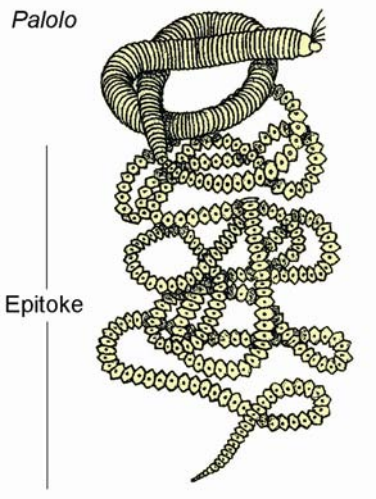
9. Palolo swarming

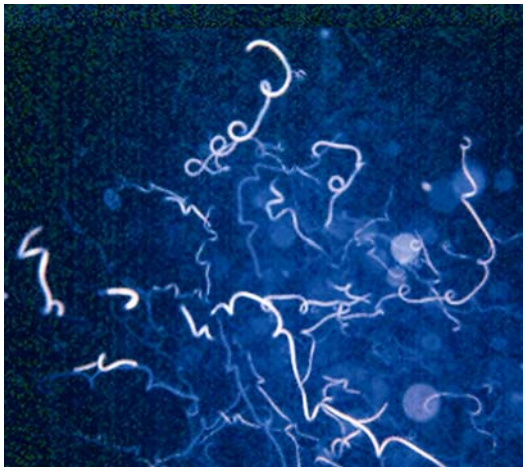
Once or twice a year, *palolo* swarm to the surface of the sea in great numbers. Samoans eagerly await this night and scoop up large amounts of this delicacy along the shoreline with hand nets. This gift from the sea was traditionally greeted with necklaces made from the fragrant *moso'oi* flower and the night of the *palolo* was and still remains a happy time of celebration. The rich taste of *palolo* is enjoyed raw or fried with butter, onions or eggs, or spread on toast.



Palolo is the edible portion of a polychaete worm (*Eunice viridis*) that lives in shallow coral reefs throughout the south central Pacific, although they do not swarm at all of these locations. This phenomenon is well known in Samoa, Rarotonga, Tonga, Fiji, the Solomon Islands and Vanuatu.

Palolo are about 12 inches long and live in burrows dug into the coral pavement on the outer reef flat. They are composed of two distinct sections (see drawing). The front section is the basic segmented polychaete with eyes, mouth, etc., followed by a string of segments called the "epitoke" that contain reproductive gametes colored blue-green (females) or tan (males). Each epitoke segments bear a tiny eyespot that can sense light (that's why islanders are able to use a lantern to attract the *palolo* to their nets).

When it comes time to spawn, *palolo* will back out of their burrows and release the epitoke section from their body. The epitokes then twirl around in the water in vast numbers and look like dancing spaghetti. Around daybreak, the segments dissolve and release the eggs and sperm that they contain. The fertilized eggs hatch into small larvae that drift with the plankton until settling on a coral reef to begin life anew.



Palolo underwater.

The swarming of *palolo* is a classic example of the coordinated mass spawning of a simple marine organism. The worms emerge from their burrows during a specific phase of the moon, but the actual date is a bit complicated. The swarms occur on the evenings of the last quarter moon of spring or early summer. In Samoa, this is seven days after the full moon in October or November. Swarming occurs for two or three consecutive nights with the second night usually having the strongest showing.

Palolo usually appear here in October, but sometimes in November or sometimes during both months. This difference is due to the fact that there are approximately thirteen lunar months in one calendar year and the *palolo* use primarily the moon to time their spawning activity. If instead they always spawned every twelve lunar months, their time of spawning would occur earlier every year. After a few years, they would be spawning in August or July. In order to make up for this difference, the *palolo* will delay spawning in some years to the thirteen lunar month.

The fact that *palolo* adjust their spawning time means that there are other factors beside the moon that determine the time of year they begin to mature and are ready to release their epitokes. Several studies

on this matter have suggested that rising seawater temperatures, tides, weather, moonlight or other biological signals may play a role in starting the maturation and release of the epitokes. Once the swarming begins, the presence of the *palolo* spawn in the water probably stimulates other *palolo* to release their mature epitokes.

Rules For Predicting Emergence. Everyone seems to have their own methods for predicting when the best *palolo* rising will occur. Several natural clues that preceded the *palolo* rising enabled islanders to predict the correct timing for *palolo* swarming. These included the flowering of the *moso'oi* tree, the closing of the *palulu* flower (a morning glory), a strong smell from the reef, brown foamy scum (from coral spawn) on the ocean, toxins occurring in reef fish, and abrupt weather changes or bad weather such as thunderstorms or lightning.

So, will *palolo* swarm seven days after the full moon in October or November? One set of rules used to predict the main night of emergence depends on the calendar date of October's third quarter moon (seven days after October's full moon). If it occurs:

1. From October 1 to 8, *palolo* will not appear until November.

2. From October 8 to 18, *palolo* will not appear in October or the swarming will be weak followed by a stronger appearance in November.

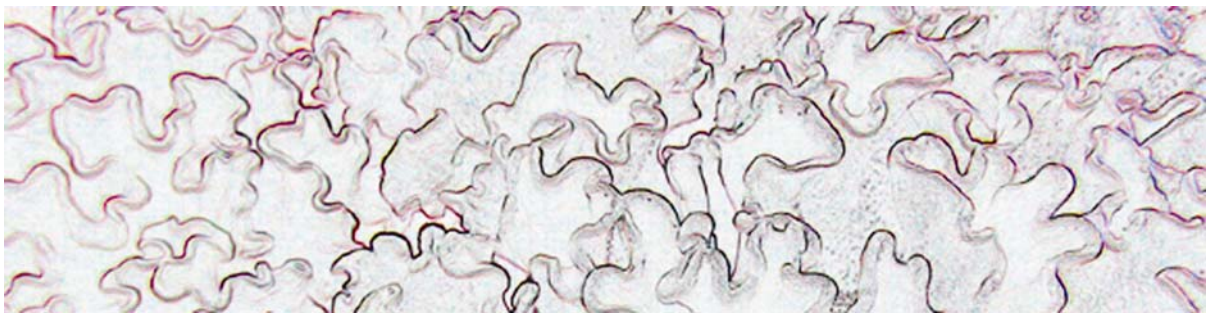
3. From October 19 to November 7, there will be a single, strong swarming centered on this date.

4. From November 8 to 17, there will be a strong appearance on this date, possibly following a weaker swarming during the previous month (see number 2 above).

A good catch of palolo.

To further complicate matters, the actual time of emergence of *palolo* in Samoa differs between islands. They usually appear around 2 am in the Manu'a Islands, 1 am on Tutuila and closer to 4 or 5 am in western Samoa. This difference is somewhat consistent from year to year and cannot be accounted for by difference in tides or moonrise. The difference in tides between islands is far less than one hour and the time of moonrise is only minutes apart.

David Itano, DMWR



10. Giant clams (*faisua*)

It's always a pleasure to see one of these beauties on the reef. Giant clams (*faisua*) are large, colorful and, surprisingly, they are part animal and part "plant". That's because giant clams, like corals, have plant-like cells (zooxanthellae) in their tissues that produce free food for the clams. When a clam opens its shell and spreads out its pretty mantle, it exposes these solar panels of zooxanthellae to the sun to make food, like a plant unfolding its leaves.

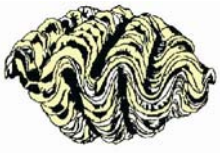
At the same time, the clam also gets some food by drawing water through its siphon and filtering out any tiny food particles (zooplankton). Perhaps that's why giant clams grow so large – they have two very different ways to get food.

We have two native species of giant clams in our local waters, *Tridacna maxima* and *T. squamosa*, which look fairly similar. They grow to about 12-15 inches in shell length, although most found today are smaller because the larger ones have been over-harvested. The largest and most famous species of giant clam (*T. gigas*), which grows as big as a large suitcase, is not native here but has been recently imported. Over the past 15 years, mariculture efforts by DMWR have introduced *T. gigas* and *T. derasa*, and re-introduced *Hippopus hippopus*, a shallow-water species that was formerly present.

Because giant clams need sunlight, they inhabit shallow, clear waters down to about 60 feet deep. They grow very slowly; one local clam was 18 years old. They spawn repeatedly over their life span and release millions of eggs each time they spawn, but most young clams do not survive, so the adults have to live a long time and spawn many times to insure that the population survives. Larval clams swim in the water for about a week, then settle permanently onto the reef to grow.

The clams are a favorite food item throughout the South Pacific and their accessibility in shallow waters and slow growth make them susceptible to overfishing. That is very much the case in American Samoa, where few remain on many of our reefs near populated areas. There is a growing concern that our population of giant clams may be getting too few and far between to spawn successfully.

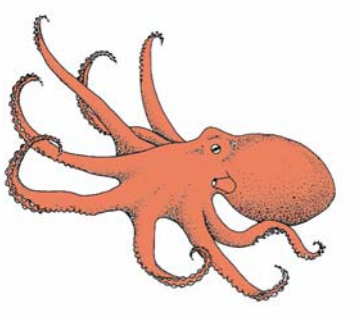
Partly for that reason, there has been an interest in growing these clams in hatcheries to supply markets for food and the aquarium trade. DMWR has operated a hatchery here for many years and tried to encourage local production by supplying small clams for local 'farmers' to grow them on their reefs. That effort has met with limited success for several reasons. Considerable dedication is needed because it may take several years to grow the clams to a commercial size, and the clams have to be protected from poachers and predators. And there are always *fa'alavelave* events that call for contributions of giant clams if anyone has some. In general, giant clam mariculture here has usually supplemented family needs rather than create a commercial business. Periodically, the idea of raising the clams to a small size for the aquarium trade is talked about as a possible market.



P.Craig, NPS

Harvest regulations in American Samoa (in 2005) are: giant clams taken for personal consumption must be at least 6 inches in shell length, or if sold, a license is required and giant clams must be at least 7 inches in shell length and sold with the clam still in its shell.

11. Master of disguise: the octopus (*fe'e*)



Locked in eye contact, we each wondered what the other was going to do. The octopus tried to become invisible by changing its color, but I could still see his eyes, and he knew it. Then a small distracting cloud of inky smoke appeared in his direction and he was gone.

There's no other reef animal quite like the octopus (*fe'e*). Although it looks like a large, unprotected meal for some big fish, it is hardly defenseless. The octopus is the "masters of disguise" for its superb ability to become invisible by changing the color and texture of its skin to match its surroundings. With its good eyesight and well-developed brain, it is probably the most intelligent of all invertebrates. And if camouflage and quick wits don't suffice, it can either squeeze down very small holes or escape by jet propulsion, leaving its calling card, an inky cloud that acts as a decoy or smoke screen to momentarily confuse a predator while the octopus vanishes.

The octopus commonly seen locally is the reef octopus, *Octopus cyanea*, which is mottled red-brown in color with a large spot beneath each eye. It typically weighs 2-3 lbs. It is a mollusk, related to squid, snails, clams, but the octopus lacks a shell and has eight strong arms covered with suckers. It breathes by sucking water into its mantle cavity and over its gills; it then expels the water through its funnel. If threatened by a predator, it can expel this water forcefully, causing it to jet away.

Fe'e feed on crustaceans (crabs, shrimps, lobsters) and mollusks (cowry snails) by creeping up on them. After pouncing on an unsuspecting prey, the octopus holds it tightly with its suckers until it can bite the animal with its parrot-like beak and inject a toxin to paralyze the prey. It may take its meal back to the safety of its den (the reef hole it calls home), and that's why there are often telltale bits of shells around an octopus den. Mating occurs year-round. The female lays her eggs inside her den and cares for them until they hatch. She then dies. When the eggs hatch, out pop miniature octopuses that are dispersed by water currents until they settle back onto the reef.

The octopus is a favorite food of local fishermen who often check particular holes on the reef known to be good den sites for *fe'e*. Octopus are taken by hand or spear and they account for about 5-10% of all the fish and invertebrates harvested on our reefs. The drooping, pale gray octopus we see hung out for sale along the roadside is a ghoulish remnant of this crafty animal.

The octopus is also caught by a traditional lure made of a large cowry shell that resembles a rat *(isumu*). That came about due to an event that happened long ago, as related in the Samoan legend about the octopus and the rat. It all started with a sightseeing canoe trip on the ocean by an owl, a snail and a rat. Their canoe started to sink, so the owl escaped by flying away, the snail sank with the canoe to the bottom of the ocean (*goto uga*), and the rat tried to swim to shore but he had a long way to go. He saw an octopus and called for help. The octopus agreed and swam to shore with the rat on his head. When they got to shore, the rat jumped off and thanked the octopus for saving his life and said that he left a little present on the octopus's head. When the octopus realized that there was a rat dropping on his head, he became extremely angry and told the rat, if I ever see you again, I'll kill you. To this day, the octopus is mad about this and is still looking for the rat.

P.Craig, NPS

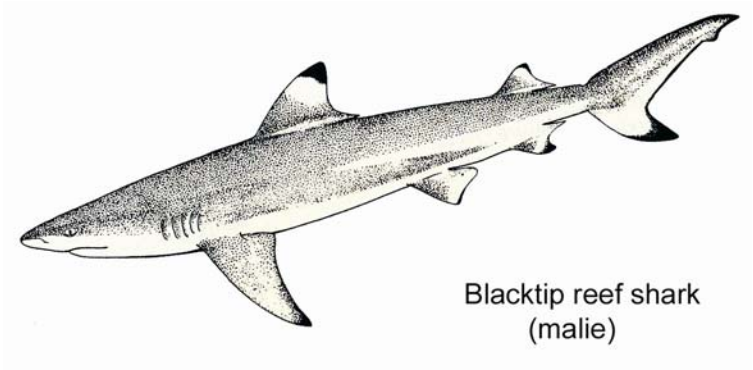
12. Sharks

We are fortunate not to have much of a “shark problem” in American Samoa. Based on conversations with long-time residents here, it appears that there have been very few shark attacks in the Territory and probably no fatalities here in the past 30 years. The few injuries that have occurred were usually related to fishing activities, and records from the hospital's Emergency Medical Services concur with this. EMS has responded to only one or two shark incidents in recent memory – one was a somewhat humorous account of two fishermen trying to land a shark in their boat. The first fisherman brought the shark up to the side of the boat so that his partner could club it, but his partner missed. The shark then reared up and bit the first fisherman, who then got mad and clubbed his partner for missing the shark.

The sharks (*malie*) living in our nearshore waters are generally not dangerous to swimmers or divers. The most commonly seen species are the blacktip reef shark (*Carcharhinus melanopterus*) and the whitetip reef shark (*Triaenodon obesus*). These are not large sharks, usually about 4-5 feet in length, although everyone swears that the one they saw was bigger. They feed on fish and shellfish. The whitetip has an unusual habit of resting occasionally on the seafloor during the daytime. These two shark species are usually not aggressive but they may swim close by to see who's in their area. But both are attracted to wounded and bleeding fish, which accounts for several shark encounters with divers who had tied speared fish around their waists. Need it be suggested that this is not a smart thing to do?

The blacktip is easily frightened away, but on rare occasions small blacktips will sometimes startle a person by swimming directly at them. They look like a little torpedo coming straight at you, but other than your brief panic attack, no harm is done. Another quirk of the adult blacktip is that, at night, it may charge at a diver's flashlight if the light shines on them for too long.

Sightings of more dangerous sharks in our nearshore waters are rare, but over the years, a few tiger sharks have been seen or caught around Tutuila. Also, hammerhead sharks are known to swim into Pago Pago Harbor, where some give birth to young and others are perhaps attracted there by the cannery wastes. The large but non-dangerous whale shark has also seen near Taema Bank and a juvenile whale shark (4.1 m total length) washed up on Aunu’u island in 1989.



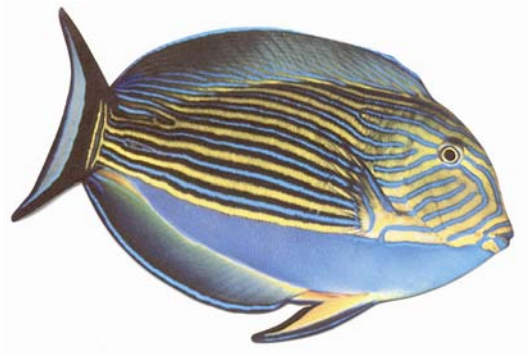
Blacktip reef shark (malie)

So, yes indeed we have sharks in our shoreline waters, but most are not of serious concern. Yet, someplace deep in our brain yells Danger! whenever we see one. But it is still very exciting to see a shark swim by. Our heart rate jumps, but then the shark is quickly gone, and our only thought is wow, did you see that?

P.Craig, NPS

13. The *alogo* surgeonfish -- ruler of the reeftop

American Samoa's coral reefs are truly a wonder of nature. Our sea is home to a very diverse and colorful assemblage of plants and animals. Some 890 species of fish occur here, which is about twice the number of marine fish species found in Hawaii.



At first glance, the reef seems to be an exotic panorama of mass confusion, complete with bizarre shapes of fish painted in psychedelic colors. It's like looking into an overstocked aquarium. But as you frequent the reef more often, you begin to notice some structure to the confusion. Each species is generally found only in certain habitats such as shallow reef flats, sandy bottom areas, or deeper waters.

Many individual fish even take up permanent residence at a particular site rather than roam around. One particular fish I watched stayed at the same coral block for 3 years (it had a unique markings on its body, so I could easily identify it). That coral block was home.

Such stay-at-home behavior is actually quite common among coral reef fishes. One abundant species on our reefs that does this is the *alogo*, also known as the blue-lined surgeonfish (*Acanthurus lineatus*) because of its knife-like blade located near its tail. The blade is usually not visible because it is folded away into a groove in the fish's skin. It is a bit poisonous, and careless handling of the fish may cause a puncture and painful swelling in your hand.

The *alogo* grows about 8 inches long and weighs half a pound. It is a very attractive fish, with bold yellow, blue, and black horizontal lines on its sides, although its basic color pattern can be swiftly altered depending on the *alogo's* mood. For example, when the *alogo* becomes aggressive and chases another fish, its face and fins darken and it looks angry (to me at least).

Alogo in black-fin coloration as they compete for a new territory. Note the substrate – that's prime real estate with a good crop of turf algae that the alogo eat.

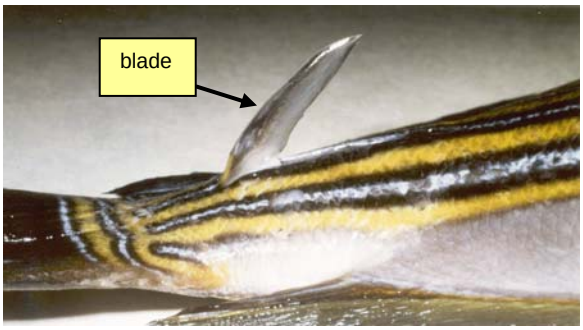
The *alogo* lives in the foamy surge zone where the waves crash against the reef. This is not an easy place to live, but the *alogo* is adept at it. When a really rough wave hits, the *alogo* darts down into a hole or over the reef edge into the safety of deeper water.

Like a lot of other reef fish, the *alogo* is a territorial animal, which means that it dwells at a particular patch of reef and protects that site from all other fish. The territory of each *alogo* measures about 5 x 5 feet. There it feeds on the thin film of plant material (algae) that covers the reeftop and appears as a greenish grassy turf. Because of their territorial nature, the *alogo* space themselves evenly across the

reeftop, and as they munch away on the algae-covered rocks, they remind me of a herd of miniature cows feeding in a distant pasture.

Many other species of coral reef fish are also algae eaters, and two general patterns of feeding have evolved among these species. One is for a species to become territorial and fiercely guard its own algal patch, the other is to be non-territorial and roam around the reef looking for an unguarded patch of algae to eat. To an underwater observer, this dual approach to feeding is readily visible -- most of the reef is picked clean of all edible algae and looks like bare rock, except where a territorial fish guards its lush algal plot.

The feisty *alogo* defends its plot from all competitors, so the turf algae grows well there and provides all the food the *alogo* needs. Protection of this garden doesn't come cheaply, however. The *alogo* must defend its territory every minute of the day from other fish that lurk nearby, waiting for a chance to sneak in and chow down.

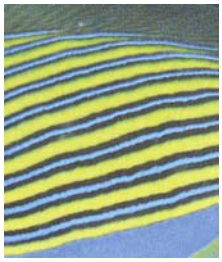


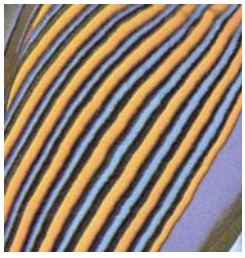
That's where the *alogo's* sharp blade comes in handy (see photo). The *alogo* will threaten to viciously sideswipe an intruder with this weapon. Most other fish heed the *alogo's* warning and back-off quickly. It's mostly a bluffing game played repeatedly through the day, and rarely does anyone get hurt.

Other aspects of the *alogo's* behavior are fascinating. Every evening at dusk, all the *alogo* migrate off the reeftop to deeper waters where they will spend the night sleeping in crevices to escape being eaten by predators like sharks (*malie*) and jacks (*malauli, ulua*). At dawn, they return by the same route. Their migrations to and from the reeftop look like rush-hour traffic on an underwater highway.

The *alogo* is a popular Samoan food fish and it is one the most important species of reef fish caught, accounting in some years for up to 30% (by weight) of all reef fish caught in the nearshore subsistence fishery. Most are caught by spear fishermen, particularly at night when the fish are sleeping in reef crevices. Daytime spear fishermen have a much harder time catching them, because the *alogo* tend to stay just out of spearing range.

P.Craig, NPS




14. *Manini* and *pone* -- two favorite reef fish

Manini and *pone* are two favorite food fishes found just about everywhere in shallow waters around the islands of American Samoa. Like *alogo*, they belong to the family of fishes called surgeonfish because of their sharp knife blades that fit into grooves near their tail. *Manini* and *pone* are rather meek fishes, however, and they do not seem to wield their weapons much.

The *manini* (*Acanthurus triostegus*) is a small fish about 5 inches long. Its coloration is yellow with vertical black bars, which looks a bit like a prisoner's uniform and that's why this fish is also called the convict tang.

Manini often swim in large schools containing hundreds or thousands of individuals. There are two good reasons for this schooling behavior -- it helps them escape predators and it also helps them get access to food. First, when a large fish attacks a school of *manini*, the *manini* scatter in all directions like a shotgun blast. This commotion momentarily confuses the predator and the *manini* get away. Each *manini* thus has a better chance of not getting eaten if it stays in a group.

The *manini* also cleverly use their schooling behavior to get food. They like to feed on the thin green algae turf that grows on reef rocks, but these algae patches are usually guarded fiercely by *alogo* surgeonfish and damselfishes (*tu'u'u*) who are nasty to intruders.

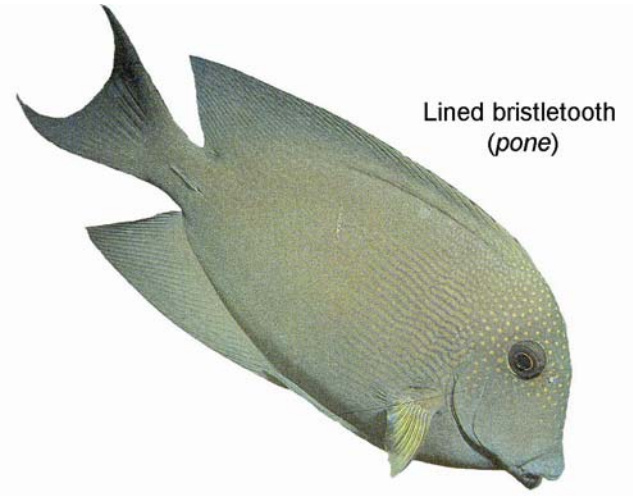
Just the sight of a *manini* gets them livid with rage. A single *manini* would not stand a chance to get by these guards, but a large group of *manini* can succeed. The *alogo* and damselfishes are simply overwhelmed when hundreds of *manini* descend into their territory to feed. While the *alogo* futilely chases one *manini* away, a hundred others are gobbling up its garden.

Manini spawning is a spectacular event. When conditions are right, thousands will assemble to spawn at a particular time and place. They often spawn in or near the reef channel (*ava*) at dusk when the tide is high. Their behavior and coloration are noticeably different at this time, as they swim around in a agitated fashion and change color to white with wider black bars. This seething mass of fish mills about until they can't take the excitement any longer. A group of them will suddenly burst upwards in the water column, spawn, and return to the seafloor again, all in a split second. Although this happens fast, you can tell that the fish actually spawned because the milt expelled by the male fish looks like a puff of smoke from a gun. When the spawning action really gets going, it looks like an underwater version of popcorn popping.

After spawning, the fertilized eggs drift away with the currents. About one month later, the small *manini* that survived this larval stage are ready to settle back onto the reef.

Pone (*Ctenochaetus striatus*, or the lined bristletooth surgeonfish) are a different type of surgeonfish in two respects. They are a dull brown color and they have funny teeth. Their lack of spectacular coloration is somewhat of an embarrassment in tropical waters which are renown for brightly colored fish. *Pone* are, however, one of the most abundant fishes on the reefs, so they must be doing something right.

Their teeth have evolved very differently from other surgeonfishes because what they feed upon is quite different. Instead of having actual teeth to bite off algae the way that *alogo* and *manini* do, *pone* have a mouthful of bristles which they use as a comb or brush to collect the detritus that lies on reef surfaces. The detritus they eat includes all the small bits and pieces of formerly living plants and animals. The detritus in your backyard, for example, might include grass clippings, old *ulu* leaves, decaying coconut husks, rotting papayas, and numerous unseen dead insects. Not a pretty meal, to be sure.



Detritus is found everywhere, but few large animals can make a meal out of it. *Pone* can, and that may account for their abundance and widespread distribution on coral reefs.

Every several years or so, *pone* have a very successful spawning event, and uncountable numbers of their young (*pala'ia*) settle onto the reef. *Pala'ia* are very pretty and look like small dark *alogo*. But their beauty fades as they grow, and in just a few weeks they turn brown in color.

P.Craig, NPS