MARINE BIOREGIONS OF SAMOA

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Executive summary

The Samoan Government's Samoa Oceans Strategy (SOS) 2020-2030 aims to support ecosystem-based adaptation by implementing a national-scale Marine Spatial Plan (MSP), while strengthening community engagement in actions that enhance resilience to the impacts of climate change. Developing a MSP is a practical way of balancing the demands of human activities with the need to maintain the health of ecosystems on which those activities depend. To help deliver on the ecological objectives, marine spatial planning provides a framework to develop an 'ecologically representative' network of marine protected areas. Within Samoa's Exclusive Economic Zone (EEZ), the classification of the marine environment into spatial units that host similar biota, or bioregionalization, can serve decision-making about representativeness by providing spatially explicit surrogates of biodiversity for marine conservation and management.

In 2018, the MACBIO[4] Project undertook a study to develop draft deepwater and reef-associated bioregions for the Southwest Pacific. The study aimed to develop bioregions that were at a scale useful for national marine spatial planning. In developing the draft bioregionalisation, the authors of the study understood that local knowledge and expertise beyond available datasets is critical to ensuring the best possible outcome. Therefore, an important subsequent non-analytical step was a within-country review, where local marine experts in each Pacific Island Country refined the draft bioregions prior to their use in planning. A workshop was held in Apia, Samoa on October 20-21, 2020, for this purpose.

The original six deepwater bioregions classified by the MACBIO Project were changed to five revised deepwater bioregions, based largely on geomorphology and climate; these new bioregions were given local names. Bioregions within the Tonga Trench, which were previously separate, were merged. Geomorphological clusters extending from the western side of the Samoa EEZ to the northern side of Upolu Island were separated from those on the southern offshore side of Upolu. The northern and southern halves of the EEZ are now also represented by two different bioregions.

Only one reef-associated bioregion was available from the original analysis. While some workshop participants indicated that the general structure of Samoan reefs was similar throughout the country, others distinguished between steep coastal reefs and those slightly further offshore that formed a barrier and coastal lagoon. These two reef types were further superimposed upon existing reef data layers and grouped into five new reef-associated bioregions.

Bioregions are just one of the important data layers used in designing an ecologically representative system of highly protected areas. To be truly ecologically representative and comprehensive, it is also important to consider any additional information about habitats, species and ecological processes. Networks of highly protected areas within Samoa's EEZ will be an important outcome of the marine spatial planning process, as will the designation of other ocean zones that meet social, economic and cultural objectives.

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2. INTRODUCTION

The Samoan Government's Samoa Oceans Strategy (SOS) 2020-2030 aims to support ecosystem-based adaptation by implementing a national-scale Marine Spatial Plan, while strengthening community engagement in actions that enhance resilience to the impacts of climate change.

Pacific Island countries, including Samoa, are moving towards greater sustainability in the management of their marine and coastal resources (e.g. see Pratt and Govan 2011, Pacific Island Country Voluntary Commitments at the United Nations Ocean conference), and many are also party to the Convention on Biological Diversity (CBD)[5]. Although Samoa's land area is small, the country has authority over large ocean spaces (over 130,973 km^2) within its Exclusive Economic Zone (EEZ).

The Samoan Government's Samoa Oceans Strategy (SOS) 2020-2030 aims to support ecosystem-based adaptation by implementing a national-scale Marine Spatial Plan, while strengthening community engagement in actions that enhance resilience to the impacts of climate change. Samoa's ocean and its resources are the foundation for people's livelihoods and food security, and contribute significantly to the country's economy (MNRE, 2015). The biodiversity, ecosystem health and productivity of Samoa's marine ecosystems underpin the resources that people rely on. Protecting these ecosystems is therefore paramount to ensure their persistence in an uncertain future, which has become especially apparent during the global COVID19 pandemic of 2020.

5 https://oceanconference.un.org/commitments/, www.cbd.int/information/parties.shtml, www.cbd.int/sp/targets/ accessed 28/9/17

Marine spatial planning, (also referred to in Samoa as Ocean Planning or Ocean Plan), is a practical way of balancing the demands of human activities with the need to maintain the health of the ecosystems on which those activities depend. This is especially important in Pacific Island countries where ~98% of the area under each nation's jurisdiction is ocean. Although marine ecosystems are known to be in global decline primarily due to human activities, the potential to minimise impacts through management of these activities has been recognised.

The Ocean Plan involves an organised and transparent inter-sectoral and participatory public process of identifying and achieving economic, social and ecological objectives. Consequently, the intended result of the Ocean Plan is to spatially organise human activities to ensure they are ecologically, economically and socially sustainable. To help deliver on the ecological objectives, marine spatial planning provides a framework to identify 'ecologically representative' and well-connected systems of highly protected areas. Such networks are the best tool to directly conserve marine biodiversity, ecological processes and ecosystem health (Graham *et al.* 2011, Edgar *et al.* 2014, Green *et al.* 2014).

Development of an 'ecologically representative' network of protected areas within Samoa's EEZ would ideally require perfect marine habitat and species data. However, as this is rarely possible, surrogates for biodiversity can provide beneficial alternatives. In 2018, the MACBIO[6] Project undertook a study to develop draft deepwater and reef-associated bioregions for the Southwest Pacific (Wendt *et al.* 2018). The study aimed to develop bioregions that were at a scale useful for national planning, as a basis for the systematic identification of an ecologically representative system of marine protected areas. Bioregionalization, or the classification of the marine environment into spatial units that host similar biota, can serve to provide spatially explicit surrogates of biodiversity for marine conservation and management (Fernandes *et al.* 2005, Last *et al.* 2010, Fernandes *et al.* 2012, Terauds *et al.* 2012, Foster *et al.* 2013, Rickbeil *et al.* 2014). Marine bioregions are useful because they offer insurance against discounting parts of the ocean where data are incomplete or absent. Bioregions delineate areas with relatively similar assemblages of biological and physical characteristics without requiring complete data on all species, habitats and processes (Spalding *et al.* 2007). This means, for example, that seamounts within a bioregion will be more alike to each other than to seamounts in another bioregion. Similarly, coral reefs within one bioregion will be more similar to each other than coral reefs in another bioregion.

In developing the draft bioregionalisation, the authors of the study understood that local knowledge and expertise beyond available datasets is critical to ensuring the best possible outcome. Therefore, an important subsequent non-analytical step requires that each Pacific Islands country reviews and refines the resulting draft bioregions with their local marine experts prior to use in planning. Once bioregions are reviewed in Samoa, an ecologically representative system of highly protected areas can then be built by including examples of every bioregion (and every habitat, where known) within the system.

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3. RATIONALE

The decline of marine biodiversity and ecosystem services is a worldwide problem and requires better management (Jackson *et al.* 2001, Worm *et al.* 2006, Mora 2008, Beger *et al.* 2015, Klein *et al.* 2015). This has been recognised at the global level and countries are attempting to address the problem through national efforts, multi- and bi-lateral initiatives and other agreements and commitments. For example, over 1,400 Voluntary Commitments to improve ocean management were made at the United Nations Ocean Conference in June 2017.[7]

These include at least 130 Pacific-specific targets. To achieve these targets many nations are currently in the process of zoning their marine and coastal areas for better management and greater protection. The placement and effective designation of sites as highly protected areas within each country requires the full representation of marine biodiversity in conservation and management areas, whilst considering socio-economic and cultural needs.

3.1 Aims of bioregionalization in Samoa

This marine bioregionalisation aims to support national marine spatial planning efforts in Samoa. Following the technical process undertaken by the MACBIO project to classify the entire marine environment within the Southwest Pacific (Wendt *et al.* 2018), the draft bioregions within the Samoa EEZ were reviewed by local experts. The resulting marine bioregions of Samoa will provide a biological and environmental framework for identifying candidate sites of an ecologically representative system of highly protected areas within Samoa's EEZ, forming part of the broader marine spatial planning process currently underway in the country.

In October 2020, the Samoan Government conducted a workshop to help deliver a description of the country's entire marine environment at a scale useful for their MSP. This report captures the process and outcomes of the workshop, and presents the revised marine bioregions for Samoa.

7 oceanconference.un.org/commitments accessed 28/9/17

4. BACKGROUND

Draft marine bioregions across the Southwest Pacific

The technical bioregionalization analysis resulted in the division of the entire area of interest into draft deepwater and reef-associated bioregions across the Southwest Pacific, including Samoa (Figure 1, Figure 2).

Names and descriptions of bioregions are provided in Wendt *et al.* (2018), and a detailed, peer-reviewed description of the methods can be found in Beger *et al.* (2019). A total of 262 deepwater bioregions and 102 reef-associated bioregions were defined for the Southwest Pacific (Table 1). Although most were contiguous, some had multiple, non-contiguous parts. Many deepwater bioregion boundaries extended beyond countries' EEZs and into areas beyond national jurisdiction. A majority of the deepwater and reef-associated bioregions had shared boundaries across neighbouring countries (Wendt *et al.* 2018).

Table 1: Number of draft deepwater and reef-associated bioregions described per country as an output of this analysis.

Because many bioregions cut across national boundaries, they are listed in more than one country. The numbers of bioregions in the table reflect the technical results before in-country expertise is used to refine and revise the bioregions.

Country name	Number of deepwater bioregions	Number of shared deepwater bioregions	Number of reef-associated bioregions	Number of shared reef-associated bioregions
American Samoa	9	9	2	2
Cook Islands	30	27	6	4
Fiji	23	23	12	3
French Polynesia	52	23	16	5
Kiribati	54	47	11	2
Marshall Islands	34	19	9	2
Micronesia	41	32	19	4
Nauru	6	6	1	1
New Caledonia	31	24	8	1
Niue	6	6	2	2
Palau	19	18	4	0
Samoa	6	6	1	1
Solomon Islands	33	26	19	6
Tokelau	8	8	2	2
Tonga	35	27	4	3
Tuvalu	13	13	4	3
Vanuatu	20	18	7	3
Wallis and Futuna	9	9	3	3

Figure 1. Draft deepwater bioregions for the Southwest Pacific.

The different coloured areas represent different bioregions Due to the limited colour palette, different bioregions may appear in the same colour.

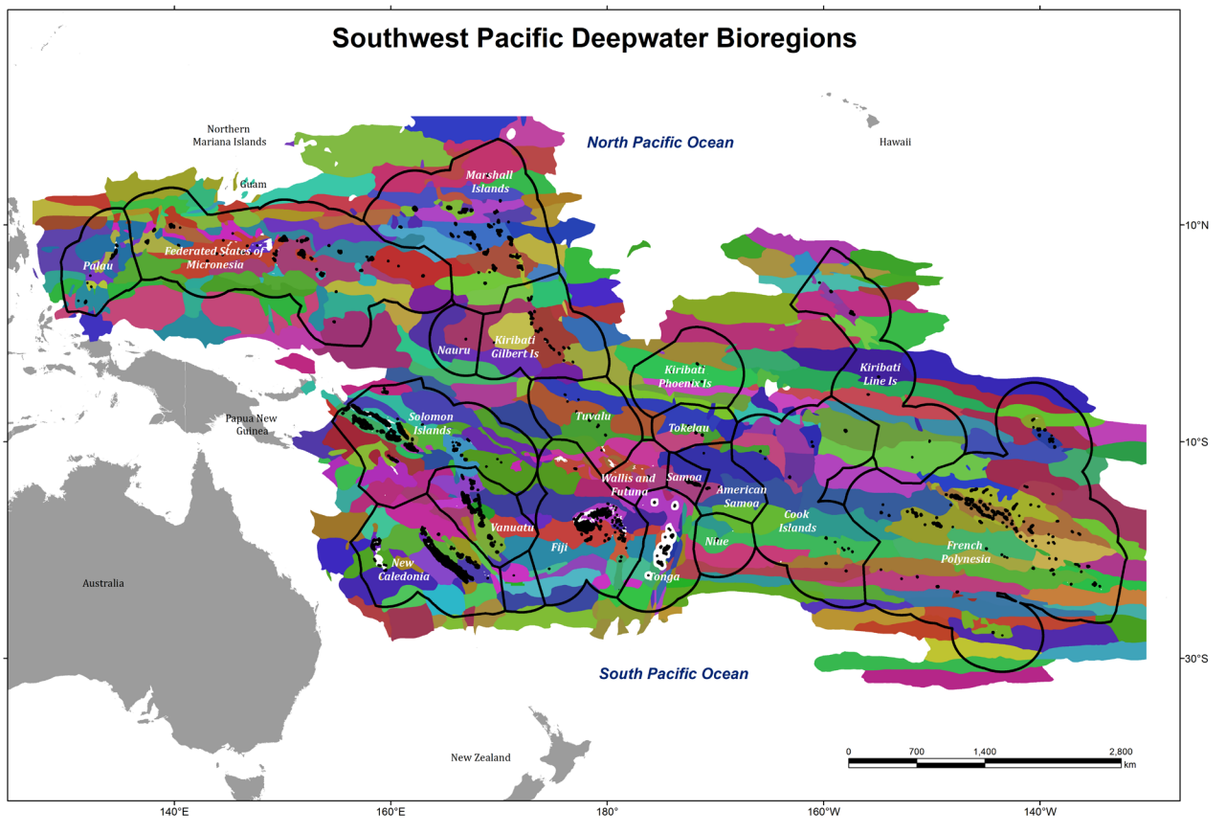
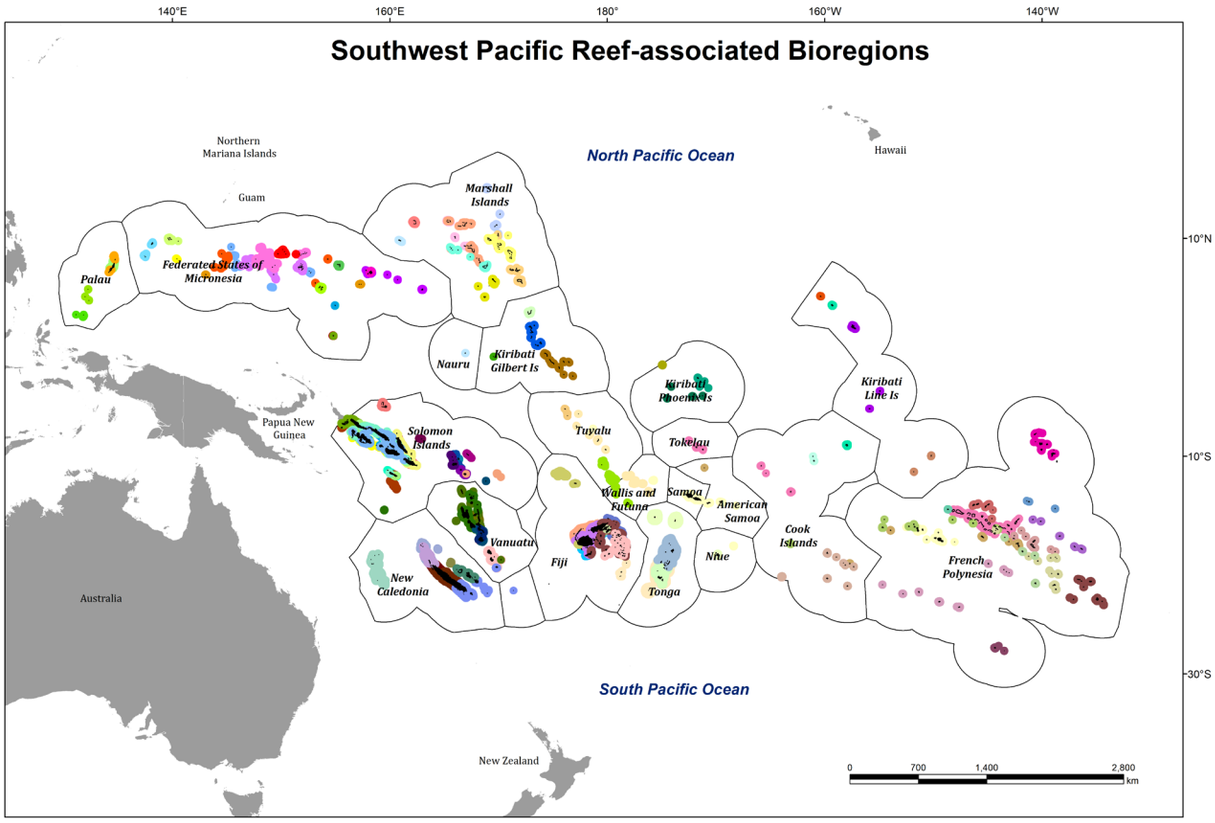


Figure 2. Draft reef-associated bioregions for the Southwest Pacific.

Reef areas are exaggerated in this Figure for ease of viewing. The different coloured areas represent different bioregions. Due to the limited colour palette, different bioregions may appear in the same colour.



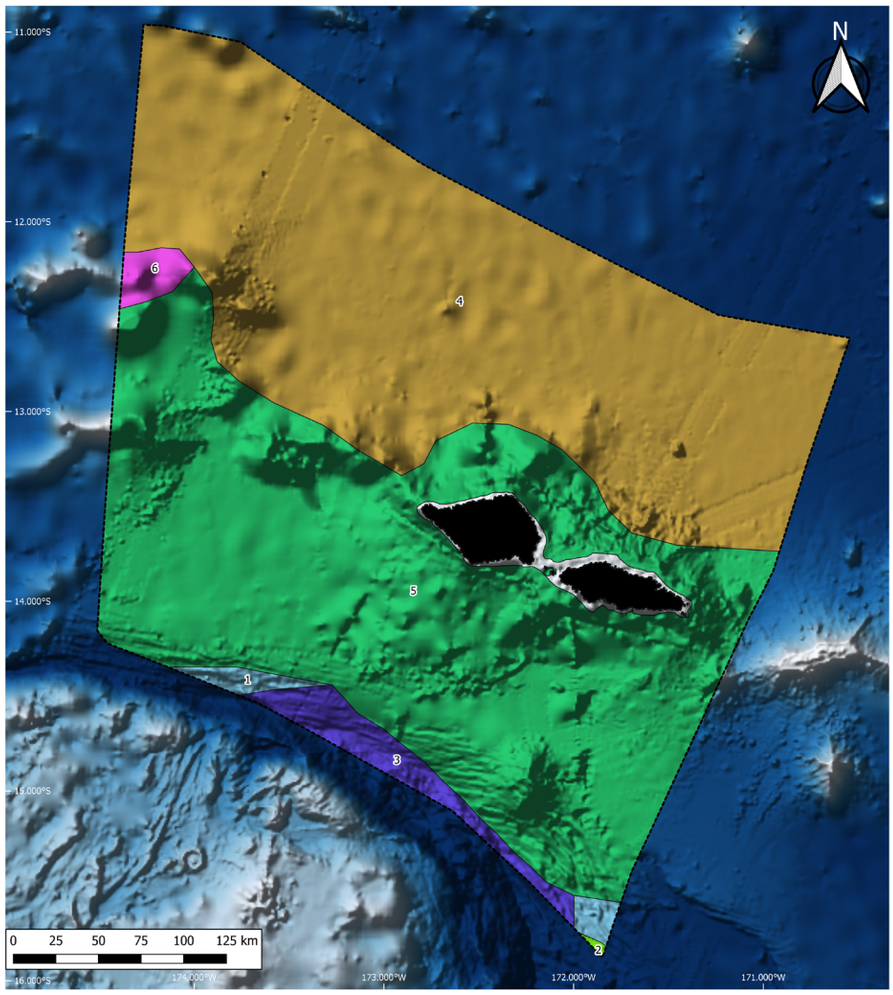
5. FINALISING MARINE BIOREGIONS OF SAMOA

5.1 Introduction

The previous section of this report provides a brief background on the draft marine bioregions across the Southwest Pacific. The original technical analysis, conducted in 2016 and published in 2018, resulted in six draft deepwater bioregions and one draft reef-associated marine bioregion in Samoa's EEZ (Figure 3, Figure 4).

Figure 3. Draft deepwater bioregions of Samoa.

These were the outcome of the original preliminary technical analysis in 2016. Each colour and code represents a different marine bioregion.



Samoa Draft Deepwater Bioregions

Bioregions are:
- Areas of relative similarity:Habitats,communites, and physical features within a bioregion are more similar to each other than those in a different bioregion.
- A way to represent the full range of biodiversity.
- A classification of habitat and environmental types.

Deep Water Bioregions were created by clustering these factors:
- calcite, oxygem, nitrate, phosphate, silicate, and chlorophyll concerntrations; solar irradiance; pH; salinity; depth of seafloor, 20°C isotherm, and mixed layer; temperature at the surface, 30m, 200m, 1000m; dynamic height of the surface; and distance from land.

Data Sources:
Land outlines: Global Self-consistent, Hierarchical, High-resolution Geography Database (GSHHG)
Bathymetry: The General Bathymetric Chart of the Oceans (GEBCO), http://www.gebco.net

Legend

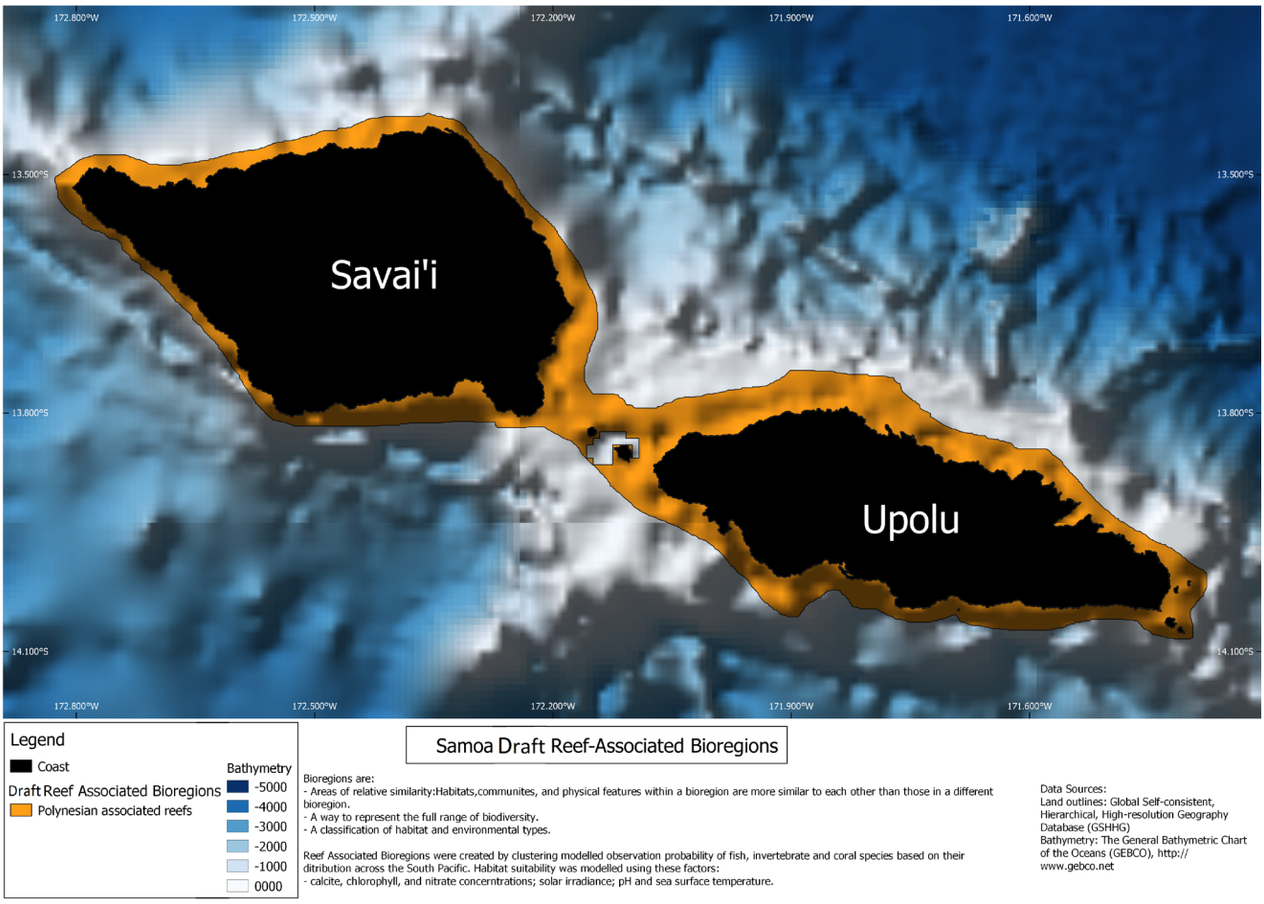
- Provisional EEZ

Draft Deep Water Bioregions

- 1. American Samoa - Cook Islands Abyssal Mountains
- 2.American Samoa Basin and North Tonga Trench
- 3. Northern Tonga Trench
- 6. Southeast Rotuma, Isle De Horne, Futuna,Samoa and Niuas plateau
- 4. Swains Atoll and Nassau Island Deep
- 5. Wallis, Samoa and American Samoa

Figure 4. Draft reef-associated bioregions of Samoa.

These were the outcome of the original preliminary technical analysis in 2016. Each colour and code represents a different marine bioregion.



In response to the authors of the original study recognising the necessity for local knowledge, marine experts in Samoa refined the resulting draft bioregions as an important non-analytical step, prior to application in national planning. This report describes the process and outcomes of the workshop, and follow-up discussions and research, during which the marine bioregions of Samoa were finalised.

5.2 Methods

On the 20th and 21st October 2020, the Ministry of Natural Resources and Environment (MNRE), with technical support from IUCN, conducted a National Stakeholder and Expert Workshop on Marine Bioregions for Samoa. Due to travel restrictions caused by COVID19, presentations for the workshop were delivered through

a combination of online and face-to-face approaches. The overall workshop objectives were to review and confirm the draft, preliminary deepwater and reef-associated bioregion boundaries and descriptions (Appendix 1: Workshop Agenda), including to:

- review current information to describe and identify boundaries of offshore / deepwater bioregions;
- review current information to describe and identify boundaries of inshore / reef-associated marine bioregions; and
- map the boundaries of deepwater and reef-associated marine bioregions update participants on the progress of the MSP Project.

A total of 30 participants (9 women and 21 men) representing a range of Government ministries, scientists and community fisheries experts gathered to review and confirm descriptions and boundaries of both the deepwater and reef-associated marine bioregions of Samoa (Appendix 2).

The workshop initially reviewed the six deepwater bioregions and then reviewed the single reef-associated bioregion. Participants were asked to consider each bioregion's location, boundaries, name and description. The format in which the information was gathered from participants can be seen in Appendix 3. The 30 participants (Figure 5) were divided into three working groups (Black, Green and Red Groups). Each working group had a rapporteur and a facilitator.

Figure 5. Workshop participants during the 2020 review of Samoa's bioregions.

Supporting material available to the workshop participants included maps of the draft bioregions at various scales for each working group to draw upon, hardcopy maps of biophysical data posted on a "resource wall" and biophysical data available in a GIS format (https://drive.google.com/drive/folders/1r7lpjUSIYJwOutGC-1eomzHLMKDwjx9l (mimecast.com); see Appendix 4). The available data were categorised into two groups: data used in developing the bioregions and; other biophysical data used solely to inform the refinement of the bioregion boundaries and descriptions.

The participants and working groups were divided/merged in two ways: people with greater knowledge about a particular area were allocated to the group dealing with their speciality; people with more general knowledge chose which group to work with. Some participants were extremely knowledgeable about more than one area – these individuals were asked to move around the groups which were working on specific geographies.

5.3 Results

5.3.1 Deepwater bioregions

The three groups presented very different outcomes from their deliberations about the deepwater bioregions. A decision was made to change terms from "deepwater" bioregions to "offshore" bioregions.

The Green group recommended a total number of eight bioregions for offshore marine habitats. The group proposed to separate bioregion 5 into three small bioregions with new boundaries, based on the similarity of the physical characteristics of the seafloor and key species found within these regions. Overall, they agreed on the draft boundaries for bioregions 1, 2, 3, 4, and 6. However, the group suggested name changes as follows:

Bioregion 1 – Satau and Sitoa;

Bioregion 2 – Siniue;

Bioregion 3 – Loto-i-Toga;

Bioregion 4 – Vasa-i-Matu;

Bioregion 5 – Vasa-i-Saute;

Bioregion 6 – Tafolā;

Bioregion 7 – Fāfā-o-Mauga; and

Bioregion 8 – I'a manu.

The Black group proposed to simplify draft offshore bioregions of Samoa into two. Bioregions 1, 2, 3, and 5 were merged into a new Bioregion 1 and renamed Tuaoloa, reflecting the prevailing southerly wind direction in this area. Draft bioregions 4 and 6 were merged as Bioregion 2 and renamed La'i, to indicate the wind direction from the north. The justification for consolidating the draft bioregions into only two was based on the high similarities of physical and biological characteristics shared amongst those merged.

The Red group agreed to the boundaries of all the draft offshore bioregions. The only recommendations presented were localising the names of the 6 bioregions as follows:

Bioregion 1 – Lagoto;

Bioregion 2 – Nu'usafe'e;

Bioregion 3 – Asuisui;

Bioregion 4 – Ala-folau;

Bioregion 5 – Tafolā; and

Bioregion 6 – Ala-afā.

Based on the results from group discussion and a combination of renaming suggestions, five revised deepwater bioregions (Appendix 6) were created as follows:

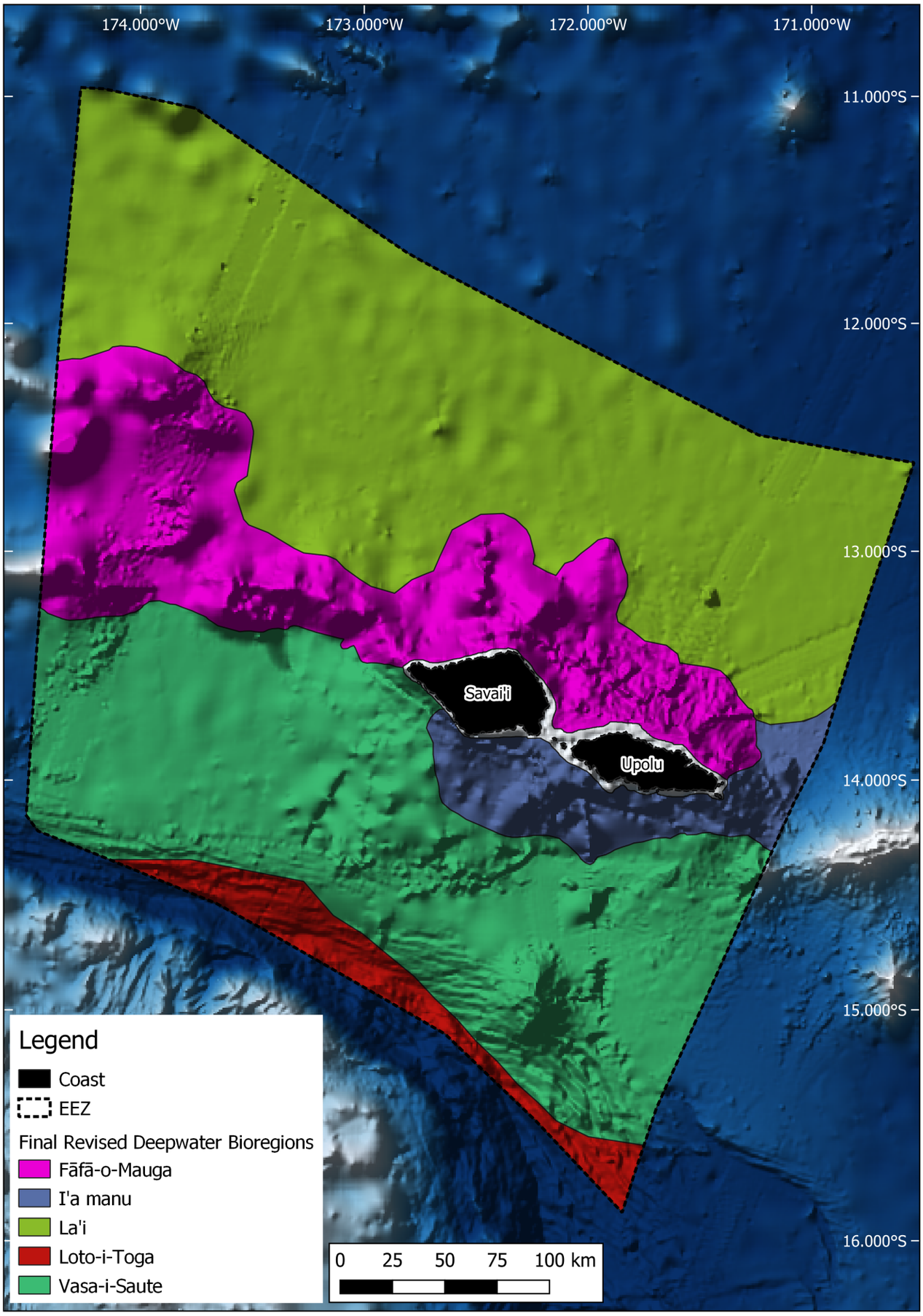
Bioregions 1, 2 and 3 were merged into new Bioregion 1 (as suggested by the Black Group) and renamed Loto-i-Toga (as suggested by the Green Group). This reflects the location of all three draft bioregions in the Tonga Trench, and the similarities in their biophysical attributes.

Bioregions 4 and 6 were merged into new Bioregion 2 and renamed La'i (as suggested by the Black Group). This indicates the prevailing northerly wind direction, and also takes into account that within the Samoa EEZ, draft Bioregion 4 is a geomorphological cluster that continues into draft Bioregion 6.

Bioregion 5 was split into three new bioregions, Bioregions 3, 4 and 5, and renamed Vasa-i-Saute, Fāfā-o-Mauga and I'a manu, respectively (as suggested by the Green Group).

The final deepwater bioregions are shown in Figure 6.

Figure 6. Final deepwater bioregions of Samoa.



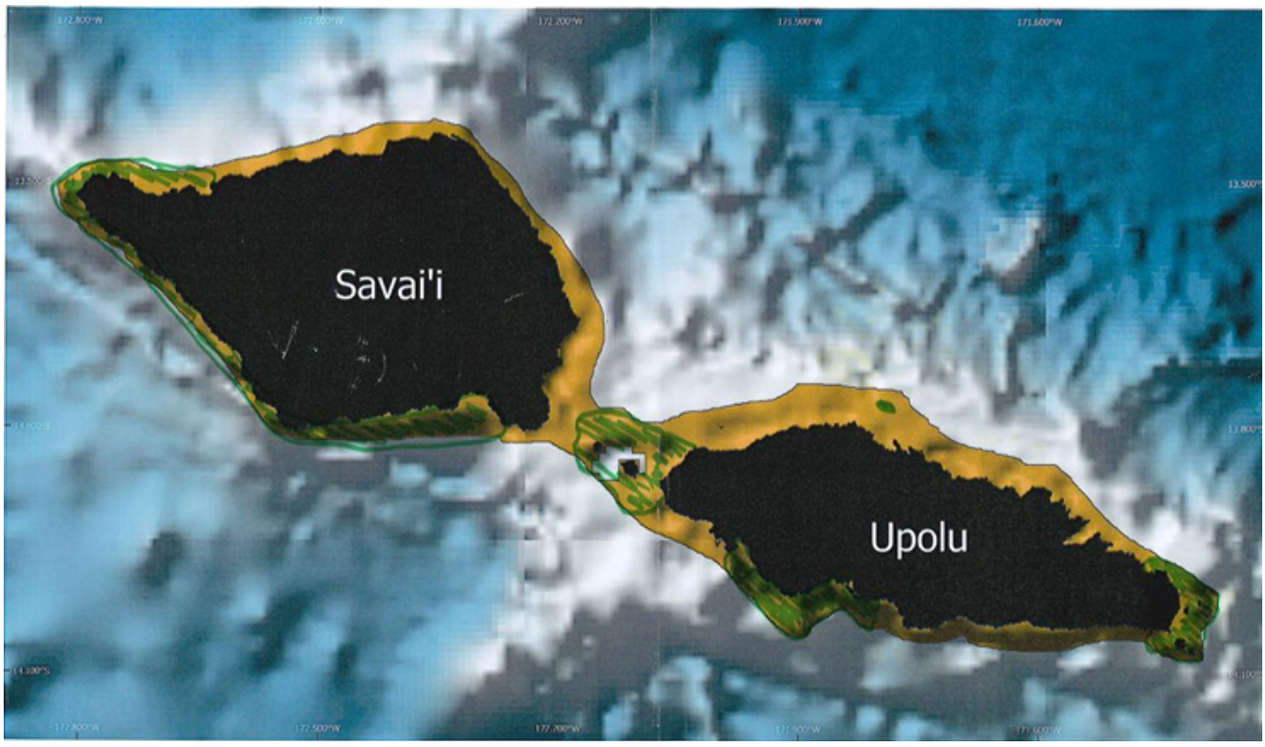
5.3.2 Reef-associated bioregions

The three groups also presented very different outcomes from their deliberations about the reef-associated bioregions. A decision was made to change terms from "reef-associated" bioregions to "inshore" bioregions.

The Green group recommended dividing the inshore bioregions into areas coded in green and orange colours, reflecting the key biodiversity areas of Samoa's nearshore marine habitats. The green proposed bioregions reflect areas that have key habitats and key species. The orange-coloured areas reflect the original description of the draft bioregion (Figure 7).

Key biodiversity areas are not considered suitable data for inclusion into the delineation of bioregions; they are instead included under the process of defining special and/or unique marine regions, or SUMAs (Ceccarelli *et al.*, 2020). However, when finalizing the reef-associated bioregions for Samoa, the areas with similar species listed as trigger species for the key biodiversity areas were taken into consideration.

Figure 7. Ideas for inshore bioregions from the Green Group.



The Black Group identified areas around Savai'i with deep waters and little or no reef formations. These areas are:

- Samata;
- Taga and Gautavai;
- parts of Saleaula, Samalaeulu and Pu'apu'a;
- parts of Asau, Aopo and Letui; and
- Tafua and part of Salelologa.

Similarly, deepwater areas without a reef flat were identified for Togitogiga and Fagaloa on Upolu island. The windward side of Apolima island also drops abruptly into deep water. The group recommended maintaining the name of the reef-associated bioregion but suggested the name "Lava" for areas with steep geomorphology, to reflect their lava-based and/or rocky nature. The group also highlighted the lack of

geomorphic detail as a major challenge they faced when deciding on redefining the boundaries or proposing new reef bioregions within the inshore area of Samoa.

The Red Group agreed to a single reef-associated bioregion for Samoa, stating similarities of the reef types and species distributions throughout the country's inshore regions. The group also highlighted that insufficient availability of physical and biological information on the inshore bioregion prevented them from providing more robust recommendations.

All discussions and Group conclusions were noted and combined with the additional reef data layer from the Institute of Marine Remote Sensing (IMARS) Millennium Reefs and Allen Coral Atlas (Figure 7).

This combined approach resulted in five new reef-associated bioregions for Samoa (see Appendix 7):

1. Coastal barrier reef complex (red), including the associated shelf slopes (pink); fringing of coastal barrier complex (purple), diffuse fringing (green) and intra-lagoon patch reef complex (brown);

2. Ocean exposed fringing reef (yellow), including the associated shelf slopes (pink), diffuse fringing (green) and lagoon exposed fringing (also green);

3. The Outer Barrier Reef complex on Savai'i, as this is a type of habitat found nowhere else in Samoa;

4. Island Lagoon on Savai'i, as this is a type of habitat found nowhere else in Samoa; and

5. Shelf Patch Reef Complex, small areas of offshore patch reefs on both Savai'i and Upolu.

The revised, and final, reef-associated bioregions for Samoa are shown in Figure 7.

Figure 8

Savai'i (top) and Upolu (bottom) highlighting the two reef types distinguished in the workshop, superimposed with the reef data layer from the Institute of Marine Remote Sensing (IMARS) Millennium Reefs and Allen Coral Atlas.

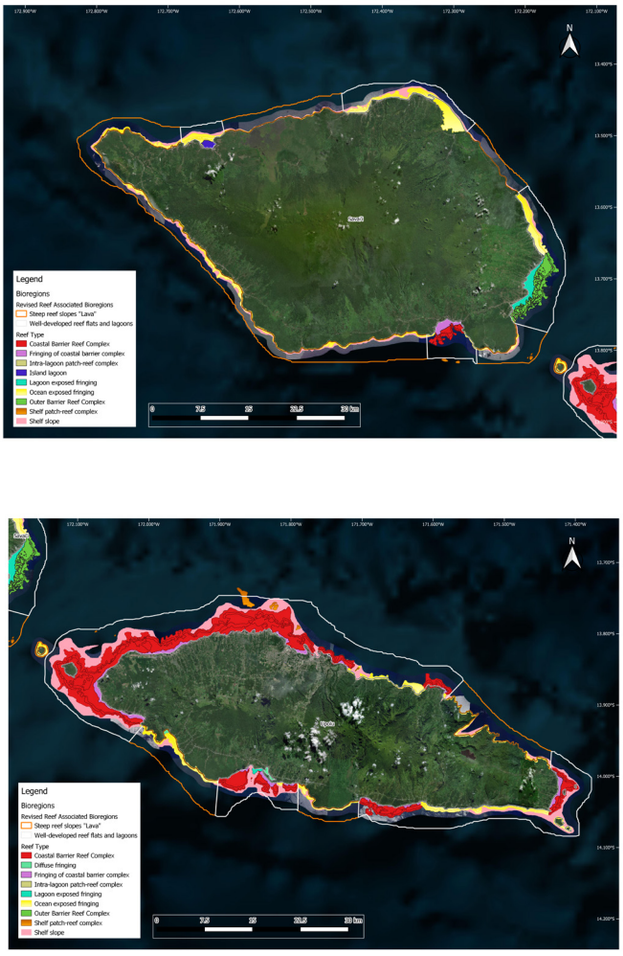
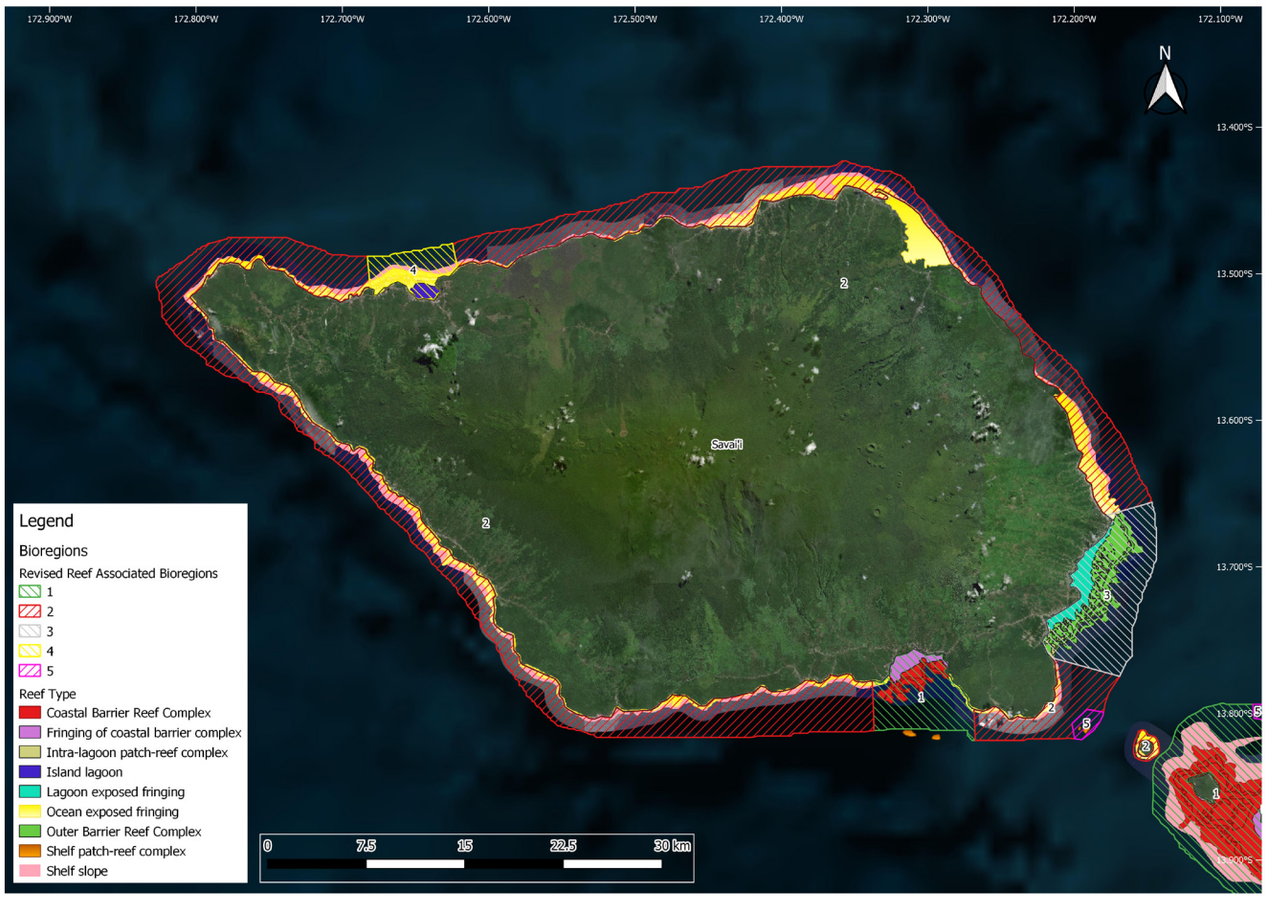
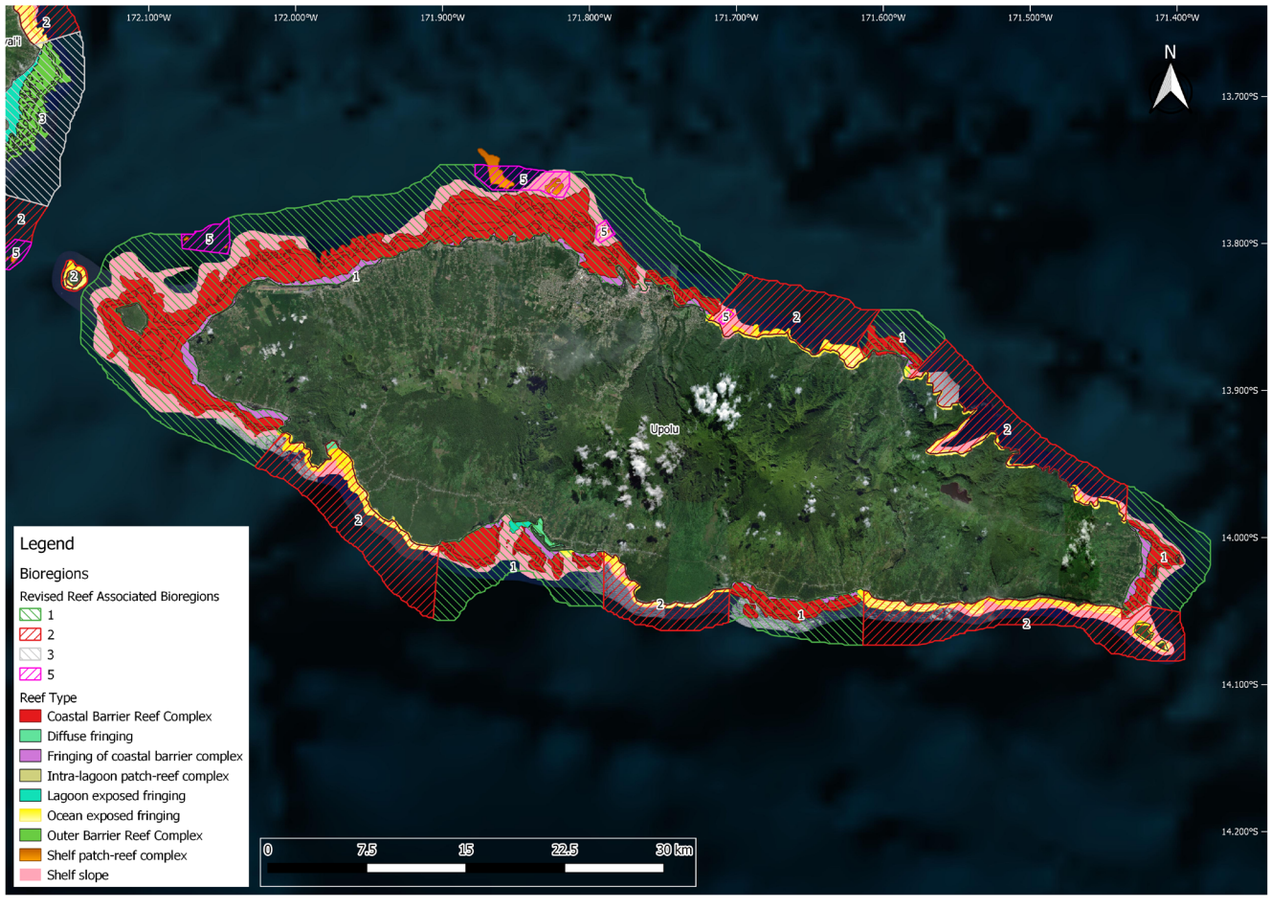


Figure 9. Revised reef-associated bioregions of Samoa, on Savai'i (top) and Upolu (bottom).





5.4 Conclusions

Workshop participants made changes to both the deepwater and the reef-associated draft bioregions of Samoa. It was acknowledged that marine data for Samoa remain imperfect, and the boundaries and descriptions of bioregions will be subject to further review and change as more data become available. The individual discussion groups at the workshop presented very different outcomes, and these revised bioregions present the best possible compromise. Workshop participants also noted a preference for changing terms from "deepwater" to "offshore" bioregions, and "reef-associated" to "inshore" bioregions. However, for the sake of compatibility with the process in other Pacific Island countries, the original terminology has been retained in this report.

The original six deepwater bioregions were changed to five revised bioregions, based largely on geomorphological and climatic knowledge and evidence from available maps. Bioregions within the Tonga Trench, which were previously separate, were merged. The distinctive geomorphology cutting horizontally through the central part of the EEZ was represented by two bioregions; one following the geomorphological clusters from the western end of the EEZ to the northern side of Upolu, and the other containing the geomorphic features on the southern offshore side of both islands. The northern and southern halves of the EEZ are also distinct, and were represented by two different bioregions. The deepwater bioregions were given local names.

Only one reef-associated bioregion was available from the original analysis; this bioregion is also represented in other Western Pacific countries. While some workshop participants indicated the general structure of the reef was similar throughout Samoa, others distinguished between steep coastal reefs with a narrow reef flat, and those slightly further offshore that formed a barrier and coastal lagoon. These two reef types were further superimposed upon existing reef data layers and grouped into five new reef-associated bioregions.

These bioregions may be subject to further revision as more data become available. The final marine bioregions as identified in this report now form a more robust and technically sound input to offshore and inshore marine spatial planning decisions in Samoa.

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7. Appendices

7.1 Appendix 1 – Workshop agenda

Marine Bioregions of Samoa

AGENDA

20-21 October 2020
Venue: LAVA Hotel Conference Room
Time: Day 1: 09.00am – 5.00pm Day 2: 09.00am – 1.30pm

Workshop Objectives

1. To describe the marine environment of Samoa
2. To review the draft, preliminary inshore and offshore bioregion boundaries and descriptions of Samoa

TIME	AGENDA ITEM	LEAD
	DAY 1	
8:30 – 9:00	Registration	MNRE/SUNGO
9:00 – 9:15	Prayer	Rev. Poasa Lofipo, EFKS, Tanugamanono
9:15-9:30	Opening remarks	Ulumalo Bismarck Crawley
9:30 – 9:40	**Agenda item 1: Introductions** • Introduction of face to face and online participants • Broad overview of the meeting	Mr Mulipola Atonio IUCN
9:40 – 10:00	**Agenda Item 2:** *Objective: Reviewing Samoa's marine spatial planning process, Update on Samoa Ocean Strategy and linkages* Presentation: Review of the current process to achieve a national marine spatial plan	Maria Satoa, Principal Marine Conservation Officer
10:00 – 10:15	**Agenda item 3:** *Objective: Review status of report on Samoa's special and unique marine areas (SUMA)* Presentation: Key outcomes and status of report on the National Marine Prioritization workshop, which identified special, unique marine areas	IUCN (online) IUCN

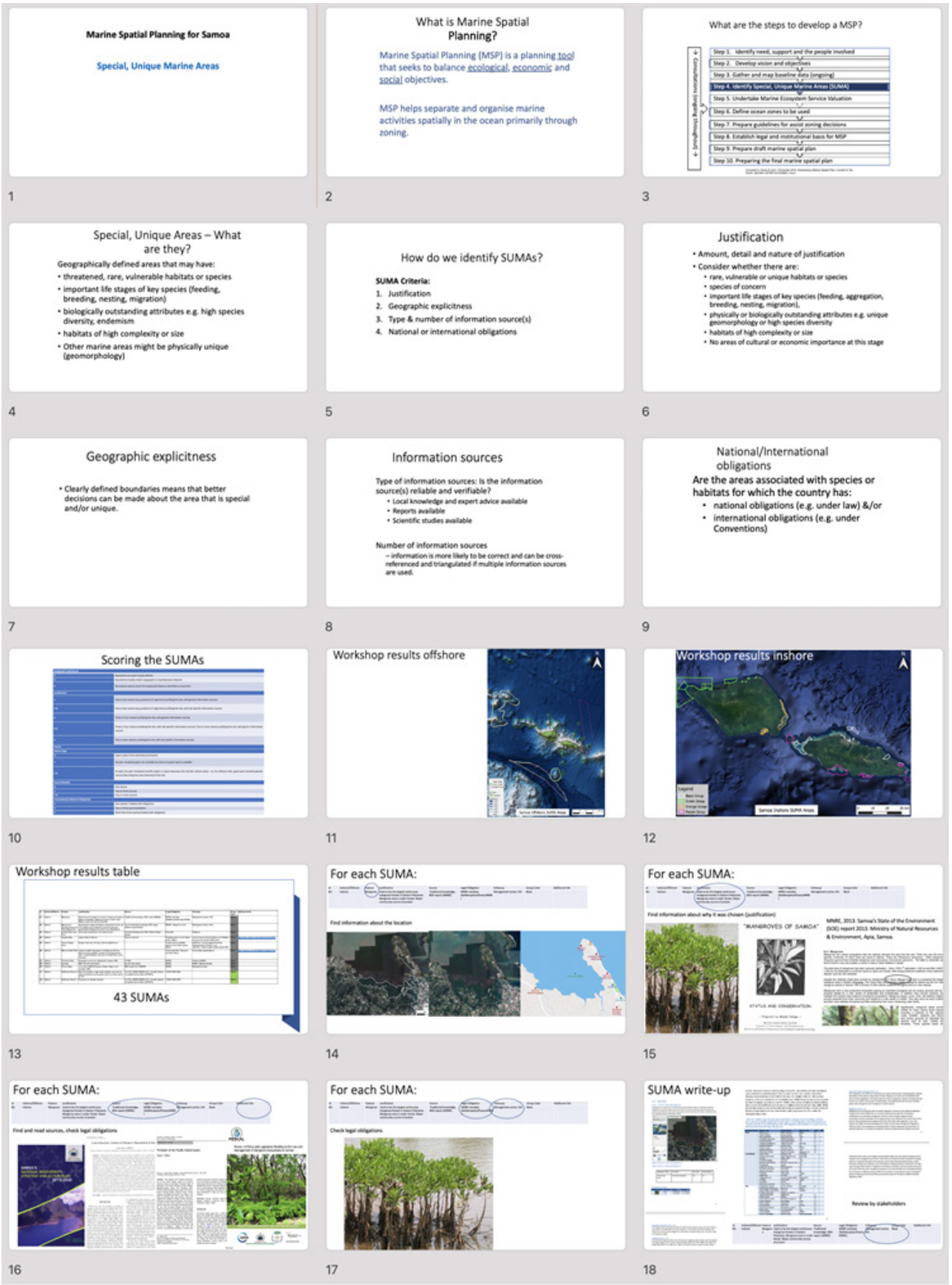
10:15 - 10:45	Tea break	
10:45 – 11:15	**Agenda Item 4:** *Objective: Introduction of approach used to describe Samoa's marine environment and results* Presentation: 4.1 Introduction to the concept of different marine biological regions (bioregions) for Samoa; how a description of the entire marine environment of Samoa differs from special, unique marine areas 4.2 Methods and data used to create draft preliminary marine biological regions (bioregions) for Samoa 4.3 Introduction of Resources and Seabed geomorphological features found in Samoa 4.4. Draft marine bioregions of Samoa	IUCN (online) Hans Wendt and John Kaitu'u
11:15 – 1:00	**Agenda item 5:** *Objective: Review the deepwater marine bioregion boundaries, names and description* Presentation: Description of group work and breakout into groups • Expert review and revision of Samoa's deepwater marine biological region boundaries, names and descriptions	IUCN (online) Hans Wendt Break-out groups
13:00-14:00	Lunch	
14:00 – 15.30	**Agenda Item 5: continued** • Group work	Break-out groups
15:15-15:30	Afternoon tea	
15:30 – 16:15	**Agenda Item 5: continued** • Feedback from breakout groups	Break-out groups
16:15 – 16:45	• Closing Remarks	Facilitator
	DAY 2	
9:00 - 09:05	Prayer	
09:05 - 09:15	**Recap Day 1** • Presentation by IUCN technical team on changes to Deepwater Bioregions	IUCN team
09:15 – 10:15	**Agenda Item 6:** *Objective: Review the reef-associated marine bioregion boundaries, names and descriptions* Presentation: Description of group work and breakout into groups • Expert review and revision of Samoa's reef-associated marine biological region boundaries, names and descriptions	Break-out groups

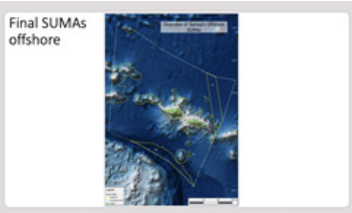
10:15 - 10:30	Morning tea	
10:30 – 12:00	**Agenda Item 6: continued.** • Group work	All Groups
12:00 - 12:45	**Agenda Item 6: continued.** • Feedback from breakout groups	Group rapporteurs
12:45 – 1:00	**Agenda Item 7:** • Next steps and follow-ups	Break-out groups
1:00	• Final Remarks • Close of Workshop • LUNCH	Ulu Bismarck Crawley CEO, MNRE

7.2 Appendix 2 – Workshop participants

No.	Participant Name	Organisation	Group	Gender
1	Vaisala Afoa	Vaisala VFMAC	Black	F
2	Maria Satoa	Ministry of Natural Resources and Environment (MNRE)	Black	F
3	Seulu Iloa	Lalovi, Mulifanua, VFMAC	Black	M
4	Aualiitia Fouina Milford	Tuana'i VFMAC	Black	M
5	Mao Peter Rasch	Saoluafata VFMAC	Black	M
6	Finau Taape Trood	Safaato'a, Lefaga VFMAC	Black	M
7	Papalii Ausetalia Tanuvasa	Samoa Port Authority	Black	M
8	Leilua Tavas Leota	Salimu and Musumusu VFMAC	Black	M
9	Maria Sapatu-Kennar	Eco Current Consultancy	Green	F
10	Leota Fiau'u Faletoese	Matautu, Lefaga Matareva Lefaga Coral Gardening	Green	F
11	Perenise Fao	Asau VFMAC / Fisher	Green	M
12	Lealifano Peni Sua	Vaitoomuli, Palauli VFAMC / Fisher	Green	M
13	Lemalama Taaloga	Savaia, Lefaga CFMAC	Green	M
14	Faitau Tuitama Ulisese	Sataua VFMAC	Green	M
15	Togia Tavita Faletoese	Matautu, Lefaga VFMAC and Coral Gardening	Green	M
16	Fatutolo Iene	Ministry of Natural Resources and Environment	Green	M
17	Danita Strickland	Conservation International Foundation	Red	F
18	Roberta Mura-Faasavalu	National University of Samoa	Red	F
19	Salū Moleni Iene	Fagalii VFMAC	Red	M
20	Ulugia Ierome Mulumulu	Samoa Port Authority	Red	M
21	Ferron Fruean	Artificial Reefs Samoa	Red	M
22	Marolionel Polataivao	Ministry of Natural Resources and Environment (MNRE)	Red	M
23	Mulipola Atonio P.	IUCN/Samoa Umberella for Non-Government Orgaisations	Red	M
24	Leulu Pale	Faga, Savaii VFMAC	Red	M
25	Katie Pogi	Meteorology Division, MNRE	Attended	F
26	Telesia Sila	Mapping Unit, MNRE	Attended	F
27	James Atherton	Samoa Conservation Society	Attended	M
28	Seumalo Afele Faiilagi	Ministry of Natural Resources and Environment (MNRE)	Attended	M

7.3 Appendix 3 – Workshop presentation





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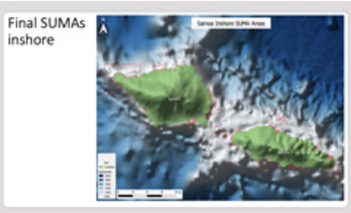

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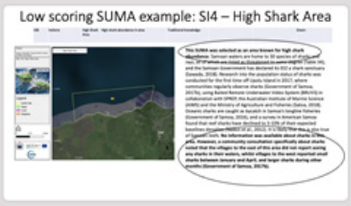

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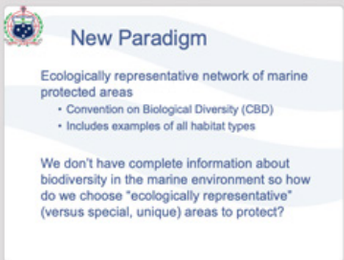

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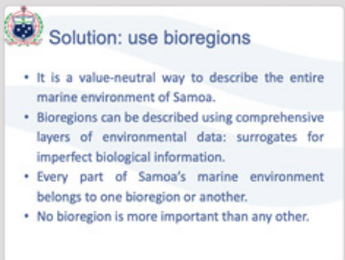

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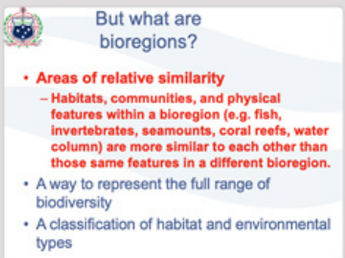

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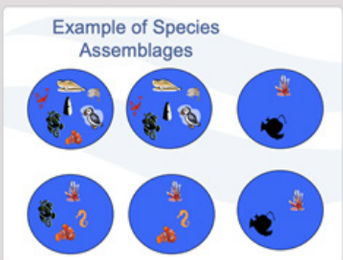

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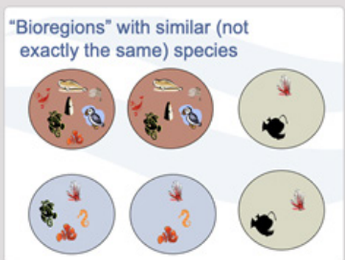

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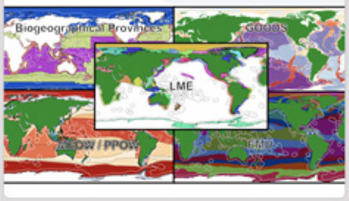
Bioregions as a planning tool

If one objective is an ecologically representative network of marine protected areas covering a minimum percentage (10% or 30%) of the marine environment with the goal of enhancing biodiversity

Then a protected area target of this percent for each bioregion will help meet that objective

10

Existing global bioregions



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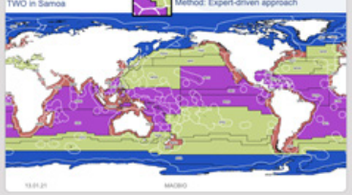
Longhurst, 2010. Biogeographical Provinces

4 global provinces: 3 in Oceania
52 sub-provinces: 9 in Oceania
TWO in Samoa

Factors: Based on biophysical proxies: phytoplankton abundance, mixed layer depth currents, clarity.
Method: Expert-driven approach



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Bioregions as a planning tool

- The MACBIO project is working with 5 countries to support Marine Spatial Planning within their EEZs.
- Global-scale bioregions are not useful for national scale marine planning and management.
- Samoa needs finer scale descriptions of its entire marine environment

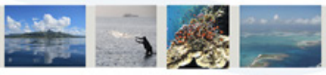
13

Questions?

14

Agenda Item 4.2. Methods used to create bioregions for Samoa (& SW Pacific)

Hans Wendt



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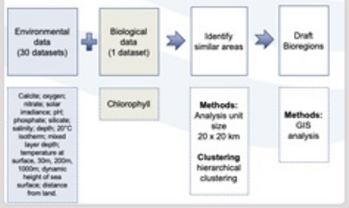
2 Types of Bioregions

- Deep water bioregions
- Reef-associated bioregions (shallow)

NOTE: in working across the five MACBIO countries it was realised that building five different sets of bioregions didn't make biological sense: so we built one set of bioregions across the entire SW Pacific
Can then also support OTHER countries doing national MSP

16

Building deepwater bioregions



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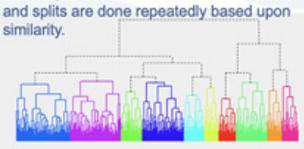
Clustering Algorithm

Clustering Algorithm

Hierarchical clustering: a hierarchy of clusters; all observations start in one cluster and splits are done repeatedly based upon similarity.



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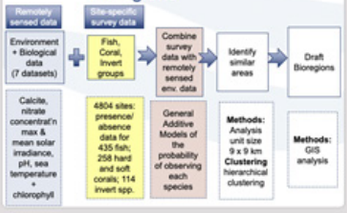
Building Reef-Associated Bioregions

MACBIO



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Data Contributors

20

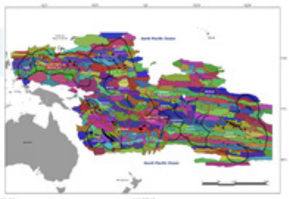
Agenda Item 4.4

Results - draft marine bioregions across the SW Pacific INCLUDING Samoa – Hans Wendt

21

Result: Deepwater Bioregions

262 Deepwater Bioregions in SW Pacific; 6 Deepwater Bioregions in Samoa



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Result: Deepwater Bioregions

6 Deepwater Bioregions in Samoa

Draft names

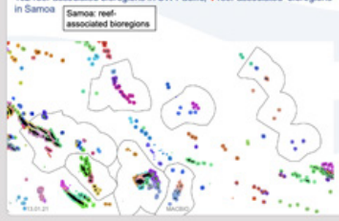
1. American Samoa - Cook Islands Abyssal Mountains
2. American Samoa Basin and North Tonga Trench
3. Northern Tonga Trench
4. Swains Atoll and Nassau Island Deep
5. Wallis, Samoa and American Samoa
6. Southeast Rotuma, Isle De Horne, Futuna,Samoa and Niuas plateau

23

Result: Reef-associated (shallow) bioregions

102 reef-associated bioregions in SW Pacific; 1 reef-associated bioregions in Samoa

Samoa: reef-associated bioregions



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Result: Reef-associated (shallow) bioregions
1 reef-associated bioregions in Samoa
Draft name
Polynesian associated reefs
Countries where this bioregion is found
Tuvalu; Wallis and Futuna; Samoa; American Samoa; Niue; French Polynesia
Savai'i
Upolu
25
Questions?
GCCA+
IUCN
SUNGO
26
Review of the draft preliminary marine bioregions for Samoa's – Hans Wendt
GCCA+
IUCN
SUNGO
27
Agenda Items 5: Break-out groups
Agenda Items 5: Break-out groups
a) Resource wall (hard copy maps posted on the wall of (i) some of the 30-odd datasets used in technical analysis and (ii) over 20 other datasets that might be useful
b) Hard copy maps and input forms on tables to guide discussions
c) GIS data (with GIS person to drive it) per table – can pull up any of 140 datasets relevant to Samoa including draft preliminary bioregions
28
Agenda Item 5. Review the draft preliminary deep-water marine bioregion boundaries and descriptions
Breakout groups: nominate a rapporteur
All groups to consider:
1. Boundaries and location of the bioregions
2. Names for the bioregions
3. Description of the bioregions
Feedback from breakout groups
29
Group work
For each deepwater bioregion consider:
• The bioregion location and boundaries – do any boundaries need to change? Do any bioregions need to be merged or split?
• The bioregion name – provide your own
• The bioregions description – review & add to the deepwater bioregion descriptions.
30
Agenda Item 6. Review the draft preliminary reef-associated bioregion boundaries and descriptions
Breakout groups: nominate a rapporteur
All groups to consider:
1. Boundaries and location of the bioregions
2. Names for the bioregions
3. Description of the bioregions
Feedback from breakout groups
31
Group work
For each reef-associated bioregion consider:
• The bioregion location and boundaries – do any boundaries need to change? Do any bioregions need to be merged or split?
• The bioregion name – provide your own
• The bioregions description - create descriptions for the reef-associated bioregions
32
Agenda Item 7 – Next steps
• Digitise and/or type up information from Bioregions Workshop
• Prepare minutes/notes from these on Bioregions workshop & distribute w map to participants for input
• Provide same to consultant to prepare report
• Distribute draft report back to participants for input
33

7.4 Appendix 4 – Workshop information gathering

Samoa Bioregions Worksheet

Group/table #	Facilitator:	Rapporteur:
Group Members (names)	Bioregions numbers:	
	General Location:	
Task	**Additional Information**	
Description of the bioregions – review & add to any of the **deepwater** bioregion descriptions; create descriptions for the **reef-associated** bioregions		
Boundaries and location of the bioregions - do any boundaries need to change? Do any bioregions need to be merged or split? Draw any suggested boundary changes onto the map.		
Name for the bioregions - suggest your own locally relevant.		

Questions to Consider when answering

Reef Associated Bioregions description

(a) Can you identify the environmental conditions/characteristics that are similar within the bioregions i.e current strength, proximity to land, rivers, wind, habitat/community types, localised upwellings etc

(b) Identify parts of the bioregion that do not make sense (ie look like they don't share the same environmental conditions)

Boundaries

(a) Looking at the bioregion boundaries – does the bioregion capture the correct features? Should it be moved towards or away from reefs/rivers etc?

Deepwater Bioregions description

(a) Briefly view the 'summary' provided for the deepwater bioregions. Can you see any patterns or major influences? i.e., chlorophyll, sea surface temperature, mixed layer depth, bathymetry

(b) Are there any bioregions that stand out or that you can provide any further comments/ details on (geomorphology, productivity)?

Boundaries

(a) Looking at the bioregion boundaries – does the bioregion capture the correct features? Should it be moved towards or away from reefs?

7.5 Appendix 5 – Data available to workshop participants

List of bioregions maps, resource wall and e-copy maps and GIS data

Note: RED font identifies data that were used to derive the draft bioregions. The black font indicates data that were NOT used to derive bioregions but directly related to the environmental conditions and biological information including on how species are distributed in the ocean.

Bioregions maps used for feedback

1. Deepwater bioregions map at EEZ scale
2. Shallow reef-associated bioregions map

Resource wall (hard copy maps posted on the walls)

1. Samoa bathymetry – used in developing bioregions
2. Samoa silicate concentration – used in developing bioregions
3. Samoa sea surface temperature – used in developing bioregions
4. Samoa chlorophyll a concentration – used in developing bioregions
5. Samoa mixed layer depth – used in developing bioregions
6. Samoa nitrate concentration in the ocean – used in developing bioregions
7. Samoa dissolved oxygen – used in developing bioregions
8. Samoa photosynthetically available radiation – used in developing bioregions
9. Samoa phosphate concentration – used in developing bioregions
10. Samoa marine species richness all species from aquamaps
11. Samoa benthic marine species richness from aquamaps
12. Samoa pelagic marine species richness from aquamaps
13. Samoa cold water corals
14. Samoa coral species richness
15. Samoa currents
16. Samoa cyclone tracks
17. Samoa downwelling diffuse attenuation coefficient
18. Samoa downwelling eddy frequency
19. Samoa ecologically and biologically significant areas (EBSA)
20. Samoa important bird areas (IBAs)
21. Samoa front count
22. Samoa geomorphology
23. Samoa hydrothermal vents
24. Samoa mangroves, reefs
25. Samoa particulate organic carbon flux
26. Samoa reefs at risk
27. Samoa seamounts and seamount morphology classification
28. Samoa historic tsunami location
29. Samoa upwelling
30. Samoa ocean productivity

E-copy of data in GIS files

All of the hardcopy maps listed above were also available on the GIS. In addition, the following data were available on the GIS and has since been centrally stored on the Cook Islands geo portal housed at Infrastructure Cook Islands (ICI) in line with Cook Islands spatial data policy.

1. Base layers
   a. Samoa EEZ
   b. Samoa Coastlines
   c. Bathymetry data
   d. Underwater feature names

2. Environmental variables
   a. Sea surface temperature – used in developing bioregions
   b. Temperature at 1000 meters depth – used in developing bioregions
   c. Temperature at 200 meters depth – used in developing bioregions
   d. Temperature at 30 meters depth – used in developing bioregions
   e. Depth of 20 degree isotherm – used in developing bioregions
   f. Mixed layer depth – used in developing bioregions
   g. Salinity – used in developing bioregions
   h. pH – used in developing bioregions
   i. Photosynthetically available radiation – used in developing bioregions
   j. Nitrate – used in developing bioregions
   k. Calcite – used in developing bioregions
   l. Silicate – used in developing bioregions
   m. Phosphate – used in developing bioregions
   n. Depth – used in developing bioregions

3. Bio-physical data
   a. Chlorophyll-a concentration – used in developing bioregions
   b. Geomorphological features
      i. Shelf classification (high, medium, low)
      ii. Escarpment
      iii. Basin
      iv. Bridge
      v. Guyot
      vi. Seamount
      vii. Rift valley
      viii. Trough
      ix. Ridge
      x. Spreading ridge
      xi. Terrace
      xii. Trench
      xiii. Plateau
      xiv. Abyssal classification (mountain, hill, plain)
      xv. Slope
      xvi. Hadal

7.6 Appendix 6 – Description of the draft and final, revised deepwater bioregions of Samoa.

Orange shading shows the original (draft) bioregions, and green shading shows the new (revised) bioregions.

ID	Depth Range	EEZ	Draft Name	Draft Description	Suggestion	Group	New Number	New Name	Group	Description
1	5,000 - 5,500	ASM, COK, WSM, TON	American Samoa - Cook Islands Abyssal Mountains	Begins on the northern tip of the Tonga EEZ on a basin and abyssal mountain. SST is high; chlorophyll-a concentrations, 20°C isotherm and deep-water temperature are low. Mixed layer depth, salinity, pH levels, nitrate and solar irradiance are moderate. Calcite is low and variable and dissolved oxygen concentrations are low and stable. Strong sea surface currents generally flow from the northeast. Contains 5 seamounts type 2 (small with deep peak, most common type); 5 seamounts type 3 (intermediate size, large tall and deep); 3 seamounts type 7 (small and short with very deep peaks, shortest); 5 seamounts type 8 (small and short with very deep peaks, deepest type) and 2 seamounts type 10 (large and tall with shallow peak: shallow). Contains 1 active, confirmed hydrothermal vent. The upper depth is 5,000m and the lower depth is 5,500m.	Merge	Black	1	Loto-i-Toga	Green	Contains Tonga trench and abyssal hills and cuts through Tonga, Niue and American Samoa. SST is high, chlorophyll-a concentrations, 20°C isotherm and the deep-water temperature are low. Mixed layer depth, salinity, pH levels, nitrate and solar irradiance are moderate. Calcite is low and variable and dissolved oxygen concentrations are low and stable. Strong sea surface currents generally flow from the northeast. Contains or intersects 13 seamounts type 2 (small with deep peak, most common type); 9 seamounts type 3 (intermediate size, large tall and deep); 4 seamounts type 7 (small and short with very deep peaks, shortest); 8 seamounts type 8 (small and short with very deep peaks, deepest type); 7 seamounts type 10 (large and tall with shallow peak: shallow) and 2 seamounts type 11 (intermediate size, largest basal area and deepest peak depth). Contains 2 active, confirmed; 1 active, inferred and 1 inactive hydrothermal vents. The upper depth is 3,500m and the lower depth is 7,500m.
2	5,000 - 5,500	ASM, COK, WSM, TON, NIU	American Samoa Basin and North Tonga Trench	Contains Tonga trench and abyssal hills and cuts through Tonga, Niue and American Samoa. SST is high, chlorophyll-a concentrations, 20°C isotherm and the deep-water temperature are low. Mixed layer depth, salinity, pH levels, nitrate and solar irradiance are moderate. Calcite is low and variable and dissolved oxygen concentrations are low and stable. Strong sea surface currents generally flow from the northeast. Contains or interests 8 seamounts type 2 (small with deep peak, most common type); 3 seamounts type 3 (intermediate size, large tall and deep); 1 seamount type 7 (small and short with very deep peaks, shortest); 3 seamounts type 8 (small and short with very deep peaks, deepest type); 4 seamounts type 10 (large and tall with shallow peak: shallow) and 2 seamounts type 11 (intermediate size, largest basal area and deepest peak depth). The upper depth is 5,000m and the lower depth is 5,500m.						

3	3,500 - 7,500	WSM, TON	Northern Tonga Trench	Begins on the northern part of the Tonga Trench. Contains seamounts formed on ridges sitting on abyssal hills and mountains. SST is high, chlorophyll-a concentrations, 20°C isotherm and the deepwater temperature are low. Mixed layer depth, salinity, pH levels, nitrate and solar irradiance are moderate. Calcite is low and variable and dissolved oxygen concentrations are low and stable. Strong sea surface currents generally flow from the northeast. Intersects 1 seamount type 3 (intermediate size, large tall and deep) and 1 seamount type 10 (large and tall with shallow peak: shallow). Contains 1 active, confirmed, 1 active, inferred and 1 inactive hydrothermal vent. The upper depth is 3,500m and the lower depth is 7,500m.						
4	4,500 - 5,500	WLF, ASM, COK, WSM, TKL	Swains Atoll and Nassau Island Deep	Mostly seamounts, abyssal features (plains, hills and mountains), basin and steep escarpments. SST is moderate and stable, chlorophyll-a concentrations are low and variable, salinity is low, dissolved oxygen is low and stable, deep-water temperature and 20°C isotherm are deep, mixed layer depth is medium, solar irradiance is high, pH level is low, silicate, phosphate and nitrate levels are moderate, calcite is low. Contains 1 seamount type 1 (small with deep peak, short with moderately deep peak); 18 seamounts type 2 (small with deep peak, most common type); 4 seamounts type 3 (intermediate size, large tall and deep); 1 seamount type 7 (small and short with very deep peaks, shortest); 13 seamounts type 8 (small and short with very deep peaks, deepest type); 6 seamounts type 10 (large and tall with shallow peak: shallow) and 1 seamount type 11 (intermediate size, largest basal area and deepest peak depth). Includes 7 blind canyon types and 1 shelf incising canyon type. The upper depth is 4,500m and the lower depth is 5,500m.	Merge	Black	2	La'i	Black	Bioregion north of the Niua Islands and includes two seamounts forming on ridges and escarpments. Other dominant features include plateau and spreading ridges, abyssal features (plains, hills and mountains), basin and steep escarpments. SST is moderate to high and stable, chlorophyll-a concentrations and salinity are low and variable, dissolved oxygen is low and stable, deep-water temperature and 20°C isotherm are deep, mixed layer depth is medium, solar irradiance is moderate to high, pH level is low to moderate, silicate, phosphate and nitrate levels are moderate, calcite is low. Contains 1 seamount type 1 (small with deep peak, short with moderately deep peak); 18 seamounts type 2 (small with deep peak, most common type); 6 seamounts type 3 (intermediate size, large tall and deep); 4 seamounts type 5 (intermediate size, small, moderately tall and shallowest peak depths of this group); 1 seamount type 7 (small and short with very deep peaks, shortest); 13 seamounts type 8 (small and short with very deep peaks, deepest type); 13 seamounts type 10 (large and tall with shallow peak: shallow) and 1 seamount type 11 (intermediate size, largest basal area and deepest peak depth). Includes 7 blind canyon type and 1 shelf incising canyon type. Contains 1 active, confirmed and 2 active, inferred hydrothermal vents. The upper depth is 2,000m and the lower depth is 5,500m.

ID	Depth Range	EEZ	Draft Name	Draft Description	Suggestion	Group	New Number	New Name	Group	Description
6	2,000 - 5,500	TUV, WLF, FJI, WSM, TON	Southeast Rotuma, Isle De Horne, Futuna,Samoa and Niuas plateau	Bioregion north of the Niua Islands including two seamounts forming on ridges and escarpments. Other dominant features include plateau and spreading ridges. SST is high and stable, chlorophyll-a concentrations are low and stable, salinity is low and variable, dissolved oxygen is low and stable, deep-water temperature and 20°C isotherm are deep, mixed layer depth is medium; solar irradiance, pH, silicate, phosphate and nitrate levels are moderate, calcite is low. Contains 2 seamounts type 3 (intermediate size, large tall and deep); 4 seamounts type 5 (intermediate size, small, moderately tall and shallowest peak depths of this group) and 7 seamounts type 10 (large and tall with shallow peak: shallow). Contains 1 active, confirmed and 2 active, inferred hydrothermal vents. The upper depth is 2,000m and the lower depth is 5,500m.						
5	2,000 - 5,000	WLF, ASM, COK, WSM, TON	Wallis, Samoa and American Samoa	Includes medium size seamounts, northern parts of the Tonga Trench, ridges that form the base of American Samoa with numerous canyons. SST is high, chlorophyll-a concentrations are low and variable, salinity is low, dissolved oxygen is low and stable, deep-water temperature and 20°C isotherm are deep, mixed layer depth is medium, solar irradiance is high, pH level is low, silicate, phosphate and nitrate levels are moderate, calcite is low. Contains 1 seamount type 1 (small with deep peak, short with moderately deep peak); 7 seamounts type 2 (small with deep peak, most common type); 9 seamounts type 3 (intermediate size, large tall and deep); 1 seamount type 7 (small and short with very deep peaks, shortest); 1 seamount type 8 (small and short with very deep peaks, deepest type); 2 seamounts type 9 (Large and tall with shallow peak, larger); 10 seamounts type 10 (large and tall with shallow peak: shallow) and 1 seamount type 11 (intermediate size, largest basal area and deepest peak depth). Includes 16 blind canyon types and 12 shelf incising canyon types. The upper depth is 2,000m and the lower depth is 5,000m.	Split	Green	3	Vasa-i-Saute	Green	Includes medium size seamounts, northern parts of the Tonga Trench, ridges, hadal habitats, escarpments, canyons, basins, abyssal mountains, abyssal hills, abyssal plains, terraces and slopes. Downwelling occurs in this bioregion. SST is high, chlorophyll-a concentrations are low and variable, salinity is low, dissolved oxygen is low to medium and stable, deep-water temperature and 20°C isotherm are deep, mixed layer depth is medium, solar irradiance is high, pH level is low, silicate, phosphate and nitrate levels are moderate, calcite is low, photosynthetically active radiation is medium to high. Contains 2 seamounts type 3 (intermediate size, large tall and deep) and 1 seamount type 10 (large and tall with shallow peak: shallow). Includes blind canyons and shelf incising canyons. The upper depth is 2,000m and the lower depth is 5,000m.
					Split	Green	4	Fāfā-o-Mauga	Green	Includes ridges, seamounts, guyots, escarpments, canyons, shelf (high shelf), abyssal mountains, abyssal hills, abyssal plains and slope. There is a moderate to high habitat suitability for cold water corals. SST is high, chlorophyll-a concentrations are low and variable, salinity is low, dissolved oxygen is low to medium and stable, deep-water

										temperature and 20°C isotherm are deep, mixed layer depth is medium, solar irradiance is high, pH level is low, silicate, phosphate and nitrate levels are moderate, calcite is low, photosynthetically active radiation is medium to high. Contains 1 seamount type 1 (small with deep peak, short with moderately deep peak); 1 seamount type 2 (small with deep peak, most common type); 2 seamounts type 3 (intermediate size, large tall and deep) and 9 seamounts type 10 (large and tall with shallow peak: shallow). Includes blind canyons and shelf incising canyons. The upper depth is 2,000m and the lower depth is 5,000m.
					Split	Green	5	I'a manu	Green	Includes ridges, canyons, escarpments, terraces, slope and high shelf. Downwelling occurs in this bioregion, and there is a moderate to high habitat suitability for cold water corals. SST is high, chlorophyll-a concentrations are low to medium and variable, salinity is low, dissolved oxygen is low to medium and stable, deep-water temperature and 20°C isotherm are deep, mixed layer depth is medium, solar irradiance is high, pH level is low, silicate, phosphate and nitrate levels are moderate, calcite is low. Contains 1 seamount type 2 (small with deep peak, most common type) and 5 seamounts type 3 (intermediate size, large tall and deep). The upper depth is 2,000m and the lower depth is 5,000m.

7.7 Appendix 7 – Description of the draft and final, revised reef-associated bioregions of Samoa

Number	Number	Name	Description
Original reef-associated bioregions	1	Polynesian associated reefs	None
Revised reef-associated bioregions	1	Coastal barrier reef complex	Relatively sheltered, reef edge further from shore, creating a barrier reef and shallow coastal lagoon. Includes associated shelf slopes, diffuse fringing reefs and intra-lagoon patch reefs
	2	Ocean exposed fringing reef	Relatively exposed, reef edge further from shore, creating a barrier reef and shallow coastal lagoon. Includes associated shelf slopes, diffuse fringing reefs and intra-lagoon patch reefs
	3	Outer barrier reef complex	Unique barrier reef and lagoon complex found only on Savai'i
	4	Island lagoon	Semi-enclosed shallow island lagoon found only on Savai'i
	5	Shelf patch reef complex	Small areas of offshore patch reefs on both Savai'i and Upolu