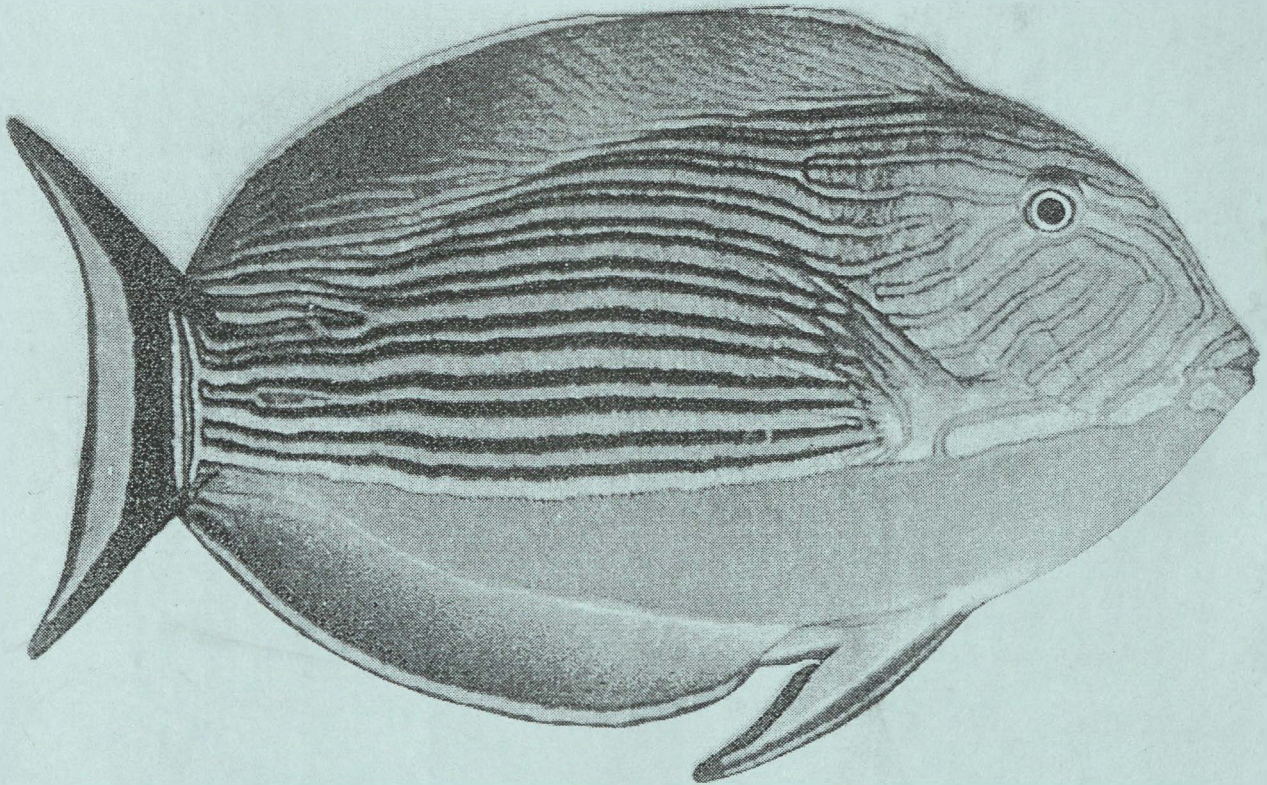


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Workshop Report and Development of a  
5-year Plan for Coral Reef Management in  
American Samoa (2000-2004)

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American Samoa Coral Reef Advisory Group



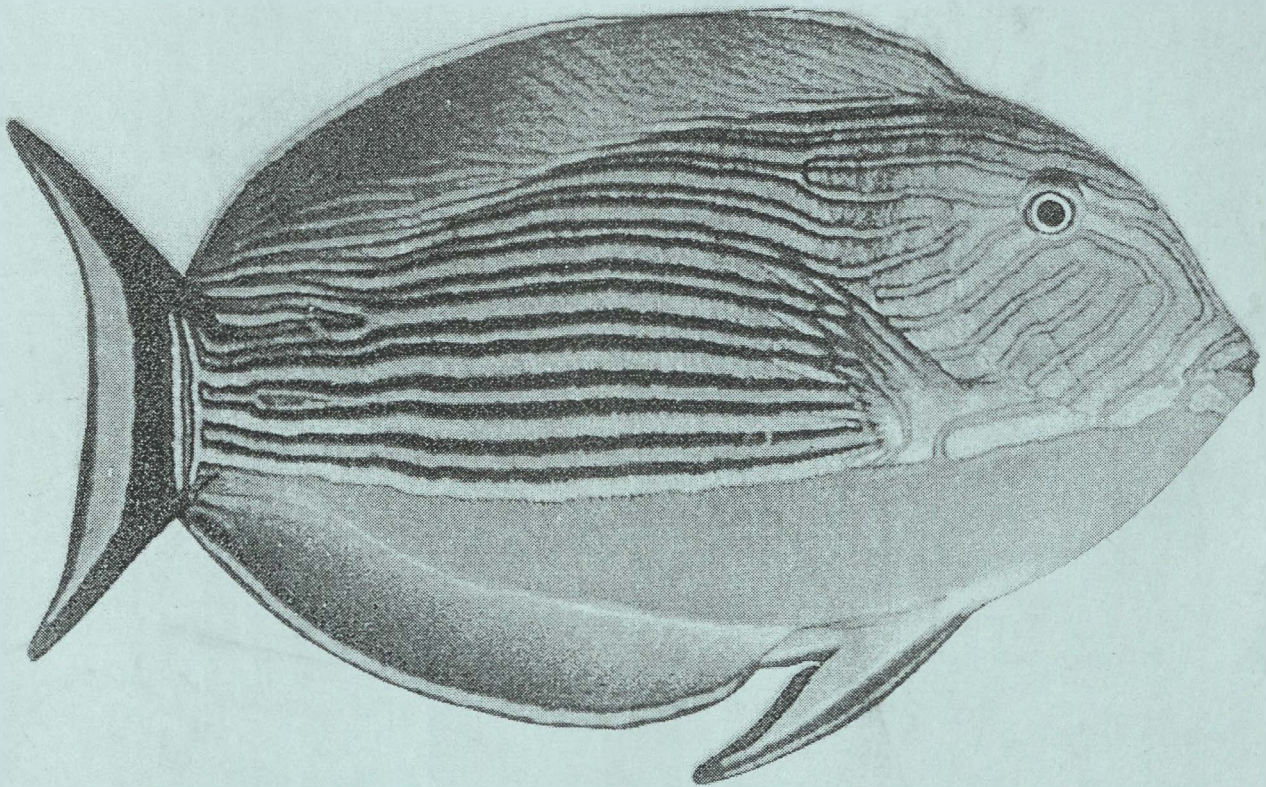
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# Workshop Report and Development of 5-year Plan for Coral Reef Management in American Samoa (2000-2004)

by the  
**American Samoa Coral Reef Advisory Group**

Prepared by:  
Peter Craig, Nancy Daschbach, Sheila Wiegman  
Flinn Curren and Jennifer Aicher

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September 1999

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## WORKSHOP INTRODUCTION

There is worldwide interest in monitoring coral reefs for two general reasons. First, coral reefs are among the most diverse and productive communities on Earth, and they provide an important source of food, potential medications, and revenue from tourism. Second, alarms have been sounded that coral reefs worldwide are showing signs of major stress and mortality from both natural and human causes. Indeed, it has been estimated that two thirds of worldwide reefs have been degraded, 10% of them "beyond recognition" (Brown et al. 1999).

Several international workshops have already been convened to address these issues and develop programs to monitor coral reefs (e.g., Rogers et al. 1994, English et al. 1997, Samoilyis 1997). The purpose of the present workshop was to view this challenge from a small-island perspective, where local resources are far fewer than found in more developed countries with numerous management agencies and academic institutions. Our focus was to determine what information is really needed for practical management, and what tasks can realistically be accomplished by local agencies.

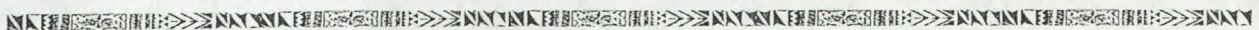
To accomplish these objectives and develop an updated 5-year Coral Reef Management Plan for the territory, the American Samoa Coral Reef Advisory Group invited a group of local and off-island coral reef experts to participate in a workshop held in May 1999 ("Coral Reef Workshop: practical management for small islands"). Participants are listed in Appendix 1.

The American Samoa Coral Reef Advisory Group would like to thank all the participants who attended the workshop in May. We appreciate everyone's contribution to the development of this five year plan.

## WORKSHOP FOCUS

Several pre-workshop meetings were held by the Advisory Group to identify coral reef issues of concern in American Samoa and to focus the workshop on these specific needs. The Advisory Group determined that a monitoring program for American Samoa should include the following elements:

- Management-driven approach. A practical set of tools identified and/or developed that are usable at the level of Samoa's capacity, and that provide indicators and answers for coral resource managers.
- Achievable with local staff. While recognizing that off-island scientific expertise would be needed to address some issues and/or conduct surveys at multi-year intervals, what meaningful aspects of a monitoring program can be accomplished by local resources?
- Resilient to fluctuating expertise. Local technical staff are typically hired on 2-year contracts, thus on-island capabilities and expertise fluctuate on a regular basis.
- Comparability to other programs. To the degree possible, methodology should be consistent with those used to monitor coral reefs in other areas.





**Overfishing.** Key species such as giant clams (*faisua*) and parrotfish (*fuga*) are overfished, and there is heavy fishing pressure on surgeonfish (*alogo*). We also see fewer and/or smaller groupers (*gatala*), snappers (*mu*), atule (*akule*) and sea turtles (*I'a sa, laumei uga*). Most village fishermen and elders that were interviewed believed that fishing had declined (Tuilagi and Green 1995).

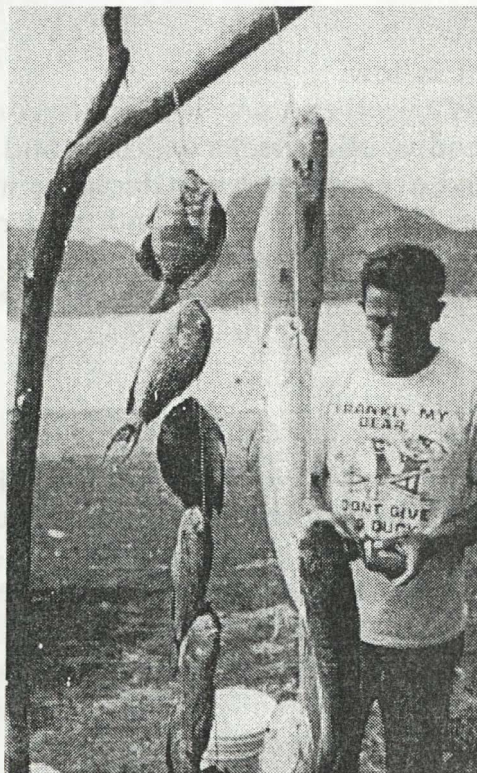
**Climate change.** Air temperature has increased steadily over the past 15 years and is now 2°C higher than during the period 1960-1980. Warmer air and ocean temperatures will probably increase the frequency of hurricanes in the region. Also, warm water temperatures are known to kill corals under some circumstances.

**Harbor pollution.** Fish and substrates in Pago Pago Harbor are contaminated with heavy metals and other pollutants. A health advisory warning people not to eat harbor fish was issued in 1991. However, nutrient loading from cannery wastes in the harbor was greatly reduced when the canneries were required to dispose of their wastes beyond the inner harbor.

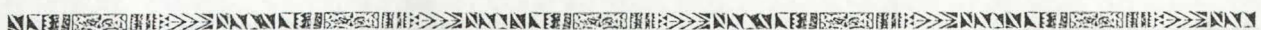
**Enforcement.** Environmental violations are more frequently detected and prosecuted, but enforcement of environmental regulations is not widespread and many problems persist. Illegal fishing is a common problem in marine protected areas.

## 2. Agency reports

Overviews of water quality, fisheries, corals, algae and coastal developments in the territory were presented (Appendices 2-6). Types of data collected and locations of past and present sampling stations were identified so that a monitoring plan could build upon existing data.



Peter Crnig





## THREATS TO CORAL REEFS IN AMERICAN SAMOA

Prior to designing a research and monitoring program, threats to local reefs need to be identified and, of those, which we can do something about. Three categories of threats were identified and ranked as being a high (H), medium (M) or low (L) concern:

(a) Human-related impacts	Priority
Overfishing of reef resources	H
Coastal development & habitat destruction	H
Oil and hazardous waste spills in Pago harbor	H
Sedimentation	M
Dumping/improper waste disposal	M
Nutrient loading/eutrophication in Pago Harbor	M
Nutrient loading/eutrophication other than Pago Harbor	L
Oil and hazardous waste spills other than Pago Harbor	L
Ship groundings	L
Anchor damage	L
Destructive fishing habits	L
Marine debris from marine sources	L
Alien species (i.e., ballast water)	L
Crown-of-thorns starfish predation	L
Coral diseases	L
Collections for aquarium market	L
Bio-prospecting/natural products	L
<b>(b) Threats that are a natural part of the ecosystem and/or we cannot affect.</b>	
Hurricanes	H
Human population growth on Tutuila Island	H
Global warming in American Samoa	H
Foreign harvest of local stocks of sea turtles	H
New industries for coral resources	M
Increased UV radiation due to ozone depletion	M
<b>(c) Management issues</b>	
Education needed about reef conservation	H
Lack of enforcement	H
Jurisdictional problems	H
Breakdown of traditional values	H





## 2. How should reef "health" be monitored?

The workshop recommended the following actions for research and monitoring of reef health:

- Prepare a 'Status of the Reef' document about current reef conditions.
- Conduct comprehensive assessment of reef ecosystem at intervals of 3-5 years. This will require scientific expertise that is not usually available in local agencies.
- Local agencies should conduct a subset of key variables on a more frequent time scale (quarterly or yearly). The subset includes: belt transects for a select list of fish species, line transects for % coral cover and growth forms, and standard water quality data.
- Conduct cause/effect research, as needed.
- Include an educational component.

These points have been incorporated into the five year plan.

## 3. How much impact does local water quality have on reef resources?

Industrial development and population growth have caused many environmental stresses in Pago Pago Harbor and other watersheds. Port activities, ship repairing, oil terminal and tank farm development, military deployment, cannery discharges, uncontrolled and inadequately treated human waste disposal, agricultural activities and residential development, and solid waste dumping have all had a negative impact on the ecosystem of Pago Pago Harbor and other watersheds. Corrective actions either through better Standard Operation Procedures (SOP), Best Management Practices (BMP), requirement of waste water treatment services, expansion of sewage treatment, solid waste collection, etc., have resulted in dramatic improvement in water quality in the harbor.

A review of water quality data and site visits to the harbor convinced the workshop panel that early signs of recovery were evident. Data collected from 1982 through 1997 shows EPA's American Samoa Water Quality Standards (ASWQS) have been achieved in deep water sections of the Pago Harbor for nutrients and some other measurements. And, at several points in the outer harbor, new coral recruitments were observed.

Other evidence indicates that stressful conditions still exist in the harbor. The existing fish consumption ban in the inner harbor highlights that a toxicity problem persists. The workshop panel also observed the harbor deluged with turbid streamflow and trash during a storm event. The known freshwater ASWQS violations in Pago Pago Harbor (and other watersheds) points to a continued source of burden to coastal ecosystems. Storm-related elevation in bacterial indicator levels puts at risk the swimming public not only in Pago Pago Harbor but at many bathing areas around American Samoa. Further, current ASWQS for the harbor should not remain static, but be continually improved.

The following actions were recommended for research and monitoring of water quality with emphasis on Pago Pago Harbor, but including the rest of the islands.

- Regular monitoring of 18 major bays.
- Complete the toxicity studies in Pago Pago Harbor and island-wide.
- Conduct shoreline sanitary survey in harbor area.
- Procure data loggers and deploy at key sites.
- Use monitoring to determine water quality "hot spots".
- Assess impact of sediment/erosion to reefs.
- Determine impact of piggeries on reef water quality.
- Examine impact of nutrients on reef flats (Nu'uuli vs. the rest of Tutuila).
- Determine nearshore ocean currents.
- Further determination of pollutant sources within the harbor and other watersheds.
- Expansion of water monitoring program to determine the dynamics of water quality parameters in the harbor watershed.
- Better enforcement of existing land-use activities to prevent conditions from deteriorating in all Tutuila watersheds.
- More frequent monitoring of public swimming areas to ensure their compliance with safe bacterial levels.

#### **The Advisory Group's resolution on water quality**

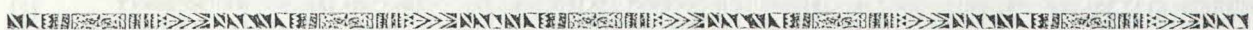
*Resolved: Despite welcome improvements in water quality in Pago Pago Bay, the harbor still does not support coral reef recovery, safe swimming, or fish that are safe to eat. A step-wise recovery plan should be implemented that builds upon the progress made to date.*

#### **4. Integrated Island Ecosystem Management**

The Advisory Group also felt that it was useful to re-emphasize that land-based activities can have a direct impact on the coral reef environment. Some local issues are:

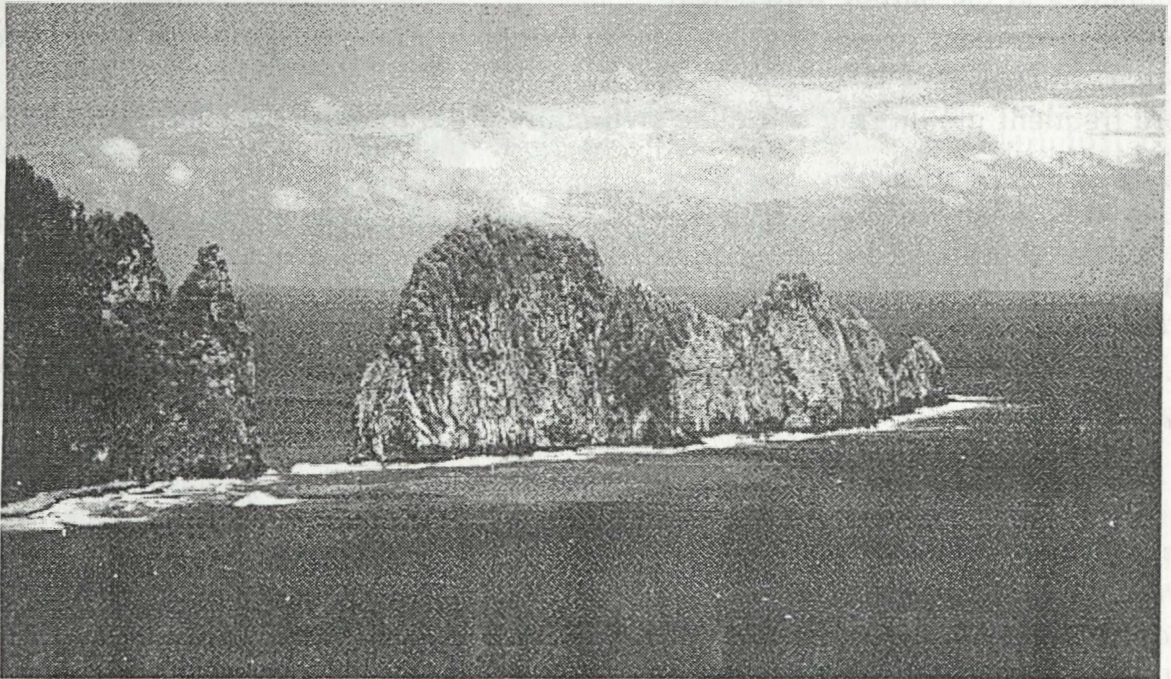
- sedimentation due to improper land development and use, mining and tree removal;
- poor water quality due to input of nutrients from sewage disposal, agricultural runoff and piggeries;
- alteration of the shoreline by sandmining, seawalls, jetties, filling and dredging;
- pollution from trash, chemicals and petroleum products.

All of these problems will continue to magnify as the population grows. The pressure for better roads, more shoreline development, more houses, more forest lost to plantations, increased number of automobiles, etc., will continue. A balance reflected in an integrated land and water management regime is needed to preserve both the resources of the land and those of the sea.

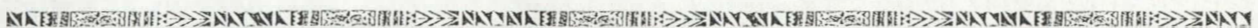


**The Advisory Group further resolved**

*Coral reefs surrounding our islands can be directly damaged by land-based activities, and so land and sea environments cannot be viewed as being separate from each other. The American Samoa Coral Reef Advisory Group strongly advocates that all land developments in the Territory be fully assessed for their potential impact to coastal waters.*



*Pola Rocks in the National Park of American Samoa*



## FRAMEWORK FOR FIVE-YEAR PLAN

Components and needs that feed into the 5-year plan are presented below. Table 1 presents proposed and ongoing projects and indicates the funding needs.

### 1. Reef Fisheries Assessment

- Monitor complete harvest of reef resources annually.

#### *Tutuila*

- a. restart subsistence creel surveys along south coast (i.e., the Wass survey area so that trends from earlier years can be determined). (dmwr)
- b. assess subsistence fishery in National Park (npsa)
- c. conduct market surveys (total catch) of the commercial coral reef fishery; if store invoices are used, should assess compliance with reporting requirements. (dmwr)
- d. conduct fishery assessments for key species based on age analysis (dmwr)  
-age validation studies needed to verify fisheries analyses
- e. examine Fagasa Bay study to determine why it is not recovering

#### *Manu'a*

- f. monitor subsistence fisheries (dmwr)
- g. assess subsistence fishery in National Park (npsa)

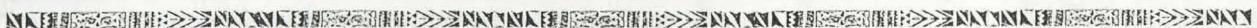
### 2. Reef Management

- Review all coastal developments. Coastal development is one of the most serious impacts on coral reef health. Permits are required for all development proposals and most go through the Project Notification and Review System.
- Review adequacy all fishing regulations. Conduct village meetings to determine what kinds of fishing and fishing gears should be 'allowable'. In this way, villagers would have a real voice in determining fishing regulations and it may result in increased conservation of coastal resources at the village level. It would also simplify fishing regulations which would not have to be re-written whenever a new fishing gear was introduced to the Territory.
- Initiate community-based management to achieve sustainable harvests on a local basis. Educate and train local villagers to monitor and manage their coral reef resources.
  - a. Alofao village pilot study
  - b. expand to all villages in territory
- Establish a network of Marine Protected Areas. In addition to small MPA's that might be established by communities (see above), assess need for additional large MPA's (managed by agencies). Are additional areas needed, or just better enforcement of existing MPA's?

- Funding to participate at relevant coral reef meetings. Because of the distances involved and the inadequate funding levels, it is difficult for local people to attend meetings, trainings and workshops. Additional funding earmarked for travel purposes is needed.
- More enforcement of all environmental regulations is needed. Additional officers, training and equipment are necessary to adequately enforce all environmental regulations, particularly those impacting coral reef health.

### 3. Reef Health

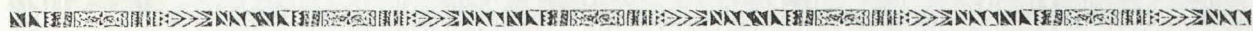
- Prepare a 'Status of the Reef' document about local reef conditions. This booklet will be used to educate decisionmakers and the local and off-island public.
- Conduct comprehensive assessment of reef ecosystem at intervals of 3-5 years.
  - a. conduct fish/coral survey in 2000 (some funding available). This is a follow-up on the initial survey done in 1995.
  - b. continue Fagatele Bay long-term monitoring. This project has been funded on a three year cycle by the National Marine Sanctuary.
- Conduct a subset of key variables on a more frequent time scale by local agencies.
  - a. annual surveys of percent coral and twice yearly surveys of selected fishes around Tutuila and Manu'a.
- Projects
  - a. re-establish giant clams on reef. Re-establishing overfished clams could supply a limited amount for subsistence use and augment dwindling populations.
  - b. examine status of endangered sea turtles; hawksbill migration study
  - c. reef mapping; detailed maps are necessary for informed management decision-making.
  - d. crown-of-thorns response plan for Special Management Area (Ofu lagoon) in National Park of American Samoa.
  - e. promote studies in Manu`a Islands by creating and equipping a field office there
  - f. enhance teaching lab facilities on Tutuila; put in a salt water pipeline to the American Samoa Community College Le Vai Moana Marine Laboratory.
  - g. resource inventories (non-fisheries resources)
- Training and education component.
  - a. travel to meetings for staff; see above.
  - b. coral identification workshop to provide training in identification of corals for management resource surveys.





#### 4. Water Quality

- Conduct monitoring projects in Pago Pago Harbor
  - a. public safety monitoring: expand the monthly bacteria monitoring in swimming areas, including Faga`alu, Utulei, Pago boat ramp, Leloaloe and Aua.
  - b. conduct a shoreline sanitary survey: biannual or annual walk-through inspection of the harbor shoreline and streams up to the high tide line.
  - c. begin stream monitoring for non-point source pollution in the harbor: quarterly monitoring for nutrients, suspended solids, dissolved oxygen metals, and turbidity for one year. Sampling should take place at the tide line and at a point in the stream above all development. Sampling should be done during two storm events and two dry periods
  - d. monitor the water column: continue monitoring at deep water stations in the harbor, as performed by the NPDES permittees.
- Island-wide ocean monitoring
  - a. continue quarterly ambient ocean monitoring program for two years to establish baseline data, afterwards once per year. Obtain data during storm events and include nearshore stations. Include multi-parameter data loggers.
  - b. conduct a water quality project in Pala Lagoon: monitor (quarterly for one year) water for nutrients, the usual water quality parameters, and targeted, tiered measurements of toxic pollutants based on previous studies.
- Toxicity studies
  - a. Complete tier II study: revisit historical studies of toxic compounds in fish, shellfish and sediments in Pago Harbor and other coastal areas noted to be of concern. Human health risk assessments would be necessary for any significant findings.
  - b. conduct a toxicity source assessment: review sources of toxicity to the harbor and other areas for their contribution to the problem. Determine data needs, collect data and prepare a report on findings.
  - c. conduct an assessment of consumer health as related to fisheries: complete testing of humans who frequently consume fish presumed to be contaminated.
- Research
  - a. conduct an integrated stream/coast study using the watershed approach. At two locations, perhaps Fagasa and Leone, conduct monthly monitoring for at least one year of stream and nearshore reef habitats. The stream sampling component will be comprise turbidity, TSS, temp, nutrients, and DO. An important aspect of this project will be to determine the major sources of sedimentation along the reach of the streams. This will be accomplished by targeting sampling locations to get representative data above all development, below plantations, and below village development. In order to help determine the effects of stream water quality on the reef ecosystem, this project will include near-shore monitoring for nutrients, chlorophyll a, temperature,



salinity, sediment loading using sediment traps, coupled with stream and coral reef ecosystem surveys.

- b. conduct an erosion and sedimentation study to identify sources and final destinations. Determine the primary source of erosion and sedimentation on the reef, including analyses of impacts to key biological resources.
- c. develop sediment criteria for local coral reefs, and determine controls and specifications for best management practices.

## 5. Education

- Establish a Governor's Task Force on population. The rapid increase of the human population in the Territory is probably the most serious environmental threat faced by the Territory
- Enhance the marine science component of the Feleti Barstow library; purchase coral reef related books, journals and other resources for the new library.
- Conduct programs for marine awareness and education
  - a. Envirobus: a bus with an environmental education theme would be an excellent way to take the message to the villages.
  - b. information boards: posted in public places highlighting coral reef issues
  - c. conduct workshops and seminars on coral reef issues
- Produce products to support marine awareness and education programs
  - a. coral reef videos
  - b. information materials
- Sea turtle public awareness programs. Sea turtles have historically been harvested for food in Samoa, but few remain today due to overharvest and habitat loss.
- Support American Samoa Power Authority's (ASPA) Erase Litter project

## 6. Enforcement

- Support and increase enforcement of existing regulations.
- Increase enforcement capacity in local agencies.

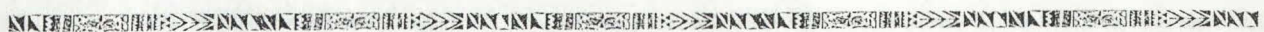
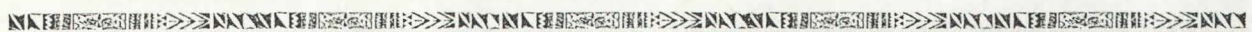


Table 1. 5-year plan for coral reef research and monitoring in American Samoa.

(f = funded, u = presently unfunded)

Projects	PROJECT YEARS					Lead agency
	FY00	FY01	FY02	FY03	FY04	
<b>REEF FISHERIES</b>						
Monitor subsistence fishery						
a. Tutuila (Wass survey area)	f	f	f	f	f	dmwr
b. Ofu, Olosega, Ta'u	f	f	f	f	f	dmwr
c. National Park areas	u	u	u	u		nps
Monitor total market fishery	f	f	f	f	f	dmwr
Stock assessment of key species	f	f	f	f	f	dmwr
Age validation studies	f	f	f			dmwr
Inventory harvested invertebrates		u	u			dmwr
<b>REEF MANAGEMENT</b>						
American Samoa Marine Laboratory	u	u	u	u	u	advisory group
Coral Reef Program Coordinator	u	u	u	u	u	advisory group
Review all coastal developments	f	f	f	f	f	pnrs
Review all fisheries regulations	u	u			u	dmwr
Improve enforcement	u	u	u	u	u	dmwr
Meeting participation (travel)	u	u	u	u	u	advisory group
Establish marine protected areas						
a. community-based sites						
- Alofao pilot	f	f				dmwr
- Territory-wide villages			f	f	f	dmwr
b. MPA network	u	u	u	u	u	advisory group
<b>REEF HEALTH</b>						
Prepare 'Status of Reefs'	f					ascc/epa
Reef mapping		u				advisory group
Fagatele long-term surveys		f			f	doc
Expert fish/coral surveys	f/u			u		dmwr
Monitor National Park reefs	u	u	u	u	u	nps
Local fish/coral surveys	u	u	u	u	u	dmwr
Crown-thorns plan (Ofu lagoon)		u				nps
Coral identification training	u					dmwr
Monitor Vaoto Marine Park	u	u	u	u	u	dmwr
Re-establish giant clams on reefs	u	u	u	u		dmwr/nps
Facility/equipment for Manu'a research	u	u				nps
College marine program enhancement	u	u	u			ascc
Indicator organisms for pollution		u	u			dmwr





## LITERATURE CITED

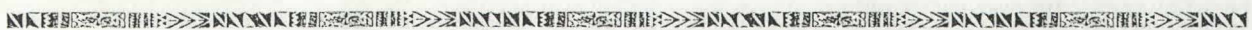
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## ACKNOWLEDGEMENTS

ASCRAAG would like to acknowledge and thank the following people for their assistance during the workshop: Peter Rappa facilitated the meetings; Charles Birkeland, Alison Green, Alan Friedlander, Jon Brodie and Wendy Wiltse provided technical and scientific expertise; Jackie Navarro, Punipua Lagai-Nagalapadi, Eileen Malae and Mark Kneubuhl assisted in recording.

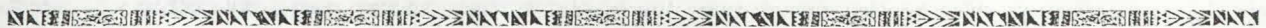
*Woodblock prints by Sven Ortquist, traditional Samoan carver*

This workshop and document were funded by Department of Interior  
technical assistance grant #GEN-137.



## APPENDIX 1. List of Workshop Participants

Dr. Charles Birkeland, University of Guam  
Wendy Wiltse, Environmental Protection Agency, Hawaii  
Dr. Jon Brodie, Great Barrier Reef Marine Park Authority, Townsville, Australia  
Dr. Alison Green, Great Barrier Reef Marine Park Authority, Townsville, Australia  
Dr. Alan Friedlander, Oceanic Institute, Hawaii  
Dr. Paul Gabrielson, Visiting Researcher  
Ufagafa Ray Tulafono, Director, Department of Marine and Wildlife Resources  
Togipa Tausaga, Director, American Samoa Environmental Protection Agency  
Peter Rappa, Sea Grant, Hawaii  
Dr. Peter Craig, National Park of American Samoa  
Sheila Wiegman, American Samoa Environmental Protection Agency  
Nancy Daschbach, Fagatele Bay National Marine Sanctuary  
Mark Barath, American Samoa Environmental Protection Agency  
Catherine Adler, Samoa News  
Jennifer Aicher, American Samoa Community College  
Flinn Curren, Department of Marine and Wildlife Resources  
Francis Huber, American Samoa Environmental Protection Agency  
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Bronwyn Mitchell, American Samoa Coastal Management Program  
Marie-Claude Filteau, Department of Marine and Wildlife Resources  
Punipua Lagai-Nagalapadi, Fagatele Bay National Marine Sanctuary  
Mark Kneubuhl  
Jackie Navarro  
Eileen Malae, Americorps  
Tisa Fa'amuli, ecotourism entrepreneur  
Candyman  
Gi Malala  
Tony Langkilde







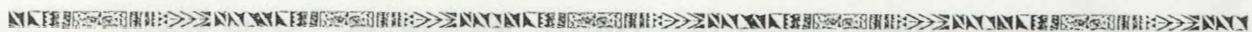


completed. This will be addressed via the TMDL activities ASEPA will undertake via the Clean Water Action Plan.

**Pollution Prevention** — recent improvements in collection of solid waste by ASPA will decrease the contribution of solid waste to the streams and nearshore waters. Better handling of hazardous materials and decrease in the generation of hazardous waste will assist to decrease toxic substances released to the environment. This program is being developed.

**Erosion and Sediment Study** — ASEPA will be utilizing contractor assistance to complete a study on erosion and sediment loading and sources building upon two past efforts and utilizing data obtained over the last 30 years.

Sheila Wiegman  
American Samoa Environmental Protection Agency





## APPENDIX 4. Background: Coral data sources

Two types of quantitative coral data have been collected in American Samoa: multiple-year monitoring programs on Tutuila Island and 1-time snapshot surveys on all 7 islands during various years. Qualitative surveys of species presence are not included here.

**1. Tutuila Island.** The principal monitoring program in the territory is that by Birkeland et al., primarily in Fagatele Bay (6 transects) but also at 14 other sites around the island. Surveys were conducted in 1985, 1988, 1995, 1998 (and some types of data in 1982). Coral communities were surveyed by the point-quarter method. Their most recent report on corals provides overviews of COT and hurricane impacts but little data analysis for the 1995 survey and the 1998 report is not available yet. These surveys also include macro-benthos, algae and fish. A second multiple-year survey is the Aua transect in Pago Harbor (surveyed in 1917, 1973, 1995) which documented decreases in coral species richness and abundance due to pollution, etc. (Green et al. 1997).

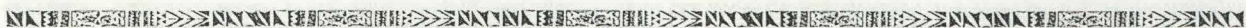
Quantitative snapshot surveys were made by Mundy (1996) in 1995 at 21 sites for coral species richness, colony size, density and % cover. Methods: 5 replicated 20m x 0.5m belt transects on the reef slope at 10-m depth. At most of the same sites, Green (1996) provided a second estimate of % coral cover and habitat characteristics at the 10-m depth, as well as at 3 depths at selected sites. An additional 15 sites were surveyed in the National Park for coral species, % cover by form, and size by genera (Green and Hunter 1998). Methods: the point method along 50-m transects at the 10-m depth.

**2. Manu'a islands (Ofu, Olosega, Ta'u).** Hunter et al. (1993) provide a detailed snapshot of Ofu in 1992, with emphasis on Ofu lagoon. Methods: corals (50-m line transect, and random points along three 10-m video transects), fish (replicated stationary counts in a 10-m cylinder), macro-inverts (5x50-m belt transect) and algae (line transect). Coral data were collected in 1995 but remain unanalyzed.

Green (1986) and Mundy (1986) provide a snapshot at 8 additional sites in 1995.

**3. Rose Atoll.** A snapshot survey of % coral cover and growth forms was conducted at 4 sites and 3 depths in 1994-95 (Green 1996). There was also a flurry of miscellaneous surveys by USFWS after the longliner grounding at Rose in 1993.

**4. Swains.** A snapshot survey of % coral cover and growth forms was conducted at 2 sites in 1996 (Green 1996).



## APPENDIX 5. Background: Algae

It is not an understatement to say that without algae there would be no “coral” reefs. Algae on coral reefs can be grouped in three categories, each of which is essential to a healthy coral reef. Algae occur as microscopic endosymbionts living and photosynthesizing within living coral tissue. It has been estimated that up to 25% of the calcium carbonate deposition by corals is supported by the productivity of the algal endosymbionts. The phenomenon known as “coral bleaching”, where algal endosymbionts are expelled from coral tissue, currently is being studied extensively, due to the proposed relationship between warming of tropical ocean waters and coral bleaching. Algae also occur as “pink rocks” on coral reefs. These are encrusting coralline red algae that frequently are the major structural component of the reef habitat. The importance of this group of algae to the formation and maintenance of “coral” reefs has been known for over 75 years (Setchell 1924 and references therein), but little research has been done on the physiology, growth rates or effects of anthropogenic activity on these species. The third major group of algae on coral reefs are the “turf algae”, composed of numerous species of fleshy and calcified green, red and brown algae and cyanobacteria (blue-green algae). Only in the last 15 years, have scientists begun to understand the importance of this group of algae to primary productivity on the reef, as a food source for reef fishes and as a habitat for small reef invertebrates.

Knowledge of all of these groups of algae in American Samoa is very limited. I know of no studies done locally on the microscopic endosymbionts of corals. The larger algae, including both the encrusting coralline red algae and the fleshy algae, were first documented by Setchell (1924), who recorded over 80 species from Tutuila. More recent studies by Birkeland et al. (1987, 1995) listed 57 and 26 species of algae, respectively, but these latter studies looked only at subtidal, coral reef habitats.

Because algae are so important to the maintenance of a coral reef ecosystem and because so little is known about these organisms in American Samoa, studies should be initiated and maintained to assess these algal groups.

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## APPENDIX 6. Background: Coastal Development

The American Samoa Coastal Management Program (ASCMP), operating in the Department of Commerce since 1980, has developed regulatory and community-based approaches to protect the coastal zone. Some examples of ASCMP's mandates are: wetlands management, mitigation of coastal hazards, non-point source pollution and shoreline development. ASCMP also administers the Project Notification & Review System (PNRS), which is a board of 8 public agencies with environmental concerns, who review land use permit applications, issue permits, and monitor compliance of all developments.

**General Impact Activities.** Given the small size of the Territory's islands, the entire Territory is considered a Coastal Zone -- any activity conducted on land is likely to impact coastal waters. Types of activities range from littering, stream degradation, and filling wetland areas for residential/commercial use, to major capital and infrastructure improvement projects such road construction, utility placement, transportation facilities, and shoreline protection.

**Threats.** The number of development activities has increased in recent years. Transportation ports have been modified; more shoreline revetment walls have been placed; utilities have been buried underground, primarily along the road and shoreline. All these activities cause surface run off, soil erosion, sedimentation, and some destruction of reef ecosystems. Wetland loss continues at an average rate of 4.5 acres annually as the wetlands are developed for residential/commercial use and dumpsites (Biosystem Analysis Inc. 1992).

**Trends.** Two socioeconomic trends affect local coastal environments: (1) population growth, and (2) economic activity. The population is increasing rapidly at 3.7% per annum, one of the highest growth rates in the world. This generates more development activities, which occur primarily along the coast due to limited developable land on our steep, mountainous islands. Within the period 1990-95, 38 permit applications were received for shoreline development (e.g., government and private proposals for seawalls, residential construction). With increasing development pressures, people are less inclined to comply with setback from streams, wetlands or coastal hazard areas. Additionally, limitations of flat land on Tutuila Island cause people to build houses and plantations on steep mountain slopes and other unfavorable areas. Economic activities also have a direct impact on the coastal areas. Two tuna companies and other industrial activities continue to stress the harbor environment.

The PNRS safety valve and environmental review process is a critical mechanism we use to manage development activities and their impacts to coastal waters in the Territory.

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American Samoa Coastal Management Program

**APPENDIX 7. List of reports that document coral reef overfishing in American Samoa and/or recommend that management action is needed to protect local reef resources.**

Ponwith, B. 1991. The shoreline fishery of American Samoa: a 12-year comparison. DMWR Biological Report Series No. 23. 51p.

-describes a major reduction (54%) in catches of reef fish.

Tuato'o, N. et al. 1991. 1993. Status of sea turtles in American Samoa. Pacific Science 47:215-221. Also DMWR Biological Report Series No. 24.

-describes the endangered status of sea turtles due to overharvest and habitat loss.

Craig, P., B. Ponwith, F. Aitaoto & D. Hamm. 1993. The commercial, subsistence, and recreational fisheries of American Samoa. Marine Fisheries Review. 55:109-116. Also DMWR Biological Report Series No. 44

-describes the decline in local subsistence fishery

Saucerman, S. 1994. The inshore fishery of American Samoa, 1991 to 1993. DMWR Biological Report Series No. 55. 35p.

-describes decline in local subsistence fishery

Craig, P. 1994. Workshop to identify important fish issues in American Samoa for FY95-FY99. DMWR Biological Report Series No. 57. 19p.

-identifies overfishing as a high priority issue for DMWR

Craig, P., A. Green & S. Saucerman. 1995. Coral reef troubles in American Samoa. South Pacific Commission, Fisheries Newsletter. 72:33-34. Also DMWR Biol. Report Series No. 66.

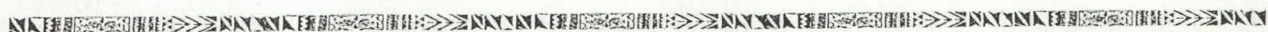
-describes overfishing as key problem in American Samoa

Craig, P. 1995. Are tropical nearshore fisheries manageable in view of projected population increases? 6p. Biological Paper 1. Proceedings South Pacific Commission-Forum Fisheries Agency Regional Inshore Management Workshop (New Caledonia), June 1995. Also DMWR Biological Report Series No. 71.

- describes overfishing as key problem in American Samoa

Tuilagi F., & A. Green. 1995. Community perception of changes in coral reef fisheries in American Samoa. 16p. Biological Paper 22. Proceed. South Pacific Commission-Forum Fisheries Agency Regional Inshore Management Workshop (New Caledonia), June 1995. Also DMWR Biological Report Series No. 72.

-100 village elders and fishermen in 50 of the 64 villages on Tutuila and Aunu'u note declines in fish abundance: 100% of those interviewed felt that faisua (giant clams) were less abundant and 70% felt that fish were less abundant.



Saucerman, S. June 1995. Assessing the management needs of a coral reef fishery in decline. 1995. 26p. Biological Paper 18. Proceed of South Pacific Commission-Forum Fisheries Agency Regional Inshore Management Workshop (New Caledonia), Also DMWR Biological Report Series No. 73.

-describes declines in subsistence catch

Saucerman, S. 1995. The inshore fishery of American Samoa, 1991-1994. DMWR Biological Report Series No. 77. 34p.

-describes continued low catches and rise of commercial scuba fishing where catches are sold to local markets

Eckert, S., K. Eckert, G. Balazs, P. Craig, J. Richardson, & J. Maragos. 1995. Recovery plan for U.S. Pacific populations of the green turtle (*Chelonia mydas*). US Fish & Wildlife Service & National Marine Fish. Service. Pacific sea turtle recovery team. Also DMWR Biological Report Series No. 83.

-documents severe reduction in green sea turtle populations

Eckert, S. et al. 1995. Recovery plan for U.S. Pacific populations of the hawksbill turtle (*Eretmochelys imbricata*). US Fish & Wildlife Service & National Marine Fisheries Service. Pacific sea turtle recovery team. Also DMWR Biol. Report Series No. 84.

-documents severe reduction in hawksbill sea turtle populations

Green, A. 1996. Status of coral reefs of the Samoan archipelago. DMWR Biol. Rep. Ser. 125p.

-identifies need for 'marine protected areas' in American Samoa

Craig P., H. Choat, L. Axe & S. Saucerman. 1997. Population biology and harvest of the coral reef surgeonfish (*Acanthurus lineatus*) in American Samoa. Fishery Bulletin 95:680-693. Also DMWR Biological Report Series No. 86.

-heavy fishing pressure on alogo surgeonfish may be impacting local populations

Page, M. 1998. The biology, community structure, growth and artisanal catch of parrotfishes of American Samoa. DMWR Biological Report Series. 87p.

-*fuga* (parrotfish) in American Samoa are being overfished

Green, A., P. Craig 1999. Patterns of distribution, abundance, size frequency and mortality of giant clams (*Tridacna maxima*) at Rose Atoll National Wildlife Refuge and elsewhere in the Samoan archipelago. Coral Reefs, in press. Also DMWR Biological Report Series No. 85. 18p.

-*faisua* (giant clams) are seriously overfished in American Samoa

Green, A. 1999. Fish community. 1999. In C. Birkeland (ed.) Fagatele Bay coral reef study. Prepared for Fagatele Bay National Marine Sanctuary.

-discusses the low abundance of fish that are typically harvested, and low abundance of large fish in general, both indicators of overfishing.

Craig, P., S. Saucerman, S. Wiegman. In press. Central South Pacific Ocean (American Samoa), Chapter X, 1999. In Sheppard (ed.) Seas at the Millennium: an environmental evaluation.

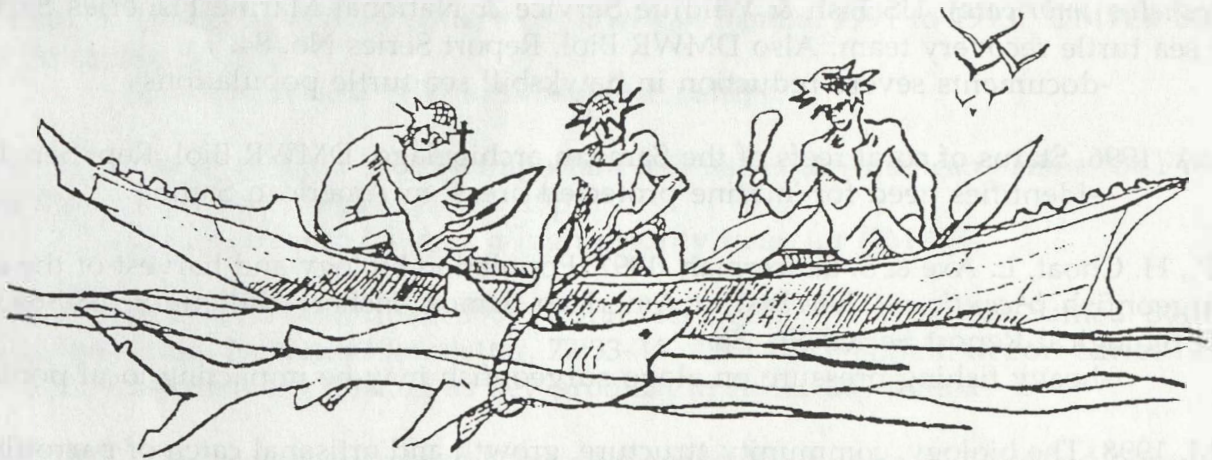
-review article reiterates overfishing of coral reef fishes in American Samoa.

1998. A preliminary survey of the coral reef resources in the Tutuila Unit of the National Park of American Samoa. Prepared for National Park of American Samoa.

-detailed survey found few giant clams or large fishes, and fish were wary of divers, all indicators of increased fishing pressure.

Green, A. 1999. An assessment of the status of the coral reef resources, and their patterns of use, in the U.S. Pacific Islands. Prepared for Western Pacific Regional Fisheries Management Council. 275p.

-discusses overharvest of giant clams.



Sven Ortquist

