Village-based planning in American Samoa to address threats posed to coral reefs by climate change

Performance Progress Report for Grant No. NA18NOS482011 for the period from 08/01/2018-01/31/2020

Award Recipient: Marine Applied Research Center, LLC of Wilmington, NC
Project PI: Dr. Jeffrey Maynard.

Summary: We developed village-specific climate impact and coral reef condition information for 30 villages in American Samoa where long-term coral reef monitoring has occurred. The project team included collaborators from NOAA PIRO, the CRAG, the DMWR, and the NPSA.

The original project objectives were:

1. Disseminate current state-of-science information on coral reef resilience and vulnerability to climate change through participatory learning and action (PLA) workshops in: Alofau, Amanave, Lauli'i, Aoa, Fagasa, Faga'itua.

2. Identify pathways for including climate change resiliency into conservation/community action plans in the six villages.

3. Follow-up with villages to provide support for the implementation of identified actions to support reef resilience and reduce climate vulnerability.

Work towards objectives 1-3 is ongoing and being led by the American Samoa Coral Reef Advisory Group (AS-CRAG).

4. Develop custom climate impacts and coral reef condition and condition trends information packages to support PLAs in 20 additional villages.

Objective 4 became the focus of this project following NOAA approving a scope of work change request that the project team submitted on 10/16/2019.

Developing local monitoring status reports

This project involved a process very similar to what our team led and went through to deliver the first NCRMP Data Summary Report – the U.S. Coral Reef Monitoring Data Summary 2018. Delivering reports on coral reef monitoring requires that we first complete a months-long process with staff in the jurisdictions to get their data organized. Local monitoring programs funded by CRCP through the states and territories grants have not ever been required to deliver their data for archiving, within any kind of standard annual report, or as summary-level data (averages with variance) for public access and use. We first worked with the Coral Reef Advisory Group (CRAG) in American Samoa to organize all of their most recent monitoring data – November 2016 and March 2017 – into summary level for ~40 metrics. ALL of their data for 30 coral reef sites near the villages of Tutuila (see Figure 1 below) was summarized into a user-friendly searchable master data table, similar to the summary level data organized by our team for each jurisdiction for NCRMP.

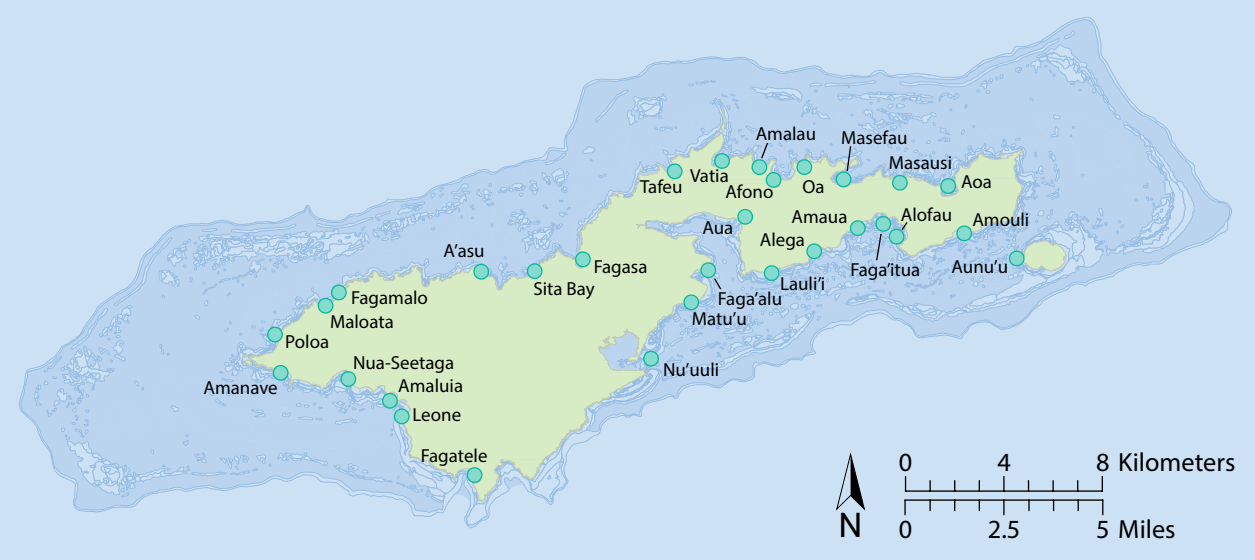


Figure 1. Map of 30 villages where the local coral reef monitoring team from the DMWR (AS-CRAG) has collected coral reef condition information we are now summarizing into report cards to provide to community members.

We then collaboratively designed a 2-page 'report card' template. Developing the template involved our adding collaborators working on the Ridge to Reef program in American Samoa, so the project now includes the US-EPA, AS-EPA and National Marine Sanctuaries, along with AS CRAG. The blank design template represented a month of collaboration with our colleagues in AS to decide what the sections would be and what information will be presented within each section. The final sections the project team settled on are: Village and Watershed, Coral Reef Fish, Coral Reefs, and Impacts of Climate Change. Variables/indicators we have decided to present within the report cards include:

Village and Watershed – Reef type, watershed class, Area disturbed 2017, Shed area 2017, Population 2010, Population area, Wave mean, Reef width, Stream name, Mean DIN, Reef DIN, Max DIN, Max Reef DIN

Coral reef Fish – Fish biomass by functional group, Predator biomass, Herbivore biomass, Size structure, Species richness.

Coral Reefs – Percent cover of all major benthic groups, Coral disease prevalence, Rugosity, Recruitment.

Impacts of Climate Change – Bleaching history, Trend, Sea level rise, Ocean acidification, Onset of annual severe bleaching.

These data have all been compiled into our user-friendly searchable MS Excel database for ASCRAG. CRAG staff and collaborators can then organize data from future reef and fish surveys into comparable databases, ensuring data from all years can be analyzed together and compared.

The thirty 2-page Site Summaries are attached here; these represent over a year-long collaboration with AS-CRAG. We settled on the design, completed and then revised several drafts of the Site Summaries for the 30 local monitoring sites (all are just offshore of villages). The drafts were finalized in late 2019 and early 2020 through one last round of review with ASCRAG and partner agencies and reef stakeholders.

The final report cards have been provided to AS-CRAG in three different file sizes/resolutions, and our Adobe InDesign files have been transferred to AS-CRAG so that they can update these report cards in future years following collecting additional reef monitoring data.

The local monitoring status reports (60 pages, 30 sites and 2 pages each) represent the final product of this project. These reports have been presented alphabetically within each habitat type. The local monitoring status reports are the main body of the final report for this project. We are sharing them here with a hyperlinked Table of Contents so that readers can quickly navigate to sites of interest within each of the habitat types (see next page).

Table of Contents

Local monitoring status reports

NORTH SITES

SOUTH SITES

WAVE-SHELTERED SITES

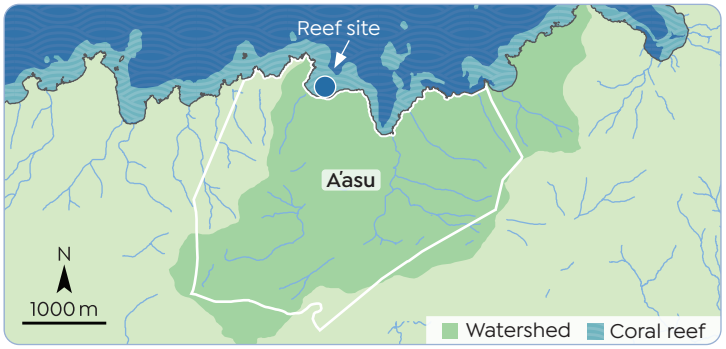
Local Monitoring Status Report

A'asu, Tutuila (2016–2017)

NORTH | SOUTH | WAVE-SHELTERED

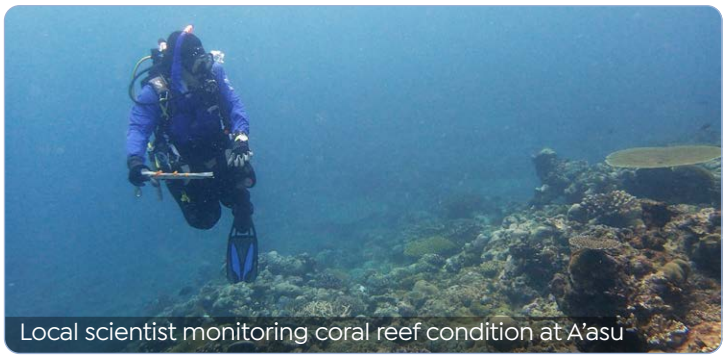
A'asu village and watershed

A'asu is not currently associated with a community-based management plan. A'asu has a larger than average watershed for a North site, but there are currently no people residing within the watershed or community.



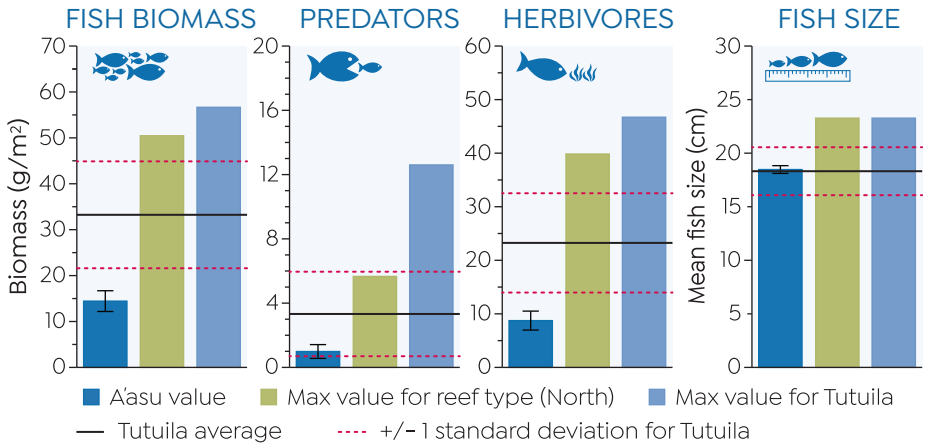
A'asu facts and figures	Value
Watershed Area (km²)	3.1 (H) [3.6, 17.6]
Disturbed Land (km²)	1.1 (H) [1.7, 9.4]
Population in watershed	0 (L) [640, 3955]
Population density (per km²)	0 (L) [204, 907]
Mean 10-year wave energy (J/m³)	282 (M) [432, 2071]
Mean stream DIN (mg/L)*	n/a [0.13, 0.29]
Maximum stream DIN (mg/L)	n/a [0.18, 0.47]

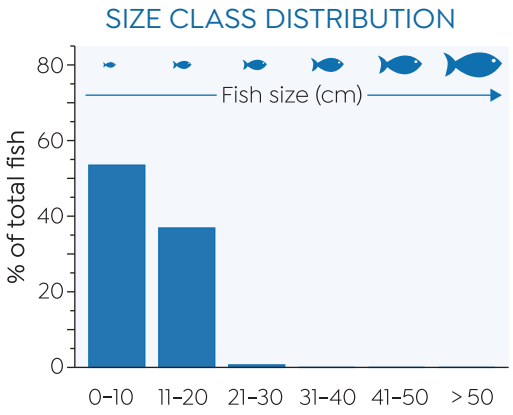
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Local scientist monitoring coral reef condition at A'asu

Coral reef fish

Mean fish size was similar to the average for Tutuila at A'asu. Fish biomass, predator biomass and herbivore biomass were all well below the Tutuila average, and far from the maximum value for North sites.

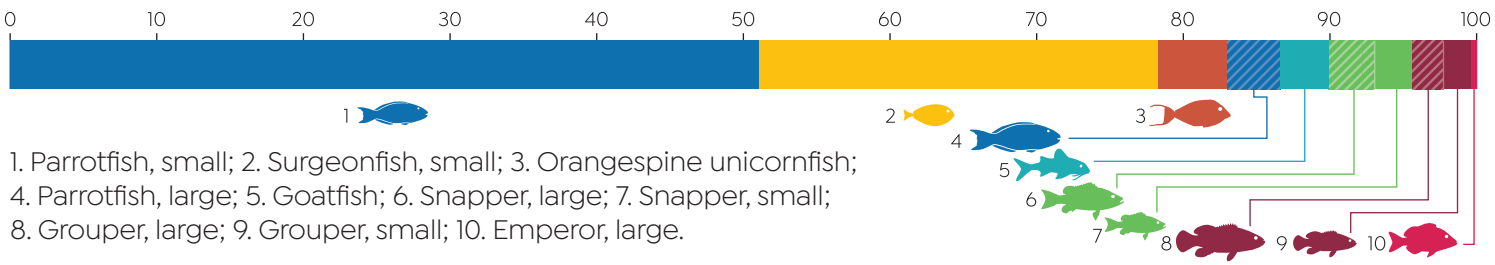




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Orangespine unicornfish; 4. Parrotfish, large; 5. Goatfish; 6. Snapper, large; 7. Snapper, small; 8. Grouper, large; 9. Grouper, small; 10. Emperor, large.

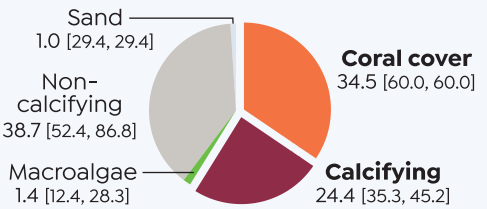
Coral reefs

A'asu – 182 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 6.0 [North max 6.8, Tutuila max 7.4].

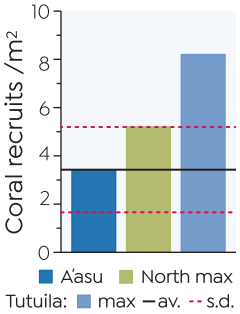
BENTHIC COVER (%)

A'asu [North max, Tutuila max]

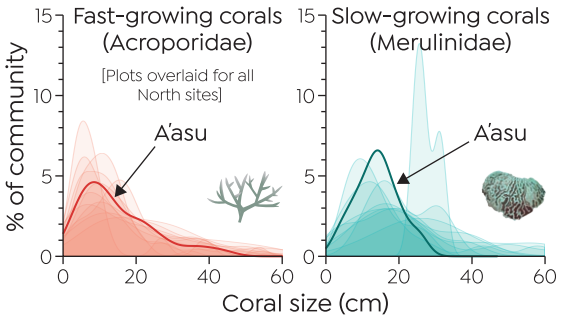


» Coral cover was 34.5%, which was less than the combined cover of sand (1.0%), macroalgae (1.4%) and non-calcifying substrate (38.7%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.4 recruits/m²) was near the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of colony sizes at A'asu with fewer small acroporids and fewer large merulinids than at other North sites.

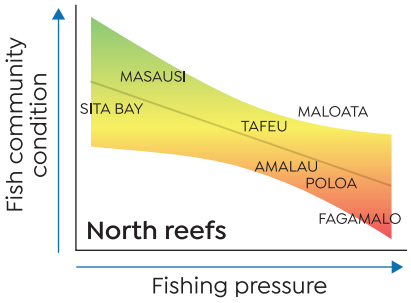
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

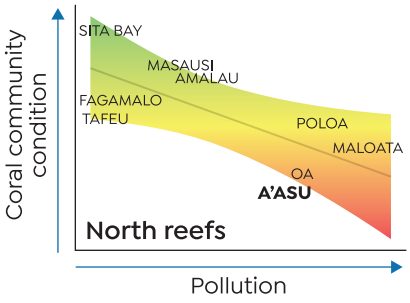
» A'asu was not assessed for fishing pressure.

» Watershed pollution was above average at A'asu and coral community condition was below average.

FISHING PRESSURE



POLLUTION AND CORAL



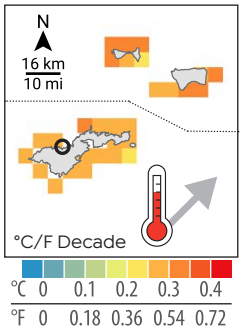
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** **2016** **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

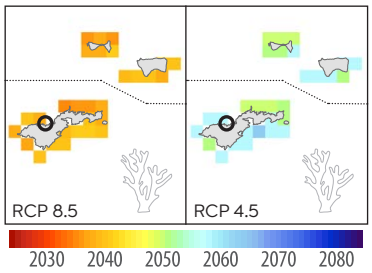
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at A'asu have been exposed to moderate thermal stress five times during this period, including in 2015, 2016, and 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

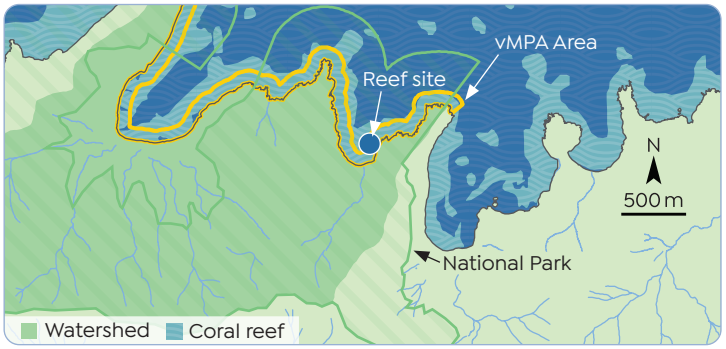
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Amalau, Tutuila (2016–2017)

Amalau village and watershed

Amalau is part of the Tutuila section of the National Park of American Samoa (NPSA), which permits use of marine resources for subsistence purposes. Amalau has a medium-size watershed for a North site, and there are only a few people residing within the watershed or community. The main stream in Amalau watershed, Tialu Falls, had relatively low concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other North sites.



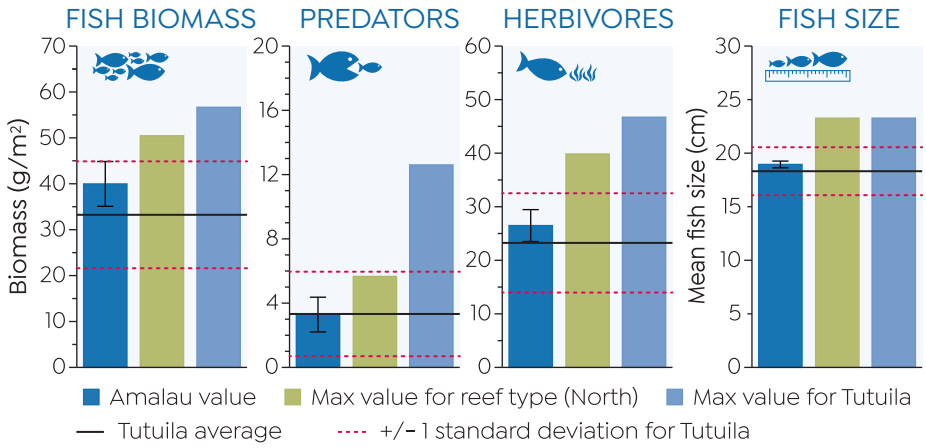
Amalau facts and figures		Value
	Watershed Area (km²)	1.1 (M) [3.6, 17.6]
	Disturbed Land (km²)	0.1 (L) [1.7, 9.4]
	Population in watershed	0 (L) [640, 3955]
	Population density (per km²)	0 (L) [204, 907]
	Mean 10-year wave energy (J/m³)	261 (M) [432, 2071]
	Mean stream DIN (mg/L)*	0.04 (L) [0.13, 0.29]
Tialu Falls	Maximum stream DIN (mg/L)	0.05 (L) [0.18, 0.47]

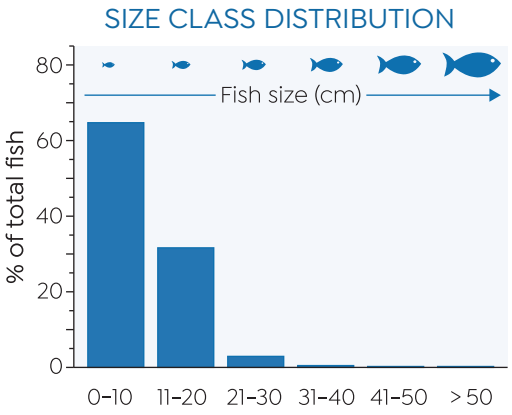
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Local scientist monitoring coral reef condition at Amalau

Coral reef fish

Mean fish size was similar to the average for Tutuila at Amalau. Fish biomass, predator biomass and herbivore biomass were all equal to or above the Tutuila average, and near the maximum value for North sites.

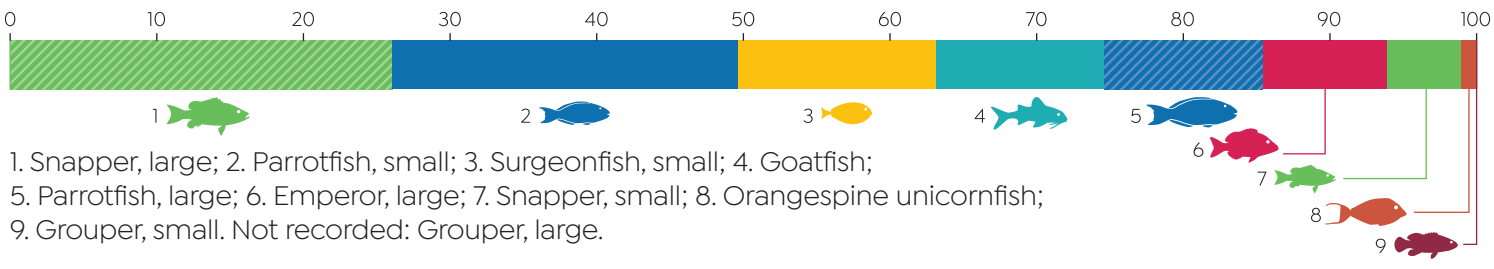




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Snapper, large; 2. Parrotfish, small; 3. Surgeonfish, small; 4. Goatfish; 5. Parrotfish, large; 6. Emperor, large; 7. Snapper, small; 8. Orangespine unicornfish; 9. Grouper, small. Not recorded: Grouper, large.

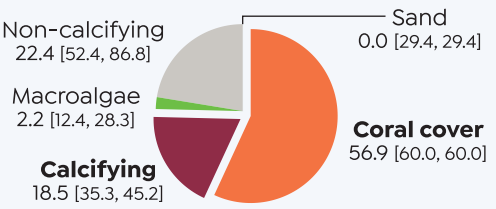
Coral reefs

Amalau – 111 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 5.3 [North max 6.8, Tutuila max 7.4].

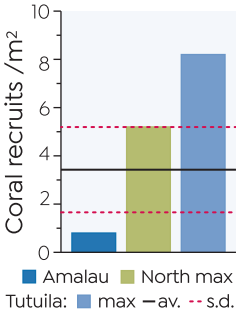
BENTHIC COVER (%)

Amalau [North max, Tutuila max]

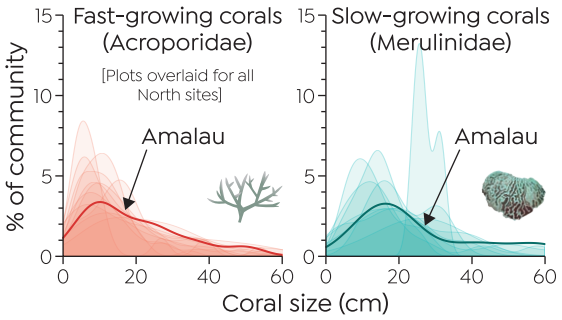


» Coral cover was 56.9%, much more than the combined cover of sand (0.0%), macroalgae (2.2%) and non-calcifying substrate (22.4%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (0.8/m²) was far below the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Amalau with fewer small acroporids and more large merulinids than at other North sites.

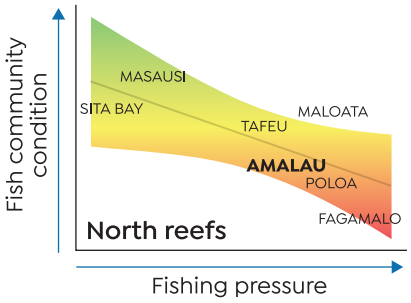
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

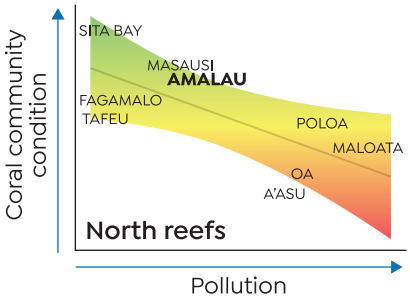
» The combination of access or distance to the boat harbor in Fagasa and low wave exposure likely contributed to relatively poor fish community condition.

» Watershed pollution was below average and coral community condition was above average.

FISHING PRESSURE



POLLUTION AND CORAL



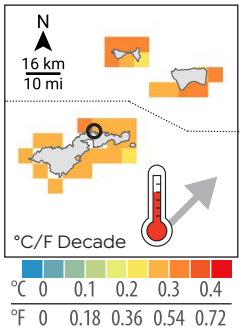
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

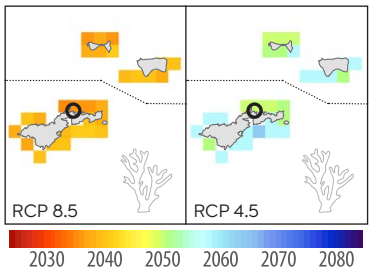
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Amalau were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

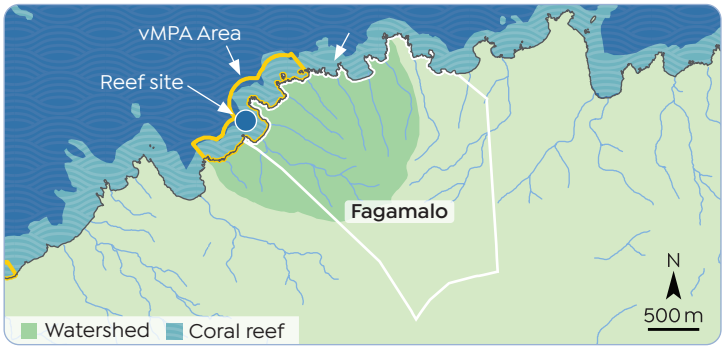
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Fagamalo, Tutuila (2016–2017)

Fagamalo village and watershed

Fagamalo is part of the Village Marine Protected Area (vMPA) program, which is co-managed with the Department of Marine & Wildlife Resources (DMWR). Fagamalo has a relatively small watershed area for a North site, and a relatively low population and population density. The main stream in Fagamalo watershed, Matavai, had relatively low concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other North sites.



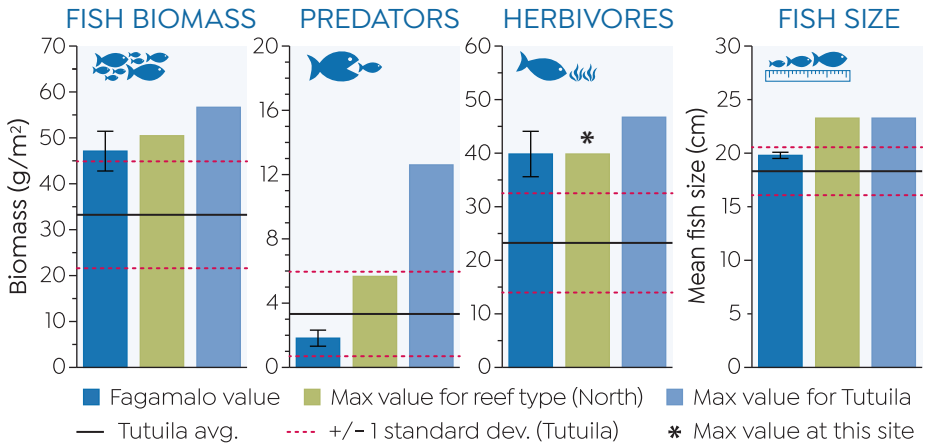
Fagamalo facts and figures		Value
	Watershed Area (km²)	1.0 (L) [3.6, 17.6]
	Disturbed Land (km²)	0.1 (L) [1.7, 9.4]
	Population in watershed	47 (L) [640, 3955]
	Population density (per km²)	46 (L) [204, 907]
	Mean 10-year wave energy (J/m³)	148 (M) [432, 2071]
	Mean stream DIN (mg/L)*	0.03 (L) [0.13, 0.29]
Matavai	Maximum stream DIN (mg/L)	0.02 (L) [0.18, 0.47]

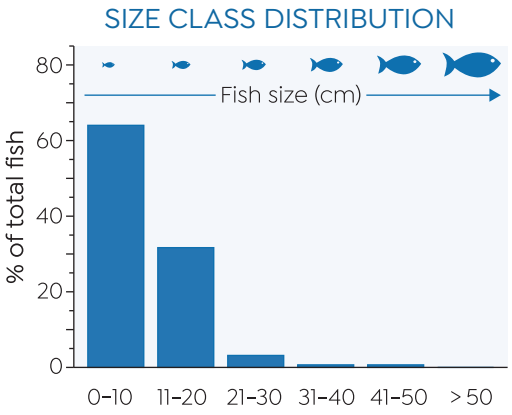
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Coral garden and abundant crustose coralline algae

Coral reef fish

Mean fish size was above the average for Tutuila. Fish biomass was far above the Tutuila average. Herbivore biomass was higher than at any other North site but predator biomass was below the Tutuila average.

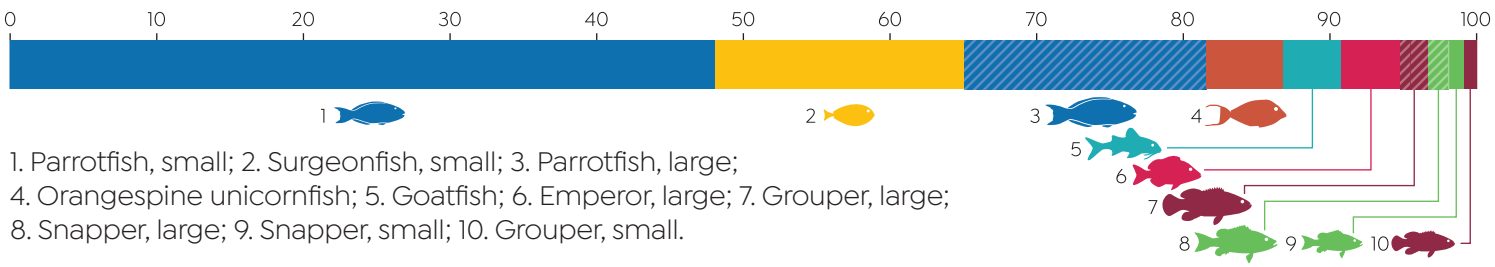




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large;
4. Orangespine unicornfish; 5. Goatfish; 6. Emperor, large; 7. Grouper, large;
8. Snapper, large; 9. Snapper, small; 10. Grouper, small.

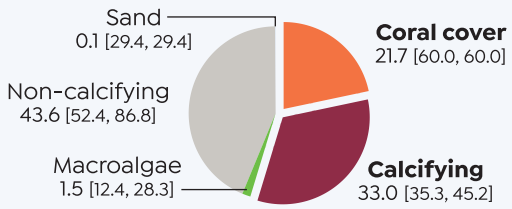
Coral reefs

Fagamalo – 103 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 4.9 [North max 6.8, Tutuila max 7.4].

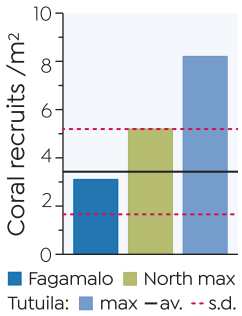
BENTHIC COVER (%)

Fagamalo [North max, Tutuila max]

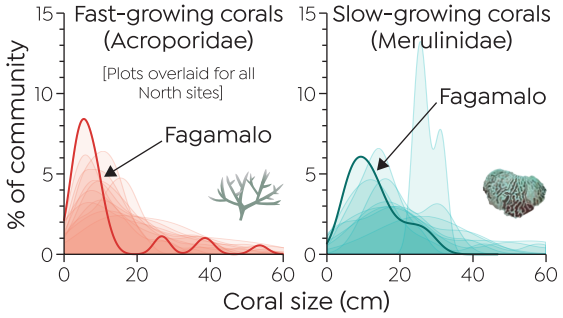


» Coral cover was 21.7%, much less than the combined cover of sand (0.1%), macroalgae (1.5%) and non-calcifying substrate (43.6%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.1 recruits/m²) was below the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Fagamalo with more small acroporids and more small merulinids than at other North sites.

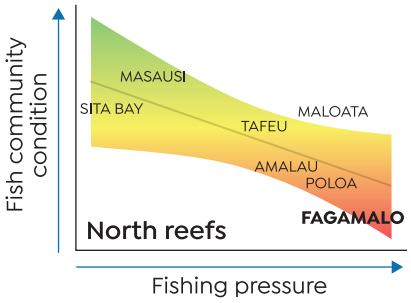
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

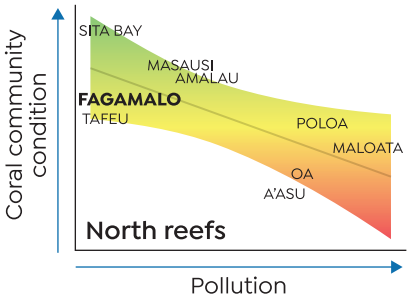
» Access or distance to the boat harbor in Fagasa and low wave exposure likely contributed to the poorest fish community condition of North sites.

» Watershed pollution was below average at Fagamalo and coral community condition was above average.

FISHING PRESSURE



POLLUTION AND CORAL



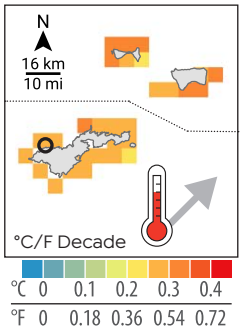
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2008 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

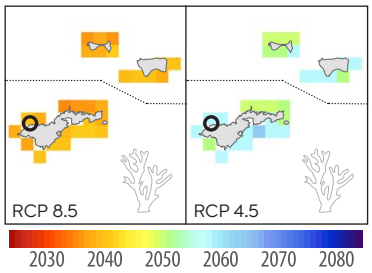
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Fagamalo were not exposed to moderate thermal stress (four or more degree heating weeks) during this time.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

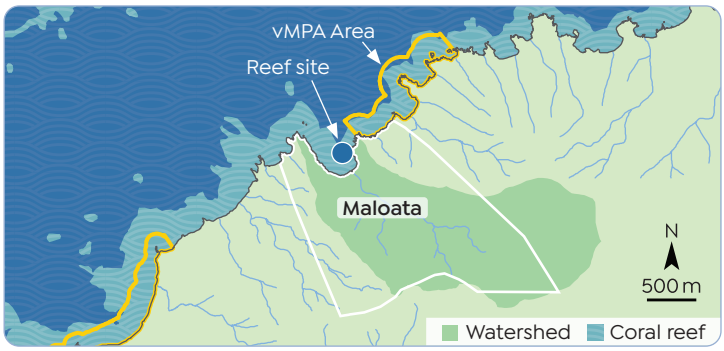
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Maloata, Tutuila (2016-2017)

Maloata village and watershed

Maloata is not currently associated with a community-based management plan. Maloata has a relatively small watershed area for a North site, and a relatively small population and low population density. The main stream in Maloata watershed, Maloata, had medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other North sites.



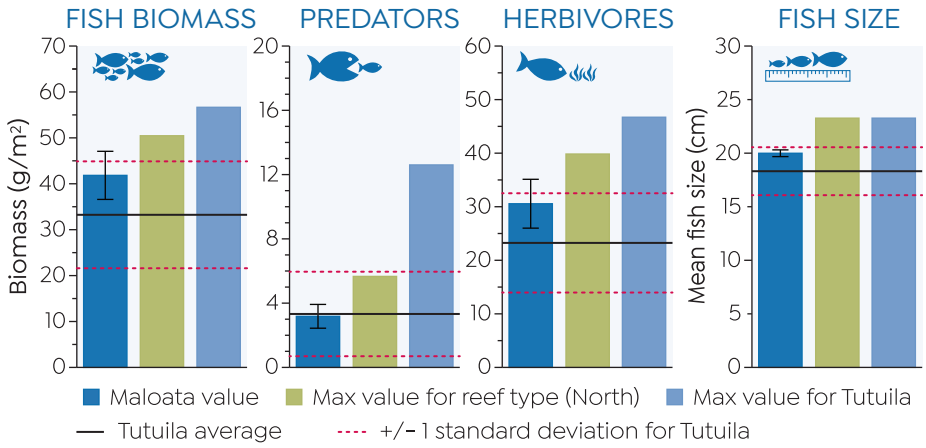
Maloata facts and figures		Value
	Watershed Area (km²)	2.8 (H) [3.6, 17.6]
	Disturbed Land (km²)	0.3 (M) [1.7, 9.4]
	Population in watershed	8 (L) [640, 3955]
	Population density (per km²)	3 (L) [204, 907]
	Mean 10-year wave energy (J/m³)	370 (M) [432, 2071]
	Mean stream DIN (mg/L)*	0.06 (M) [0.13, 0.29]
Maloata	Maximum stream DIN (mg/L)	0.09 (M) [0.18, 0.47]

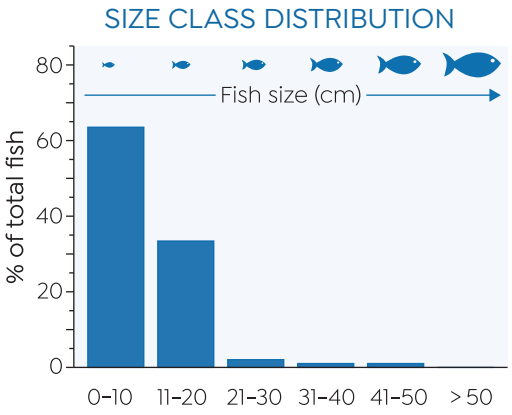
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Corals on the reef slope at Maloata

Coral reef fish

Mean fish size was above the average for Tutuila at Maloata. Fish biomass and herbivore biomass were far above the Tutuila average. Predator biomass was similar to the Tutuila average.

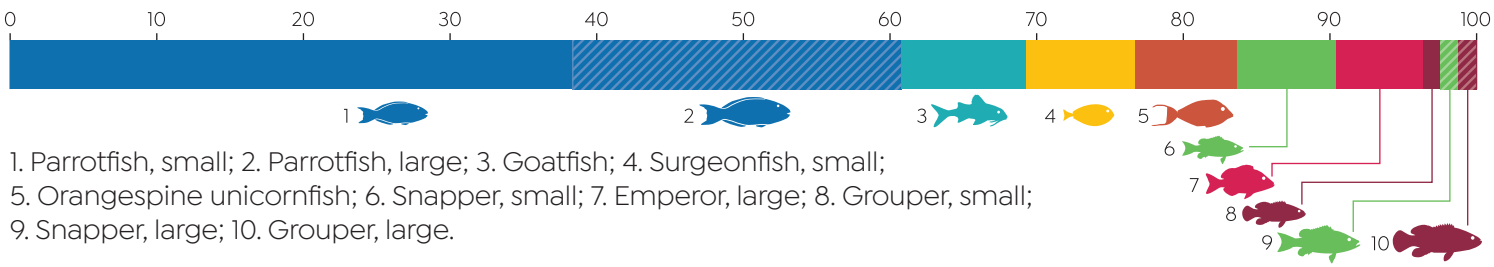




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Parrotfish, large; 3. Goatfish; 4. Surgeonfish, small; 5. Orangespine unicornfish; 6. Snapper, small; 7. Emperor, large; 8. Grouper, small; 9. Snapper, large; 10. Grouper, large.

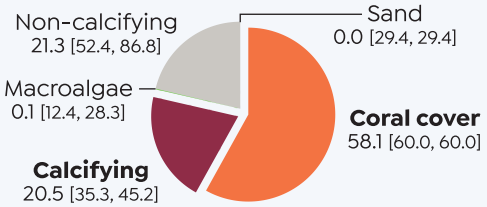
Coral reefs

Maloata – 137 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 4.5 [North max 6.8, Tutuila max 7.4].

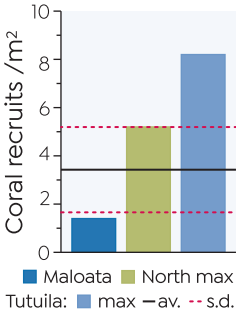
BENTHIC COVER (%)

Maloata [North max, Tutuila max]

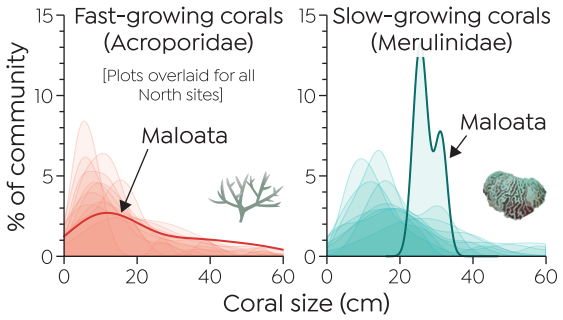


» Coral cover was 58.1%, much less than the combined cover of sand (0.0%), macroalgae (0.1%) and non-calcifying substrate (21.3%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (1.4 recruits/m²) was near the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Malaota with fewer small acroporids and many more large merulinids than at other North sites.

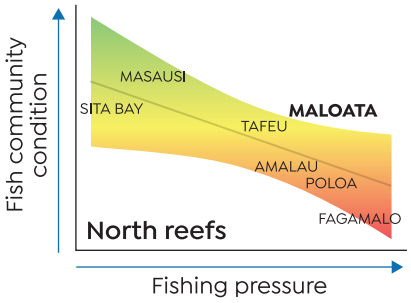
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

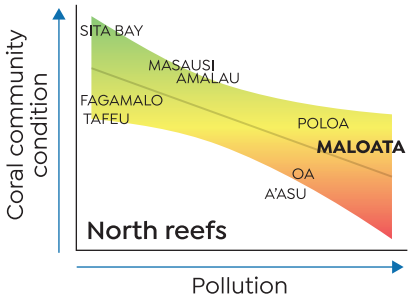
» Fish community condition at Maloata fell in the middle of the North sites (neither relatively poor or relatively good).

» Watershed pollution was above average at Maloata and coral community condition was relatively poor.

FISHING PRESSURE



POLLUTION AND CORAL



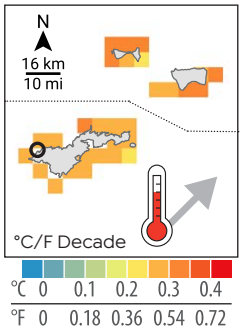
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2008 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

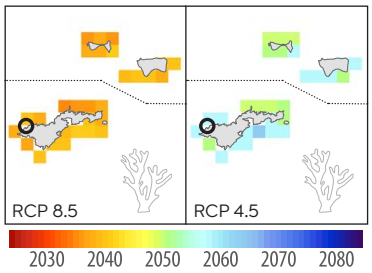
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Maloata were not exposed to moderate thermal stress (four or more degree heating weeks) during this time.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING

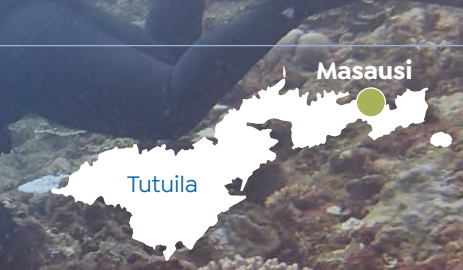


Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

WHAT YOU CAN DO TO HELP

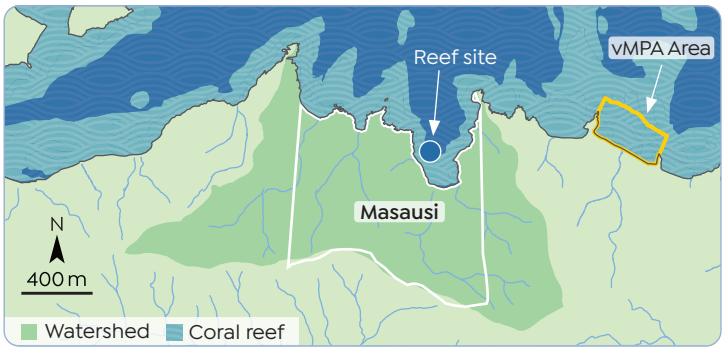
- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Masausi, Tutuila (2016–2017)



Masausi village and watershed

Masausi is not currently associated with a community-based management plan. Masausi has a relatively small watershed area for a North site, and medium population and population density. The main stream in Masausi watershed, Vaipito, had relatively low concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other North sites.



Masausi facts and figures	Value
Watershed Area (km²)	0.8 (L) [3.6, 17.6]
Disturbed Land (km²)	0.3 (L) [1.7, 9.4]
Population in watershed	164 (M) [640, 3955]
Population density (per km²)	204 (M) [204, 907]
Mean 10-year wave energy (J/m³)	185 (M) [432, 2071]
Mean stream DIN (mg/L)*	0.05 (L) [0.13, 0.29]
Maximum stream DIN (mg/L)	0.09 (M) [0.18, 0.47]

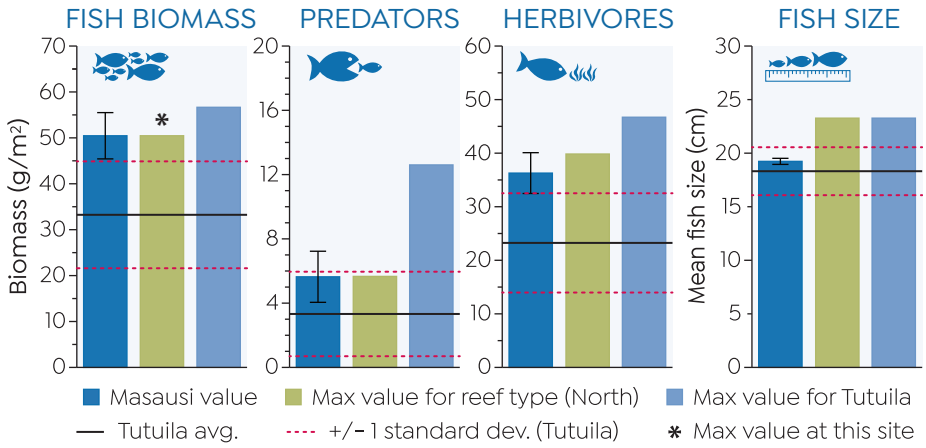
Vaipito

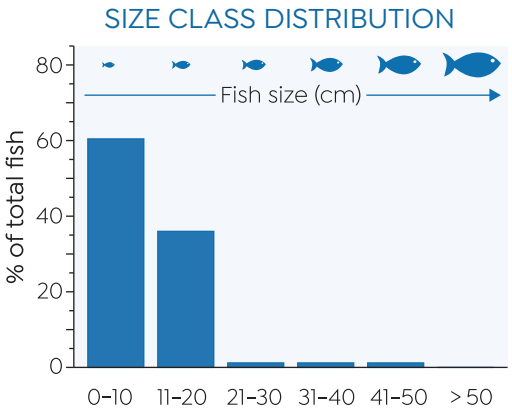
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Recovering reef at Masausi

Coral reef fish

Mean fish size was above the average for Tutuila at Masausi. Fish biomass (highest of any North sites), predator biomass and herbivore biomass were all well above the Tutuila average.

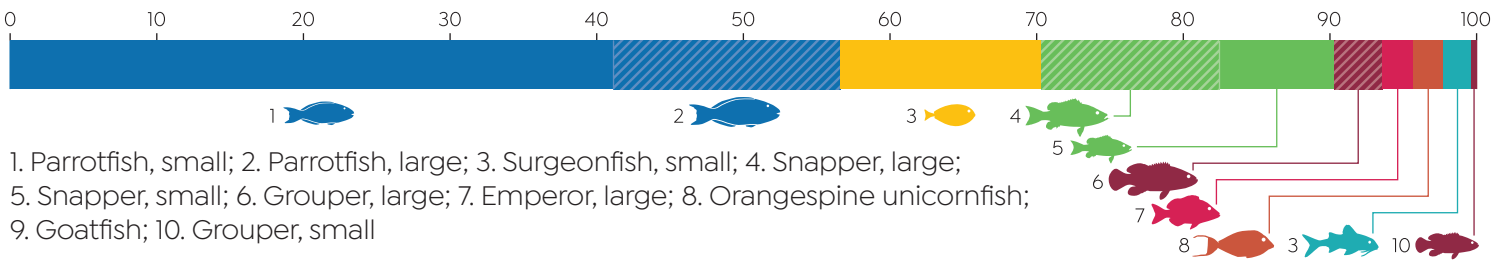




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Parrotfish, large; 3. Surgeonfish, small; 4. Snapper, large; 5. Snapper, small; 6. Grouper, large; 7. Emperor, large; 8. Orangespine unicornfish; 9. Goatfish; 10. Grouper, small

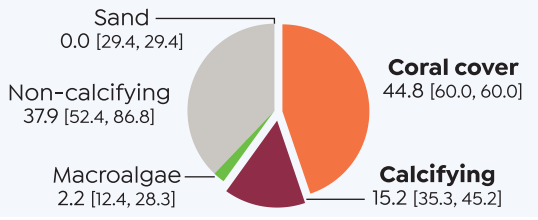
Coral reefs

Masausi – 184 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 6.8 [North max 6.8, Tutuila max 7.4].

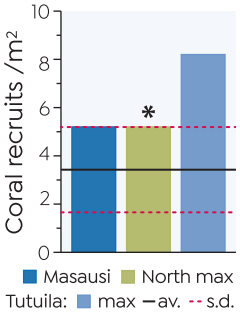
BENTHIC COVER (%)

Masausi [North max, Tutuila max]

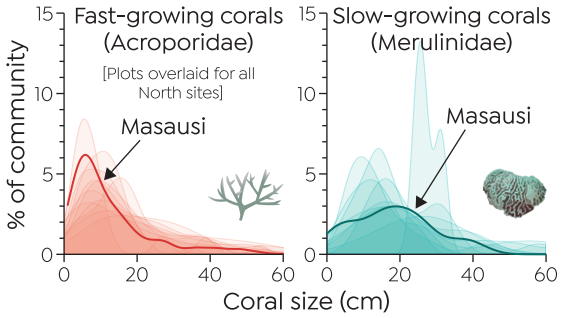


» Coral cover was 44.8%, which was less than the combined cover of sand (0.0%), macroalgae (2.2%) and non-calcifying substrate (37.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (5.2/m²) was well above the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Masausi with more small acroporids and more large merulinids than at other North sites.

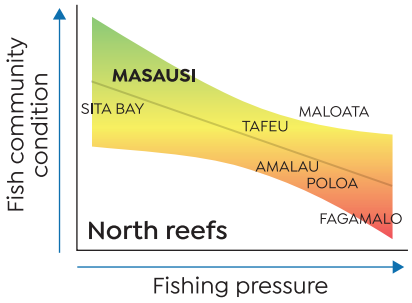
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

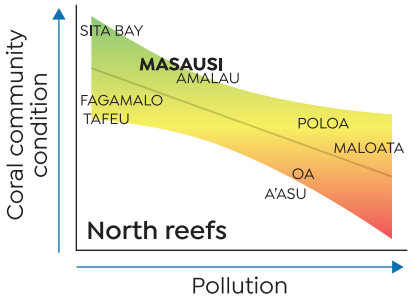
» Fishing pressure was relatively low and fish community condition was relatively good at Masausi.

» Watershed pollution was below average at Masausi and coral community condition was relatively good.

FISHING PRESSURE

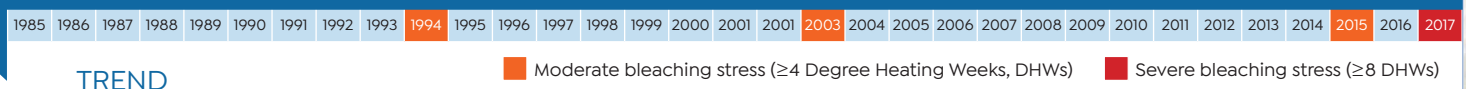


POLLUTION AND CORAL

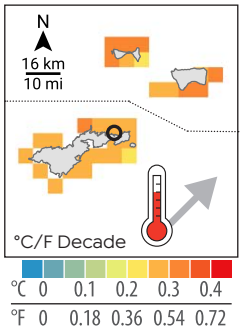


Impacts of climate change

Past (1985–2017)



TREND



Rate of increase of sea surface temperatures.

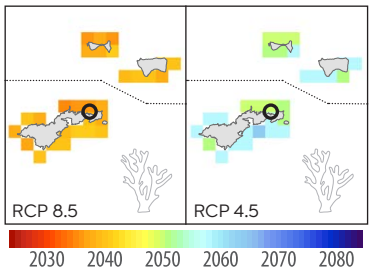
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Masausi were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING

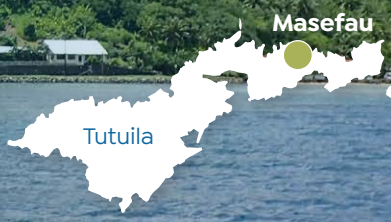


Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

WHAT YOU CAN DO TO HELP

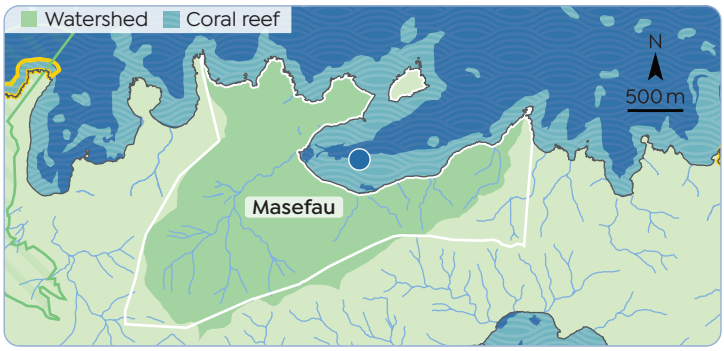
- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Masefau, Tutuila (2016–2017)



Masefau village and watershed

Masefau is not currently associated with a community-based management plan. Masefau has a relatively large watershed area for a North site, and medium population and population density. The main stream in Masefau watershed, Talaloa, had medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other North sites.

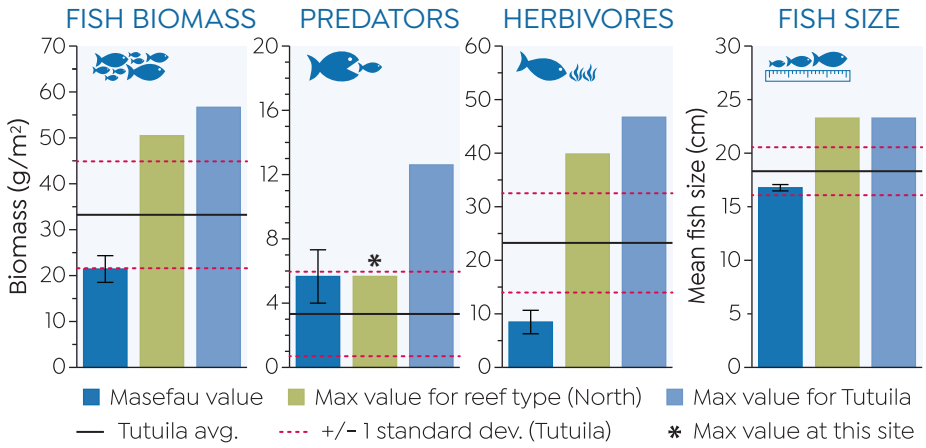


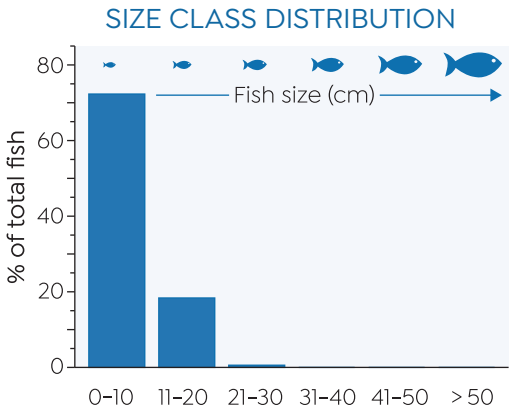
Masefau facts and figures	Value
Watershed Area (km²)	3.6 (H) [3.6, 17.6]
Disturbed Land (km²)	1.7 (H) [1.7, 9.4]
Population in watershed	425 (M) [640, 3955]
Population density (per km²)	117 (M) [204, 907]
Mean 10-year wave energy (J/m³)	108 (L) [432, 2071]
Mean stream DIN (mg/L)*	0.08 (M) [0.13, 0.29]
Talaloa — Maximum stream DIN (mg/L)	0.09 (M) [0.18, 0.47]

High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period

Coral reef fish

Mean fish size was below the average for Tutuila at Masefau. Fish biomass and herbivore biomass were well below the Tutuila average. Predator biomass was well above the Tutuila average.

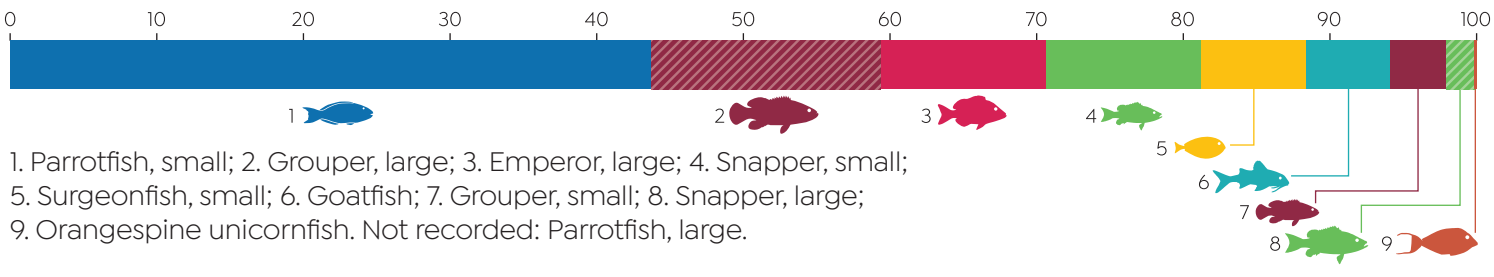




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Grouper, large; 3. Emperor, large; 4. Snapper, small; 5. Surgeonfish, small; 6. Goatfish; 7. Grouper, small; 8. Snapper, large; 9. Orangespine unicornfish. Not recorded: Parrotfish, large.

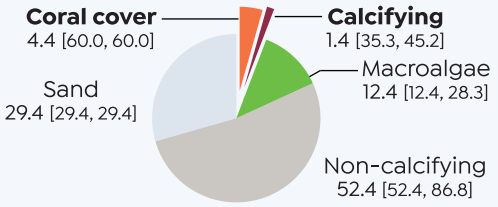
Coral reefs

Masefau – 70 spp.
North reefs max – 184 coral species
Tutuila max – 195 species

Coral species richness was 3.7 [North max 6.8, Tutuila max 7.4].

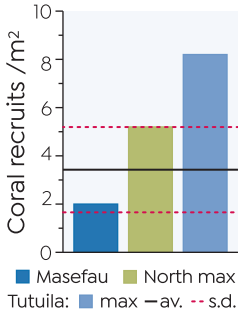
BENTHIC COVER (%)

Masefau [North max, Tutuila max]

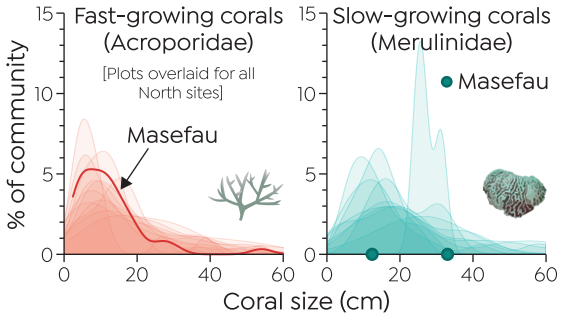


» Coral cover was 4.4%, much less than the combined cover of sand (29.4%), macroalgae (12.4%) and non-calcifying substrate (52.4%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (2.0/m²) was well below the average for Tutuila.

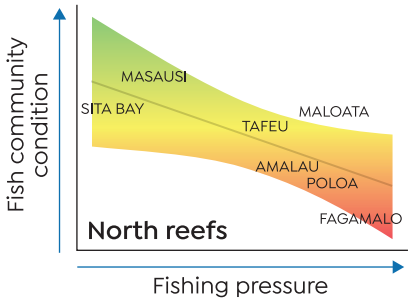
Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were mostly small corals at Masefau with more small acroporids than at other North sites and just two merulinids (17 and 33 cm).

Human impacts

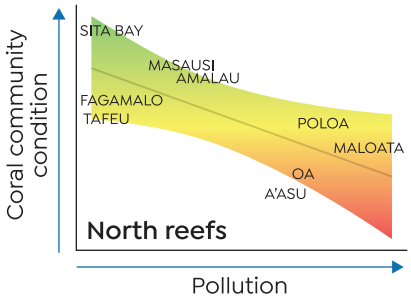
» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

» Masefau was not included in these assessments.

FISHING PRESSURE



POLLUTION AND CORAL



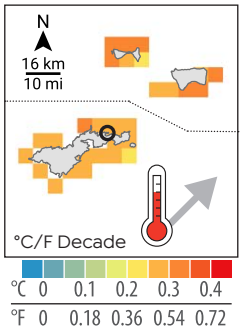
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

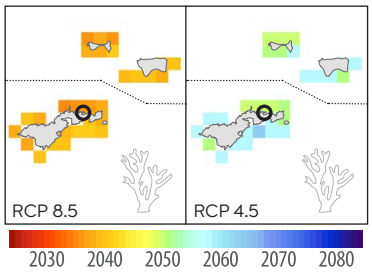
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Masefau were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

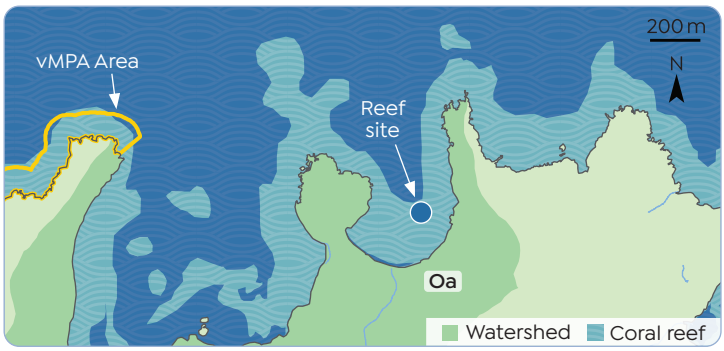
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Oa, Tutuila (2016–2017)

Oa village and watershed

Oa is not currently associated with a community-based management plan. Oa has a relatively small watershed area for a North site, with an undisturbed stream emerging from the valley. No people reside within the watershed.



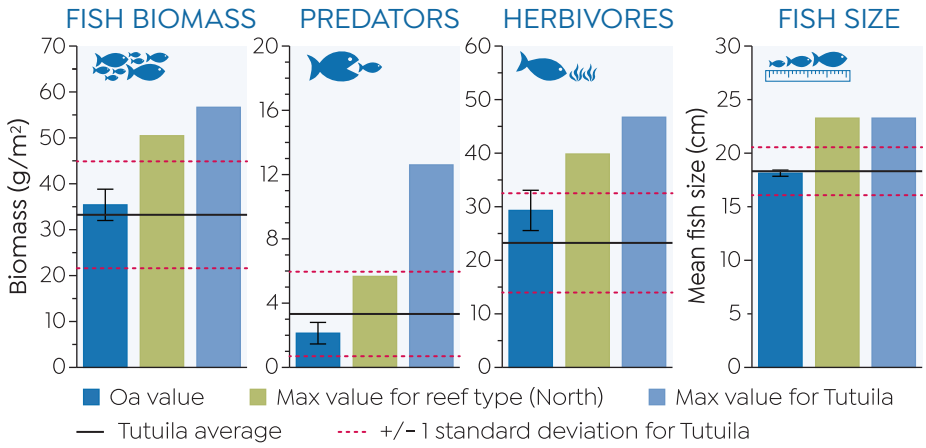
Oa facts and figures	Value
Watershed Area (km²)	0.5 (L) [3.6, 17.6]
Disturbed Land (km²)	0.0 (L) [1.7, 9.4]
Population in watershed	0 (L) [640, 3955]
Population density (per km²)	0 (L) [204, 907]
Mean 10-year wave energy (J/m³)	276 (M) [432, 2071]
Mean stream DIN (mg/L)*	n/a [0.13, 0.29]
Maximum stream DIN (mg/L)	n/a [0.18, 0.47]

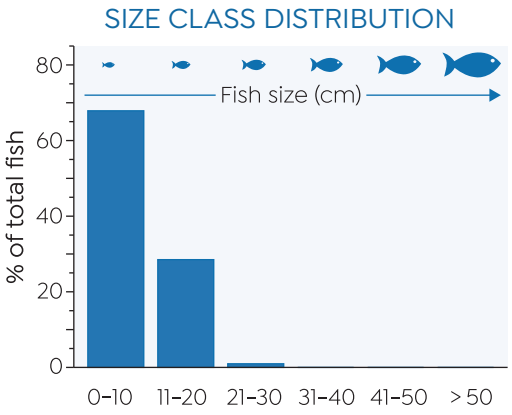
Oa

High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period

Coral reef fish

Mean fish size was similar to the average for Tutuila at Oa. Fish biomass was similar to the Tutuila average. Predator biomass was below the Tutuila average and herbivore biomass was above the Tutuila average.

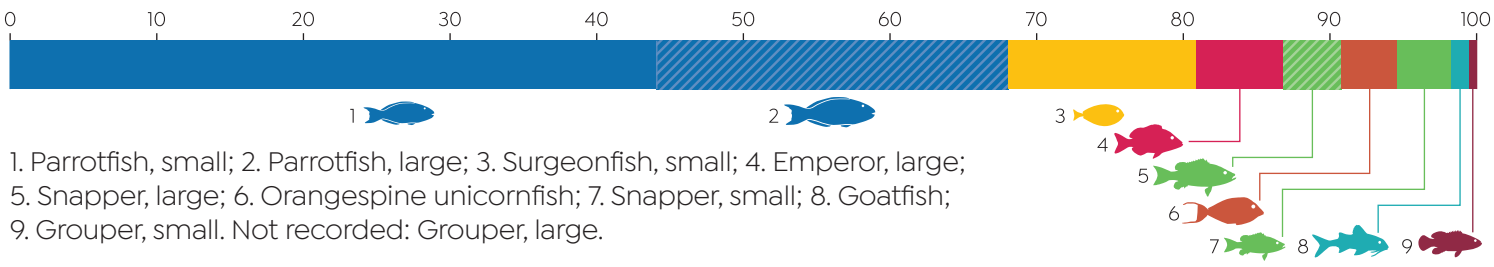




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Parrotfish, large; 3. Surgeonfish, small; 4. Emperor, large; 5. Snapper, large; 6. Orangespine unicornfish; 7. Snapper, small; 8. Goatfish; 9. Grouper, small. Not recorded: Grouper, large.

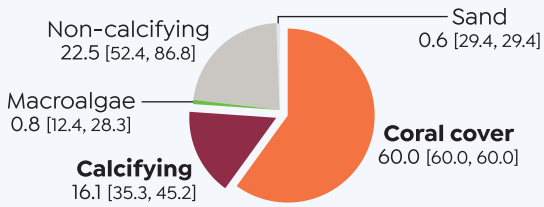
Coral reefs

Oa – 155 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 5.3 [North max 6.8, Tutuila max 7.4].

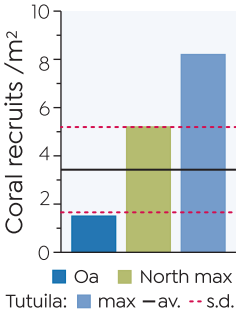
BENTHIC COVER (%)

Oa [North max, Tutuila max]

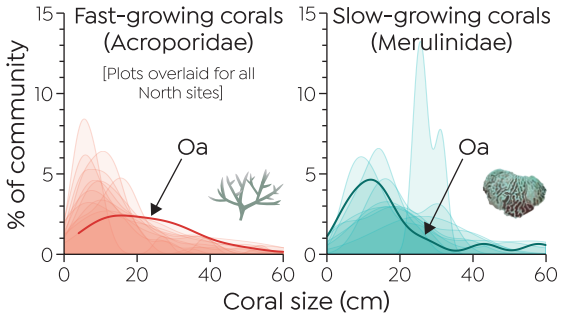


» Coral cover was 60% (highest in Tutuila), much more than the combined cover of sand (0.6%), macroalgae (0.8%) and non-calcifying substrate.

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (1.5/m²) was well below the average for Tutuila.

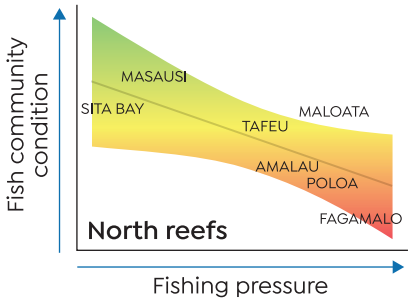
Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Oa with more large acroporids and more small merulinids than at other North sites.

Human impacts

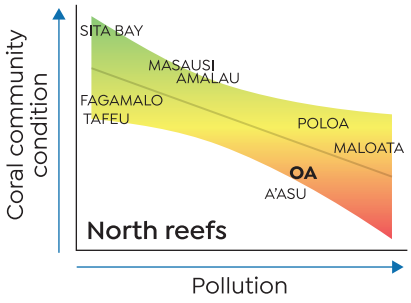
» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

» Watershed pollution was above average at Oa and coral community condition was relatively poor.

FISHING PRESSURE

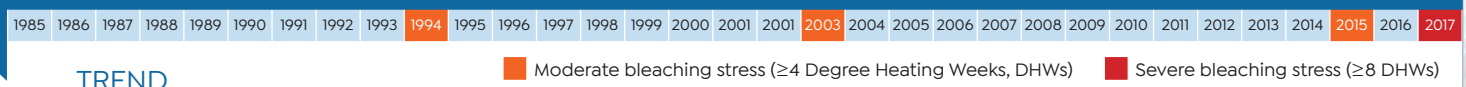


POLLUTION AND CORAL



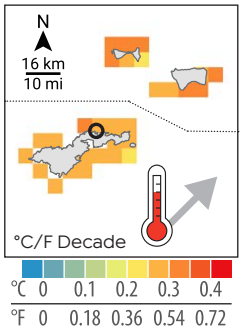
Impacts of climate change

Past (1985–2017)



Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

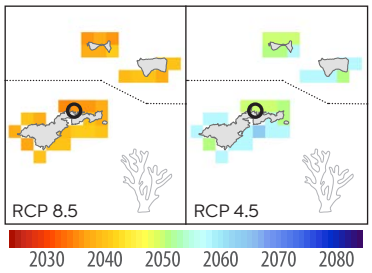
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Oa were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

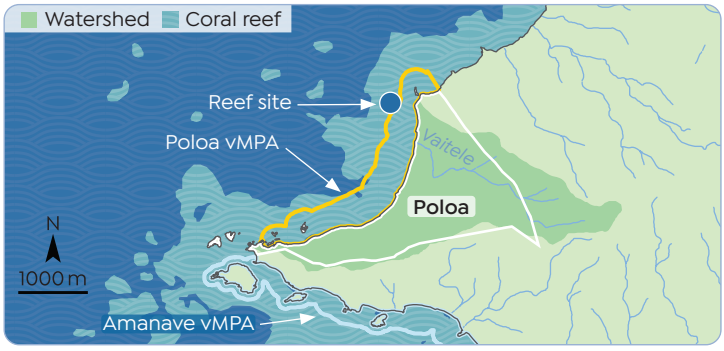
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Poloa, Tutuila (2016–2017)

Poloa village and watershed

Poloa is part of the Village Marine Protected Area (vMPA) program, which is comanaged with the Department of Marine & Wildlife Resources (DMWR). The main stream in Poloa watershed, Vaitele, had relatively high concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other North sites.

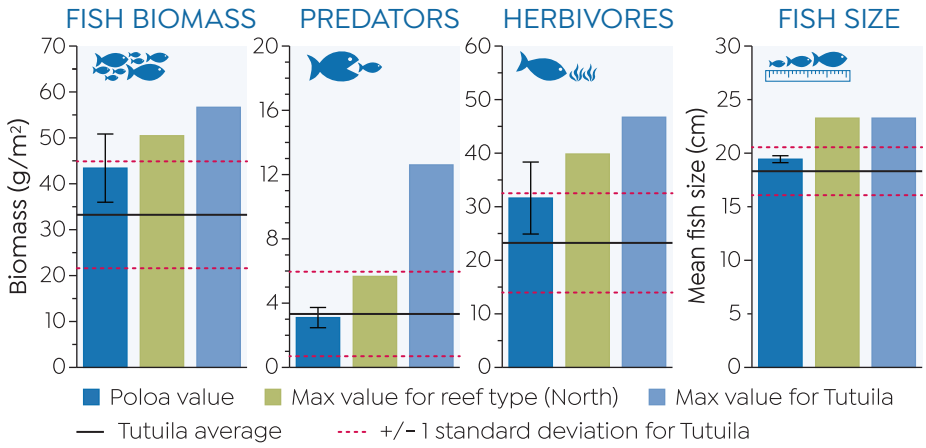


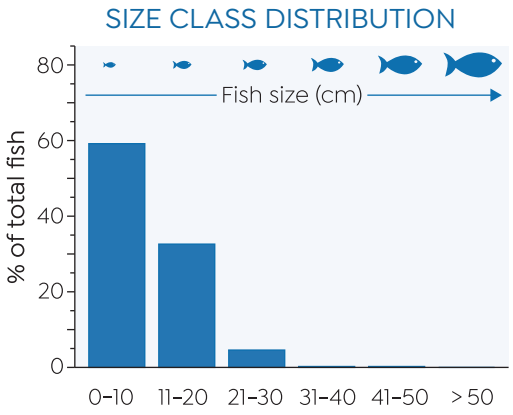
Poloa facts and figures	Value
Watershed Area (km²)	1.0 (M) [3.6, 17.6]
Disturbed Land (km²)	0.4 (M) [1.7, 9.4]
Population in watershed	193 (M) [640, 3955]
Population density (per km²)	184 (M) [204, 907]
Mean 10-year wave energy (J/m³)	432 (M) [432, 2071]
Mean stream DIN (mg/L)*	0.13 (H) [0.13, 0.29]
Vaitele Maximum stream DIN (mg/L)	0.18 (H) [0.18, 0.47]

High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period

Targeted coral reef fish

Average fish size, herbivore biomass and fish biomass at Poloa were all above the Tutuila average, but below the maximum value for North sites. Predator biomass was just below the Tutuila average.

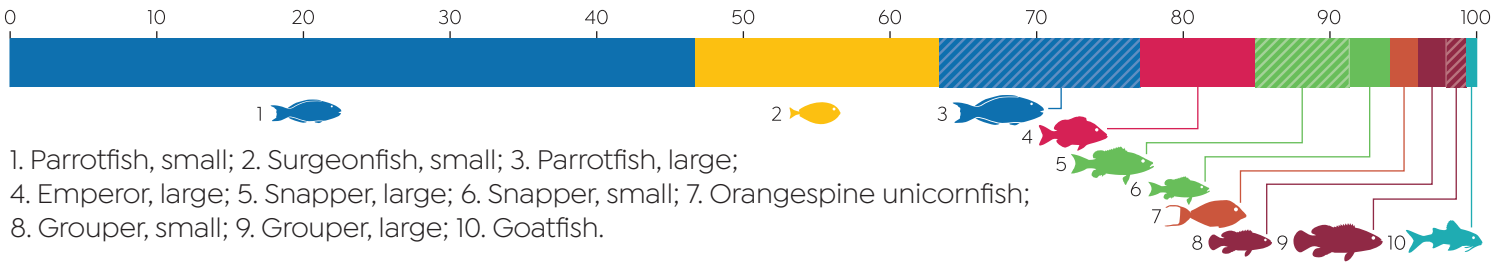




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of targeted fish community made up by various groups.



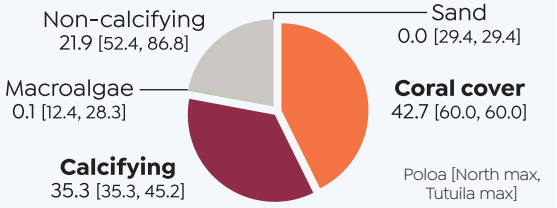
1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large;
4. Emperor, large; 5. Snapper, large; 6. Snapper, small; 7. Orangespine unicornfish;
8. Grouper, small; 9. Grouper, large; 10. Goatfish.

Coral reefs

Poloa – 172 coral species
North reefs max – 184 species
Tutuila max – 195 species

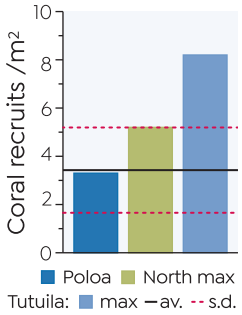
Coral species richness was 6.4 [North max 6.8, Tutuila max 7.4].

BENTHIC COVER (%)

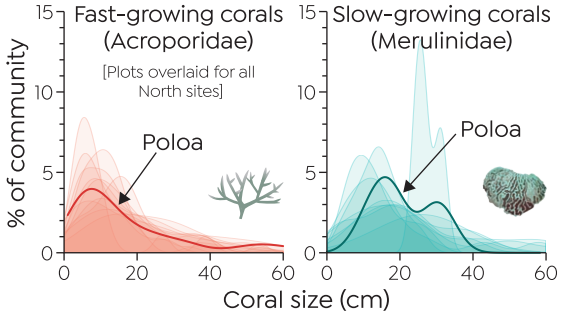


» Coral cover was 42.7%, exceeding the combined cover of sand (0%), macroalgae (0.1%) and non-calcifying substrate (21.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.4 recruits/m²) was near the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of colony sizes at A'asu with fewer small acroporids and fewer large merulinids than at other North sites.

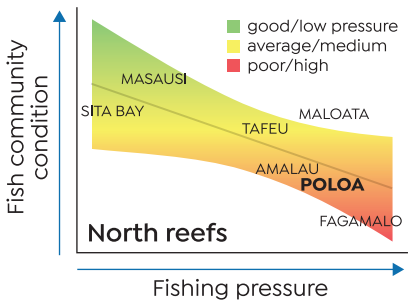
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

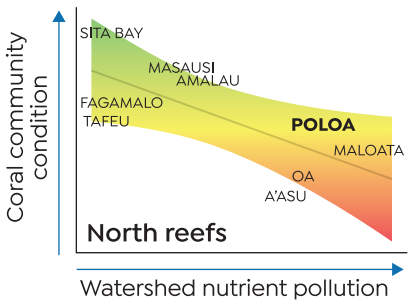
» The combination of easy access to the boat harbor in Fagasa and low wave exposure likely contributed to relatively poor fish community condition.

» Watershed pollution was above average and coral community condition was average.

FISHING PRESSURE



POLLUTION AND CORAL



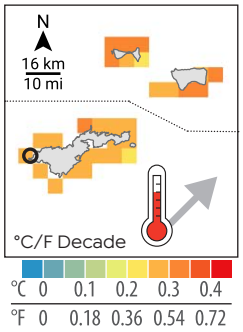
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

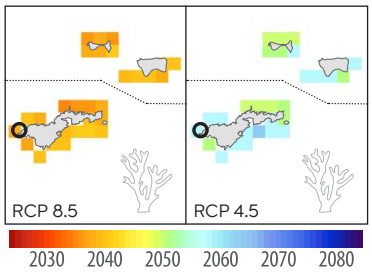
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Poloa have been exposed to moderate thermal stress four times during this period, including in 2015 and 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

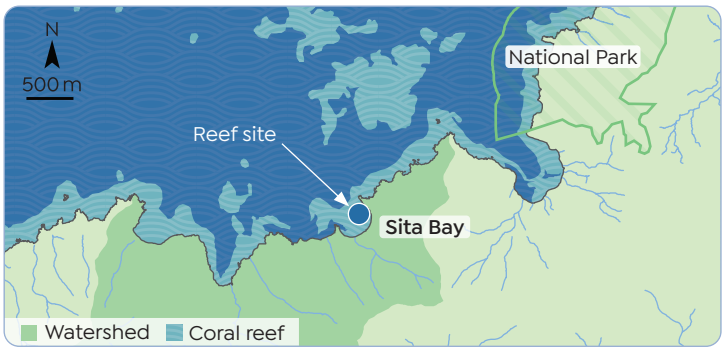
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Sita Bay, Tutuila (2016-2017)

Sita Bay village and watershed

Sita Bay is not currently associated with a community-based management plan. Sita Bay has a relatively small watershed area for a North site, which is largely undisturbed. There are no people residing within the watershed area.



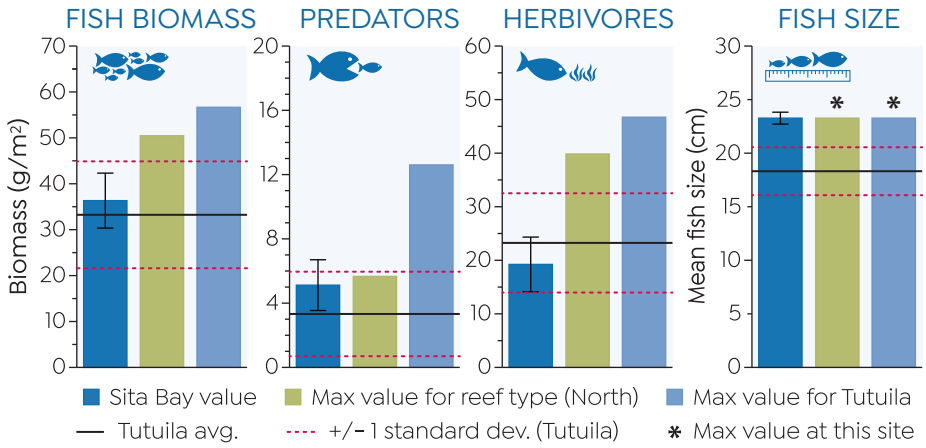
Sita Bay facts and figures	Value
Watershed Area (km²)	0.5 (L) [3.6, 17.6]
Disturbed Land (km²)	0.0 (L) [1.7, 9.4]
Population in watershed	0 (L) [640, 3955]
Population density (per km²)	0 (L) [204, 907]
Mean 10-year wave energy (J/m³)	383 (M) [432, 2071]
Mean stream DIN (mg/L)*	n/a [0.13, 0.29]
Sita — Maximum stream DIN (mg/L)	n/a [0.18, 0.47]

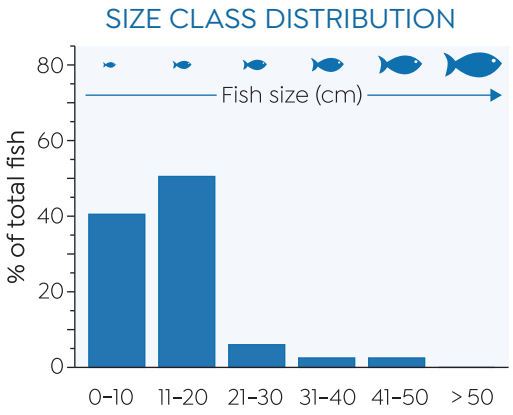
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Local scientist monitoring coral reef condition at Sita Bay

Coral reef fish

Sita Bay had the greatest mean fish size of all North sites and all sites in Tutuila. Fish biomass, predator biomass and herbivore biomass were all above the Tutuila average.

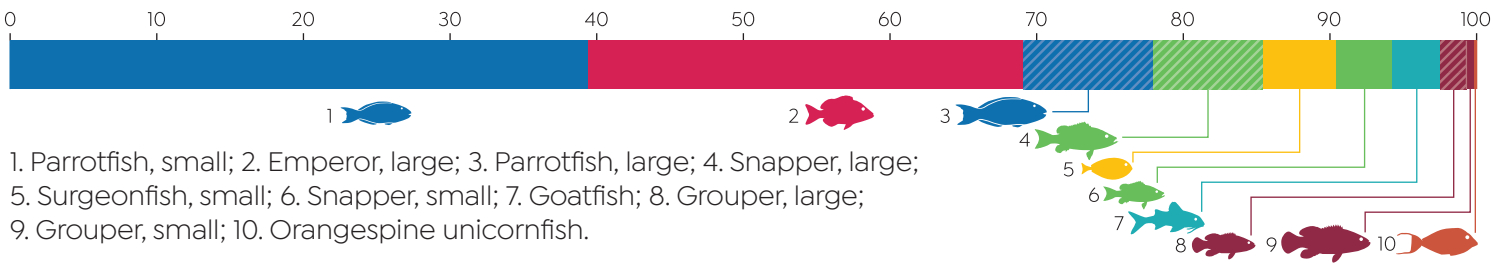




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Emperor, large; 3. Parrotfish, large; 4. Snapper, large; 5. Surgeonfish, small; 6. Snapper, small; 7. Goatfish; 8. Grouper, large; 9. Grouper, small; 10. Orangespine unicornfish.

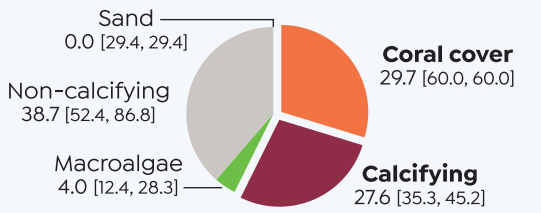
Coral reefs

Sita Bay – 133 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 6.4 [North max 6.8, Tutuila max 7.4].

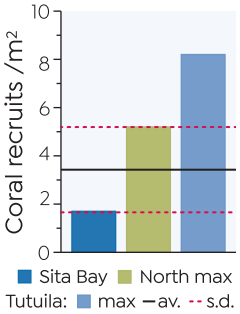
BENTHIC COVER (%)

Sita Bay [North max, Tutuila max]

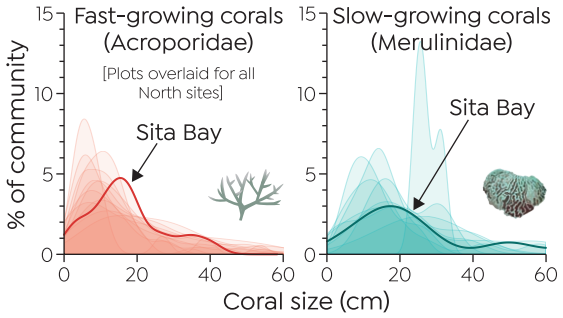


» Coral cover was 29.7%, which was less than the combined cover of sand (0.0%), macroalgae (4.0%) and non-calcifying substrate (38.7%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (1.7/m²) was well below the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Sita Bay with more small acroporids and more small merulinids than at other North sites.

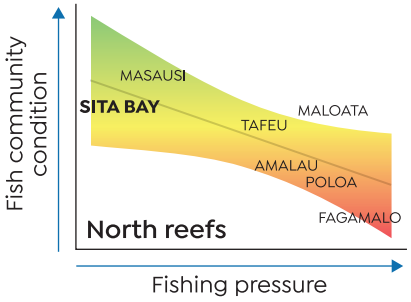
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

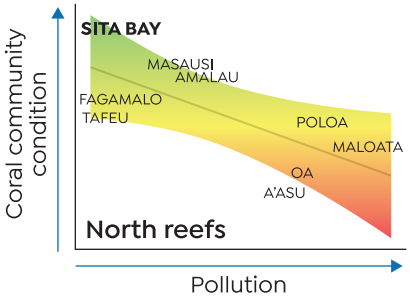
» Fishing pressure was relatively low and fish community condition was relatively good at Sita Bay.

» Watershed pollution was below average at Sita Bay and coral community condition was better than at any other North site assessed.

FISHING PRESSURE



POLLUTION AND CORAL



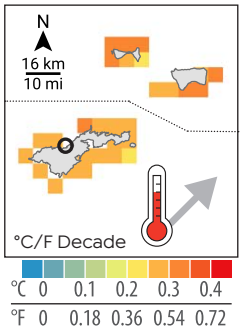
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

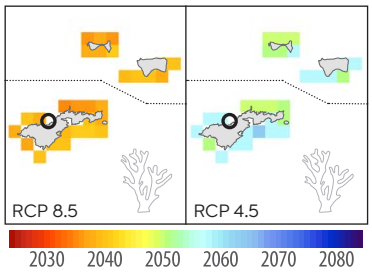
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Sita Bay have been exposed to moderate thermal stress four times during this period, including in 2015 and 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

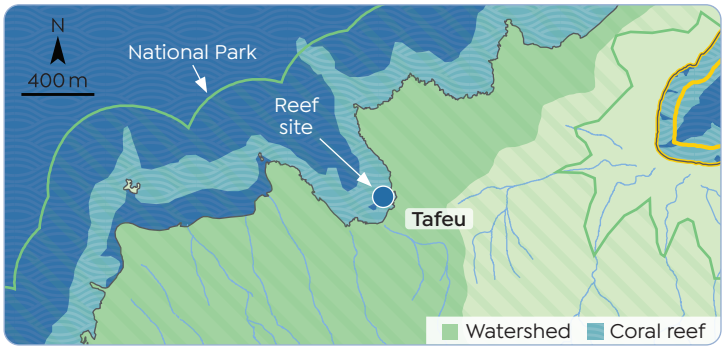
Local Monitoring Status Report

Tafeu, Tutuila (2016–2017)

NORTH
SOUTH
WAVE-SHELTERED

Tafeu Cove and watershed

Tafeu Cove is part of the Tutuila section of the National Park of American Samoa (NPSA), which permits use of marine resources for subsistence purposes. Tafeu Cove has a relatively small watershed area for a North site. There are no people residing in the watershed.



Tafeu facts and figures	Value
Watershed Area (km²)	0.4 (L) [3.6, 17.6]
Disturbed Land (km²)	0.0 (L) [1.7, 9.4]
Population in watershed	0 (L) [640, 3955]
Population density (per km²)	0 (L) [204, 907]
Mean 10-year wave energy (J/m³)	201 (M) [432, 2071]
Mean stream DIN (mg/L)*	n/a [0.13, 0.29]
Maximum stream DIN (mg/L)	n/a [0.18, 0.47]

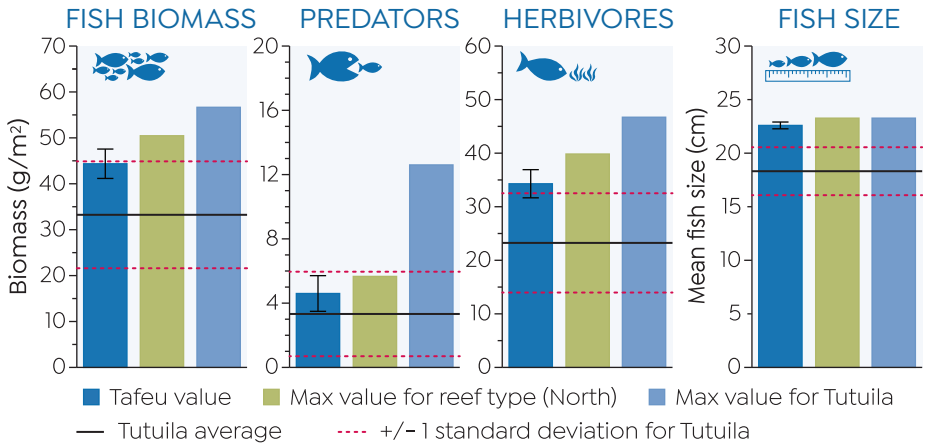
Tafeu

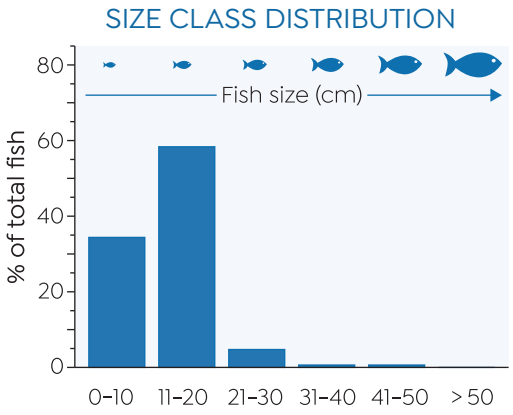
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Large *Favia* sp. colony at Tafeu

Coral reef fish

Tafeu Cove had a far greater mean fish size than the Tutuila average and nearly as great as the site with the greatest mean fish size in Tutuila (Sita Bay). Fish biomass, predator biomass and herbivore biomass were all above the Tutuila average.

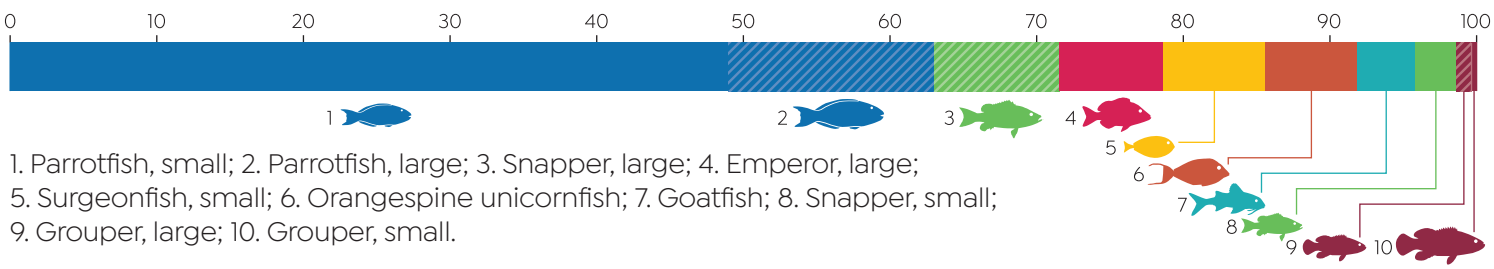




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Parrotfish, large; 3. Snapper, large; 4. Emperor, large; 5. Surgeonfish, small; 6. Orangespine unicornfish; 7. Goatfish; 8. Snapper, small; 9. Grouper, large; 10. Grouper, small.

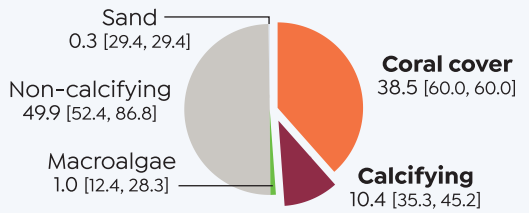
Coral reefs

Tafeu – 123 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 4.6 [North max 6.8, Tutuila max 7.4].

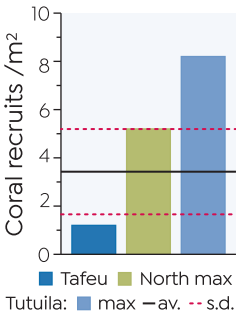
BENTHIC COVER (%)

Tafeu [North max, Tutuila max]

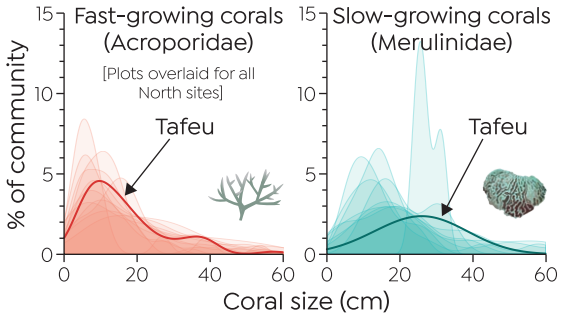


» Coral cover was 38.5%, which was less than the combined cover of sand (0.3%), macroalgae (1.0%) and non-calcifying substrate (49.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (1.2/m²) was well below the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Tafeu Cove with more small acroporids and more large merulinids than at other North sites.

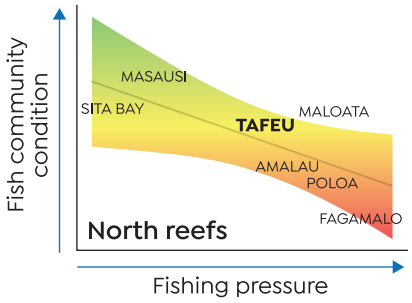
Human impacts

» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

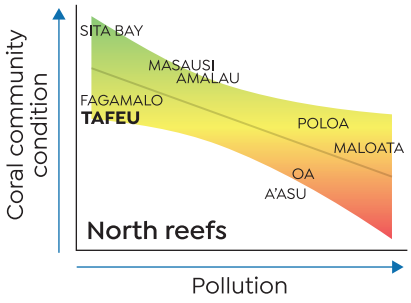
» Fishing pressure was medium and fish community condition was also medium (neither relatively poor or relatively good).

» Watershed pollution was below average at Tafeu Cove and coral community condition was relatively good.

FISHING PRESSURE



POLLUTION AND CORAL



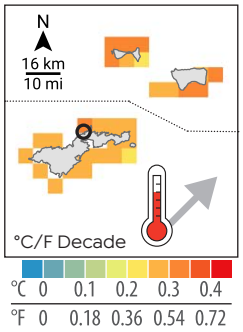
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

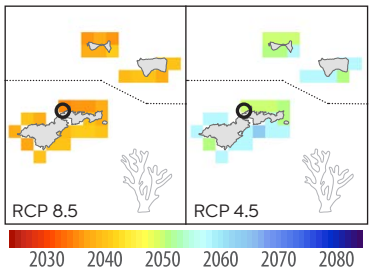
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Tafeu were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

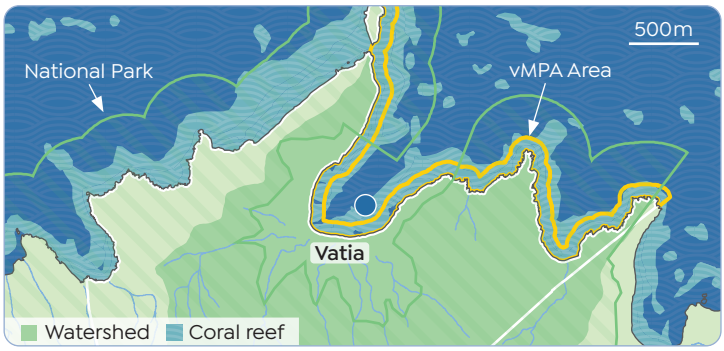
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Vatia, Tutuila (2016-2017)

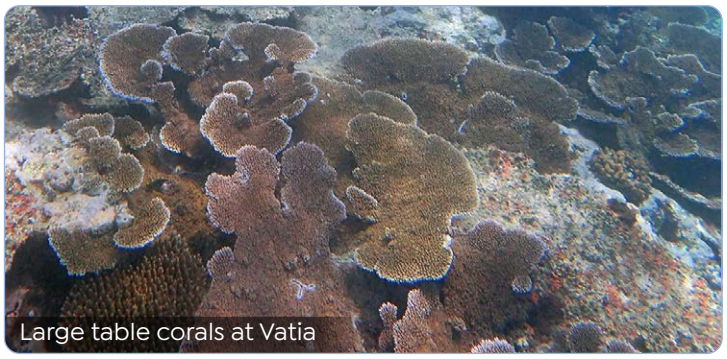
Vatia village and watershed

Vatia is a former vMPA and is now actively involved in community-based watershed management planning meetings with local resource agency staff. Vatia village is also part of the Tutuila section of the National Park of American Samoa (NPSA), which permits use of marine resources for subsistence purposes. Vatia has a relatively large watershed area with medium population size and density. The main stream in Vatia, Lausa'a, had medium concentrations of the dissolved nitrogen pollution indicator (DIN).



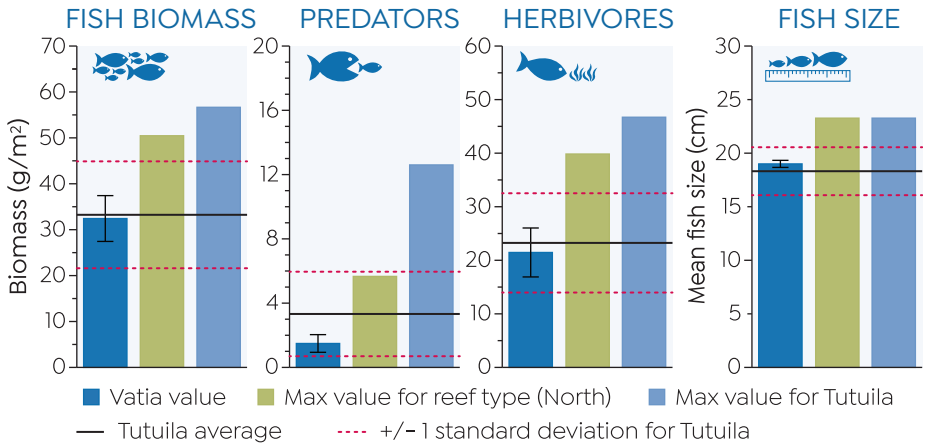
Vatia facts and figures	Value
Watershed Area (km²)	3.6 (H) [3.6, 17.6]
Disturbed Land (km²)	0.9 (M) [1.7, 9.4]
Population in watershed	640 (M) [640, 3955]
Population density (per km²)	177 (M) [204, 907]
Mean 10-year wave energy (J/m³)	220 (M) [432, 2071]
Mean stream DIN (mg/L)*	0.09 (M) [0.13, 0.29]
Lausaa — Maximum stream DIN (mg/L)	0.16 (M) [0.18, 0.47]

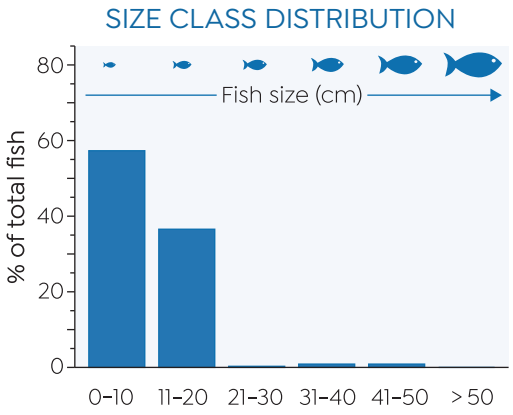
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (north), max for Tutuila]
*Over 12 month period


Large table corals at Vatia

Coral reef fish

Vatia had a mean fish size similar to the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all below the Tutuila average.

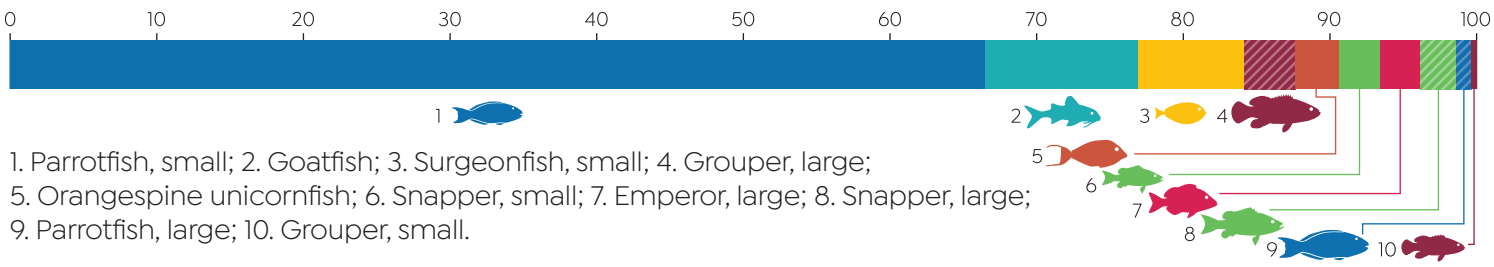




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Goatfish; 3. Surgeonfish, small; 4. Grouper, large; 5. Orangespine unicornfish; 6. Snapper, small; 7. Emperor, large; 8. Snapper, large; 9. Parrotfish, large; 10. Grouper, small.

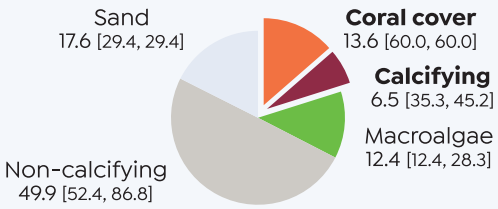
Coral reefs

Vatia – 135 coral species
North reefs max – 184 species
Tutuila max – 195 species

Coral species richness was 4.2 [North max 6.8, Tutuila max 7.4].

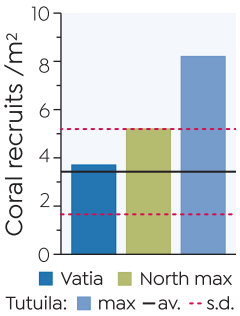
BENTHIC COVER (%)

Vatia [North max, Tutuila max]

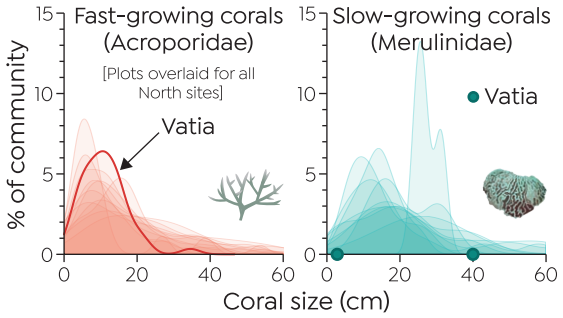


» Coral cover was 13.6%, much less than the combined cover of sand (17.6%), macroalgae (12.4%) and non-calcifying substrate (49.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.7 recruits/m²) was near the average for Tutuila.

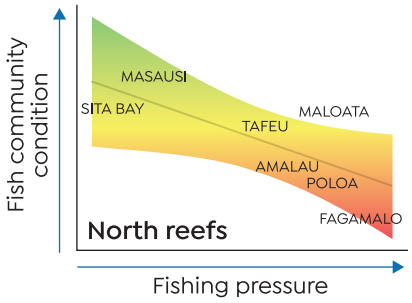
Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Vatia with more small acroporids than at other North sites. There were just two merulinids (one <5 cm and another ~40 cm).

Human impacts

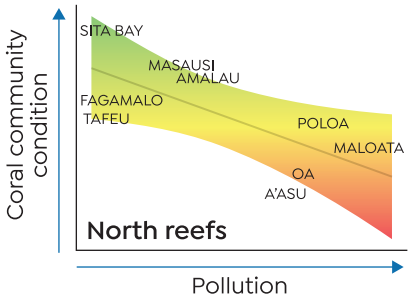
» Seven of eleven North sites were assessed for fishing pressure and nine were assessed for watershed nutrient pollution (DIN).

» Vatia was not included in these assessments.

FISHING PRESSURE



POLLUTION AND CORAL



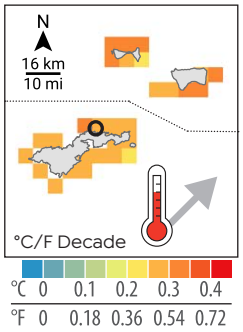
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

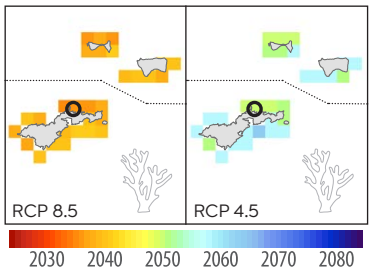
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Vatia were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

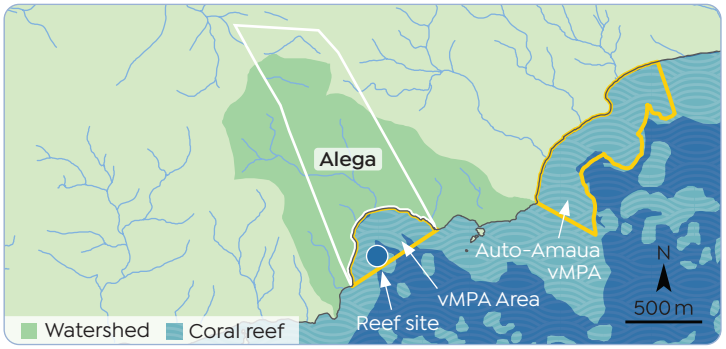
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Alega, Tutuila (2016–2017)

Alega village and watershed

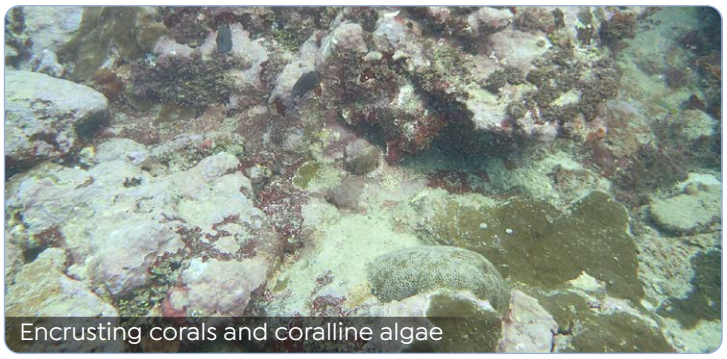
Alega is a privately managed Marine Sanctuary. Alega has a medium-size watershed area for a South site, and medium population and population density. The main stream in Alega watershed had medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



Alega facts and figures	Value
Watershed Area (km²)	1.0 (M) [17.6, 17.6]
Disturbed Land (km²)	0.5 (M) [9.4, 9.4]
Population in watershed	54 (M) [3955, 3955]
Population density (per km²)	52 (M) [687, 907]
Mean 10-year wave energy (J/m³)	1671 (H) [2071, 2071]
Mean stream DIN (mg/L)*	0.13 (M) [0.18, 0.29]
Maximum stream DIN (mg/L)	0.18 (H) [0.27, 0.47]

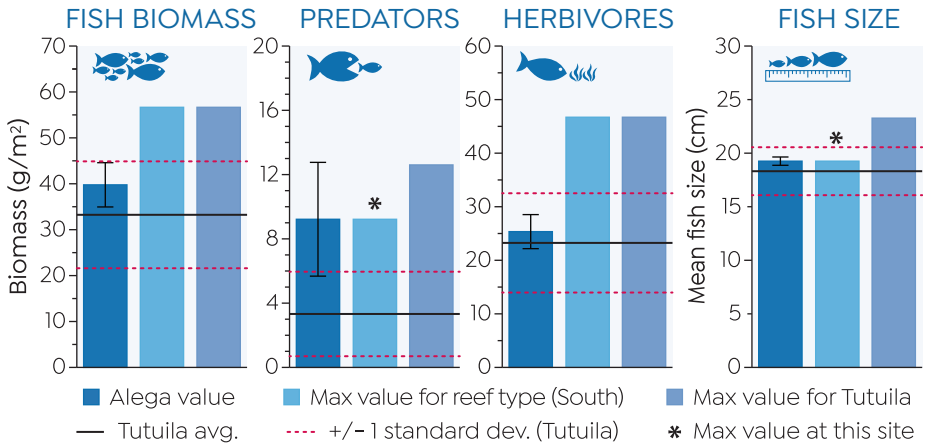
Alega

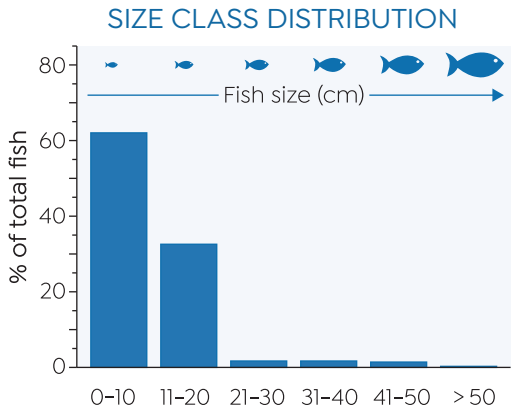
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Encrusting corals and coralline algae

Coral reef fish

Alega had a mean fish size similar to the Tutuila average. Fish biomass and herbivore biomass were also similar to the Tutuila average. Predator biomass was much greater than the Tutuila average and was the highest observed at a South site.

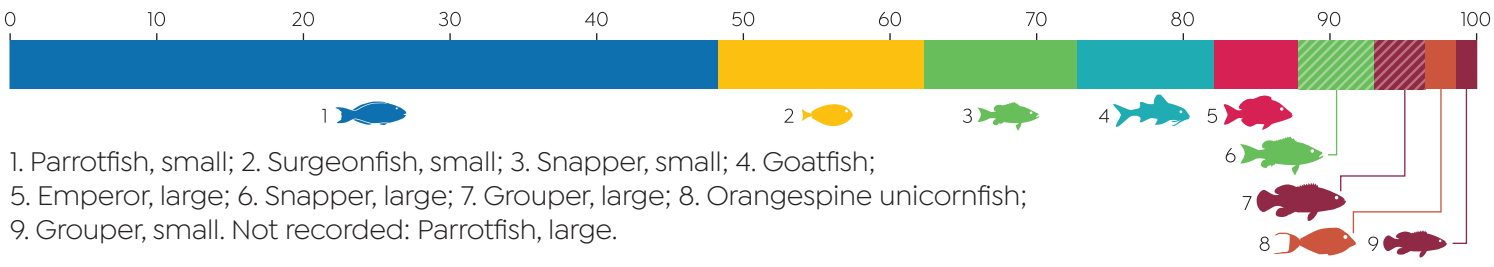




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Snapper, small; 4. Goatfish;
5. Emperor, large; 6. Snapper, large; 7. Grouper, large; 8. Orangespine unicornfish;
9. Grouper, small. Not recorded: Parrotfish, large.

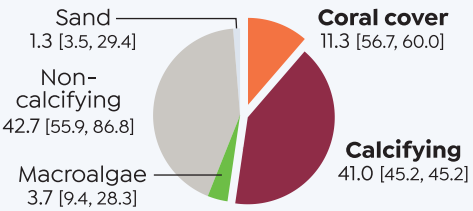
Coral reefs

Alega – 122 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 4.8 [South max 7.4, Tutuila max 7.4].

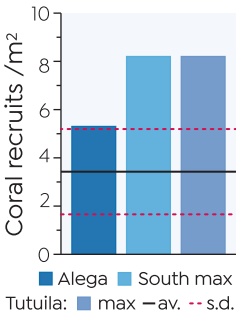
BENTHIC COVER (%)

Alega [South max, Tutuila max]

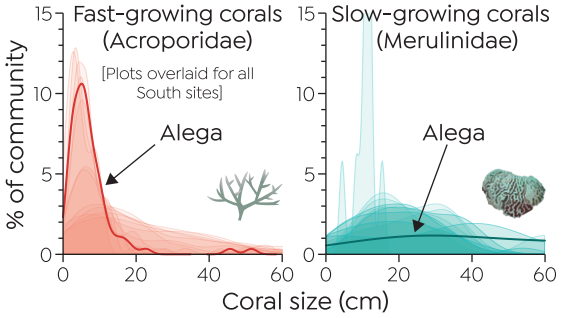


» Coral cover was 11.3%, much less than the combined cover of sand (1.3%), macroalgae (3.7%) and non-calcifying substrate (42.7%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (5.3 recruits/m²) was above the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Alega with more small acroporids and more large merulinids than at other South sites.

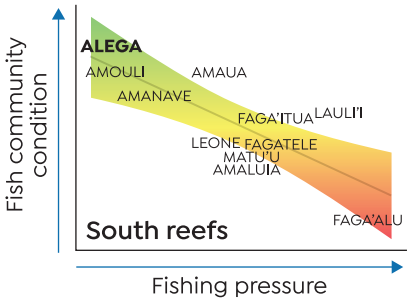
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

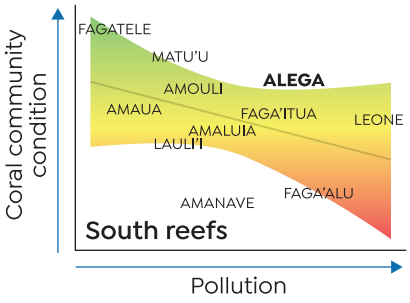
» Fishing pressure was low at Alega and fish community condition was relatively good.

» Watershed pollution was relatively high at Alega and coral community condition was relatively moderate.

FISHING PRESSURE

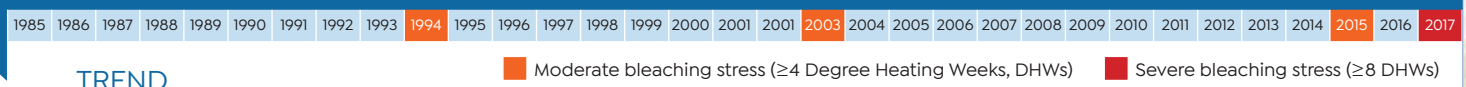


POLLUTION AND CORAL

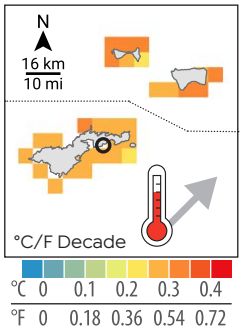


Impacts of climate change

Past (1985–2017)



TREND



Rate of increase of sea surface temperatures.

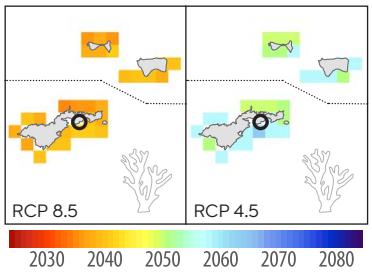
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Alega were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

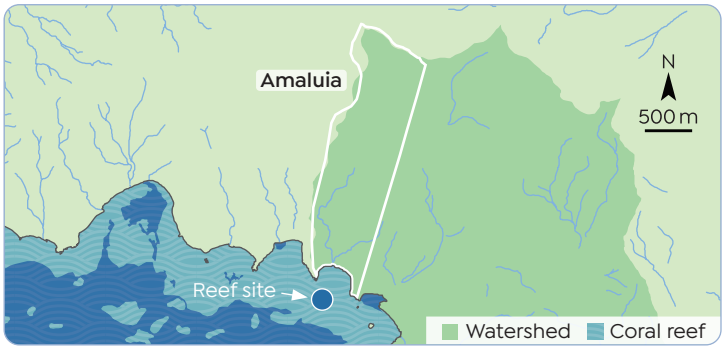
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Amaluia, Tutuila (2016-2017)

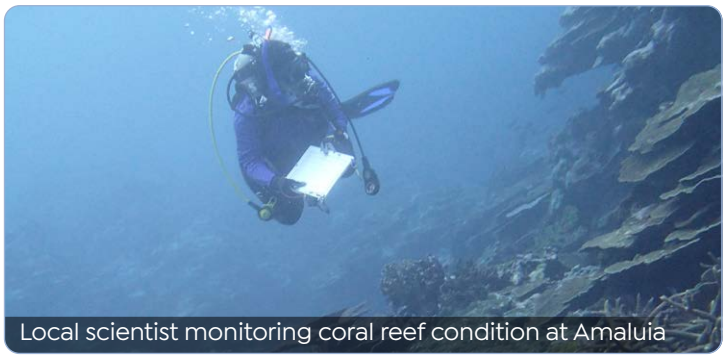
Amaluia village and watershed

Amaluia is not currently associated with a community-based management plan. Amaluia has a medium-size watershed area for a South site, and medium population and population density. The main stream in Amaluia watershed, Vaipuna, had medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



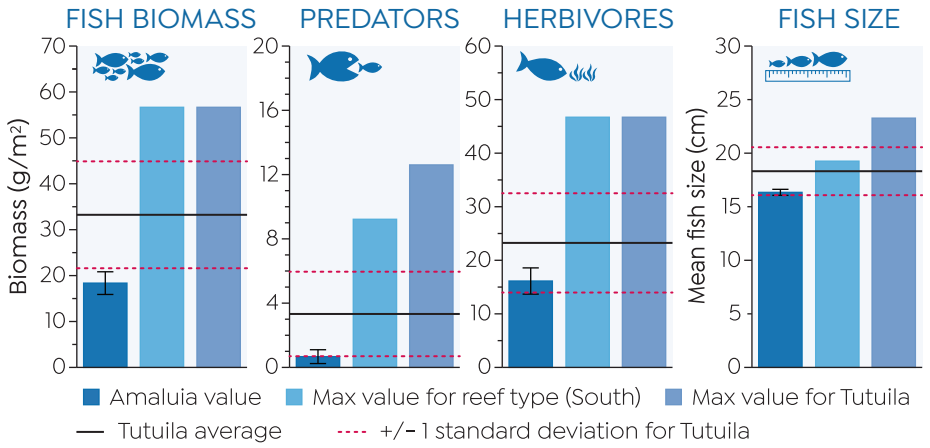
Amaluia facts and figures	Value
Watershed Area (km²)	1.1 (M) [17.6, 17.6]
Disturbed Land (km²)	0.4 (M) [9.4, 9.4]
Population in watershed	162 (M) [3955, 3955]
Population density (per km²)	151 (M) [687, 907]
Mean 10-year wave energy (J/m³)	45 (L) [2071, 2071]
Mean stream DIN (mg/L)*	0.08 (M) [0.18, 0.29]
Vaipuna Maximum stream DIN (mg/L)	0.07 (L) [0.27, 0.47]

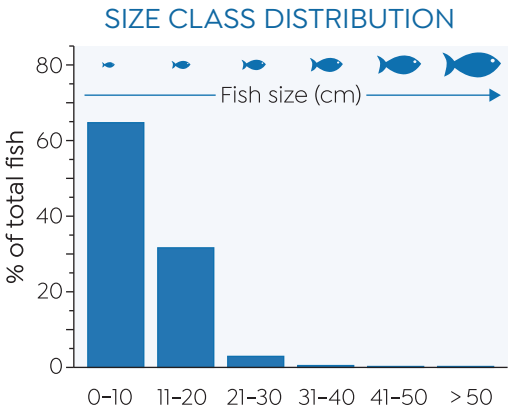
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Local scientist monitoring coral reef condition at Amaluia

Coral reef fish

Amaluia had a mean fish size below the Tutuila average. Fish biomass, predator biomass, and herbivore biomass were also all well below the Tutuila average.

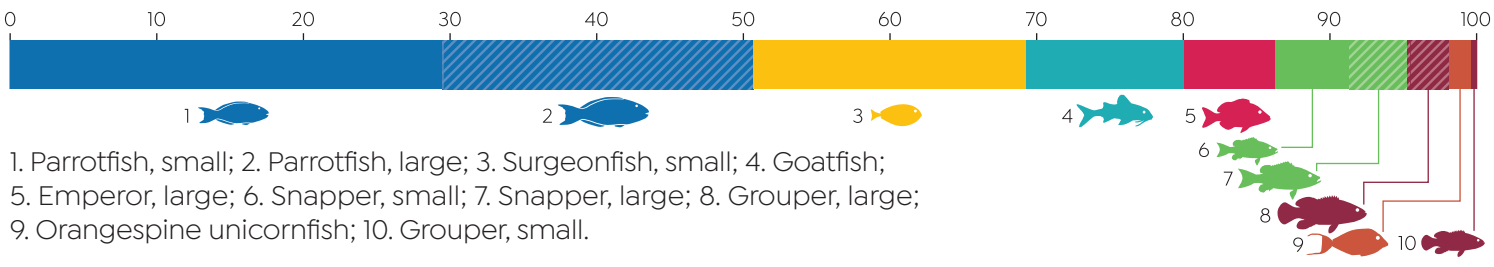




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Parrotfish, large; 3. Surgeonfish, small; 4. Goatfish; 5. Emperor, large; 6. Snapper, small; 7. Snapper, large; 8. Grouper, large; 9. Orangespine unicornfish; 10. Grouper, small.

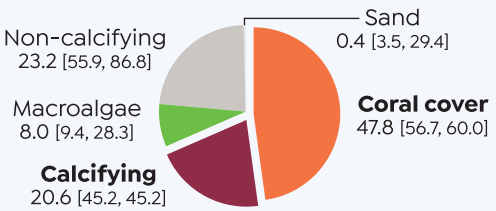
Coral reefs

Amaluia – 146 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 5.8 [South max 7.4, Tutuila max 7.4].

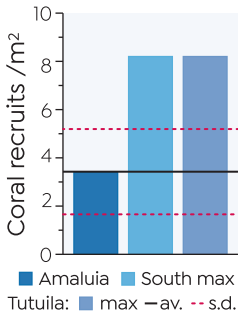
BENTHIC COVER (%)

Amaluia [South max, Tutuila max]

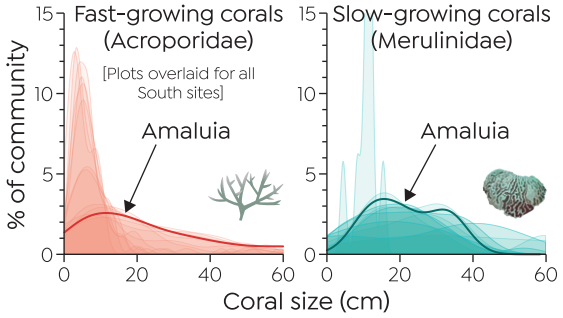


» Coral cover was 47.8%, much more than the combined cover of sand (0.4%), macroalgae (8.0%) and non-calcifying substrate (23.2%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.4 recruits/m²) was near the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Amaluia with more large acroporids and more large merulinids than at other South sites.

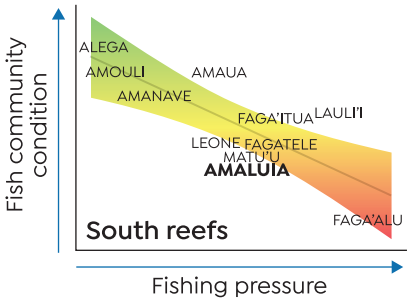
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

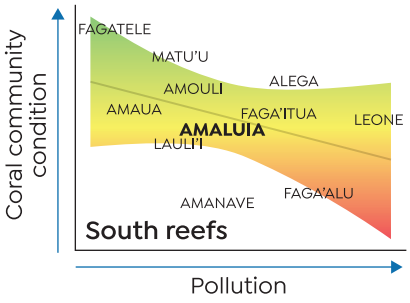
» The combination of access or distance to the boat harbor in Pago Pago likely contributed to relatively poor fish community condition.

» Watershed pollution was moderate at Amaluia and coral community condition was relatively moderate.

FISHING PRESSURE



POLLUTION AND CORAL



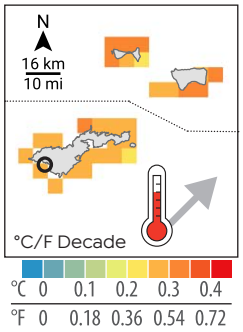
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

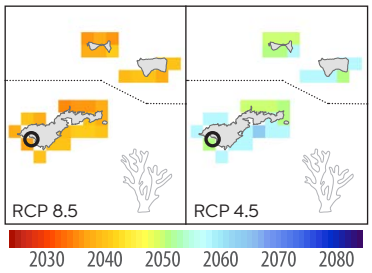
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Amaluia have been exposed to moderate thermal stress twice during this period, in 2015 and 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

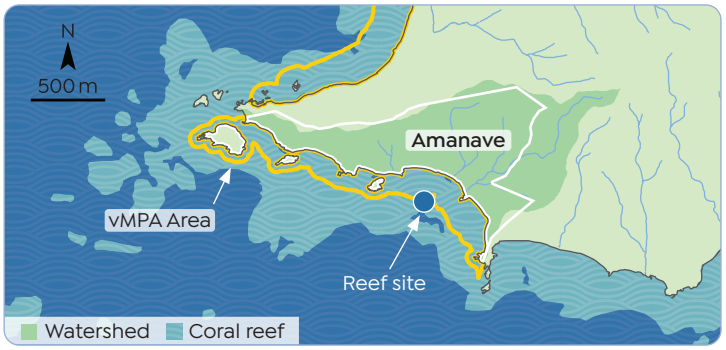
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Amanave, Tutuila (2016-2017)

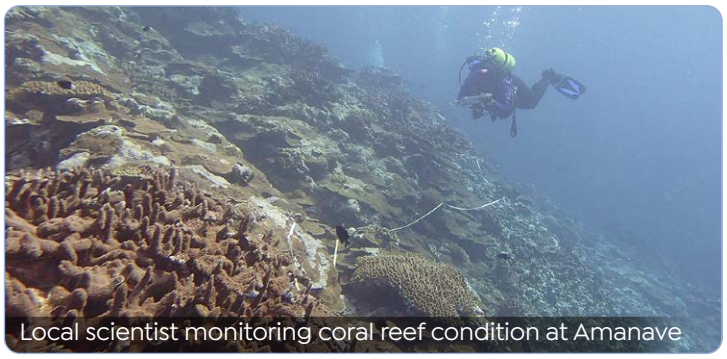
Amanave village and watershed

Amanave is part of the Village Marine Protected Area (vMPA) program, which is co-managed with the Department of Marine and Wildlife Resources (DMWR). Amanave has a small watershed area for a South site, and medium population and population density. The main stream in Amanave watershed, Puna, had medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



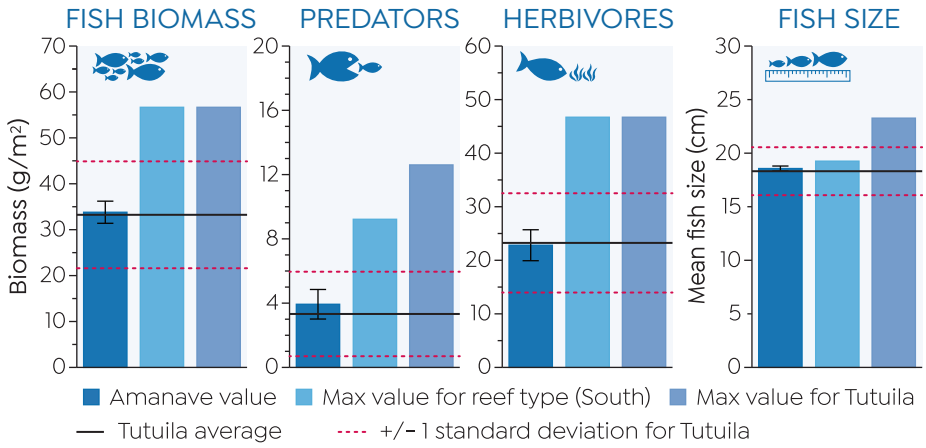
Amanave facts and figures	Value
Watershed Area (km²)	0.9 (L) [17.6, 17.6]
Disturbed Land (km²)	0.4 (M) [9.4, 9.4]
Population in watershed	250 (M) [3955, 3955]
Population density (per km²)	289 (M) [687, 907]
Mean 10-year wave energy (J/m³)	198 (M) [2071, 2071]
Mean stream DIN (mg/L)*	0.10 (M) [0.18, 0.29]
Puna — Maximum stream DIN (mg/L)	0.15 (M) [0.27, 0.47]

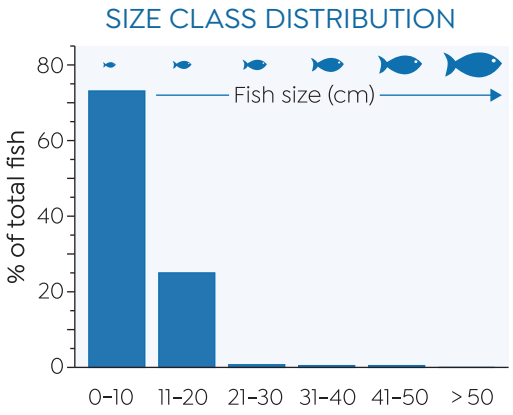
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Local scientist monitoring coral reef condition at Amanave

Coral reef fish

Amanave had a mean fish size very similar to the Tutuila average. Fish biomass, predator biomass, and herbivore biomass were also all very similar to the Tutuila averages.

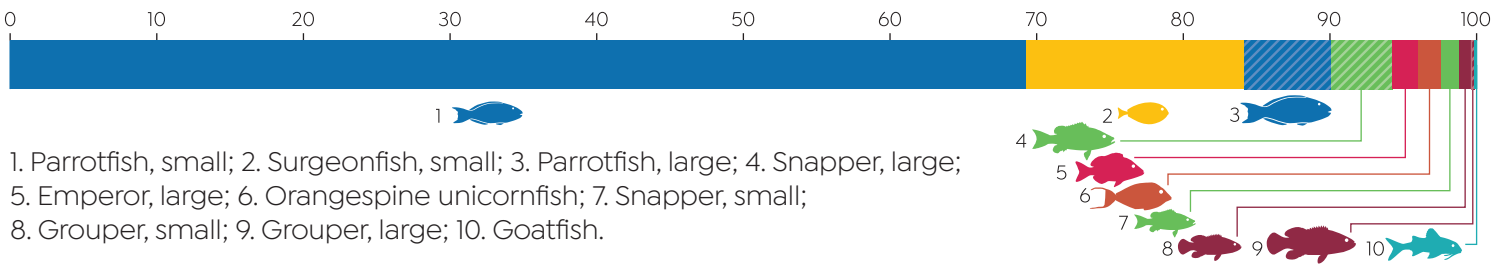




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large; 4. Snapper, large; 5. Emperor, large; 6. Orangespine unicornfish; 7. Snapper, small; 8. Grouper, small; 9. Grouper, large; 10. Goatfish.

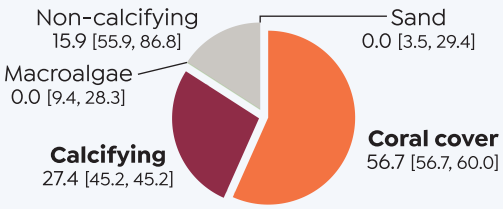
Coral reefs

Amanave – 157 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 4.6 [South max 7.4, Tutuila max 7.4].

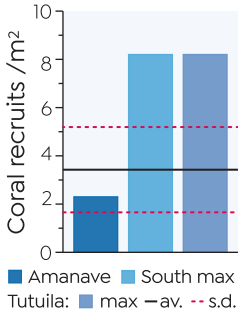
BENTHIC COVER (%)

Amanave [South max, Tutuila max]

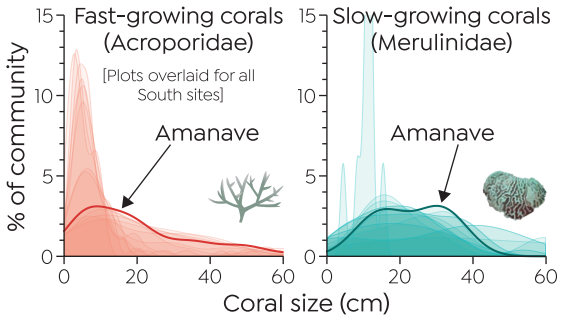


» Coral cover was 56.7%, much more than the combined cover of sand (0.0%), macroalgae (0.0%) and non-calcifying substrate (15.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (2.3 recruits/m²) was below the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Amanave with more large acroporids and more large merulinids than at other South sites.

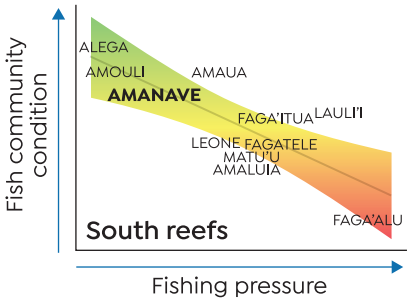
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

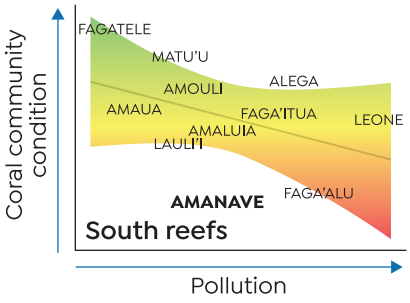
» Fishing pressure was relatively low at Amanave and fish community condition was relatively good.

» Watershed pollution was moderate at Amanave and coral community condition was relatively moderate.

FISHING PRESSURE



POLLUTION AND CORAL



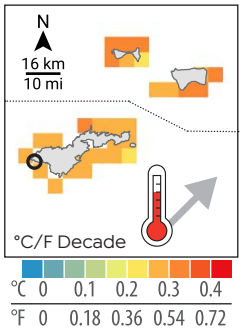
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2008 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

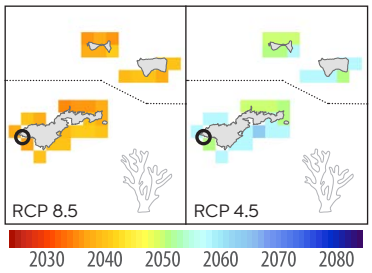
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Amanave were not exposed to moderate thermal stress (four or more degree heating weeks) during this time.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

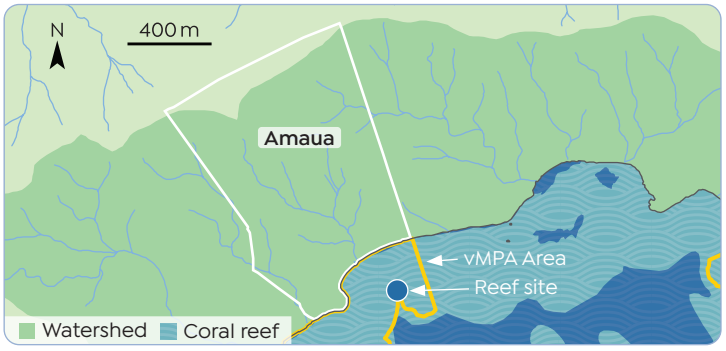
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Amaua, Tutuila (2016–2017)

Amaua village and watershed

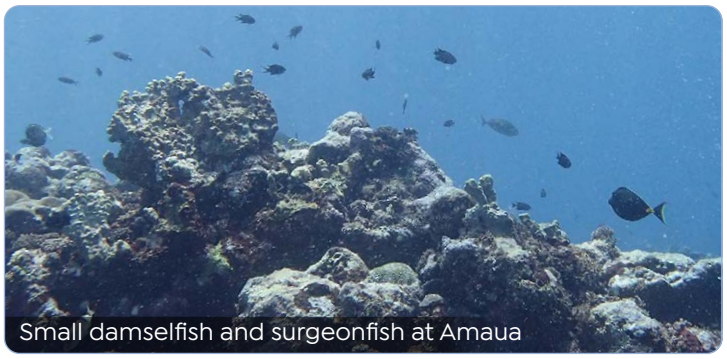
Amaua is part of the Village Marine Protected Area (vMPA) program, joint with the adjacent village of Auto, which is co-managed with the Department of Marine and Wildlife Resources (DMWR). Amaua has a small watershed area for a South site, and medium population and population density. The main stream in Amaua watershed, Amaua, had low concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



Amaua facts and figures	Value
Watershed Area (km²)	0.5 (L) [17.6, 17.6]
Disturbed Land (km²)	0.2 (L) [9.4, 9.4]
Population in watershed	96 (M) [3955, 3955]
Population density (per km²)	176 (M) [687, 907]
Mean 10-year wave energy (J/m³)	703 (H) [2071, 2071]
Mean stream DIN (mg/L)*	0.05 (L) [0.18, 0.29]
Maximum stream DIN (mg/L)	0.08 (L) [0.27, 0.47]

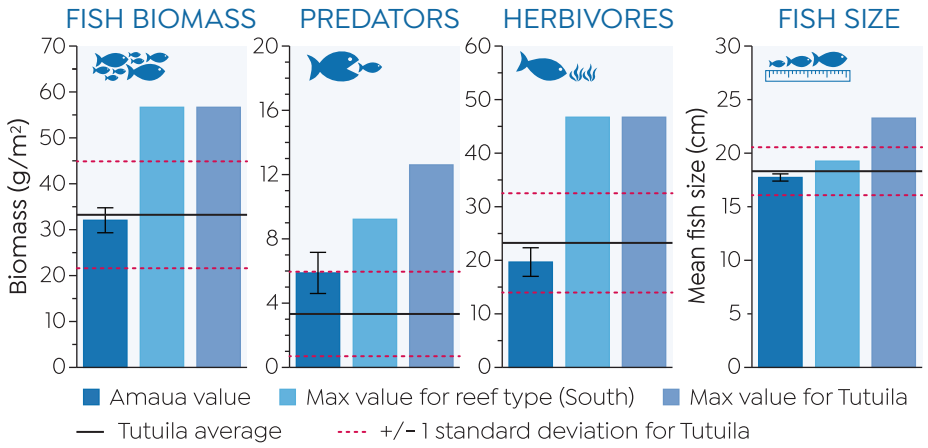
Amaua

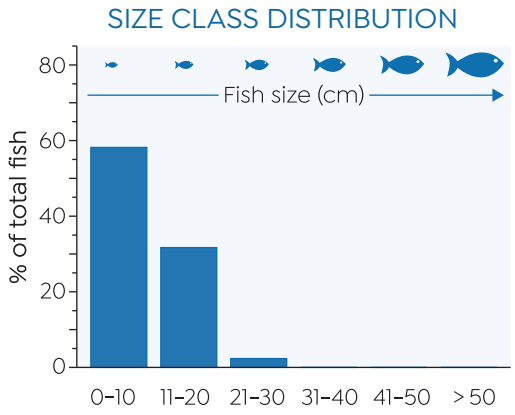
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Small damselfish and surgeonfish at Amaua

Coral reef fish

Amaua had a mean fish size similar to the Tutuila average. Fish biomass and herbivore biomass were similar to the Tutuila average. Predator biomass was above the Tutuila average.

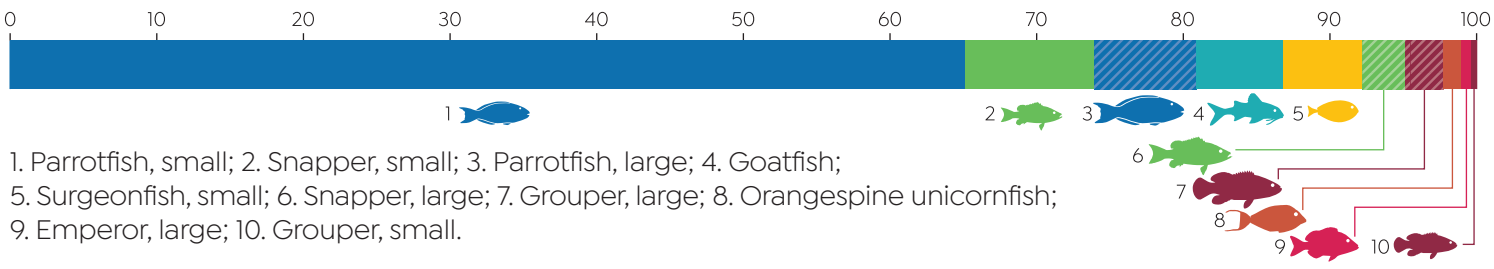




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Snapper, small; 3. Parrotfish, large; 4. Goatfish;
5. Surgeonfish, small; 6. Snapper, large; 7. Grouper, large; 8. Orangespine unicornfish;
9. Emperor, large; 10. Grouper, small.

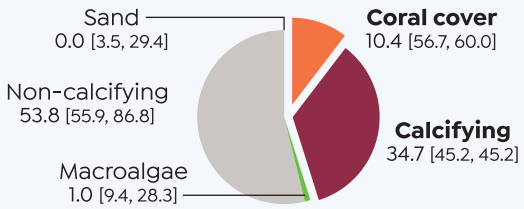
Coral reefs

Amaua – 102 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 3.9 [South max 7.4, Tutuila max 7.4].

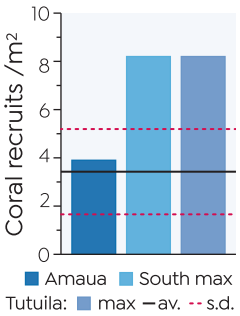
BENTHIC COVER (%)

Amaua [South max, Tutuila max]

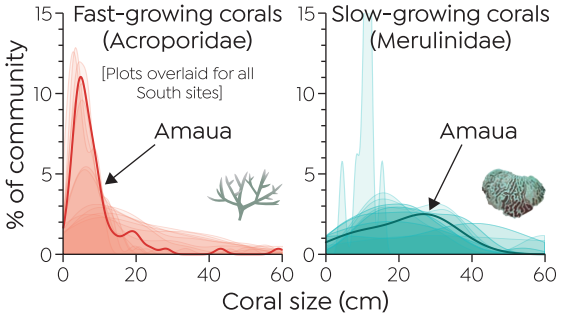


» Coral cover was 10.4%, much more than the combined cover of sand (0.0%), macroalgae (1.0%) and non-calcifying substrate (53.8%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.9/m²) was similar to the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Amaua with more small acroporids and more large merulinids than at other South sites.

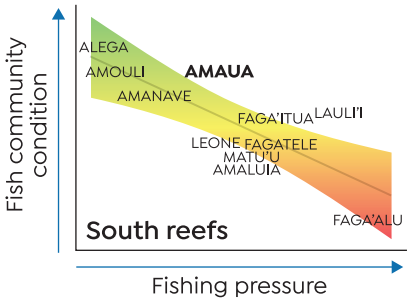
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

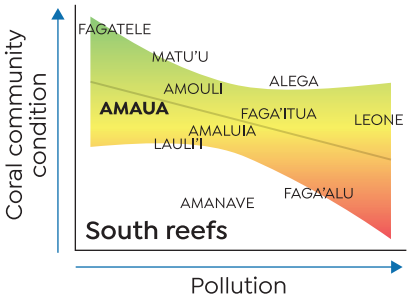
» Fishing pressure was relatively low at Amaua and fish community condition was relatively good.

» Watershed pollution was relatively low at Amaua and coral community condition was relatively good.

FISHING PRESSURE



POLLUTION AND CORAL



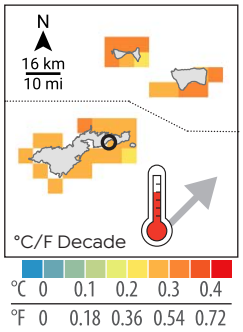
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

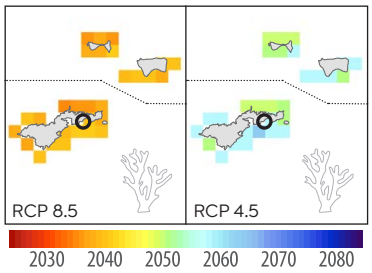
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Amaua were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Amouli, Tutuila (2016-2017)

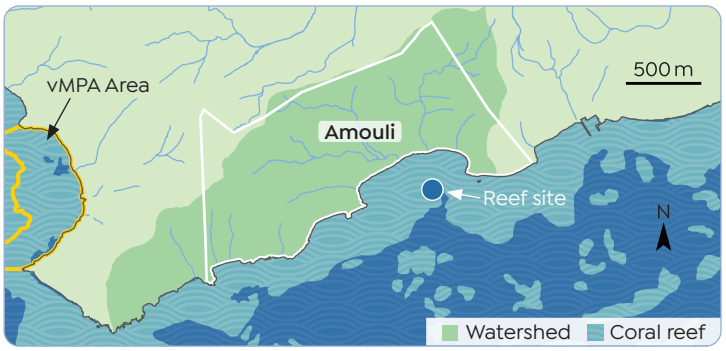
Amouli village and watershed

Amouli village community is actively managing its natural resources through the Amouli Climate Resiliency Plan, developed in 2012. Amouli has a medium watershed area for a South site, and high population and population density. The main stream in Amouli watershed, Televai, had medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.

Amouli facts and figures	Value
Watershed Area (km²)	1.3 (M) [17.6, 17.6]
Disturbed Land (km²)	0.5 (M) [9.4, 9.4]
Population in watershed	920 (H) [3955, 3955]
Population density (per km²)	687 (H) [687, 907]
Mean 10-year wave energy (J/m³)	454 (H) [2071, 2071]
Mean stream DIN (mg/L)*	0.09 (M) [0.18, 0.29]
Maximum stream DIN (mg/L)	0.10 (M) [0.27, 0.47]

Televai

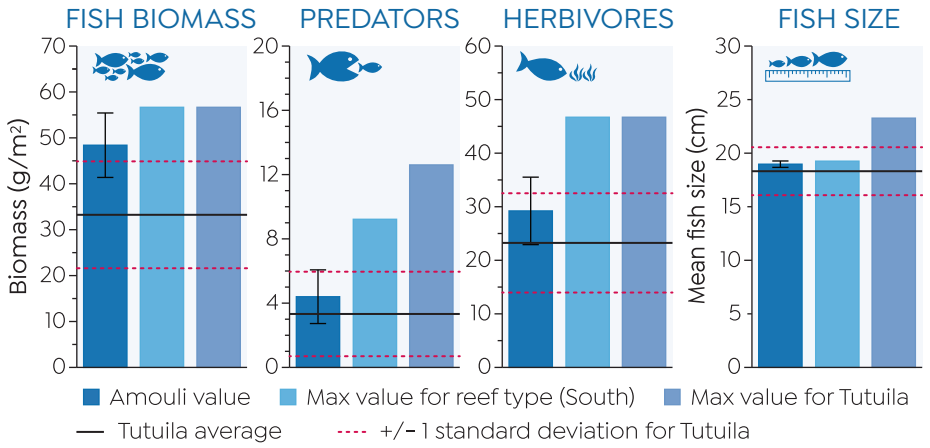
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period

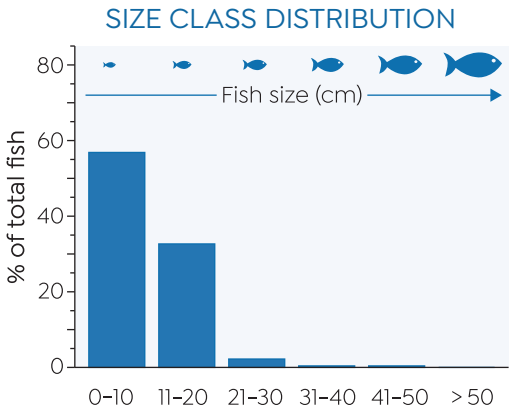



Coral reef with scattered bleached colonies at Amouli

Coral reef fish

Amouli had a mean fish size similar to the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all above the Tutuila average.

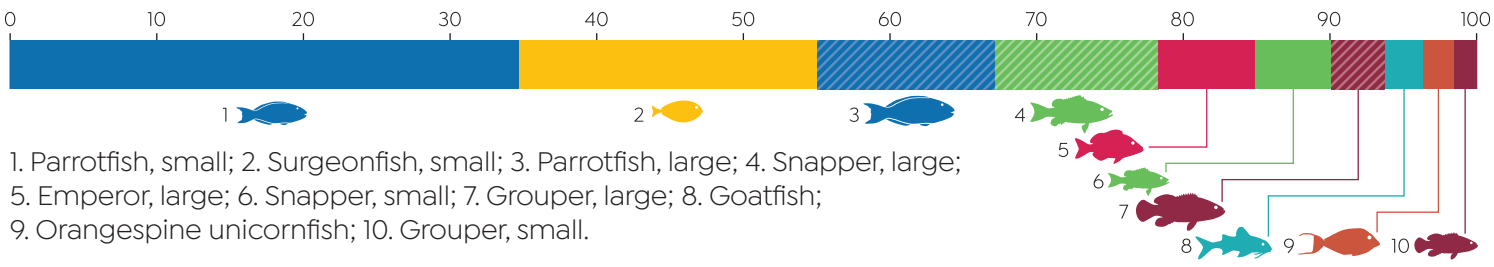




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large; 4. Snapper, large; 5. Emperor, large; 6. Snapper, small; 7. Grouper, large; 8. Goatfish; 9. Orangespine unicornfish; 10. Grouper, small.

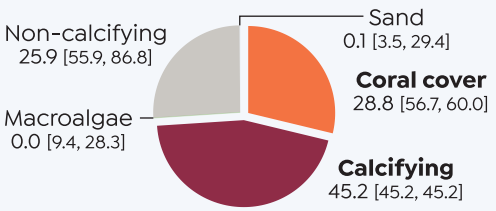
Coral reefs

Amouli – 152 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 5.5 [South max 7.4, Tutuila max 7.4].

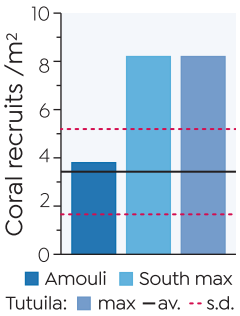
BENTHIC COVER (%)

Amouli [South max, Tutuila max]

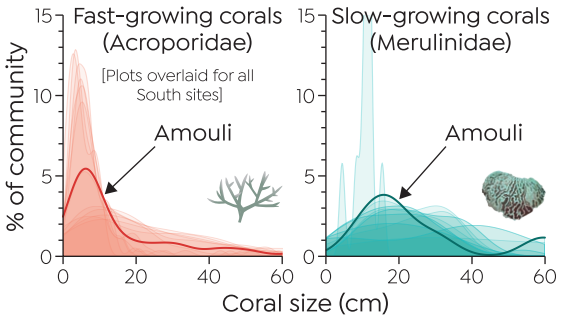


» Coral cover was 28.8%, much more than the combined cover of sand (0.1%), macroalgae (0.0%) and non-calcifying substrate (25.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.8 recruits/m²) was near the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Amouli with more small Acroporids and more small Merulinids than at other South sites.

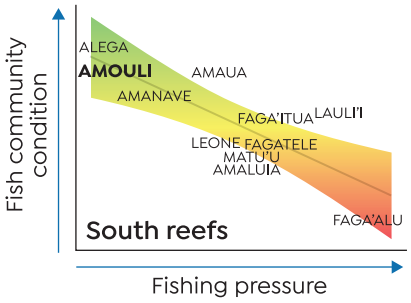
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

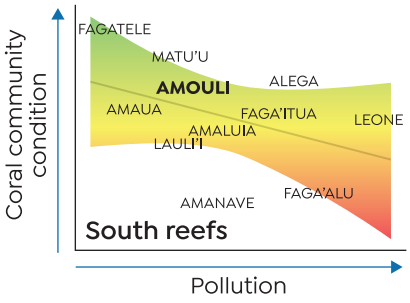
» Fishing pressure was relatively low at Amouli and fish community condition was relatively good.

» Watershed pollution was relatively low at Amouli and coral community condition was relatively good.

FISHING PRESSURE



POLLUTION AND CORAL



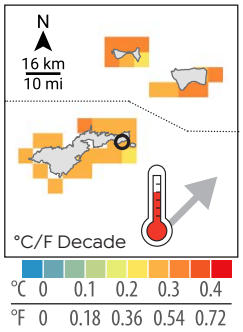
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

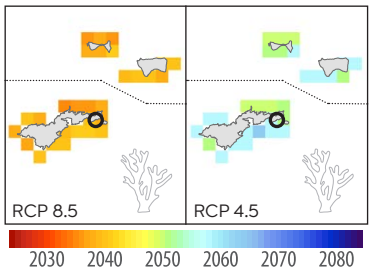
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Amouli were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

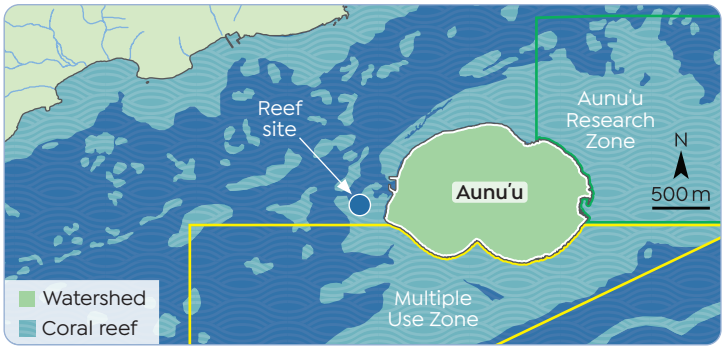
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Aunu'u, Tutuila (2016-2017)

Aunu'u village and watershed

National Marine Sanctuary of American Samoa (NMSAS) is composed of six protected areas, including waters around Aunu'u (designated in 2012). Of all areas in the NOAA National Marine Sanctuary System, the NMSAS is thought to support the greatest diversity of marine life.



Aunu'u facts and figures	Value
Watershed Area (km²)	1.0 (L) [17.6, 17.6]
Disturbed Land (km²)	0.6 (M) [9.4, 9.4]
Population in watershed	436 (M) [3955, 3955]
Population density (per km²)	450 (H) [687, 907]
Mean 10-year wave energy (J/m³)	505 (H) [2071, 2071]
Mean stream DIN (mg/L)*	n/a [0.18, 0.29]
Maximum stream DIN (mg/L)	n/a [0.27, 0.47]

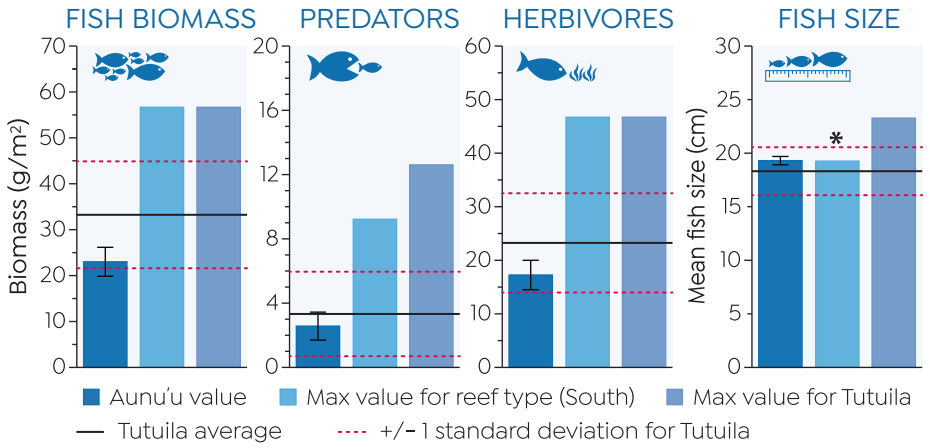
Aunu'u

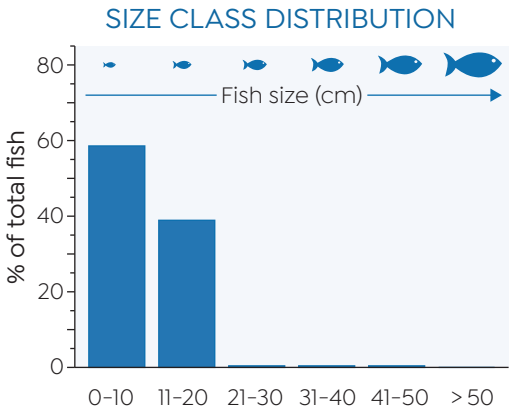
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Coral reef at Aunu'u damaged by bleaching

Coral reef fish

Mean fish size was slightly above average for Tutuila at Aunu'u. Fish biomass, predator biomass and herbivore biomass were all below the Tutuila average, and far below the maximum value for South sites.

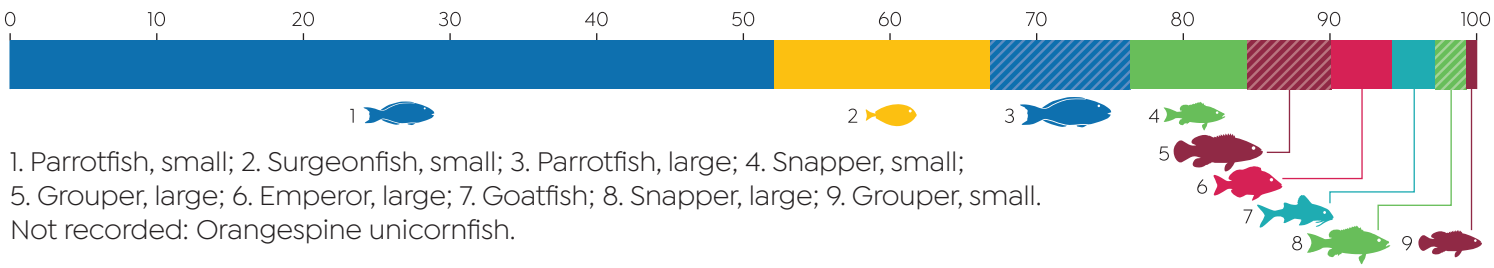




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large; 4. Snapper, small; 5. Grouper, large; 6. Emperor, large; 7. Goatfish; 8. Snapper, large; 9. Grouper, small.
Not recorded: Orangespine unicornfish.

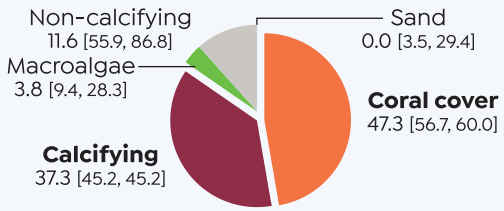
Coral reefs

Aunu'u – 170 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 7.4 [South max 7.4, Tutuila max 7.4].

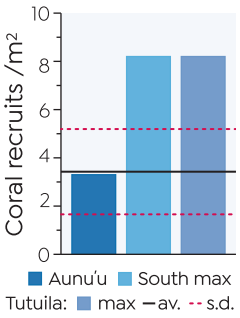
BENTHIC COVER (%)

Aunu'u [South max, Tutuila max]

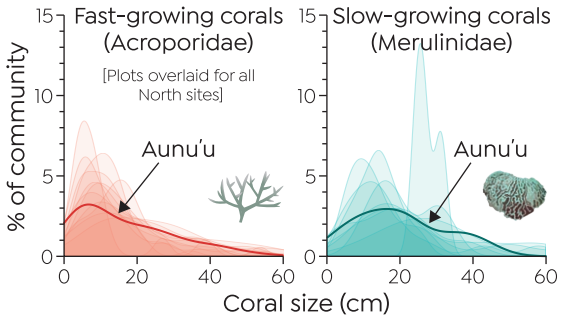


» Coral cover was 47.3%, much more than the combined cover of sand (0%), macroalgae (3.8%) and non-calcifying substrate (11.6%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.3 recruits/m²) was near the average for Tutuila.

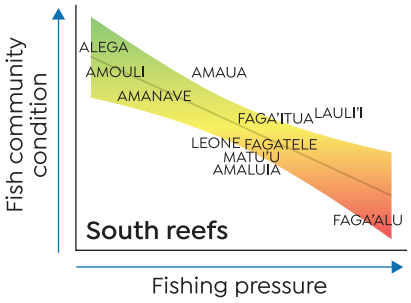
Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Aunu'u with fewer small acroporids and more large merulinids than at other North sites.

Human impacts

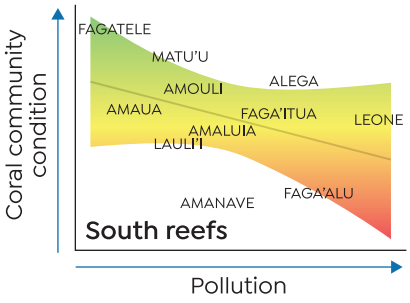
» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

» Aunu'u was not included in these assessments.

FISHING PRESSURE



POLLUTION AND CORAL



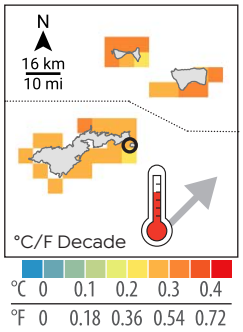
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

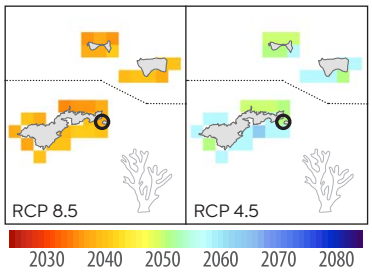
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Aunu'u were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

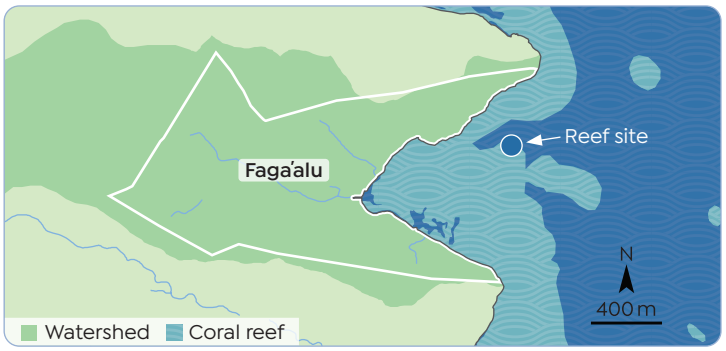
Faga'alu, Tutuila (2016-2017)

Faga'alu village and watershed

Faga'alu village community is actively managing its natural resources through the Faga'alau Watershed Management Plan, developed in 2012. Faga'alu has a medium watershed area for a South site, and high population and population density. The main stream in Faga'alu watershed, Faga'alu, had medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.

Faga'alu facts and figures	Value
Watershed Area (km²)	2.5 (M) [17.6, 17.6]
Disturbed Land (km²)	0.8 (M) [9.4, 9.4]
Population in watershed	910 (H) [3955, 3955]
Population density (per km²)	367 (H) [687, 907]
Mean 10-year wave energy (J/m³)	1664 (H) [2071, 2071]
Mean stream DIN (mg/L)*	0.10 (M) [0.18, 0.29]
Faga'alu — Maximum stream DIN (mg/L)	0.18 (M) [0.27, 0.47]

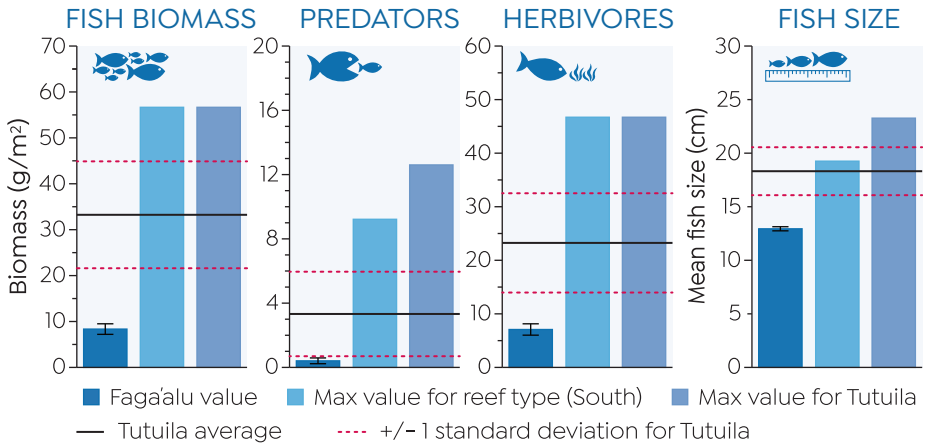
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period

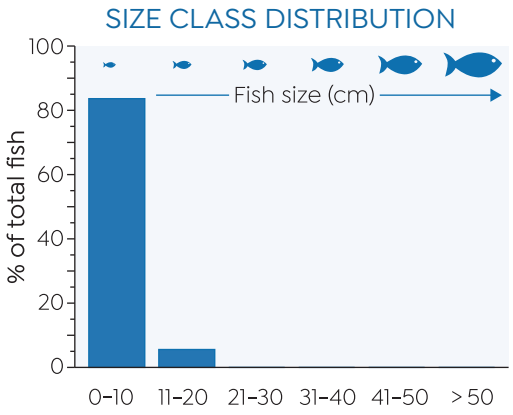



Large foliose corals on the reef slope at Faga'alu

Coral reef fish

Faga'alu had a mean fish size far below the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all far below the Tutuila average.

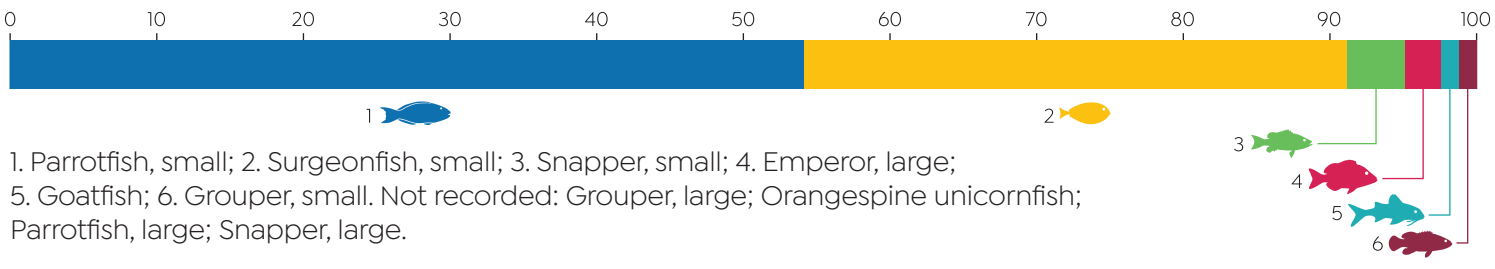




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Snapper, small; 4. Emperor, large; 5. Goatfish; 6. Grouper, small. Not recorded: Grouper, large; Orangespine unicornfish; Parrotfish, large; Snapper, large.

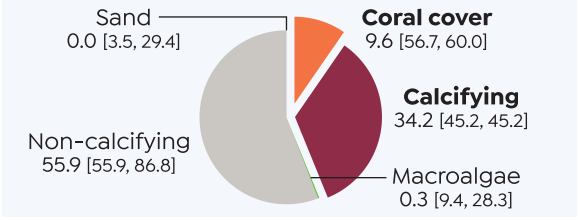
Coral reefs

Faga'alu – 178 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 4.7 [South max 7.4, Tutuila max 7.4].

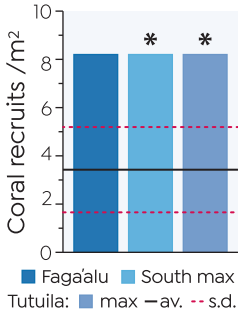
BENTHIC COVER (%)

Faga'alu [South max, Tutuila max]

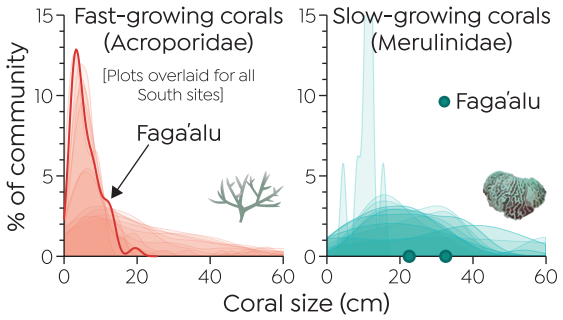


» Coral cover was 9.6%, much less than the combined cover of sand (0.0%), macroalgae (0.3%) and non-calcifying substrate (55.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (8.2 recruits/m²) was the highest in Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Faga'alu with more small acroporids than at other South sites. There were only two merulinids (one 22 and one 32 cm).

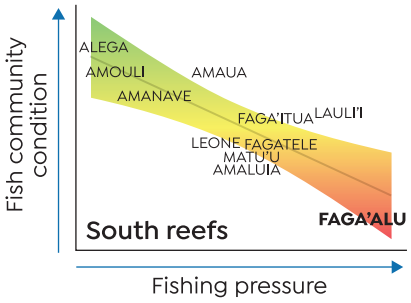
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

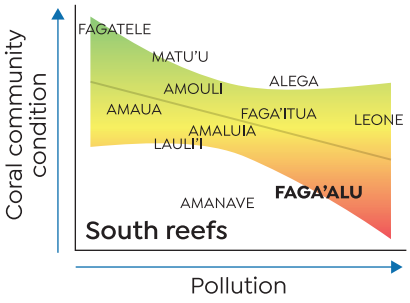
» Access or distance to the boat harbor in Pago Pago and high population likely contributed to relatively poor fish community condition.

» Watershed pollution was relatively high at Faga'alu and coral community condition was relatively poor.

FISHING PRESSURE



POLLUTION AND CORAL



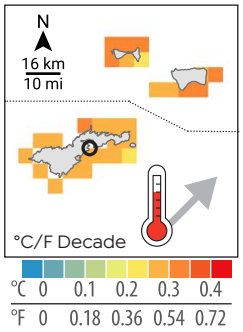
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

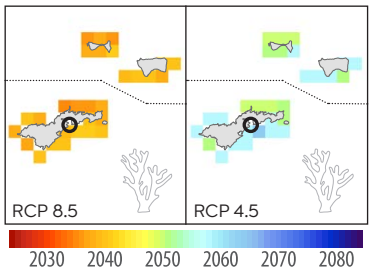
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Faga'alu were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

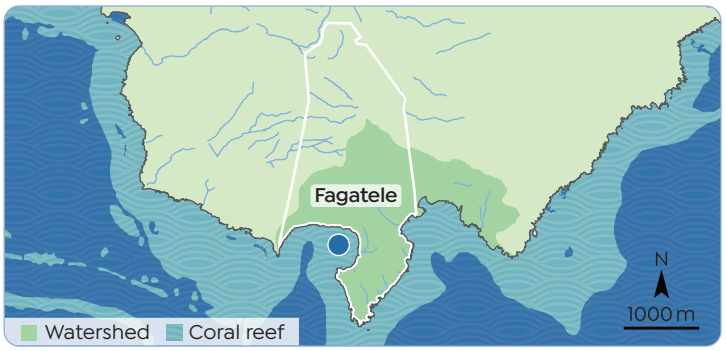
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Fagatele, Tutuila (2016–2017)

Fagatele village and watershed

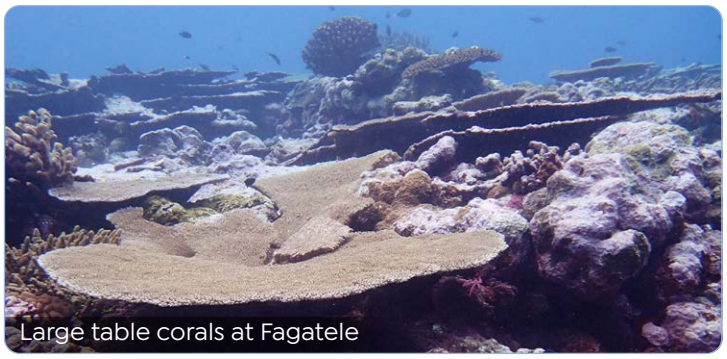
National Marine Sanctuary of American Samoa (NMSAS) is composed of six protected areas, one of which is Fagatele Bay (designated in 1986). Fagatele has a medium watershed area for a South site. There are no people residing in the watershed. The main stream in Fagatele watershed, Fagatele, had low concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



Fagatele facts and figures	Value
Watershed Area (km²)	1.9 (M) [17.6, 17.6]
Disturbed Land (km²)	1.5 (H) [9.4, 9.4]
Population in watershed	0 (L) [3955, 3955]
Population density (per km²)	0 (L) [687, 907]
Mean 10-year wave energy (J/m³)	39 (L) [2071, 2071]
Mean stream DIN (mg/L)*	0.03 (L) [0.18, 0.29]
Maximum stream DIN (mg/L)	0.05 (L) [0.27, 0.47]

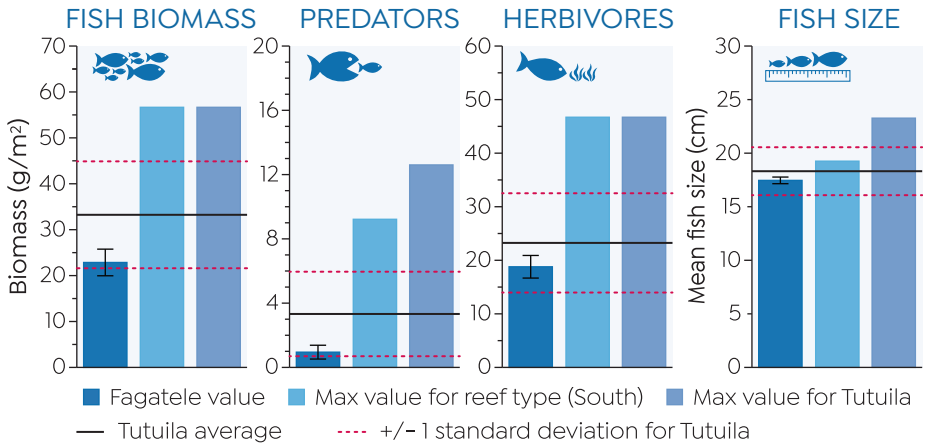
Fagatele

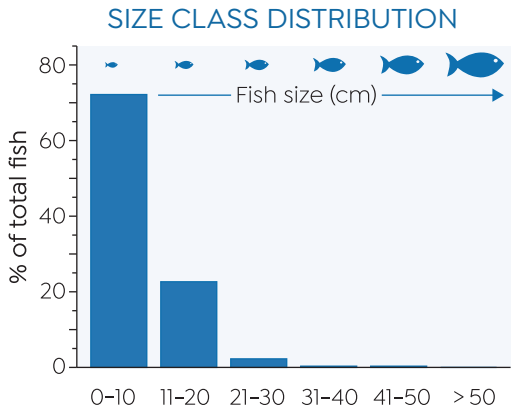
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Large table corals at Fagatele

Coral reef fish

Fagatele had a mean fish size similar to the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all below the Tutuila average.

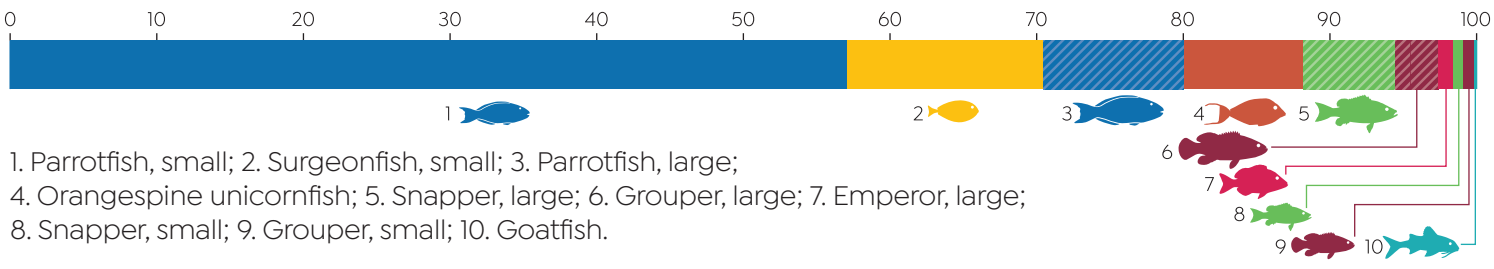




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large;
4. Orangespine unicornfish; 5. Snapper, large; 6. Grouper, large; 7. Emperor, large;
8. Snapper, small; 9. Grouper, small; 10. Goatfish.

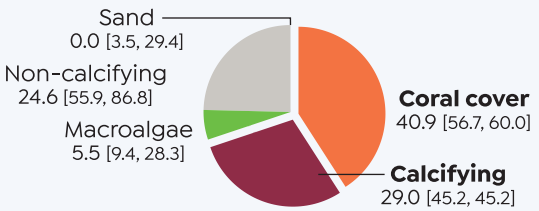
Coral reefs

Fagatele – 137 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 5.8 [South max 7.4, Tutuila max 7.4].

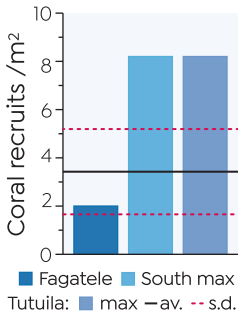
BENTHIC COVER (%)

Fagatele [South max, Tutuila max]

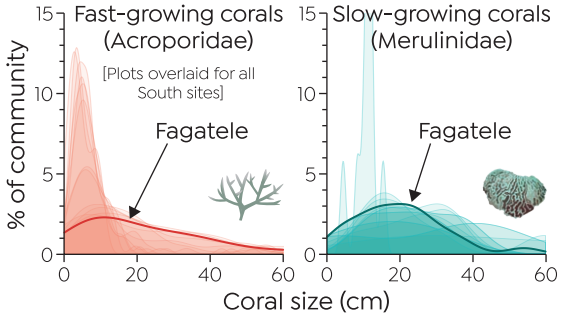


» Coral cover was 40.9%, much greater than the combined cover of sand (0.0%), macroalgae (5.5%) and non-calcifying substrate (24.6%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (2.0/m²) was lower than the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Fagatele with more large acroporids and large merulinids than at other South sites.

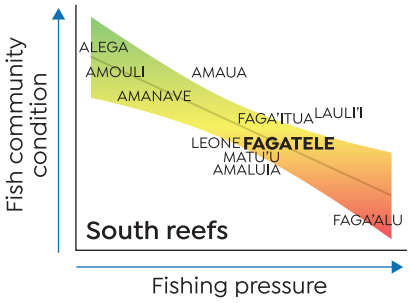
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

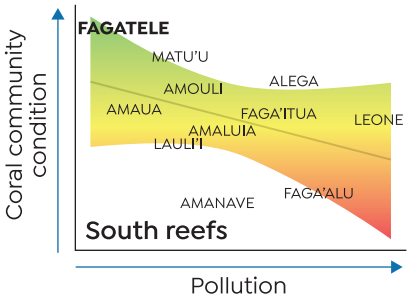
» Fishing pressure was relatively moderate at Fagatele and fish community condition was relatively moderate.

» Watershed pollution was relatively low at Fagatele and coral community condition was relatively good.

FISHING PRESSURE



POLLUTION AND CORAL



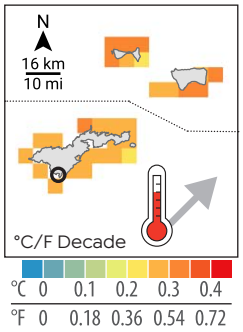
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

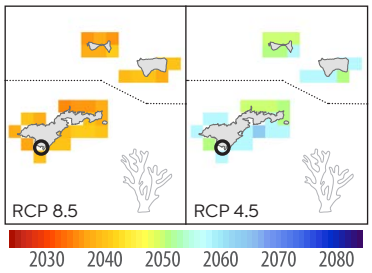
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Fagatele have been exposed to moderate thermal stress twice during this period, in 2015 and 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

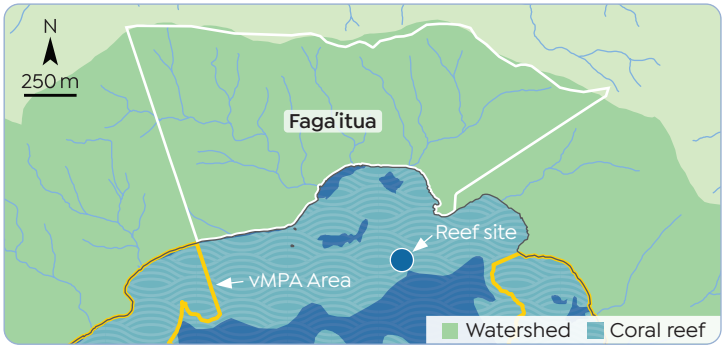
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Faga'itua, Tutuila (2016-2017)

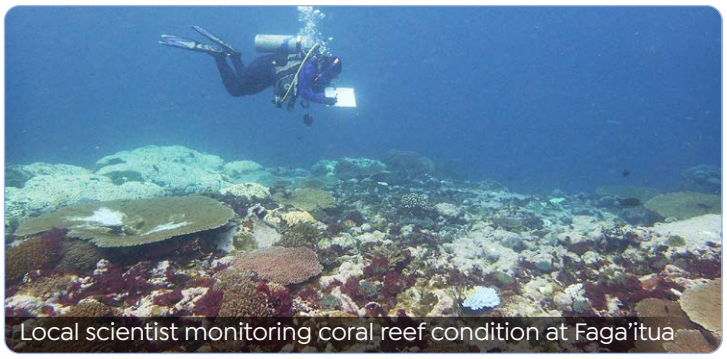
Faga'itua village and watershed

Faga'itua is not currently associated with a community-based management plan. Faga'itua has a medium watershed area for a South site, and a medium population and population density. The main stream in Faga'itua watershed had relatively high concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



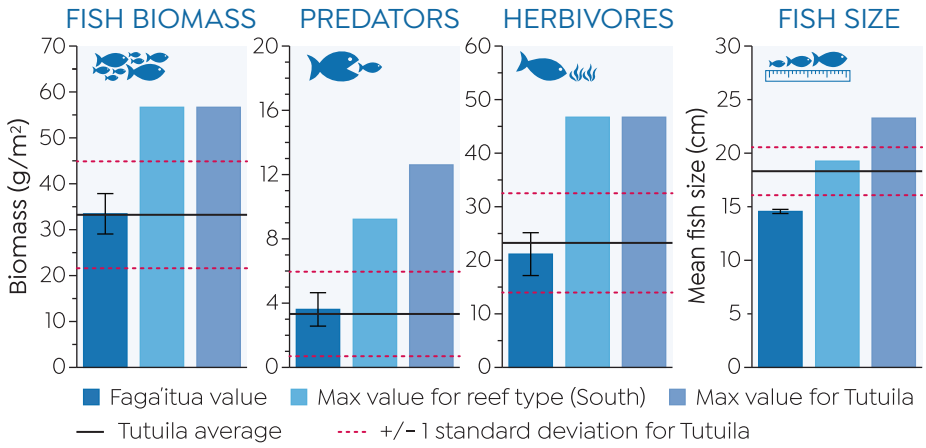
Faga'itua facts and figures	Value
Watershed Area (km²)	1.5 (M) [17.6, 17.6]
Disturbed Land (km²)	0.5 (M) [9.4, 9.4]
Population in watershed	433 (M) [3955, 3955]
Population density (per km²)	292 (M) [687, 907]
Mean 10-year wave energy (J/m³)	57 (L) [2071, 2071]
Mean stream DIN (mg/L)*	0.13 (H) [0.18, 0.29]
Tialu — Maximum stream DIN (mg/L)	0.15 (M) [0.27, 0.47]

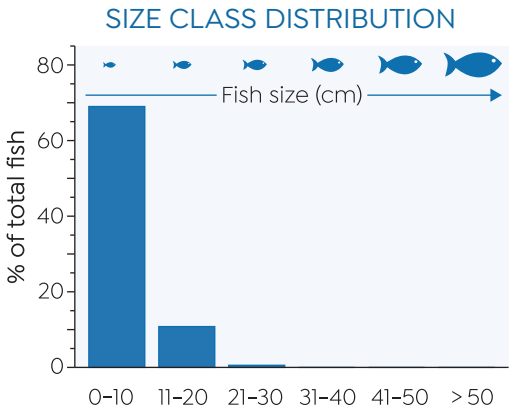
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Local scientist monitoring coral reef condition at Faga'itua

Coral reef fish

Faga'itua had a mean fish size below the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all similar to the Tutuila average.

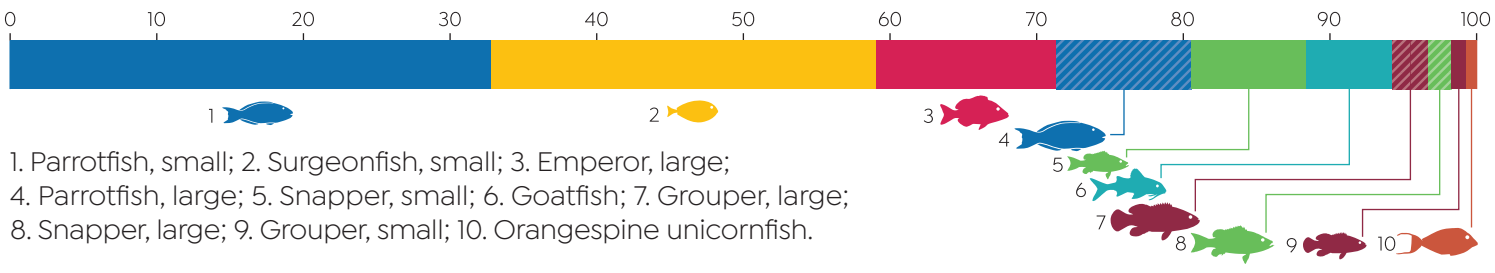




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Emperor, large;
4. Parrotfish, large; 5. Snapper, small; 6. Goatfish; 7. Grouper, large;
8. Snapper, large; 9. Grouper, small; 10. Orangespine unicornfish.

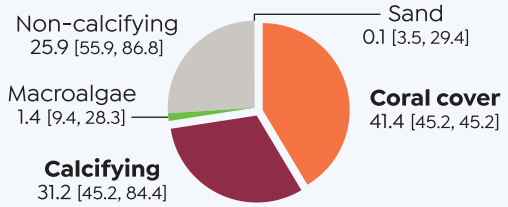
Coral reefs

Faga'itua – 195 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 5.7 [South max 7.4, Tutuila max 7.4].

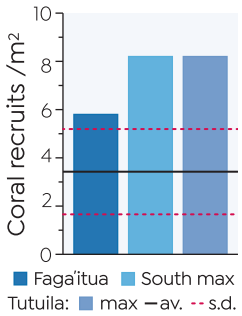
BENTHIC COVER (%)

Faga'itua [South max, Tutuila max]

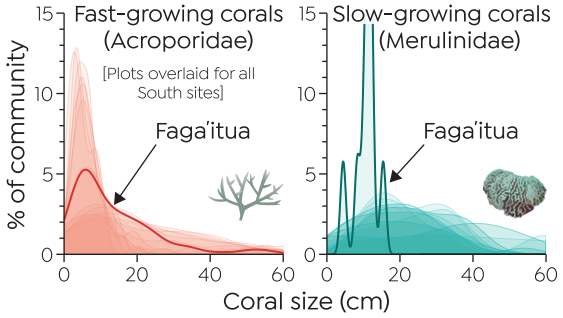


» Coral cover was 41.4%, much greater than the combined cover of sand (0.1%), macroalgae (1.4%) and non-calcifying substrate (25.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (5.8/m²) was well above the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Faga'itua with more small acroporids and small merulinids than at other South sites.

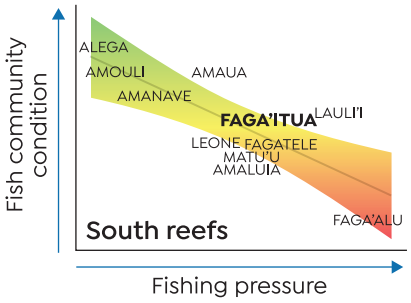
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

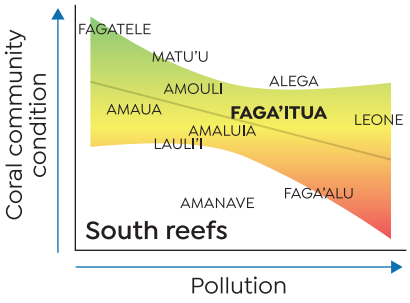
» Fishing pressure was relatively moderate at Faga'itua and fish community condition was relatively moderate.

» Watershed pollution was relatively moderate at Faga'itua and coral community condition was relatively moderate.

FISHING PRESSURE



POLLUTION AND CORAL



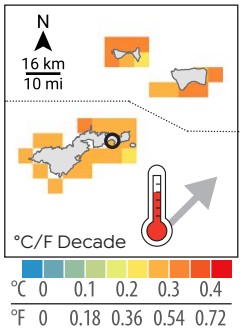
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

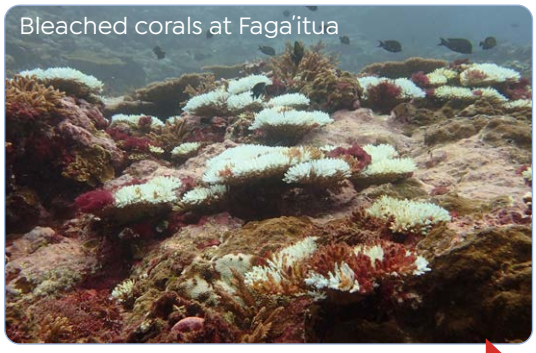
TREND



Rate of increase of sea surface temperatures.

A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Faga'itua were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

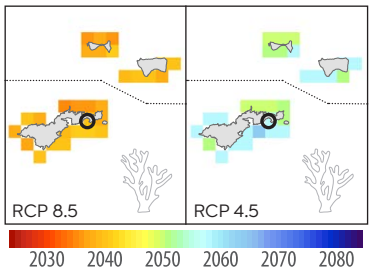
The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.



Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

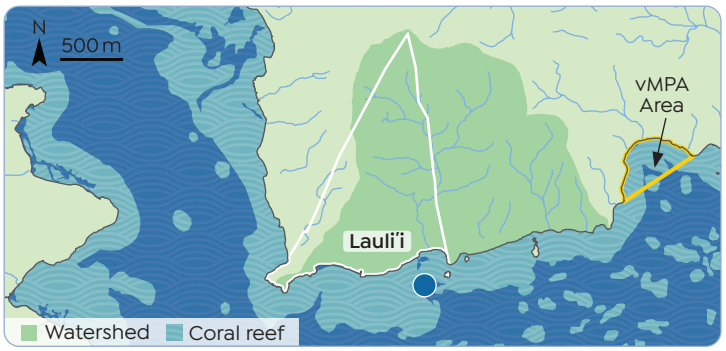
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Lauli'i, Tutuila (2016-2017)

Lauli'i village and watershed

Lauli'i is not currently associated with a community-based management plan. Lalulii'i has a medium watershed area for a South site, and a high population and population density. The main stream in Lauli'i watershed, Vaitele, had relatively medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



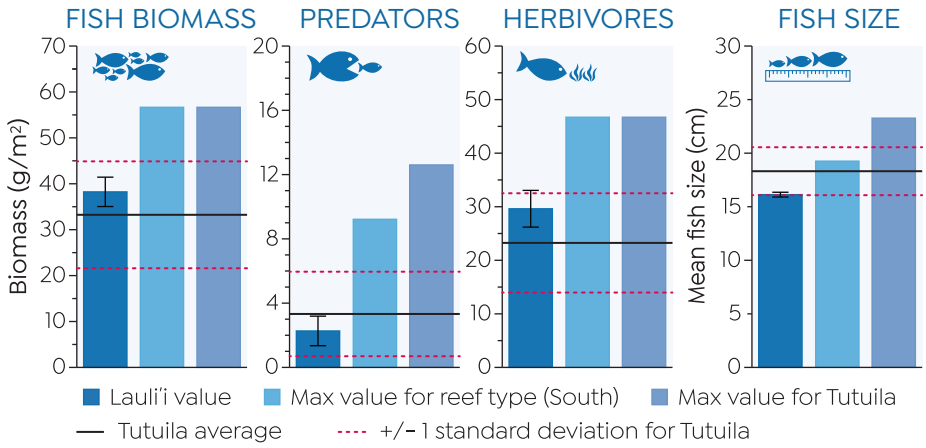
Lauli'i facts and figures	Value
Watershed Area (km²)	1.8 (M) [17.6, 17.6]
Disturbed Land (km²)	0.5 (M) [9.4, 9.4]
Population in watershed	892 (H) [3955, 3955]
Population density (per km²)	507 (H) [687, 907]
Mean 10-year wave energy (J/m³)	1987 (H) [2071, 2071]
Mean stream DIN (mg/L)*	0.07 (M) [0.18, 0.29]
Vaitele Maximum stream DIN (mg/L)	0.08 (M) [0.27, 0.47]

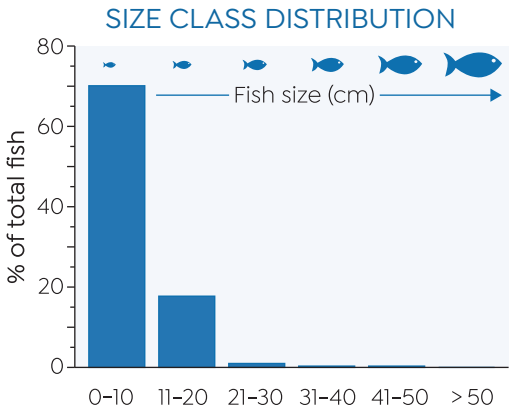
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


Plating corals at Lauli'i

Coral reef fish

Lauli'i had a mean fish size below the Tutuila average. Fish biomass and herbivore biomass were both above the Tutuila average. Predator biomass was just below the Tutuila average.

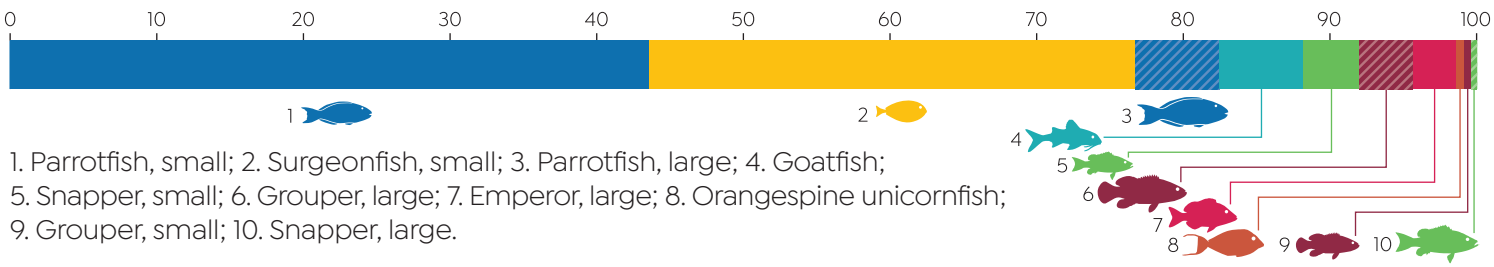




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large; 4. Goatfish; 5. Snapper, small; 6. Grouper, large; 7. Emperor, large; 8. Orangespine unicornfish; 9. Grouper, small; 10. Snapper, large.

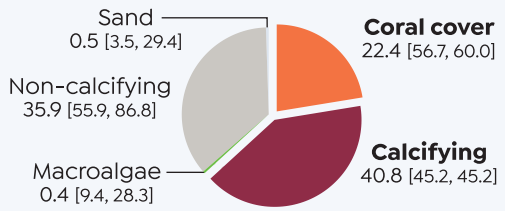
Coral reefs

Lauli'i – 144 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 4.8 [South max 7.4, Tutuila max 7.4].

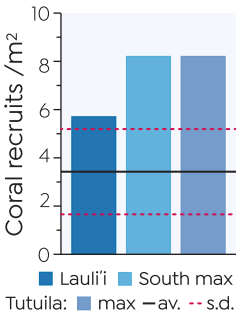
BENTHIC COVER (%)

Lauli'i [South max, Tutuila max]

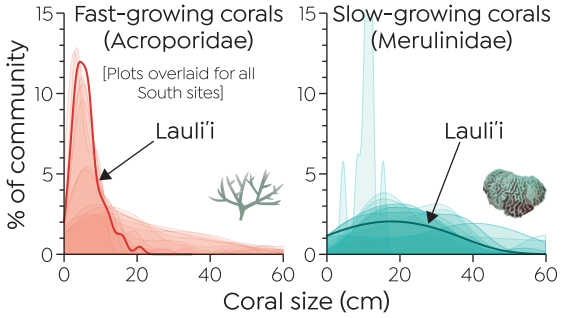


» Coral cover was 22.4%, much greater than the combined cover of sand (0.5%), macroalgae (0.4%) and non-calcifying substrate (35.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (5.7/m²) was well above the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Lauli'i with more small acroporids and more large merulinids than at other South sites.

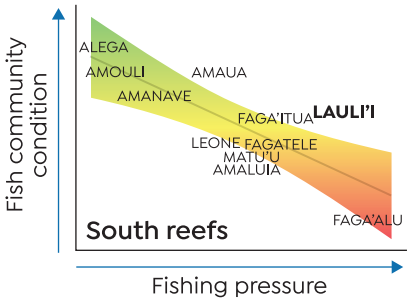
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

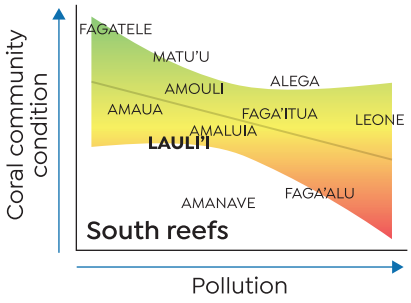
» Fishing pressure was relatively moderate at Lauli'i and fish community condition was relatively moderate.

» Watershed pollution was relatively moderate at Lauli'i and coral community condition was relatively moderate.

FISHING PRESSURE



POLLUTION AND CORAL



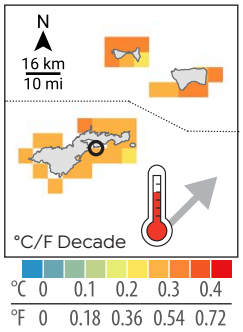
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

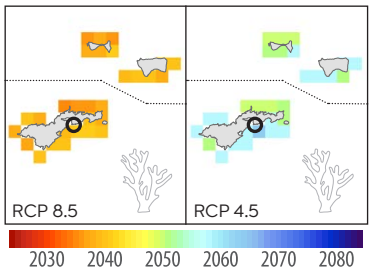
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Lauli'i were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

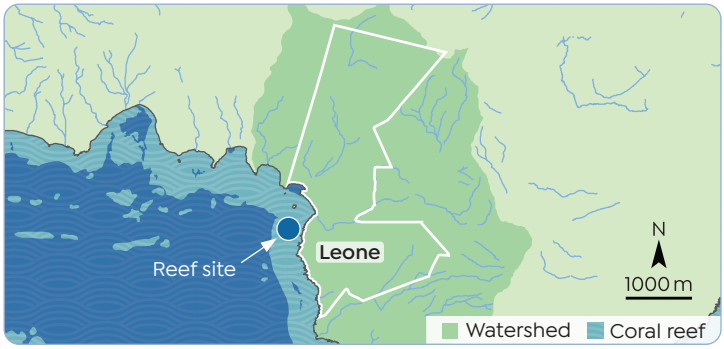
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Leone, Tutuila (2016-2017)

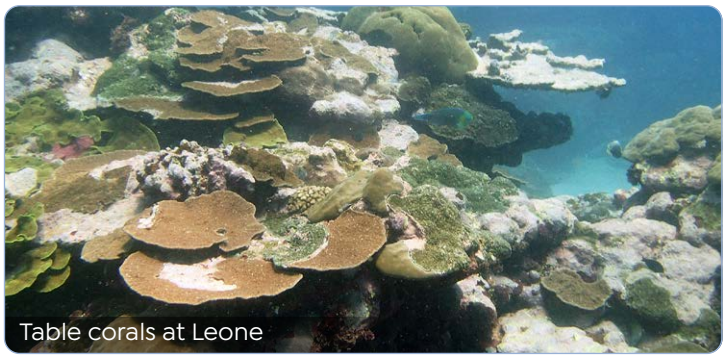
Leone village and watershed

Leone is actively involved in a community-based wetland management and restoration project with local resource agency staff. Leone has a large watershed area for a South site, and a high population and medium population density. The main stream in Leone watershed, Leafu, had relatively high concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



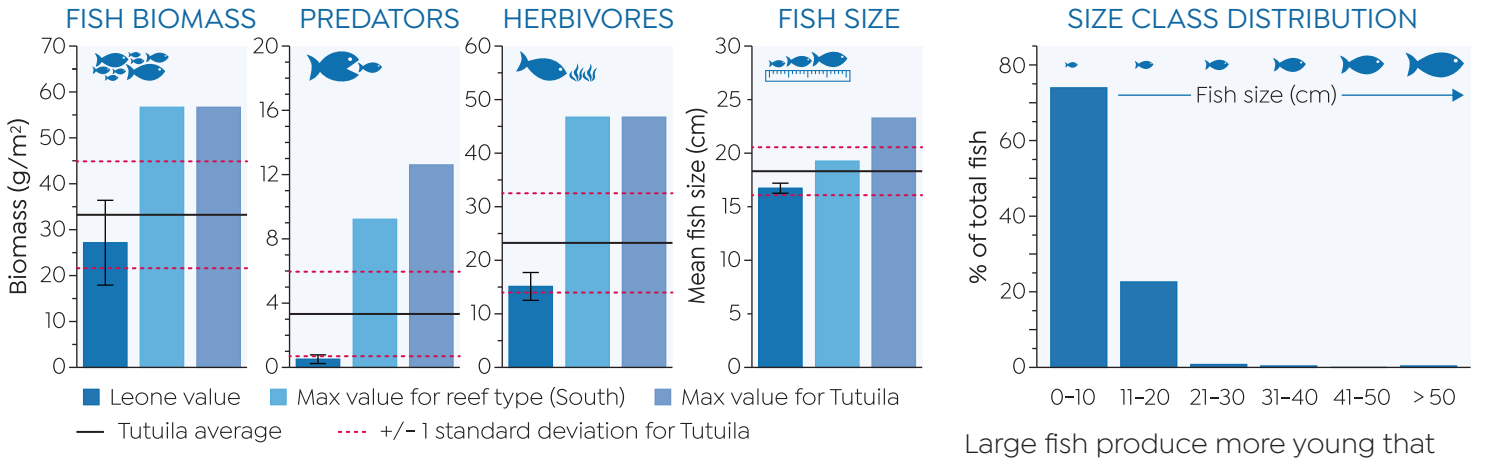
Leone facts and figures	Value
Watershed Area (km²)	9.5 (H) [17.6, 17.6]
Disturbed Land (km²)	5.2 (H) [9.4, 9.4]
Population in watershed	1019 (H) [3955, 3955]
Population density (per km²)	108 (M) [687, 907]
Mean 10-year wave energy (J/m³)	63 (L) [2071, 2071]
Mean stream DIN (mg/L)*	0.18 (H) [0.18, 0.29]
Leafu — Maximum stream DIN (mg/L)	0.27 (H) [0.27, 0.47]

High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period



Coral reef fish

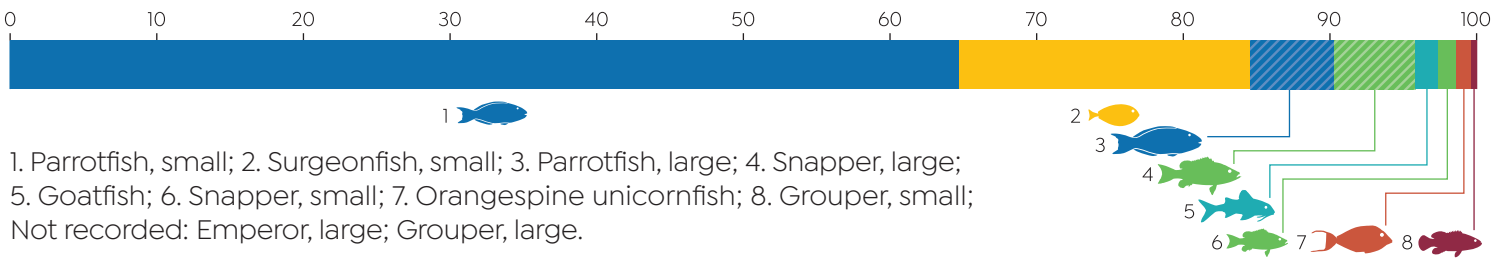
Leone had a mean fish size below the Tutuila average. Fish biomass, predator biomass, and herbivore biomass were all below the Tutuila average.



Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Parrotfish, large; 4. Snapper, large; 5. Goatfish; 6. Snapper, small; 7. Orangespine unicornfish; 8. Grouper, small; Not recorded: Emperor, large; Grouper, large.

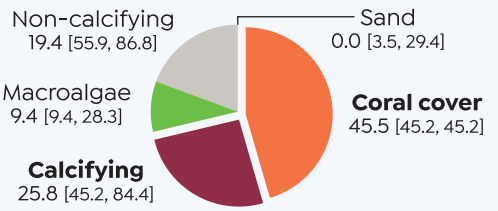
Coral reefs

Leone – 135 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 5.1 [South max 7.4, Tutuila max 7.4].

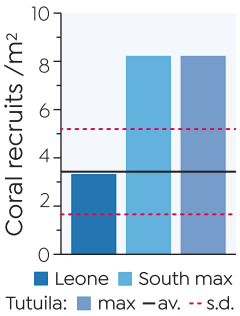
BENTHIC COVER (%)

Leone [South max, Tutuila max]

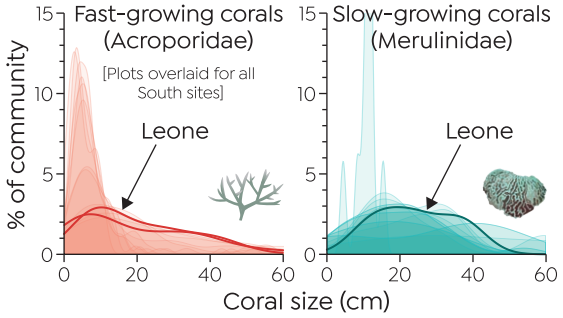


» Coral cover was 45.5%, much greater than the combined cover of sand (0.0%), macroalgae (9.4%) and non-calcifying substrate (19.4%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.3 recruits/m²) was near the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Leone with more large Acroporids and more large Merulinids than at other South sites.

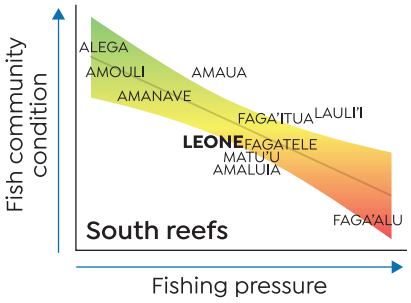
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

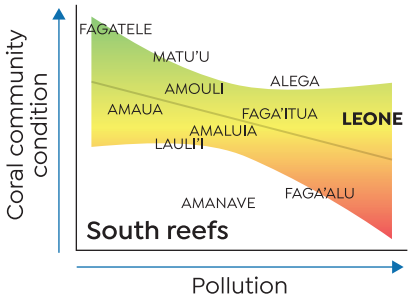
» Fishing pressure was relatively moderate at Leone and fish community condition was relatively moderate.

» Watershed pollution was relatively high at Leone and coral community condition was moderate.

FISHING PRESSURE



POLLUTION AND CORAL



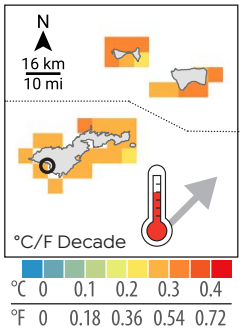
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

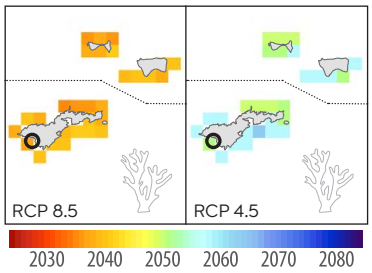
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Leone have been exposed to moderate thermal stress twice during this period, in 2015 and 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

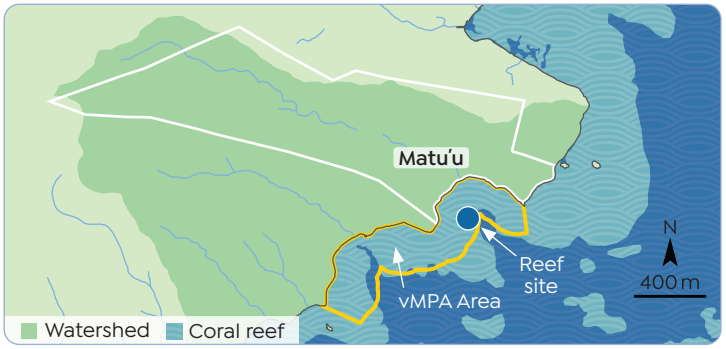
Matu'u, Tutuila (2016–2017)

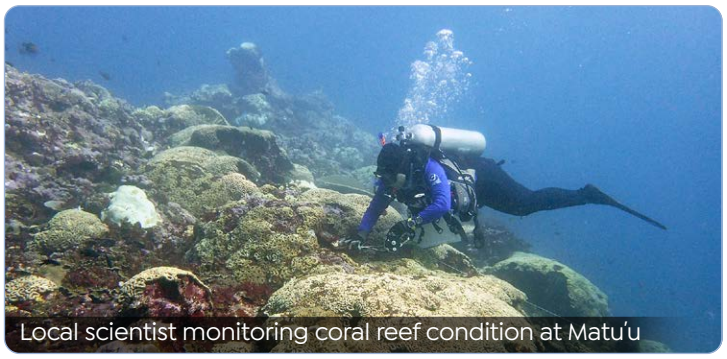
Matu'u village and watershed

Matu'u is part of the Village Marine Protected Area (vMPA) program, joint with the adjacent village of Faganeanea, which is co-managed with the Department of Marine and Wildlife Resources (DMWR). Matu'u has a medium watershed area for a South site, and a medium population and high population density. The main stream in Matu'u watershed, Afuelo, had relatively low concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.

Matu'u facts and figures	Value
Watershed Area (km²)	1.2 (M) [17.6, 17.6]
Disturbed Land (km²)	0.3 (L) [9.4, 9.4]
Population in watershed	399 (M) [3955, 3955]
Population density (per km²)	333 (H) [687, 907]
Mean 10-year wave energy (J/m³)	2071 (H) [2071, 2071]
Mean stream DIN (mg/L)*	0.06 (L) [0.18, 0.29]
Afuelo Maximum stream DIN (mg/L)	0.05 (L) [0.27, 0.47]

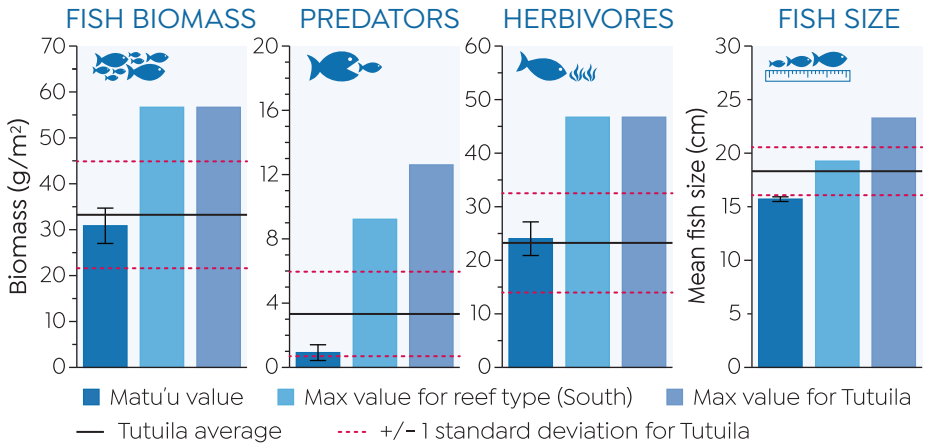
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period

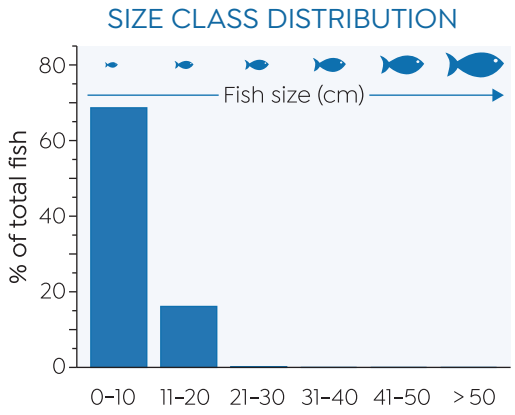



Local scientist monitoring coral reef condition at Matu'u

Coral reef fish

Matu'u had a mean fish size below the Tutuila average. Fish biomass and herbivore biomass were similar to the Tutuila average. Predator biomass was below the Tutuila average.

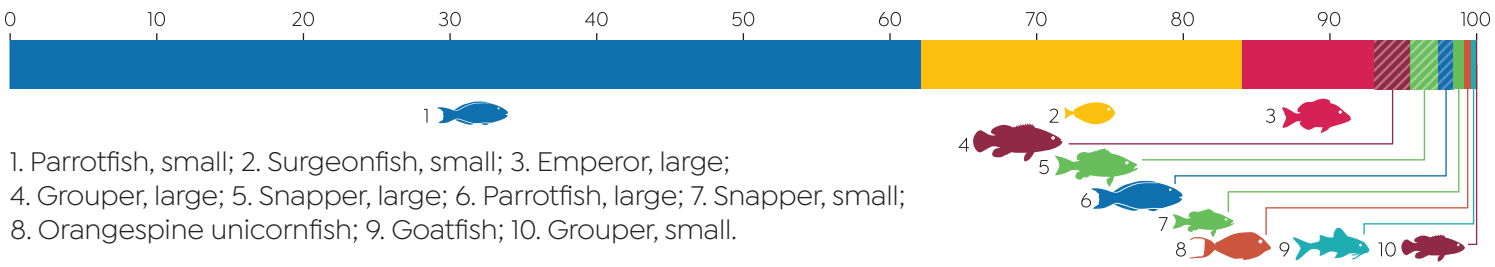




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Emperor, large;
4. Grouper, large; 5. Snapper, large; 6. Parrotfish, large; 7. Snapper, small;
8. Orangespine unicornfish; 9. Goatfish; 10. Grouper, small.

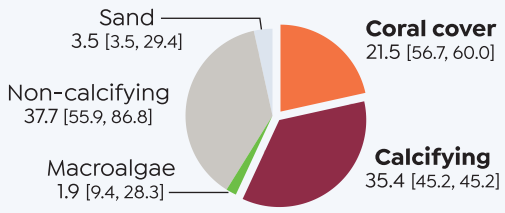
Coral reefs

Matu'u – 153 coral species
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 5.5 [South max 7.4, Tutuila max 7.4].

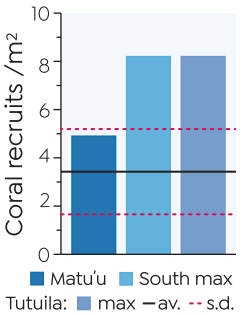
BENTHIC COVER (%)

Matu'u [South max, Tutuila max]

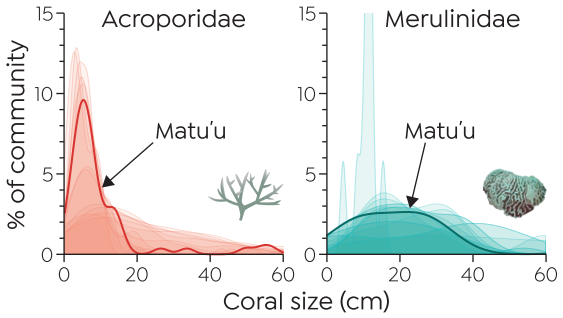


» Coral cover was 21.5%, much less than the combined cover of sand (3.5%), macroalgae (1.9%) and non-calcifying substrate (37.7%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (4.9 recruits/m²) was above the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Matu'u with more small acroporids and more large merulinids than at other South sites.

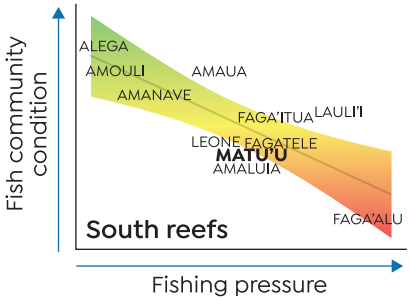
Human impacts

» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

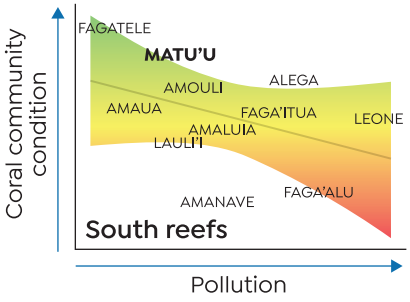
» Fishing pressure was relatively moderate at Matu'u and fish community condition was relatively moderate.

» Watershed pollution was relatively low at Matu'u and coral community condition was relatively good.

FISHING PRESSURE



POLLUTION AND CORAL



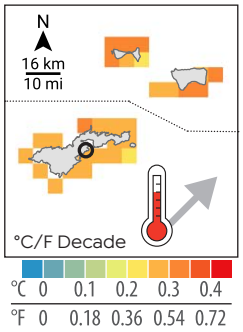
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

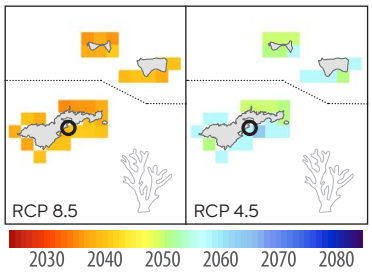
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Matu'u were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

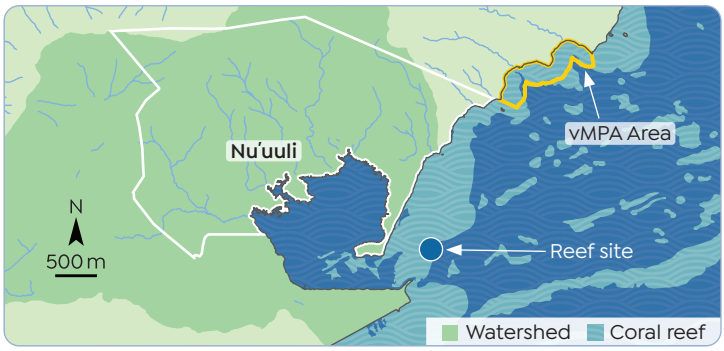
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Nu'uuli, Tutuila (2016-2017)

Nu'uuli village and watershed

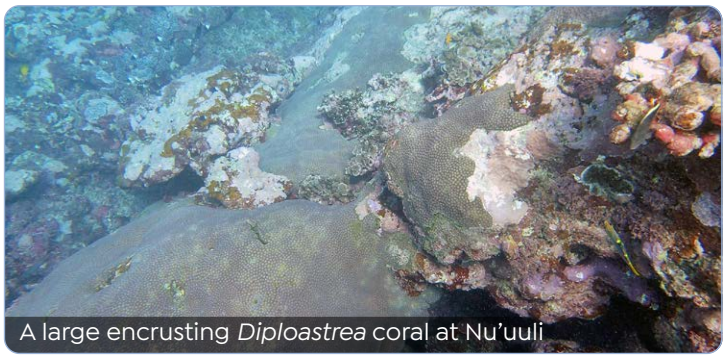
Nu'uuli is not currently associated with a community-based management plan. Nu'uuli has a large watershed area for a South site, high population and medium population density. The main stream in Nu'uuli watershed, Amalie, had relatively medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other South sites.



Nu'uuli facts and figures	Value
Watershed Area (km²)	17.6 (H) [17.6, 17.6]
Disturbed Land (km²)	9.4 (H) [9.4, 9.4]
Population in watershed	3955 (H) [3955, 3955]
Population density (per km²)	225 (M) [687, 907]
Mean 10-year wave energy (J/m³)	1971 (H) [2071, 2071]
Mean stream DIN (mg/L)*	0.09 (M) [0.18, 0.29]
Maximum stream DIN (mg/L)	0.18 (M) [0.27, 0.47]

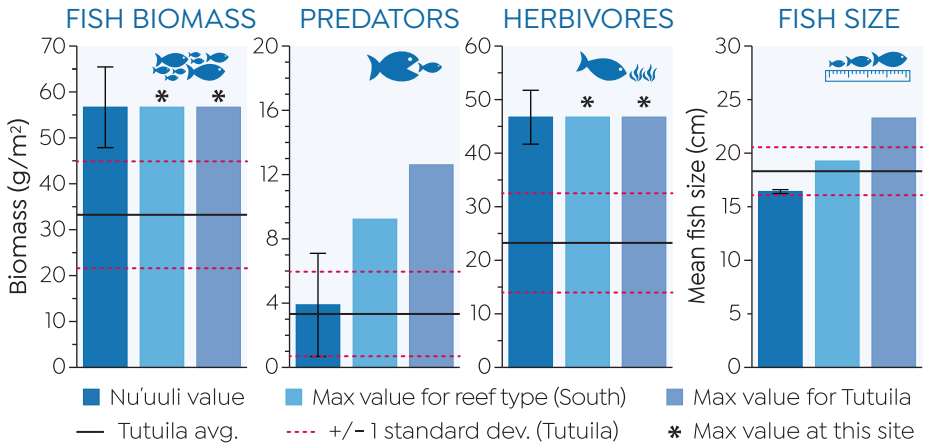
Amalie

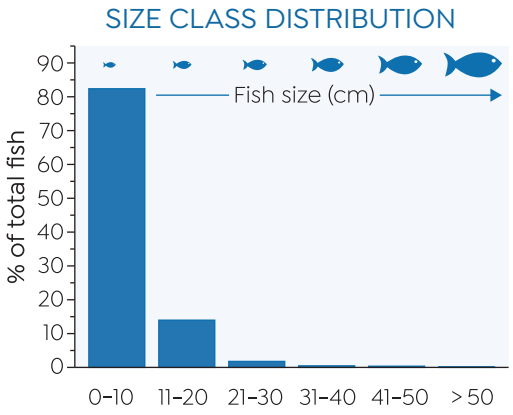
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (south), max for Tutuila]
*Over 12 month period


A large encrusting *Diploastrea* coral at Nu'uuli

Coral reef fish

Nu'uuli had a mean fish size below the Tutuila average. Fish biomass and herbivore biomass were far above the Tutuila average. Predator biomass was similar to the Tutuila average.

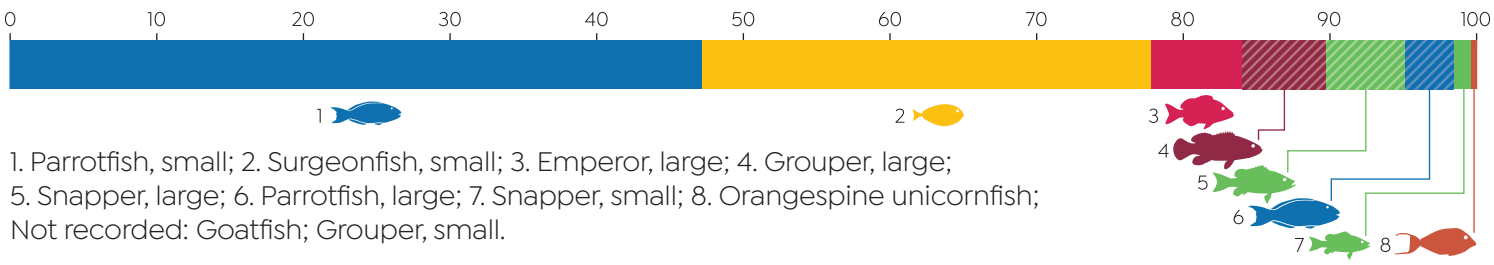




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Emperor, large; 4. Grouper, large; 5. Snapper, large; 6. Parrotfish, large; 7. Snapper, small; 8. Orangespine unicornfish; Not recorded: Goatfish; Grouper, small.

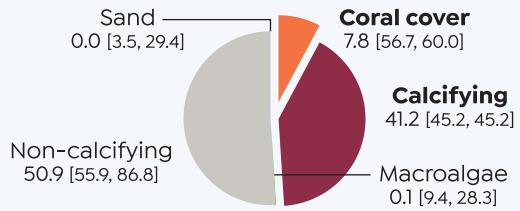
Coral reefs

Nu'uuli – 86 coral spp.
South reefs max – 195 species
Tutuila max – 195 species

Coral species richness was 4.4 [South max 7.4, Tutuila max 7.4].

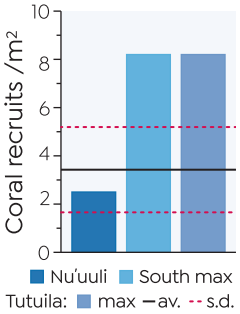
BENTHIC COVER (%)

Nu'uuli [South max, Tutuila max]

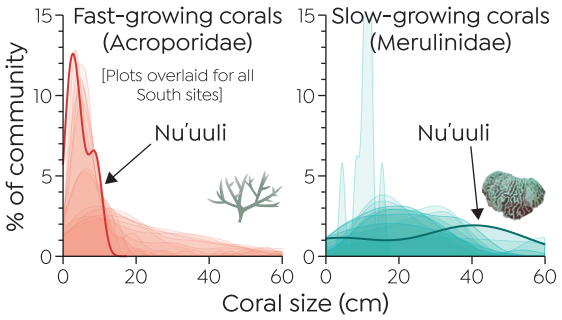


» Coral cover was 7.8%, much less than the combined cover of sand (0.0%), macroalgae (0.1%) and non-calcifying substrate (50.9%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (2.5 recruits/m²) was below the average for Tutuila.

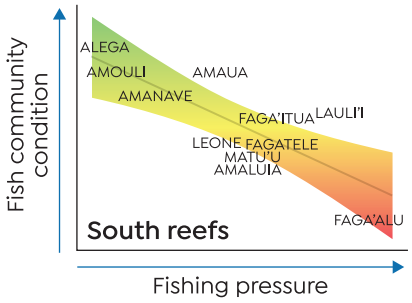
Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Nu'uuli with more small acroporids and more large merulinids than at other South sites.

Human impacts

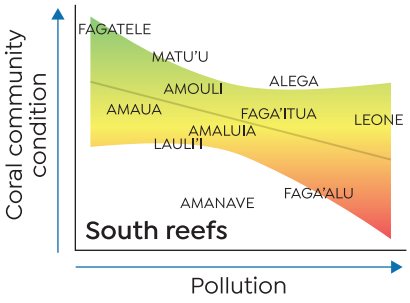
» Eleven of thirteen South sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

» Nu'uuli was not included in these assessments.

FISHING PRESSURE



POLLUTION AND CORAL



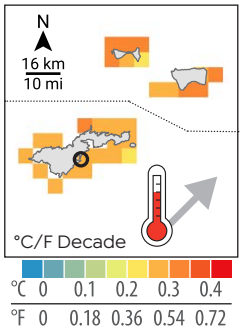
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs) Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

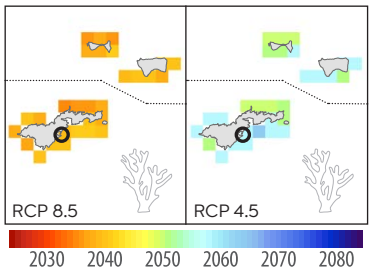
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Nu'uuli were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

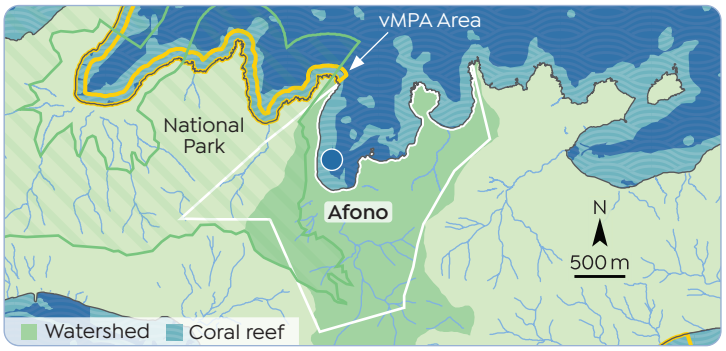
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Afono, Tutuila (2016-2017)

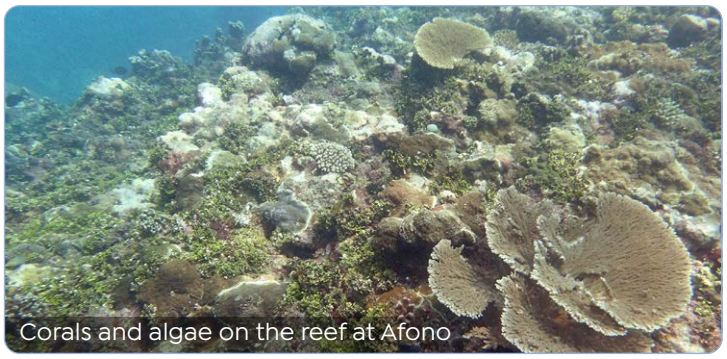
Afono village and watershed

Afono is part of the Tutuila section of the National Park of American Samoa (NPSA), which permits use of marine resources for subsistence purposes. Afono has a large watershed area for a Wave-sheltered site, and a medium population and medium population density. The main stream in Afono watershed, Pago, had relatively medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other Wave-sheltered sites.



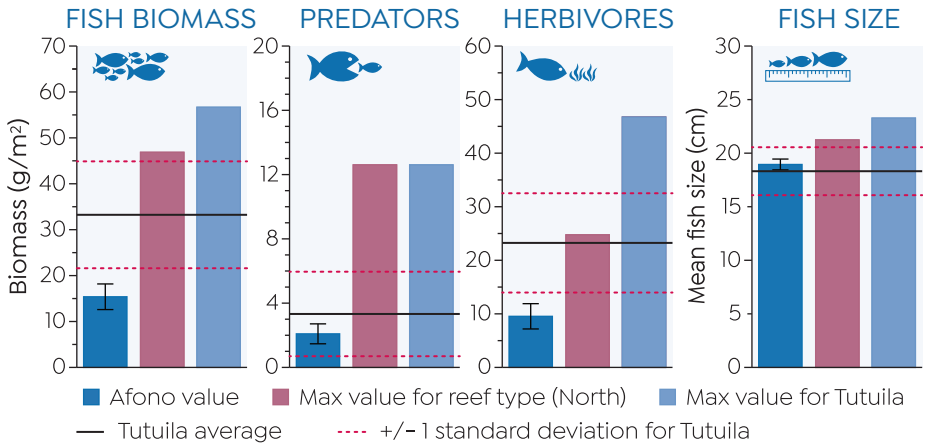
Afono facts and figures	Value
Watershed Area (km²)	2.8 (H) [3.5, 17.6]
Disturbed Land (km²)	0.9 (H) [1.5, 9.4]
Population in watershed	524 (M) [2077, 3955]
Population density (per km²)	185 (M) [907, 907]
Mean 10-year wave energy (J/m³)	199 (M) [263, 2071]
Mean stream DIN (mg/L)*	0.09 (M) [0.29, 0.29]
Pago — Maximum stream DIN (mg/L)	0.17 (M) [0.47, 0.47]

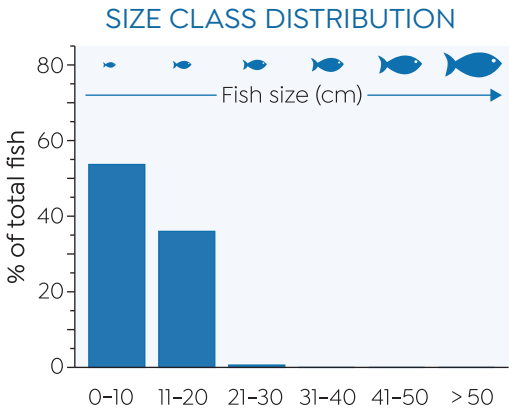
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (wave-sheltered), max for Tutuila]
*Over 12 month period


Corals and algae on the reef at Afono

Coral reef fish

Afono had a mean fish size similar to the Tutuila average. Fish biomass, predator biomass, and herbivore biomass were all far below the Tutuila average.

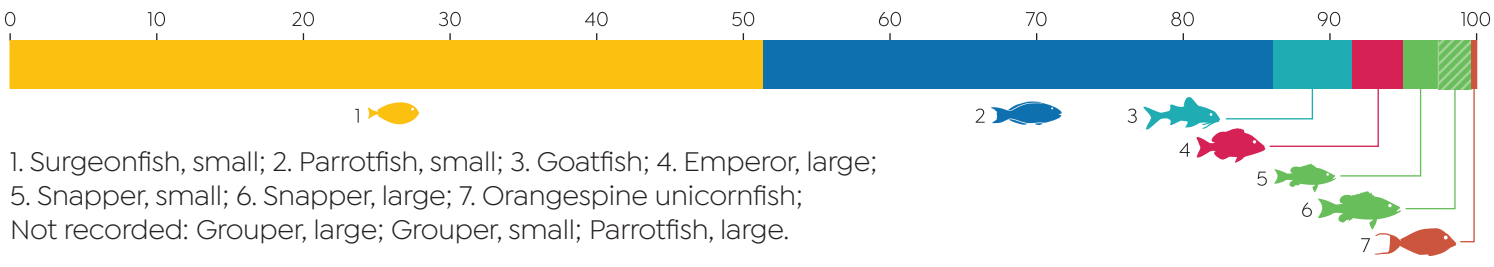




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Surgeonfish, small; 2. Parrotfish, small; 3. Goatfish; 4. Emperor, large; 5. Snapper, small; 6. Snapper, large; 7. Orangespine unicornfish; Not recorded: Grouper, large; Grouper, small; Parrotfish, large.

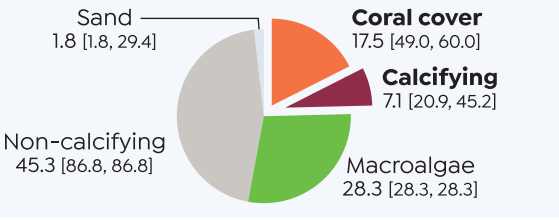
Coral reefs

Afono – 192 coral species
Sheltered reefs max – 192 species
Tutuila max – 195 species

Coral species richness was 6.8 [Sheltered max 6.8, Tutuila max 7.4].

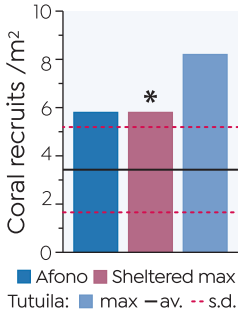
BENTHIC COVER (%)

Afono [Sheltered max, Tutuila max]

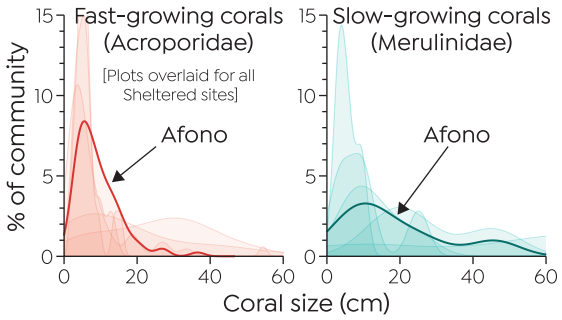


» Coral cover was 17.5%, much less than the combined cover of sand (1.8%), macroalgae (28.3%) and non-calcifying substrate (45.3%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (5.8/m²) was highest among the sheltered sites.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Afono with more small acroporids and more large merulinids than at other Wave-sheltered sites.

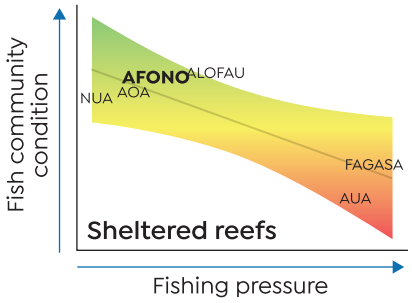
Human impacts

» Six Wave-sheltered sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

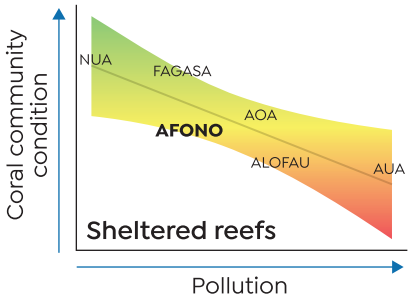
» Fishing pressure was relatively low at Afono and fish community condition was relatively good.

» Watershed pollution was relatively moderate at Matu'u and coral community condition was relatively medium.

FISHING PRESSURE



POLLUTION AND CORAL



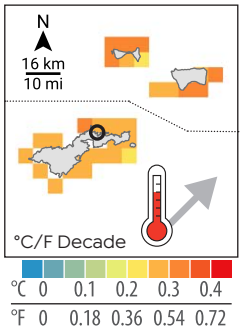
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 **1994** 1995 1996 1997 1998 1999 2000 2001 2001 **2003** 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 **2015** 2016 **2017**

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

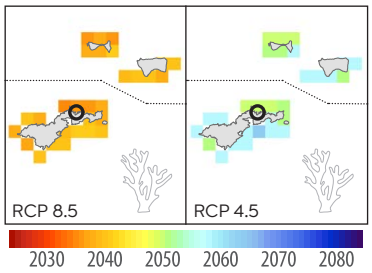
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Afono were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

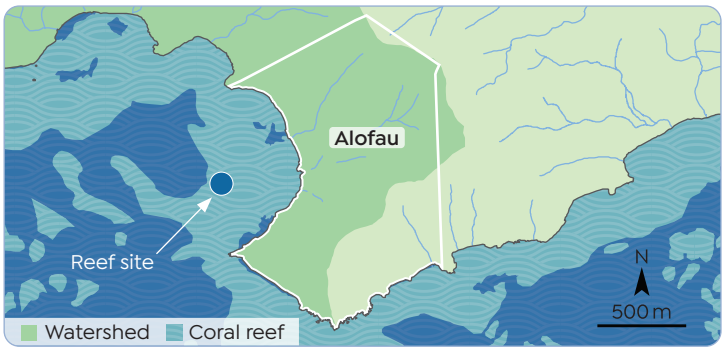
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Alofau, Tutuila (2016–2017)

Alofau village and watershed

Alofau is part of the Village Marine Protected Area (vMPA) program, which is co-managed with the Department of Marine and Wildlife Resources (DMWR). Alofau has a medium watershed area for a Wave-sheltered site, and a medium population and high population density. The main stream in Alofau watershed, Nu'u, had relatively high concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other Wave-sheltered sites.



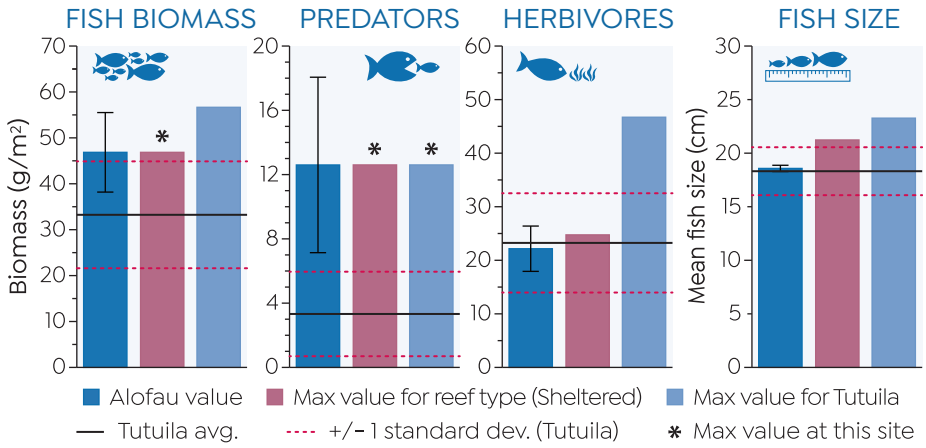
Alofau facts and figures		Value
	Watershed Area (km²)	1.1 (M) [3.5, 17.6]
	Disturbed Land (km²)	0.6 (M) [1.5, 9.4]
	Population in watershed	646 (M) [2077, 3955]
	Population density (per km²)	595 (H) [907, 907]
	Mean 10-year wave energy (J/m³)	63 (L) [263, 2071]
Nu'u	Mean stream DIN (mg/L)*	0.19 (H) [0.29, 0.29]
	Maximum stream DIN (mg/L)	0.21 (H) [0.47, 0.47]

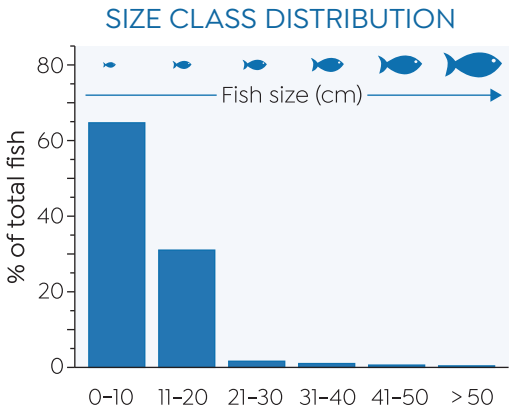
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (wave-sheltered), max for Tutuila]
*Over 12 month period


A large encrusting *Diploastrea* coral at Alofau

Coral reef fish

Alofau had a mean fish size similar to the Tutuila average. Fish biomass and predator biomass were far above the Tutuila average. Fish biomass was the highest observed among Wave-Sheltered sites. Predator biomass was the highest observed among all Tutuila sites. Herbivore biomass was similar to the Tutuila average.

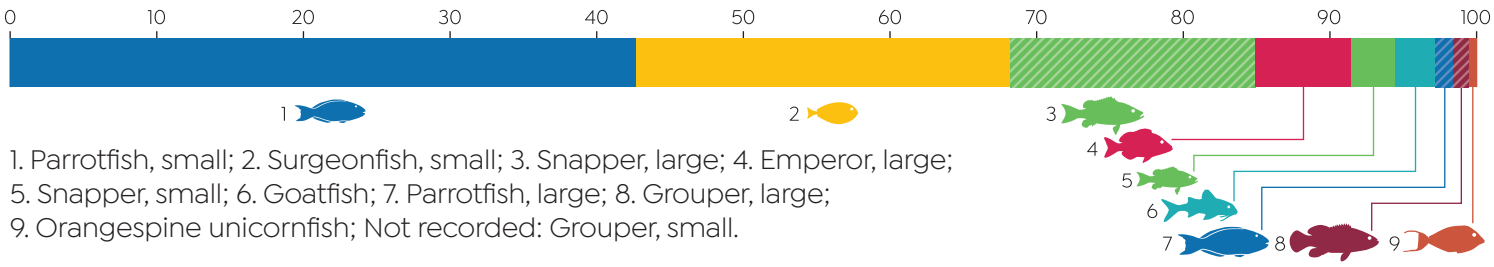




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Snapper, large; 4. Emperor, large; 5. Snapper, small; 6. Goatfish; 7. Parrotfish, large; 8. Grouper, large; 9. Orangespine unicornfish; Not recorded: Grouper, small.

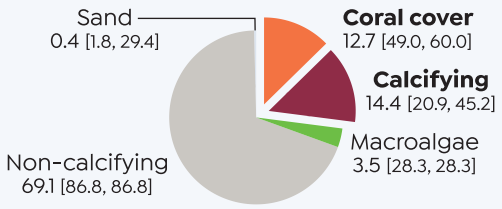
Coral reefs

Alofau – 110 coral species
Sheltered reefs max – 192 species
Tutuila max – 195 species

Coral species richness was 4.3 [Sheltered max 6.8, Tutuila max 7.4].

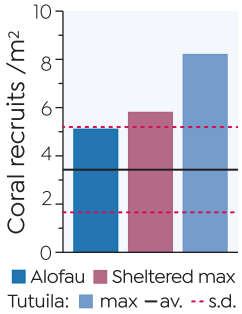
BENTHIC COVER (%)

Alofau [Sheltered max, Tutuila max]

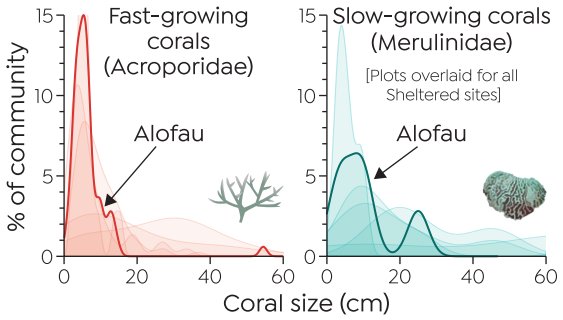


» Coral cover was 12.7%, much less than the combined cover of sand (0.4%), macroalgae (3.5%) and non-calcifying substrate (69.1%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (5.1 recruits/m²) was above the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Alofau with more small acroporids and more small merulinids than at other Wave-sheltered sites.

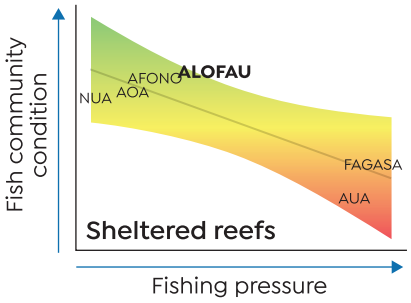
Human impacts

» Six Wave-sheltered sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

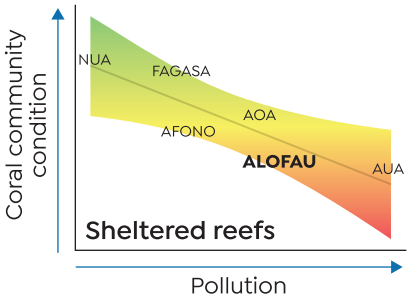
» Fishing pressure was relatively low at Alofau and fish community condition was relatively good.

» Watershed pollution was relatively moderate at Alofau and coral community condition was relatively medium.

FISHING PRESSURE



POLLUTION AND CORAL



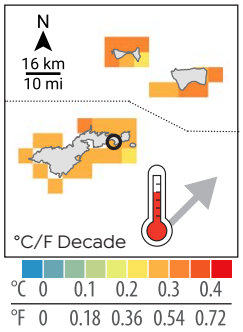
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

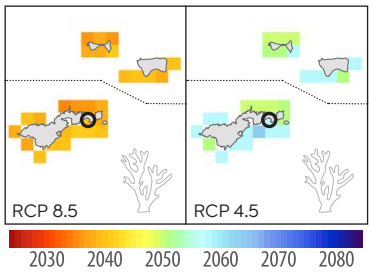
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Alofau were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

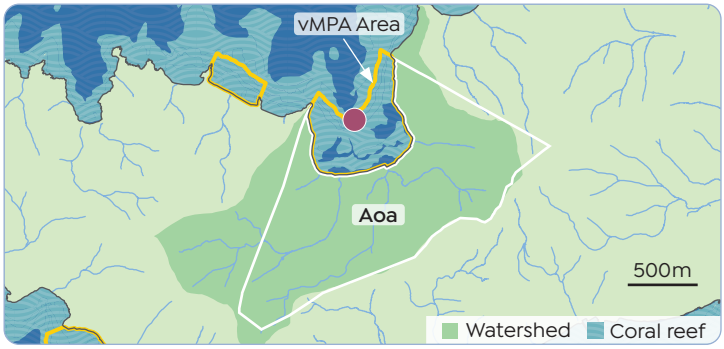
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Aoa, Tutuila (2016-2017)

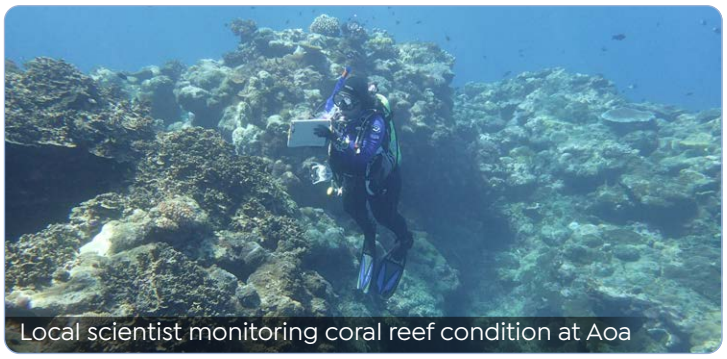
Aoa village and watershed

Aoa is part of the Village Marine Protected Area (vMPA) program, which is co-managed with the Department of Marine and Wildlife Resources (DMWR). Aoa has a medium watershed area for a Wave-sheltered site, and a high population and high population density. The main stream in Aoa watershed, Vaitolu, had relatively high concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other Wave-sheltered sites.



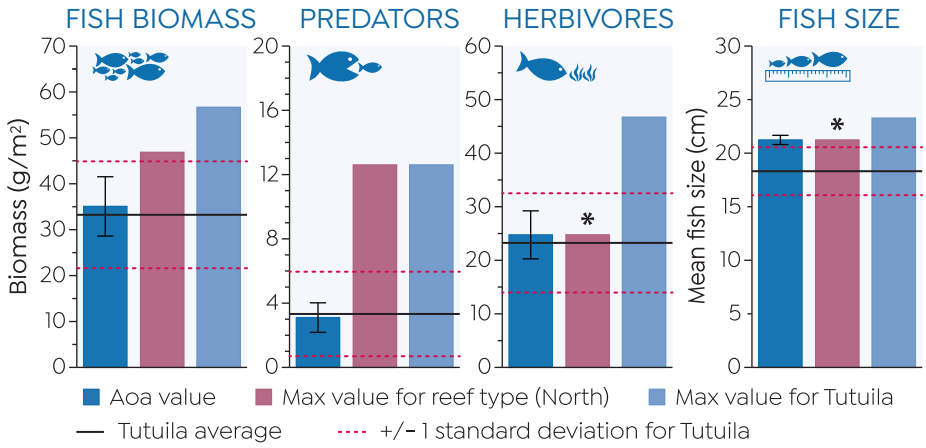
Aoa facts and figures		Value
	Watershed Area (km²)	2.2 (M) [3.5, 17.6]
	Disturbed Land (km²)	0.5 (M) [1.5, 9.4]
	Population in watershed	855 (H) [2077, 3955]
	Population density (per km²)	389 (H) [907, 907]
	Mean 10-year wave energy (J/m³)	263 (M) [263, 2071]
Vaitolu	Mean stream DIN (mg/L)*	0.16 (H) [0.29, 0.29]
	Maximum stream DIN (mg/L)	0.25 (H) [0.47, 0.47]

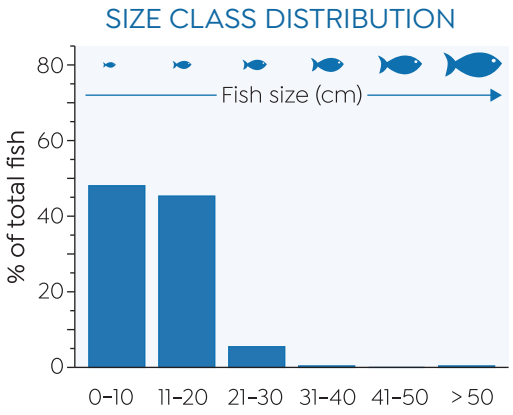
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (wave-sheltered), max for Tutuila]
*Over 12 month period


Local scientist monitoring coral reef condition at Aoa

Coral reef fish

Aoa had a mean fish size greater than the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all similar to the Tutuila average.

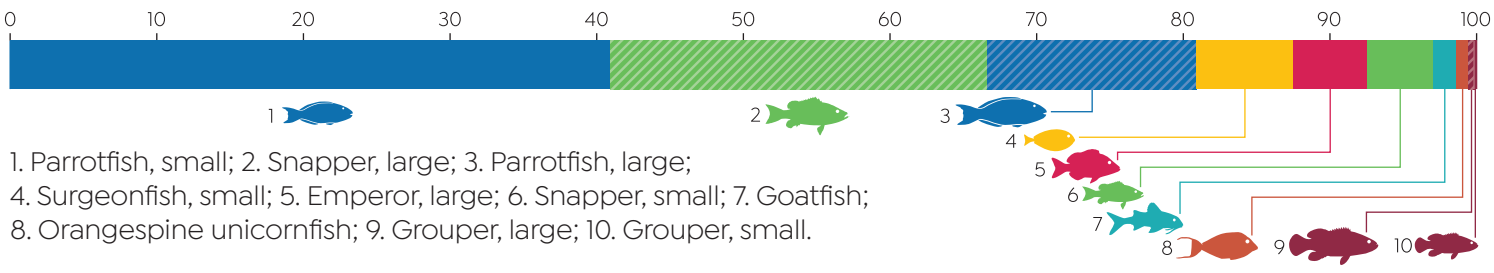




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Snapper, large; 3. Parrotfish, large;
4. Surgeonfish, small; 5. Emperor, large; 6. Snapper, small; 7. Goatfish;
8. Orangespine unicornfish; 9. Grouper, large; 10. Grouper, small.

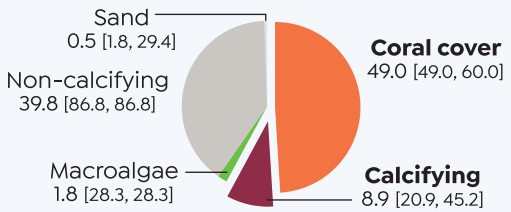
Coral reefs

Aoa – 98 coral species
Sheltered reefs max – 192 species
Tutuila max – 195 species

Coral species richness was 5.4 [Sheltered max 6.8, Tutuila max 7.4].

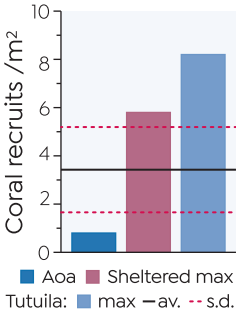
BENTHIC COVER (%)

Aoa [Sheltered max, Tutuila max]

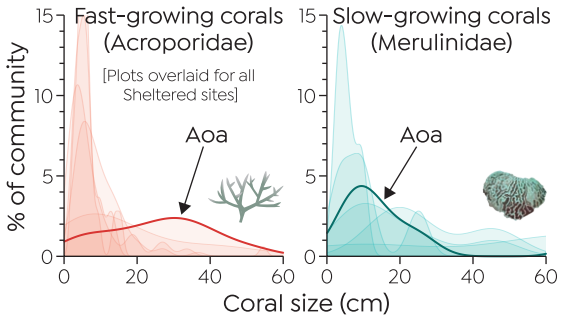


» Coral cover was 49.0%, much greater than the combined cover of sand (0.5%), macroalgae (1.8%) and non-calcifying substrate (39.8%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (0.8/m²) was much less than the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Aoa with more large acroporids and more large merulinids than at other Wave-sheltered sites.

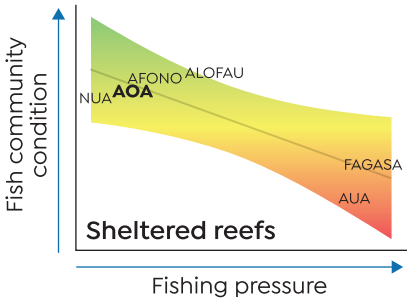
Human impacts

» Six Wave-sheltered sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

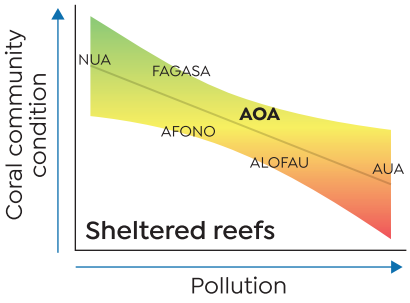
» Fishing pressure was relatively low at Aoa and fish community condition was relatively good.

» Watershed pollution was relatively moderate at Aoa and coral community condition was relatively medium.

FISHING PRESSURE



POLLUTION AND CORAL



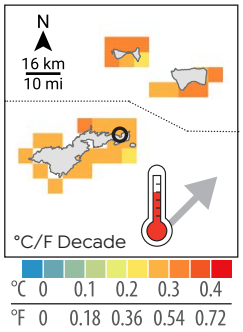
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

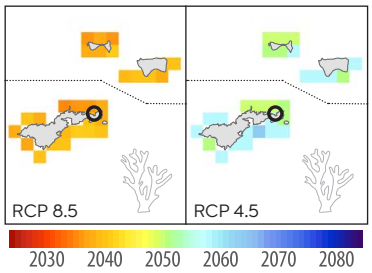
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Aoa were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

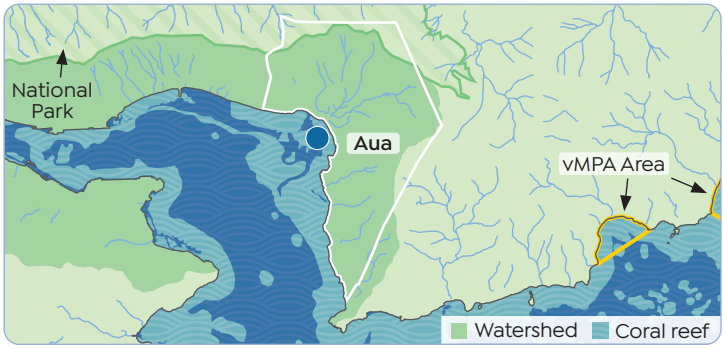
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Aua, Tutuila (2016-2017)

Aua village and watershed

Aua is a former vMPA and is now actively involved in community-based watershed management planning meetings with local resource agency staff. Aua has a medium watershed area for a Wave-sheltered site, and a high population and high population density. The main stream in Aua watershed, Lalomauna, had the highest concentrations of the dissolved nitrogen pollution indicator (DIN) in Tutuila.



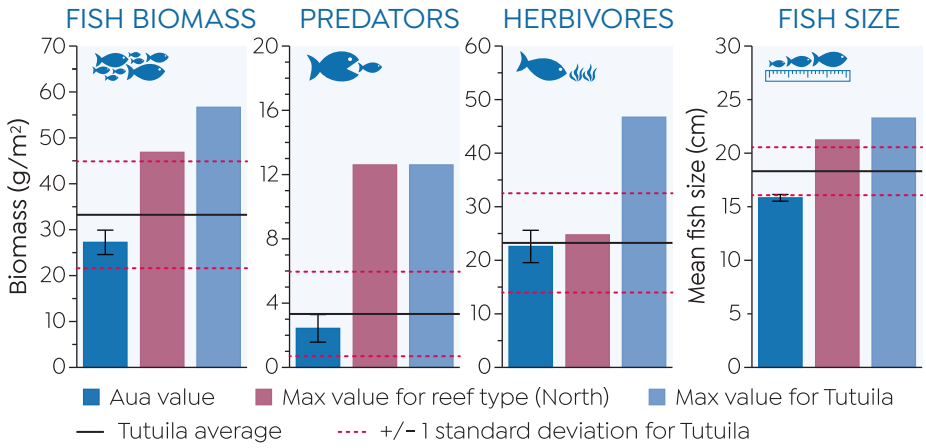
Aua facts and figures		Value
	Watershed Area (km²)	2.3 (M) [3.5, 17.6]
	Disturbed Land (km²)	1.0 (H) [1.5, 9.4]
	Population in watershed	2077 (H) [2077, 3955]
	Population density (per km²)	907 (H) [907, 907]
	Mean 10-year wave energy (J/m³)	19 (L) [263, 2071]
Lalomauna	Mean stream DIN (mg/L)*	0.29 (H) [0.29, 0.29]
	Maximum stream DIN (mg/L)	0.47 (H) [0.47, 0.47]

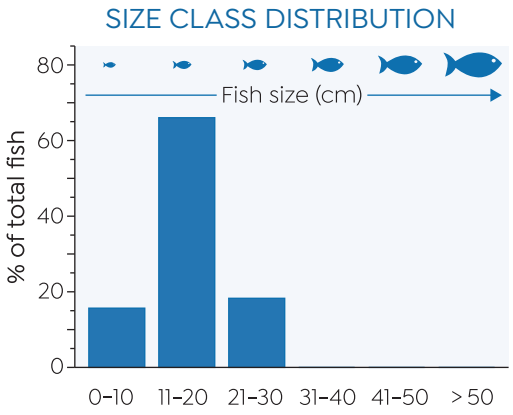
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (wave-sheltered), max for Tutuila]
*Over 12 month period


Soft coral on the reef at Aua

Coral reef fish

Aua had a mean fish size less than the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all similar to the Tutuila average.

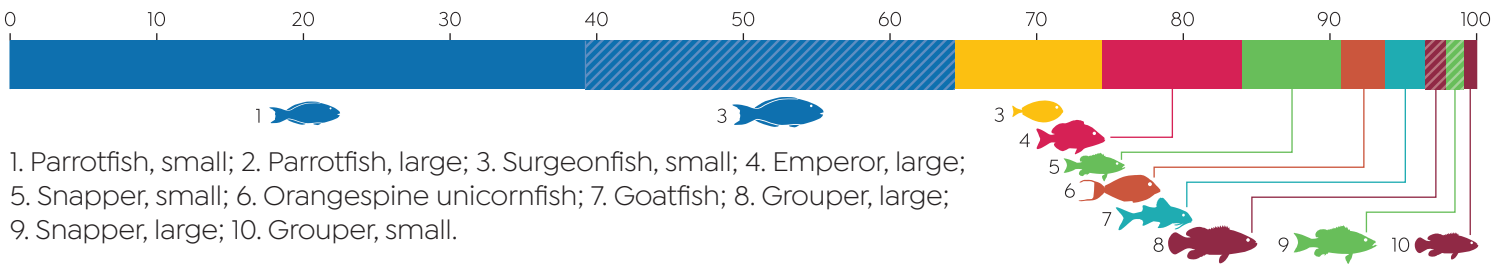




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



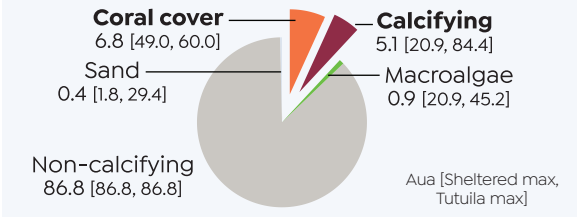
1. Parrotfish, small; 2. Parrotfish, large; 3. Surgeonfish, small; 4. Emperor, large; 5. Snapper, small; 6. Orangespine unicornfish; 7. Goatfish; 8. Grouper, large; 9. Snapper, large; 10. Grouper, small.

Coral reefs

Aua – 93 coral species
Sheltered reefs max – 192 species
Tutuila max – 195 species

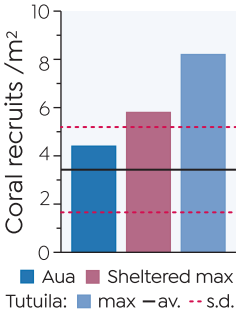
Coral species richness was 3.6 [Sheltered max 6.8, Tutuila max 7.4].

BENTHIC COVER (%)

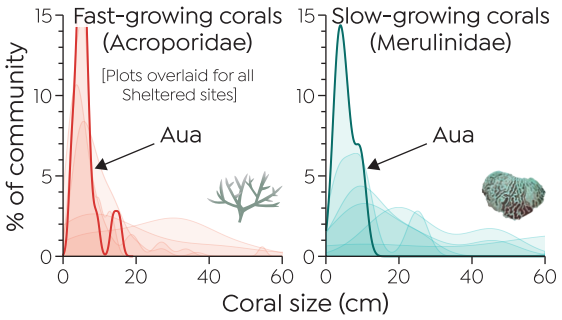


» Coral cover was 6.8%, much greater than the combined cover of sand (0.4%), macroalgae (0.9%) and non-calcifying substrate (86.8%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



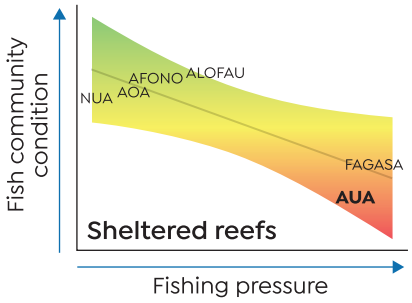
» Coral recruitment (4.4 recruits/m²) was above the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Aua with more small acroporids and more small merulinids than at other Wave-sheltered sites.

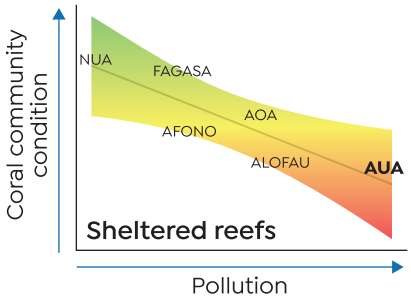
Human impacts

» Six Wave-sheltered sites were assessed for fishing pressure and watershed nutrient pollution (DIN).
» Fishing pressure was relatively high at Aua and fish community condition was relatively poor.
» Watershed pollution was relatively high at Aua and coral community condition was relatively poor.

FISHING PRESSURE



POLLUTION AND CORAL



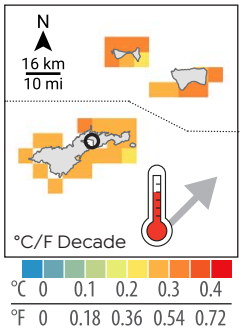
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

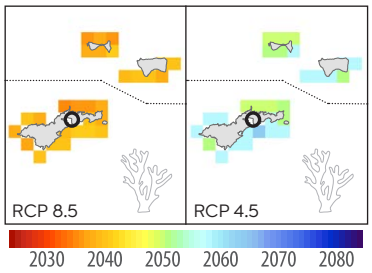
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Aua were exposed to moderate thermal stress three times during this period, and to severe thermal stress in 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

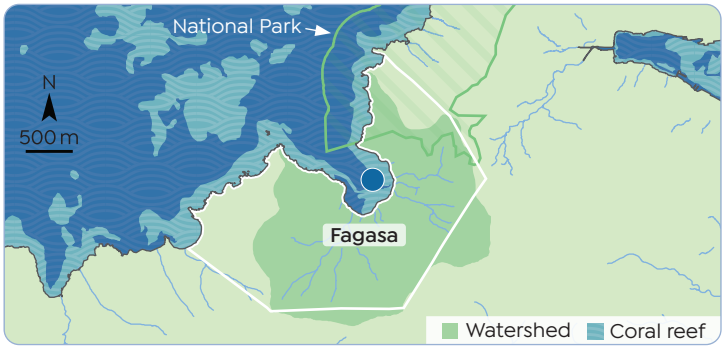
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Fagasa, Tutuila (2016-2017)

Fagasa village and watershed

Fagasa is part of the Tutuila section of the National Park of American Samoa (NPSA), which permits use of marine resources for subsistence purposes. Fagasa has a large watershed area for a Wave-sheltered site, and a high population and medium population density. The main stream in Fagasa watershed, Le'ele, had relatively medium concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other Wave-sheltered sites.



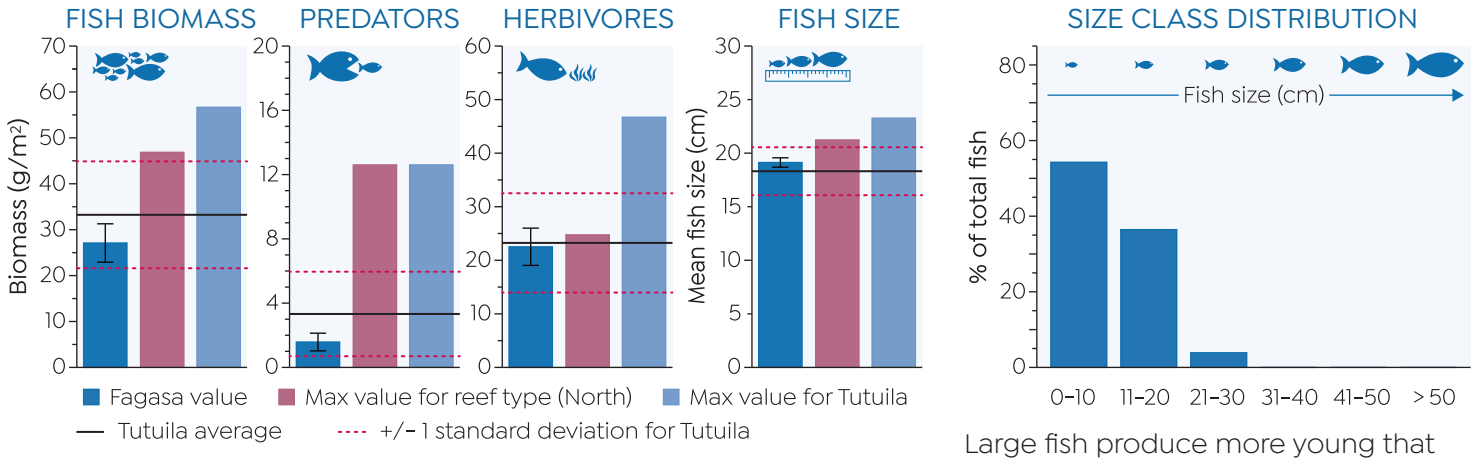
Fagasa facts and figures	Value
Watershed Area (km²)	3.5 (H) [3.5, 17.6]
Disturbed Land (km²)	1.5 (H) [1.5, 9.4]
Population in watershed	831 (H) [2077, 3955]
Population density (per km²)	238 (M) [907, 907]
Mean 10-year wave energy (J/m³)	231 (M) [263, 2071]
Mean stream DIN (mg/L)*	0.10 (M) [0.29, 0.29]
Le'ele Maximum stream DIN (mg/L)	0.13 (M) [0.47, 0.47]

High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (wave-sheltered), max for Tutuila]
*Over 12 month period


Green turtle on the reef at Fagasa

Coral reef fish

Fagasa had a mean fish size similar to the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all below the Tutuila average.



Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.

1. Parrotfish, small; 2. Parrotfish, large; 3. Surgeonfish, small; 4. Emperor, large; 5. Snapper, small; 6. Orangespine unicornfish; 7. Snapper, large; 8. Goatfish; 9. Grouper, large; 10. Grouper, small.

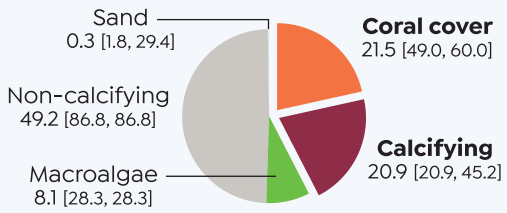
Coral reefs

Fagasa – 117 coral species
Sheltered reefs max – 192 species
Tutuila max – 195 species

Coral species richness was 5.7 [Sheltered max 6.8, Tutuila max 7.4].

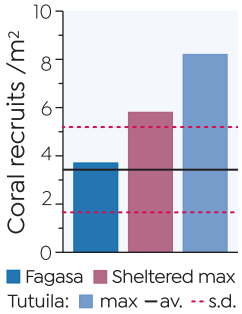
BENTHIC COVER (%)

Fagasa [Sheltered max, Tutuila max]

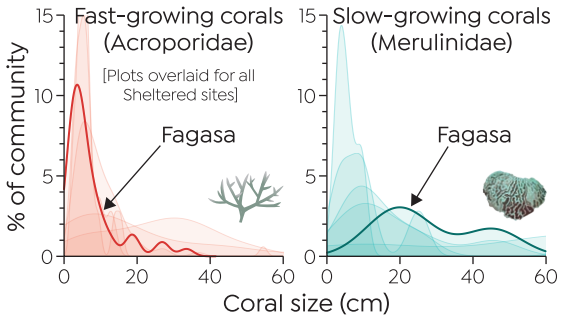


» Coral cover was 21.5%, much less than the combined cover of sand (0.3%), macroalgae (8.1%) and non-calcifying substrate (49.2%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



» Coral recruitment (3.7 recruits/m²) was near the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Fagasa with more small acroporids and more large merulinids than at other Wave-sheltered sites.

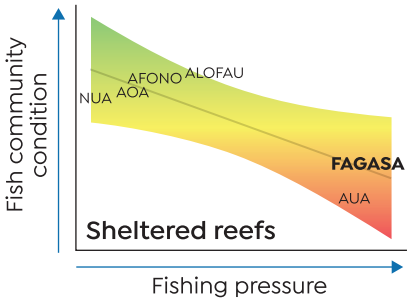
Human impacts

» Six Wave-sheltered sites were assessed for fishing pressure and watershed nutrient pollution (DIN).

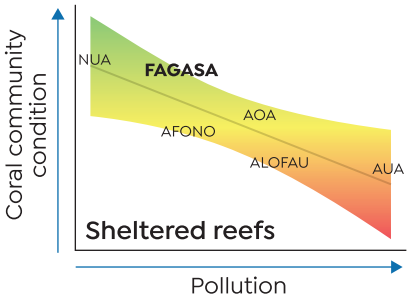
» Fishing pressure was relatively high at Fagasa and fish community condition was relatively poor.

» Watershed pollution was relatively low at Fagasa and coral community condition was relatively good.

FISHING PRESSURE



POLLUTION AND CORAL



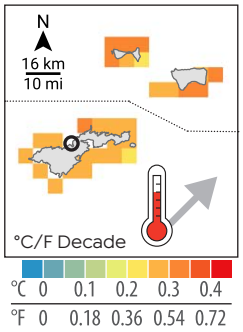
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2001 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

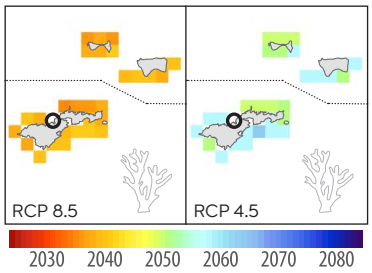
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Fagasa have been exposed to moderate thermal stress four times during this period, including in 2015 and 2017.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

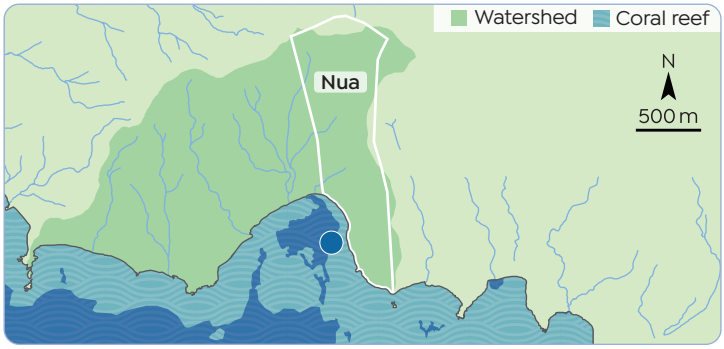
WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.

Nua, Tutuila (2016-2017)

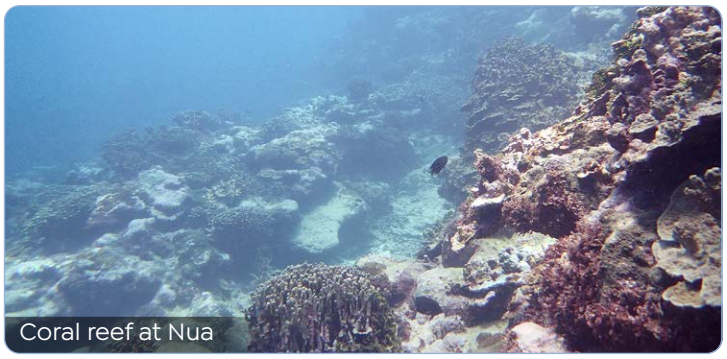
Nua village and watershed

Nua is not currently associated with a community-based management plan. Nua has a medium watershed area for a Wave-sheltered site, and a medium population and medium population density. The main stream in Nua watershed, Saonapule, had relatively low concentrations of the dissolved nitrogen pollution indicator (DIN), compared to other Wave-sheltered sites.



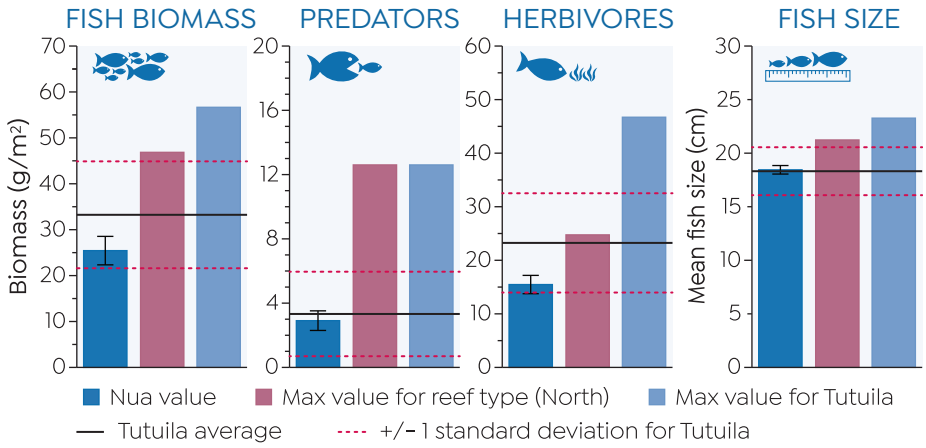
Nua facts and figures		Value
	Watershed Area (km²)	2.1 (M) [3.5, 17.6]
	Disturbed Land (km²)	0.4 (M) [1.5, 9.4]
	Population in watershed	440 (M) [2077, 3955]
	Population density (per km²)	209 (M) [907, 907]
	Mean 10-year wave energy (J/m³)	48 (L) [263, 2071]
Saonapule	Mean stream DIN (mg/L)*	0.06 (L) [0.29, 0.29]
	Maximum stream DIN (mg/L)	0.08 (L) [0.47, 0.47]

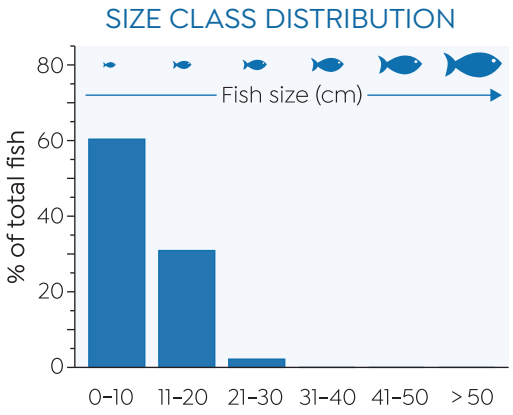
High (H) >75th percentile; Med (M) 25th–75th percentile; Low (L) ≤25th percentile
Values in square brackets are [max for reef type (wave-sheltered), max for Tutuila]
*Over 12 month period


Coral reef at Nua

Coral reef fish

Nua had a mean fish size similar to the Tutuila average. Fish biomass, predator biomass and herbivore biomass were all below the Tutuila average.

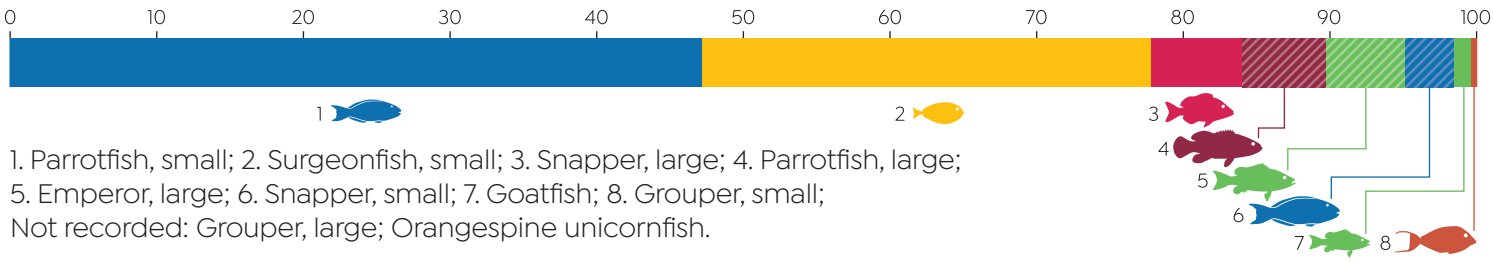




Large fish produce more young that are likely to survive to adulthood. Their absence means fish populations dwindle over time.

Fish functional groups

Percentage of fish community made up by various functional groups.



1. Parrotfish, small; 2. Surgeonfish, small; 3. Snapper, large; 4. Parrotfish, large; 5. Emperor, large; 6. Snapper, small; 7. Goatfish; 8. Grouper, small;
Not recorded: Grouper, large; Orangespine unicornfish.

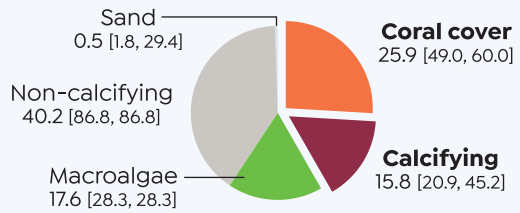
Coral reefs

Nua – 78 coral spp.
Sheltered reefs max – 192 species
Tutuila max – 195 species

Coral species richness was 4.0 [Sheltered max 6.8, Tutuila max 7.4].

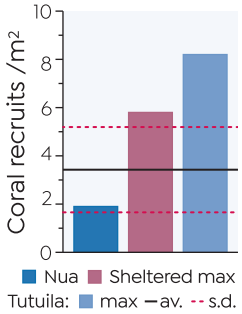
BENTHIC COVER (%)

Nua [Sheltered max, Tutuila max]

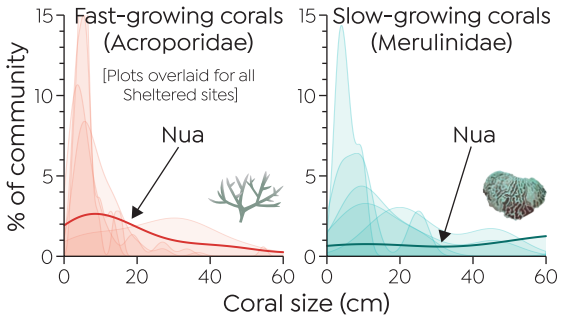


» Coral cover was 25.9%, much less than the combined cover of sand (0.5%), macroalgae (17.6%) and non-calcifying substrate (40.2%).

CORAL RECRUITS



CORAL DEMOGRAPHICS



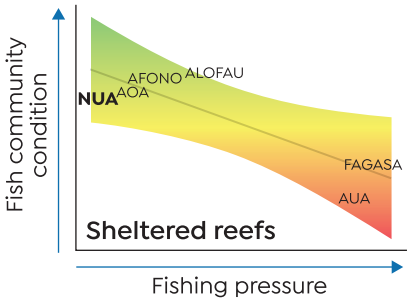
» Coral recruitment (1.9 recruits/m²) was below the average for Tutuila.

Acroporid corals are fast-growing and provide good habitat for fishes and other invertebrates, but are more sensitive to natural disturbances. Merulinid corals are moderately-growing, provide moderate habitat quality, and are less sensitive to disturbances. There were a mix of sizes at Nua with more large acroporids and more large merulinids than at other Wave-sheltered sites.

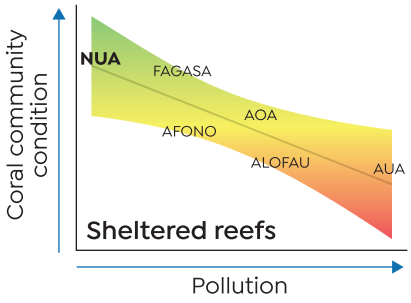
Human impacts

» Six Wave-sheltered sites were assessed for fishing pressure and watershed nutrient pollution (DIN).
» Fishing pressure was relatively low at Nua and fish community condition was relatively good.
» Watershed pollution was relatively low at Nua and coral community condition was the best of the Wave-sheltered sites.

FISHING PRESSURE



POLLUTION AND CORAL



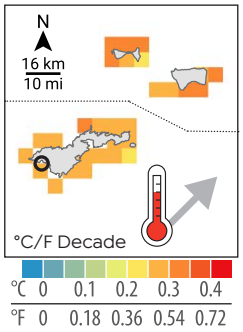
Impacts of climate change

Past (1985–2017)

1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2008 2011 2012 2013 2014 2015 2016 2017

Moderate bleaching stress (≥4 Degree Heating Weeks, DHWs)
Severe bleaching stress (≥8 DHWs)

TREND



Rate of increase of sea surface temperatures.

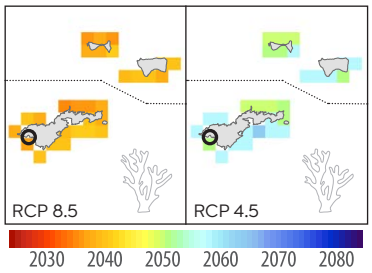
A third (30%) of the coral reefs in American Samoa were exposed to moderate thermal stress five times or more during the study period (1985–2017). Reefs at Nua were not exposed to moderate thermal stress (four or more degree heating weeks) during this time.

The observed increase in exposure to severe thermal stress events can be attributed to increases in sea temperature, which have averaged 0.35°C/decade in American Samoa.

Projected future (2018–2100)

Climate models suggest that all coral reefs in American Samoa will be exposed to severe thermal stress (8DHWs) every year by 2045–2050, irrespective of the effectiveness of any recent climate policy. Such frequent thermal stress may cause recurrent bleaching, suggesting coral cover will decline further in the decades ahead.

ONSET OF ANNUAL SEVERE BLEACHING



Climate model projections of the onset of annual severe bleaching under RCP4.5 (scenario with greater emissions reductions than currently pledged), and RCP8.5 (assumes climate policy is ineffective).

WHAT YOU CAN DO TO HELP

- Abide by fisheries regulations.
- Don't damage or remove live coral.
- Protect mangroves and wetlands.
- Take your fishing gear with you.
- Keep chemicals out of waterways.