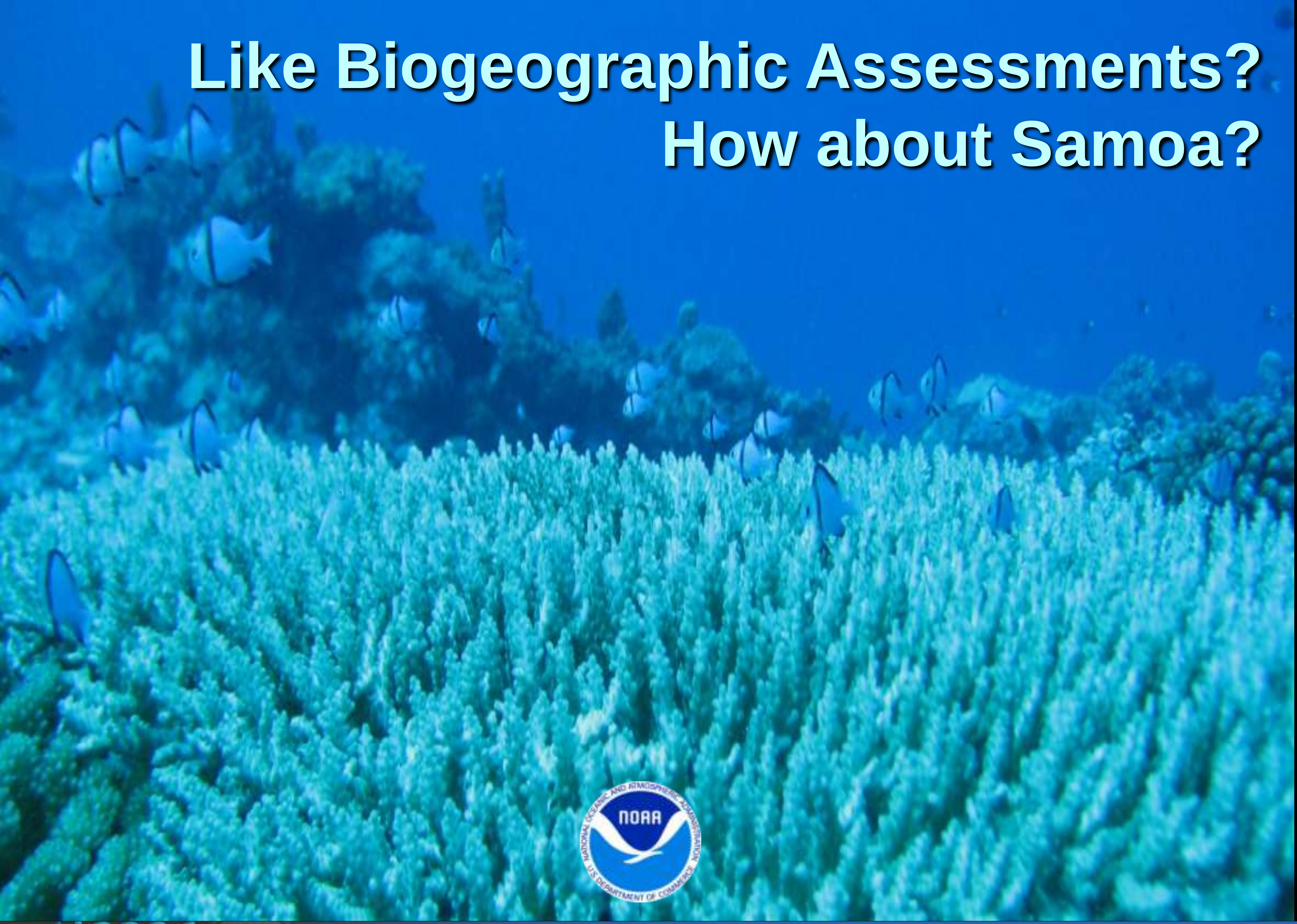
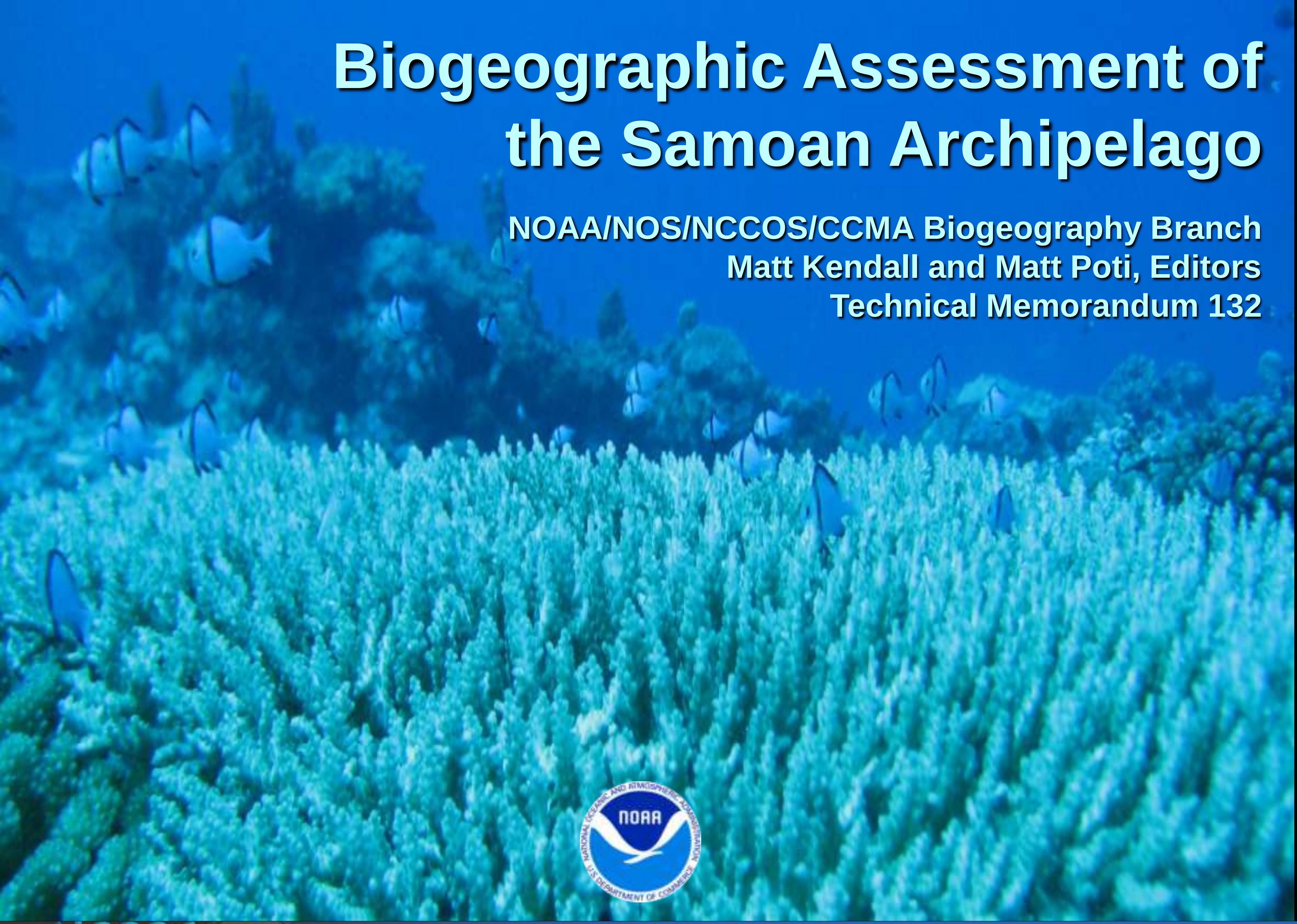
Like Biogeographic Assessments?
How about Samoa?





Biogeographic Assessment of the Samoan Archipelago

NOAA/NOS/NCCOS/CCMA Biogeography Branch
Matt Kendall and Matt Poti, Editors

Technical Memorandum 132

Chapter Topics

1. **Introduction**
   Kendall[1] and Poti[12]

2. **Ocean Climate**
   Pirhalla[3], Ransi[3], Kendall[1], and Fenner[4]

3. **Currents and Larval Connectivity**
   Kendall[1], Poti[12], Wynne[3], Kinlan[12], and Bauer[12]

4. **Reef Fish and Coral Communities**
   Kendall[1], Poti[1], Carroll[4], Fenner[4], Green[5], Jacob[4], Samuelu ah Leong[6], Kinlan[12], Williams[7], and Zamzow[7]

5. **Existing Marine Protected Areas of American Samoa**
   Poti[12], Kendall[1], Brighouse[8], Clark[9], Grant[8], Jacob[4], Lawrence[10], and Reynolds[9]

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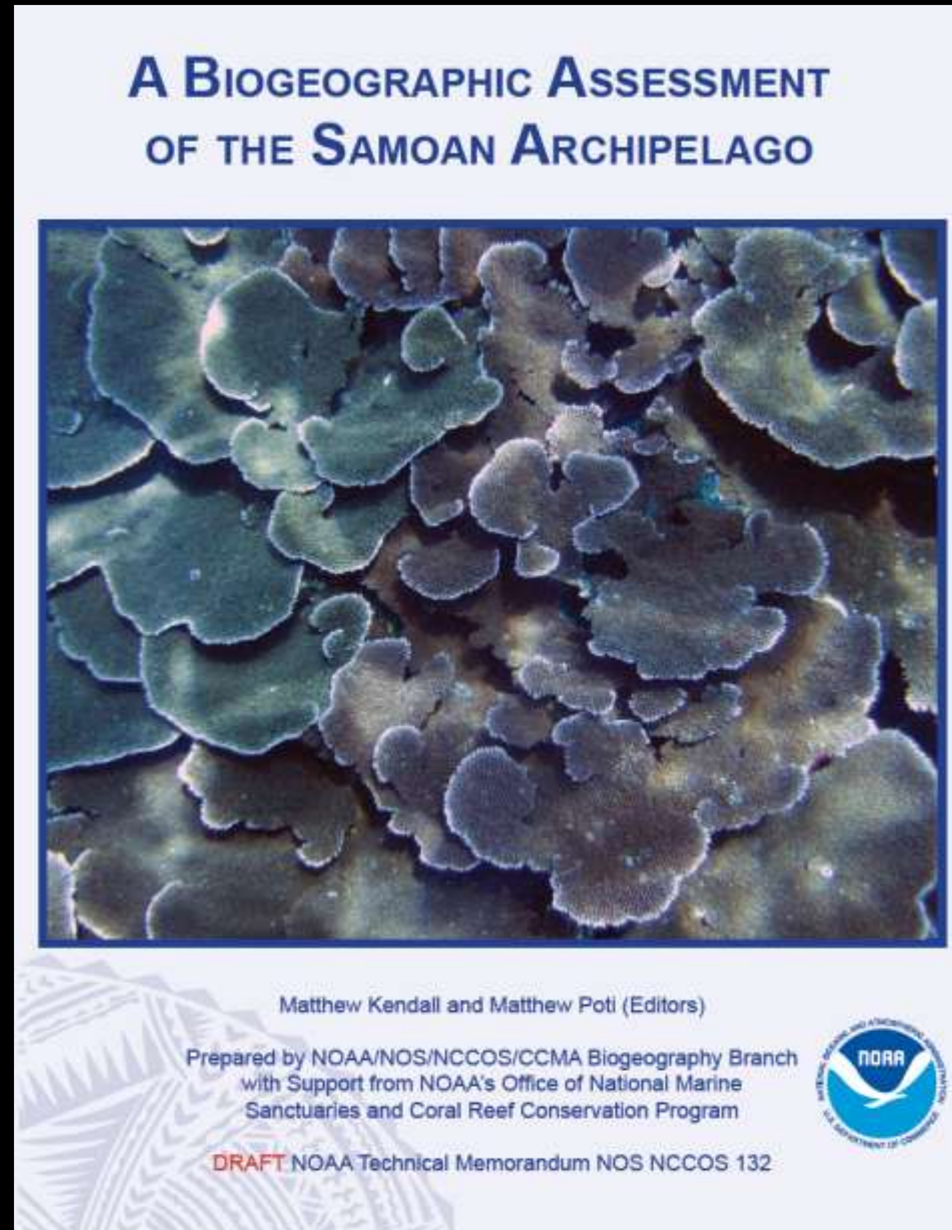
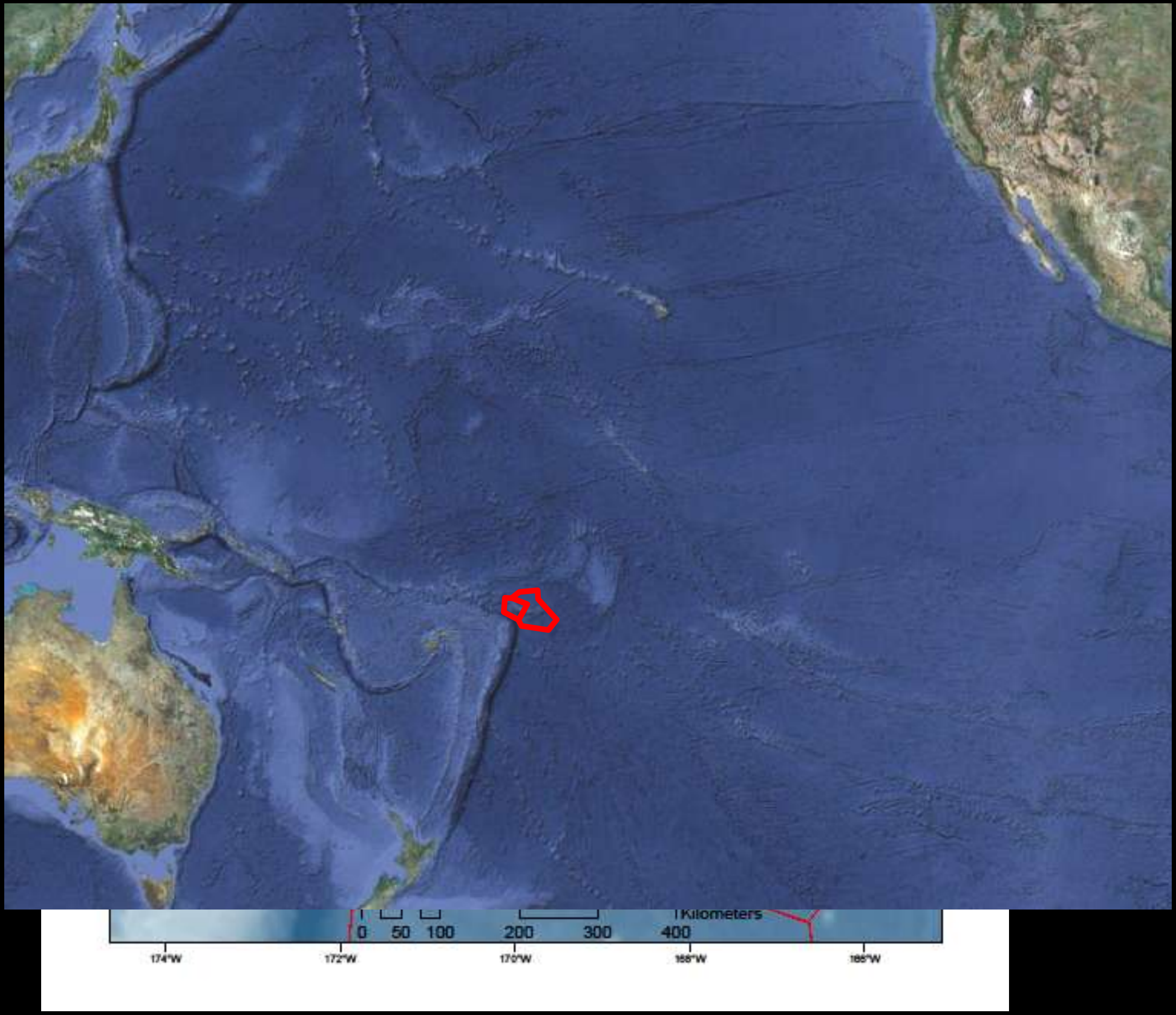


Chapter 1

- Defines biogeography
- Sets physical scope
    - Multiscale approach
- Describes analytical scope
    - Climate, reef fish, coral, larvae, habitats, MPAs
- Notes key conservation initiatives



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Chapter 2 - Oceanography

Oceanography of the Samoan Archipelago

Doug Pirhalla[1], Varis Ransi[1], Matthew S. Kendall[2] and Doug Fenner[3]

INTRODUCTION

The biogeography and health of coral reef ecosystems in the Samoan Archipelago are shaped in part by the oceanographic conditions and processes of the equatorial South Pacific. Larvae that reach the archipelago are carried to the region on ocean currents and those organisms that arrive and thrive must be adapted to the climatic conditions that characterize the region including temperature, winds, waves, nutrients, tides, sea level, and other factors. Once established, reef ecosystems can be stressed and modified by a wide range of climate-related phenomena such as elevated ocean temperatures, sea level fluctuations, and ocean acidification. Many oceanographic and atmospheric processes affecting Samoan reefs are presently in flux due to global climate change (Chase and Veitayaki 1992, Timmerman et al. 1999, US EPA 2007, Young 2007, Barshis et al. 2010). This chapter provides a summary of regional atmospheric and oceanographic conditions and trends including winds, waves, currents, sea surface temperature, chlorophyll, and sea surface height anomalies, and discusses potential influences they may have on Samoan reef ecosystems.

Image 7. A close-up look at a diverse benthic community. Photo credit: Matt Kendall, NOAA, Biogeography Branch.

Climate Background

The climate of the Samoan Archipelago is characterized by year-round mild air temperatures, high humidity, persistent easterly or northeasterly trade winds, and infrequent but severe cyclonic storms. Mean daily air temperature varies between 22°C and 30°C (SPSLCMP 2007). The islands are noted for high annual rainfall that averages >3,000 mm (120 inches) per year but varies locally depending on topography (http://www7.ncdc.noaa.gov/CDO/cdo). Maximum rainfall occurs in the austral summer (December-February) where it can exceed 300 mm/month. In winter (June-August), rainfall is 30% lower at approximately 200 mm/month.

Data and Methods

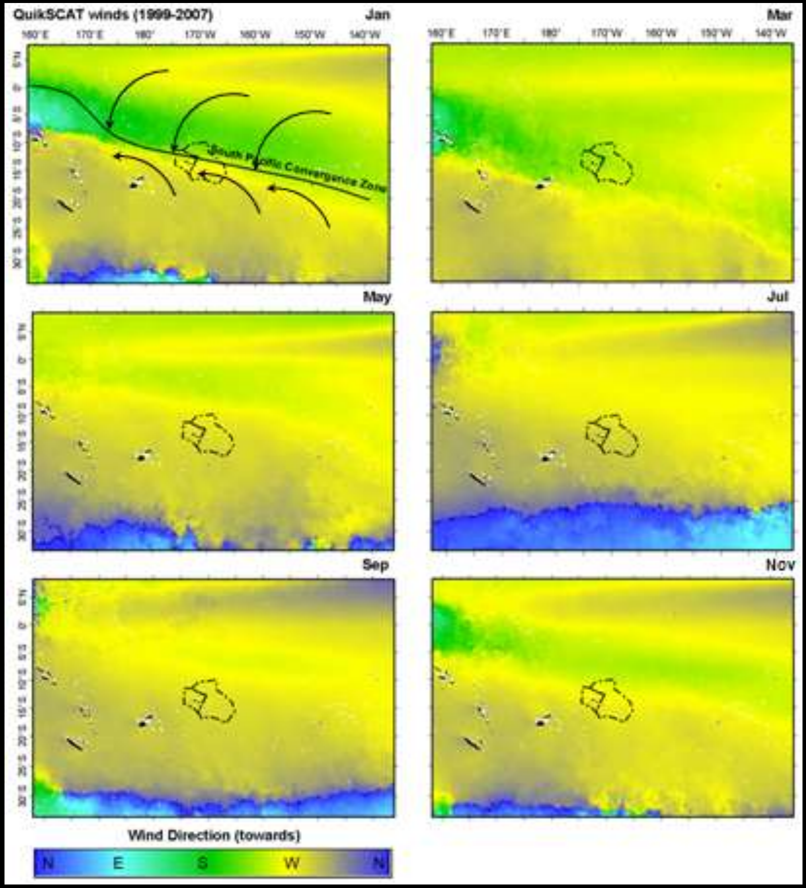
A diversity of satellite sensors has provided estimates of oceanic and atmospheric variables at global scales for the last few decades. These satellite-based datasets and other supporting information were used to describe the typical seasonal fluctuations, inter-annual variability, long-term trends, and anomalous events of importance to coral reef ecosystems in the Samoan Archipelago. Oceanographic variables in this assessment include winds, waves, ocean circulation, sea surface temperature, chlorophyll, and sea surface height anomalies. For each variable, the assessment provides: 1) a brief description of the remote sensing and other data that were analyzed, 2) a broad-scale overview of the major ocean features and processes at work while highlighting the position of the Samoa and American Samoa Exclusive Economic Zones (EEZs), 3) a finer-scale description of the seasonal patterns for each variable comparing ocean measurements close to the islands of Savaii (172.66 W, 14.26 S) and Tutuila (170.2 W, 14.26 S) respectively (for these analyses, ocean characteristics were extracted for an area of 80 km^2 at the same latitude excluding land and shallow water areas) and throughout the American Samoa EEZ (only the American Samoa EEZ is included for simplicity since it encompasses the conditions experienced in the Samoan EEZ). 4) a time series of available

[1] NOAA/NOS/NCCOS/CCMA Coastal Oceanographic Assessment Status and Trends Branch
[2] NOAA/NOS/NCCOS/CCMA Biogeography Branch
[3] American Samoa/Department of Marine and Wildlife Resources

page 7

Ocean Climate

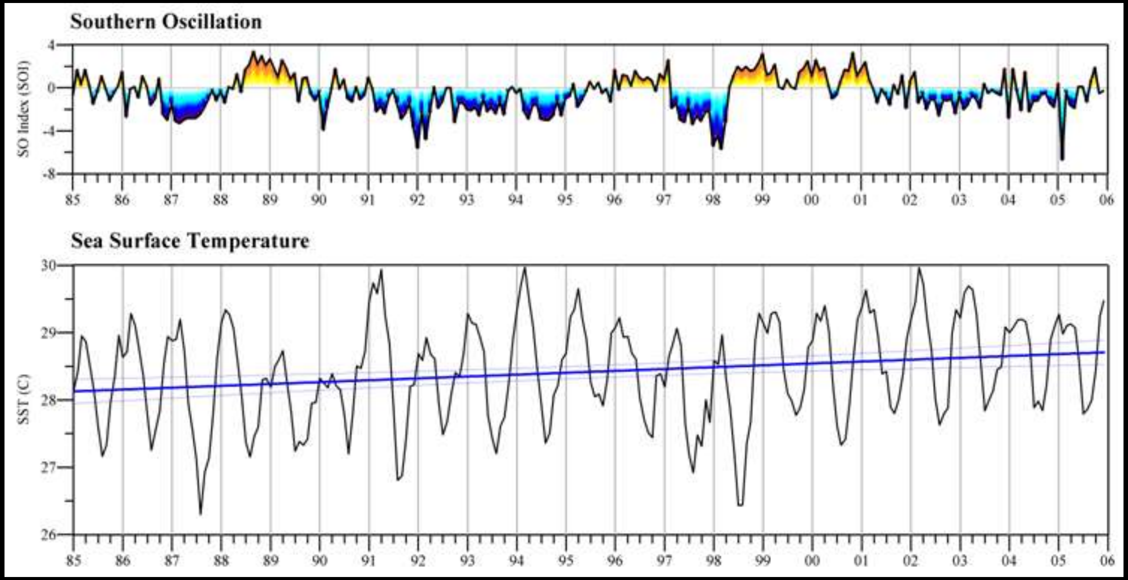
- Biogeography is shaped by ocean climate
- Wind, temperature, currents, chlorophyll, sea surface height, ENSO, and others
- Objectives were to describe:
    - Satellite data in local context
    - Regional, EEZ, local phenomena
    - Average seasonal fluctuations
    - Multiyear trends
    - SOI relationships
    - Anomalous observations

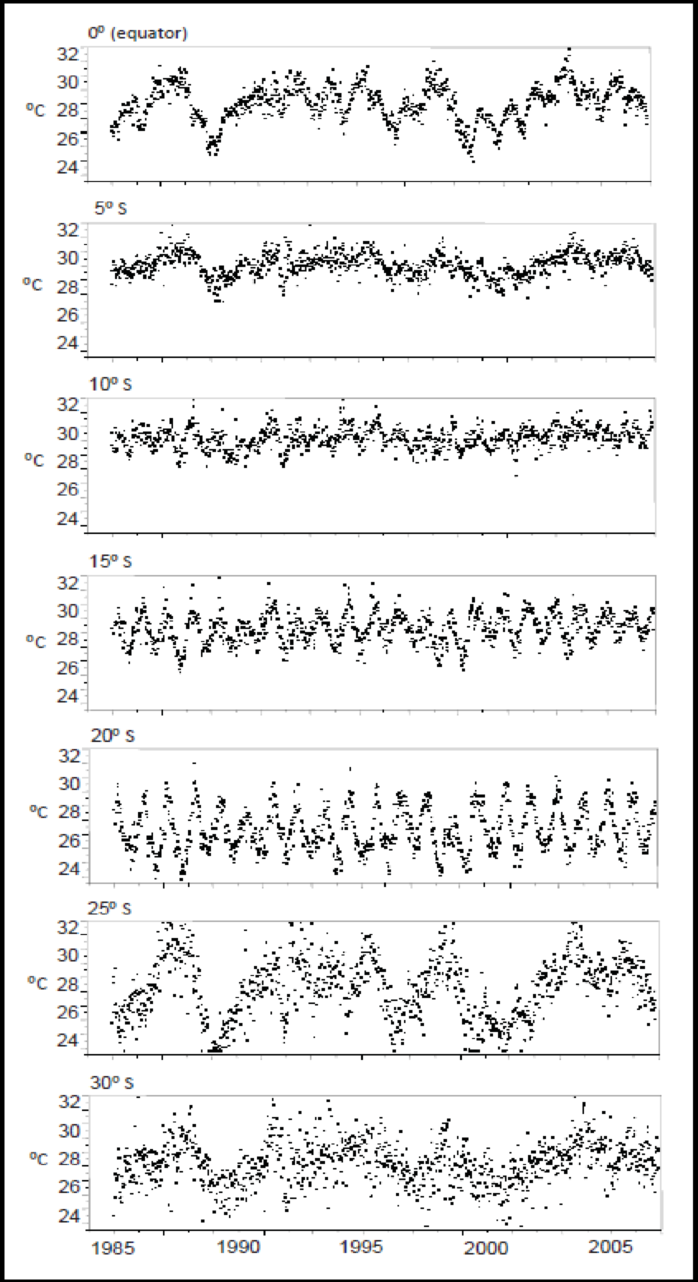


Sea surface temperature

- 1-3 ºC seasonal range
- ~ cooler during El Niño (- SOI)
- Steady rise ~0.5 ºC over 20 years
- Samoan stability

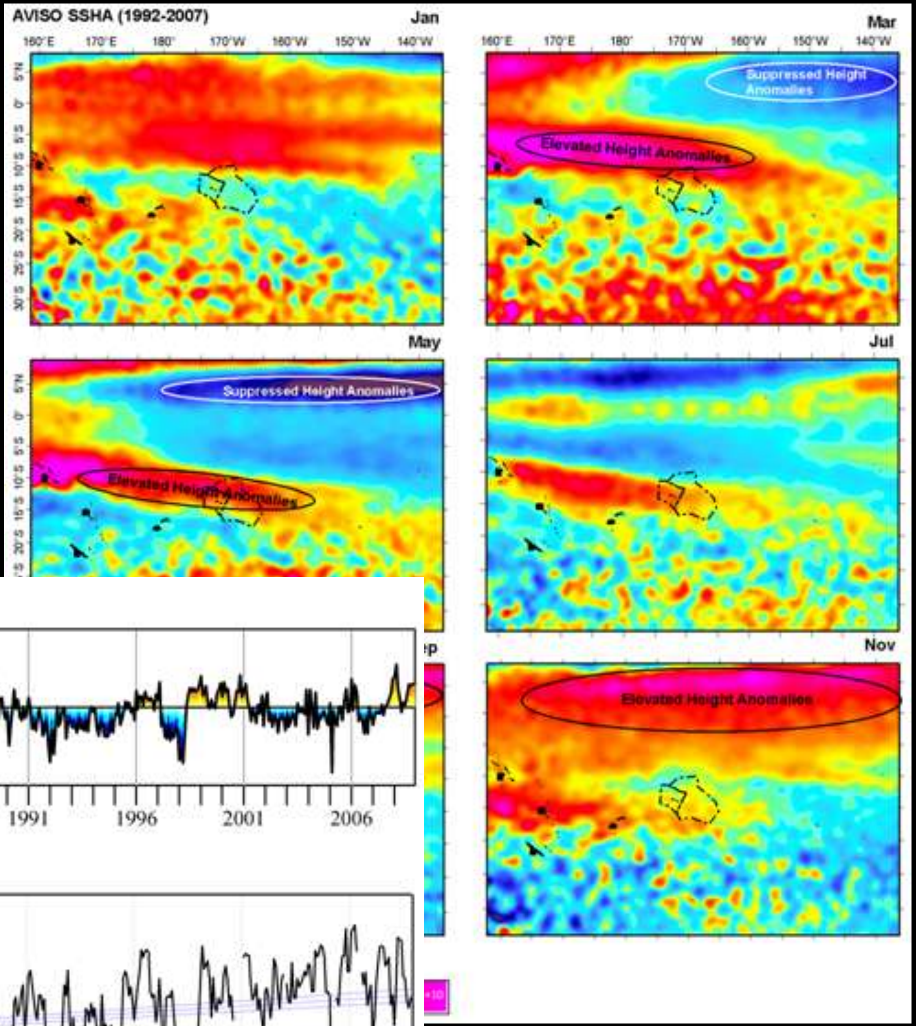
“this is a boring part of the ocean” D. Pirhalla

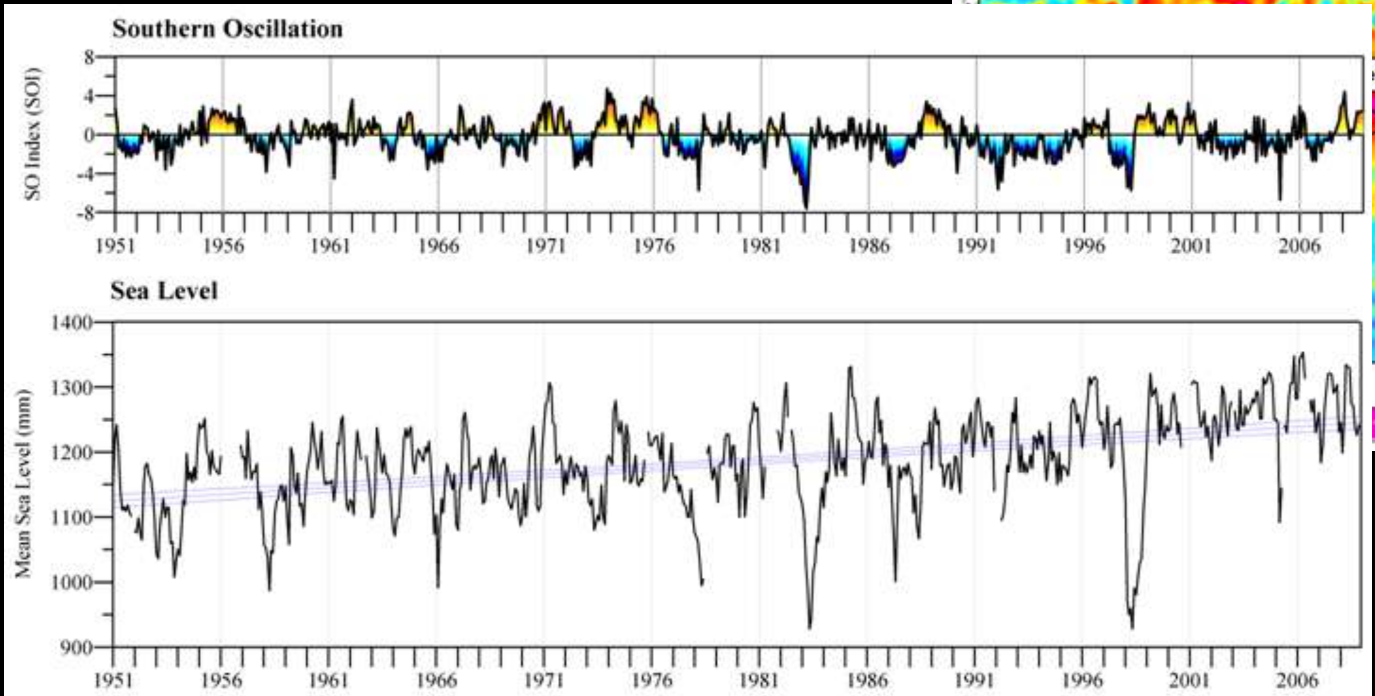




Sea surface height

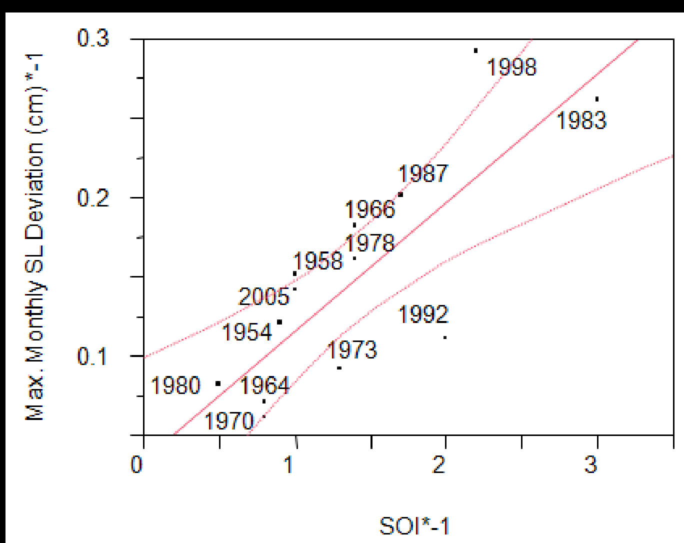
- Seasonal shifts in SEC/SECC
- Rising 2-4 mm per year
- Low tide/Low SSHA events

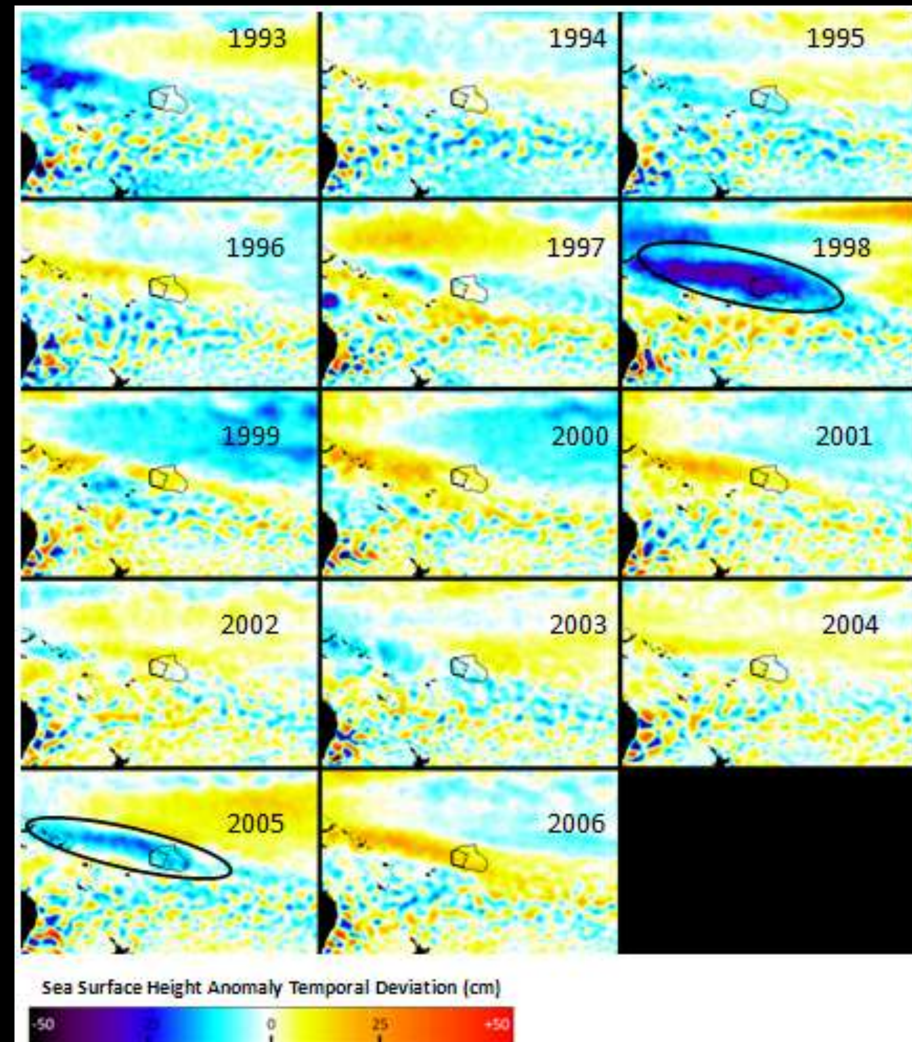




Sea surface height

- March anomalies every 4-8 yrs
- 10 - 30 cm depressions
- Significant SOI relationship
- Reef flat mortality events





“Reef flats” represent ~10% of reefs in American Samoa

Chapter 2 Ocean Climate: Key Findings

- More latitudinal than longitudinal variability
- Seasonal patterns in all variables
- Winds, currents, and SST more seasonally variable
- Chlorophyll and SSH more interannually variable
- Samoan EEZs lie in a relatively “stable” region
- Magnitude of anomalies/trends may be exacerbated by climate change which could have relatively greater consequences for reefs of the Samoan Archipelago which are “used to” stable conditions

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CHAPTER 3: OCEAN CURRENTS AND LARVAL TRANSPORT AMONG ISLANDS AND SHALLOW SEAMOUNTS OF THE SAMOAN ARCHIPELAGO AND ADJACENT ISLAND NATIONS

Kendall MS, M Poti, T Wynne, BP Kinlan and L Bauer

3.1 INTRODUCTION

The biogeography of coral reef ecosystems in the Samoan Archipelago is shaped in part by the ocean currents which carry the eggs and larvae of marine biota to and from the islands and seamounts in the region (Craig and Brainard 2008). Many of the marine organisms that inhabit the coral reef ecosystems of the region posses a pelagic larval phase. This includes bony fish, broadcast spawning corals, giant clams, palolo worms, crown-of-thorns starfish and a diversity of other fauna that are subject to transport by ocean currents for at least some portion of their larval life. The connectivity among island populations that results from larval transport is important because it means that the ecology, conservation, and management of each place in the Samoan Archipelago is intricately linked to and dependent on decisions made at other locations (Gaines et al. 2007, Christie et al. 2010). Even when management efforts are focused on particular sites within the archipelago, information on connectivity patterns via larval exchange is necessary to achieve management and conservation planning goals (Gaines et al. 2007, Cowen and Sponaugle 2009, Costello et al. 2010). This chapter provides a detailed characterization of ocean currents in and around the archipelago and discusses their potential influence on important sources of larvae for maintaining Samoan reef ecosystems, and the contribution of Samoan reefs to population replenishment throughout the regional ecosystem.

Image 7. Mass recruitment event of Ctenochaetus striatus. Photo credit: Peter Craig, NPS.

There has been a recent proliferation of studies on reef connectivity and MPA resilience (Almany et al. 2009, Jones et al. 2009, McCook et al. 2009, Steneck et al. 2009, Sale et al. 2010). It has become clear that planning a regional network of MPAs that are resilient to disturbance, whether natural or anthropogenic, is dependent upon an understanding of larval transport (Gaines et al. 2003, Shanks et al. 2003, Botsford et al. 2009, Planes et al. 2009). Sufficient larval sources must be protected and spaced appropriately such that network sites can successfully repopulate between disturbance events. In addition, the fates of larvae produced at network sites should be considered to understand the role of protected areas in maintaining the broader ecosystem (Botsford et al. 2009, Christie et al. 2010, Costello et al. 2010).

A variety of factors can affect the transport of larvae among islands. Most obviously it is necessary to understand the speed, direction, and seasonality of the ocean currents by which larvae are transported. It is also necessary to understand how aspects of the larvae themselves can affect their transport. Size of source populations, timing of spawning, duration of the larval period, daily mortality rates, sensory and swimming capabilities, and even random chance arising from the turbulent nature of ocean flows can all affect the probability that larvae will be transported from a source island to a particular destination (Siegel et al. 2008, Cowen and Sponaugle 2009).

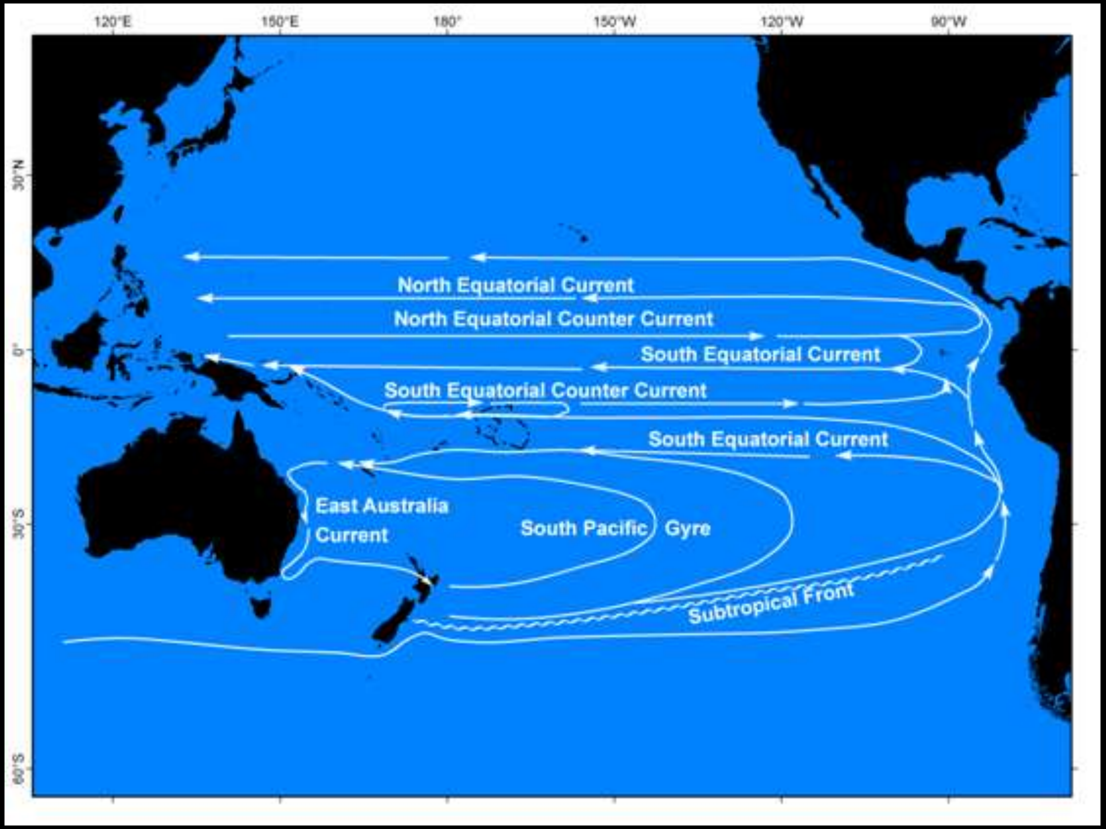
The goals of this chapter were to:

1. Quantify and describe regional ocean currents in the Samoan Archipelago.

Biogeography is shaped by ocean currents

Objectives:

- Describe main current features
- Quantify larval connectivity among islands

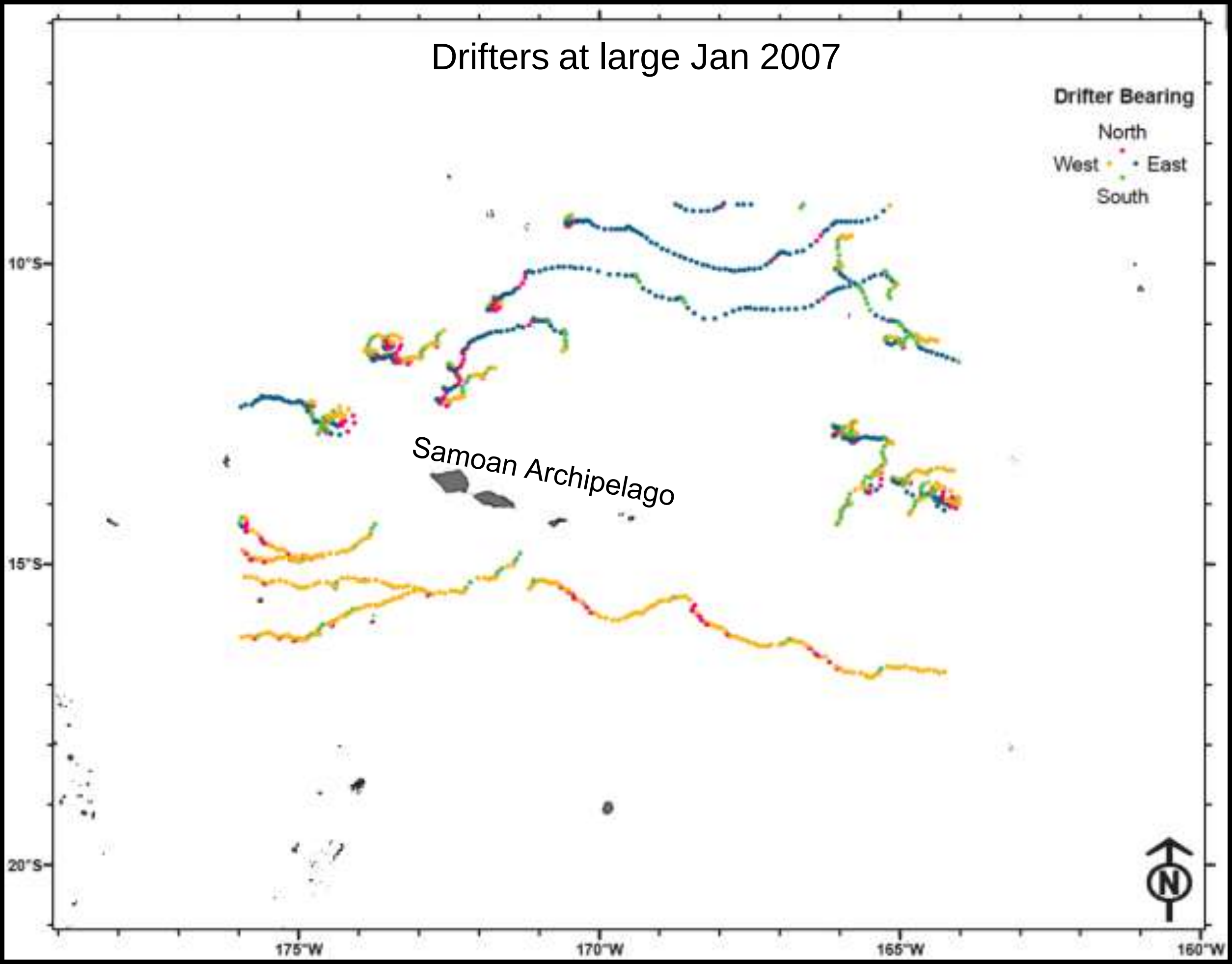


Current setting

- Basin gyre

Tools to Map Currents and Interisland Connectivity

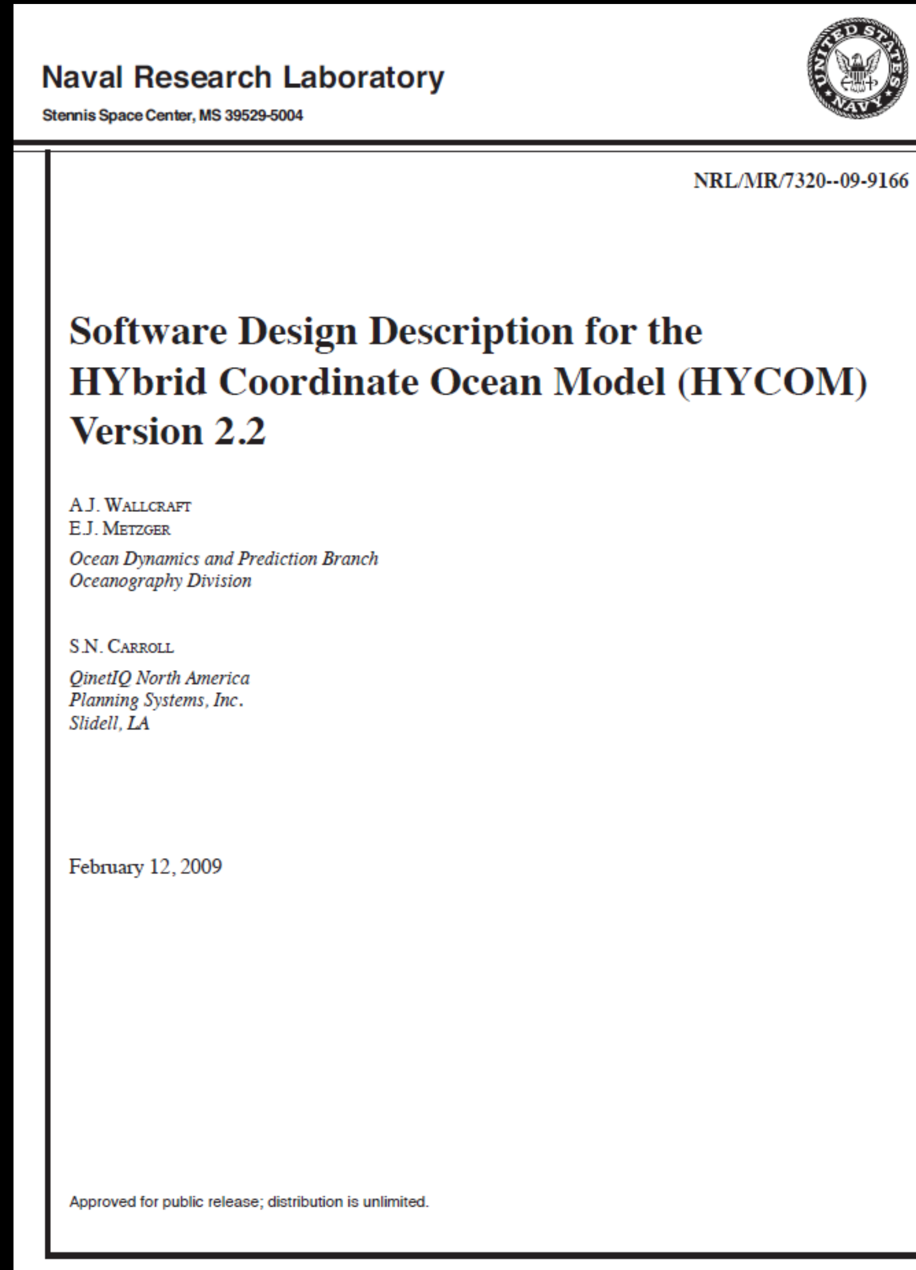
- Satellite-tracked drifters (n = 216); Global Drifter Program



Tools continued…

Hybrid Coordinate Ocean Model (HYCOM)

- 4 dimensional hydrodynamic model (x, y, z, t)
- Based on meteorological and oceanographic variables (e.g. wind, pressure, tide, temp.)
- Surface currents (10 m deep) 2004-2009
- 9 km grid size
- 6 hour time step


Naval Research Laboratory
Stennis Space Center, MS 39529-5004

NRL/MR/7320--09-9166

Software Design Description for the HYbrid Coordinate Ocean Model (HYCOM) Version 2.2

A.J. Wallcraft
E.J. Metzger
Ocean Dynamics and Prediction Branch
Oceanography Division

S.N. Carroll
QinetIQ North America
Planning Systems, Inc.
Slidell, LA

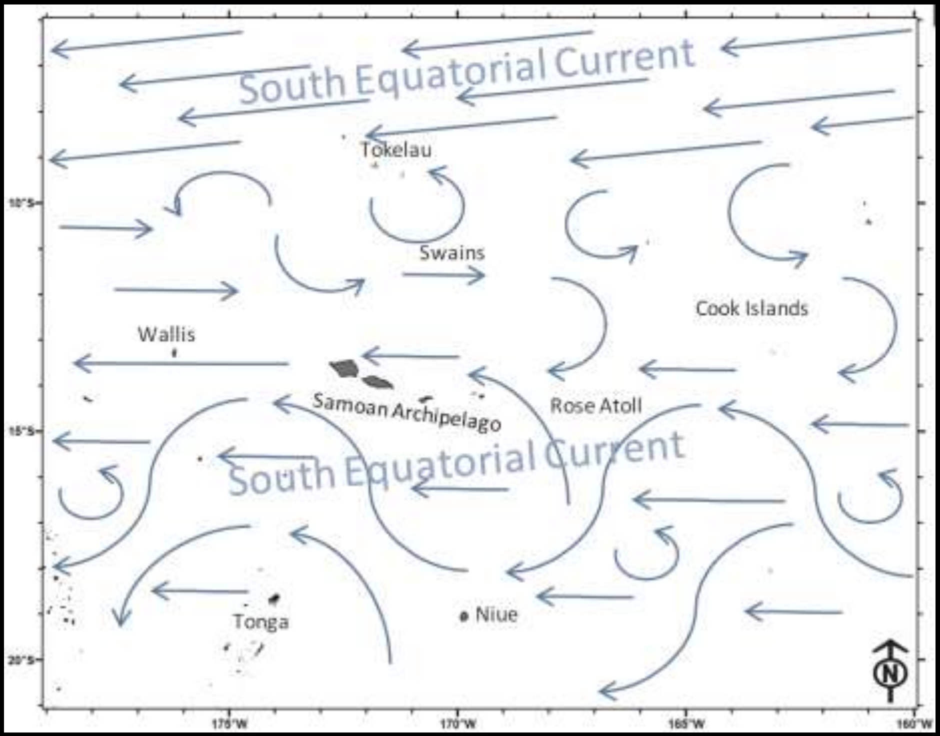
February 12, 2009

Approved for public release; distribution is unlimited.

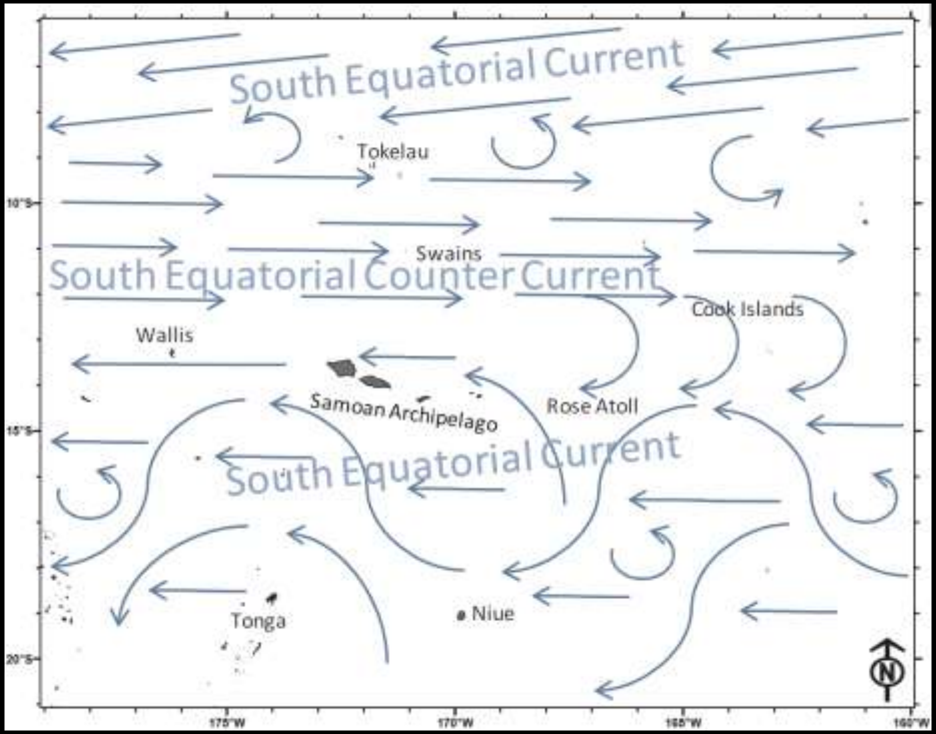
Defined 2 generalized current seasons and 3 current features

(used drifters to quantify heading and speed by season and ENSO)

- South Equatorial Current
- South Equatorial Counter Current
- Tonga Trench Eddy

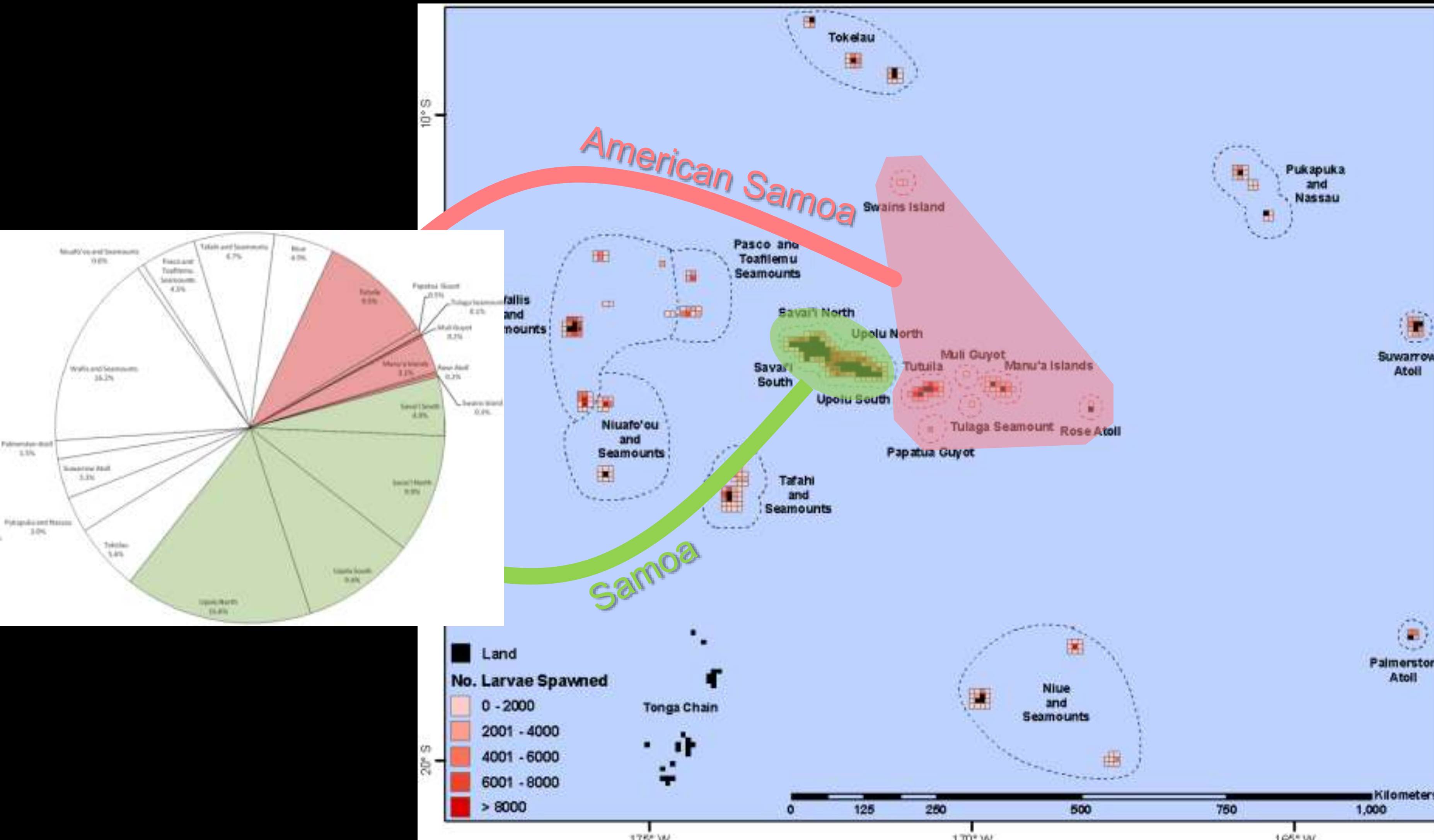


May - September



October – April

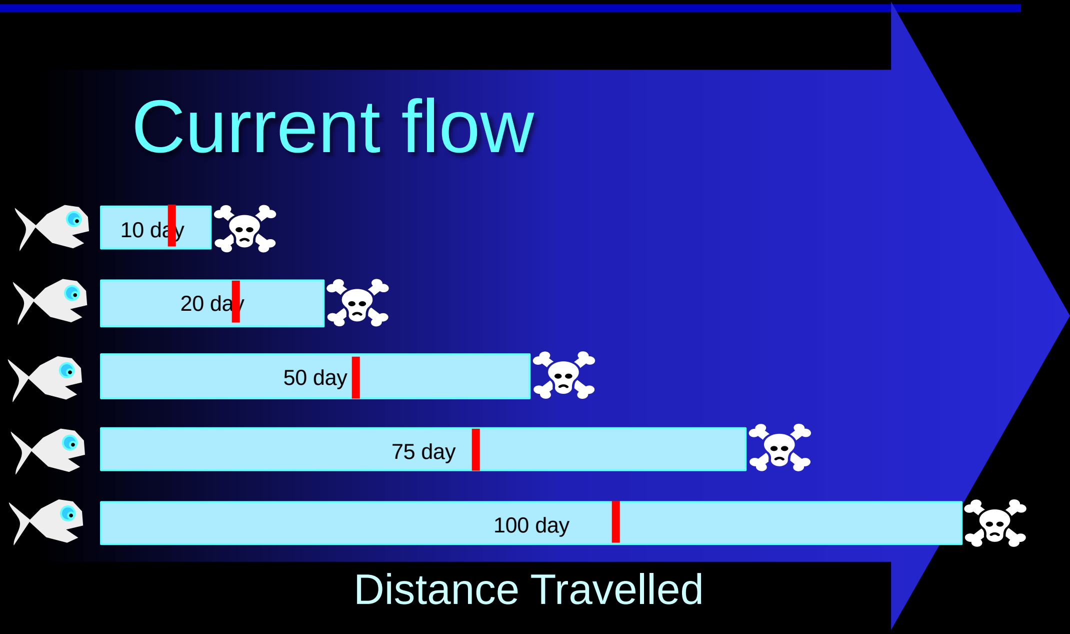
Larval Sources (scaled to potential reef ecosystem area <150 m*)



* Mesophotic Coral Ecosystems 2010, Bare et al. 2010

Modeled dispersion of >800,000 "passive" larvae with variable…

- Explored a range of values rather than specific species
- Annual mass spawning date (After full moons in Oct-Nov)
- Larval lifespan (10, 20, 30, 50, and 100 day Pelagic Larval Durations)
- Settlement competency period (>60% of PLD)
- Daily mortality (3, 18, and 46%)
- Reef sensing and swimming capability (9, 18, and 36 km settlement zones)



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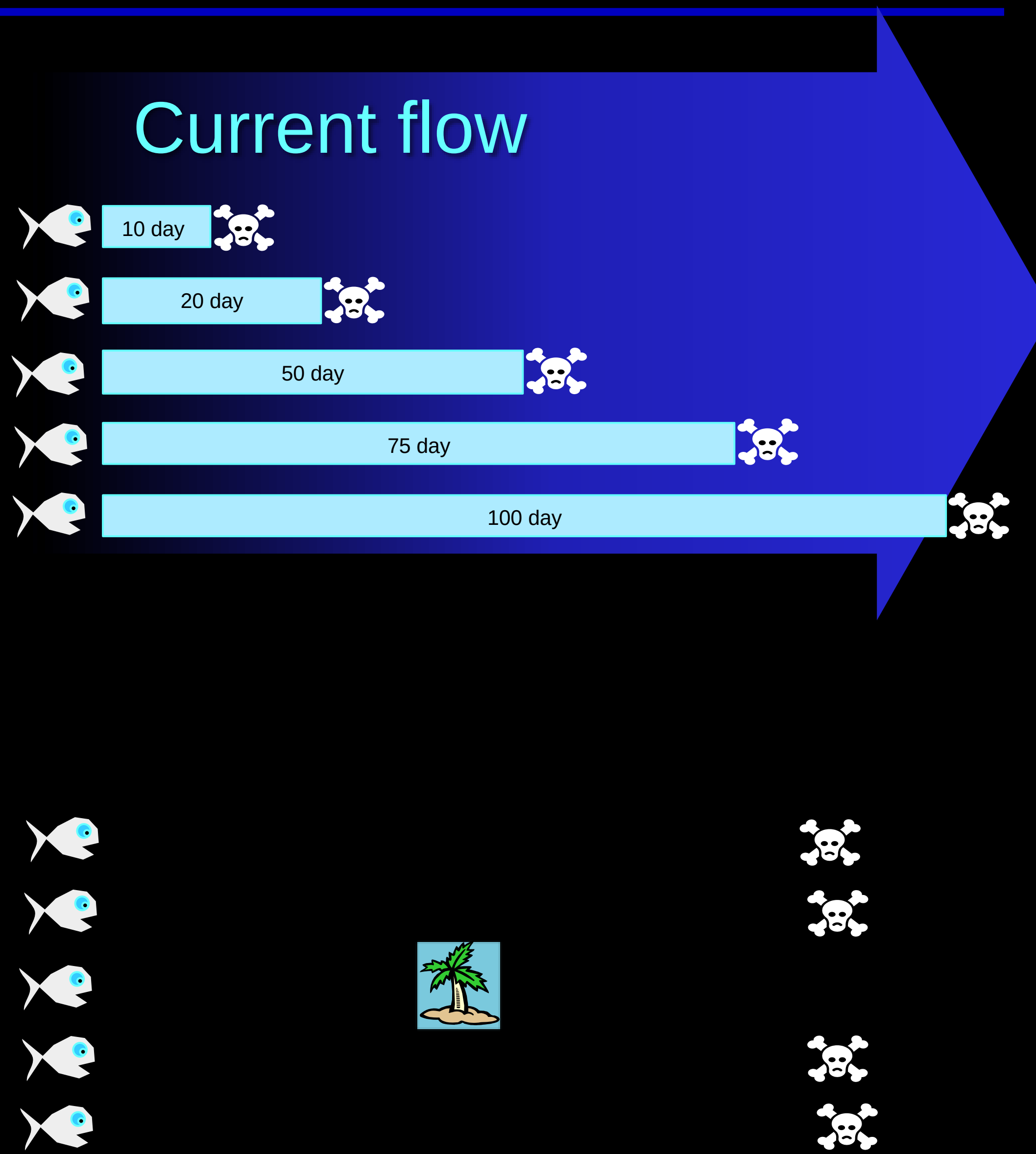

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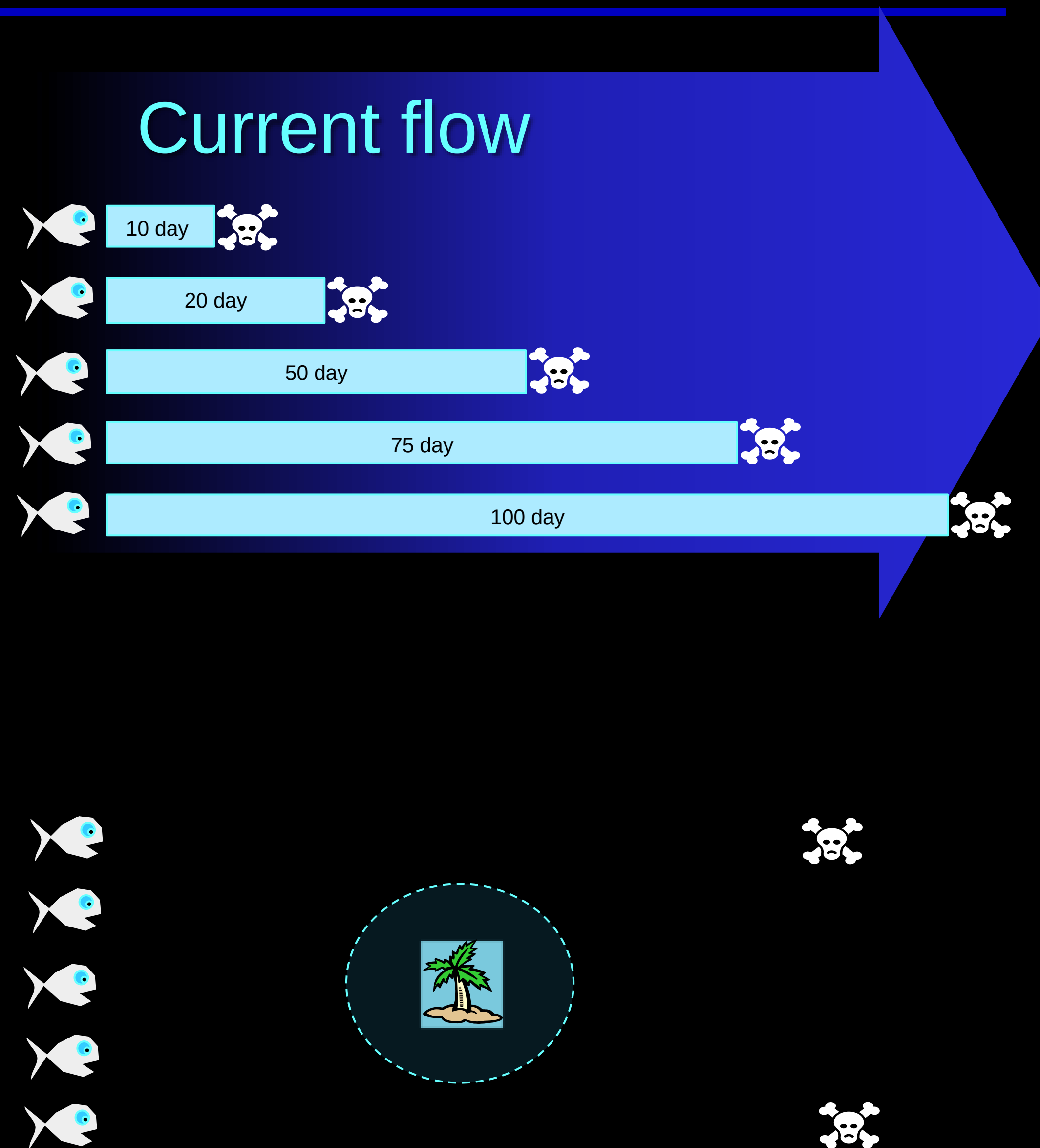
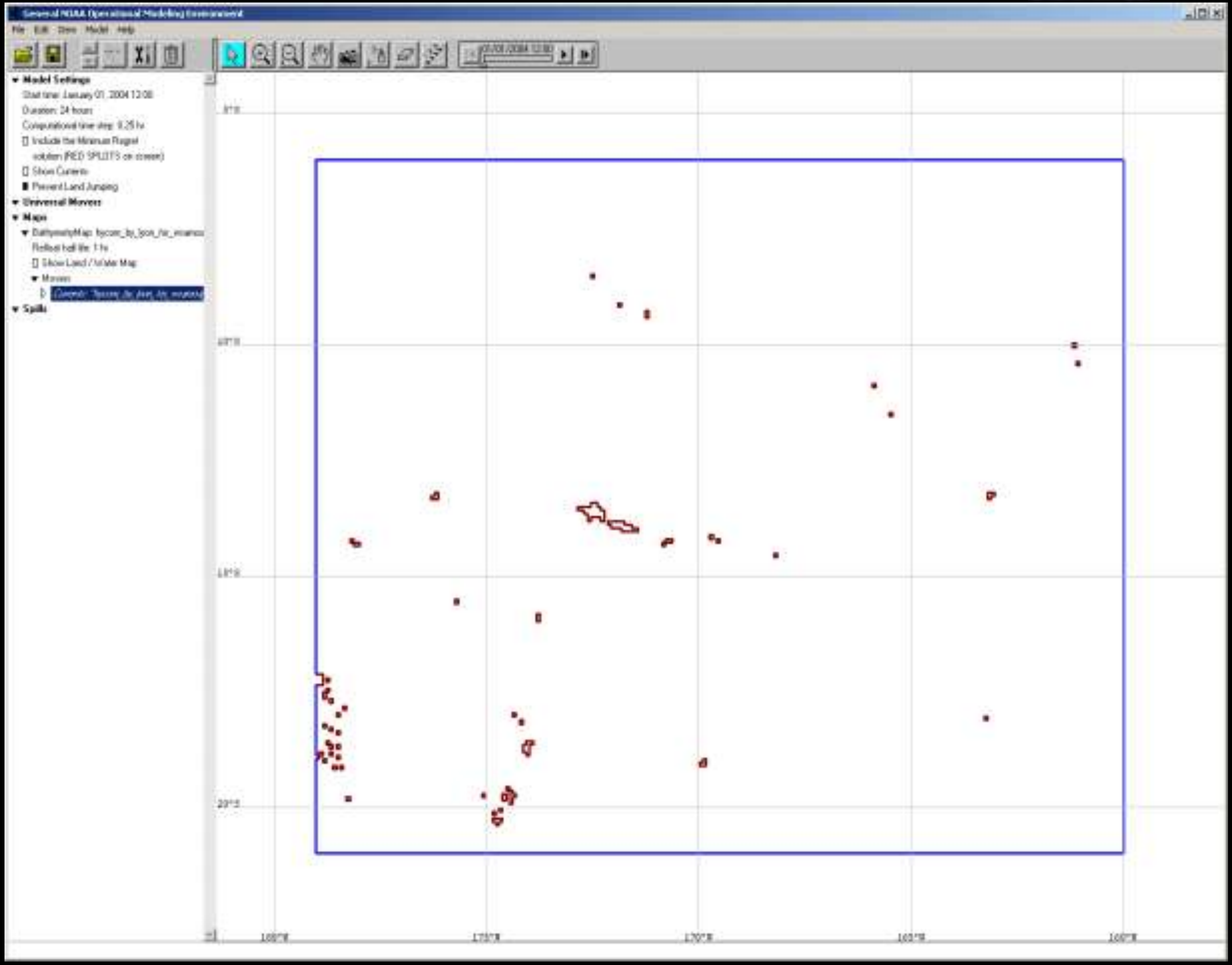


General NOAA Operational Modeling Environment

Gnome

- HYCOM surface currents (10 m)
- 9 km grid size
- 6 hour time step
- 50% XY uncertainty
- 100 days
- Annual spawning 2004-2009

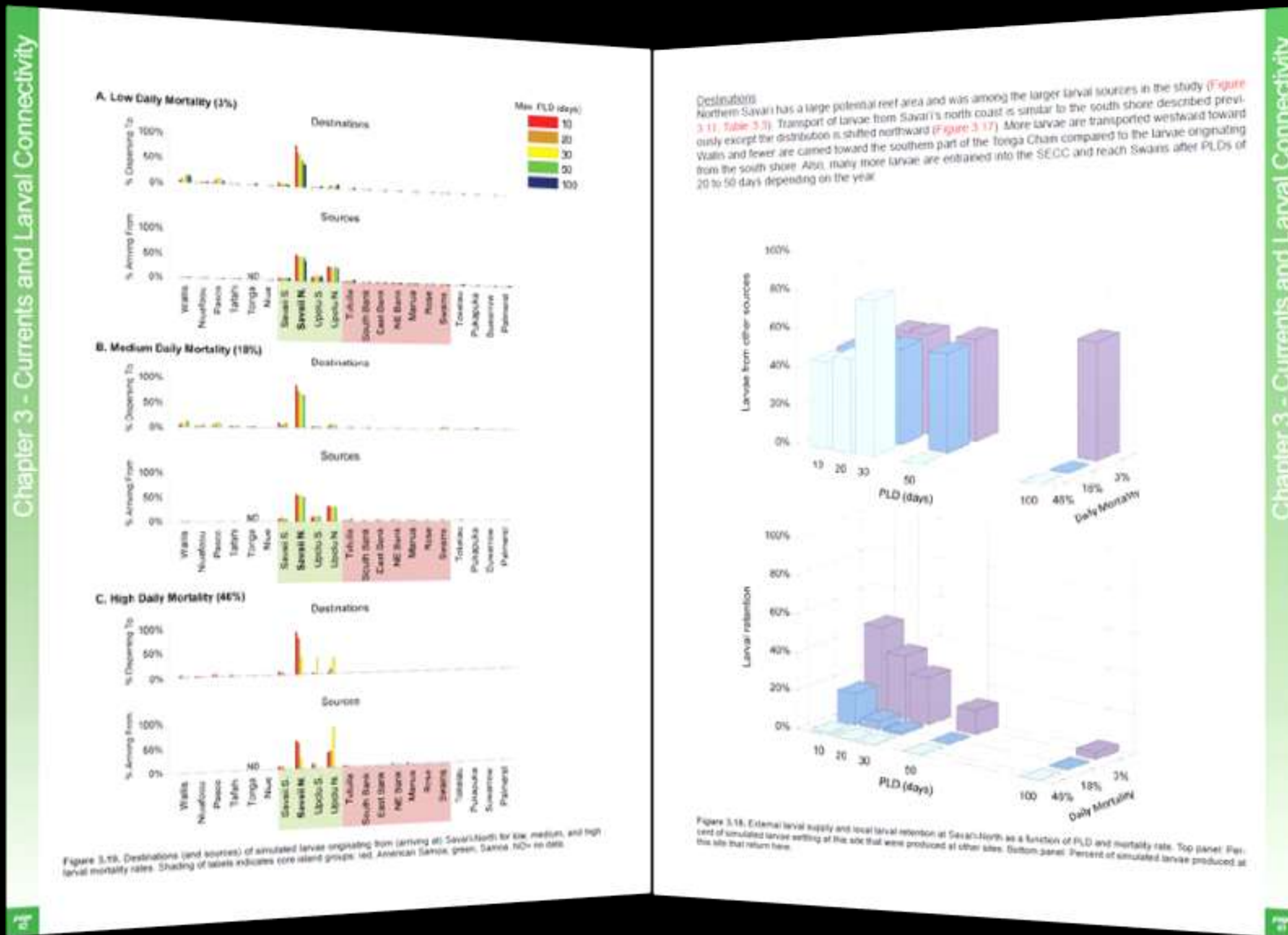


Example Video:

Rose Atoll

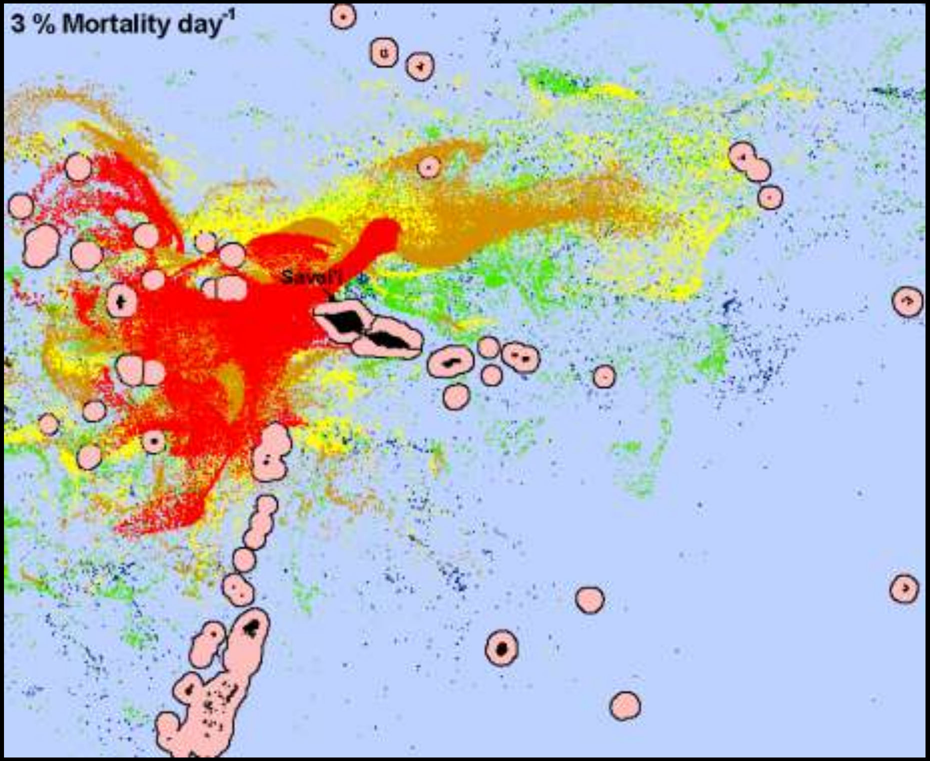
Spawn date: 23 Oct 2005

Results: 4 page summaries by island/region

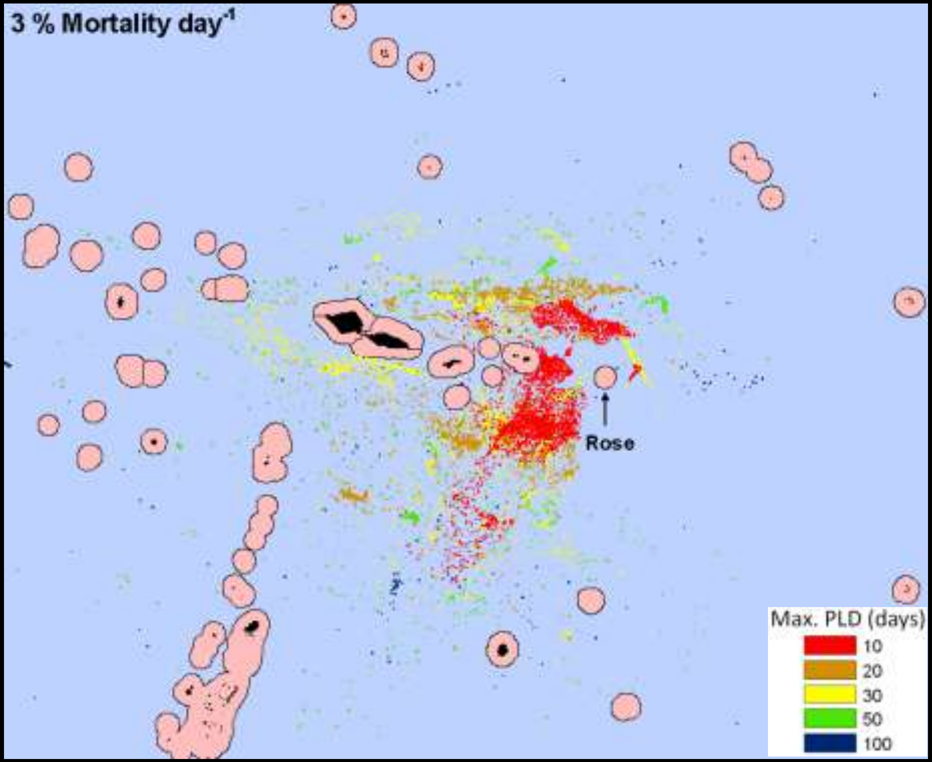


Contrasting Results:

N. Savai'i

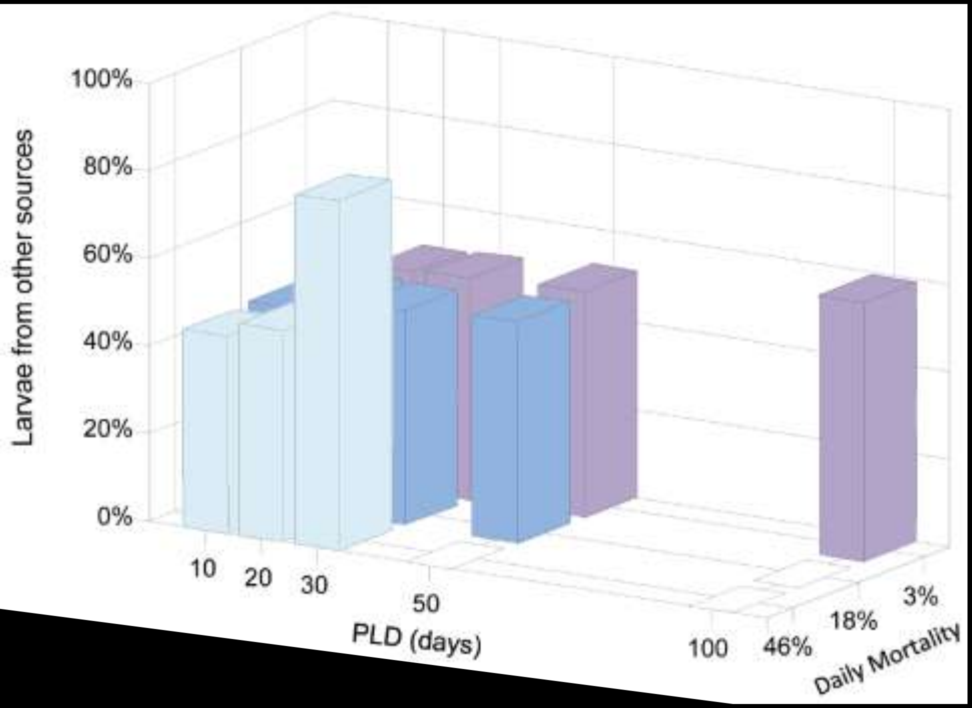


Rose Atoll (Muliava)

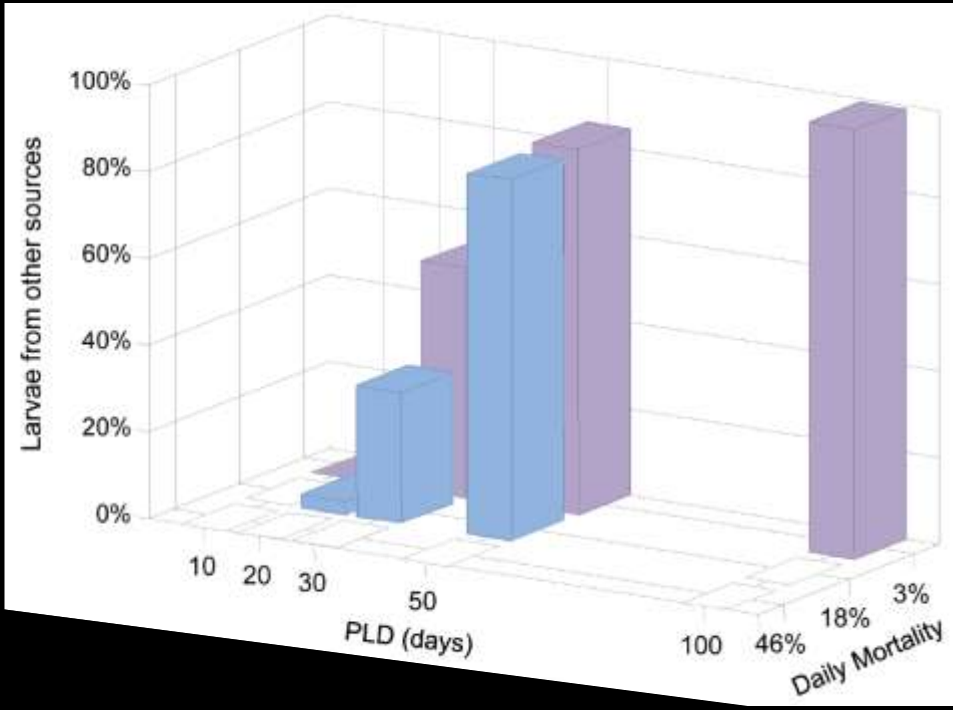


Contrasting Results:

N. Savai'i

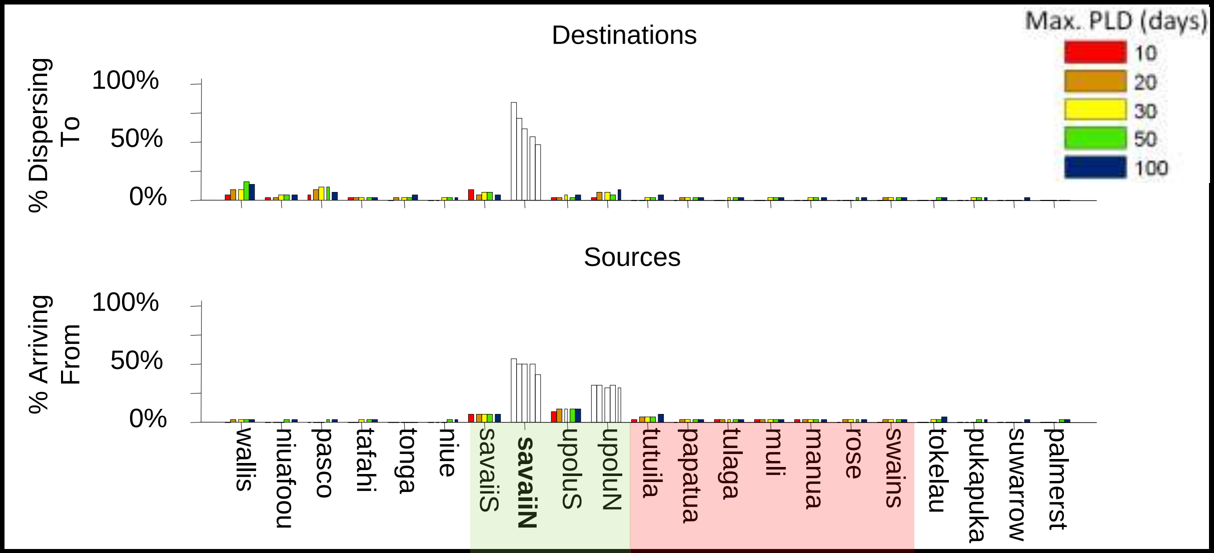


Rose Atoll (Muliava)

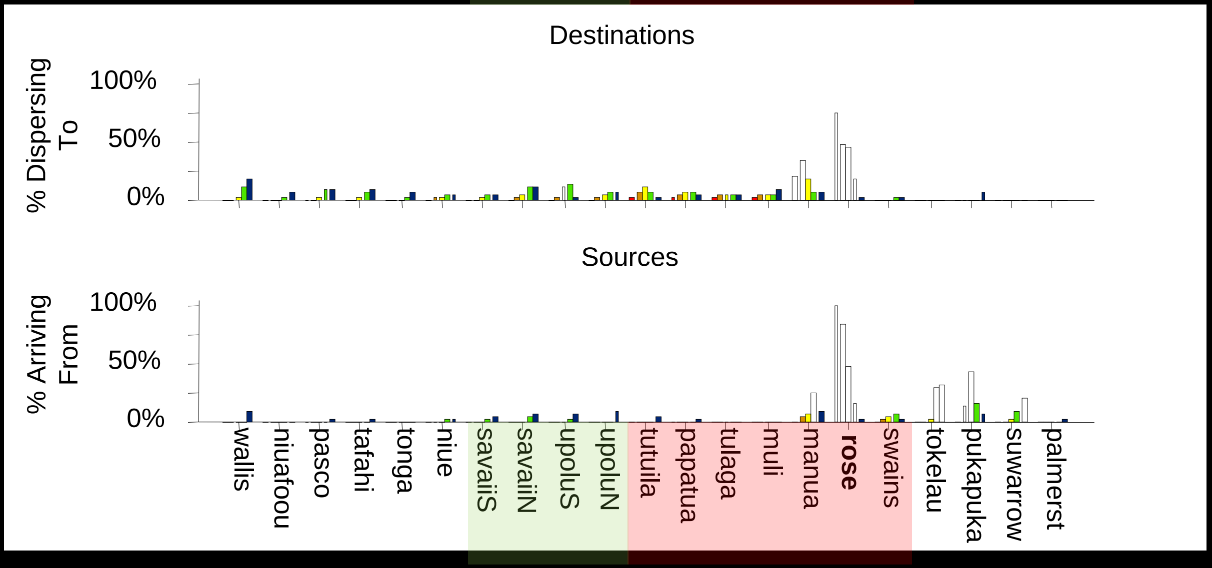


Contrasting Results: 3% daily mortality

N. Savai'i



Rose Atoll



Chapter 3 Currents/Larval Connectivity: Key Findings

- 3 generalized current features, 2 current seasons
- Upolu and Savai’i are major larval sources in the region
- Islands seed themselves and neighbors to the west
- SEC/SECC loops larvae among Samoa/American Samoa
- Rose and Swains are very isolated from upstream sources
- Coordinated resource management is warranted

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Chapter 4 - Biogeography of Fish and Coral

Biogeographic Assessment of Fish and Coral Communities of the Samoan Archipelago

Kendall MS[1], M Poti[2], B Carroll[3], D Fenner[3], A Green[4], L Jacob[3], J Samuelu Ah Leong[5], BP Kinlan[2], ID Williams[6], J Zamzow[6]

INTRODUCTION

Reef fish and corals are two of the most iconic and locally important components of the marine ecosystem in the Samoan Archipelago. These organisms provide a wealth of aesthetic, cultural, and economic opportunities to island residents and visitors (Craig 2009, Sabater 2010). Coral reefs of the archipelago fringe the steep sided islands and atolls forming a diversity of structures including lagoons, reef flats, slopes, pinnacles, and banks (NCCOS 2005, Brainard et al. 2008, Bare et al. 2010). The rich biodiversity of corals comprising these structures with their various encrusting, massive, and branching morphologies form the physical foundation of the reef and thereby provide a home for most other organisms in the reef ecosystem. Reef fish in turn have evolved sizes, colors, and shapes to fill every habitat and occupation on the reef.

Image #. Pair of long nosed filefish in American Samoa. Photo credit: Kevin Lino. NOAA/CRED.

There are multiple scales at which the marine biogeography of the Samoan Archipelago may be described. At the broadest scale, the entire archipelago has been placed into a global context as a unit in the "central Polynesia" ecoregional province within the "eastern Indo-Pacific" realm as defined by Spalding et al. (2008) and has a biodiversity determined by its location on the diversity gradient between the high at the "Coral Triangle" in the Philippines, Indonesia, northern New Guinea and the Solomon Islands, and the low at the Pacific Americas (Veron 2000, Veron et al. 2009). The present study focuses at finer scales on biogeographic patterns of fish and coral among and within the islands of American Samoa and Samoa.

Coral and fish communities are not evenly distributed throughout the Samoan Archipelago. Island age (e.g. distance from volcanic hotspot), size, geomorphology, reef structure, oceanographic climate (Chapter 2), position in ocean currents (Chapter 3), habitats, wave exposure, human impacts, and other factors have shaped the distribution of reef fish and coral among and within the islands (e.g. Green 1996, 2002, Craig et al. 2005, Whaylen and Fenner 2005, Sabater and Tofaeono 2006, 2007, Birkeland et al. 2008, Brainard and others 2008, Fenner 2008, Fenner et al. 2008, Samuelu and Sapatu 2008, Craig 2009, Fenner 2009 a b, Houk et al. 2010, Carroll 2010, Williams et al. 2011, Ochavillo et al. 2011). Basic physiography alone can be used to broadly divide the archipelago from west to east into relatively larger high islands with several broad reef flats and shallow lagoon areas (Savai'i and Upolu), a moderately sized high island with relatively narrow fringing reefs as well as submerged bank reef formations (Tutuila), smaller high islands with fringing reefs and steep shelf slopes (Manu'a Islands of Ofu, Olosega, and Tau), and the small, low-lying and geologically separate atolls of Rose (Muliava) which lies to the east of the Samoan volcanic hotspot, and Swains Island, which lies ~400 km to the north and may share geologic origins with the Tokelau Island group. The purpose of this chapter of the characterization was to identify geographic patterns, spatial trends, and relatively high values or "hotspots" of coral and fish distribution among and around these islands. Documenting biogeo-

[1] NOAA/NOS/NCCOS/CCMA/Biogeography Branch
[2] NOAA/NOS/NCCOS/CCMA/Biogeography Branch and Consolidated Safety Services, Inc., Fairfax, VA, under NOAA Contract No. DG133C07NC0616
[3] American Samoa/Department of Marine and Wildlife Resources
[4] The Nature Conservancy, Asia Pacific Resource Center
[5] Samoa/Ministry of Agriculture and Fisheries/Fisheries Division
[6] NOAA/NMFS/PIFSC/Coral Reef Ecosystem Division

Objective: Identify biogeographic hotspots, trends, and breakpoints in reef fish and coral communities through data synthesis.

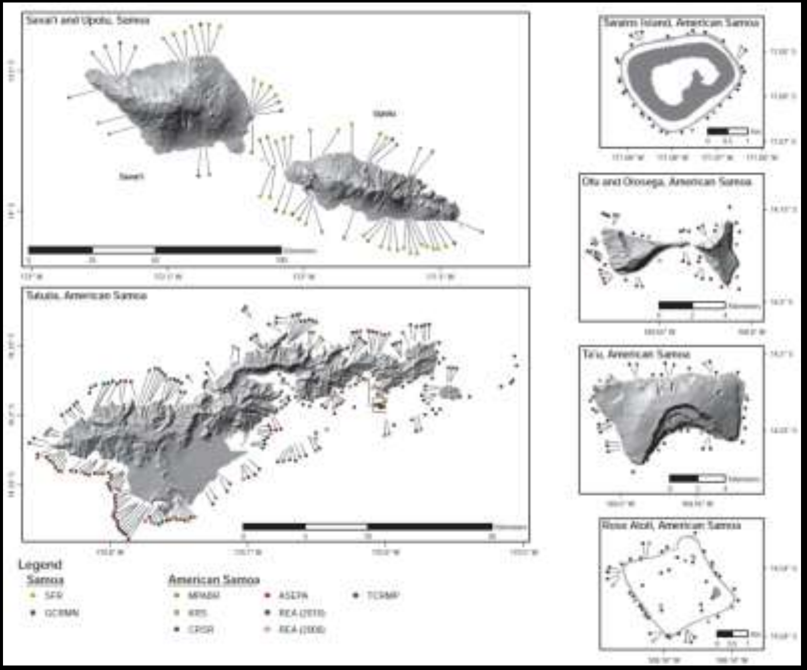
Focal Variables

1. Coral Cover
2. Coral Richness
3. Coral Community

4. Fish Abundance
5. Fish Richness
6. Fish Community

Preferred Data Criteria

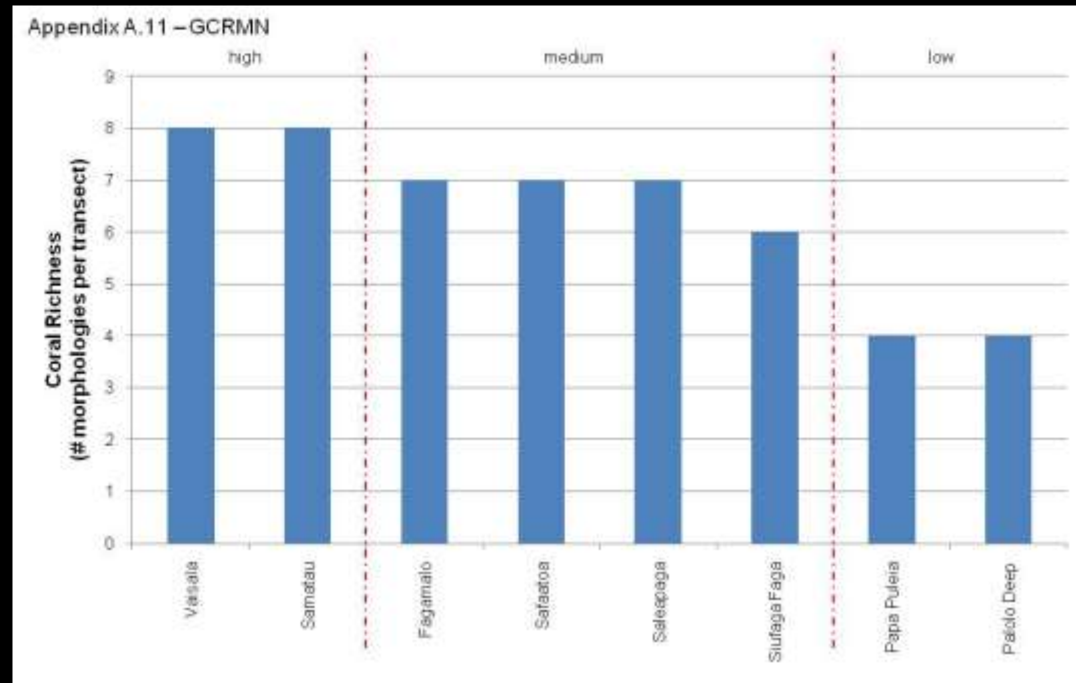
- Spatial data on reef fish and coral <u>communities</u>, not particular species
- Recent (<10 years)
- Standardized and quantitative
- Widely distributed sites
- Un-biased, or random stratified designs

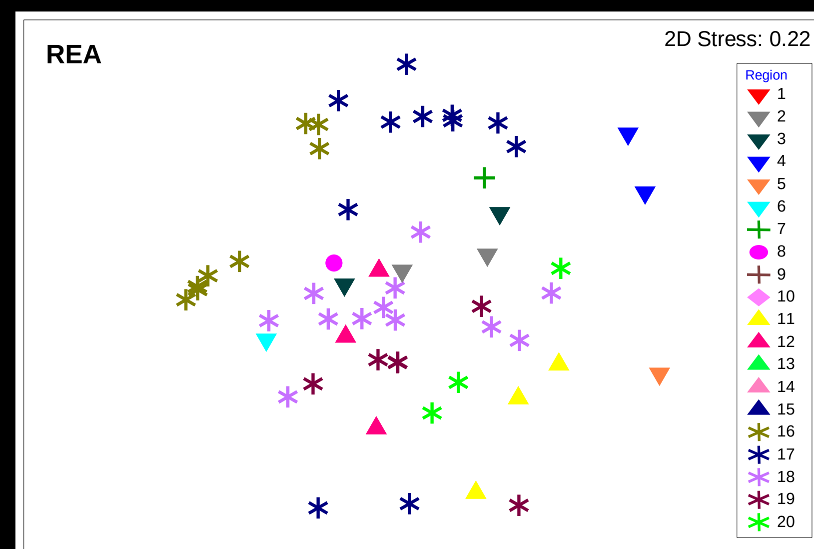


Study	Coral Variables			Fish Variables		
	Coral Cover	Coral Richness	Coral Community	Fish Biomass	Fish Richness	Fish Community
American Samoa Enviromental Protection Agency[a]	Y	Y	Y	Y	Y	Y
Coral Reef Status Report[b,c]	Y	Y	Y	Y	Y	Y
Global Coral Reef Monitoring Network[d]	Y	Y	Y	Y	Y	Y
Key Reef Species[e]	Y	NA	NA	Y	Y	Y
Marine Protected Area Bioreconaissance[f]	Y	Y	Y	Y	Y	NA
Rapid Ecological Assessment[g,h]	Y	Y	Y	Y	Y	Y
Samoan Fish Reserves[i]	Y	Y	Y	Y	Y	Y
Territorial Coral Reef Monitoring Program[j]	Y	Y	Y	Y	Y	Y

Approach

- Raw values incompatible among studies due to different methods
- Used categorical scale (High, Medium, Low)
- Sites categorized relative to others within a given study
    - coral richness and cover
    - fish richness and biomass
- Used MDS to define fish and coral communities



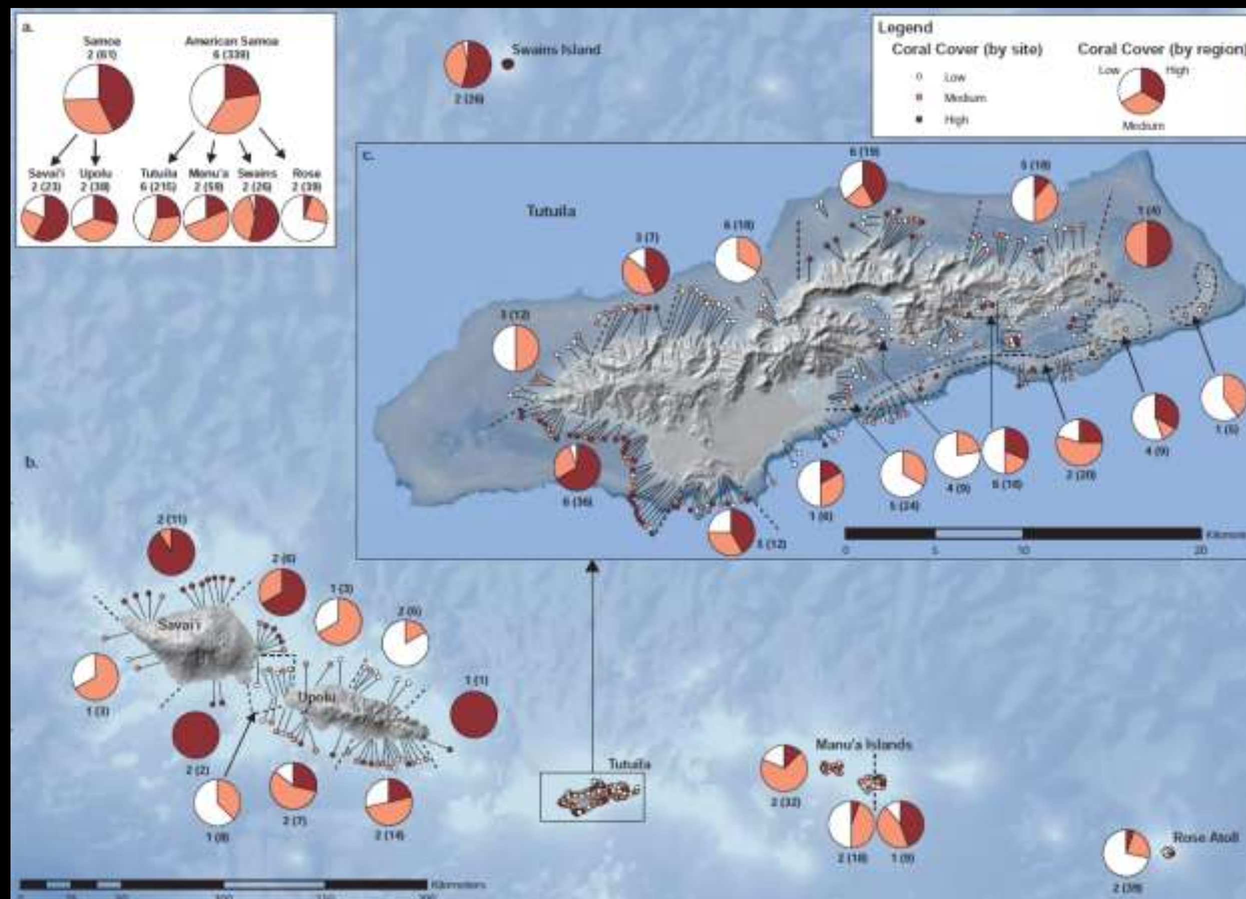


Defined Biogeographic Regions (Bioregions)

- Defined as a segment of coast (or island) with distinct values for one or more variables relative to adjacent areas
- Plotted all site values by variable
- Identified cluster breaks
- Noted coastal morphology
- Built upon prior studies

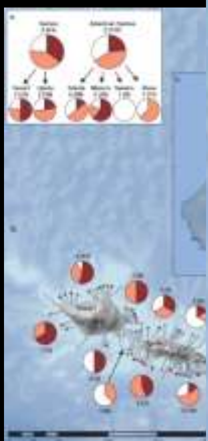
- Show # studies (sites)
- Summarized by
  - Jurisdiction*
  - Island (group)*
  - Region

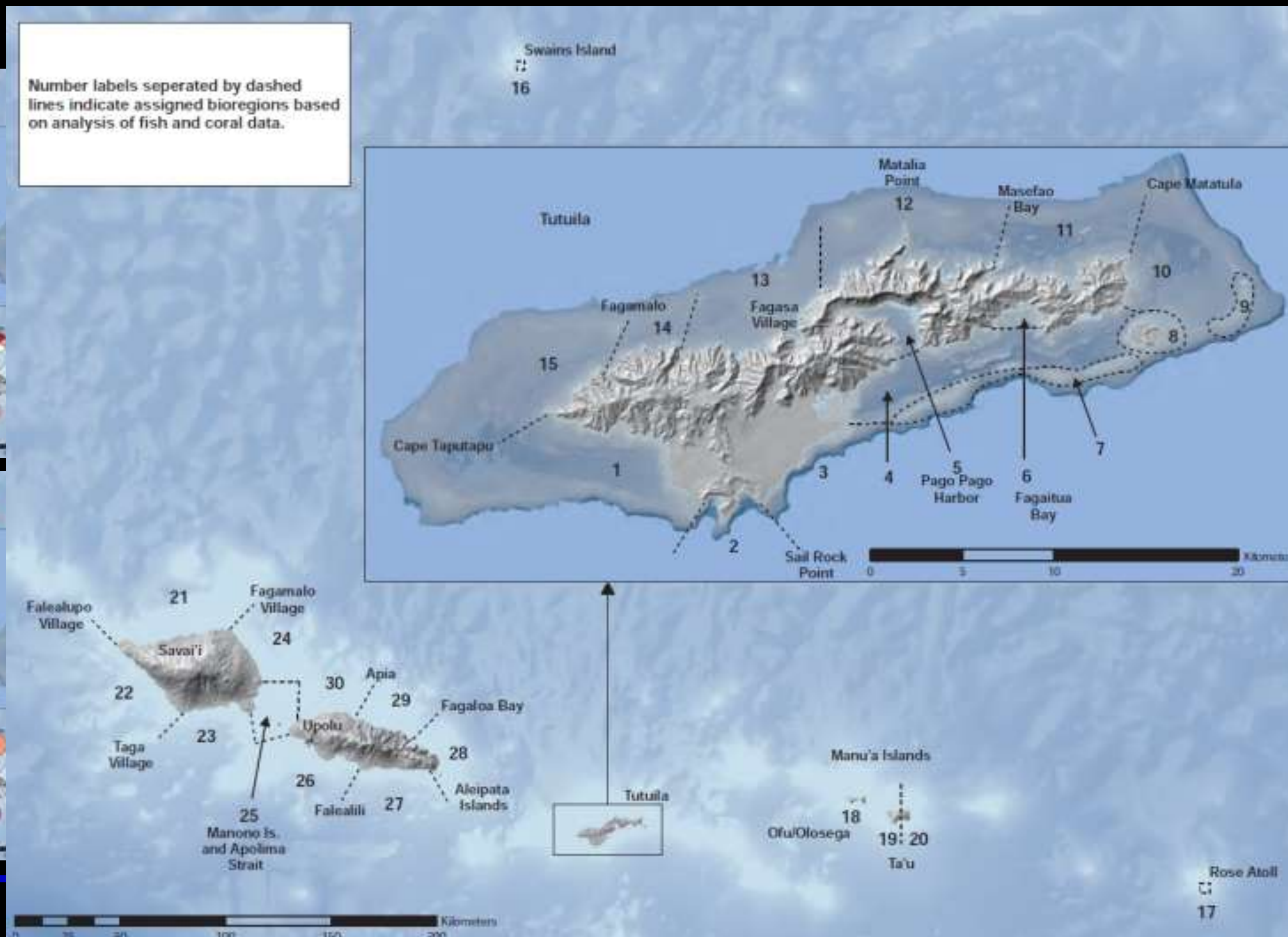
* scaled to coast length

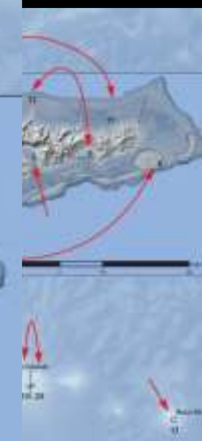


Defined BioRegions

- Found 30 composite bioregions based on results for all six focal variables

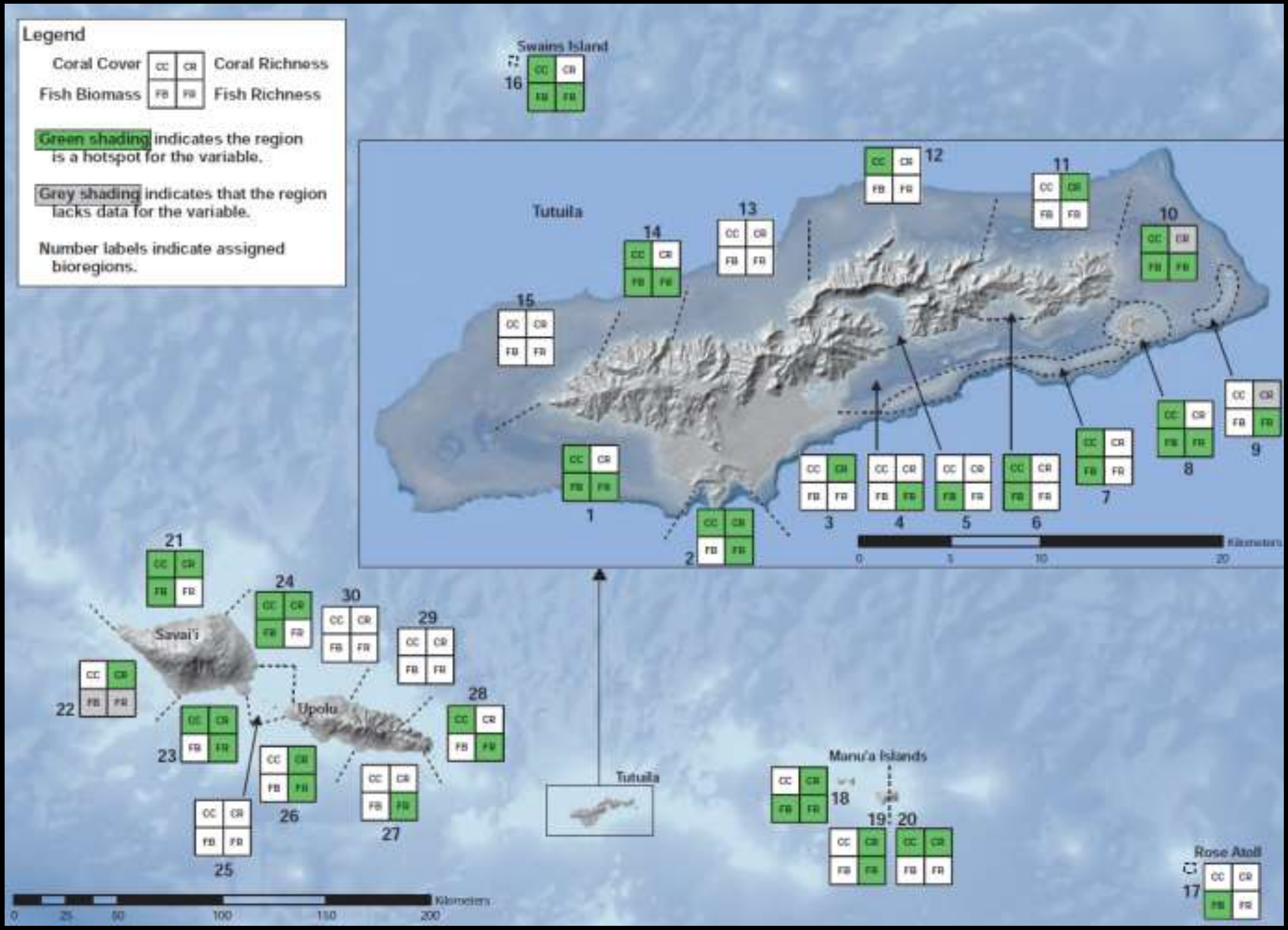






Defined Hotspots

- Defined as bioregions with a > proportion “high” values than the jurisdiction overall
- Used re-sampling to calculate probability of occurrence
- Ten bioregions were hotspots for 3-variables
- Five “coolspots”
- Savai’i is hot
- N. Upolu is cold
- Swains is hot but Rose is not
- Eastern and SW Tutuila are hot



Chapter 4 Biogeography of Fish and Coral: Key Results

- Defined 30 bioregions in the archipelago based on 6 coral and fish variables
- Found 51 hotspots, 12 had low probability of occurring by chance (<10%)
- Smoother distribution of fish values than for coral variables
- Many results consistent with Island Biogeography Theory and Chapter 3
    - Higher values on upstream islands
    - Higher values on larger islands
- Results are scaled to Samoan Archipelago only
- Only six variables analyzed, patterns for others may differ
- Archipelago-wide survey using consistent methodology and stratified random sampling design is needed

Chapter Topics

1. Introduction
Kendall[1] and Poti[12]

2. Ocean Climate
Pirhalla[3], Ransi[3], Kendall[1], and Fenner[4]

3. Currents and Larval Connectivity
Kendall[1], Poti[12], Wynne[3], Kinlan[12], and Bauer[12]

4. Reef Fish and Coral Communities
Kendall[1], Poti[1], Carroll[4], Fenner[4], Green[5], Jacob[4], Samuelu ah Leong[6], Kinlan[12], Williams[7], and Zamzow[7]

5. Existing Marine Protected Areas of American Samoa
Poti[12], Kendall[1], Brighouse[8], Clark[9], Grant[8], Jacob[4], Lawrence[10], and Reynolds[9]

NOAA Biogeography[1], CSS[2], NOAA COAST[3], ASDMWR[4], TNC[5], Samoa MAF/FD[6], NOAA CRED[7], NOAA FBNMS[8], NPS[9], ASDOC[10]

The Existing Network of Marine Protected Areas in American Samoa

Matthew Poti[1], Matthew S. Kendall[2], Gene Brighouse[3], Tim Clark, Kevin Grant, Lucy Jacob, Alice Lawrence, Mike Reynolds, and Selaina Vaitautolu

INTRODUCTION

Marine Protected Areas and Marine Managed Areas (hereafter referred to collectively as MPAs) are considered key tools for maintaining sustainable reef ecosystems. By limiting or promoting particular resource uses and activities in different areas and raising awareness issues on reef sustainability within MPAs, managers can promote long term resiliency. Multiple local and federal agencies have eagerly embraced MPA concepts in Samoa and American Samoa with a diversity of MPAs now in place across the archipelago from the village and local community level to national protected areas and those with international significance. Many of the different MPAs in the network were created through independent processes and therefore have different objectives, have been in existence for different lengths of time, have a wide range of sizes and protection regulations, and have different management authorities. Each contributes to the diverse mosaic of marine resource management in the region (See Text Box: Summary of MPA Programs).

Image ?. Fagatele Bay National Marine Sanctuary sign. Photo credit: Matt Kendall, NOAA Biogeography.

Understanding the variety of fish, coral, and habitat resources that this multifaceted network of MPAs encompasses is critical for assessing the scope of current protection and thoughtfully designing additional network elements. Here we seek to summarize what aspects of the coral reef ecosystem are protected by MPAs individually, through brief summaries of each MPA, and then collectively, through analysis of the combined area encompassed by all MPAs. Based on the available datasets used to broadly characterize the biogeography of the region in the previous chapters and appendices of this assessment, key concepts of MPA network design including biogeographic representation and replication will be addressed. Representation is the idea that at least part of each distinct biogeographic region should be included in a 'complete' network of MPAs. Replication is the idea that there should be more than one MPA in each distinct biogeographic region. Replication spreads protection within each region thereby reducing the risk to the network that is associated with localized degradation at any one site.

In this chapter of the assessment we focus our analysis only on the MPAs of American Samoa. While Samoa is a key part of the MPA landscape in the archipelago as demonstrated in Chapters 3 and 4, two key datasets are in need of further development. First, benthic maps similar in spatial scope and categorical detail to those available in American Samoa are needed to inventory the protected habitats of Samoa. Second, MPA boundaries in Samoa must be made available for analysis, but at present many are proprietary at the village level as part of the Community Based Fisheries Management Program (King and Faasili 1998, Samuelu 2003).

The objectives of this chapter were to:
1) Characterize the reef fishes, corals, habitats, and other key features of each existing MPA relative to all of American Samoa.
2) Evaluate the distribution of MPA sites in the context of the biogeographic regions and ecological hotspots defined in Chapter 4 and identify key areas not currently in the network.
3) Summarize the area of reef ecosystem, by bottom type and reef type, that is currently protected relative to American Samoa overall.

[1] NOAA/NOS/NCCOS/CCMA/Biogeography Branch and Consolidated Safety Services, Inc., Fairfax, VA, under NOAA Contract No. DG133C07NC0616
[2] NOAA/NOS/NCCOS/CCMA Biogeography Branch
[3] Fagatele Bay National Marine Sanctuary
[4] National Park of American Samoa
[5] American Samoa/Department of Marine and Wildlife Resources

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Chapter 5 - Marine Protected Areas

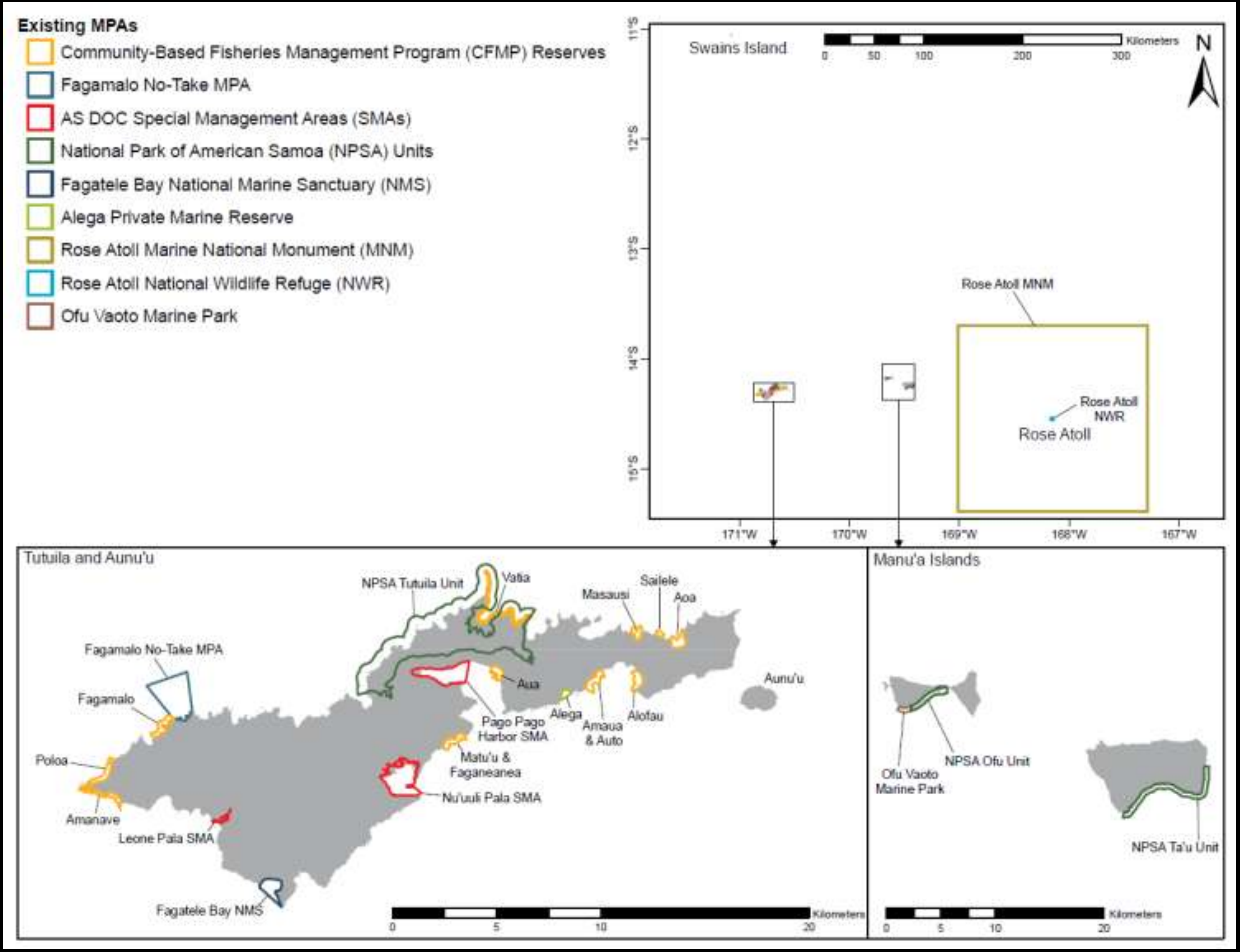
Objectives

- Inventory MPAs in American Samoa
- Characterize habitats, fish and coral in MPAs
- Evaluate MPA coverage relative to bioregions and hotspots from Chapter 4
- Quantify proportion of American Samoa protected

Inventory

23 total

- 11 CFMP
- 3 NPS
- 3 SMA
- 6 others



MPA Site Characterizations: For each MPA…

National Park of American Samoa – Tutuila unit

Overview

The Tutuila unit of the National Park (Figure 5.58) was authorized by Public Law 100-571 in 1988 and formally established in 1993 following a lease agreement with the villages (16 U.S.C. 410qq-410qq-1, NPS 1997). It lies between the villages of Fagasa and Afono on the north-central coast of Tutuila with a seaward boundary that extends 0.25 miles offshore (16 U.S.C. 410qq-410qq-1, NPS 1997). The park partially overlaps the Vatia CFMP reserve. The 1986-7 NPS feasibility study noted that this area includes "the longest stretch of undeveloped coastline and undisturbed forest on Tutuila" (NPS 1988). The ~6.5 km² marine portion of the Tutuila park unit primarily fronts two watersheds. The western of these is a ~5.1 km² watershed that is uninhabited and in relatively pristine condition. Nearshore waters may however, be impacted by sediment runoff resulting

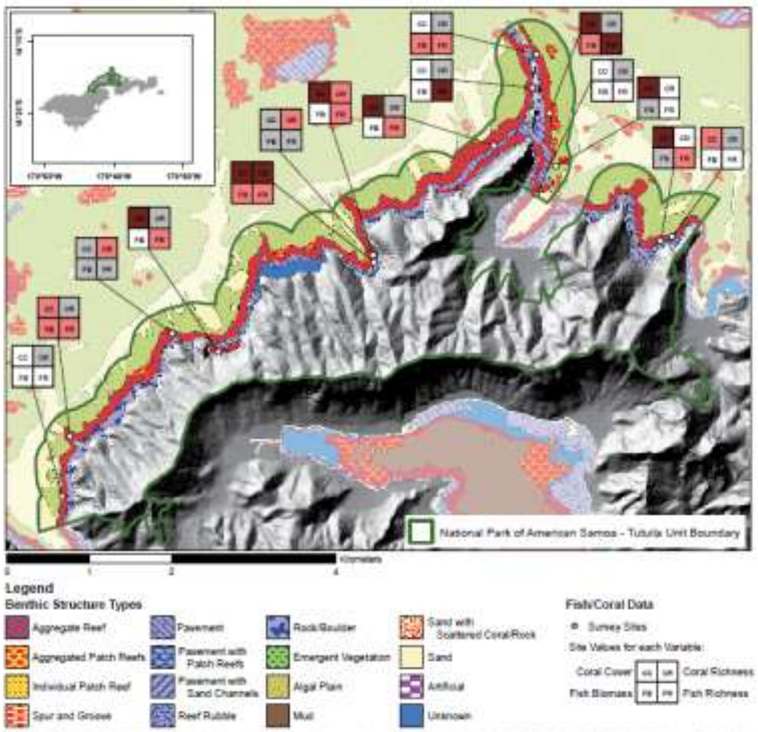


Figure 5.58. Benthic habitat (by structure type) and fish and coral survey data within the Tutuila Unit of the National Park. Coral cover, coral richness, fish biomass, and fish richness values at each survey site are classified as high (red shading), medium (pink shading), or low (white shading). Grey shading indicates variables with no data at a given site. Fish and coral survey data are from ASEPA, KRS, MPABR, and REA.

from the erosive soil types on steep inland slopes. To the east is a 4.9 km² watershed in minimally impacted condition with the population concentrated around Vatia Bay. In this area there is moderate to high erosion and runoff potential and slight impacts from groundwater and surface water contamination. The southwest and eastern boundaries of the park extend slightly into adjacent watersheds, with the watershed to the southwest being in intermediately impacted condition. There is a low density of pigs in these adjacent watersheds and most of the area is uninhabited. Fishing or gathering is prohibited in the park, except subsistence fishing by native American Samoans using traditional methods in accordance with rules established by NPS and village leaders (16 U.S.C. 410qq-410qq-1, NPS 1997).

Habitat Composition, Reef Fish, and Coral Communities

Coral reef and hardbottom structures together comprise ~43% of the offshore areas of the Tutuila unit of the National Park (Figure 5.59a). Coral reef structures comprise ~28% of the area and are dominated by aggregate reefs, a structure type often with a high percentage of reef building corals. Also, algal plain covers ~43% of the area within this park unit. The relative proportions of benthic structure types within the park unit are representative of American Samoa in general. About 4% and ~59% of the coral reef and hardbottom in this park unit are in the reef flat and fore reef zones, respectively, compared to ~9% and ~22% around American Samoa (Figure 5.59b). Also of note, 36% of the coral reef and hardbottom is in the bank/shelf compared to ~50% around American Samoa.

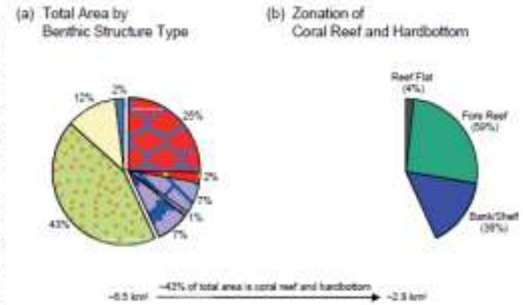


Figure 5.59. (a) Proportion of benthic structure types in the Tutuila Unit of the National Park. (b) Proportion of coral reef and hardbottom in each reef zone. Structure types or zones representing <1% of the total area are not shown.

Fifteen surveys were located within the park. Coral data suggests relatively higher cover and similar richness values compared to all of American Samoa. Fish biomass and richness values were relatively lower compared to all of American Samoa (Figure 5.60).

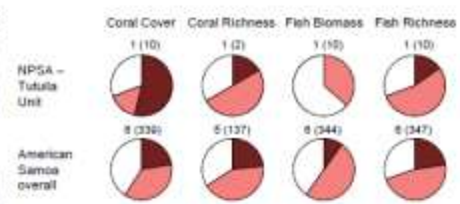


Figure 5.60. Comparison of fish and coral data collected in the Tutuila Unit of the National Park to data from all of American Samoa. Pie charts depict the proportions of high (red), medium (pink), and low (white) values for coral cover, coral richness, fish biomass, and fish richness. Number labels represent the number of studies and sites (in parentheses) comprising each pie chart.

Biogeographic Characteristics

Most of the Tutuila unit of the National Park overlaps with a biogeographic region along the north shore of Tutuila that is a hotspot for coral cover (Bioregion 12, Chapter 4). The region's fish and coral communities are similar to those around Fagaitua Bay on the SE coast of Tutuila.

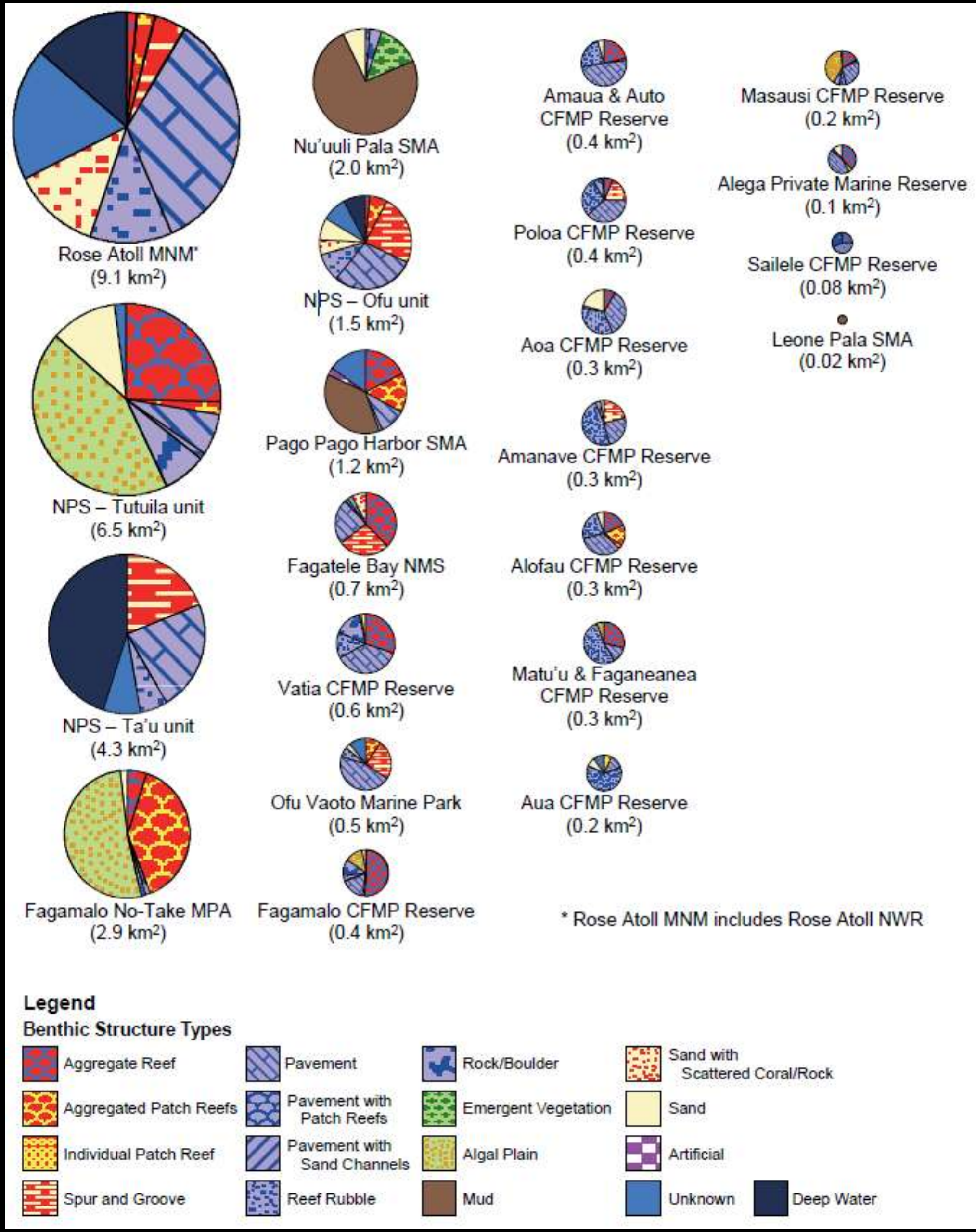
Additional References

Green and Hunter 1996, Craig and Basch 2001, Coles et al. 2003, Pendleton et al. 2005

Chapter 5 - Marine Protected Areas

Size Comparisons

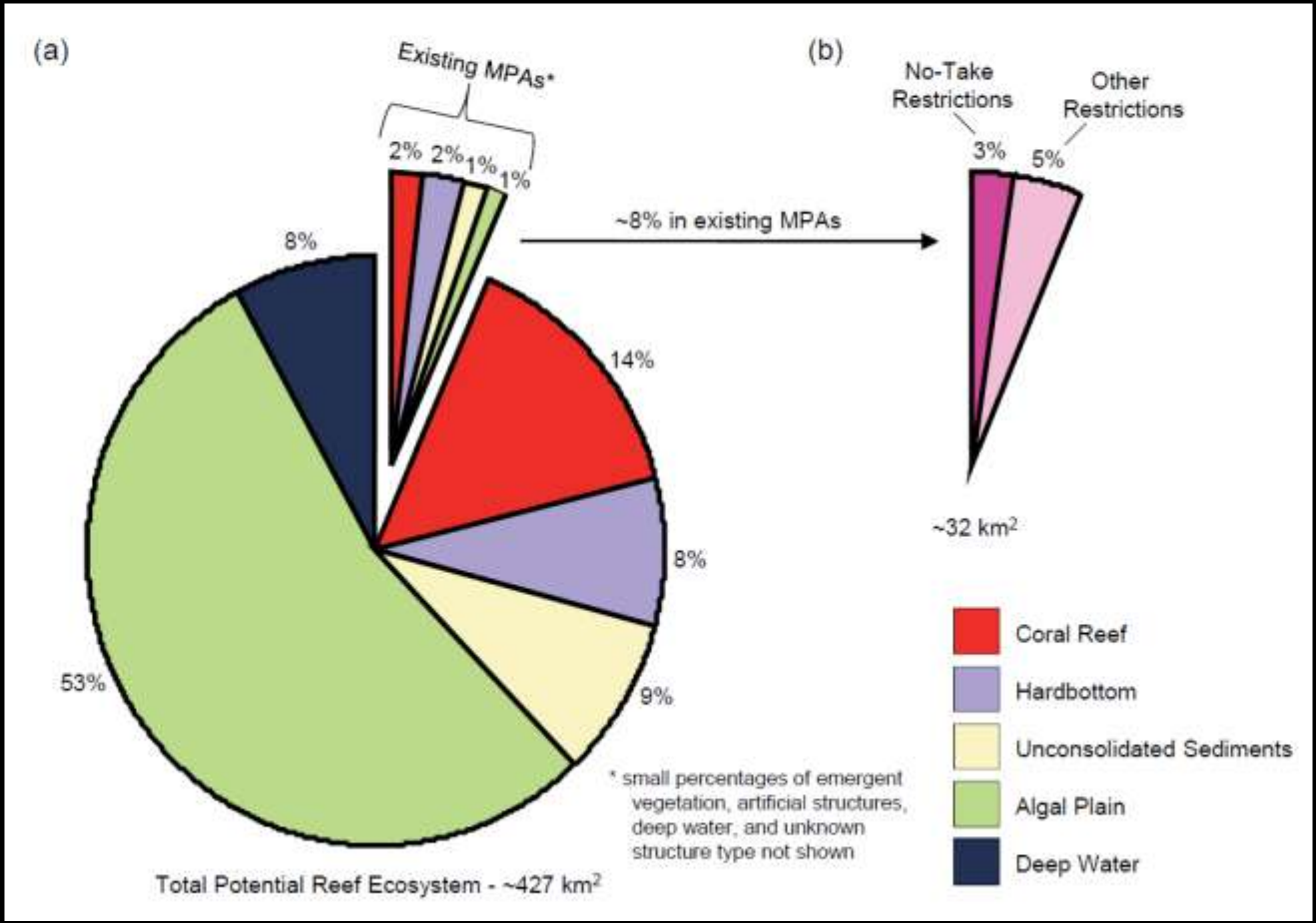
- Smaller MPAs are often more efficient at encompassing reef
- 15 MPAs are under 1 km^2
- These encompass ~25% of the protect reef habitats
- Rose Atoll MNM alone encompasses another ~30% of protected reefs or more than all 15 of the smallest MPAs combined
- Larger MPAs are more effective in protecting fish with larger home range sizes and variety of habitats



How much of American Samoa is protected in the MPA network?

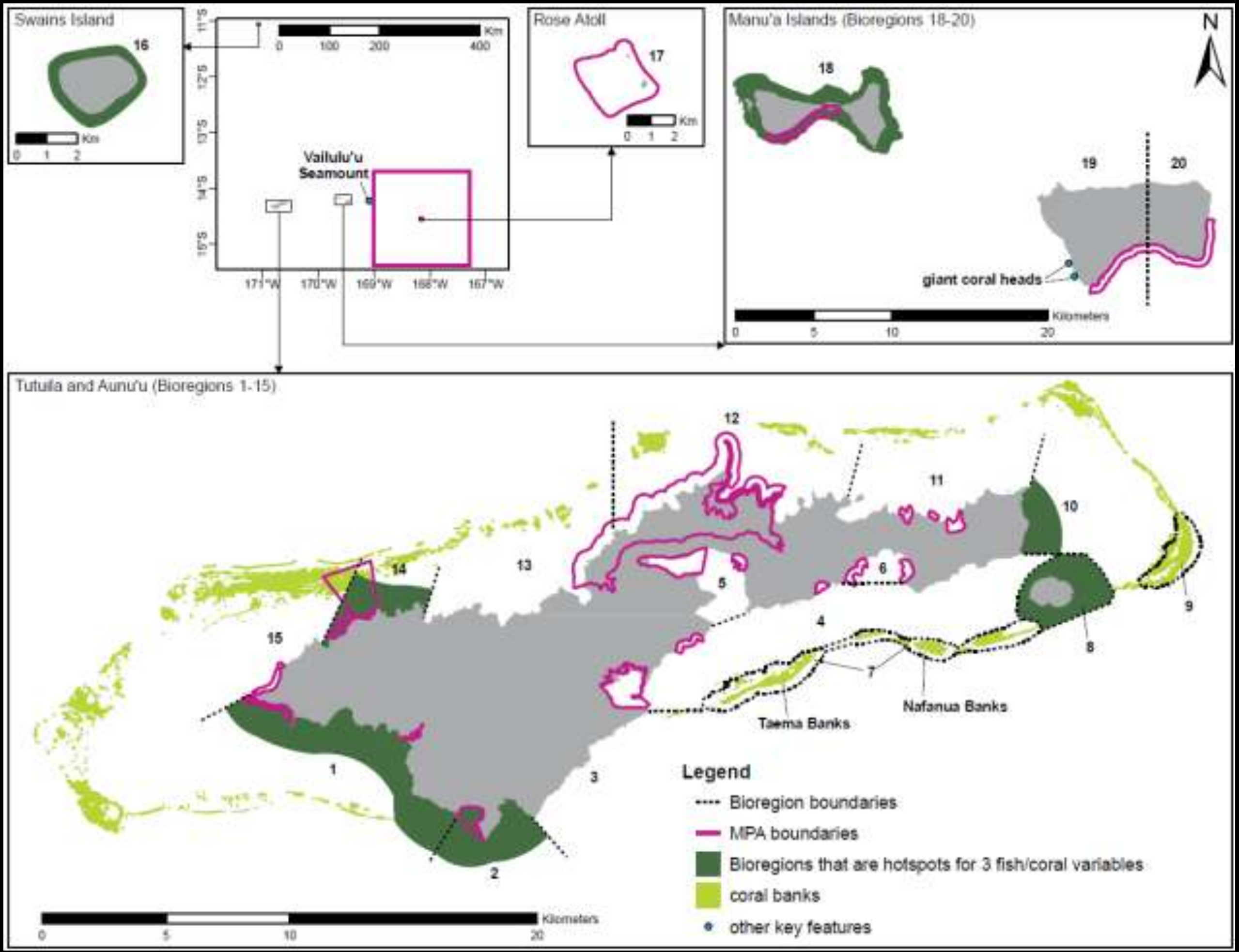
- ~8% of potential reef <u>ecosystem</u> is protected
- ~3% is no-take

20% No-Take Goal



Which bioregions and ecological hotspots (Chapter 4) are represented in the MPA network?

- 6 out of the 20 bioregions lacked any MPA, many had at least 2
- 25 out of the 36 hotspots are partly protected by MPAs
- 3 “high value” bioregions don’t presently have an MPA
- Other key features not included (Vailulu’u, big coral, mesophotic reefs)



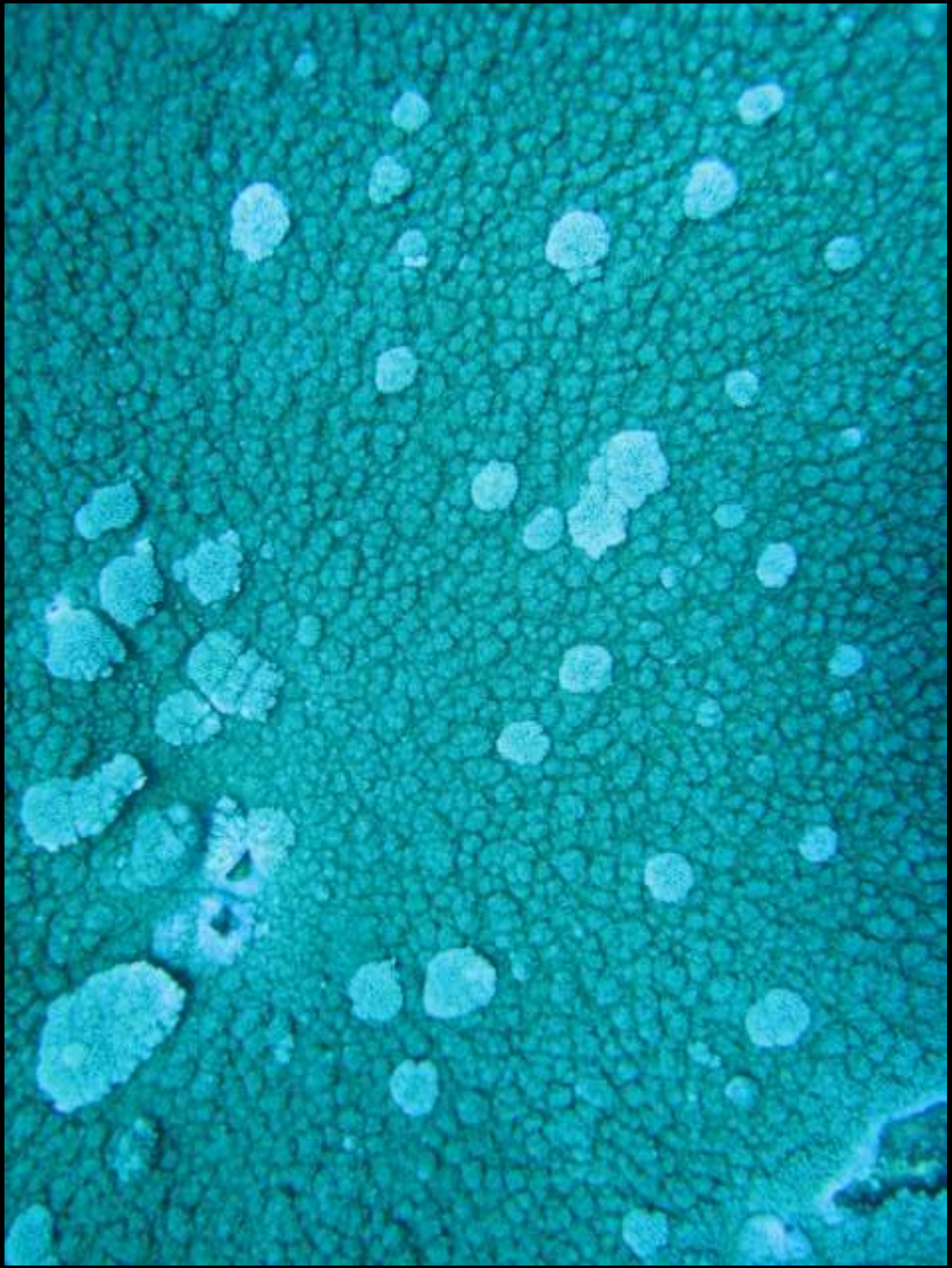
Chapter 5 MPA Inventory: Key Findings

- High density of MPAs and management authorities
- Big MPAs needed to meet 20% No-Take goal
- Important bioregions/features lacking protection
- New NMS, NPS, and CFMP sites are under consideration
- Coordination of the developing MPA network is critical
- Benthic maps and MPA boundary data needed for Samoa

Biogeographic Assessment of the Samoan Archipelago

Next Steps

- Monitor effects of climate change
- Evaluate connectivity in different seasons and with fine-scale hydrodynamic models
- Encourage archipelago-wide monitoring of reef fish and corals
- Fill in key MPA gaps
- Samoa, Samoa, Samoa



Fa'afetai…

- Co-funding by ONMS and CRCP
- Local facilitators and collaborators
- Generosity of data providers
- Tremendous in-kind contributions from co-authors
- Many reviewers who improved multiple drafts
- Jamie Higgins who made it all look pretty

National Marine Sanctuaries ™

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http://ccma.nos.noaa.gov/about/biogeography/