Samoan Archipelago Marine Alien Species Workshop

March 18 & 19, 2008

Pago Pago, American Samoa

This document is for the purpose of providing background to participants prior to the scheduled workshop. The agenda is a draft and titles of presentations and speakers might change before date of event.

Samoan Archipelago Marine Alien Species Workshop

March 18 & 19, 2008

Fagatele Bay National Marine Sanctuary Conference Room

Pago Pago, American Samoa

Sponsored by: National Marine Sanctuaries Program, Amercian Samoa Division of Marine and Wildlife Resources, and Hawaii Institute of Marine Biology

AGENDA

Tuesday March 18, 2008

9:00 AM	Welcome and Introductions	S. Godwin
9:15 AM	An Overview of Marine Alien Species in American Samoa and Transport Mechanisms	S. Godwin
10:15 AM	Break and Discussion	
10:30 AM	Marine Alien Species Survey of Apia, Samoa	P. Skelton
11:00 AM	Pacific Invasives Learning Network (PILN)	J. Key
11:30 AM - ?	Discussion and Ajourn	S. Godwin

Wednesday March 19, 2008

9:00 AM	Opening Statement on Goals	S. Godwin
9:15 AM	Management of Marine Alien Species for Remote Marine Protected Areas of Hawaii	S. Godwin
9:45 AM	Shipping-related Introduced Marine Pests in the Pacific Islands: A Regional Strategy	A. Talouli
10:15 AM	Marine Alien Species Program for the State of Hawaii: Perspectives, Actions and Strategies	J. Leonard
10:45 AM	Break and Discussion	
11:00 AM	Samoan Archipelago Marine Resource Management Priorities: Issues and Collaboration	G. Brighouse/D. Harper
11:30 AM	Break and Discussion	
11:45 AM-?	Open Discussion	

Presenters

Gene Brighouse - Program Manager, Coastal Management Program, American Samoa Dept. of Commerce, Pago Pago, AS

Scott Godwin - Research Specialist, Hawaii Institute of Marine Biology, Kaneohe, Hawaii. Workshop Facilitator

Doug Harper - Coastal Management Program, American Samoa Dept. of Commerce, Pago Pago, AS

Jill Key - Coordinator, Pacific Invasives Learning Network, South Pacific Regional Environmental Program, Apia, Samoa

Jason Leonard - Ballast Water and Hull Fouling Coordinator, Dept of Land and Nat. Resources-Div. of Aquatic Resources, Honolulu, Hawaii

Posa Skelton - Director of the International Ocean Institute Operational Centre, Townsville, Queensland, Australia

Anthony Talouli - Marine Pollution Officer, South Pacific Environmental Program, Apia, Samoa

Introduction

Marine habitats can be considered robust when dealing with gradual disturbances such as climate change measured on a scale of thousands of years. When disturbances occur over shorter time scales, marine communities can be severely disrupted. Such short time frames and intense disturbances that are relevant to human society and the anthropogenic effects induced on marine habitats. The introduction of non-native marine organisms is one form of anthropogenic change that can cause irreversible alterations to marine communities that has become of great concern.

The alien algae *Kappaphycus* overgrowing coral in Hawaii (J. Smith)

The native species of the marine and terrestrial environments of tropical Pacific islands arrived as natural biological events over a period of millions of years, and through evolution and adaptation evolved into the present communities uniquely associated with these remote archipelagos. The islands of the tropical Pacific are some of the most isolated areas in the world and all of the native plants and animals are derived from the pioneering species that settled through natural mechanisms of dispersal.

The advent of modern human technology has created a means for biological introductions that readily overcome the vast geographical barriers that limited invasion rates. Human activity has greatly accelerated the process of biological change and in many cases new introductions have led to the depletion or extinction of naturally occurring populations.

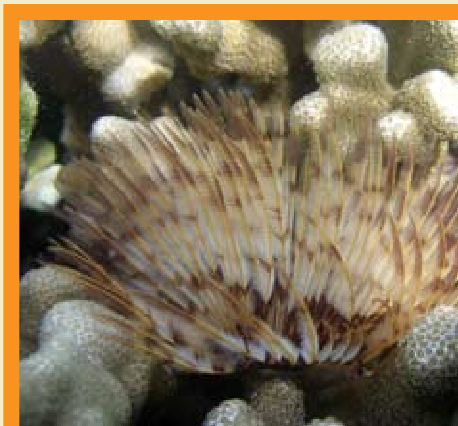
Presently, the world is experiencing great ecological change in the coastal marine environments in every region. These areas that provide fisheries, recreation and aesthetic value are being altered by biological invasions facilitated by anthropogenic mechanisms. These invasions are decreasing biodiversity through the homogenization of distinctly separate biological communities that have evolved over millions of years.

Pacific Examples

Algae: *Acanthophora spicifera*
(J. Smith)

Found throughout tropical areas but introduced unintentionally to Hawaii from Guam in the 1950's. Overgrows corals in Hawaii.

Native Range: Widely distributed in tropics and subtropics



Worm: *Sabellastarte spectabilis*
(S. Godwin)

Introduced into various parts of the Indo-Pacific. Competes for space with coral in Hawaii.

Native Range: Red Sea, Indo-Pacific

Hydroid: *Thyroscyphus frusticosus*
(S.Godwin)

This species is found from the United Kingdom to the Mediterranean and throughout the Indo-Pacific. It is commonly seen associated with with both natural and man-made hard substrates. There is no information on any impacts or effects of its introduction

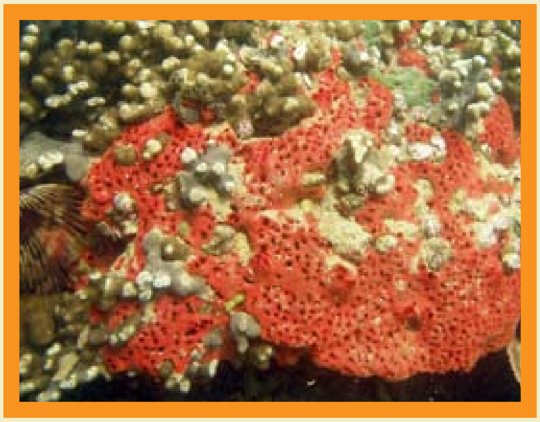
Native Range: Unknown

Algae: *Spatoglossum macrodontum*
(J. Huisman)

Found in Australia, French Polynesia, Hawaii and Samoa. There is no information on any impacts or effects of its introduction. Exhibits invasive behavior in Apia, Samoa

Native Range: Queensland, AUS

Samoa Examples



Sponge: *Mycale* **(S. Godwin)**

Introduced into Hawaii (*M. grandis*) Samoa and Mexico (*Mycale* sp.). Overgrows corals in Kaneohe Bay, Hawaii.

Native Range: Asia and the Australasia-Pacific

Algae: *Caulerpa serrulata* **(biol.tsukba.ac.jp)**

Found in Pago Pago Harbor and Fagatele Bay in Am. Samoa and in Apia, Samoa. Considered cryptogenic

Native Range: Unknown

Bryozoan: *Schizoporella* **(S. Godwin)**

Common fouling organism on surfaces in Pago Pago Harbor. No information on any effects or impacts of its introduction

Native Range: Mediterranean

Tunicate: *Phallusia nigra* **(S. Godwin)**

Found at various Indo-Pacific locations. Common in harbors (such as Pago Pago but has moved into coral reef habitats in Hawaii

Native Range: Tropical Western Atlantic

Polychaete: *Salmcina* **(S. Godwin)**

Common fouling organism on surfaces in Pago Pago Harbor. No information on any effects or impacts of its introduction

Native Range: Unknown

Transport Mechanisms

Intentional Pathways

Aquaculture and Aquarium Trade
Sport and Commercial Fisheries Enhancement
Control of unwanted organisms (biocontrol)
Unknown

Unintentional Pathways

Hull fouling
Ballast water and solid ballast
Aquaculture escapes
Marine debris fouling
Multiple Vectors [eg, accidental release on or with imported commercial products, inside airplane cabins, in soil, and on or with aquarium plants and greenhouse plants

The global transfer of alien species by human activities is recognized as a leading threat to aquatic ecosystems throughout the world. Increased activities associated with the movement of humans and commodities throughout the world have allowed barriers to naturally occurring biological invasions to be overcome more readily. Examples of these activities are maritime vessel operations, live seafood and bait shipments, aquaculture, shipments of commercial and institutional aquarium species, and activities of education and research institutions.
The specifics of some of these mechanisms are covered in this section.

Pago Pago Harbor, American Samoa

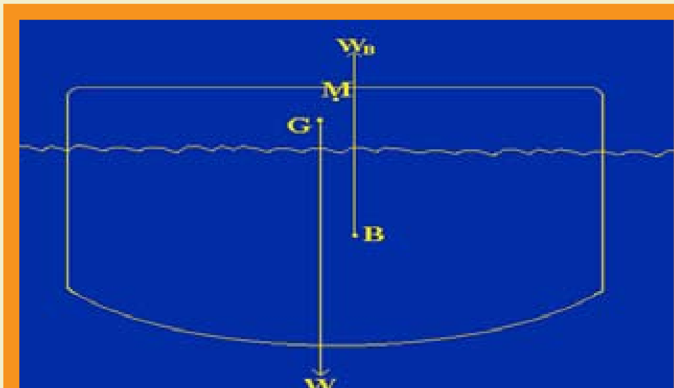
Transport Mechanisms

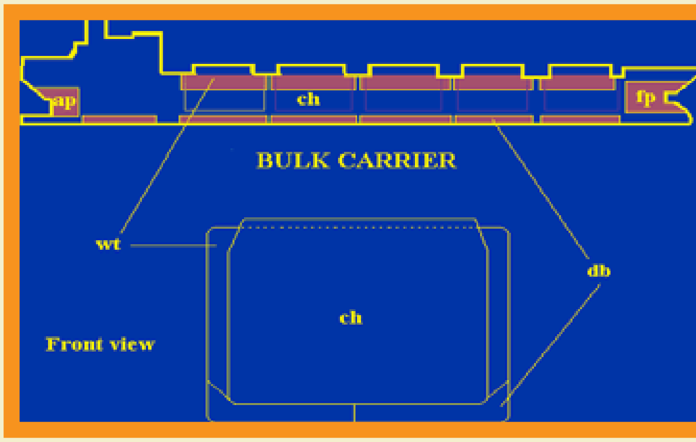
Maritime Vessel Activity: Ballast Water

From the early history of seafaring to the present, ocean-going vessels have needed ballast. All vessels before the middle of the 19th century used solid ballast in the form of sand, rocks, and other heavy materials. As ships became larger it became necessary to design ballast systems into vessels, in the form of dedicated tanks that could be filled with water. The need to use the aquatic environment for a transportation medium in the growing global economy has lead to the increases in vessel size and ballast water volume. This increased ballast water volume combined with faster ship speeds allows the uptake and survival of an increased number of organisms.

Ballast water discharge from commercial vessel (S. Godwin)

Why do vessels need ballast? Ballast is used to provide stability in the absence of, or in addition to, cargo weight. A ship displaces an amount of water that is equal to its own weight. The force of its weight (W) acts downward through its center of gravity (G) and is resisted by an equal buoyant force (WB), which passes upward through the center of buoyancy (B) (see figure below). The point at which these vertical forces are acting is referred to as the metacenter (M). A vessel's initial stability is judged by the height of (M) above (G), so that the lower a vessel stays in the water the more stable it will be. Vessels that are light or empty of cargo will ride higher in the water and therefore be less stable. Ballast water provides this stability through decreasing the metacenter height and limiting the amount of loll side to side.





Transport Mechanisms

Organisms Associated with Ballast Water

Organisms that are associated with marine plankton communities can be pulled into the ballast tanks of vessels during ballasting operations. These organisms are characterized as holoplankton, meroplankton, and tychoplankton. The holoplankton are the species that live entirely in the water column their entire life. Holoplankton are further divided into the phytoplankton, which includes unicellular algae and various bacteria, and the zooplankton. This latter grouping includes small crustaceans, gelatinous species and a variety of other organisms. Meroplankton are the larval forms of marine species that use the water column to feed and disperse before becoming adult organisms. The larvae and eggs of crabs, barnacles, snails, clams, starfish, worms, fish and many other species are present in meroplankton and represent a large part of the biomass of plankton communities. Tychoplankton are species that normally live in bottom communities and become suspended in the water column temporarily. Additionally, adult organisms of animals such as fish and crabs can become entrained in ballast tanks by being in close proximity to seachest intakes or as attached organisms on debris.

Various types of marine larvae found in plankton

Transport Mechanisms

Maritime Vessel Activity: Sediments

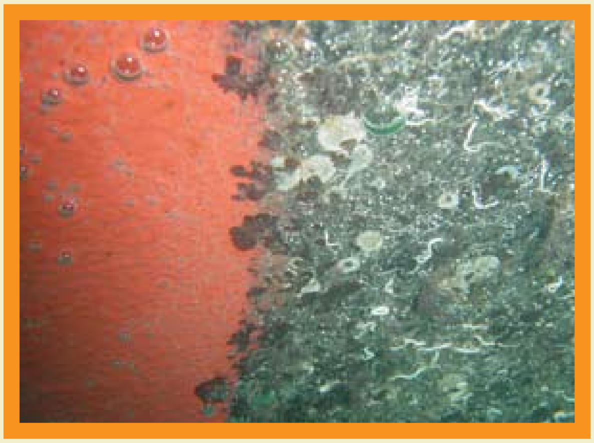
Vessels generally ballast in coastal areas or ports that have a great deal of particulate matter suspended in the water column. This suspended matter is made up of organic and inorganic detritus and plankton. Particles begin to settle and form a sediment layer after ballast water is pumped into tanks. These layers can provide a habitat for sediment-dwelling fauna. A portion of the sediments can become re-suspended and discharged during ballasting and deballasting operations. These ballast water sediments and other sediment accumulations associated with ships can harbor communities of adult organisms that result from the settlement of larvae and eggs from the water column. These organisms can mature and become a source for new larvae that become suspended within the water column of the ballast tank. Another common component of the sediment is the resting stages of phytoplankton species such as dinoflagellates and diatoms, which have the potentai to cause toxic algae blooms.

Sediment on an anchor pulled aboard a commercial cargo vessel (S. Godwin)

Transport Mechanisms

Maritime Vessel Activity: Hull Fouling

The organisms that generally foul vessel hulls are the typical species found in natural marine intertidal and subtidal sessile invertebrate communities. The typical invertebrate organisms associated with marine fouling communities are arthropods (barnacles, amphipods, and crabs), molluscs (mussels, clams, and sea slugs), sponges, bryozoans (moss animals), cnidarians (hydroids and anemones), protozoans, annelids (marine worms), and chordates (sea squirts and fish), as well as macroalgae (seaweed). If these fouling communities become very developed they can also provide microhabitats for mobile organisms such as fish. Initial settlement of fouling organisms tends to be in sheltered areas of the hull, such as sea chest intakes and rudder posts, and develop in areas where anti-fouling coatings have been compromised. Anti-fouling coatings wear off along the bilge keel and weld seams, and are inadequately applied in some cases, all which make the surfaces susceptible to settlement by fouling organisms.



Fouled and clean area of a vessel hull (S.Godwin)

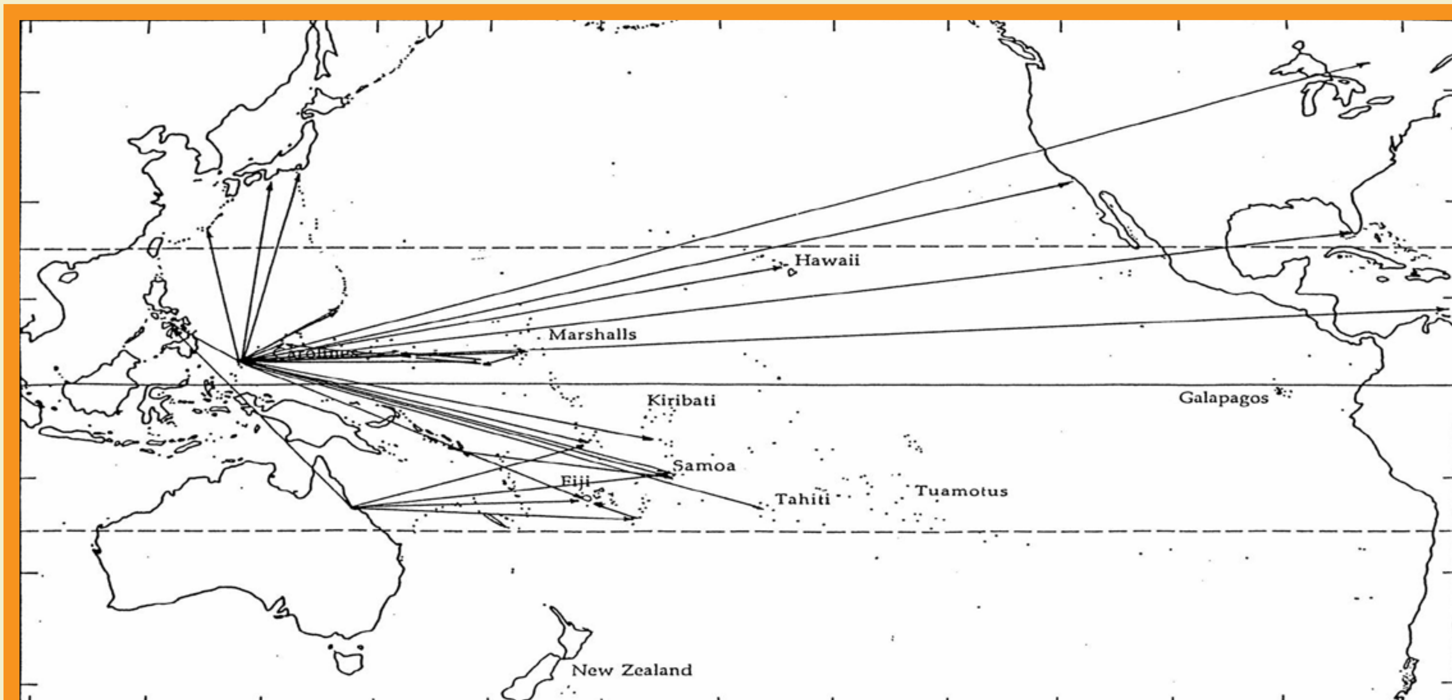
Fouled seawater intake of commercial vessel (S. Godwin)

Fouled prop of commercial vessel (S. Godwin)

Transport Mechanisms

Aquaculture, Aquarium Trade, Live Seafood

The activities that intentionally transport live organisms for the aquarium and live seafood industry are a pathway that is generally overlooked. In most Pacific Islands nations extensive permitting and preventative measures are in place for aquaculture broodstock transfers but not for algae, invertebrates and fish being transported for pet stores and seafood markets. Seafood products are inspected for human pathogens but no consideration is given to pathogens and other symbionts that associated with the primary organism. Studies have shown that the potential is great in areas of high population density and that some non-native species attributed to well-known transport mechanisms may actually be sourced from the live organism trade.



Generalized map of giant clam transfers among Pacific Islands for the purpose of aquaculture and fisheries enhancement. (Eldredge, 1994)

The giant clam *Tridacna squamosa* **(S. Godwin)**

Transport Mechanisms

Aquaculture, Aquarium Trade, Live Seafood (Cont.)

The Lemon Peel Angelfish appeared in the main Hawaiian Islands in the 1990's and can be found in a few locations around the island of Oahu. The appearnace of this species has been attributed to either accidental or intentional introduction by private saltwater aquarium owners.

Lemon Peel Angelfish (K. Stender)

Another case of an aquarium introdcution in Hawaii was the soft coral *Discosoma*, which was introduced intentioanlly in a yacht harbor on the island of Oahu. The State of Hawaii took measures to eradicate this species before it spread to coral reef habitats outsdie of the harbor. This is a popular and valuable species for sale in the aquarium trade and it was intentionally introduced for the economic gain of one individual.

The soft coral *Discosoma* from Oahu, Hawaii before eradication (S. Godwin)

Management

Marine alien species is a management issue that has not dealt with by many agencies focused on marine resources. The first step in any new management issue is to set a realistic goal. The fact that once a marine alien species is established in an environment it is difficult tio eradicate. A realistic goal in this case would be minimize the introduction of marine alien species. A framework of a management strategy based on this goal would be made up of a series of proactive, reactive and post-event measures. These measures would be overseen by a hyptothetical central authority made up of appropriate agencies that focus on the preservation and conservation of marine resources. Marine alien species should be included within an overall framework of issues considered important to marine resource management agencies.