Kwajalein Underwater

The Kwajalein Underwater DVD is a 72-minute diving tour of the pristine tropical reefs of Kwajalein Atoll.

Lying 9 degrees north of the equator and roughly halfway between Hawaii and Australia, Kwajalein is part of the Marshall Islands, a group of 34 atolls that make up the eastern edge of Micronesia. Water temperature here varies from a winter minimum of 79º to a summer peak of 86º F (26º to 30º C). With lots of rainfall but little land area for runoff, the waters tend to be crystal clear, and the lush coral reefs support a wide variety of fish and invertebrate inhabitants.

Irregularly boomerang-shaped, Kwajalein is the largest atoll in the world. Altogether, about 200 miles of perimeter reef enclose a lagoon of nearly 1000 square miles that contains innumerable coral pinnacles and knolls that rise off its 150 to 200-foot bottom, some reaching right to the surface. The possibilities for underwater exploration seem limitless.

From colorful minute nudibranchs and flatworms and other tiny invertebrates to sea turtles, sharks, and huge manta rays, Kwaj has it all. Kwajalein Underwater offers a small taste of the wondrous variety to be found on these living reefs. More than 430 video scenes cover such animals as corals, anemones, jellyfish, flatworms, starfish, sea urchins, feather stars, seashells, nudibranchs, giant clams, octopus, crabs, shrimp, fish, manta and stingrays, sharks, sea turtles, and more.

This document provides a scene-by-scene description of the DVD. Each separate scene on the video has a corresponding paragraph below. The boldface title of each paragraph matches the subtitle on the video scene. To locate the scene you are watching, turn on subtitles on your DVD player and search for that subtitle through the boldface paragraph titles here.

Where appropriate, the scientific name of the animal being depicted is listed below the boldface heading in italics. The scientific name consists of two parts, the genus and species names. The genus, which usually indicates a group of related species, comes first and is capitalized. The species name comes second and refers to the particular species. The genus and species names, which are based on Latin (or are words from other languages that have been Latinized), are by convention always italicized, although in pre-computer days you could substitute underlining for the italics. For example, the giant clam family is represented here at Kwajalein by four species in two genera (plural for genus). One genus is *Tridacna*, and it contains three species, *gigas*, *squamosa*, and *maxima*. So the scientific names of those three species are *Tridacna gigas*, *Tridacna squamosa*, and *Tridacna maxima*.

Because the scientific names are Latinized, they appear harder to learn than common names. Sometimes they are, but for any serious use they are much preferable to the common names. For one thing, common names are rarely truly common. Since there is no worldwide standard for common names, the same animal may, and often does, have different common names throughout its range. For example, as a child growing up out here in the ‘60s, I learned the names of some common reef-dwelling cowries as monkey faces, brownies, grapes, and strawberries. When I went away to college and attended a meeting of the Hawaiian Malacological Society, the members didn’t know what I was talking about—the common names for those same four species in Hawaii are money, snakehead, porous, and honey cowries. However, most Society members usually used the scientific names of *Cypraea moneta*, *Cypraea caputserpentis*, *Cypraea poraria*, and *Cypraea helvola*.

If you see a name such as *Acropora* sp., with the genus name italicized but the species name consisting of a normal “sp.” it means that we are not sure of the species. The “sp.” is an abbreviation for “species” and means we know (or think) this is a member of the indicated genus, but we cannot positively identify it. If you see “spp.” it means multiple species.

The main DVD menu contains three icons representing different entry points into the movie. The first icon at upper left starts the movie at the beginning. The middle icon jumps into the continuous movie about 25 minutes in from the beginning. The third icon at lower right jumps into the movie at about 50 minutes.

BEGINNING, FIRST MENU ICON

Bubbles rise from diver
Bubbles rising from a diver below come right up into the camera lens. Right before the bubble strikes the camera and the scene shifts, you can see the reflection of the photographer in the surface of the bubble.

Diver swims over coral
A diver carrying a camera and silhouetted by the sun swims slowly down the oceanside dropoff. In the lower foreground is a silhouette of the gorgonian locally called "black coral."

Diver passes above
A diver swims across the edge of the steep oceanside slope with the sun shining just off the top of the screen. Most of the fish visible near the diver are Thompson's surgeonfish, *Acanthurus thompsoni*. It shares the same habitat with a damselfish, *Chromis xanthura*, which like the surgeon also has a black body and white tail.

Elkhorn coral
Acropora sp.
This coral reef covered with a variety of corals is dominated by the erect colony of *Acropora* commonly known as elkhorn coral for its resemblance to the antlers of an elk.

Various corals, mostly *Acropora*
Many of the lagoon pinnacles are densely covered with a variety of living corals. In this scene, the central colony of elkhorn-type coral is bordered on the right by a couple of small table corals. Both of these are species of *Acropora*. Other corals are visible in the background.

Elkhorn and other corals
Another growth form of the elkhorn type *Acropora* coral is in the center of the frame and the target as the camera approaches. To the right is a large stand of another *Acropora*, staghorn coral. Other corals extend down the slope to the left. Among the branches of the elkhorn is a Dick's damselfish, *Plectroglyphidodon dickii*, a small, aggressive, territorial species that will often try to defend its coral colony against even us big bubbling monsters when we venture too close.

Swim over coral reef
The camera moves forward across a field of living corals on a lagoon pinnacle. Most of what we see is branching *Acropora* down the center and staghorn *Acropora* to the right and behind. Other corals are off to the left and interspersed with the *Acropora*. The Acroporidae family of corals is the most abundant and diverse of all the families here in the Marshalls. Yet in Hawaii, there are very few acroporids, and most of those are in the Leeward chain that stretches about a thousand miles to the northwest from Kauai.

Mostly stalk coral
Lobophyllia corymbosa
The camera passes over a field of mostly stalk coral on a lagoon reef. The rounded coral domes don't really look as though they should be called "stalk coral." However, when the colony breaks apart, whether from age, weight, or storms, it can be seen that the surface of the dome is where the living coral animals or polyps reside, and that each polyp is at the end of a long, straight stalk. If you imagine that the dome we see is just part of a circle that continues on underground, each polyps stalk leads down toward the center of that imaginary circle. When a planktonic stalk coral larva settles to the reef and begins to form a colony, it starts very small with few small polyps. As it grows, it pushes the dome-shaped outer surface outward, with the individual polyps dividing to create more to fill the gaps created as the come expands. Although the colony looks quite solid, the separate stalks are actually only loosely glued together and can break apart without much provocation. In some areas you can see piles of stalks where a colony has come apart. As the camera passes over the stalk domes, there are other corals around and on top of some of the domes. Near the end of the scene, the yellowish coral in the upper center is a colony of what we call crinkly coral, *Porites rus.*

Swim over coral reef
On another lagoon coral reef, the camera passes over a field of various corals. The purplish bushes are another species of Acropora, while the larger fingery yellow mounds are a kind of Pocillopora. A couple of colonies of crinkly coral disappear off the left of the screen near the end of the scene, and a cracked-open dome of stalk coral can be seen in the upper left.

Whitetip shark over staghorn and elkhorn corals
Triaenodon obesus
A whitetip reef shark approaches the camera over a field of staghorn and elkhorn *Acropora* corals. Whitetips are among the mellowest of sharks, and are likely to be aggressive only in the presence of spearfishing and blood in the water. For the most part, we regard this particular species as simply large fish and don't ever worry that one might come in to bite.

Whitetip shark
Triaenodon obesus
Whitetip sharks do, however, sometimes come quite close to divers to get a good look. But just as often, they pass us by without ever even acknowledging our existence.

Hawksbill turtle over fire coral
Eretmochelys imbricata
There are two kinds of sea turtles likely to be seen on the reefs at Kwajalein, the green turtle and the hawksbill. The one passing lazily by over this field of fire coral is the latter. The differences between the two kinds of turtles can be seen in later scenes.

Parrotfish over coral reef
Chlorurus microrhinos
A few parrotfish swim over a living coral reef.

Bicolor parrotfish, adult male
Cetoscarus bicolor
The parrotfish and a number of other fish families go through several life stages. They begin as unsexed juveniles. As they mature, they all become female. After some time as a female, they change to male for the latter part of their lives. This kind of change, from female to male, is termed protogyny and is common in a number of fish. Often, as in these parrots, the fish are quite different in appearance during the different stages. Years ago, the male and female forms of a number of fish species were given different names since they looked as though they must be different species. Only after the advent of scuba diving, when researchers were able to watch their behavior and interactions, as well detect as the presence of intergrades between the stages, did it become apparent that in many cases two names were given to the same species. This one is the male form of *Cetoscarus bicolor.* Obviously this was not the name originally given to this form, since these males have more than a mere two colors.

Bicolor parrotfish, adult female
Cetoscarus bicolor
The female form of *Cetoscarus bicolor* looks quite different from the male. This one is busy grazing the thin layer of algae from reef rock. While a few of the parrots will occasionally chew on living coral, the majority eat only algae that they scrape from the bottom. The hard, fused teeth, likened to a parrot's jaw, tend to scrape not only the algae from the rock but the top layer of the rock as well. Parrots are important bioeroders of the reef, gradually turning reef rock into find sand, which is returned to the reef after passing through the parrotfish's digestive system.

Bicolor parrotfish, juvenile
Cetoscarus bicolor
Cetoscarus bicolor juveniles look different yet. They are truly bicolored, mostly white with a vivid orange-red band running through the face. This band can actually still be seen in the adult female, but it has turned brown and become enmeshed in the rest of the female color pattern. Juveniles of this species tend to be solitary and live at the bases of ledges and small caves, and are often seen in oceanside surge channels. Also early in this scene is a five-lined cardinalfish, *Cheilodipterus quinquelineatus.*

Yellow Magnificent sea anemone

Heteractis magnifica

The magnificent sea anemone is one of the two largest anemones found here in the Marshalls. It comes in a variety of colors; the tentacles here are yellow but they also come in tan, brown, or even white with blue or green tips. The colors, at least the yellow, tan, or brown shades, are derived from microscopic, single-celled plants called zooxanthellae that anemones, as well as their relatives the corals, harbor within their tissues. These plants act the way all plants do: they convert sunlight and carbon dioxide into oxygen and carbohydrate compounds, otherwise known as "food." The anemone and its resident algae have a mutually advantageous partnership going here. The zooxanthellae take the waste carbon dioxide from the anemone and produces oxygen and food, which is used by the anemone. This kind of close relationship between two different species of organisms is called symbiosis, or literally "living together." Symbiosis is actually a general term used for different kinds of relationships. A relationship such as this when both parties in the relation derive mutual benefit is called mutualism. This same mutualistic relationship with zooxanthellae also occurs in most reef corals (as well as some other invertebrates), and it is this symbiosis that permits the very existence of coral reefs, one of the richest ecosystems on earth, in the midst of what is otherwise an ocean rather devoid of nutrients. Nutrients are limited in warm oceans since over time they tend to sink down into deep cold water, which doesn't usually mix with the less dense warm waters above, so the nutrients often stay lost in the depths. The yellow *Heteractis magnifica* in this scene resides on a lagoon reef that supports a good population of reef fish and corals.

Apricot anemonefish

Amphiprion perideraion

Another kind of symbiosis in which some species of sea anemones take part is with some species of fish in the damselfish family. There are five different kinds of anemonefish here at Kwajalein: four in the genus *Amphiprion* and one *Dascyllus*. *Heteractis magnifica* anemones nearly always have a small group of resident apricot anemonefish. Anemonefish live among the tentacles of anemones for protection. Anemones, like their coral relatives, have stinging cells called nematocysts scattered throughout their tissue. These nematocysts are coiled springs, and a touch is usually enough to trigger them to fire, injecting a venomous spine or barb into whatever triggers it. Most corals and even most anemones have nematocysts so mild that they don't penetrate human skin, although some can be quite virulent and painful. But they apparently are effective against potential fish predators; the sting on lips or the soft tissues inside a mouth is strong enough to deter many predators. If the anemonefish hide among the spines, they can be protected by the deterrence offered by the stinging nematocysts. But wait. Why don't the anemonefish get stung? Well, it seems that they secrete a mucous over their bodies that somehow prevents the anemone's nematocysts from firing. This mucus seems to develop over time. If an anemonefish is kept away from an anemone for some time, when they are again reintroduced, you can see the anemone quickly and lightly touching the anemone time after time, possibly getting stung in the process. But this seems to cause the mucus to start to flow, and soon the fish is fully protected and can nestle down in the tentacles with impunity.

Apricot anemonefish

Amphiprion perideraion

Here are several *Amphiprion perideraion* in a *Heteractis magnifica* that has brownish tentacles with white tips. In many books, you will see anemonefish called "clownfish" as well. It seems most scientists prefer to use anemonefish instead. The symbiosis relationship between anemones and their anemonefish is also a mutualistic one. Although at first glance it seems as though the fish are just freeloading squatters, they do provide an important service to their host anemones. There are certain coral and anemone eating fish that would gladly risk the stinging nematocysts to peck away at an anemone's tentacles. The anemonefish, however, are quite aggressive little fish and will actively drive away any predators that come to attack their anemone. Some anemonefish will even charge divers, to the point of actually striking a diver's mask or regulator mouthpiece. It's a good thing these fish are not the size of sharks or we'd not be safe in the water.

Brown Magnificent sea anemone

Heteractis magnifica

This large individual of *Heteractis magnifica* was draped over a rock spire, making the anemone look taller than it actually is. The brown tentacles sway in the light surge on a lagoon reef near North Loi Island. A few *Amphiprion perideraion* can be seen darting among the tentacles.

Magnificent sea anemone
Heteractis magnifica
Heteractis magnifica attaches to rocky substrates. The stalk of the anemone is often hidden from view as the tentacle-covered oral disk spreads over the rocky surface, but sometimes the anemone balls up and exposes the stalks. Like the tentacles, the stalks can vary in color. A sequence of different stalk colors can be seen later in this video. But usually the stalks are uniformly colored. This one was different in that it was predominantly blue with white vertical bands. The tentacles are light tan with pale purple tips. Actually, there are two differently colored *Heteractis magnifica* anemones in the frame. The mass of tentacles at the lower left side is another anemone, living adjacent to the blue- and white-based one. The two anemones had a crowd of *Amphiprion perideraion* that shared the two anemones, jumping between them at will. These anemones are on the lagoon pinnacle known as Twin Peaks.

Spotted jellyfish
Mastigias papua
The spotted jelly is not commonly seen around Kwajalein, but it is unmistakable when you do see it. Most of the ones we've run into have been drifting across lagoon pinnacles in the middle portion of the atoll. Generally, if you see one, look around because there will probably be more being carried along in the same water mass.

***Cramboine* jellyfish pulses along**
Crambione mastigophora
The jelly *Crambione mastigophora* is probably the most common of the large jellies we see here at Kwajalein. They can be found both in the lagoon and drifting along the oceanside reefs as well. Occasionally they travel in large groups. Several times a mass of them have drifted into the Kwajalein end of the lagoon and ended up filling the harbor and being washed ashore along the beaches. Do be wary of these, since their trailing tentacles can pack a pretty powerful sting. The stinging cells are nematocysts, similar to the stingers of anemones and corals but in many cases more powerful. As a scientific test one day, the photographer rubbed one of these on the inner surface of his wrist. There's no doubt that these guys can sting!

Moon jellyfish
Aurelia aurita
The moon jelly is a large species that is also occasionally found drifting in groups across midlagoon pinnacles. If the jelly is disturbed, the long tentacles seen in this clip can retract right up the bell to the point where they are practically invisible. The pulsating motion of these animals is almost hypnotic.

Tree soft coral
Dendronephthya sp.
Tree soft coral, a species of *Dendronephthya*, can come in a variety of colors. It is not common at Kwajalein, but when seen it is usually hanging down from an overhang. While often in areas of high current flow such as atoll passes, it can also be seen on some quiet lagoon pinnacles and on shipwrecks. At Chuuk, some of the shallow shipwrecks are just covered with multicolored *Dendronephthya* colonies, and it is a conspicuous part of the reef around passes at Pohnpei.

Pink Tree soft coral
Dendronephthya sp.
This is a pinkish variety of *Dendronephthya*. Although technically a soft coral, these colonies are not entirely soft. Their soft tissues are embedded with numerous sharp, hard calcareous spicules, making them rather pointy and sharp. You'd notice it if your skin accidentally brushed against one. Fortunately, their nematocysts are mild and stings from them do not harm divers.

Red Tree soft coral
Dendronephthya sp.
Sometimes you might run into a very large colony of *Dendronephthya*. This red one was more than a meter from base to tip. It used to live at a depth of about 35 meters near South Pass, but recent attempts to find it again have not been successful. Perhaps it just got too heavy and fell off the reef!

Black coral gorgonian
Rumphella antipathes
The animal most often called "black coral" here at Kwajalein is actually not in the black coral group, which is in an entirely different subclass of animals. To put that in perspective, human beings and mice are less far apart on the taxonomic tree than are the black coral gorgonian and true black corals. The black coral gorgonian is actually an octocoral, more closely related to soft corals. It does possess a shiny black skeleton when the covering of brown living tissue dies and flakes off. Although collected heavily from southern Kwajalein atoll reefs by divers 30 or more years ago, the skeleton of the black coral gorgonian is not usable for jewelry as are the true black corals; it is not sufficiently dense to take a good polish. I'm sure this fact crushed the hopes of many an early diver who thought they'd be able to retire from the sale of their black coral collections. Unfortunately, it takes some time for this to grow and even now, there is little of this left on the reefs near Kwajalein. On mid atoll lagoon pinnacles and oceanside reefs, however, it is still quite common.

Soft coral in ledge
Siphonogorgia sp.
This orange fanlike soft coral is probably a species of *Siphonogorgia*. It grows in ledges and sometimes exposed on the reef in areas affected by strong tidal currents. Behind it is another octocoral, the large orange sea fan *Subergorgia mollis*.

Soft coral in ledge
Siphonogorgia sp.
This is a closer shot of the *Siphonogorgia* from the previous scene.

Mimic filefish, juvenile next to sea fan
Paraluteres prionurus
This filefish is called a mimic because of its resemblance to a sharpnose puffer, *Canthigaster valentini* (two scenes ahead). Especially when they are adults, they are difficult to tell apart. The strong resemblance between the two species illustrates a phenomenon called Batesian mimicry. This is said to exist when a harmless, quite edible species resembles a distasteful or even downright poisonous species. As long as the mimic is less common than the model, predatory fish would quickly learn that a fish with that color pattern is not good to eat. The mimic, then, gains protection simply by looking like the model. In this scene and the next, the little file is trapped between the photographer and the large fan gorgonian, *Subergorgia mollis*.

Mimic filefish, juvenile next to sea fan
Paraluteres prionurus
After racing along the fan coral, the little file finally finds a break in the branches and slips through to the other side.

Black-saddled sharp nose puffer
Canthigaster valentini
This puffer is the poisonous model for the mimic filefish from the previous two scenes. Sharp nose puffers are very poisonous to eat, and even have poisonous skin secretions. It is likely that as soon as a predatory fish took one into its mouth, it would immediately spit it out, leaving the puffer mostly unharmed. All species of sharp nose puffers are probably not safe to have in a home aquarium, especially if there are small children or pets present. I have had these puffers jump out of an aquarium before, and a child or pet who put one in his or her mouth could be in trouble. I very nearly lost a house cat that picked up one of these from the floor and simply carried it across the room. The cat collapsed, became very ill, and took days to recover. Certain times of the year, young green-spotted sharp nose puffers are common in intertidal reef tide pools, so be aware of what you catch for an aquarium.

Map puffer, with cleaner wrasse
Arothron mappa and *Labroides dimidiatus*
This large puffer has a rather intricate pattern of lines, particularly across its face, that gives it its common name of map puffer. They are uncommon, but can be occasionally seen on both oceanside and lagoon reefs, and sometimes also on lagoon shipwrecks. This individual is having its parasites picked by the cleaner wrasse *Labroides dimidiatus.*

Blue-spotted puffer, feeding
Arothron caeruleopunctatus
The scientific name of *Arothron caeruleopunctatus* gives this puffer its common name as the blue-spotted puffer. In fact, while the body is somewhat bluish, the spots on the body appear mostly white and black from a distance. Close up some of the spots are light blue. This is a large puffer, the second largest here in the Marshalls. They are rare, and when spotted are usually on the oceanside slopes or in surge channels. This one is trying to eat something underneath that dead coral, possibly sponges or other invertebrates. Like the previous *Arothron mappa*, this puffer is also having its parasites picked by the cleaner wrasse *Labroides dimidiatus.*

Star puffer, with pilot fish
Arothron stellatus with *Gnathanodon speciosus*
The star puffer is the largest of the puffers here in the Marshalls. They can often be seen hanging out in the water off the oceanside reef slope, but will occur inside the lagoon as well. They have huge teeth and their mouths and faces usually look as though the animal has been in a fight—or maybe caught in a grinder. This may be due in part to their diets. They're known to eat starfish, and I saw one once that looked mighty interested in a spiny crown-of-thorns star. If they eat those, it might account for a few wounds around the mouth. This one is accompanied by a small pilot fish, a juvenile of the jack *Gnathanodon speciosus.*

Pennant bannerfish
Heniochus chrysopterus
Also sometimes called the false moorish idol, *Heniochus chrysopterus* is in the butterflyfish family. Usually in pairs, these fish are often seen around ledges and overhangs and may hide back in them when divers come around. A few times we have observed apparently persistent groups of 20 or more individuals hanging around the same coralhead; one of these groups was maintained for at least a couple of years on the reef between Kwajalein and Sar Pass.

Pennant bannerfish, juvenile
Heniochus chrysopterus
The young specimens of *Heniochus chrysopterus* are usually solitary. Not only are they smaller than the adults, but the small ones usually have a false eye spot near the base of the tail. Watching the fake eye of this one, it almost resembles a fish moving in reverse.

Longfin bannerfish on shipwreck
Heniochus acuminatus
Another species of bannerfish is usually seen living around deeper lagoon reefs and on shipwrecks. This pair was hanging around the foredeck of the Fumi Maru, a small sunken Japanese vessel locally called the Daisan. A couple of bushes of black coral can been seen growing from the wreck in the background.

Masked bannerfish
Heniochus monoceros
Heniochus monoceros is the largest of the bannerfish here in the Marshalls. The specific name "monoceros" means one horn, indicating the little black protrusion on the forehead above the eyes. However, another species in this genus (next scene) has an even more impressive horn on its forehead.

Humphead bannerfish
Heniochus varius
The large protrusion on the forehead gives this fish its common name of humphead or sometimes horned bannerfish. Here two of them come up to mug for the camera before meandering on their way.

Speckled butterflyfish
Chaetodon citrinellus
The name *Chaetodon citrinellus* would seem to indicate lemons, but the common name lemon butterfly is already used for a different species from Hawaii. The speckled butterfly is yellow with purplish spots. These are commonly seen in pairs in shallow water both in the lagoon and oceanside. They typically do not range out on oceanside reefs as far as the dropoff, but rather remain in the shallows near shore.

Bennett's butterflyfish
Chaetodon bennettii
Chaetodon bennettii always looks to me as though it has a large burned spot on its upper back. These butterflyfish tend to occur in wandering pairs both in the lagoon and oceanside. These two were on a slope covered with multicolored stalk corals on the lagoonside of Ningi Island near Bigej Pass.

Saddled butterflyfish
Chaetodon ephippium
I have always known *Chaetodon ephippium* as the saddleback butterflyfish, but I suppose "saddled" works just as well. These are common on lagoon and oceanside reefs and usually wander about in pairs.

Lined butterflyfish
Chaetodon lineolatus
Chaetodon lineolatus, the largest of the butterflyfish, is usually one of the most difficult to get close to. This one apparently decided to come in and take a look at the camera.

Lined butterflyfish school
Chaetodon lineolatus
Most often these *Chaetodon lineolatus* are found in pairs. This was an atypical school of them observed on the oceanside reef.

Moorish idol school
Zanclus cornutus
The Moorish idol is another species that is usually observed paired or in small groups. Occasionally, however, a large school can be seen, usually moving rapidly along the oceanside dropoff. These are nearly always large individuals, all with long trailing top fins. Specimens occurring in twos and threes along the reef do not appear to join the group as it passes by. But then the ones along the reef often have more ragged top fins that do not flow back as far as those in the school, so perhaps they don't look good enough to be accepted into the group.

Forktail rabbitfish school
Siganus argenteus
The Forktail rabbitfish usually lives in schools that wander around lagoon and oceanside reefs, dropping down to feed on algae growing on the reef.

Forktail and Gold-spotted rabbitfish feeding
Siganus argenteus and *Siganus punctatus*
Here a school of *Siganus argenteus* with a few mixed in *Siganus punctatus* (the greener ones) feed on a patch of algae. An occasional parrotfish also drops by to take part in the feeding frenzy.

Masked rabbitfish
Siganus puellus
Usually in pairs, the masked rabbitfish lives on both lagoon and oceanside reefs.

Gold-spotted rabbitfish, synchronized swimming
Siganus punctatus
This trio of *Siganus punctatus* seems pretty well in sync. They are swimming over a field of mostly fire coral, *Millepora*.

Foxface rabbitfish
Siganus vulpinus
A characteristic feature of *Siganus vulpinus* is its oddly shaped protruded mouth. This species is most common on lagoon reefs and pinnacles, where it usually travels in pairs feeding on algae. Juveniles are seldom seen, but we've run across a few on lagoon reefs with heavy coral cover, and on some of the lagoon shipwrecks.

Parrotfish feeding
Chlorurus microrhinos
This school of parrotfish is grazing algae on the top of a large lagoon pinnacle reef. There are several parrot species mixed in with the school, but most of them appear to be *Chlorurus microrhinos.* In the background, a school of Forktail rabbitfish, *Siganus argenteus*, is also busy grazing away. The algae both groups are feeding upon grow on the bare rocks around the living soft and hard coral colonies visible on the reeftop.

Pacific steephead parrotfish
Chlorurus microrhinos
This is a large male *Chlorurus microrhinos* parrotfish. Some refer to this species as a humphead parrot, but the real humphead parrotfish is another, larger species that is very rare here in the Marshalls. Perhaps this one could be called the bumphead.

Pacific steephead parrotfish color form
Chlorurus microrhinos
Usually *Chlorurus microrhinos* is a combination of blue and green, but sometimes an odd individual shows up with reddish or yellowish coloration, sometimes called a xanthic color form. This one is busy scraping the thin layer of algae from the reef. It must be rather tedious spending all your days chomping on hard rocks.

Red parrotfish
Scarus xanthopleura
This striking red parrotfish is a female of the species *Scarus xanthopleura*. It is relatively uncommon here at Kwajalein, but can occasionally be seen on the oceanside slope.

Nudibranch *Chromodoris elisabethina*
Nudibranchs are shell-less mollusks—basically seashells without the shells. Lacking the protection of a hard shell, many of them have developed poison glands to make them unpalatable to predators. As an additional deterrent to predators, many have also developed bright warning coloration that may help clue visual predators in to the fact that this thing is not edible. *Chromodoris elisabethina* is one of the more common nudibranchs found in the Marshalls, and is most often seen in ledges and small caves on lagoon pinnacles and sometimes on the oceanside reef. The two orange tentacles on the right side of this individual are called rhinophores, and effectively act as the nose, detecting chemicals (smells) in the water. The tuft of orange tentacles near the left end are the naked gills, from which this group of animals derives its name of nudibranch.

Nudibranch *Chromodoris tinctoria*
This nudibranch is found sporadically in the lagoon, often crawling exposed on *Halimeda* algae. Like other nudibranchs in this particular family, *Chromodoris tinctoria* eats sponges. What makes many nudibranchs unpalatable to predators are the chemical compounds picked up from the sponges they eat.

Nudibranch *Chromodoris kuniei*
Like the previous species, *Chromodoris kuniei* is most often found crawling exposed during the day. However, the only specimens we have found have been on the oceanside slope at depths of about 15 meters and deeper. In 1990 we found a dozen or so over the span of a few months. Then none until one specimen was observed in 2005. It would appear that Kwajalein might get a small group of colonists when the conditions are right, but the species may not live here all the time. *Chromodoris kuniei* is one of a few species that waves its mantle skirt as it crawls along.

Bert's olive shell
Oliva berti
The olive shells are sand dwellers that spend most of their time beneath the surface of the sand. They sometimes emerge at night to feed, but more often just dig their way through the sand, leaving a distinct trail. This *Oliva berti* was dug out of the sand and is starting to dig its way back in. Very similar to the widespread Indo-Pacific *Oliva miniacea*, *Oliva berti* was determined by some experts to be just different enough to warrant separate species status. As far as I know, *Oliva berti* is presently known only from the Marshall Islands, where it prefers fine lagoon sand habitats.

Annulate olive shell
Oliva annulata
Another common olive shell here at Kwajalein is *Oliva annulata*. It lives mostly in sand patches and surge channels on the oceanside reef and on lagoon pinnacles. It spends most of its life buried in sand; this one was dug out and is in the process of diving back in.

Pimpled basket shell
Nassarius papillosus
Like other members of its family, *Nassarius papillosus* is a very active snail with a large foot and quite rapid movement. The brown scab near the rear part of the large foot is called the operculum; it is essentially a trap door that the animal uses to close off the aperture of the shell when it retracts inside. In the nassariids, this operculum is reduced and does not completely close off the opening, but in some mollusks the operculum is a primary means of defense. Most of the nassariids are scavengers and are quickly attracted to any dead or decaying material, but they apparently will eat live prey as well. They usually live buried in sand beneath rocks during the day, and come out at night.

Pimpled basket shells
Nassarius papillosus
Occasionally you might see a cluster of *Nassarius papillosus* at night. In such a case, they have either found some tasty decaying matter to devour or are in the process of gang mating.

Bonnet shell
Casmaria erinaceus
Casmaria erinaceus is a nocturnally active sand dweller that can be found in sandy areas of both lagoon and oceanside reefs. It digs deep in the sand by day, so is rarely encountered alive. It is apparently a prized food item for some animal, since empty shells are common.

Small abalone
Haliotis crebisculpta
While in the same family as the edible abalone of temperate shores, the most common species in the Marshalls, *Haliotis crebisculpta*, rarely exceeds about one inch in length. Not common, it is most often encountered near the top of the oceanside slope at night. With its large foot, it is capable of moving across the hard substrate quickly.

Maxima giant clam
Tridacna maxima
There are four species in the giant clam family Tridacnidae here in the Marshall Islands. *Tridacna maxima* is the most common, and the name *maxima* must refer to that, since it also happens to be the smallest species in this area. Shells are generally well embedded in the hard reef or coral substrate, and the animals vary in color from black and white to wild combinations of blue, green, turquoise, brown, orange, purple, and more. But one color characteristic is common to all color forms and is a sure way to identify this species. Near the margins of the colored animal is a row of close-set black spots. In the bluish green specimen in this scene, these spots are fairly small but are still distinct.

Maxima giant clam
Tridacna maxima
This blue *Tridacna maxima* shows the black spots at the animal's, or mantle's, edge clearly.

Maxima giant clam
Tridacna maxima
Purple and yellow is an uncommon color form in *Tridacna maxima*. Again, the black spots near the mantle's perimeter show up clearly.

Maxima giant clam
Tridacna maxima
This one is dark green with a little brown. The color on these *Tridacna maxima* often vary with the angle from which you view it. A clam that looks green from one angle might look blue from another. The coloration of these

clams comes not from pigments in the clam itself, but from pigments associated with microscopic single-celled algae called zooxanthellae that the clams harbor within their tissue. The symbiotic association between the clams and their zooxanthellae is similar to the relationship between reef corals (including anemones) and their zooxanthellae. *Tridacna* clams are perfectly capable of feeding and they do so by drawing water in one of the openings in the mantle, filtering out the plankton, and sending the filtered water out another opening. But they also obtain food, perhaps most of their diet, by farming the zooxanthellae within their tissues. The zooxanthellae, being plants, use sunlight and carbon dioxide to produce oxygen and carbon compounds (i.e., "food"). The clam, being an animal, requires oxygen and food and can get both from the algae. In turn, metabolic activity within the clam produces carbon dioxide, which the algae can then use to produce more oxygen and carbon compounds. Quite a deal. This is one reason why you tend to find these tridacnid clams only relatively shallow in areas with good sunlight. Occasionally, we have seen specimens that have been covered by fallen coral or rocks. If in the dark for an extended period, the clam tissue loses all its symbiotic zooxanthellae algae and turns kind of watery milky white. While they can still survive by filter feeding, they probably do not do as well, so when we find clams in this state we always try to get them more exposed to the sunlight again.

Maxima giant clam
Tridacna maxima
Here's a *Tridacna maxima* in mostly black and white with a hint of brown. It's growing out of a colony of living coral. The shell of a tridacnid clam is a harder form of calcium carbonate than the skeletons of most corals. The larva of the giant clams float in the plankton for a while, then settle down to the reef to grow into the clams we see. Once *Tridacna maxima* settles and as it grows, it can work its hard shell back and forth and effectively bore its way down into the coral a bit. Occasionally you can see a fresh depression where a clam has been ripped out by an octopus or a nurse shark or some other predator. Often some tough brown strands, called a byssus and used by the clam to hold itself to the bottom, remain stuck to the bottom of the depression.

Maxima giant clam
Tridacna maxima
This *Tridacna maxima* is mostly blue with a green trim. But note that the black spots still line the mantle margins.

Maxima giant clam
Tridacna maxima
Here's one with an intricate combination of brown, yellow, blue and black, with the blue concentrated down on the inner part of the mantle.

Maxima giant clam
Tridacna maxima
An attractive combination of orange-brown and black.

Maxima giant clam
Tridacna maxima
Blue with an olive green trim.

Maxima giant clam and algae
Tridacna maxima
This *Tridacna maxima* is wildly colored, with successive bands of mottled brown, purple, orange, and blue. It is backed by some leafy green algae.

Green algae
This green alga grows up on stalks in sandy areas lagoon areas.

Red algae
One of the red algae, this one sways in the surge.

Plating red algae
Peyssonelia sp.

Another member of the red algae group, this one forms plates in shaded areas. It appears to be a species of *Peyssonelia*.

***Caulerpa* algae**
Caulerpa sp.
Another green alga, this one is in the genus *Caulerpa*. The clusters of grape-like green balls are characteristic, although other kinds of *Caulerpa* may have other growth forms. This species can be sporadically abundant.

Three-banded anemonefish
Amphiprion tricinctus
And speaking of clusters of balls, the inflated tentacle tips of this *Entacmaea quadricolor* sea anemone have a similar appearance to the ball algae in the previous scene. Here a young three-banded anemonefish, Amphiprion tricinctus, finds refuge among the stinging tentacles of its host anemone. Like other kinds of anemonefish, this one is immune to the sting of the anemone, probably due to mucus secreted on the fish's skin that prevents the anemone's stinging cells from firing.

Three-banded anemonefish
Amphiprion tricinctus
These are the same animals as in the previous scene observed a couple of months later. The anemonefish has grown somewhat, turning a bit darker colored in the process. The fish bites at a drifting piece of mucus, but apparently finds it inedible. *Amphiprion tricinctus* is thought to be endemic to the Marshall Islands; that is, it is currently known only from the Marshalls.

Three-banded anemonefish
Amphiprion tricinctus
Both the anemone *Entacmaea quadricolor* and the anemonefish *Amphiprion tricinctus* can vary somewhat. Both of these are somewhat different from their counterparts in the previous two scenes. Sometimes young specimens of this fish are very orange, like the smaller one shown here. The larger individual that emerges from the hole has more typical *Amphiprion tricinctus* coloration.

Three-banded anemonefish, with cleaner shrimp
Amphiprion tricinctus with *Periclimenes holthuisi*
Amphiprion tricinctus is known to inhabit several different kinds of anemones, including the one in the previous scenes and the sand anemone, *Heteractis aurora*, seen here. This group of fish includes one medium large individual with at least two tiny juveniles. Also living in the anemone are two or three nearly transparent cleaner shrimp in the genus *Periclimenes*. One of them appears to try to clean the parasites off the larger anemonefish. You have to be a bit careful with these anemones. While their stinging cells are not potent enough to cause a diver much distress, they do help protect their anemonefish from predators, who try to avoid the anemone's stingers. However, this anemone is a bit sensitive, and if disturbed will retract completely under the sand, leaving its various fish and shrimp inhabitants exposed on the surface without protection. Try not to irritate the anemone and cause it to retract.

Three-banded anemonefish
Amphiprion tricinctus
This anemone, *Heteractis malu*, is an unusual sea anemone for Kwaj. Currently we know of only one specimen, and it is in the lagoon near the west end of Kwajalein Island. While similar to the common long tentacle anemone *Heteractis crispa*, there are some significant differences between the two species. Living in the anemone are one fair sized and at least four smaller *Amphiprion tricinctus.*

Three-banded anemonefish
Amphiprion tricinctus
Here is another interesting symbiosis. A couple of juvenile *Amphiprion tricinctus* are living in a corkscrew anemone, *Macrodactyla doreensis*. What makes this interesting is that, like the symbiotic relationship in the previous scene, such a relationship has never been officially reported between this species of anemone and this species of anemonefish. In fact, this anemone has not previously been reported to live in the Marshall Islands, and since *Amphiprion tricinctus* lives only in the Marshalls, their relationship has been unknown to scientists. Although the corkscrew anemone is officially known only from the far western Pacific, especially the Philippines and New

Guinea, it is not too uncommon here in the Marshalls in lagoon patches of *Halimeda* algae on an otherwise sandy bottom. This goes to show that the authors of the books don't know everything; there is a lot left to learn about the animals in this part of the world.

Three-banded anemonefish, black color form
Amphiprion tricinctus
For some reason, any time a normally mostly orange *Amphiprion tricinctus* lives very long in a carpet anemone, *Stichodactyla mertensii*, the orange parts of the fish turn mostly black. Sometimes they retain a bit of orange only in the face, but sometimes even that goes away. The smaller fish in this scene still has some orange left on the edges of its pectoral fins, but that will probably fade as the fish grows.

Three-banded anemonefish, black color form
Amphiprion tricinctus
Here a couple of large *Amphiprion tricinctus* that have apparently lived their entire lives in this carpet anemone. The fish have gone mostly black. Even their faces have faded from orange to gray.

Coral reef
A shallow reef on top of a lagoon pinnacle shows a variety of different coral species.

Hawksbill turtle resting
Eretmochelys imbricata
This small hawksbill turtle is resting on the slope of a lagoon pinnacle. It looks as though it may have been feeding before its attention was diverted by the approach of the photographer. Hawksbills eat a variety of invertebrate animals, usually preferring sponges but later we will see one munching on some gorgonians. You can usually distinguish a hawksbill turtle from the more common green turtle by its longer neck (not seen here), more pointed beak, and more mottled pattern on the shell; green turtle shells often have a large reddish brown patch on each of the plates.

Hawksbill turtle
Eretmochelys imbricata
A larger hawksbill turtle rises up out of a depression in the reef where it had been resting or feeding at the approach of the photographer. It is cautious but not overly afraid, since it swims below fairly close. Again look at the mottled dark and light pattern on the shell. This pattern is characteristic of the hawksbill. There is also a bit of green algae forming a film over the shell.

Turtle passes around diver
Eretmochelys imbricata?
A sea turtle swimming along a lagoon pinnacle slope passes cautiously around a diver, who sits still to watch. It looks as though the turtle did not notice the cameraman until it got rather close, at which time it turned off to pass between the two divers. Although the shell is a bit overgrown to determine the pattern, the long neck and somewhat pointed bill looks most like a hawksbill turtle rather than a green.

Photographer in school of aweoweo
Priacanthus hamrur
A still photographer is surrounded by a large school of aweoweo, *Priacanthus hamrur*, on a lagoon pinnacle reef. Many years in Hawaii drummed the common name of aweoweo into my brain instead of the "Goggle-eye" or "Bigeye" seen in some books. These fish can be found either individually, hanging low over coral reefs where they dive for shelter when big lumbering divers approach, or they may form large schools such as this one. Nocturnally active, at night they disperse to feed on plankton. They can change color rapidly, going from silver to red in seconds.

Aweoweo with cleaner wrasse
Priacanthus hamrur with *Labroides dimidiatus*
Some aweoweo have dropped down from a school to a cleaning station, where a couple of cleaner wrasses, *Labroides dimidiatus*, pick parasites from their bodies and even from their gills.

Aweoweo school
Priacanthus hamrur
A school of mostly red aweoweo approach and pass the photographer on a lagoon pinnacle reef.

Twinspot snapper
Lutjanus bohar
This large snapper drops in to investigate the photographer on the oceanside of the atoll's east reef. It derives its common name from two distinct white spots below the dorsal fin in young specimens; this large one has lost the spots. This is a good fish to recognize. It is a voracious predator on fish and invertebrates, and eating its flesh will often produce ciguatera poisoning. Don't try to eat this one.

Latticed sand perch
Parapercis clathrata
The circle a bit behind the eye of this bottom dweller indicates that it is a male. These fish prop themselves on the bottom on their stiff pelvic fins and wait for signs of prey. They eat small fish and invertebrates and will sometimes hang around divers to wait for them to disturb and expose potential prey.

Latticed sand perch
Parapercis clathrata
A closer shot of a male *Parapercis clathrata*.

Lizardfish
Saurida gracilis
Much like the sand perches in the previous scenes, lizardfish rest on the bottom and wait for potential prey. They can dart quickly forward to grab an unsuspecting prey should one happen to appear. Here three individuals are piled up on a rock.

Lizardfish
Saurida gracilis
A closer shot of the same three individuals.

Purple queens
Pseudanthias pascalis
Purple queens are a common sight on oceanside and some lagoon pinnacle reefs. They belong to the fairy basslet group and are in the grouper family. Usually found schooling like this, they are plankton eaters (planktivores). However, they do not adapt well to aquaria, usually never learning to eat provided fish food. Best to avoid catching these for your aquarium. This group is milling around above some staghorn *Acropora* coral.

Randall's Anthias, male
Pseudanthias randalli
Also called Randall's fairy basslet, *Pseudanthias randalli* lives relatively deep on the oceanside slope. Here at Kwaj they are always deeper than about 35 meters. Where you see them, there are generally a few males and more females. The females are mostly uniform reddish, while the males develop the longitudinal red and magenta stripes. Like the parrotfish noted earlier, fairy basslets such as these and the species in the next few scenes start their adult lives as females and may change to males later in life.

Longfin Anthias, male
Pseudanthias ventralis
I think one of the prettiest fish is the longfin fairy basslet. The female is mostly purplish with a yellow streak down the back. Here at Kwaj, the males are purple with a red crown and red running down the back, a large red spot on the tail fin, and long yellow ventral fins. Either this species varies fairly considerably between different island groups in the Pacific, or it is possible that there may be more than one species involved. Like Randall's Anthias in the previous scene, these live fairly deep on the oceanside slope.

Bartlett's and Peach Anthias
Pseudanthias bartlettorum and *Pseudanthias dispar*

Both the Bartlett's and peach anthias have a basic color pattern of yellow on the upper half of the body and purplish below. In the Bartlett's, the colors are more vivid and distinct, particularly in the larger males. In the peach anthias, the colors are more subdued, but the males of this species have a long, distinct red dorsal fin. Most of the fish you see in this scene are Bartlett's; a single male peach shows up in the latter part of the scene. You can't miss his long red dorsal fin. These two species share the habitat at the upper edge of the oceanside dropoff. *Pseudanthias bartlettorum* is less common, usually found only in a few a few isolated schools between Kwajalein and Sar Pass. They are much more common at Namu Atoll, the next atoll south. The ending "orum" on the specific name "*bartlettorum*" indicates that this fish was named after more than one person named Bartlett. In this case, the fish was named after Nate and Pat Bartlett, two exceptional fish photographers who lived at Kwaj in the early 1970s and were among the first to recognize the fish as something different.

Princess Anthias
Pseudanthias smithvanizi
Another common fairy basslet is *Pseudanthias smithvanizi*. Here a large school mills around the oceanside dropoff near a bush of black coral.

Longnose hawkfish
Oxycirrhites typus
The longnose hawk is certainly one of the more distinctively colored fish. It is occasionally observed living in gorgonian, black coral, or sometimes large soft coral colonies at depths exceeding about 35 meters on the oceanside slope or on some lagoon shipwrecks. At such depths, the red plaid pattern fades to gray and makes the fish hard to see. At Pohnpei this species can be much shallower, sometimes in as little as about 10 meters.

Pixy hawkfish
Cirrhitichthys oxycephalus
Sometimes also called the spotted hawkfish, *Cirrhitichthys oxycephalus* is a relatively common inhabitant of shallow oceanside reefs on the windward side of the atoll. They are less frequently seen on the leeward side, although you can occasionally find specimens there or even inside the lagoon.

Blacktip grouper
Epinephelus fasciatus
The blacktip grouper is a relatively common fish on the oceanside slopes and on some lagoon pinnacles. It spends most of its time perched in coral, probably watching and waiting for the small fish and crustaceans that make up its diet.

Blacktip grouper
Epinephelus fasciatus
A closer shot of the head of *Epinephelus fasciatus.* The common name "blacktip" no doubt refers to the black upper portion of the dorsal fin, although the very tips are often white.

Coral hind
Cephalopholis miniata
The coral hind is an attractive grouper that is most often observed on lagoon shipwrecks, although they also live around deeper lagoon reefs. A fair number of them live on the South Pass Cha, a rubble shipwreck on the west reef lagoon slope at about 25 to 30 meters, where this footage was taken.

Peacock grouper
Cephalopholis argus
A common species, *Cephalopholis argus* can be seen on lagoon and oceanside reefs. Here two of them cross paths. They tend to be a bit shy and difficult to approach very closely.

Camouflage grouper
Epinephelus polyphekadion
One of the most common large groupers in the Marshalls, *Epinephelus polyphekadion* is given its common name by the camouflage pattern of brown and tan on its body. Occasionally, especially in areas that have not seen spear guns, this species can be relatively curious and come very close to divers. This individual allowed me to approach within

inches for this and especially for the next scene. Unfortunately, their relative tameness have made them easy targets for spears, and on some reefs they are now shy and hard to find. Spearing this species really doesn't make much sense; their diet of small reef fish and crustaceans often makes them ciguatoxic and dangerous for humans to consume.

Camouflage grouper
Epinephelus polyphekadion
Close-up of the head. The row of small teeth within the large mouth are easily visible. These large mouths permit them to swallow surprisingly large prey.

Camouflage grouper with cleaner shrimp
Epinephelus polyphekadion
Here is another *Epinephelus polyphekadion*, in a small cave with a cleaner shrimp crawling over its face in search of parasites to pick.

Black jack
Caranx lugubris
On the oceanside slope, a black jack rises above the photographer and joins several others on their way down to investigate the bubbling demon below themt. This species is another one that has been frequently implicated in ciguatera poisoning. Many of the old time spear fishermen used to say that you could eat other jacks up to 10 pounds or so, but you shouldn't eat a black jack of any size.

Bluefin trevally chasing Bluestreak fusiliers
Caranx melampygus and *Pterocaesio tile*
Here come the bad boys. A couple of *Caranx melampygus*, sometimes called bluefin trevally or blue jacks (or blue ulua in Hawaii), come in to chase around a school of fusiliers. Although the fusiliers seem a bit large for the jacks, the predators apparently have no trouble eating them.

Bluefin trevally
Caranx melampygus
These blue ulua often travel in pairs, but sometimes form larger groups. There is a large school of hundreds of fish that seems to move up and down the oceanside of the west reef between Kwaj and Ennubuj. In the old days, they frequently used to come in and swarm around divers. They've kept their distance for some years now, and frequently turn tail and run when they see divers. I think they must have become aware of spears.

Scissor-tailed fusiliers
Caesio caerulaurea
A group of young *Caesio caerulaurea* swim by and investigate an isolated *Porites* coralhead on a sandy lagoon reef slope. They're difficult to see, but the crowded dark colored fish low over the coralhead near the right side are pigmy sweepers, *Parapriacanthus ransonneti*, living in a hole in the coralhead. The sweepers are a fast moving schooling species that seems to be not very common around here.

Yellowback fusiliers
Caesio teres
This common fusilier can be seen in large numbers on some oceanside and lagoon pinnacle reefs. They will frequently swarm around divers, as if coming over to see what's going on. While the adults at Kwajalein are primarily blue with a yellow tail, juveniles have the yellow extending forward across much of the dorsal surface, hence the name "yellowback." In other areas, even the adults may be so colored.

Bluestreak fusilier school with diver
Pterocaesio tile
A school of *Pterocaesio tile* and a diver go opposite directions over a stand of staghorn *Acropora* coral. This was filmed on the oceanside of Legan Island.

Bluestreak fusilier school with diver
Pterocaesio tile
A diver settles down in a sandy channel as a numerous *Pterocaesio tile* swarm over reefs.

Whitetip shark with pilot fish
Triaenodon obesus
Triaenodon obesus with an accompanying pilot fish comes in for a close look. Even though I know these sharks are not aggressive, while filming I was starting to wonder when (or if) she would turn away .

Gray reef shark
Carcharhinus amblyrhynchos
A gray reef approaches over staghorn *Acropora* and suddenly darts away.

Gray reef shark
Carcharhinus amblyrhynchos
Another *Carcharhinus amblyrhynchos* comes in for a close look. Apparently the photographer was too large and scary, so the small shark turned tail.

Spotted eagle ray pair courting
Aetobatis narinari
These two spotted eagle rays appear to be ready to mate. Pre-mating behavior in this species is said to include the male grabbing the dorsum of the female with its upper tooth plate, then flipping her over to perform actual mating. Apparently these two were sufficiently preoccupied to not notice the presence of divers until they approached rather close, and were then startled enough to break off and dart away.

Sticky sucker anemone
Cryptodendrum adhaevisum
The sticky suckers are technically named *Cryptodendrum adhaevisum*, but we call them sticky suckers for two reasons: their fine low tentacles are quite sticky to the touch (hence the specific name "*adhaevisum*"), and when disturbed they rapidly withdraw back into the hole from which they extend. One kind of anemonefish from other areas is said to occasionally use this anemone for a home, but in the Marshalls no fish live in it. Instead, there are usually several commensal shrimp and at least one crab that do live on nearly every one of these anemones. If you watch closely, you can see one of these shrimp move into the upper right corner of the anemone. These anemones vary considerably in color, often with the outer rim a distinctly different color. Here, the brown rim differs from the yellow oral disk.

Stick sucker anemone with commensal shrimp
Cryptodendrum adhaevisum and *Periclimenes brevicarpalis*
This is another color form of *Cryptodendrum adhaevisum*, this one with a brown oral disk with a white trim. In the dip in the upper middle portion of the anemone, you can see one large and one smaller commensal shrimp living on the anemone's surface. These are shown up close in the next scene. They are sometimes referred to as commensal shrimp because of the kind of relationship they form with their host anemone. Commensalism is a form of symbiosis. The term symbiosis simply means two organisms of different species living together in some sort of specific association. The relationship is referred to as commensalism when one of those species derives some sort of advantage from the relationship, while the other is neither benefited nor harmed. Another kind of symbiosis, where both parties derive mutual benefit (such as corals or giant clams with their zooxanthellae) is called mutualism. But quite often, our calling a relationship commensalism or mutualism is simply a guess. Do we really know if these shrimp, for example, benefit or perhaps even harm the anemone in which they live?

Short-clawed shrimp on sticky sucker anemone
Periclimenes brevicarpalis and *Cryptodendrum adhaevisum*
This species of shrimp is always found living with some kind of anemone or coral. The name "short-clawed" is derived from the scientific name *Periclimenes brevicarpalis*. The larger shrimp at left is the female, while the smaller male is to the right. These shrimp seem to graze for food stuck to the tentacles of the anemone, and in this scene, the female apparently irritates the anemone causing a minor retraction. If really disturbed, the anemone would have fully retracted, disappearing within its hole.

Sticky sucker anemone
Cryptodendrum adhaevisum
Yet another color variation of *Cryptodendrum adhaevisum.*

Short-clawed shrimp on sticky sucker anemone
Periclimenes brevicarpalis and *Cryptodendrum adhaevisum*
Here is the female *Periclimenes brevicarpalis* living on the sticky sucker shown in the previous scene.

Short-clawed shrimp on Hell's fire anemone
Periclimenes brevicarpalis and *Actinodendron arboreum*
Periclimenes brevicarpalis will also live on other kinds of anemones. This one is on an individual of the sand dwelling anemone *Actinodendron arboreum*, sometimes called the Hell's fire anemone for the severity of the stings it can cause. Don't mess with this character. If disturbed, it will retract suddenly into a hole in the sand, and often little bits of tentacles break off and flush outward, sometimes hitting divers who are too near. The sting is far worse than you would expect from little tiny bits of tissue. But apparently the sting doesn't seem to bother the shrimp.

Mole lobster, usually hides by day
Palinurella wieneckii
Palinurella wieneckii is called the mole lobster because of its small eyes and because it hides well back in dark caves and tunnels nearly all of the time. On rare occasions at night it ventures close enough to the openings to be seen. This one was coaxed out into the open for photos before being allowed to retreat back into the safety of its cave. If you have a sharp eye, early in the scene a very tiny dragon wrasse can be seen at the left side of the screen.

Green spiny lobster foraging at night
Panulirus penicillatus
This species, also commonly called the tufted spiny lobster, is one of several species living here at Kwajalein. This was a very large individual roaming around on the oceanside reef at night in search of food.

Slipper lobster, on coral at night
Parribacus antarcticus
A smaller member of the lobster group is *Parribacus antarcticus.* Despite the specific name (a mistake by the person who described it), it does not live in Antarctica, but only in warm seas. Another nocturnal species, the slipper is usually observed on the oceanside reef at night. Here it is crawling across a colony of branch coral, *Acropora*.

Green leaffish, walking on pectoral fins
Taenionotus triacanthus
The leaffish get their common names by sitting on the bottom, swaying their bodies back and forth like a leaf blowing in the wind. This species varies in color from this green to white, yellow, red, and black. They are ambush predators, waiting until some small fish comes close enough to engulf. Although they do not move much, this one is sort of hopping across the bottom on its pectoral fins.

Red leaffish
Taenionotus triacanthus
This is a red form of the species shown in the previous scene.

Red leaffish, close-up of head
Taenionotus triacanthus
Moving in on the fish from the previous scene, we get a close profile shot.

Stonefish, highly venomous spines
Synanceia verrucosa
Although there are several scorpionfish that resemble rocks, this is the real, highly venomous stonefish, *Synanceia verrucosa*. Spines in the dorsal and other fins are connected to bulbs at the spine bases that contain an extremely virulent venom. It requires a fair bit of force to get the venom into a wound, however. The thick tissue around the spine needs to be forced down to squeeze the bulb, pushing venom into the spine and injecting it into the wound.

This can easily happen by, for instance, stepping on a stonefish, but usually does not happen if one is accidentally punctured while lightly handling the fish. Still, if the venom does get into a wound, it is extremely painful and has been known to cause death. Rarely do these fish bother to move; this one happened to get agitated from the attention given it by the photographer and decided to move to a safe cave.

Stonefish, colorful yet well camouflaged
Synanceia verrucosa
The stonefish can be surprisingly colorful for an animal that blends in so well against a rocky bottom. About the only movement you can see is something moving inside its mouth as it draws water in to flow across its gills. As we zoom out, you also can see movement at the gill openings where the water is being forced out.

Titan or mustache triggerfish defending nest
Balistoides viridescens
Most triggerfish make a nest in a depression in a sandy or rubbly area. Eggs are deposited into this nest, and remain open and exposed until they hatch. Since eggs are a tasty meal for many other fish, the nest would not last long if the parent trigger did not vigilantly watch over them, chasing away any fish that approach. The triggers get very aggressive during this time. The titan trigger, one of the larger species, will not only chase away intruding fish, they may also chase, butt or even bite divers who blunder too close. This one was defending a nest and the photographer is getting too close. Fortunately, the diver had the sense to retreat when the trigger started charging.

Titan or mustache triggerfish, asleep
Balistoides viridescens
As you can see, the teeth on these aggressive triggers are things to respect. This one is peacefully sleeping in a cave at night. The close-up of the mouth illustrates why some people refer to this as the mustache trigger.

Clown triggerfish
Balistoides conspicillum
Balistoides conspicillum has a conspicuous pattern indeed. This shot looks as though the clown is uttering an expletive at the photographer when it turns to face the camera. Juveniles are popular aquarium fish, although hard to find.

Minnows in bait ball
This school of minnows near the Prinz Eugen shipwreck was swirling around and tightening up into a bait ball because there were a couple of small jacks herding them around and picking off the stragglers.

Diver descending from boat
In clear water, a diver adjusts his gear as he settles down toward the bottom from the boat.

Diver swims through sandy channel
A diver slowly frog kicks through a sandy bottom surge channel.

Diver passes coral mount
A diver swims in front of a large mound of various kinds of living corals on a lagoon pinnacle.

Divers pass overhead, glassy calm
Here's why we like the doldrums. The lagoon can become flat calm, which makes for a gorgeous day of boating and diving.

Divers drift past sea fan
A pair of divers drifts with a current past an orange sea fan, Subergorgia mollis, in an atoll pass.

Diver at bottom of channel
A diver searches through the bottom of a narrow surge channel for treasures that have fallen from the channel walls.

Diver descends outer reef slope
A diver swims leisurely down the oceanside reef slope over gorgonians, unaware that a gray reef shark is passing overhead behind him.

Hawksbill turtle eating gorgonians
Eretmochelys imbricata
Eretmochelys imbricata typically eats bottom-dwelling invertebrates such as sponges. This scene shows that they also munch on gorgonians. This may explain why you sometimes see little piles of broken-off gorgonian branches underneath damaged colonies.

Stingray escorted by two jacks
Himantura fai and *Carangoides orthogrammus*
The stingray *Himantura fai* swims along a sandy lagoon reef accompanied by a pair of yellow-spotted trevally. The jacks (trevally) follow stingrays because when the rays dig in the sand for food, they often scare up sand dwelling fish and crustaceans that the jacks snatch away.

Stingray escorted by jack
Himantura fai
Another *Himantura fai* cruising along a sandy bottom. This one has a single jack freeloader.

Gray reef shark through goatfish school
Carcharhinus amblyrhynchos
On a lagoonside reef, a small gray reef approaches the photographer, then turns away to pass through a school of small goatfish. I like the shadow moving along the sand beneath the shark.

Gray reef sharks on reef slope
Carcharhinus amblyrhynchos
A group of curious *Carcharhinus amblyrhynchos* come up from the bottom of a steep slope into an atoll leeward reef pass to see who's intruding on their space. Atoll passes often seen large populations of sharks, since the daily ebb and flow of the tides through those passes encourages an abundant fish fauna, such as the group of *Caesio teres* in the foreground, which provides a steady food source for the predatory gray reefs. Generally this does not present too much of a danger, but you do have to watch for aggressive behavior on the part of the sharks.

THE SECOND MENU ICON ENTERS THE MOVIE HERE

Crown-of-thorns starfish eating coral
Acanthaster planci
The crown-of-thorns star is an interesting animal for several reasons. First, it eats live coral by crawling over it, extruding its stomach and dissolving the living tissue right out of a coral colony, leaving a pure white patch of coral that is soon covered with algae. At some times and places, these stars have been known to increase in numbers to the point where they devour nearly all the living coral on some reefs. There is still debate about whether this is all bad (in that large swaths of coral reef are killed) or somewhat good (in that like a forest fire, it clears away the old growth and permits recolonization by a more vigorous and diverse young coral fauna). But even if it is good, it is painful to see areas where these stars have killed off large amounts of coral. But be careful. Some people have suggested that divers should try to kill or otherwise hassle these stars to try to discourage them. This may be counterproductive. First of all, they're difficult to kill and regenerate very well. Secondly, while I do not know if this is the case for starfish, their relatives the sea urchins are known to respond to a stressful or near death experiences by spawning, possibly in a last ditch attempt to spread their genes around before they die. If starfish can do the same, stabbing or otherwise stressing out a crown-of-thorns may only prompt it to spawn earlier than it otherwise might, and earlier spawning is one of the most effective ways to increase population size. So hassling these starfish might only increase their numbers. Many species of sessile or slow moving invertebrates practice broadcast spawning; that is, they release very large numbers of eggs and sperm (gametes) out into the surrounding water, and fertilization and development take place while drifting around in the plankton. Since unfertilized gametes do not survive long floating free, spawning when you're the only one doing it would not be very worthwhile. Consequently, many species have evolved to spawn when they sense that another member of their species in the same area has spawned.

This can lead to mass spawnings and lots of fertilized eggs, which in the case of the crown-of-thorns, might also lead to lots of coral-eating starfish and wiped-out reefs.

Crown-of-thorns starfish tube feet
Acanthaster planci
Starfish move by means of a hydraulic water vascular system. Muscles compress vessels and spaces that contain water drawn in from the outside, and this varying water pressure extends and reracts the tube feet that the stars use to pull themselves along. These *Acanthaster* are also covered with sharp spines that you don't want to have puncture your skin. They are coated with a slimy toxin that is not only quite painful but also inhibits the coagulation of blood. A wound from one of these spines will bleed for a long time.

Granulated starfish
Choriaster granulatus
This hefty starfish is quite rare here at Kwajalein. It is, however, common at Pohnpei, where dozens can be seen in a single dive. All the Kwaj specimens we've seen were on the oceanside slope, most of them at night.

Red and yellow starfish
Fromia sp. ?
This may be a species of *Fromia*. It is a small but common star, seen most often on lagoon pinnacles at night.

Barf starfish
Echinaster callosus
What we call the barf star is normally nocturnal. Sometimes it can be found inside caves and ledges during the day, but at night it comes out onto the reef. Most specimens are seen on the oceanside reef, but we've run across a few specimens on lagoon pinnacles. The common name is due it its supposed resemblance to, well…..

Pencil sea urchin
Phyllacanthus imperialis
This pencil sea urchin usually hides well back in holes on the oceanside slope during the day. You can sometimes spot them wedged into their dark holes if you use a flashlight. At night, they emerge to graze on algae.

Small pencil sea urchin
Eucidaris metularia
Eucidaris metularia is common under rocks on oceanside and some lagoon reefs. In this scene, it is crawling over a purple colonial tunicate.

Sea urchin with long pedicellaria
Paraselenia gratiosa
This sea urchin appears to be a dark color form of *Paraselenia gratiosa*. In addition to the characteristic spines, urchins also have long tentacles often tipped with small jaw-like structures. These are called pedicellaria and can be seen waving around this urchin. Pedicellaria can be used in locomotion, and in some cases for defense. There is one rare species here called *Toxopneustes* that has large and venomous pedicellaria that can injure divers who handle them carelessly. The light orange branching colony down in the lower left is a kind of bryozoan, sometimes called a sea moss, although it is an animal.

Bennett's feather star
Oxycomanthus bennetti
Feather stars are related to starfish and sea urchins. Some species hide during the day in holes and under rocks, but *Oxycomanthus bennetti* tends to sit exposed on coral all the time. They are filter feeders, catching plankton in their numerous pinnate arms. This species, like some of the others, comes in a range of colors.

Bennett's feather star
Oxycomanthus bennetti
Here is an all yellow form of the previous species. The arms on feather stars are very brittle and break off easily if handled or if they brush against a diver's wet suit. While they are very good at regenerating lost feathers, it does cause them to use up energy, so it is best to try to avoid breaking them up.

Bella feather star on gorgonian
Cenometra bella
Another species of feather star, this *Cenometra bella* is perched on a gorgonian and has its arms somewhat curled up. Being filter feeders, the feather stars, also called crinoids, like to try to get pretty high up off the reef on top of coral colonies or gorgonians to get more into the currents carrying their planktonic food.

Bella feather star
Cenometra bella
This *Cenometra bella* is expanded out and feeding. It is also perched on a gorgonian. Part of another crinoid can be seen in the upper right as we zoom out.

Commensal crab and shrimp on feather star
Allogalathea elegans
Feather stars are habitats in themselves. There are a number of commensal animals, mostly crabs and shrimps, that live their entire lives hanging onto the body of a crinoid. Here a crinoid has been carefully turned over to reveal a crab called *Allogalathea elegans*, a species found only living with crinoids. Also, a bit harder to see, is an elongate shrimp to the left of the crab that flips around in the early part of the scene. These hitchhikers, which are not found on all crinoid individuals, do not damage the feather star itself, but may eat some of the plankton caught in the arms before the crinoid can work it down to its mouth. Commensal, once again, is a term given to a kind of symbiosis (remember "living together" from earlier in this movie?). Symbiosis is a general term meaning just living together. Commensalism is used when one party in the symbiotic relationship gains an advantage of some sort while the other party is pretty much unaffected one way or the other. In this case, the crab and shrimp both gain; they remain hidden, eat some of their hosts food, and are less likely to be preyed upon, since not many animals eat these hard, brittle, pointy crinoids. Another kind of symbiosis is called mutualism, and that is where both parties gain from the relationship. Yet another is parasitism, where one party (the parasite) gains and the other (the host) is damaged. Normal predation of one species on another is not usually considered symbiosis, because the two are not really "living" together. One of them dies.

Decorator crab covered with zoanthids
Camposia retusa
Some crabs camouflage themselves in unusual ways. Several species are referred to as decorator crabs; like this *Camposia retusa*, they usually cover their shells with sponges and other growths to cause them to blend in with the bottom. This one, however, managed to start a little garden of zoanthids, an animal related to sea anemones, on its shell. This illustrates another case of symbiosis. Most people would call this mutualism. The crab gains some protection from camouflage and from the fact that few animals want to eat zoanthids, some of which are poisonous and which have the typical coral nematocyst stinging cells. The zoanthids gain mobility, possibly getting them to better feeding areas and possibly even protecting them from animals such as crown-of-thorns or cushion starfish that eat corals and anemones. Even a slow crab like the decorator can outrun a starfish.

Orangutan crab
We call this bizarre little spider crab an orangutan crab because of its reddish brown fur (probably algae) and its habit of waving its forward appendages sort of like an orangutan waving its arms.

Hairy spotted spider crab
This is another of the spider crabs, also covered with hair and spotted along the appendages. These small crabs live hidden under rocks and in holes and are not easy to find.

Soft coral
Pachyclavularia violacea
This field of flowers is a soft coral that appears to be the one called *Pachyclavularia violacea*. It is common in some areas, for example in very shallow water (2 to 5 meters depth) along the reef between Bigej and Meck Islands, where it tends to grow in shaded areas on the sides of and in ledges underneath coralheads.

Grasping soft coral
Xenia sp.

Most soft corals don't move much except perhaps to sway in the current, but this one, called *Xenia*, is an exception. Unless disturbed, it continually grasps with its polyps. Presumably this allows it to filter more water for plankton. Each of these flowery polyps on stalks is a coral animal. They are connected at the base and together form the coral colony. A colony is originally created from a coral larva that settles to the bottom and forms a single polyp, which then divides as it grows into a colony of numerous polyps. One characteristic of the group known as soft corals is that each polyp has eight pinnate tentacles that surround a mouth. In most species the polyps are much smaller than these so it is not as easy to discern the morphology.

Coral polyps, waving in the surge
Goniopora sp.
Although these look kind of similar to the previous *Xenia*, we can see that each polyp has more than eight tentacles; in fact, there are 24, and they are smooth rather than pinnate. This is actually a hard coral with a calcium carbonate skeleton down there at the base of those long stalks. When disturbed, the stalked polyps will retract completely down to the hard surface of the coral. Since this one has 24 tentacles on each polyp, it is a species of *Goniopora*. Its close relative, *Alveopora*, has only 12 tentacles per polyp.

Coral polyps, two kinds with plate algae
Alveopora sp.
These are the 12-tentacled *Alveopora* referred to in the previous scene. These are probably two different species, although there can be considerable intra-specific variation in some corals. The white one probably has little or none of the symbiotic zooxanthellae plants living within its tissue.

Bubble or grape coral
Pleurogyra sinuosa
This cluster of grapes is called either bubble or grape coral, but its real name is *Pleurogyra sinuosa*. You tend to see it in lagoon habitats, often hanging from the underside of coral ledges. This too is a hard coral. The bubble-shaped tentacles can be retracted right down to the sharp-edged hard coral skeleton.

Gorgonian and pink coral
Gorgonians are also kinds of soft corals. If you look could look close enough in this scene, the small white polyps on this one each have eight pinnate tentacles. To the right is a pink *Stylaster* coral, a hard coral related to the fire corals.

Red gorgonian with white polyps
In this gorgonian, you can see the white polyps, each with eight pinnate tentacles.

Pink coral in ledge
Stylaster sp.
Pink coral, or *Stylaster*, prefers to live in shaded ledges and caves. Fine tentacles from the coral reach out into the narrow gaps between branches and filter plankton from the passing water.

Gorgonians in ledge
The orange fan in the center and the long reddish whips mostly on the right side are more gorgonians. The fine branches at upper left and on the other side of the ledge are true black corals.

Gorgonians and feather star above
Here the camera pans up through a field of various branching and whip gorgonians. Early in the scene, a feather star or crinoid is spread out on one of the whips.

Diver coming down reef by whip corals
A diver swims down the dropoff towards some whip gorgonians.

Crack in reef with fan corals
Subergorgia mollis
This is a large crack in the oceanside slope that has been colonized by several fan gorgonians, *Subergorgia mollis*. A moorish idol and a couple of racoon butterflyfish swim along the edge of the crack.

Crack in reef with fan corals
From the inside of the crack in the previous scene, we look out through the fan gorgonians.

Looking up reef into sun
From a position a ways down the oceanside dropoff, we turn around and look back up towards the surface. A school of silhouetted fusiliers pass in front of the sun.

Diver over reef
A diver swims along the knee of the oceanside dropoff.

Cornet fish squadron
Fistularia commersonii
A school of cornet fish cruises over a lagoon reef. Cornetfish are one of several kinds of elongate fish, but this species is easy to distinguish because of its long, whiplike tail. They are carnivores that feed mostly on small fish and some invertebrates, which they slurp up through their long, tubular mouths.

Needlefish silhouetted above
Long and slender like the cornetfish, needlefish do not have a whiplike tail and are usually found just below the water's surface. They have a long, pointed beak that they use to grab small fish prey. The beak is quite sharp, and needlefish have been known to skip across the surface of the water and impale swimmers. They seem most likely to be startled at night, so night divers should be careful entering and leaving the water when needles are present.

Heller's barracuda swirling above
Sphyraena helleri
Many small barracuda, *Sphyraena helleri*, swirl around directly overhead before heading off. This was filmed on the oceanside slope near South Pass.

Blackfin barracuda
Sphyraena qenie
On Victor buoy pinnacle, a trio of the barracuda *Sphyraena qenie* pass close to the camera. This pinnacle is usually home to a school of these barracuda, and they sometimes intermix with another large barracuda, *Sphyraena barracuda*.

Red-striped goby
Amblygobius rainfordi
This goby is common in surge channels on the oceanside reef and on lagoon reefs and pinnacles. It has the curious habit of switching from forward to reverse repeatedly, hovering while it's shifting its gears. Watch the movement of the pectoral fins (on the sides, just behind the head), which appears to direct the motion ahead or astern.

Yellow coralgoby
Gobiodon okinawae
The yellow coralgoby is a lagoon dweller usually found hovering over or among the branches of live *Acropora* coral. It generally does well in aquaria if you can catch it. When threatened they dive down between the branches of the coral to hide.

Fire dartfish
Nemateleotris magnifica
The fire dartfish, or often called firefish, is a goby that hovers just over the bottom. When approached, it can dive into its hole in the blink of an eye. The one who dives in this scene is moving rather slowly. The fish's proper name is *Nemateleotris magnifica*, but in our early days as photographers, we used to refer to them as disappearing fish. With our old lenses, we had to get close to a subject to take its picture. We'd creep slowly in on one of these, and just as we got within range and clicked the camera shutter, the fish would disappear down its hole. I ended up with many pictures of rubbly sand where one of these had been just a moment before. Shooting them with modern zoom lenses is a bit easier.

Helfrich's dartfish
Nemateleotris helfrichi
Nemateleotris helfrichi, a relative of the fish in the previous scene, has the same behavior. It will dart rapidly into a hole when threatened. This species is pretty much restricted to the deeper slope on the oceanside reef. It is rarely seen as shallow as about 20 meters and is more common below 30.

Helfrich's dartfish
Nemateleotris helfrichi
The two in the previous scene decided not to dive for me, but this one darts into a hole when I get too close.

Morrison's dragonet
Synchiropus morrisoni
Locally, these are usually called "scooter blennies" even though they are in the dragonet family rather than the blennies. They move in a "stop and go" fashion, scooting along in short spurts. The live on the rubbly bottom of oceanside surge channels and in some lagoon reef areas. Males tend to be larger and have a tall dorsal fin with an intricate pattern that they will erect to impress females during courtship. When kept in aquaria, the males seem to be trying to impress the females day after day. When a female finally consents, the two appear to lock pectoral fins and spiral up to the surface of the aquarium, where they burst apart and glide back down to the bottom. They may continue this for hours.

Gravel gobblers and blackfin dartfish
Valenciennea strigata and *Ptereleotris evides*
Two gravel gobblers and three blackfin dartfish emerge from a hole in the reef. These fish dive into holes to escape danger, and these apparently didn't mind sharing the same hole with a different species. The gravel gobbler, *Valenciennea strigata*, is also called the bluestreak goby. We prefer gravel gobbler, which refers to its behavior. This species spends a good deal of time picking up gravel and sand in its mouth and moving it around. In an aquarium, they will excavate holes under rocks by gobbling gravel and spitting it out elsewhere.

Onespot wormfish
Gunnellichthys monostigmus
These wormfish can sometimes be seen in large numbers hovering over sandy lagoon bottoms. When approached too closely, this fish will dive rapidly into a hole in the sand that hardly seems as wide as its body.

Purple-headed sand tilefish
Hoplolatilus starcki
This is *Hoplolatilus starcki*, which is also called Stark's tilefish. We used to call it the "blue-headed disappearing fish" because of its habit of disappearing into a hole just as we were about to snap its picture. As with the dartfish, using telephoto lenses made shooting some of these disappearing fish much easier. *Hoplolatilus starcki* is found on the oceanside slope, usually deeper than about 20 meters. The juvenile is all bluish purple.

Pearly dartfish
Ptereleotris microlepis
A group of all sizes of pearly dartfish hovers a hole at the approach of potential danger. All at once, they dive in. A couple of neon damsels share their hole.

Neon damsels
Pomacentrus coelestis
The bright blue neon damsel is common on both oceanside and lagoon shallow reefs.

Sapphire damsels and red coral
Pomacentrus pavo
These blue sapphire damsels are common on lagoon reefs and some pinnacles. In the background is an unusually orange-red form of the coral that may be *Symphyllia recta*.

Indo-Pacific sergeant
Abudefduf vaigiensis
Scuba divers rarely see this rapidly moving damsel because it typically lives in very shallow water, almost up on the intertidal reef.

Golden damsel
Amblyglyphidodon aureus
The golden damsel is common on oceanside and lagoon reefs.

Blue-green chromis school around coral
Chromis viridis
Chromis viridis is often seen in large numbers swarming around bushes of live coral on oceanside and lagoon reefs. When threatened, they will dive between the branches of the coral for protection. In this shot, there are also a couple of black and white striped damsels called reticulated damsels, or *Dascyllus reticulatus.* Also, there are numerous yellow cardinalfish in the shadow under the coral colony at the bottom of the frame.

Blue-green chromis school around coral
Chromis viridis
Here the *Chromis viridis* are a bit larger than in the previous scene. They are around a colony of Porites coral.

Sapphire damsels, Chromis, and Cardinalfish
Pomacentrus pavo, *Chromis viridis*
This colony of *Porites* coral sitting out in the sand has a large resident population of fish. The blue ones are sapphire damsels, *Pomacentrus pavo*. The blue-green chromis, *Chromis viridis*, mill around above the colony. Swarming all around the colony is a dense school of cardinalfish.

Cardinal fish school with one Fusilier damsel
Lepidozygus tapeinosoma
Partly transparent cardinalfish cluster in the gap between two coralheads. Later in the scene, a single fusilier damsel, *Lepidozygus tapeinosoma*, swims through towards the camera. These fusilier damsels are shaped more like fusiliers and fairy basslets than typical damsels.

Yellow cardinalfish school around coral
Apogon luteus
A school of *Apogon luteus* is spread out over a field of Porites coral.

Yellow cardinalfish school around coral
Apogon luteus
A closer look at some of the *Apogon luteus* from the previous scene. The branch of the *Porites* coral in the center is covered with a red sponge.

Striped cardinalfish
Apogon nigrofasciatus
This appears to be *Apogon nigrofasciatus*, a species of cardinalfish that lives in ledges and caves during the day and emerges at night to feed.

Batfish
Platax orbicularis
Here at Kwajalein and in many other places, these *Platax orbicularis* are called batfish. Unfortunately, there is another quite different fish sometimes referred to as a batfish, so some books have taken to calling our *Platax* a spadefish. Whatever they're called, they are interesting and often very curious fish that will follow divers around and sometimes even come within reach. Not long ago, I had one that persisted in coming too close to the camera lens to be photographed, and once when I stuck out my finger, it nibbled on it. Fortunately, they don't have much for teeth. While they can show up anywhere along lagoon or oceanside reefs, we frequently see large individuals feeding on plankton above lagoon bottom shipwrecks. These four looked as though they knew where they were

going; they were cruising down the reef at a good clip and didn't stop to visit. Note that the long ventral fins on all four of these are black.

Batfish
Platax orbicularis
This *Platax orbicularis* came around while we were doing our safety stop after a shipwreck dive. It appeared to be eating plankton and mucus drifting about in the water. This was about the same size as the four in the previous scene, but this one's long ventral fins are quite yellow.

Batfish school
Platax orbicularis
This school of batfish came in for a quick look during a dive on R-buoy pinnacle. All of these had the yellow ventral fins. Why were the fins black on the four that swam by a couple of scenes ago? There were also a few rainbow runners, *Elagatis bipinnulata*, mostly in the distance in the upper part of the frame.

Undulated moray eel hunting at night
Gymnothorax undulatus
Although moray eels live in holes in the reef most of the time, at night many species will emerge to hunt small fish and probably some invertebrates. Morays have long sharp teeth that can easily rip through flesh, causing deep bloody gashes. Fortunately, most species are not overly aggressive and will bite only if cornered or by accident. I have been nipped a couple of times while reaching into a hole in the reef. Apparently the eel thought my pale finger resembled some prey fish. The one pictured, *Gymnothorax undulatus*, acts like one of the more aggressive ones with its long, narrow, open jaw.

Masked moray with *Anthias* in hole
Gymnothorax breedeni
This moray eel, *Gymnothorax breedeni*, shares its hole with a group of Bartlett's anthias that had retreated into it as the photographer approached. It seems strange to me that these fish are willing to stay in there with the eel, which could (and I would assume does) pick off one or two fish every now and then for dinner. This masked moray is usually not too large, but pound for pound is one of the meanest, most aggressive of the morays. This is not a species to try to tickle barehanded.

Giant moray eel extends from hole
Gymnothorax javanicus
Gymnothorax javanicus is the largest of the moray eels in this area. These are thought to reach up to 10 feet in length although they may not get that large around here. Still, I have seen many individuals that looked a good deal longer than I am tall. Fortunately, this one does not have a nasty disposition. In some areas (not here that I know of) divers have tamed this species and it will allow itself to be handled. I wouldn't recommend it—these things have big sharp teeth and even an accidental or gentle bite would do considerable damage. But probably the biggest danger from this species would come from eating it. A top carnivore, *Gymnothorax javanicus* is frequently ciguatoxic and is never safe to eat. Even these, though, are not at the top of the food chain. One of us once witnessed a gray reef shark dart into the reef, pull one of these from its hole, and swim off chomping on it.

Giant moray eel swimming free
Gymnothorax javanicus
It is very unusual to see a moray out of its hole during the day. This *Gymnothorax javanicus* apparently had some reason to move from one side of an oceanside surge channel to the other.

Giant moray eel swimming free
Gymnothorax javanicus
The moray from the last scene continues on to the other side of the channel.

Orangefin anemonefish in purple crispa anemone
Amphiprion chyrsopterus in *Heteractis crispa*
The orangefin anemonefish usually lives in these long-tentacled anemones, *Heteractis crispa*, or in carpet anemones, *Stichodactyla mertensii*, but sometimes inhabits other kinds as well. The anemonefish has two white stripes that

often have a blue tint in large individuals. Typically just two adults live in a particular anemone, often with one to three small juveniles. We suspect the juveniles are there for "backups" in case one of the adults dies or disappears. If one of the juveniles grows too large with both adults still around, the large ones probably will chase it off. These *Heteractis crispa* anemones come in a variety of colors, most commonly brown with pink or purple-tipped tentacles, but yellow ones are also common. The colors mostly come from symbiotic zooxanthellae plants living within and tissue of the anemone. Occasionally the anemones seem to temporarily lose these algae, leaving the tentacles white or even purple like this one.

Orangefin anemonefish in yellow crispa anemone
Amphiprion chyrsopterus in *Heteractis crispa*
Here are two adult and several juvenile *Amphiprion chrysopterus* in a yellow *Heteractis crispa*. Like the parrotfish discussed earlier, anemonefish also go through a sex change during life. However, instead of changing from female to male, anemonefish change from male first to female second, so the female is typically the larger of the pair. This type of change, from female to male, is called protandry and is not as common as the parrotfish's protogyny (female to male).

Orangefin anemonefish in crispa anemone
Amphiprion chyrsopterus in *Heteractis crispa*
More *Amphiprion chrysopterus* in a brownish *Heteractis crispa*, whose long tentacles continually wave back and forth in the mild surge.

Orangefin anemonefish in white crispa anemone
Amphiprion chyrsopterus in *Heteractis crispa*
These two *Amphiprion chrysopterus* live in a small and at this time somewhat contracted white *Heteractis crispa*. Again, this anemone has probably temporarily lost its symbiotic zooxanthellae plants, leaving it with its own mostly white base coloration.

Orangefin anemonefish in white crispa anemone
Amphiprion chyrsopterus in *Heteractis crispa*
Here is a closer view of a small *Amphiprion chrysopterus* in a white *Heteractis crispa*. The anemone's purple tentacles tips are easy to see in this clip.

Orangefin anemonefish in quadricolor anemone
Amphiprion chyrsopterus in *Entacmaea quadricolor*
The anemone *Entacmaea quadricolor* typically does not play host to *Amphiprion chrysopterus* here at Kwajalein. Larger specimens of these anemones usually are inhabited by *Amphiprion tricinctus*, the three-banded anemonefish. Younger *E. quadricolor* anemones, which are usually colonial, have *Amphiprion melanopus*, called either the dusky or the red and black anemonefish, depending upon which book you read. (Again, this is why the scientific names are better—they're more consistent.) But occasionally you'll see an *Entacmaea quadricolor* with *Amphiprion chrysopterus*, as in this case.

Orangefin anemonefish in carpet anemone
Amphiprion chyrsopterus in *Stichodactyla mertensii*
Most carpet anemones, *Stichodactyla mertensii*, are inhabited by *Amphiprion chrysopterus*. Occasionally, as seen earlier in the movie, *Amphiprion tricinctus* occupies carpets, but when they do, the anemonefish turn mostly black. *Amphiprion chrysopterus* does not turn black in carpets. This scene also shows a few of the one species of anemonefish here in the Marshalls that is not in the genus Amphiprion. These three-spot damsels, *Dascyllus trimaculatus*, live in and around anemones when they are young. When they get older and larger, they typically move away and live just out on the reef.

Orangefin anemonefish in carpet anemone
Amphiprion chyrsopterus in *Stichodactyla mertensii*
Amphiprion chyrsopterus grows fairly large here, some well exceeding 100mm (about four inches). They are quite territorial and will often aggressively defend their anemone. I have had this species charge and actually nip at me. It's a good thing they are not as large as sharks; then we'd REALLY have something to worry about down there.

Actually, sometimes I think they are being aggressive not to me, but to their own reflection that they see in my chrome plated regulator mouthpiece. That seems to be where they hit most often.

***Nemanthus* anemones on dead whip coral**
Nemanthus sp.
Many kinds of anemones do not form symbiotic relationships with anemonefishes. This small species is usually found growing thickly together on branches of dead whip coral on the oceanside dropoff.

Plate anemones, open
Amplexidiscus fenestrafer
There are several kinds of plate anemones. This one is *Amplexidiscus fenestrafer*. It is usually seen on lagoon reefs and pinnacles, sometimes several of them growing adjacent to each other. On plate anemones, the tentacles are quite small, just bumps on the surface. The plate anemones are actually only rather distantly related to the other anemones shown here.

Plate anemone, starting to close
Amplexidiscus fenestrafer
Plate anemones can close up by folding their outer margins in over the top. This one is just starting.

Plate anemone, mostly closed
Amplexidiscus fenestrafer
This one has mostly closed up.

Sea anemone
Heterodactyla hemprichii
Another anemone with short tentacles, this one is *Heterodactyla hemprichii*. This one also never has associated anemonefish, although it is usually home to a pair of commensal shrimp. This species of anemone usually lives with its stalk extending down into a hole in the reef and just the oral disk exposed to provide sunlight for its symbiotic zooxanthellae algae. Different individuals vary considerably in color.

Short-clawed shrimp in sea anemone
Periclimenes brevicarpalis and *Heterodactyla hemprichii*
Looking closely at the *Heterodactyla hemprichii* anemone from the previous scene, we see a commensal short-clawed shrimp, *Periclimenes brevicarpalis*. The bodies of these shrimp are mostly transparent. They have a white opaque mass where most of their internal organs are, and scattered white patches on the shell. This may make them harder for potentially predatory fish to recognize.

Sea anemone with short-clawed shrimp
Heterodactyla hemprichii and *Periclimenes brevicarpalis*
This is actually the very same anemone as in the previous two scenes, just taken a few months earlier. They apparently can change color over time. If you look close, you can see two of the shrimp *Periclimenes brevicarpalis*, a female (at left) and a male (closer to the center of the anemone).

Sea anemone
Heterodactyla hemprichii
As mentioned earlier, specimens of *Heterodactyla hemprichii* can very considerably in color.

Sea slug *Cyerce*
Cyerce sp.
This is an as yet unidentified species of sea slug in the genus *Cyerce*. It is not quite a nudibranch, but instead a member of a related group, the sacoglossans. While all nudibranchs are carnivorous on sponges, hydroids, and other animals, all sacoglossans are herbivores, eating only plants. Species of *Cyerce* are very delicate animals; the paddle-like tentacles crowded on the dorsum break off very easily. Fortunately, they grow back quickly as well.

Sea slug *Cyerce elegans*

Another sacoglossan sea slug. This *Cyerce elegans* is a very dark specimen—most of them are much lighter in color. The translucent paddles wave around in the slight surge. This one was out at night; the little shrimp zipping around the frame were attracted to the video lights much like moths to a porch light.

Sea slug *Polybranchia orientalis*
This is yet another sacoglossan sea slug.

Nudibranch *Jorunna rubescens*
Jorunna rubescens is one of the real nudibranchs. This species is pretty large for Kwajalein, most individuals being about 100 to 150mm long. Most nudibranchs we see here are much smaller. We see these occasionally on both shallow oceanside and lagoon reefs. The first ones we saw were in the reef quarry known as the Japanese swimming pool near the air terminal on Kwajalein.

Nudibranch *Nembrotha cristata* eating tunicates
While most of the nudibranchs out here seem to eat sponges or cnidarians (corals and their relatives), there are a few with different kinds of diets. Some, like this green spotted *Nembrotha cristata*, feed only upon these small dark green tunicates. The head end of this nudi (short for nudibranch) is over on the right side, and it has its mouth right on a clump of its tunicate prey. It rasps away at the surface of the tunicate with its radula, which is almost like a tongue composed of numerous hooked teeth. The teeth scrap off the layers of the tunicates as the nudibranch devours it. These can be found occasionally on some lagoon pinnacles and less commonly on the oceanside reef.

Nudibranch *Nembrotha kubaryana* on algae
A close relative of the species in the previous scene, this is *Nembrotha kubaryana*. It differs from *Nembrotha cristata* primarily in the brilliant red coloration around the margin of the foot, as well as on the rhinophores (at right) and on the naked gills (approximately midbody).

Orange spotted flatworm
Acanthozoon sp.
Flatworms are easy to confuse with nudibranchs. Both are mostly soft bodied, both crawl around on the bottom, and often they are both colorful and exotic looking. But flatworms are flat—very flat. In fact, they are generally only a few cells thick. And they wouldn't survive much thicker. They have no specialized respiratory system (gills or lungs) to get necessary oxygen into their bodies, nor do they have a circulatory system (heart and blood vessels) to move it around once it is inside. So since cells require oxygen, they all have to be close enough to the surface of the body to get their oxygen by having it diffuse in from the surrounding water. If the body were too thick, the cells on the inside would die. That wouldn't do the animal much good.

Flatworm *Pseudoceros fulgor*
This flatworm is crawling on colonial tunicates and red sponge. In higher animals the circulatory system acts not only to move oxygen around the body and remove wastes, but also to carry digested food to all the cells. Since flatworms lack a circulatory system, they have to have another way to move digested food. In most of these marine flatworms, the digestive system itself—essentially the stomach—branches throughout the body such that no body cells are very far away from the gut. Digested food diffuses from the gut directly to the cells.

***Thysanozoon* flatworm on sponge**
The *Thysanozoon* flatworms are dorsally covered with bumps. Flatworms are very primitive animals. Although they have a highly branched digestive system to get digested food to all the cells, they never developed a separate opening to get indigestible material out of the body—they have no anus. Anything they take in that cannot be digested has to come back out the same way—through the mouth.

Flatworm *Pseudoceros dimidiatus*
This colorful flatworm is occasionally seen on the oceanside reef.

Flatworm *Pseudobiceros gloriosus*
Here is another flatworm with a striking magenta margin. We've seen these only a few times, usually on lagoon pinnacle reefs.

Flatworm *Pseudobiceros gloriosus* swimming
Many flatworms are capable of swimming. It seems they often do it after being disturbed, so it is likely an "escape from predator" response. Some can swim for quite a distance and some minutes before settling back down.

Banded sole swimming
Soleichthys heterorhinos
Shaped like and swimming much like a flatworm, this is actually a kind of flounder or sole, *Soleichthys heterorhinos.* The two close-set bulging eyes on the anterior end (left side) reveal it as a fish rather than a flatworm.

Banded sole
Soleichthys heterorhinos
A banded sole crawls slowly over some sand. This species often buries itself under the top layer of sand with just its eyes and snout above the surface, making it quite difficult to find.

Flowery flounder
Bothus mancus
The common name of this *Bothus mancus* comes from the blue flowery spots on its dorsal surface. Very pretty at some times, it can change its color in an instant to blend in with the bottom, as it does at the end of this scene. My question is, how does its body know what coloration camouflages with the bottom? With both eyes on top, I'd think it would be hard to even see the bottom.

Guilded pipefish
Corythoichthys schultzi
This could also be called Schultz' pipefish, based on its scientific name. This one is perched on coral, probably looking for a good place to feed.

Network pipefish, feeding
Corythoichthys flavofasciatus
Here you can see a pipefish eating. Most species slurp minute crustaceans and other tiny bits of food into their long tubular mouths. If you watch closely, you can see a couple of little tidbits get sucked in.

Guilded pipefish, close-up of head
Corythoichthys schultzi
Back to *Corythoichthys schultzi*, this is a close shot of the anterior end. You can see the long tubular mouth with its opening on the very end.

Bluestripe pipefish, pair in cave
Doryrhamphus excisus
I don't see much of a blue stripe on these pipefish, but that's what the book calls them. These little pipes usually live in pairs under rocks or in caves. Although they look as though they'd make good aquarium pets, pipefish are very hard to keep. They will eat only minute living things such as live brine shrimp. To keep these pipefish alive, you'd have to have a continual brine shrimp raising farm and daily feed the shrimp to the fish through a pipette. Far too much effort. As an aside, those long, black and white banded strings on the ceiling of the cave are the feeding tentacles of a terebellid worm. Terebellids extend these long, sticky tentacles from their holes to snare bits of food or small animals. Every now and then, they slurp a strand back into their mouths to eat any food that has stuck to it. It is this strand slurping behavior that gives these animals their common name of spaghetti worms.

Black ghost pipefish, swaying in the surge
Solenostomus cyanopterus ?
Ghost pipefish are fairly close relatives of sea horses. This one is a species of *Solenostomus,* possibly *S. cyanopterus,* and is in its usual position, drifting about with its head down. We have at least a couple of species here in the Marshalls. This one is seen occasionally in surge channels on the oceanside reef. It is not easy to see, since it looks a lot like a bit of detritus floating about in the surge. Ghost pipes are also difficult or impossible to keep alive in an aquarium. Don't even try.

Orangeband surgeonfish school grazing algae
Acanthurus olivaceus
The orangeband surgeonfish is also frequently called the orange-shouldered tang. Here a school moves about, settling down all together to graze on the thin layer of algae that covers most rocks. Individuals can change color quickly, usually from all black to half gray and half black, but both forms have the ever-present orange streak behind the eye.

White-spotted surgeonfish school
Acanthurus guttatus
These *Acanthurus guttatus* are common but rarely seen. The reason for this is their restricted habitat. This species prefers the shallow reefs under or just beyond the eastern oceanside reef breakers. It is not an easy place to dive due to the typically rough conditions, but during the doldrums, it is possible to get out there to see them.

Achilles tang
Acanthurus achilles
The Achilles tang is another species that is rarely seen at Kwajalein. It is rare here in the southern part of the atoll. We've found only two specimens over quite a few years of diving. There is, however, a substantial colony on the oceanside of Ebadon, at the northwestern tip of the Kwajalein atoll, and they are more common in the northern Marshalls atolls.

Palette surgeonfish stops to graze
Acanthurus hepatus
Acanthurus hepatus is another species with multiple common names. We've typically called it the blue tang. A striking fish, it also has a sporadic distribution at Kwajalein. We know of small populations at Bigej, oceanside near Ennubuj, and oceanside of Kwajalein itself.

Bignose unicornfish posing for cleaner wrasses
Naso vlamingi
Naso vlamingi, like several of the other *Naso* tangs, can change color dramatically and quickly. This one has come down over a table coral to have its parasites picked off by some cleaner wrasses. He starts off light colored so the dark colored parasites are easy to see, then turns dark to show off the light colored parasites.

Bignose unicornfish posing for cleaner wrasses
Naso vlamingi
This is the same *Naso vlamingi* we just saw but a few seconds later. After turning dark in the previous scene, he switches back to light color.

White-margin unicornfish with long horns
Naso annulatus
This species has one of the most impressive unicorn horns we've seen. *Naso annulatus* is most often seen on the oceanside slope, usually down at about 30 meters and deeper, where they form small schools. Like other *Naso* species, this one is capable of changing its color from light to dark.

Spotted unicornfish school
Naso brevirostris
Another of the horned unicornfish, *Naso brevirostris* is also common on the seaward slope but shallower than *Naso annulatus.* A smaller species, they are also common on many lagoon pinnacles, which is where this scene was shot. The "spot" in the common name must refer to the spot on their tail fin.

Barred unicornfish school
Naso thynnoides
Naso thynnoides is called the barred unicornfish due to the somewhat indistinct vertical bands on the body. It could probably just as easily be called the black-eyed unicornfish. As can be easily seen, this species does not have a unicorn-type horn on its forehead, but it does belong to the same genus as those fish that do. This species is typically found around some of the large pinnacle reefs up in the central part of the Kwajalein lagoon.

Blacktongue unicornfish, two color phases
Naso hexacanthus
I presume that *Naso hexacanthus* must have a black tongue, although they generally don't let me close enough to see. This is a large, hornless unicornfish that is common on seaward and pinnacle reefs. Like many others in this genus, they are capable of switching from light to dark coloration. Here a light and a dark one swim past. It almost looks like the dark one is a shadow of the lighter one.

Bluespine and Orangespine unicornfish
Naso unicornis and *Naso lituratus*
Here we have a mixed school of fish on a shallow lagoonside reef that includes two more species of unicornfish. The light colored fish with a short horn in front of its eye is the bluespine unicorn, *Naso unicornis*. The dark colored fish with the patch of bright orange near the base of the tail is the orangespine unicorn, *Naso lituratus*. Like most other members of the surgeonfish family, these *Nasos* have one or two spines or sharp blades right at their caudal peduncle, the narrow point at the posterior end of the fish, just before the start of the tail fin. The common name of surgeonfish comes from these blades; they can be extremely sharp, like a surgeon's scalpel. In fact, these fish need to be handled carefully if caught on a hook and line. In these two species the common names of orangespine and bluespine come from the colors of these blades.

Forktail rabbitfish feeding, Lined tang chases
Siganus argenteus and *Acanthurus lineatus*
The rabbitfish *Siganus argenteus* usually travels around in schools, dropping down en masse to graze algae from rocks. This is usually not to the liking of resident grazers, who see the rabbits as interlopers coming in to steal all their algae. The tang *Acanthurus lineatus* swims back and forth, trying to chase the rabbits away. They pull away for a moment, but the lure of algae pulls them back, and the tang once again has to charge in to chase them off.

Parrotfish school producing sand
Parrotfish feed by scraping algae from dead coral rocks. In the process, they also scrap off and injest the top layer of dead coral itself. After passing through the parrotfish digestive system, these bits of coral become fine sand and are dropped with other metabolic wastes in a fine cloud. The sand settles to the bottom. Fortunately, most corals are pretty good at moving this fine sand off their colonies or our coral reefs would probably be buried. Much of our lagoon is filled with parrotfish droppings.

Moorish idols past giant clam
Zanclus cornutus and *Tridacna gigas*
Three *Zanclus cornutus* swim past a giant clam *Tridacna gigas* (in foreground) on a coral-covered reef.

Moorish idol school
Zanclus cornutus
A school of *Zanclus cornutus* swims up the reef.

Tiger cowry
Cypraea tigris
The tiger cowry is one of the more common large cowries shells. Although not as abundant as it once was, it can still be found on a variety of lagoon and oceanside reefs in shallow water. Here the tiger has its mantle about halfway extended over its shell. The mantle is the part of the snail's body that actually deposits the calcium carbonate that makes up the shell. In cowries, the mantle can and often does completely cover the shell. In many other mollusks, such as cone shells, the mantle is just on the inside of the shell and shell growth is confined to the edge of the shell's aperture.

Deer cowry
Cypraea vitellus
Another of the shiny cowries, this one is just showing a bit of its mantle near the anterior (right side) end. This shot also shows on the right one of the long gray sensory tentacles; there are two, and each one has an eye near its base. Just above the anterior tentacles is a yellow fringed siphon, which the cowry animal uses to draw water into its shell, where it passes over the gills, flows past the anus, and carries away wastes out the posterior end of the shell. The

name of this cowry is *Cypraea vitellus*, the specific name meaning the yolk of an egg. This species is most common on lagoon reefs.

Eyed cowry
Cypraea argus
This has to be one of the most striking cowry color patterns. The scientific name for this species is *Cypraea argus*, named for a Greek mythological creature who had a hundred eyes. According to the myth, after Argus was killed, the goddess Hera placed his eyes in a peacock's tail. Maybe she saved a few for this cowry as well. The mantle is partly visible, lower on the shell and over the back side. The spotted mass below the right side of the shell is the animal's foot, and the sensory tentacles and a siphon are visible on the right.

Labrolineata cowry
Cypraea labrolineata
On this fast moving *Cypraea labrolineata*, you can see the mantle rising on the near side of the shell. It is a small cowry, less than 20mm long. Here the sensory tentacles are orange, and the siphon is long and extends well up out of the anterior end of the shell.

Mole cowry
Cypraea talpa
The mole cowry has a mantle that strongly contrasts with the color of the shell. The mantle is black, usually (but not always) scattered with numerous small green spots. The mantle of most cowries hav fingerlike projections called papillae that help break up the outline of the shell, making the shape harder for a predator to distinguish. The papillae, by increasing the surface area of the mantle, may also aid in either respiration or absorption of calcium carbonate from the water to use in shell growth. It is interesting that a thin, black and green flap of tissue can lay down a mostly yellow and brown shell.

Maria's cowry
Cypraea mariae
Cypraea mariae is another cowry with a striking shell pattern, but it is one of the small species. Most shells are less than 15mm long, or considerably less than an inch. Empty shells are fairly common in the sandy bottom surge channels, where they come to rest after dying or being eaten in their normal habitat, back in the caves and ledges of the surge channel walls. The animal is usually shy, and this one is not showing its mantle at all. The mantle on this cowry is not impressive, being just a translucent white that allows the shell's pattern to show through.

Carnelian cowry
Cypraea carneola
The carnelian gets its common name from its scientific name, *Cypraea carneola*. It is one of potentially several species that have similar shells but are supposed to differ based on animal characteristics. It may turn out that the animals are all sufficiently variable that they are all in fact one species, but their DNA will probably have to be extracted and compared before we can be sure. Carnelians are common in most atoll habitats, but are more often seen as empty shells rather than as living animals.

Golden cowry, mostly shell
Cypraea aurantium
The big orange cowry out here is the golden, *Cypraea aurantium.* These were not known to be found at Kwajalein until the latter part of 1969, when a divemaster taking a new student on a checkout dive stumbled upon one. Their primary habitat is the leeward seaward slope at depths of about 10 to 20 meters, although a few have been found deeper and shallower. They are very sensitive to light, so they hide well back in holes and caves during the day and are rarely seen. At night, they emerge to feed or find mates, and can then be found crawling in the open. This one has its mantle mostly retracted.

Golden cowry, mantle partway
Cypraea aurantium
This golden cowry has its mantle mostly extended, covering all but a bit of the top of the shell.

Golden cowry, full mantle
Cypraea aurantium
Here the golden cowry's mantle covers the entire shell, and the branching papillae that adorn the mantle are fully expanded. A few swimming crustaceans attracted to the video lights show that this segment was filmed at night.

Fluted giant clam
Tridacna squamosa
This is one of the four species of the giant clam family found here in the Marshalls. It is *Tridacna squamosa*, a midsized clam larger than most *Tridacna maxima* but smaller than the giant *Tridacna gigas.* The animal coloration varies considerably, but is usually some kind of spotted or streaked pattern. The common name comes from the flutes on the sides of the shell, which are more distinct than in the other *Tridacna* species.

Fluted giant clam
Tridacna squamosa
Another color form of *Tridacna squamosa*.

Fluted giant clam
Tridacna squamosa
On this specimen of *Tridacna squamosa*, the yellowish spots are denser than on many others, but there are still some darker background patches.

Fluted giant clam
Tridacna squamosa
Tridacna squamosa with all blue spots are quite uncommon. This individual has crowded small light blue spots.

Fluted giant clam
Tridacna squamosa
On this individual, the blue spots are darker and have stretched out into streaks.

Octopus expands to discourage predators
Octopus cyanea
An octopus resting on sand first stretches his body out to make himself look larger, maybe too large for a potential predator (the photographer) to eat. However, expanding himself did not deter the approaching monster, so the octopus changed color to match the surrounding sand and darted away, hoping to escape. He did.

Octopus on fire coral
Octopus cyanea
The same octopus from the last scene tries to make himself inconspicuous on coral. Not only can these animals change color rapidly, they can also extend bumps and points from their bodies to break up their outline and make them harder to distinguish. Several large gray *Dascyllus trimaculatus* and a school of cardinalfish swim around in the background. The gray *Dascyllus* are adults of the small three-spot damsels that as juveniles live in sea anemones.

Octopus ballooning out to catch prey
Octopus cyanea
One hunting technique for octopus is something I like to call ballooning, although barrier netting might be a better description. The octopus settles down over some coral or rock and expands out the thin tissue between its arms while probing into holes and crevices beneath the rock with its tentacles. Any small fish or crustaceans hiding in those areas dart out to escape the tentacles but are caught in the balloon and quickly grabbed and moved to the octopus' mouth for consumption. It's a tough world out there. Everybody eats or gets eaten.

Octopus changing color on coral
Octopus cyanea ?
This small octopus changed color quickly when it decided to move from its position on a colony of live *Porites* coral.

Octopus, very small inside seashell
Octopus sp.
This tiny octopus has found a safe lair inside an empty spider conch, *Lambis chiragra*. Next to the octopus is an empty moon snail, possibly a prior dinner for the octopus.

Cuttlefish eggs, one hatches
These brown bubbles attached to the undersurface of some dead coral rocks are the eggs of cuttlefish. Cuttlefish are related to octopus and squid and are rarely seen here, although are not especially uncommon. During the day they hide away under rocks or in piles of dead coral rubble, but they may emerge at night to feed. Most of these eggs are ready to hatch. In fact, the cluster of wrinkled bubbles to the upper left are already empty; the baby cuttlefish have hatched out and gone. While we watch, a tiny cuttlefish breaks free from an egg in the middle of the mass and quickly swims or gets washed away in the small surge. At the very end of the scene, a bit of cuttlefish ink like that of squid and octopus, wafts back into the picture. The tiny cuttle must have squirted to confuse any possible nearby predators.

Cuttlefish egg, hatches
Here one of the cuttlefish eggs about to hatch has become detached from the rest of the bunch and the black capsule deflates. The tiny cuttlefish forces its way out and slips away. Its first instinct seems to be to hide.

THE THIRD MENU ICON ENTERS THE MOVIE HERE

Spotted garden eels
Heteroconger hassi
Garden eels are slender, sand-dwelling eels that feed by extending from their holes in the sand and grabbing passing plankton. The common species here, *Heteroconger hassi*, is often found in large colonies in lagoon sandy areas such as this, but it also lives in sand patches in oceanside surge channels and flats. Their bodies are finely spotted with black, but that is hard to see because they are shy and retract into their holes at the approach of a diver.

Spotted garden eels
Heteroconger hassi
If you wait a long time, the garden eels might let you close enough to see their spotting. But they tend to retract every time you breathe. Here's where one of those electronic rebreathers would be nice.

Napoleon snake eel
Ophichthus bonaparti
Ophichthus bonaparti is another sand-dwelling eel. They are rarely noticed because they barely stick their head out of the sand and will often retract completely under the sand if approached.

Napoleon snake eel emerges for food
Ophichthus bonaparti
However, sand-dwelling snake eels such as this Napoleon will stretch out in the presence of food. This one emerges a short way out of its hole to grab a chunk of fish left nearby. It hesitates a bit as a small hermit crab crawls past. Note that the finely spotted head changes to mostly light color with a few dark saddles on the visible portion of the body.

Thorny stingray
Urogymnus africanus
The thorny stingray is given its common name because its back is covered with rather pointed spines or thorns. This one is digging in the sand for buried mollusks shells or sand-burrowing sea urchins, which it will crush up with its powerful jaws. A couple of remoras swim over its back and behind it while waiting for the ray to finish dinner and move on. Finally the photographer comes a bit too close and the ray and his entourage move away.

Spotted eagle ray, chewing prey
Aetobatis narinari
The spotted eagle ray also feeds on sand-dwelling mollusks and urchins. This one has apparently just come from the dinner table, since it is still chewing up whatever it found. It drops a couple of crumbs—probably bits of shell—as it swims past.

Spotted eagle ray….and Whitetip shark
Aetobatis narinari and *Triaenodon obesus*
The same eagle ray from the last scene continues on past. Suddenly and unexpectedly, a whitetip shark passes right in front of the camera. It was startling enough that it is amazing that the camera didn't jump out of the photographer's hands.

Whitetip shark near overgrown cable
Triaenodon obesus
Kwaj lagoon seems to be crisscrossed with cables. This one is near a lagoon pinnacle near Eniwetak and Kwadak Islands. You can tell it has been there a while because of the amount of coral growth on it.

Whitetip shark approaches
Triaenodon obesus
A whitetip shark swims up almost to the camera lens before turning off to go around the photographer. Whitetips are generally pretty mellow sharks and are rarely aggressive. They might, however, become more agitated in the presence of spearfishing and may be quite persistent in their attempts to take speared fish away from divers.

Whitetip shark resting in cave
Triaenodon obesus
Unlike many sharks, the whitetip is able to stay in one place and breathe. Many other reef sharks must swim all the time to keep a fresh supply of oxygen-bearing water flowing over their gills. The pumping action of the whitetip opening and closing its mouth pushes water over this one's gills, allowing him to rest on the bottom.

Look at those teeth
Triaenodon obesus
When the shark is resting like this, it is sometimes possible to approach them very closely. You can see how the teeth are in layers in this one's mouth. If it loses a tooth, another one is there to take its place.

Blacktip shark
Carcharhinus melanopterus
The blacktip reef shark prefers shallow water. Small ones can often be seen on the reef flat near shore, often in only inches of water. Larger ones are on the shallow lagoon and oceanside reef flats or on tops of shallow lagoon pinnacles. They tend to be quite shy and hard to approach, and are rarely aggressive.

Tawny nurse shark with pilot fish
Nebrius ferrugineus with *Gnathanodon speciosus*
The shark is *Nebrius ferrugineus* and the small black-striped yellow pilot fish are juveniles of the golden trevally, *Gnathanodon speciosus.* The nurse was resting peacefully in a cave when disturbed by the approach of the photographer. Finally she could take it no longer and swam away, taking with her the school of pilots.

Gray reef shark over coral
Carcharhinus amblyrhynchos
This gray reef shark approaches the photographer over a field of staghorn coral. Numerous *Naso* tangs can be seen in the background early in the scene.

Gray reef shark
Carcharhinus amblyrhynchos
This gray reef passes the diver and a school of the spotted unicornfish, *Naso brevirostris*.

Several Gray reef sharks come to investigate
Carcharhinus amblyrhynchos
The gray reef is common and curious, but may get agitated in the presence of divers. Down around Kwaj where there is heavy diving activity, the gray reefs have either become so accustomed to divers that they don't bother to come around or may have even moved away up the reef. Getting agitated over divers so often might be upsetting enough that the sharks decide to move on to less crowded reefs. It is certainly the case that when we dive on isolated midlagoon pinnacles or reefs we often see many more gray reefs, and they are frequently curious. Here we dropped into the water on a very large lagoon pinnacle in the middle of the lagoon that we'd never been to before. We were in the water only a couple minutes before the gray reefs came up the side of the pinnacle to see what was going on. They stayed around a while, but after 10 or 15 minutes mostly faded back into the depths and we were able to proceed with our dive without constantly looking over our shoulders.

Bicolor angelfish
Centropyge bicolor
These bicolor angelfish are aptly named and the distinct yellow front and dark blue rear are unmistakable. Even the scientific name says it: *Centropyge bicolor.* The angels in the genus *Centropyge* are generally referred to as pygmy angels since most of them are quite small, most species reaching only 75 to 100 millimeters (3-4 inches) at most. The bicolor can get a bit larger. This species is relatively common here at Kwaj but only in certain areas. They are most often seen on the lagoon slopes, for example at Shell Island, or on the slopes on certain lagoon pinnacles. North Loi coralhead is a good place to see them. Several times in this scene, you can see one or two individuals of another pygmy angel. These are called coral beauties, *Centropyge bispinosus.* They are blue in the face, dark blue around the rim and orange in the center with narrow vertical black lines.

Herald's angelfish
Centropyge heraldi
Another pygmy angel, *Centropyge heraldi* kind of resembles the Lemonpeal angel, *Centropyge flavissimus,* but it lacks the blue rings around the eyes. *Centropyge heraldi* is most common deeper on oceanside and lagoon slopes than you usually find the Lemonpeal, but sometimes they do overlap in the same areas.

Lemonpeal angelfish bickering
Centropyge flavissimus
These two *Centropyge flavissimus* are showing some aggression towards each other until a flame angel, *Centropyge loriculus,* arrives. Then it seems the two lemonpeals forget their differences to go chase after the one who doesn't look like them.

Flame angelfish, confrontation
Centropyge loriculus
Two flame angelfish meet up in a ledge and display at each other. Most angelfish are very territorial and often play these dominance games. Two of the same species from different parts of the reef will sometimes fight to the death if confined in an aquarium, and often different species will pick at each other quite a bit as well.

Multicolor angelfish
Centropyge multicolor
Because these small angelfish are often aggressive towards other angel species, they have a tendency to divide up the habitat, although there is quite a bit of overlap. The lemonpeals tend to take the shallowest parts of the reef. Flames are concentrated right around the knee of the oceanside dropoff and a short ways down the slope. Around 20 meters, these multicolors start to show up, and they become more common deeper.

Emperor angelfish, juvenile
Pomacanthus imperator
Adult emperor angels scatter about on the reef; they can be found just about anywhere. Their juveniles, however, are found only in certain habitats. One of these is in the reef quarries (locally called "Japanese swimming pools" since the Japanese were the first to quarry the reef for building materials). Another place to see juvenile emperors is on deeper lagoon reefs at depths of 25 meters or more. This one happened to be on a shallower isolated reef surrounded by sand and which was also home to a large sea anemone and numerous cardinal fish.

Emperor angelfish, adult coloration
Pomacanthus imperator
Emperors change color dramatically as they age. The white circular lines straighten out, the tail fin becomes bright yellow, and a blue-edged dark mask develops on the face to hide their eyes. This particular individual lived in a home aquarium for about five years, dropping its juvenile pattern and taking on its adult color before it got too large and had to be released. It is always difficult to release fish safely. First, they have to get back into a habitat where that particular species might live. Second, a fish being released is initially disoriented, both from being in a new place and often because it is deep enough in the water that its swim bladder is compressed. This causes the fish to lose its neutral buoyancy forcing it to struggle to stay up. Predators are good at quickly recognizing disoriented or struggling prey and take quick advantage. When we release a fish, we find an appropriate place; if it is a territorial fish, we find a spot where it doesn't look as though others of the same species will chase it off. We acclimate the fish to the depth where we're going to release it for an hour or more to give its swim bladder time to adjust. Then we spend a whole dive after letting it out of a fish bucket staying with it to protect it from groupers, snappers, and moray eels while it orients itself and gets comfortable. This seems to work. This scene was filmed about six months after we released this emperor angel. It had, on its own, moved about 100 meters down the reef from where we left it, but it could easily be recognized by its color pattern; the pattern of lines on its body forms a sort of "fingerprint" pattern, and we were able to compare this video clip with photos we had from the day we released it.

Regal angelfish, juvenile
Pygoplites diacanthus
Regal angelfish are common on both lagoon and oceanside reefs, but juveniles are not often seen by most divers. This is because the young ones seek the shelter of ledges and caves filled with honeycombed holes and cracks in which to hide. As they get older and develop the adult coloration, they more move out in the open. This orange coloration with a distinct eye spot at the back of the dorsal fin is characteristic of the young ones. They change considerably as they grow older.

Regal angelfish, adult coloration
Pygoplites diacanthus
This is an adult of the *Pygoplites diacanthus* species seen in the previous scene. As you can see, they pick up a lot more blue color as they age, and the tail becomes bright yellow.

Watanabe's angelfish, male
Genicanthus watanabei
This angelfish seems to be restricted to relative deep habitats on the oceanside slopes. They seem to come up a bit shallower on the oceanside of the east reef, where they have been spotted as shallow as about 30 to 35 meters. A good place to spot them is near the south tip of Kwaj, approximately off the air terminal, where this clip was filmed. This is a male; the female lacks the longitudinal black lines. Usually you see groups with a few males and more numerous females. They may be seen from a distance swimming up off the bottom eating plankton, but will drop down into the coral when divers approach.

Yellow-saddle goatfish
Parupeneus cyclostomus
This is one of the larger goatfish. While most goatfish use the barbels under the mouth to help dig in the sand to find sand-dwelling invertebrate prey, the *Parupeneus cyclostomus* is said to use those barbels to probe under rocks to chase out its typical prey, small fish. Young individuals of this species are often bright, uniform yellow.

Half & half goatfish
Parupeneus barberinoides
This relatively uncommon goatfish has a distinctive and unmistakable color pattern. These goats are fairly small and here at Kwaj seem to be most common around lagoon pinnacles. Most of the other fish in the background are small parrotfish along with one female bird wrasse, *Gomphosus varius*.

Dash dot goatfish shadowed by Trumpetfish
Parupeneus barberinus and *Aulostomus chinensis*
The goatfish *Parupeneus barberinus* is common on both lagoon and oceanside reefs, and spends its day moving from one sand patch to another, digging in the sand with its mouth and barbels—a pair of tentacles on the chin—in

search of small invertebrate prey. If you see clouds of sand rising up in a nearby sand patch, it is likely one of these stirring things up. Occasionally they pick up a shadow. Here a yellow trumpetfish, *Aulostomus chinensis*, tags along right over the goat's shoulder. The trumpet is waiting for the goat to scare something out of the sand, which the trumpet will try to pick off before the goat can get to it. And it works. Near the end of the scene, you can see the trumpet making a quick dart to the forward and a bit left, snagging a small creature that was trying to get away from the goat' probing barbels. There is also a large red-breasted wrasse, *Chelinus fasciatus*, hanging around and hoping to get in on the action. We also call these wrasses "chomper fish" because if you are lifting rocks to look for nudibranchs or other small creatures beneath them, the chompers will often stay right there with you to try to scarf anything they can get from the underside of the rock. On lagoon pinncles, these chompers are nearly fearless, but those on the oceanside reefs tend to keep their distance.

Yellowfin goatfish school
Mulloidichthys vanicolensis
These yellowfin goats seem to be most common along lagoon reefs and pinnacles, but they can be on the oceanside as well. By day they rest in schools, but disperse at night to feed by digging in sand much like the *Parupeneus barberinus* in the previous scene. This group was at a depth of about 30 meters near the base of a lagoon pinnacle

School of small yellowfin goatfish
Mulloidichthys vanicolensis
This is the same species as the previous scene, but here all the individuals are small, probably juvenile, and are spread out over a shallow coral interisland reef between Omelek and Gellinam Islands.

Yellow boxfish, adult
Ostracion cubicus
The scientific name for this species suggests it should be called the cubical boxfish. This was an unusual individual. This species tends to be a bit shy, rarely allowing divers to approach too closely. This one, however, was hovering low over a bed of *Halimeda* algae, and almost seemed interested in the camera. He kept approaching the lens, forcing me to slowly move back.

Yellow boxfish, juvenile
Ostracion cubicus
This is the same species as in the previous scene, but it is a small juvenile, only a couple of centimeters long. While adult *Ostracion cubicus* can be seen commonly on a variety of lagoon and oceanside reefs, the juveniles are rarely encountered. In a good year, there may be a crop of them settling out, usually in the reef quarries of Kwajalein and on lagoon pinnacles in the southern portion of the lagoon. This clip was shot on a small shipwreck near the west end of Kwaj at a depth of about 15 meters. These small boxes are very cute and look as though they would be nice aquarium pets, but I recommend caution. Boxfish are highly toxic, and when stressed they can release that toxin into the water surrounding water. In an enclosed aquarium, this could potentially kill everything else in the tank (including the boxfish who secreted it). They're fine if they never get upset, but who can tell what might upset a boxfish?

Spotted boxfish, male
Ostracion meleagris
Ostracion meleagris is the other common boxfish here in the Marshalls. Adults are smaller than the yellow box, rarely more than about 125mm or about 5 inches. Juveniles and females are just black with white spots, but the adult males develop some blue and orange coloration. They usually stay low in and among the corals, and hide underneath something at the approach of divers. I'm not sure why they should be so cautious, however, since they are also quite poisonous and are not likely to be eaten by predators.

Thornback cowfish
Lactornia fornasini
In the same family as the boxfish, the cowfish are characterized by hard spines on their heads and sometimes other parts of the body. This species has spines above the eyes, below the tail, and one on the middle of its back. These are rarely seen here. We've only observed a few, all over *Halimeda* algae patches on otherwise sandy lagoon interisland reefs, such as that between Bigej and Meck Islands. Its flattened bottom and the way it glides along makes me think it should have been a model for a spaceship in Star Trek. At least one other cowfish, tentatively identified as

Lactornia cornuta, has also been spotted here, right in the boat harbor at Kwaj. *Lactornia cornuta* has not officially ever been reported from the Marshalls, so it would be good to get a photo for confirmation. Keep an eye open for them.

Porcupine puffer
Diodon hystrix
The porcupine or spiny puffer has hard sharp spines all over its body. Normally the spines lie flat against the skin, but when threatened or irritated, the puffer can puff up, which erects all the spines. In a fully puffed state, it looks like a round ball covered with spikes. It is an effective defense.

Scorpionfish
Scorpaenopsis sp.
I think this is a young *Scorpaenopsis diabolis*. As they age, they become more mottled gray in color and look just like a rock. They do, however, have bright orange color hidden behind their pectoral fins. When they lift their fins and flash that color, it can be startling. Their dorsal spines are venomous, but the venom is not as nasty as their relatives, the stonefish.

Yellow-spotted scorpionfish
Sebastapistes cyanostigma
This attractive little scorpionfish lives between the branches of living *Pocillopora* corals on shallow subtidal seaward reefs. Occasionally they can also be found under rocks in those same areas.

Spinycrown scorpionfish
Scorpaenopsis sp.
Here is a profile shot of one of the small scorpionfish. Like most of its relatives, its dorsal spines are probably venomous.

Spinycrown scorpionfish
Scorpaenopsis sp.
This is another shot of the previous scorpionfish, this time showing the entire animal. Most scorpions spend most of the time sitting more or less motionless on the bottom, waiting for their prey to wander by. Most eat small fish or crustaceans.

Zebra Lionfish swims away
Dendrochirus zebra
Dendrochirus zebra is one of five different kinds of lionfish found at Kwaj. The two species of *Dendrochirus* lionfish can be distinguished from their cousins in the genus *Pterois* by the wing-like pectoral fins that do not form long filaments at their outer edges. This one expands its fins while swimming, appearing as though it is flying across the bottom. It typically lives on shallow lagoon interisland reefs, where it nestles up against dead coral waiting for prey fish to swim by. Although brightly colored and patterned, they sometimes blend into their surroundings and remain unnoticed. Divers need to be careful where they put their hands. Like the other lionfish, the dorsal spines of this species are venomous. Although usually not fatal, the venom from a zebra sting is quite painful and is best avoided.

Spotfin lionfish
Pterois antennata
Note on this lionfish how the pectoral fins extend out in long white filaments. This differs from species of *Dendrochirus*, the other Kwaj lionfishes, whose pectoral fins are more wing-like and lack long filaments. *Pterois antennata* is probably the most common lionfish here at Kwaj, and can be found in a variety of lagoon and oceanside reef habitats. They prefer living in ledges and caves, where they often hang upside down on the ceiling. They may emerge from their ledges at night to hunt their prey. They are reported to eat mostly shrimps and crabs, but will take small fish in an aquarium. Like the other lionfish, the dorsal spines are venomous. The common name is derived from dark spots in the pectoral fins.

Lionfish
Pterois volitans
The largest of the lions is *Pterois volitans.* They are often seen floating near reefs or shipwrecks where large schools of small fish such as cardinalfish have taken refuge. Juveniles can be black or red and have proportionally very long fins. Like the other lionfish, the dorsal spines are venomous. Human fatalities have been reported from stings from this species.

Red-spotted *Saron* shrimp
Saron sp.
This nocturnal shrimp is rarely seen during the day but is relatively common on the oceanside slope at night. They tend to be a bit shy and usually retreat into holes in the reef at the approach of divers. Partway through this scene, which was unusual in that it was taken during the day, a small juvenile wrasse can be seen coming down from the right side. The shrimp swings over its antenna and clobbers the fish as it passes.

Cleaner shrimp
Lysmata amboinensis
The cleaner shrimp gets its common name from its habit of picking the parasites from fish that enter the ledges and small caves within which it lives. It is most often seen cleaning moray eels. These shrimp are not common here at Kwaj, but can occasionally be found on lagoon or oceanside reefs in caves.

Mantis shrimp
Pseudosquilla ciliata
Mantis shrimps are so called because their forward appendages fold up much like those of a praying mantis. However, the direction of the joints in these appendages in praying mantis are opposite those in the shrimp; the praying mantis strike their insect prey from above, while the mantis shrimps strike their fish, crustacean, or mollusk prey from underneath, where they are typically softest. They are sometimes commonly called "thumb splitters." In some species, the ends of the appendages are very sharp, and the shrimp can whip them out and make deep cuts in the fingers of anyone careless enough to handle them. In some other mantis shrimp species, the appendages are more clublike to knock prey senseless or even to break apart the shells of crabs or mollusks, or are comb-like with numerous sharp, fine, long spines used to skewer and hold prey while it is being consumed. Normally shy, they are rarely exposed long enough to take photos of them.

Green mantis shrimp
Odontodactylus scyllarus
This is one of the larger and is certainly the most spectacularly colored mantis shrimp at Kwaj. For years the only specimens of this species we had seen were two or three individuals on the deep oceanside slope between Kwaj and Ennubuj Islands. Recently we ran across a small group of them in a very different habitat, on a rubble flat along the lagoon's east reef. Here they live under rocks or in holes they build in piles of dead coral rubble and will often peek out of their holes to look at you when you approach. Occasionally you can entice one out with food. Once out of his hole, this one decided to move to another, perhaps where he figured he wouldn't be pestered by bubbling giants. *Odontodactylus scyllarus* is one of the "smashing" mantis shrimps, whose forward mantis-like appendages are club or blade-like and used to smash or cut prey.

Green mantis shrimp, strange eyes
Odontodactylus scyllarus
These mantis shrimp have the most bizarre compound eyes. Each eye contains as many as 10,000 cells or visual elements called ommatidia. The fields from the different elements overlap, often allowing for highly accurate visual acuity. Looking straight down into an ommatidium, it looks black, while those viewed from even a slight angle are colored like the rest of the eye, in this case reddish. The eyes are divided into three sets of ommatidia, and each element in each of those sets is set at a slightly different angle, so that as the shrimp moves its eyes, you're looking directly down into different elements, but you might be looking right down the barrel of some elements in each of the three sets. Making it more interesting, the eyes are mounted on separately moving stalks, allowing the animal to look in different directions at the same time. How does the brain process such an influx of information?

Mantis shrimp in sandy hole
Lysiosquilla maculata
Lysiosquilla is one of the spearing mantis shrimps. The sharp, spiny comb on its mantis appendages are used to skewer and hold prey. These live in deep holes in the sand that are usually partly covered with a thin layer of sand and mucus. The shrimp may sit with its head at the surface of the hole as in this scene, or it may retract into the burrow that may extend as long as 5 meters. If you look down the hole (after the shrimp has retracted, of course), you can see the smooth walls of the hole that extends downward and curves out of sight. *Lysiosquilla's* eyes are more elongate, but also show the bizarre compound behavior of the separate visual elements. In this scene, which was taken at night, the shrimp finally retreated from the approaching diver and disappeared down its hole. A small shrimp that had been attracted to the video lights followed the mantis down.

Orange-striped hermit crab
The appendages of this hermit are striped with orange and dark reddish brown, but the crab's body is mostly white. This one inhabits the shell of a *Cerithium.*

Hermit crabs trying to flip over
Calcinus sp.
These two red, black, and white banded hermit crabs are reaching out for the bottom trying to flip their shells over. The one in the little frog shell flips over and starts crawling away. It looks like the other is reaching out for the other, as though saying, "Hey, wait for me."

White-spotted hermit crab
Calcinus argus
This little *Calcinus argus* is also the shell of a *Cerithium.* The ceriths, or horn shells, are common and empty ones are favorites for hermits.

Red hermit crab in old Triton shell
Dardanus megistos
One of the largest hermit crabs in the Marshalls, adult *Dardanus megistos* need the larger shells found here to make their homes. This one is in the biggest he can get: a triton's trumpet shell. But you can also find these crabs in the large *Bursa bubo* or in giant finger shells, *Lambis truncata*.

Turquoise-kneepad hermit crab
Dardanus guttatus
Another large hermit crab, this one has a relatively flattened body and is often found in shells like this juvenile giant finger, *Lambis truncata*. It is also one of the few species able to take advantage of empty cowry and cone shells, whose narrow aperture will permit only a flattened body to occupy. While the scientific name "*guttatus*" refers to the while spots, the turquoise spots on each leg are characteristic and make the common name appropriate.

Buoy blenny and algae
Petrocirtes mitratus
We call these buoy blennies because they are always hanging around the lines and subsurface mooring buoys the scuba club attaches to sunken shipwrecks. These lines also frequently get coated with various kinds of algae, which provides a good habitat for small fish and inverts. *Micronesian Reef Fishes* calls this a Floral fangblenny.

Xestus fangblenny in hole
Petrocirtes xestus
Although closely related to the previous buoy blenny, *Petrocirtes xestus* lives in small holes along the reef. This one happens to be in a hole in a chunk of coral growing on a giant finger shell, *Lambis truncata*. That gives this fish a mobile home. Even while I was filming it, the finger was hopping along, using its foot to pole itself across the bottom. Since that shook up the picture considerably, I had to restrict my edits to the periods between the finger shell's steps.

Whip coral goby, vibrating in current
Bryaninops youngei
This little goby is always found, usually in pairs, on living colonies of the whip coral *Cirripathes*.

Piano fangblenny in hole in coral
Plagiotremus tapeinosoma
This fish is also called a sabertooth blenny. Its body, most of which is hidden in a hole in live coral, is longitudinally striped similar to a cleaner wrasse. The blenny also swims a bit like a cleaner. It can often approach fish waiting to be cleaned. But instead of picking parasites, this fish uses its large saber teeth to bite a hole in the unsuspecting fish. The blennies may also dart out of hiding in holes like this and bite a chunk out of a passing fish. People who dive barelegged might also be prey; blennies like these quite frequently nip at divers as they pass. Fortunately, they rarely would break the skin. I think mostly they pull leg hairs.

Moon jelly
Aurelia aurita
A moon jelly with long tentacles pulsates by overhead.

Moon jelly
Aurelia aurita
You can see the surface and, beyond that, clouds in the sky behind this pulsating moon jelly. It almost seems to be floating in the sky.

Saucer jelly
This jelly almost looks like some sort of flying saucer. It was pulsing past while we waited on our safety stop over one of the lagoon shipwrecks.

Crambione jellyfish
Crambione mastigophora
The Crambione jelly is a pretty common visitor to the atoll. It is usually seen in the lagoon, sometimes in large groups, but may drift past oceanside reefs as well. Its tentacles can deliver a relatively powerful sting, so be wary.

Crambione jellyfish
Crambione mastigophora
Crambione jellies often travel in groups. In this scene, several can be seen in the background.

***Crambione* jellyfish**
Crambione mastigophora
Crambione jellies often travel in groups. In this scene, several can be seen in the background.

Large group of Crambione jellyfish
Crambione mastigophora
It was difficult to swim through this group of *Crambione* jellies without being stung. What a day to forget your wetsuit!

Bearpaw clam
Hippopus hippopus
Hippopus is probably the least colorful of the four species of the giant clam family Tridacnidae found here at Kwaj. They are, however, distinctively patterned with the light lines stretching along the clam's animal. Here we start zoomed in on the siphon where water is drawn in to be filtered for plankton. Then we zoom out until nearly the entire clam is visible. Note that the siphon hole closes as we zoom away. The shell of this individual is covered with algae and other growths, making it rather hard to see. They live in a variety of habitats, but seem to prefer lagoon reefs and *Halimeda* algae patches.

Maxima giant clam
Tridacna maxima
As noted earlier, *Tridacna maxima* is the smallest but most numerous of the giant clam family here in the Marshalls. They live embedded in the reef and come in a variety of colors. One color character all *Tridacna maxima* share is a row of black dots along the edge of the mantle (animal), right up next to the sinuous shell valves. Here a brown and a blue one grow side by side.

Fluted giant clam
Tridacna squamosa
This is one of the four species of the giant clam family found here in the Marshalls. As noted earlier, *Tridacna squamosa* is a mid-sized clam larger than most *Tridacna maxima* but smaller than the giant *Tridacna gigas.* The animal coloration varies considerably, but is usually some kind of spotted or streaked pattern. This one has blue spots within yellowish streaks on a brown background. The common name comes from the flutes on the sides of the shell, which are more distinct than in the other *Tridacna* species. Here we're zooming out from the fringed incurrent siphon until we get a view of the entire clam

Giant clam
Tridacna gigas
Tridacna gigas is the true giant among clams. The largest clam shell in the world, this species has been reliably reported to grow to about 137cm—well over 5 feet in length. They range through much of the western Pacific but not including Hawaii, and extend slightly into the Indian Ocean. Sadly, they are under pressure throughout their range. Not only are they eaten by the local residents of many island groups (including the Marshalls), but fishing boats from some Asian countries have been caught entering lagoons and illegally harvesting clams through much of the Pacific. In some areas, they are completely gone. Despite our many dive trips to Pohnpei, Caroline Islands, we have not seen a living *Tridacna gigas,* and the guides with whom we dive do not know of any. They were once there; you can find ancient empty *Tridacna gigas* shells on many beaches and small islands. But they've been harvested out. Kwajalein is in pretty good shape, but even here, there are very few specimens left in the southern part of the atoll. In the 1970s I knew of two large individuals in the Ski Boat Area of Kwajalein and several more on nearby lagoon pinnacles. Now all of those are gone but one. About 15 specimens we were watching for several years along the long reef between Bigej and Meck Islands all were killed in a single weekend a few years ago, all invited to a dinner party on Ebeye. The empty shells were left behind, sometimes dumped back into the water after the animal was removed on the boat that took them. Fortunately, in the middle and northern parts of the atoll, they are still common. Let's hope they stay that way. These are gorgeous, impressive, long-lived animals; it's a tragedy for a hundred-year-old animal to be killed for the sake of a few calories. The individual pictured here is a small juvenile in an algae patch. Even a small *Tridacna gigas* can quickly be distinguished from the other two *Tridacna* species by the presence of iridescent blue or green rings on the animal.

Giant clam
Tridacna gigas
This mustard colored individual is on a shallow reef on the lagoonside of one of the mid atoll islands. Hopefully it is a bit out of the way for most of the local fishermen. Note that even if you find an empty shell, you cannot bring it back into the States. All four Kwaj members of the Tridacnidae family (the three *Tridacna* species and *Hippopus hippopus*) are on the CITES list. CITES stands for Convention on International Trade in Endangered Species. Basically CITES is a list of species chosen by member countries (those who have signed on to the convention) to protect from their waters. At least one of those nations has selected the Tridacnidae to be on the list, and therefore all countries that belong to the convention are obligated to restrict the import or export of these species. It seems to me that they could have come up with a more scientific way to determine which species should be protected, but at least in the case of the giant clams, being on the list is a good thing.

Giant clam
Tridacna gigas
This one is a bit larger than the previous one.

Giant clam
Tridacna gigas
Like the other species of giant clams, *Tridacna gigas* can vary quite a bit in color. The color may appear to change, however, depending upon the angle upon which you look at it. From one direction, the clam animal may look mostly green; from another, mostly blue.

Giant clam
Tridacna gigas
This angle of view shows this one as a bright green color.

Giant clam
Tridacna gigas
This is a very large specimen.

Giant clam and diver
Tridacna gigas and *Homo sapiens*
A photographer snaps a shot of a giant clam nestled in a living coral reef.

Salp twirls in the water
Salps are jelly-like planktonic animals that are related to the tunicates, which in turn are more closely related to vertebrate animals (such as fish and mammals and so on) than are the rest of the invertebrates, such as mollusks and crustaceans. Salps come in a variety of shapes, and some are colonial. The body of this animal is up at the front part of the twirling string, and the long trailing tail may be reproductive parts. Watching this creature spin was mesmerizing.

Salp pulses along
Another kind of salp moves in bursts as it draws in water at the front and expels it out the back.

Segmented salp in plankton
This segmented colonial salp worms its way through the water by each of its individual cells, each a different individual, pulsing water through its body. These strings can be meters long.

Christmas tree worm emerges
Spirobranchus giganteus
These worms live in holes usually in living coral. They have two spiraling trees of filaments that capture plankton from the water and probably function in respiration as well. They come in a wide variety of colors and patterns. When disturbed, they retract into their holes in the blink of an eye, and after some seconds, slowly extend out their feeding crowns again. The furry disk in front of the worm is the operculum. It functions as a trap door to close off the opening to the worms tube when the Christmas tree feeding crown is retracted. This worm has obviously been here a long time; the shadow from its operculum has left a scar on the living coral.

Christmas tree worm
Spirobranchus giganteus
This is a blue individual of the same species as the previous scene.

Bristle worm
Notopygos albiseta
One of the more colorful worms, this one has bright red patches on each segment of its body. The bristle worms are mostly fast moving and are armed with tufts of long, sharp bristles running down the sides of the body. Those bristles can easily penetrate human skin and cause a distinct and often painful burning sensation. Consequently, these worms are often called fireworms.

Crown jellyfish
Cephea cephea
The crown jelly is one of the larger you're likely to see in this area. They're not common and seem to come in a variety of shapes; some of these might actually be different species. All of the forms have the central depression on top of the bell from which extend jelly-like protrusions, sometimes large like this one and sometimes very small. Most often we see them drifting by while we're diving on lagoon pinnacles.

Crown jellyfish
Cephea cephea ?
We assume this is the same species as the previous scene, but it has enough differences that it might not be. This was a very large individual passing over a pinnacle up near Onemak Island in the middle of the atoll.

Crown jellyfish
Cephea cephea ?
This is the same individual as the previous scene. Most of this view is from the underside.

Bluestreak fusilier, synchronized swimming
Pterocaesio tile
These fish certainly are good at staying together, turning in unison and slowing down or speeding up at the same time.

Yellowback fusilier
Caesio teres
Caesio teres forms large schools on lagoon pinnacles and oceanside reefs. This scene was shot at the south end of Ninni oceanside, near the edge of Gea Pass.

Ring wrasse mimics parrotfish
Hologymnosus annulatus with *Chlorurus microrhinos*
Although all these green fish appear at first glance to be parrotfish, the camera is following a more slender one that is in fact a wrasse instead. This ring wrasse seems to be accompanying the group of similarly colored parrots. The wrasse is reported to be primarily a fish eater. Perhaps it tags along with parrots to sneak close to small fish who are not frightened by the large, grazing, harmless parrots.

Twinspot wrasse, small juvenile
Coris aygula
Some of the books call this a "clown coris." Juveniles are attractive little fish who live in shallow rubbly areas, often up next to small walls or ledges. Small ones like this have two red spots on each side, giving them their common name, but their color changes considerably as they grow.

Twinspot wrasse, medium juvenile
Coris aygula
On this larger juvenile *Coris aygula*, the posterior red spot has turned black and stretched out along the fin. Still, the forward half of the body is white with lots of black spots around the head. This one is digging in the sand for small prey.

Twinspot wrasse, large juvenile
Coris aygula
On this even larger juvenile, the black from around the red spots has taken over the entire posterior half of the body, although both red spots are still present. The fish has taken on a distinctly half and half appearance with the black spotted white in front and mostly black behind.

Twinspot wrasse, female
Coris aygula
As they reach adulthood, they become more uniformly gray black on the posterior half and mostly white with a few black facial spots anteriorly. Like other wrasses, *Coris aygula* is a serial hermaphrodite. As it matures, it first becomes a female. Later it may change sex to become a male.

Twinspot wrasse, male
Coris aygula
The terminal male phase of *Coris aygula* is very different from the younger forms. The fish turns all black with a big humped head and big white teeth. Among other things, it eats mollusks, whose shells it will pick up and chew, often dropping and catching them, until it breaks the shell and consumes the animal.

Dragon wrasse
Novaculichthys taeniourus
The juvenile dragon wrasse can be found in sandy and rubbly areas on both lagoon and oceanside reefs. Its peculiar swimming behavior makes it resemble a piece of debris drifting around in the currents and surges. When chased, it might dive to the bottom and bury itself in the sand to escape. Adults lose the tall filaments on the fins and are active

rock movers on the reef. They often feed by grabbing quite substantial sized chunks of dead coral rock in their mouths and flipping them over, looking underneath for any edible prey.

Humphead or Napoleon wrasse, juvenile
Cheilinus undulata
Cheilinus undulata is the largest of the wrasses and has been measured up to 180cm or nearly 6 feet in length. The large, humpheaded adults are often seen around lagoon pinnacles or on the oceanside slope, but juveniles like this one seem to like shallow lagoon coral reefs.

Humphead or Napoleon wrasse, midsize
Cheilinus undulata
This individual is much larger than the juvenile in the previous scene, but it still hasn't grown large enough to develop the large humped head. This wrasse is reported to eat a wide variety of invertebrates, including crown-of-thorns starfish and thick turban shells which the fish can crush in its powerful jaws.

Humphead or Napoleon wrasse, adult male
Cheilinus undulata
The big humpheads turn dark green and develop the large bump or their foreheads. They are also pretty shy and will usually not approach divers. In many island groups to the west of the Marshalls, they have been all but fished out.

Blacklip butterflyfish, feeding
Chaetodon kleinii
Also called Klein's butterfly, this species occurs in pairs on lagoon pinnacles and the oceanside slope. They seem to be more common in the middle part of the atoll than in the southern end. This one is pecking at a piece of dead coral that had been knocked over. Later in the scene, a regal angelfish, *Pygoplites diacanthus*, comes in and gets chased off by an *Acanthurus nigricans* tang.

Raccoon butterflyfish
Chaetodon lunula
The raccoon butterfly is usually found in pairs and tends to be somewhat inactive during the day, often hanging like this above the bottom or resting under table corals. It is said to be one of the only nocturnally active butterflies, when it feeds upon benthic invertebrates. Gut content analysis indicates that they primarily feed on opisthobranch mollusks such as bubble shells and nudibranchs, but they will also take small crustaceans and even coral polyps. The other fish hanging up in the water column with the two raccoons are bigeye emperors, otherwise known as *Monotaxis grandoculis*. Inactive during the day, these emperors hunt at night primarily for mollusks and crustaceans.

Ornate butterflyfish, coral eater
Chaetodon ornatissimus
The large ornate butterfly lives both on lagoon and oceanside reefs and is usually found in pairs. It is strictly an eater of live coral polyps, so does not survive well in an aquarium.

Meyer's butterflyfish, coral eater
Chaetodon meyeri
This is usually quite a rare fish at Kwajalein. For a number of years, I searched for a specimen to photograph. Then one year, the water mass moving eastward during an El Nino brought in a large settling of juveniles. Like many other fish, these butterflies spend the first part of their development drifting in the plankton before settling out on the reef to begin a benthic existence. Suddenly that year, there were hundreds of small *Chaetodon meyeri*, both on the oceanside and lagoon reefs. As they grew, they became less common as some no doubt succumbed to predation and competition from other reef fish. Now they are relatively scarce. Unless we get another settling, they may nearly vanish from Kwajalein again until the next chance settling. *Chaetodon meyeri* feeds only on live coral and is not suitable for most aquaria.

Fourspot butterflyfish
Chaetodon quadrimaculatus
The fourspot butterflies, or "quads" as we often call them, are very rare at Kwaj. Most of the few individuals we've seen have been shallow, three or four meters or less depth, on oceanside west reef islands such as Ninni. This one was part of a pair that was on the lagoonside of the east reef north of Omelek Island, also very shallow. This species is relatively common in Hawaii.

Dotted butterflyfish
Chaetodon semeion
Chaetodon semeion is not common at Kwaj. Most often they are seen on coral pinnacles with high cover of living coral, but occasionally one or two will show up on the oceanside slope.

Teardrop butterflyfish
Chaetodon unimaculatus
The common name comes from the large black spot that looks like an inverted teardrop. Teardrops or unimacs, as they are sometimes called, are not especially uncommon both on lagoon and oceanside reefs. They usually wander about in pairs or sometimes in groups or three or four.

Pyramid butterflyfish
Hemitaurichthys polylepis
These butterflies are usually found in large schools on both leeward and windward oceanside reefs as well as on lagoon pinnacles exposed to currents from atoll passes. They are usually seen swimming well up off the bottom, where they feed on plankton. The school in this scene had retreated to the safety of the coral at the approach of the photographer.

Threespot damsels in anemone
Dascyllus trimaculatus in *Stichodactyla haddoni*
Juveniles of this damselfish are able to live in and around anemones, but the adults usually move away and live around coral. This particular small anemone was providing shelter to an unusually large number of damsels, and there were even a few tiny specimens of the three-banded anemonefish, *Amphiprion tricinctus.*

Three-banded anemonefish in Haddon's anemone
Amphiprion tricinctus in *Stichodactyla haddoni*
Here is another color form of the anemone species shown in the previous scene. This anemone harbors a few of the threespot damsels, but it is dominated by some nearly adult-sized *Amphiprion*. Generally this species of anemone seems to act as a nursery for juvenile damsels and anemonefish. As the fish get larger, they wander off, the damsels to live around coral and the anemonefish to seek out a different kind of anemone. Many of the latter probably do not survive to find another anemone.

Three-banded anemonefish in Haddon's anemone
Amphiprion tricinctus in *Stichodactyla haddoni*
These are the same species in the previous scene, but this anemone is larger and supports a larger population of anemonefish. This one is in a patch of *Halimeda* algae on the lagoon slope of the east reef.

Three-banded anemonefish in Haddon's anemone
Amphiprion tricinctus in *Stichodactyla haddoni*
Again, the same species as in the previous two scenes. This particular anemone is in the sand next to the Prinz Eugen shipwreck off Ennubuj Island.

Three-banded anemonefish in orange anemone
Amphiprion tricinctus in *Stichodactyla haddoni*
Once again, these are the same species as the previous few scenes. Haddon's anemone is quite variable in color; this one is a bright orange red, quite a contrast to the rather drab *Halimeda* algae patch surrounding it. Some juvenile specimens of a couple of species of goatfish swim back and forth in front of the camera.

Three-banded anemonefish in pink anemone
Amphiprion tricinctus in *Stichodactyla haddoni*
Again the same species, but this time the anemone is pink.

Handnet crab feeding in pink Haddon's anemone
Neopetrolisthys maculatus in *Stichodactyla haddoni*
The *Stichodactyla haddoni* anemones we've been seeing support a variety of other inhabitants in addition to the fish. This handnet crab is always found with one of several species of anemone, and nearly every Haddon's has its own resident pair. The crabs often hide under the edges of the tentacle-covered oral disk so are often hidden from view. These crabs get their common name from their feeding technique. Specialized forward appendages are terminated with many, close-set long slightly curved filaments that the crab uses to scoop plankton out of the passing water currents. After holding up the "handnet" for a few seconds, the crab retracts it and uses small brush-like appendages next to the mouth to clean the plankton from the net and transport it to the mouth. It is fascinating to watch. Notice also the small shrimp right behind the crab; several species of shrimp also live in these sea anemones. Generally these crabs and shrimp living on anemones are called commensals. The name comes from the symbiotic relationship between the species. Symbiosis, remember, is an association between two different species of organism. The fact that these crabs always live in association with sea anemones precisely fits this definition. This type of symbiosis is thought to be commensalism, roughly meaning that one of the two species is benefited by the relationship while the other is neither benefited nor harmed. The crab gains the benefit of a safe place to live—not many predators would risk the anemones stinging tentacles to try to catch a small crab. The anemone, however, could probably care less. The crab doesn't seem to do anything for or against it.

Handnet crab cleaning eggs in Haddon's anemone
Neopetrolisthys maculatus in *Stichodactyla haddoni*
Crabs carry their eggs under their abdomen. Here the crab flaps its tail apparently to flush her eggs.

Shrimp on Haddon's anemone, walking on balloons
Periclimenes holthuisi on *Stichodactyla haddoni*
The shrimp *Periclimenes holthuisi* lives in association with a number of different anemones and hard corals. This one is walking over the anemone's short tentacles, looking as though it is balancing on a field of balloons. Most of the body of the shrimp is comp letely transparent, so you can easily see the anemone's tentacles through the shrimp.

Short-clawed shrimp, male and female
Periclimenes brevicarpalis on *Stichodactyla haddoni*
Other shrimps always found as commensal symbionts on sea anemones are these *Periclimenes brevicarpalis*. This scene shows a small male at right and a larger female at left with its tail facing us. It kind of looks as though there is a bit of aggression between the two. A few anemonefish *Amphiprion tricinctus* almost look as though they're trying to get in on whatever's going on.

Popcorn shrimp, pair on anemone
Thor amboinensis on *Stichodactyla haddoni*
By now you probably realize that these *Stichodactyla haddoni* anemones are almost little worlds in themselves, with a varied cast of inhabitants. It's true. Here are a couple more shrimp that we call popcorn shrimp. They have a habit of popping their tails up and down much of the time. The larger one here is not doing it, but the smaller one starts up part way through the scene. Partway through he scene, a young and transparent specimen of the previous shrimp, *Periclimenes brevicarpalis* comes into view from the left.

Popcorn shrimp, group of five
Thor amboinensis
Actually there were six shrimp in this group, but one is visible only for an instant at the far left side of the scene (and may be out of the field of view on most TV sets). The anemone these shrimp are associated with is off to the left, just out of the frame.

Bumblebee shrimp near anemone
Gnathophyllum americanum next to *Stichodactyla haddoni*

Although often found associated with echinoderms such as starfish, these bumblebee shrimp also often live hidden under the edge of Haddon's anemone. Most are white with black lines, but some range all the way to this bright yellow. It is a tiny shrimp, generally less than 15mm (a bit over half an inch) long.

Magnificent anemone with white base
Heteractis magnifica inhabited by *Amphiprion perideraion*
This large colorful anemone truly deserves the name magnificent. It is one of the largest anemones here in the Marshalls; the carpet is usually wider but tends to lie flat on the bottom. We've seen some of the expanded *Heteractis magnifica* earlier in this video, but they sometimes "ball up" showing their variably-colored bases. This one has an unusual pure white base. *Heteractis magnifica* is usually home to several apricot anemonefish, *Amphiprion perideraion*.

Magnificent anemone with blue base
Heteractis magnifica inhabited by *Amphiprion perideraion*
This balled up anemone is showing off its bright blue base. The tentacles are almost completely hidden, leaving the several apricot anemonefish exposed and wary.

Magnificent anemone with orange base
Heteractis magnifica inhabited by *Amphiprion perideraion*
More of the same. We're not sure why the anemones ball up like this occasionally. Perhaps they have captured a morsel of food and are drawing it into their body cavity for digestion. Mostly, the anemones are farmers. As we mentioned early in the video, these anemones harbor unicellular plants called zooxanthellae within their tissues, and are able to use the oxygen and carbon compounds produced by the plants in exchange for carbon dioxide, produced by the anemone as a metabolic waste.

Magnificent anemone with pink base
Heteractis magnifica inhabited by *Amphiprion perideraion*
Some of the anemone bases are just vividly colored. On this one, the larger apricot anemonefish is acting very possessively about the tentacles remaining in view.

Apricot anemonefish in Magnificent anemone
Amphiprion perideraion in *Heteractis magnifica*
This relatively large anemonefish appears to be either trying to put something in or take something out of the anemone's mouth.

Cardinalfish and anemone on small reef
Some small isolated reefs in the middle of a wide expanse of sand become oases for numerous fish and other animals. This small reef is less then 3 meters in diameter, yet is home to thousands of fish and even two sea anemones.

Diver watches fish-covered reef
This is the same reef as in the previous scene. Here a diver sits back and watches the action on this crowded reef. The large yellowish colored anemone on top is *Heteractis magnifica* while the brown one just below it and a bit to the left is *Heteractis quadricolor.*

Green turtle comes to rest on sand
Chelonia mydas
Some sea turtles are quite unfazed by the presence of divers, while others are wary and keep their distance. The wary ones may have had an experience with people who tried to catch them. Sea turtles are still popular food items among the Marshall islanders. The green turtle is one of the two common sea turtle species here in the Marshalls.

Green turtle resting on sand
Chelonia mydas
This one did not seem bothered by having a diver nearby.

Green turtle out of hole and around
Chelonia mydas
Although this green turtle came out of its resting hole as the photographer approached, it did not seem unduly concerned. It swam in a full 360 degrees and more around the camera before easing away.

Green turtle continuing around
Chelonia mydas
The same turtle from the previous scene continues its circle around the photographer. The shell on this turtle is quite clean and is typical of the greens. The hawksbill turtle has a more mottled shell pattern.

Diver passes above
Swimming fast, a diver passes overhead and up and over a coral reef.

Diver through school of tangs
A diver swims through a school of black tangs.

Diver passes large fan coral
A diver swims behind a large gorgonian, *Subergorgia mollis*. A gray reef shark swims by in the background.

Diver photographs gray reef shark
Homo sapiens and *Carcharhinus amblyrhynchos*
A diver photographs a passing gray reef shark. There are times when this action would not be safe. If a gray reef shark is aggressively posturing, taking a flash picture of it could trigger an attack. If the shark is not posturing, it is probably safe to do. Probably, but I don't recommend it. A posturing shark can be seen in the next scene.

Gray reef shark in aggressive posture
Carcharhinus amblyrhynchos
Accompanied by a few pilot fish, this gray reef swims in toward the camera. As it passes, it goes into an aggressive posture with pectoral fins down and back arched but nose up, and swims in the characteristic aggressive 'S' shape. After making a turn, it continues away, still posturing. When a shark is swimming in this fashion, a diver must be very careful to not make it feel threatened. Lunging toward the shark, shooting a spear at it, even taking a flash picture of it could trigger a lightning fast attack.

Spotted eagle ray, very large specimen
Aetobatis narinari
This is the largest individual of *Aetobatis narinari* I have ever seen. It was quite deep on the oceanside slope and looked like it measured well over 2 meters from wingtip to wingtip.

Black-belly manta ray with remora
Manta birostris
A large manta slowly approaches and then passes low over the photographer. A remora is attached to the underside. Mantas can be seen both in the lagoon and oceanside, but one of the better areas is along the lagoon side of the east reef between North Loi and Gugeegue. Here they often come in to the reef to have their parasites picked by cleaner wrasses. They seem little concerned about the presence of divers, as long as the divers do not chase or harass them. They seem to think a diver is just another big animal coming in for a cleaning. Mantas come in two forms, one with a mostly black underside and the other with the underside mostly white. There is some controversy about whether there are two different species, or just a single variable one.

White-belly manta ray with remora
Manta birostris
This manta passed quickly by with its anterior "plankton scoops" extended in feeding position. These flaps on either side of the head channel water into the ray's mouth, where it is filtered for their planktonic food before passing out the gill openings. The bit of a cloud low in the water column in this scene is mostly plankton, which the ray is eating.

White-belly manta ray
Manta birostris
Sometimes you can identify individual mantas by the markings on their undersides. We've seen this one with the 'V' shaped black mark at least a couple of different times.

Very large manta ray eating bubbles
Manta birostris
This huge manta came in on us on the oceanside reef at Gea. It seems to be trying to eat our bubbles.

Very large manta ray eating bubbles
Manta birostris
This is the same manta as in the previous scene. Here it is obviously altering its swimming path to engulf bubbles. You can see the bubbles that have passed out of its gills trailing along behind the ray.

At the end, the credits roll up over a pulsating crown jellyfish, *Cephea cephea*.

This DVD was filmed, edited, and described by Scott and Jeanette Johnson. Music is by Michael G. Brewer of QCCS Productions. Video footage was filmed using a variety of Hi8 and mini DV video cameras in underwater housings made by Light & Motion Industries. Video footage was captured to disk using a Pinnacle Systems DV500 video capture card and edited using Adobe Premiere 6.5.

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