge of the shipping channel.
-
Ko e hakau feo 'i he tafa'aki faka-Tokelau 'o Pangaimotu, 'oku hifo hangataonu ki lalo ki he tahi loloto 'o e 'alu 'anga vaka.

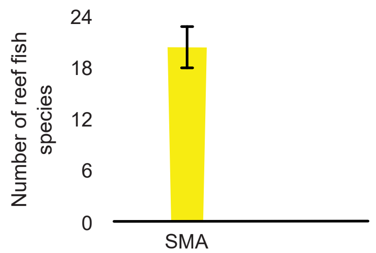
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
639	4.89 km^2	17.9%	-	-%	-

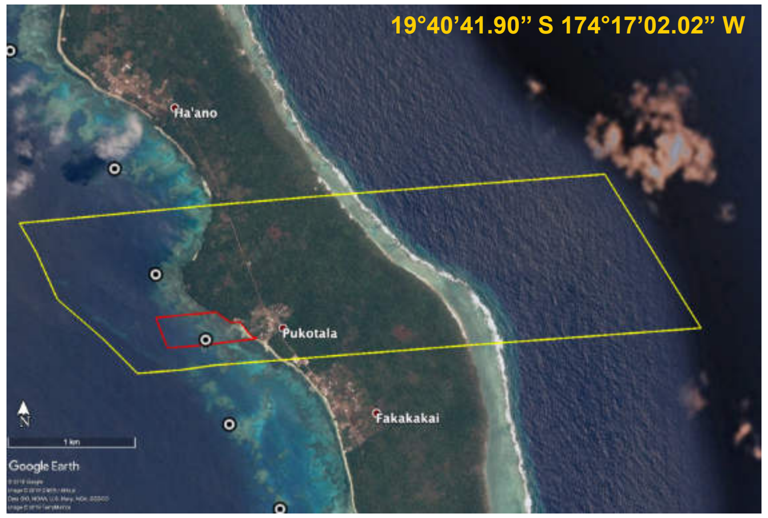
Five sites were surveyed inside the boundaries of the proposed Pangaimotu SMA in Vavav'u. Overall these sites were in very poor condition, with very low coral cover at all five sites (0 to 1%). The poor condition of these reefs may be the result of poor quality from the lagoons, or past coral bleaching events. In environments with limited water movement, heatwaves may increase the water temperature to the point that corals die from bleaching. This can be made worse by limited water movement.

Adult food fish abundance was very low across all sites (23.3 to 78.3 fish/km^2), as was reef fish species richness (13.8 to 28.3 species).

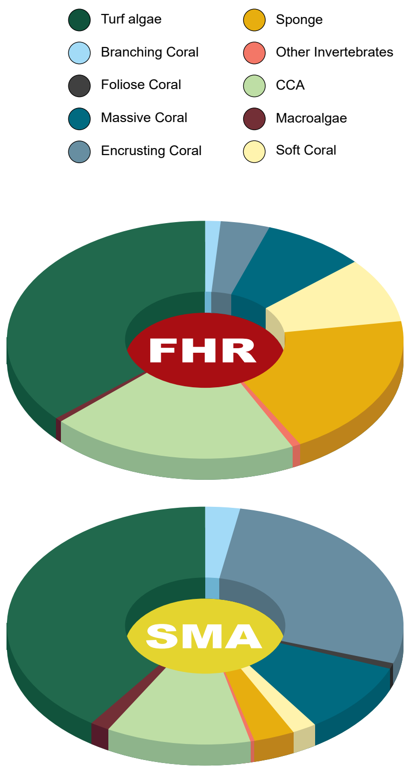
Ko e 'elia 'e 5 na'e savea'i 'i loto 'i he feitu'u 'oku loto 'a Pangaimotu ke fokotu'u ko honau Feitu'u Pule'i Makehe (SMA). 'I he tu'unga fakalukufua 'o e ngaahi 'elia ni 'oku 'i he tu'unga fakatu'utamaki pea holo mo e tupulaki 'o e feo 'i he 'avalisi 'o e 0 – 1%. 'Oku makatu'unga 'a e holo ko eni 'a e tu'unga 'o e feo 'i he 'uli 'a e tahi pea lahi mo e mate 'a e feomei he feliuliuaki 'a e 'ea. Ko e 'atakai 'oku malu pea si'isi'i ke vilo/fetogi e tahi 'iai, 'oku malava ke ma'olunga e mafana e tahi ki ha tu'unga ke mate ai e feo. 'Aia 'oku fakatupunga eni mei he si'isi'i ke vilo/fetongi e tahi.

Ko e tu'unga 'o e ika lalahi na'e holo 'i he ngaahi 'elia kotoa na'e savea'i (23.3 - 78.3 ika/km^2), kae pehe foki ki he'enau kalasi kehekehe (13.8 – 28.3).

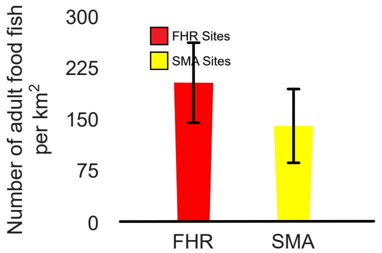
The coral reef along the northern edge of the Pangaimotu FHR slopes steeply down into deeper water along the edge of the shipping channel.
-
Ko e hakau feo 'i he tafa'aki faka-Tokelau 'o Pangaimotu, 'oku hifo hangataonu ki lalo ki he tahi loloto 'o e 'alu 'anga vaka.



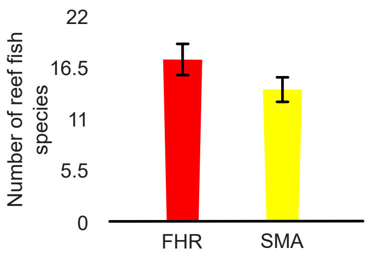
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
88	5.68 km^2	13%	0.23 km^2	35.1%	4%

Two sites were surveyed in 2018 inside the new Pukotala SMA and FHR. Coral cover at these sites was high inside the SMA (40.6%) but low at the FHR site (13.6%), with recent evidence of cyclones and bleaching along much of the western side of the northern Ha'apai islands. Fish diversity at both sites was low to moderate (26 and 32 species), while abundance was high (142.5 and 206.7 fish/km^2). In general, the reefs along the western side of the northern Ha'apai islands are shallow and fringing, changing between 5 m and 12m into a sandy bottom with sharp overhangs.

The sheltered condition of these reefs from open ocean swell and current may limit flushing by cooler water and exacerbate coral bleaching, driving the observed conditions.

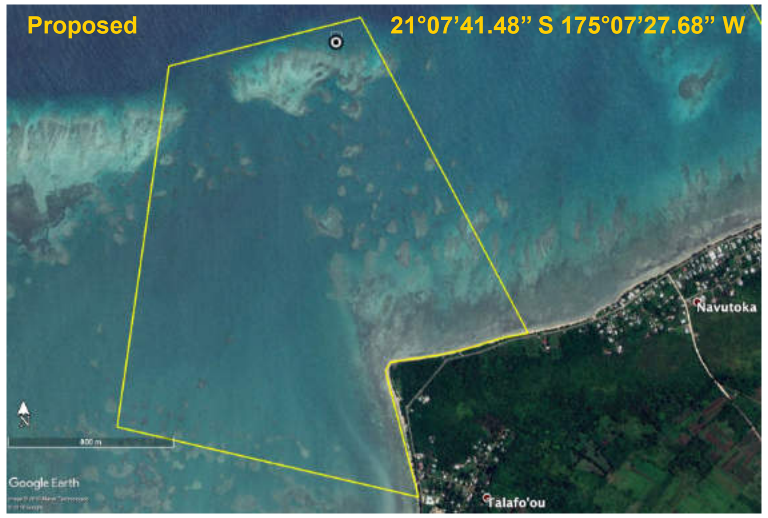
Ko e 'elia 'e 2 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) mo e 'elia tapu (FHR) 'o Pukotala 'i he 2018. Ko e tupulaki 'o e feo 'i he ngaahi 'elia ni na'e lahi ange 'i loto 'i he SMA (40.6%) kae si'isi'i ange 'i he 'elia tapu (13.6%) pea mo e ngaahi maumau ko e fakatupunga 'e he fakatamaki fakaenatula mo e feliuliuaki 'o e 'ea 'i he tafa'aki faka-Hihifo. 'I he kalasi kehekehe 'o e ika na'e 'i he 'avalisi 'o e holo ki he fakafiemalie (26 mo e 32), kae lahi ange 'enau tokolahi (142.5 - 206.7 ika/km^2). 'I he vakai fakalukufua, ko e hakau 'i he tafa'aki fakahihifo 'oku mamaha e hakau 'i he loloto ko e 'avalisi 'i he 5m – 12m pea mo 'one'one.

Ko e konga 'o e hakau 'i loto 'i he konga tahi 'oku malu 'i Pukotala 'oku malava ke uesia 'i he feliuliuaki 'o e 'ea, makatu'unga pe mei he si'isi'i ke vilo/fetongi mo e tahi 'i tu'a 'oku mokomoko lelei pea 'oku hoko ia fakatatau ki he ola 'o e savea na'e fakahoko.

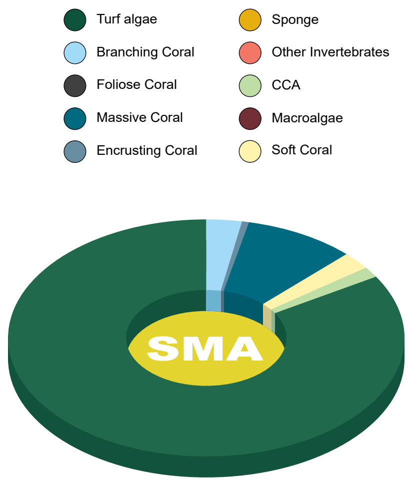
The Pukotala SMA had very clear conditions and extensive fringing reef habitat with many sharp overhangs.

-

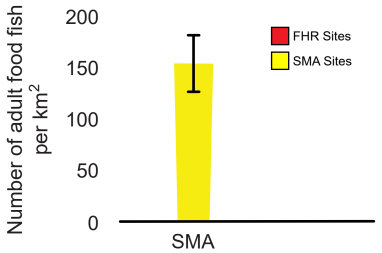
Ko e SMA 'o Pukotala 'oku mahino 'a e tu'unga 'oku 'iai pea mo e natula 'o 'ene hakau.



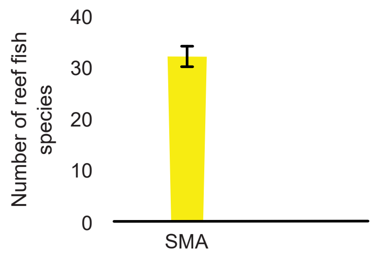
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
355	2.87 km^2	12%	-	-%	-

One site was surveyed along the outer edge of the proposed Talafo'ou SMA. The reefs inside the proposed Talafo'ou SMA were in poor condition and very turbid due to runoff from the Fanga'uta lagoon. Coral cover was 12.1% and dominated by *Porites* bommies. Low coral cover is a pattern that is present along the whole mouth and eastern edge of Tongatapu near the lagoon. A similar pattern also occurs in Vava'u near the Ofu and Olo'ua SMA. It is very important for water quality to be improved at these locations.

The abundance of adult food fish was moderate (155 fish/km^2), as was reef fish diversity (32.3 species).

Ko e 'elia 'e taha na'e savea'i 'i he konga ki tu'a 'o e hakau 'i he feitu'u toutai'anga koia 'a Talafo'ou 'oku 'amanaki ke fokotu'u ai 'enau Feitu'u Pule'i Makehe (SMA). Ko e hakau 'i loto 'i he feitu'u ni 'oku 'i he tu'unga fakatu'utamaki pea mo to e 'uli foki 'a e tahi makatu'unga mei he tafe mai 'a e tahi mei Fanga'uta. Ko e tupulaki 'a e feo na'e 12.1% pea na'e lahilahi ki he kalasi 'oku ui ko e Porites bommies. Ko e holo koia 'a e tupulekina 'o e feo 'i he ngaahi hakau ki he tafa'aki faka-Hahake 'o Tongatapu 'oku makatu'unga ia mei he tafe mai 'a e tahi mei Fanga'uta. Pea ko e natula tatau pe 'oku hoko 'i Vava'u 'i Ofu mo Olo'ua. Koia ai 'oku fu'u mahu'inga 'aupito ke fai ha tokangaekina ki he ma'a 'o e tahi, kae lava ke fakalakalaka kimu'a 'a e tu'unga 'oku 'iai 'a e feo 'i he ngaahi feitu'u ni.

Ko e tokolahi 'a e ika na'e i he tu'unga fakafiemalie pe (155 ika/km^2) kae pehe ki he'enau kalasi kehekehe (32.3).

The reefs inside the proposed Talafo'ou SMA were very turbid from the lagoon and dominated by large *Porites* bommies.

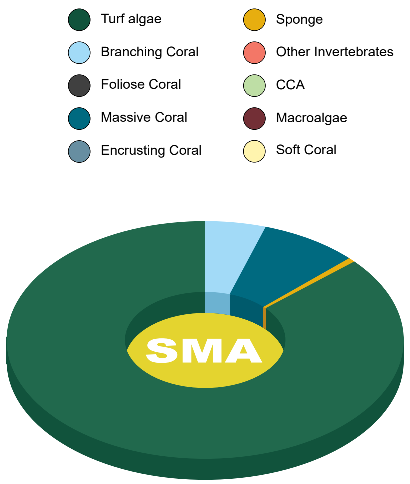
-

Ko e hakau 'i loto 'i he Feitu'u Pule'i Makehe fakangaanga 'o Talafo'ou 'oku fu'u kele/'uli e tahi makatu'unga mei he'ene tafe mai mei Fanga'uta pea lahilahi ki he kalasi 'o e feo 'oku 'iloa ko e Porites bommies.

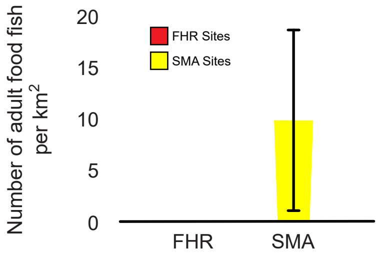
TALIHAU SMA 2017 VAV

SMA SCORE

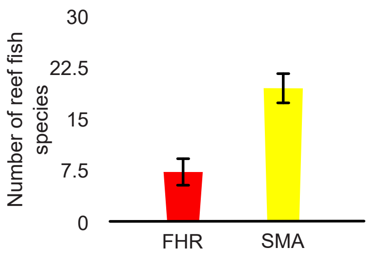
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
180	2.52 km^2	4.8%	0.36 km^2	0.7%	14.3%

Four sites were surveyed within the Talihau SMA as part of the 2017/18 national monitoring program and the Asian Development Bank 2016 SMA baseline surveys. The village is surrounded by sandy slopes with little coral cover and large rubble fields.

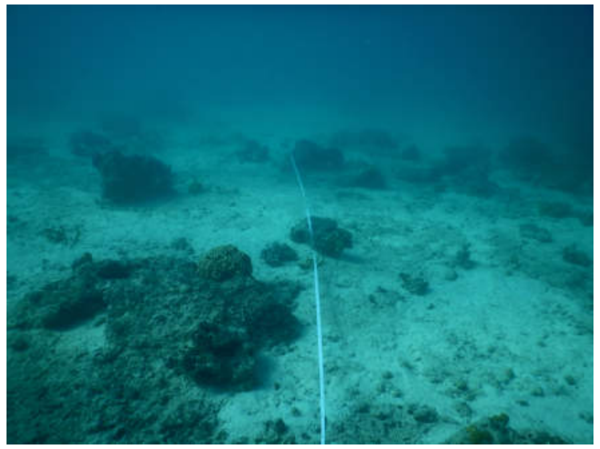
At all sites adult food fish abundance was very low (0 to 23.3 fish/km^2), as was reef fish species richness (7.3 to 23.8 species).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e 'elia 'e 4 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o Talihau 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama pea mo e 2016 'e he poloseki 'a e Pangike Fakalakalaka 'o 'Esia. Ko e SMA ko eni 'oku lahi takatakai'i 'e he 'one'one pea mo e konga si'i pe 'o e hakau pea mo e ngaahi maka/punga lalahi.

*Kotoa 'a e ngaahi 'elia na'e savea'i ko e tokolahi 'a e ika 'oku fu'u holo 'aupito (0 to 23.3 ika/km^2), kae pehe ki he'enau kalasi kehekehe (7.3 – 23.8).**

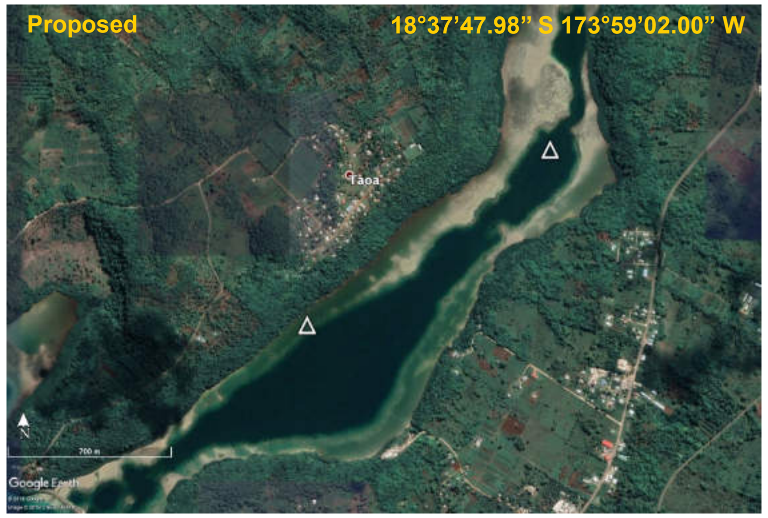
**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he savea na'e fakahoko 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia 2016*



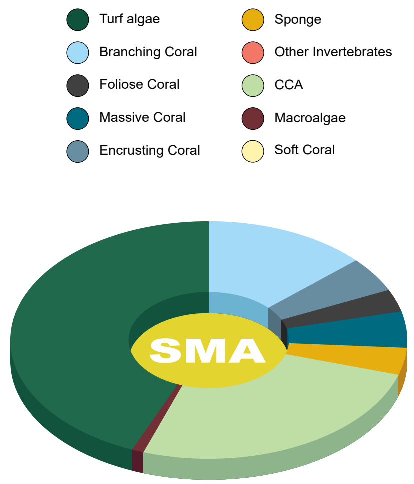
The Talihau SMA is mostly comprised of sand and small bommies with little live coral cover.
-
Ko e kolo SMA ko Talihau 'oku lahilahi ki he 'one'one mo e ngaahi maka/punga pea si'isi'i mo e ngaahi maka feo mo'ui.

TAOA SMA 2020 VAV

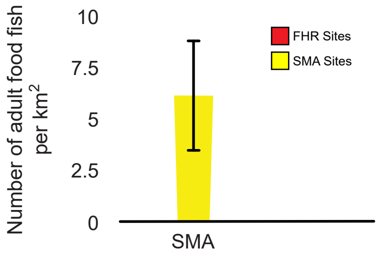
SMA SCORE



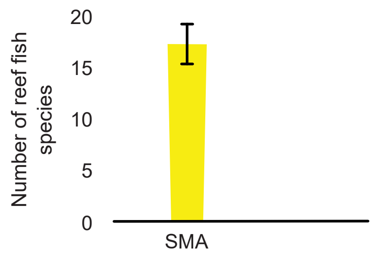
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
522	- km^2	-%	-	-%	-

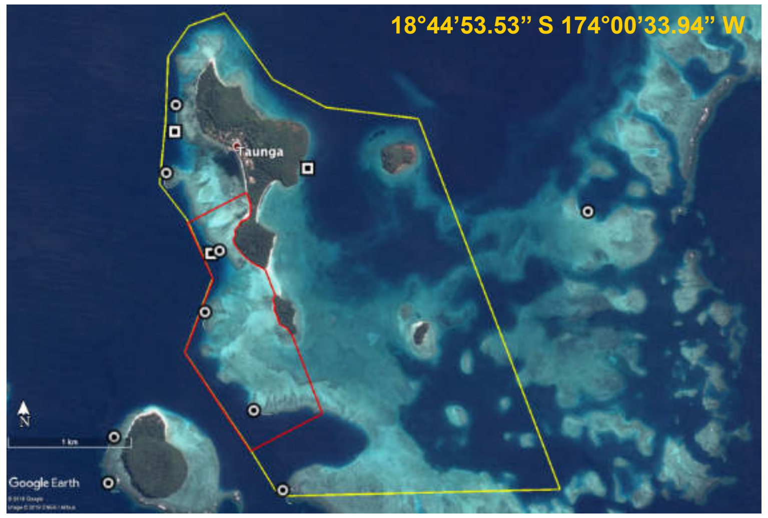
Two sites were surveyed around the proposed Taoa SMA as part of the 2019 VEPA baseline SMA monitoring. The abundance of adult food fish was extremely low (6.1 fish/km^2), and reef fish diversity was low (17.5 species). Coral cover was low to moderate, with occasional patches of *Porites rus* and *Porites cylindrica*, which both do well in turbid environments.

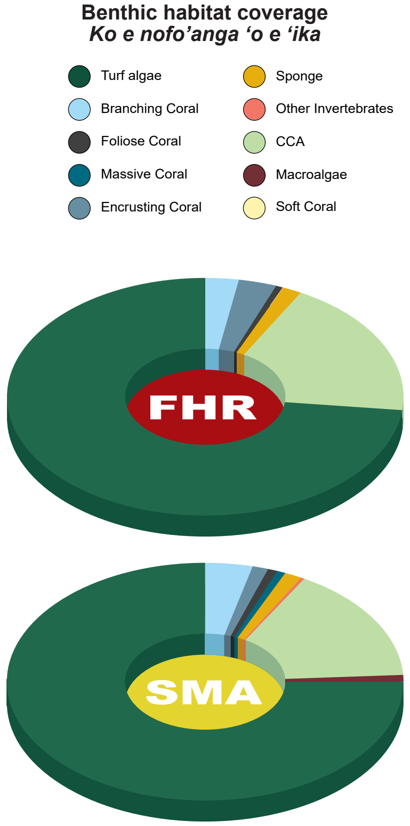
Ko e 'elia 'e 2 na'e savea'i 'i he Feitu'u Pule'i Makehe (SMA) fakaangaanga 'o Taoa 'i he 2019 'e he VEPA. Ko e tokolahi 'o e ika na'e holo 'aupito (6.1 ika/km^2) kae pehe ki he'enau kalasi kehekehe (17.5). 'I he tupulaki 'o e feo na'e 'i he tu'unga 'o e holo ki he fakafiemalie, pea 'asi mo e kalasi 'o e feo 'oku 'iloa ko e Porites rus mo e Porites cylindrical, ko e ongo kalasi ni 'oku na lava matu'uaki 'a e 'atakai 'oku 'uli e tahi.

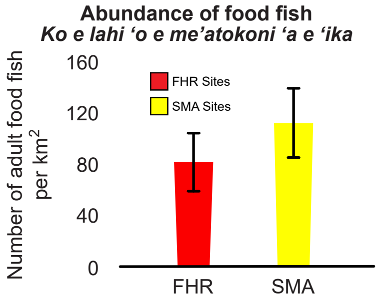
A school of juvenile parrotfish swim along a shallow slope within the proposed Taoa SMA.
-
Ko e pupunga ika iiki 'o e kalasi 'o e hohomo 'oku 'elia 'oku mamaha 'i loto 'i he SMA fakaangaanga 'o Taoa.

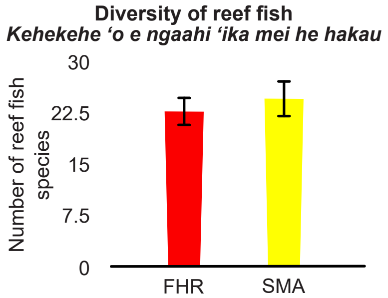
TAUNGA SMA 2013 VAV

SMA SCORE









POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
28	7.74 km^2	5.7%	1.21 km^2	17.8%	15.6%

Nine sites were surveyed within the Taunga SMA and FHR as part of the 2017/18 national monitoring program and the 2017 Vava'u Ocean Initiative Marine Expedition. The area in front of the village and along the western side was dominated by rubble flats and sandy areas. There was evidence of widespread cyclone damage in the recent past, and very low live coral cover.

Adult food fish abundance was very high along the southern 3 sites surveyed (183.3 to 343.3 fish/km^2) and lowest at the eastern sandy area (1.3 fish/km^2). Reef fish species richness was highest at the southernmost SMA sites (38.8 species) and lowest along the eastern sandy area (7.4 species). Live coral cover was low throughout (<1 to 13.7%), with the lowest along the eastern sandy area.*

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

Ko e 'elia 'e 9 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o Taunga 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'a e polokalama pea mo e 2017 'e he Ocean Initiative Marine Expedition. Ko e 'elia 'i mu'a 'i he kolo pea mo e tafa'aki faka-Hihifo na'e lahilahi ki he ngaahi 'oku feleti hono konga ki 'olunga pea mo 'one'one. Pea na'e 'iai mo e ngaahi faka'ilonga pe fakamo'oni 'a e ngaahi maumau ki he hakau ko e fakatupunga mei he fakatamaki fakaenatula kimui ni pe, pea holo 'aupito moe tupulaki 'a e feo.

*Ko e tokolahi 'o e ika lalahi na'e lahi ange ki he ngaahi 'elia 'e 3 ki he tafa'aki faka-Tonga (183.3 - 343.3 ika/km^2) pea si'isi'i ange ki he tafa'aki faka-Hahake 'oku lahilahi 'one'one (1.3 ika/km^2). 'I he tu'unga 'o e kalasi 'o e ika, na'e lahi ange ki he 'elia taupotu taha ki he tafa'aki faka-Tonga (38.8) pea si'isi'i ange ki he tafa'aki faka-Hahake aipe (7.4). Ko e tupulekina 'o e feo na'e holo 'i he 'avalisi 'o e <1 – 13.7% 'o a'u ai pe ki he holo 'aupito 'i he tafa'aki faka-Hahake 'oku lahilahi 'one'one.**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition 2017.*

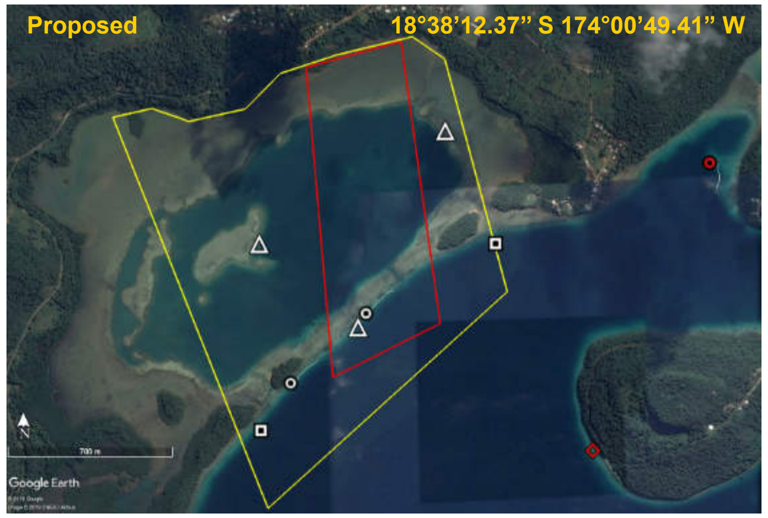
Most of the areas surveyed inside the Taunga SMA and FHR had been damaged by cyclones, with little live coral cover.

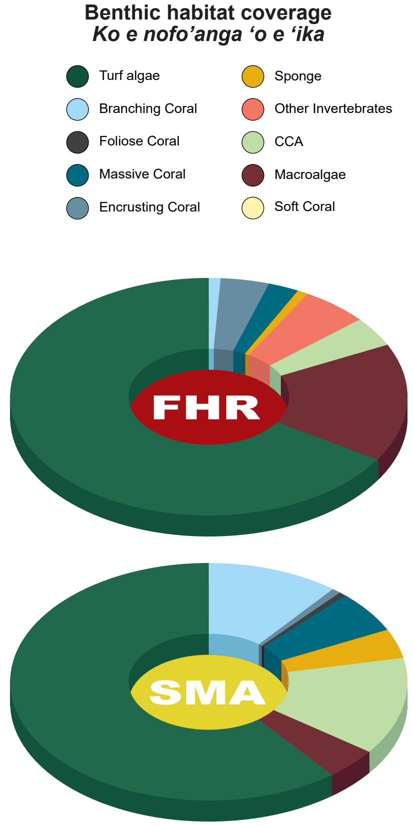
-

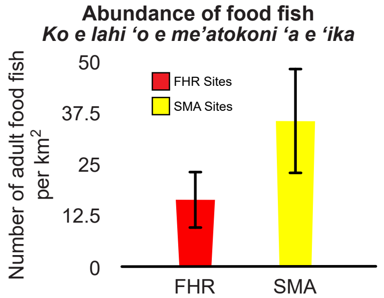
Lahi taha 'o e ngaahi 'elia na'e savea'i 'i loto 'i he SMA mo e 'elia tapu (FHR) 'o Taunga, 'oku maumau e feo 'iai makatu'unga mei he fakatamaki fakaenatula pea si'isi'i mo ha feo mo'ui.

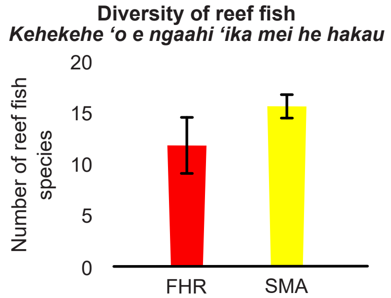
TEFISI SMA 2020 VAV

SMA SCORE









POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
508	1.92 km^2	14.1%	0.56 km^2	5.6%	29.2%

Seven sites were surveyed within the proposed Tefisi SMA as part of the 2017 Vava'u Ocean Initiative Marine Expedition, the 2017/18 national monitoring program and the 2019 VEPA baseline SMA surveys. The ridge along the outside of the lagoon is dominated by shallow sandy habitat with lots of rubble and very little live coral. Within the lagoon water was not clear. However, occasional bommies of *Porites rus* were present, which do well in turbid conditions.

Adult food fish abundance was low in both the SMA and FHR areas (16.6 to 35.8 fish/km^2), as was reef fish diversity (11.92 to 15.7 species).*

*For additional details on this SMA please read the 2017 Vava'u Ocean Initiative Marine Expedition Interim Report.

Ko e 'elia 'e 7 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) fakaangaanga 'o Tefisi 'i he 2017 'e he Vava'u Ocean Initiative Marine Expedition, 2017/18 lolotonga hono muimui'i fakalukufua 'o e polokalama pea mo e 2019 'e he VEPA. Ko e ngatangata'anga 'o e fo'i 'aa 'oku lahilahi ki he ngaahi 'elia mamaha 'oku 'one'one pea mo makamaka pea si'isi'i mo e feo mo'ui. 'I loto 'i he foi loto 'aa 'o e tahi 'o Tefisi 'oku 'uli. Kae pehe, makatu'unga mei he'ene 'uli 'oku malava ke 'asi ai 'a e kalasi 'o e feo ko e Porites rus, 'aia 'oku ne malava ke matu'uaki 'a e 'atakai 'oku 'uli e tahi.

*Ko e tokolahi 'o e ika lalahi 'oku holo 'o tatau pe 'i he 'elia SMA mo e 'elia tapu (FHR) fakaangaanga (16.6 - 35.8 ika/km^2), kae pehe ki he'enau kalasi kehekehe (11.92 to 15.7 species).**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he Vava'u Ocean Initiative Marine Expedition 2017.*

The water inside the Tefisi lagoon was turbid, but with occasional bommies of *Porites rus.*

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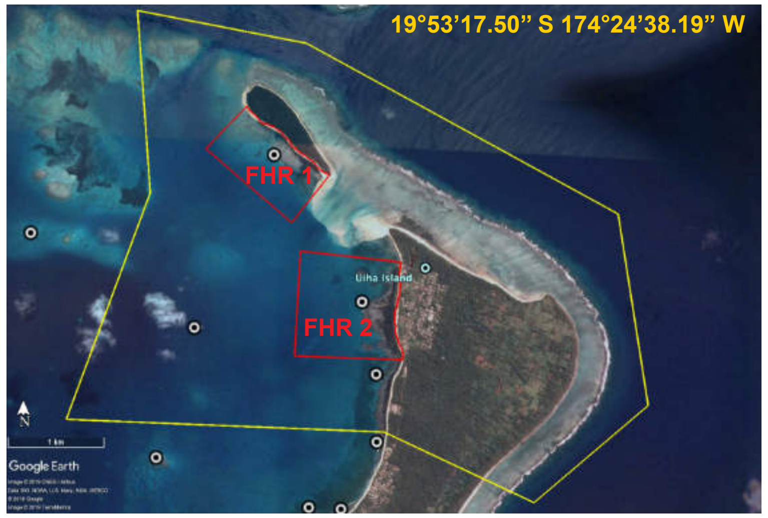
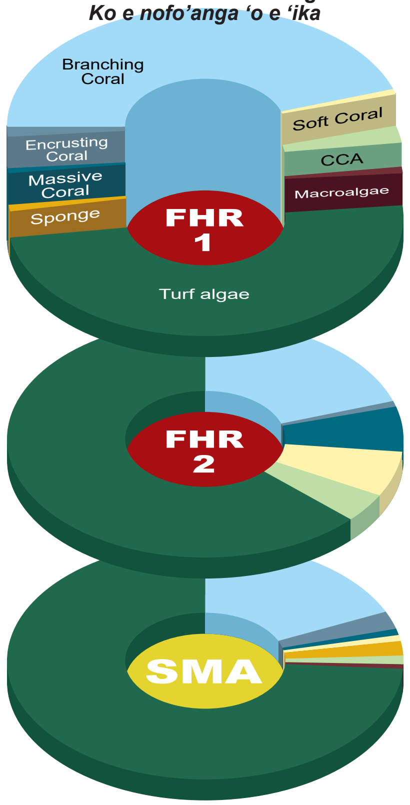
Ko e tahi 'i he foi loto 'aa 'oku 'uli, ka 'oku malava ke mo'ui ai kalasi 'o e feo ko e Porites rus.

UIHA SMA 2018 HAP

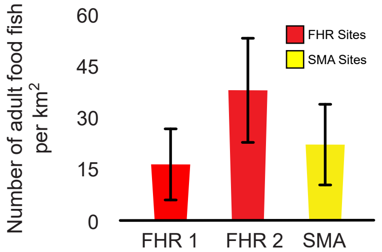
SMA SCORE



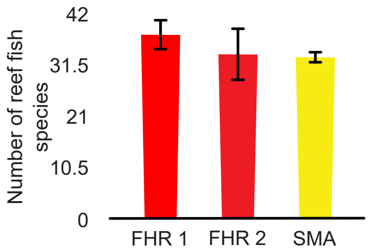
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHRs	% Reef of FHR	FHRs as % of SMA
362	17.09 km^2	18%	0.37 & 0.46 km^2	14.2%	4.9%

The Uiha SMA has two FHRs, one in front of the village and a second along the small island to the north. This SMA is characterized by shallow fringing reefs and a sandy bottom, with large coral bommies further from shore.

Adult food fish abundance was very low (1.7 to 43.3 fish/km^2), and much lower than the well-established Felemea FHRs to the south, which are having a large effect. Reef fish diversity was moderate (32.3 to 34 species). Coral cover was moderate to high (20.1 to 47%).

Ko e Feitu'u Pule'i Makehe (SMA) 'o 'Uiha 'oku 'iai 'a e fo'i 'elia tapu (FHR) 'e ua, pea ko e taha 'oku 'i mu'a pe 'i he kolo, pea taha 'i he ki'i motu si'isi'i ki he tafa'aki faka-Tokelau. Ko e SMA ko eni 'oku 'oku fakakalakalasi hono 'atakai 'i tahi ki he hakau 'oku lahi pea mo 'one'one hono faliki, pea mo e ngaahi fu'u maka feo mama'o mei he matafanga.

Ko e tokolahi 'o e ika lalahi na'e holo 'aupito (1.7 to 43.3 ika/km^2) 'o to e fu'u holo ange ia he tu'unga 'oku 'iai 'a e 'elia tapu (FHR) ki he tafa'aki faka-Tonga 'o Felemea. 'I he kalasi kehekehe 'o e ika, na'e tu'unga fakafiemalie pe (32.3 – 34), pea ko e tupulaki 'o e feo na'e mei he fakafiemalie ki he to e lelei ange (20.1 – 47%).

The shallow fringing reefs around Uiha were characterized by high coral cover and a shallow sandy bottom.

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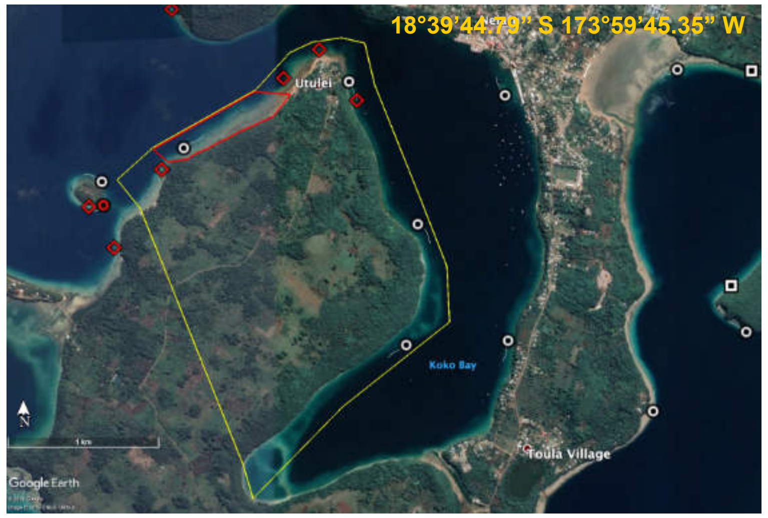
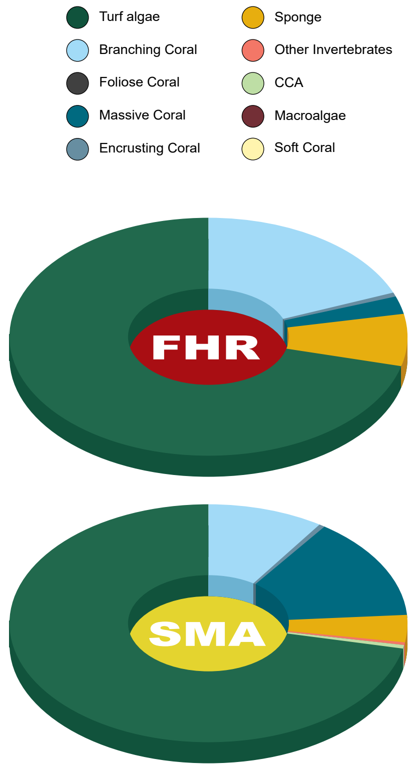
Ko e hakau mamaha takai 'o 'Uiha 'oku ma'olunga 'a e tu'unga tupulekina 'o e feo 'iai pea lahilahi 'one'one.

UTULEI SMA 2017 VAV

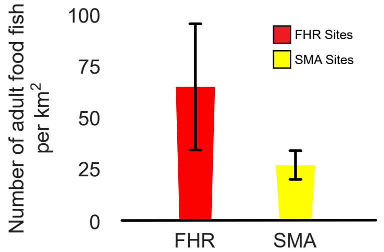
SMA SCORE



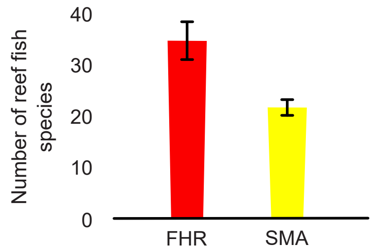
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
110	4.16 km^2	6.2%	0.21 km^2	25.4%	5%

Eight sites were surveyed inside the Utulei SMA as part of the 2017/18 national monitoring program and the Asian Development Bank 2016 SMA baseline surveys. The Utulei SMA is dominated by sandy slopes and occasional fringing reefs. It extends outside the harbour near the military island all the way along the coastline to the end of Koko bay.

Adult food fish abundance was very low (26.7 to 44.4 fish/km^2). Reef fish species richness was also very low (15 to 31 species). Coral cover was low to moderate (14 to 21.8%).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e 'elia 'e 8 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o 'Utulei 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'a e polokalama pea mo e 2016 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia. Ko e SMA 'o 'Utulei 'oku lahilahi 'one'one'a hono hakau takai pea mo e ngaahi hakau feo pe. 'Oku lele 'ene hakau 'o a'u ki he motu 'a e kau sotia pea mo e tafa'aki 'oku 'iloa ko Koko hono hingoa.

*Ko e tokolahi 'o e ika lalahi, na'e holo 'aupito (26.7 - 44.4 ika/km^2) kae pehe foki ki henau kalasi kehekehe na'e holo 'aupito moia (15 – 31). Ko e tupulaki 'o e feo, na'e 'i he tu'unga 'o e holo ki he fakafiemalie (14 – 21.8%).**

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he savea na'e fakahoko 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia 2016*

The Utulei SMA has many bommies of the coral *Porites rus*, which thrives in more turbid conditions.

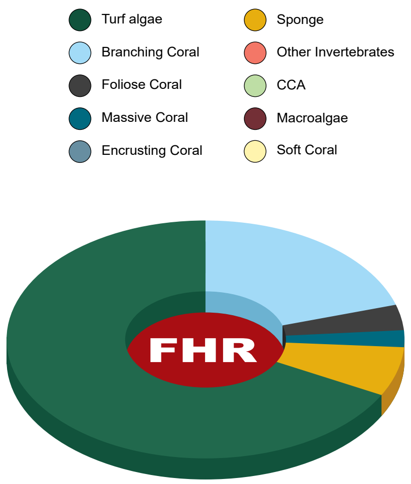
-

Ko e SMA 'o 'Utulei 'oku lahi ai 'a e ngaahi maka/punga 'o e kalasi 'o e feo 'oku 'iloa ko e Porites rus, 'aia 'oku nau lava matu'uaki 'a e 'atakai 'oku 'uli'a e tahi.

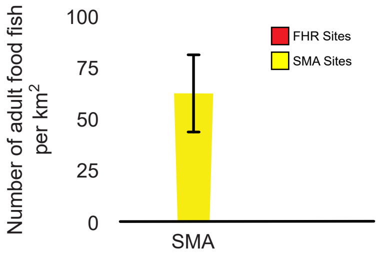
UTUNGAKE SMA 2017 VAV

SMA SCORE

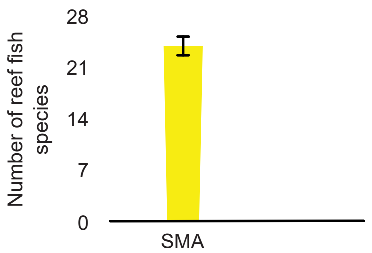
Benthic habitat coverage
Ko e nofo'anga 'o e 'ika



Abundance of food fish
Ko e lahi 'o e me'atokoni 'a e 'ika



Diversity of reef fish
Kehekehe 'o e ngaahi 'ika mei he hakau



POPULATION	AREA OF SMA	% Reef of SMA	AREA OF FHR	% Reef of FHR	FHR as % of SMA
280	2.34 km^2	3.6%	1.08 km^2	4.7%	46.2%

Four sites were surveyed inside the Utungake SMA as part of the 2017/18 national monitoring program and the Asian Development Bank 2016 SMA baseline surveys. No sites were surveyed inside the current FHR. Habitat along the coastline was dominated by sandy bottom and occasional patches of coral reef with moderate coral cover (25.9%).

Adult food fish abundance was low (21.7 to 95.5 fish/km^2), as was reef fish species richness (21 to 26.8 species).*

*For additional details on this SMA please read the Asian Development Bank 2016 Vava'u SMA baseline survey report.

Ko e 'elia 'e 4 na'e savea'i 'i loto 'i he Feitu'u Pule'i Makehe (SMA) 'o 'Utungake 'i he 2017/18 lolotonga hono muimui'i fakalukufua 'a e polokalama pea mo e 2016 'e he poloseki 'a e Pangike Fakalakalaka'o 'Esia. Na'e 'ikai ke fakahoko ha savea 'i loto 'i henau 'elia tapu (FHR). Ko e ngaahi nofo'anga ika 'i he matafanga na'e lahilahi 'one'one pea totoholo 'a e ngaahi hakau feo 'i he tu'unga fakafiemalie pe 'enau tupulekina (25.9%).

Ko e tokolahi 'o e ika na'e holo (21.7 - 95.5 ika/km^2) pea holo aipe mo 'enau kalasi kehekehe (21 – 26.8).

**Ki ha to e fakaikiiki fekau'aki mo e Feitu'u Pule'i Makehe ko eni, kataki kae lau ange 'a e lipooti mei he savea na'e fakahoko 'e he poloseki 'o e Pangike Fakalakalaka 'o 'Esia 2016*

The outer slopes Utungake SMA is made up of sandy slopes and many large coral bommies.

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Ko e tafatafa'aki ki tu'a 'o e hakau 'o e SMA 'o 'Utungake 'oku lahi ki he 'one'one pea mo e ngaahi maka/punga nofo'anga ika.

Section 7. Key questions, limitations and recommendations

Overall, both the Ministry of Fisheries and Tongan communities should be proud of the positive results of the SMA program. It has been no small task for the ministry or the communities to grow a program such as this from the first SMA in 2006 to over 50 a decade later. Furthermore, the information provided in this report now demonstrates for the first time that fish stocks are improving. Clearly, in many ways the program has been a success story for community-based marine management and should be seen as such both in Tonga and abroad.

However, these results should also be considered with caution. Ultimately the most fundamental component of the SMA program is more fish. This is made clear by the primary objectives of most SMA management plans: improve fish catch, improve livelihoods, increase fish abundance and decrease environmental degradation. Likewise, the perceived benefits of SMAs by community members are also largely based on ecological trends: secure access to more fish, increase fishing catches, spend less time fishing and sustain marine resources. The extensive surveys and analysis included in this report demonstrate that while this has occurred, it is to a lesser extent than people may realize. While fish stocks have improved inside some FHRs, there is very little evidence for any improvements inside the SMAs, where fishing is still allowed.

A serious consideration therefore is that if improvements inside the SMA areas (non-FHR) are not eventually demonstrated, support for the program may erode. However, it may be that current levels of fishing pressure inside the SMAs are preventing recovery in these areas. Therefore it is essential to continue improving marine management in Tonga, either as part of, or in addition to the SMA program. Likewise any backwards steps, such as temporarily opening the FHRs to harvesting, or degazetting any SMAs or FHRs should be viewed with extreme caution.

In the sections that follow we summarize the main findings of these surveys, address key questions likely to arise from the results, discuss limitations of the SMA program and provide recommendations for future action.

Box 2. Focusing on long-term goals and the importance of monitoring

It is important to recognize that the long-term goal of the SMA program rests on having a healthy ecosystem and a healthy community, not just more SMAs. SMAs are only one tool that is being used to reach the desired objectives of the Tongan communities and Ministry of Fisheries. SMAs can be expensive, and donors may spend lots of money in implementation. But ultimately no matter how many SMAs are implemented, the only way to demonstrate the success of the program is through the difference it makes to its intended or unintended outcomes. This is why monitoring is essential.

Ultimately, unless changes to the ecosystem are observed, many other benefits and objectives of SMAs (e.g. community empowerment and ownership, food security) may erode. This can be further exacerbated by broken promises to communities if they are given unrealistic expectations of what the outcomes will be. Therefore ongoing monitoring is a very necessary part of the program, both to demonstrate to donors that their efforts have been worthwhile, and to show communities what is actually happening from their efforts. If we only focus on implementing SMAs and not on if and how they are achieving the changes that they are meant to, we risk confusing the means with the end.

Question 1: Why are fish recovering inside some FHRs and not others?

The surveys clearly show that fish stocks are recovering in the FHRs of some communities and not in others. There are three primary reasons why this might be the case:

1. *Poor enforcement/regulation*

Fish stocks only begin to recover when fishing pressure changes. This means there has to be sufficient change in the behavior of people within and beyond the SMA communities. If fishers continue to fish inside the FHR then it is unlikely that any recovery will occur.

For example, in discussions with the Fafa island FHR, it became clear that fishers from Nuku'alofa were often still entering the FHR in order to fish. This is therefore a likely reason why there is no evidence of recovery of fish abundance inside the Fafa island FHR. In addition, the boundaries of the FHRs need to be clear to members of the community. The Nomuka and Atata FHR have very visible boundaries in front of the village that are strictly enforced and monitored. It is easy to see if someone is fishing where they should not be. In contrast, from the village it is not clear where the Ha'afeva FHR is. During the surveys we visited the Ha'afeva village and found that the SMA sign was also no longer visible and when asked, people were unsure about the location of the FHR. Unless people are aware of the FHR location it is unlikely that fishing will cease and fish will be able to recover.

2. *Small size of the FHR*

Many studies have shown that larger no-fishing areas have greater recovery than smaller ones. This is because the larger the area, the greater the number of fish can grow to maturity inside its boundaries and the greater the availability of space and other resources. Many FHRs in Tonga are extremely small, and too small to contain the home ranges of target fish species. However, despite this consideration fish abundance did recover in some very small FHRs (e.g. Felemea). So while this may be the case broadly, it was not clear if the larger FHRs in Tonga were having a greater effect.

3. *Poor quality habitat inside the FHR*

Fish Habitat Reserves will only work if there is enough good quality habitat within the area for fish stocks to recover. For example, if the FHR is placed over large areas of sand, where there wouldn't be many fish even if no one was fishing there, then it would be unlikely to show any recovery. Care should therefore be taken to configure FHRs on high quality habitat where there will be the greatest

Question 2: Why has recovery only occurred primarily inside the FHRs and not the SMAs?

Recovery of fish stocks only occurs when fishing pressure is reduced. In addition, the greatest and most rapid changes will occur when there is the greatest change to fishing pressure. Therefore it would be expected that fish stocks would begin to show greater signs of recovery faster inside the FHRs over the SMAs, where fishing is still allowed. Furthermore, it may be that fishing pressure inside the SMA areas has remained the same, just who is doing the fishing has changed. Restricting outside access to a reef may not change the volume harvested, just who harvests it (Polunin, 1984). Whether or not this is considered negative depends on the objectives of the community. If the goal is to foster a sense of ownership over local reefs than it may be acceptable that fish stocks are not recovering inside the SMAs. However if the objective is to also increase fish stocks in these areas, then additional management actions may also be required, or it may take much longer for smaller changes to be observed. These could include gear restrictions or limiting certain destructive fishing activities, such as night time spearfishing.

Polunin, N. V. C., 1984. Do traditional marine "reserves" conserve? A view of Indonesian and New Guinean evidence. Pp 267–283 in Traditional marine resource management in the Pacific Basin: an anthology ed by K. Ruddle and R. E. Johannes. UNESCO/ROSTSEA, Jakarta,

Box 3. Summary of main findings:

SMA Recovery

1. Fish stocks are improving in roughly half of the older FHRs in the country.
2. The diversity of reef fish is also improving in roughly half of the older FHRs in the country.
3. There is limited evidence of any recovery inside the SMA areas (outside the FHRs), where fishing is still allowed by the community.

Ecosystem health

1. The coral reefs and reef fish fishery in Vava'u is in noticeably worse condition than elsewhere in the country.
2. There is extensive evidence of damage to reefs from coral bleaching in Vava'u and northern Ha'apai.
3. There is extensive evidence of cyclone damage in in southern Vava'u and northern Ha'apai
4. Poor water quality appears to have damaged many of the reefs around lagoonal areas in both Vava'u and Tongatapu.

Limitations of the Special Management Area program

While this report has clearly demonstrated many merits of the SMA program, it is important to note that it is not a panacea for marine conservation and management. Below we list ten limitations of the SMA program. In addition, a review by Dr. Bob Gillett on the SMA program in 2017 provides specific details some of the overarching issues with costs, implementation and streamlining of the program.

1. Anticipated changes are not occurring in some older SMA communities. As detailed above, some FHRs and almost all SMAs are not having an effect. This is likely due to community issues with enforcement and management. Recovery is a slow process, and in order for changes to occur communities must consistently follow the rules of their management areas. Otherwise these risk becoming 'paper parks', which only contribute to national targets without realizing any change on the ground.

2. Some threats cannot be addressed solely by SMAs. Climate change is an issue that requires large-scale changes in international behavior. As such, SMAs and FHRs are unlikely to protect reefs from climate change related threats such as cyclones or coral bleaching. SMAs act by changing fishing pressure, and while this may boost the resilience of a reef to climate related impacts, it cannot prevent them. Likewise, the openness of the marine environment means that at a local level SMAs will not limit the amount of pollution from land based runoff that is affecting reefs.

3. SMAs are only one tool among many. Many additional methods also exist to achieve the desired objectives of the SMA program, and it is important not to rely too heavily on only one. Jupiter et al. (2014) outlined six strategies that could be used to achieve eight different objectives from locally managed marine areas. These were: permanent closures (e.g. FHRs), periodically-harvested closures, species restrictions, gear restrictions, access restrictions (e.g. SMAs) and alternative livelihood strategies. Different combinations of these can be used to achieve the objectives of: increasing long-term sustainable yield, increase efficiency of harvests for short-term yield, maintain biodiversity and ecosystem function, maintain biomass and breeding populations, enhance economy and livelihoods, maintain or reinforce customs, assert access rights and increase community organization, cohesiveness and empowerment.

4. Many FHRs are very small. Currently there is no minimum size, nor minimum percent area of the SMA, that is required for the FHRs. Consequently some FHRs may be too small to realistically expect changes to occur. For example, three FHRs in Vava'u (Koloa and two FHRs at Matamaka) are each less than .1 km^2. While some small FHRs in Tonga are having an effect (e.g. Felemea, 0.44 km^2), where the lower limit is on the minimum size that will still be effective in unclear. At this stage, there should be a push for FHRs to be as large as possible.

5. Discussion over periodic harvesting inside FHRs. FHRs are the cornerstone of the SMA program. Without them it is unclear whether any ecological recovery, and hence it's trickle down socioeconomic impacts, will occur. Some discussion has occurred over the possibility of opening up the FHRs to periodic harvesting. This is strongly discouraged. Recovery inside no-fishing areas can take many years and very little harvesting effort is needed to undo years of progress. Most studies on periodically harvested areas in the South Pacific show that as soon as any harvesting occurs, stocks return to pre-protection levels. Harvesting the FHRs will also minimize the long-term benefits to the SMA communities, as once these areas reach carrying capacity they will act as a source of fish to the SMA areas through spill-over. Ultimately, great care should be taken to minimize any harvesting inside the FHRs.

6. Clarification over specific rules. Issues have been raised in Tonga over specific rules of what can and cannot be done inside SMAs and FHRs. Some FHRs have been placed around islands that tourist operators frequent, and are now being told they cannot enter these areas. Likewise many yachts in Vava'u frequently anchor inside SMAs, and occasionally FHRs, which has also created tension between SMA communities and transiting vessels. Clarification on the specific rules should be made available to all concerned. In general it is the view of the authors that preference be given to solutions that are likely to maximize the health of the ecosystem for the communities benefit.

A fisher casts a net in the shadow of a large cruise ship at the Nuku'alofa warf.

7. Displacing fishers from larger towns and inland communities. This issue was also raised by Gillett (2017), who noted that landlocked communities (and those from larger towns with no SMAs) will have less access to coastal fishing areas as more SMAs are implemented. Several recommendations to mitigate this issue were: i) to ensure adequate communication occurs between coastal and landlocked communities, ii) implement district level SMAs, which include multiple (both coastal and landlocked) communities and iii) maintain certain areas (e.g. land adjacent to King's land and urban areas) as open access.

8. SMAs will not help ecosystems away from communities. It is important to note that SMAs are only based around communities. Therefore they are unable to provide support for areas further from human populations. Additional management, such as marine protected areas, may be necessary for this.

9. FHRs may disproportionately affect different groups. In Tonga women primarily undertake reef gleaning for invertebrates. Many FHRs are situated close to villages and in intertidal areas, and this may disproportionately affect gleaning activities.

10. Costs. A review of the SMA program by Gillett (2017) estimated the cost per SMA of implementation as US$ 26,191 for Vava'u, US$ 21,731 for Ha'apai and US$ 8,118 for Tongatapu. This estimate made SMAs some of the most expensive community managed areas in the South Pacific

Gillett, R. (2017). *A review of special management areas in Tonga* (Vol. FAO Fisher).

Jupiter, S. D., Cohen, P. J., Weeks, R., Tawake, A., & Govan, H. (2014). Locally-managed marine areas : multiple objectives and diverse strategies, *20*(2), 165–179.

From top to bottom: i) The volcanic island of Kao in Ha'apai. There is no village on this island therefore other management apart from SMAs will be neccessary. **ii and iii)** A fish fence and gill net. In addition to SMAs, regulations regarding size and gear restrictions will be important for improving fish stocks. **iv)** Coral colonies such as this large *Porites* bommie can be hundreds of years old. However, coral bleaching from climate change is damaging Tonga's coral reefs both within and beyond the SMA boundaries.

Recommendations

Based on the results of this report, below are nine recommendations for marine management in Tonga:

1. FHRs should be larger, both in absolute terms and relative to the size of the SMA (for example 30%).

2. FHRs should be configured over the best quality habitat within each SMA. This will ensure that the FHR has the greatest possible recovery and the greatest chance to export these benefits to the SMA areas.

3. Fish Habitat Reserves should remain closed permanently to all extractive or damaging activities. It can take many years for recovery to build up and spill over to occur, and only days to reduce this recovery to its pre-existing state.

4. Additional management strategies should be implemented in conjunction with the SMA program. These include other methods by which to reduce fishing effort inside the SMAs, such as gear restrictions or minimizing damaging fishing practices such as night-time spear fishing.

5. Management should be improved beyond the SMAs. Additional management strategies should be implemented beyond the borders of the SMAs. While marine protected areas may be an option, in Tonga these have failed in the past due to the limited ability of a centralized government to enforce them. Therefore other management strategies may be better suited for Tonga. These could include banning or limiting certain gear types (e.g. gill nets of a specific size) or activities (e.g. night-time spear fishing).

6. Degazetting SMAs should be prevented. It has taken many years for the SMA program to develop into what it is today. Unfortunately, this progress could be undone relatively quickly if enthusiasm for the program wains. If a single SMA is degazetted then this may open a pandoras box, whereby confidence in the program is reduced and a precedent is set for going back to the previous, open access state.

7. Water quality around the lagoons and estuarine areas of Vava'u and Tongatapu should be seriously addressed. Based on the surveys it appears that poor water quality around the lagoonal areas of Tonga may be affecting the health of the marine ecosystem. While only correlative, many dead reefs with large urchin barrens were surveyed near the mouths of lagoons in both Vava'u and Tongatapu. Large outbreaks of the *Diadema* sea urchin were only found in these areas and they may prevent the settlement of new coral recruits through their grazing. While these results are still tentative, and we are unsure of the mechanisms involved, it nonetheless warrants serious consideration.

8. An ongoing national monitoring program should be implemented. Many funders are putting money towards expanding the SMA program, but few resources are available for ongoing monitoring. Monitoring is the only way to clearly demonstrate if the objectives of the program are being achieved. An emphasis should be on good quality data, as poor data may not only provide ambiguous results, but also preclude good quality data from being collected or result in double handling, thereby increasing costs. While trained individuals should therefore be used for data collection, there may be ways of minimizing the costs. A dedicated team of three individuals, with support from fisheries and a small vessel, could complete detailed surveys and reporting of one island group per year, in addition to other tasks. This would result in a national monitoring program that covers the whole country on a rolling three year basis.

9. Socioeconomic monitoring could be integrated into the national census. Socioeconomic monitoring is important for understanding whether the livelihoods and health of communities are changing as a result of the SMA program. However, with the expansion of the program this will become an expensive and labor intensive procedure. One alternative, suggested in the 2017 review by Dr. Bob Gillett, would be to integrate the socioeconomic monitoring into the national census. There are three reasons for this. Firstly, many questions are similar in nature and this will minimize double handling and improve efficiency. Second, additional questions not currently in the census could potentially be implemented with minimal difficulty into section H (Agriculture and Fishing). Lastly, demonstrating change from management requires sampling both SMA and non-SMA communities, which can be difficult to do when the focus is primarily on the SMAs. The national scale of the census minimizes this issue and potentially allows for proper counterfactual estimations. Further investigation should occur into the feasibility of integrating these two programs.

Ultimately, these recommendations are made with the intent of benefiting the communities and ecosystems of Tonga. They are suggestions for how to strike a balance between Tongans today and future generations.

Box 5. Periodic harvesting and the Royal Agricultural Show

The Royal Agricultural Show is one of the highlights of Tongan culture, where each year communities demonstrate the bounty of their resources. As such there are many stalls that show the diversity and scale of marine life within the coastal environment of each community, including SMA communities. While this is an important part of Tongan culture, care must be taken to prevent any illegal harvesting inside the FHRs. It can take many years for recovery to occur even from a single large harvesting event.

To preserve Tongan culture for future generations it is important to make sure marine life is just as abundant for the Royal Agricultural Show in the future. Therefore there may be other ways to demonstrate the bounty of each community's marine life instead of or in addition to catching it. Various media types could be used to show the diversity of marine life. In addition, another benefit of ongoing monitoring is that posters could be made each year demonstrating how much recovery has occurred within each SMA and FHR, thereby reducing the need to harvest.

Clockwise from top: i and ii) stall holders at the 2019 Vava'u Royal Agricultural Show from the Koloa and Nuapapu SMA communities respectively **iii)** Crayfish at the 2019 Ha'apai show **iv)** large tuna, snapper and parrotfish at the 2019 Vava'u show **v)** various squid and fish species at the 2019 Tongatapu show.

Section 8. Concluding remarks

In 2017 a review of the SMA program concluded that while most SMA communities were very enthusiastic about the benefits of the program, at the time it was not possible to substantiate these claims with quantitative data (Gillett 2017). These surveys now demonstrate that this program is on the way to achieving its objectives.

It has been no small feat for Tonga to change from a completely open access fisheries system to a national network of locally managed marine areas and over 50 no-fishing zones. This transformation is suggested to be the biggest change in Tonga's fisheries sector since the Royal Proclamation of 1887 and will likely to affect many more Tongan lives than any other fisheries event in the country (Gillett 2017).

However, change also takes time. It is very likely that in the next five years the Ministry of Fisheries will achieve its objective of establishing an SMA in close to 100% of coastal communities. This will mark the completion of the first step. From there the responsibility will lie with making sure that these tools are actually achieving the objectives they were designed for. It can take many years for ecosystems to recover from generations of overexploitation. **Therefore we ask for patience when considering the changes required to sustain Tonga's future generations. We are on our way…**

Gillett, R. (2017). *A review of special management areas in Tonga* (Vol. FAO Fisher).

S.V. Chaveta sailing past Euakafa (Vava'u) on route to Ha'apai in 2018 to conduct six months of ecological surveys

Section 9. Appendices

Appendix A: Recommendations on how to use this resource for community consultations

This report is intended as a multi-use document for managers, stakeholders, communities and anyone with a broad interest in the SMA program. Therefore while certain challenges have arisen from trying to display this information clearly to various groups, we hope that it will nonetheless be useful to all involved.

If presenting this report to SMA communities then we feel that the most important sections to show are:

1. What is an SMA and FHR? (Page 1, Tongan Appendix C)
2. Objectives of the SMA program (Page 1, Tongan Appendix C)
3. Rules of the SMA program (Page 2, Tongan Appendix C)
4. How does an SMA and FHR work? (Page 3, Tongan Appendix C)
5. Overall map of the Tonga's SMA network and the surveys completed (Page iv)
6. Individual SMA report (Two pages for older SMAs, one page for the newer SMAs)

The individual SMA reports have also been designed so they can also be printed as stand-alone leaflets or posters. However, copies of the entire report should also be made available to each SMA community for their use.

Appendix B: Articles for further reading

The aim of this section is not to exhaustively list all additional resources that could be read regarding the SMA program and community-based marine management in the South Pacific. Rather, it provides a concise set of articles that may provide useful additional information for those interested, particualrly in Tonga. A comprehensive reference list is available at the end of many of these articles.

Ahmadia, G. N., Glew, L., Provost, M., Gill, D., Hidayat, N. I., Mangubhai, S., … Fox, H. E. (2015). Integrating impact evaluation in the design and implementation of monitoring marine protected areas. *Philosophical Transactions of the Royal Society B: Biological Sciences*. https://doi.org/10.1098/rstb.2014.0275

Gillett, R. (2017). *A review of special management areas in Tonga* (Vol. FAO Fisher).

Govan, H. *et al.* (2009). Status and Potential of Locally-Managed Marine Areas in the South Pacific: meeting nature conservation and sustainable livelihood targets through wide-spread implementation of LMMAs. SPREP/ WWF/WorldFish-Reefbase.

Jupiter, S. D., Cohen, P. J., Weeks, R., Tawake, A., & Govan, H. (2014). Locally-managed marine areas : multiple objectives and diverse strategies, *20*(2), 165–179.

Malimali, S. (2013). Socioeconomic and Ecological Implications of Special Management Areas (SMAs) Regime in the Kingdom of Tonga. A thesis presented to the Bangor University for the degree of Doctor of Philosophy, School of Ocean Sciences, Bangor University. 235 pages.

Smallhorn-West, P. F., Bridge, T. C. L., Malimali, S., Pressey, R. L., & Jones, G. P. (2018). Predicting impact to assess the efficacy of community-based marine reserve design. *Conservation Letters*, (August), 1–8. https://doi.org/10.1111/conl.12602

Smallhorn-West, P., Weeks, R., Gurney, G., Pressey, B. (2019) Ecological and Socioeconomic impacts of marine protected areas in the South Pacfic: Assessing the evidence base. *Biodiversity and Conservation*

Smallhorn-West, P., Sheehan, J., Malimali, S., Halafihi, T., Bridge, T., Pressey, B., Jones, G. (In review) Incentivizing co-management for impact: mechanisms driving the successful national expansion of Tonga's Special Management Area program. *Conservation letters.*

Smallhorn-West, P., Stone, K., Ceccarelli, D., Malimali, S., Halafihi, T., Bridge, T., Pressey, B., Jones, G. (In review) Community management yields positive impacts for coastal fisheries resources and biodiversity conservation. *Conservation letters.*

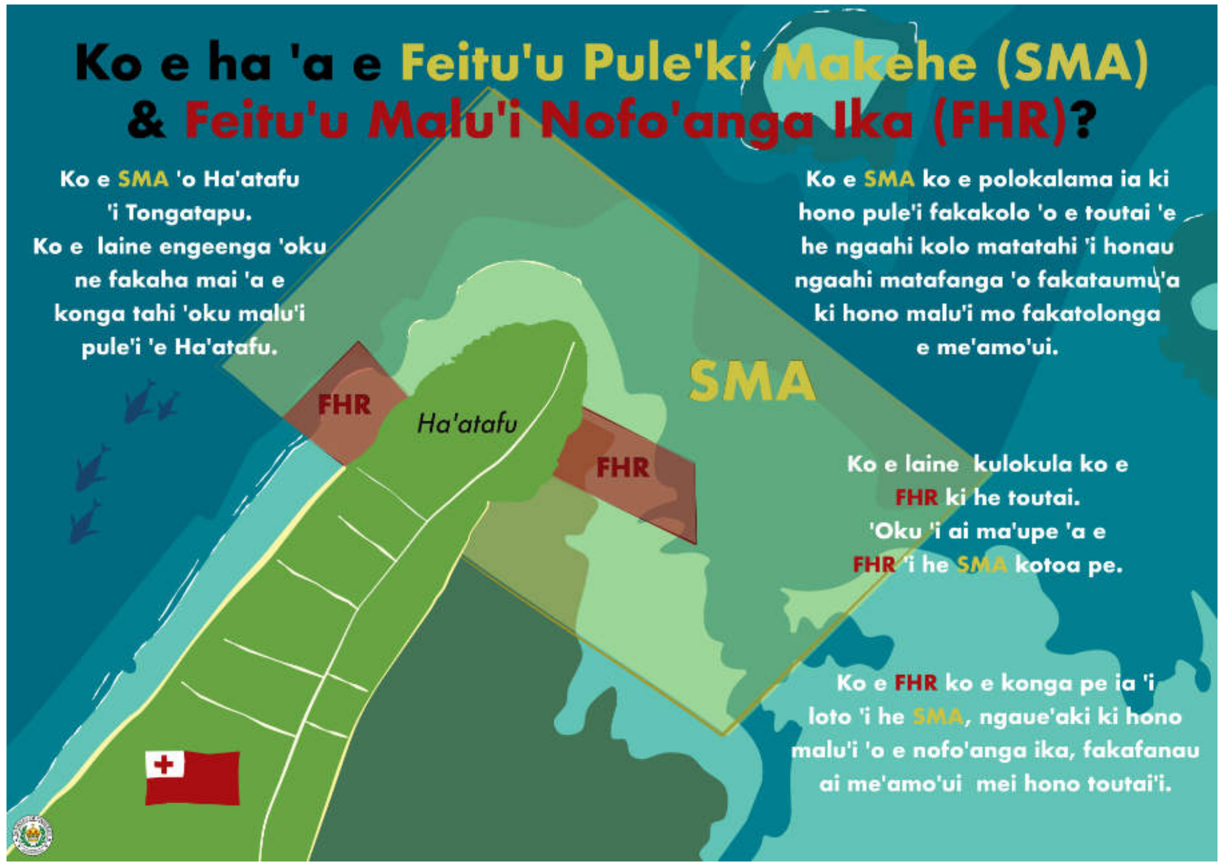
Smallhorn-West, P., Gordon, S., Stone, K., Ceccarelli, D., Malimali, S., Halafihi, T., Wyatt, M., Bridge, T., Pressey, B., Jones, G. (In review) Ecological status of Tonga's coral reefs and associated fish resources: national trends and socio-environmental drivers. *PLOS ONE*

Smallhorn-West P, Gordon S, Dempsey A, Purkis S, Malimali S, Halafihi T, Southgate P, Bridge T, Pressey B, Jones G (In review) Tongan socio-environmental spatial layers for marine ecosystem management. *Pacific conservation biology*

Smallhorn-West P, Govan H (2018) Towards reducing misrepresentation of national achievements in marine protected area targets. *Marine policy* 97, 127-129

Smallhorn-West P, Garvin J, Slayback D, DeCarlo T, Gordon S, Fitzgerald S, Halafihi T, Jones G, Bridge T (2019) Coral reef annihilation, persistence and recovery at Earth's youngest volcanic island. *Coral reefs*

Appendix C: Tongan translations of key figures



Puha 1. Ngaahi Taumu'a mo e Tu'utu'uni 'a e Polokalama Feitu'u Pule'I Makehe

Ko e ngaahi taumu'a 'o e Polokalama Feitu'u Pule'i Makehe 'i Tonga:

1. Pule'i ngaahi founga toutai
2. Fakatupulekina 'a e me'amo'ui mo e ngaahi nofo'anga ika 'i loto 'i he Feitu'u Malu'i 'o e Nofo'anga 'a e Ika
3. Fakahoko ha ngaahi ako mo e ngaahi kolo fekau'aki mo hono fakatolonga mo e pule'i 'o e toutai
4. Faka'ai'ai toutai fakapotopoto 'i hono ngaue'aki 'o e ngaahi founga toutai
5. Fakalakalaka'i 'a e tu'unga ma'u'anga mo'ui 'o e ngaahi kolo

Ko e ngaahi taumu'a ko eni 'oku lava ke fakama'opo'opo ia 'i he visone 'o e Polokalama Feitu'u Pule'i Makehe, 'a ia ke **"fakatupulekina 'a e tu'unga mo'uilelei 'oku 'iai 'a e me'amo'ui mo e ngaahi nofo'anga ika 'i he feitu'u mamaha 'i Tonga, ma'ae to'utangata ko eni kae pehe ki he kaha'u foki"***.

* Fisheries Division, Ministry of Agriculture & Food, F. and F. (2010). Community-Managed Special Management Areas in Tonga Brochure, 1–2.

Puha 3. Ngaahi tefitoí ola naé maú í he fekumi naé fakahoko:

Ko e tupulekina ó e Fietuú Puleí Makehe (SMA)

1. Tuúnga ó e kalasi ó e ika óku tupulaki í he tuúnga fakafiemalie pe, í he ngaahi Élia Tapu (FHR) motuá taha í he fonua fakalukufua.

2. Ko e lahi ó e ika í he hakau óku tupulaki í he tuúnga fakafiemalie pe moia, í he ngaahi Élia Tapu (FHR) motuá taha í he fonua fakalukufua.
3. Óku íkai ha fakamoóni feúnga felaveí mo e tupulekina ó e meámoúi í loto í he ngaahi élia SMA (í tuá í he Élia Tapu (FHR) óku ngofua ke fakahoko ai á e toutai ó e kakai.

Tuúnga moúi lelei ó e Átakai ó óseni

1. Ko e tuúnga óku íai á e hakau feo mo e ika í he vahefonua Vavaú óku í he tuúnga fakatuútamaki fakahoa í he tuúnga fakalukufua ó e fonua.
2. Óku íai mo e ngaahi fakamoóni makehe felaveí mo e mate á e hakau feo í he vahefonua Vavaú mo Haápai, makatuúnga mei he mafana á e tahi mei he Feliuliuaki á e éa.
3. Óku íai mo e fakamoóni felaveí mo e ngaahi maumau ó e feo makatuúnga mei he saikolone í he tafaáki fakaTonga ó Vavaú mo e fakaTokelau ó Haápai
4. Ko e úli ó e tahi óku ne maumauí á e feo í he ngaahi élia ó tatau pe í Vavaú mo Tongatapu.