

Coral reef fish feeding behavior in the Caribbean

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Table of Contents

- 1 Introduction
- 2 Herbivorous Fishes
 - 2.1 Nomadic Herbivores
 - 2.2 Sedentary Feeders
- 3 Planktivorous Fishes
- 4 Carnivorous Fishes
 - 4.1 Fishes That Eat Invertebrates
 - 4.2 Fishes That Eat Fish
- 5 Further Reading

Introduction

Fishes living in the Caribbean Sea rely on a variety of food sources including plants, plankton, invertebrates, and other fishes. Fishes can feed either on the reef or off of the reef in the sandy bottoms or sea grass beds. Fishes can feed either diurnally (during the day) or nocturnally (at night). Their diet and mode of feeding strongly influences their morphology. Moreover, their foraging strategy should affect their susceptibility to predators and thus influence their anti-predator mechanisms.

Herbivorous Fishes

Only 10 – 25% of species on a Caribbean reef fishes are herbivores. Although there are relatively few herbivorous fish species, these species tend to have relatively large population sizes such that the total biomass of herbivores is high. Herbivorous fishes are most common in shallow water which is not surprising because light levels are higher in shallow water which promotes algal growth. In general, herbivores are the most common fishes above 30 feet whereas carnivores are the most common fishes below 30 feet. On shallow reefs herbivores may take over 150,000 feeding bites per meter each day and consume from half to all of the daily algal production (one reason that there is limited algal growth on a healthy reefs).

Nomadic Herbivores

Nomadic herbivores such as parrotfishes (Family Scaridae), surgeonfishes (Family Acanthuridae), and chubs (*Kyphosus* sp.) may forage across wide areas of the reef. Parrotfishes use their strong jaw and fused teeth (beak) to scrape algae off of the surface of corals and bite off chunks of corals. Nutrients are digested and the remaining materials (up to 75 percent of the gut content of parrotfish is inorganic material) are excreted. A large adult parrotfish can excrete over 1 ton of sand per year!

Surgeonfishes are diurnal herbivores that feed all around the reef. Blue Tang (*Acanthurus coeruleus*) are specialized algal browsers who may feed as solitary individuals or in groups. Blue Tang may benefit in feeding groups in two ways. First, they may be able to overwhelm the defense of a territorial damselfish by invading an individual damselfish's territory with overwhelming numbers. Second, they may experience some protection from predators. Ocean Surgeonfish (*Acanthus bahianus*) and Doctorfish (*Acanthurus chigurgus*) are specialized grazers. Doctorfish typically feed above the reefs and surgeonfish typically feed in sandy areas and sea grass beds adjacent to the reef. They have a gizzard that helps them break up and digest detritus and invertebrates that are held in the sediments. Chubs forage in schools that can travel long distances. Some days chubs can be common in a particular location, but then they will disappear from that section of the reef for several days.



Stoplight Parrotfish. "Reef Fish Identification", New World Publications © 1994.

Herbivorous fishes need to be able to hover in the water column and must be able to maneuver in and out of tight places. This need has selected for narrow compressed bodies and flexible pectoral and ventral fins that they use as paddles that allow them to precisely control their position in the water column. Their mouths are small and contain small incisor-like teeth that can occasionally be fused to form a beak-like structure (e.g., parrotfishes). The digestive tracts of herbivorous fishes may contain protistan and bacterial endosymbionts that aid in the digestion of the plant material.

Sedentary Feeders

Damselfishes (Family Pomacentridae) are the most important sedentary herbivores on the reef. In fact, they are the most abundant herbivores on the reef. Many damselfishes care for "algae gardens or lawns" that they defend from other herbivores.



Yellowtail Damselfish. "Reef Fish Identification", New World Publications © 1994.

Planktivorous Fishes

Most reef fishes eat plankton during their juvenile stage and some continue to feed on plankton after they have matured. Planktivores feed either above the reef or feed near the reef or sandy bottom and may feed during the day or at night.

Diurnal planktivorous fishes that feed above the reef are able to capture the plankton before it reaches the species living on the reef. Some of these species are very large (e.g., Giant Manta (*Manta birostris*) and Whale Sharks (*Rhincodon typus*)) and swim through the water column with their mouths open picking up plankton. Because they are so large, they generally do not need to worry about predators. These species often forage alone.



Blue Chromis. "Reef Fish Identification", New World Publications © 1994.

Smaller planktivores feeding in the water column could be subject to predation because they are removed from the safety of the reef. Thus, these fishes are often found in schools, which have been shown to provide some protection from predators. Sometimes these schools contain multiple species (e.g., Blue Chromis (*Chromis cyanea*), Brown Chromis (*Chromis multilineata*), and Creole Wrasse (*Clepticus parrae*)). These fishes rely on speed to escape predators so they are more elongated and streamlined than species that live on the reef and they have forked tails. They tend to have monochromatic coloration; their blue or silver coloration makes them harder to see in open waters. Their keen eyesight, binocular vision, small upturned mouths, and protrudable jaws allow them to pluck plankton from the water column. In addition, many planktivores have closely spaced, long

gill rakers that prevents ingested food from escaping through the gills.

Other planktivores feed on plankton that falls to the reef or sandy bottom. Fairy Basslets (*Gramma loreto*) are common reef-inhabiting planktivores. They remain close to the reef and they have the unusual habit of keeping their belly near the substrate, happily swimming upside down beneath ledges. Yellowhead Jawfish (*Opistognathus aurifrons*) inhabit sandy bottoms. They hover just above the sand, near holes they have dug, picking up plankton. If they are disturbed then they will back up into their holes for safety.

Some planktivorous fishes, including cardinal fishes (Family Apogonidae) and some squirrelfishes (Family Holocentridae) are nocturnal. Obviously, locating prey is much more difficult at night so these species have evolved large and sensitive eyes. Nocturnal planktivores have lost some visual acuity so they are forced to feed on larger prey than their diurnal counterparts. Nocturnal fishes hiding under ledges in the coral reefs during the day. At dusk they leave the shelter of the reef in search of food.

Carnivorous Fishes

Carnivorous fishes make up from 41 - 68% of species on the reef.

Fishes That Eat Invertebrates

Most invertebrate prey are well hidden, camouflaged, or are protected by chemical or physical means. Thus, they present special problems to the fishes that use them as food. The fact that relatively few species with relatively small population sizes feed on invertebrates during the day suggests that feeding on invertebrates is a difficult way to make a living. In order to successfully feed on invertebrates on the reef, fishes must possess precise swimming ability so that they can reach in and pull prey from inaccessible areas. Thus, they have morphologies similar to the herbivores: good close-up vision with mouths that can grasp prey and deal with prey defenses (e.g., crushing shells). Many of the invertebrate-eaters have beaklike mouths, strong jaws, and pharyngeal teeth.



Because species attempting to capture hidden prey have better luck when foraging alone, these species do not rely on schooling to protect them from predators and need to rely on other means of protection. Filefishes (Family Monacanthidae), triggerfishes (Family Balistidae), trunkfishes (Family Ostraciidae), and porcupinefishes (Family Diodontidae), have evolved interesting solutions to this problem. Pufferfishes enlarge by taking in water to make them hard to swallow; some species may produce toxins. Filefishes and triggerfishes have spines on their backs that they can extend to make themselves more difficult to swallow. Porcupinefishes are covered with protective spines and are also able to make themselves larger. Trunkfishes have a series of fused body plates that surrounds them with armor. Because they are well-defended against predators and they are trying to catch primarily immobile prey, these species don't have to be fast. Thus, many of these species have odd shapes and swim by the coordinated use of all of their fins.

There are also several small sedentary species that primarily feed on invertebrates including sea horses (Family Syngnathidae), some blennies (Family Labrosomidae), and some gobies (Family Gobiidae).



Spotted Goatfish. "Reef Fish Identification", New World Publications © 1994.

Species that feed off of the reef face some problems including greater risk of predation, finding prey that are hidden beneath the sand, and dealing with prey protected by large shells. Thus, relatively few species feed on invertebrates off of the reef. Species feeding in this way use a variety of strategies. Spotted Eagle Rays (*Aetobatus narinari*) feed on clams, oysters, and gastropods that are buried beneath the sand. They crush the shells of their prey using specialized dental plates. Goatfishes (Family Mullidae) feed in the sand, but generally remain near the safety of the reef. They have appendages near their chins, barbells, which they use to detect prey by touch and taste. Trunkfishes are so well protected from predators that they are able to move far from the safety of the reef. When they identify signs of prey, they uncover the prey by shooting a jet of water out

of their mouths. Hogfishes (Family Labridae) are large enough that they are safe from most predators. They have large jaws and teeth that allow them to feed on well-protected prey.

At night, invertebrates come out to feed on the sand flats and in sea grass beds. Thus, there is a lot of food for invertebrate-feeders at night off of the reef. Because it is dark, predators can not rely on vision to detect their prey. Instead they rely on touch, taste, smell, and their lateral lines. Because these senses are not as effective as sight in determining the exact location of a prey item, they have had to come up with different mechanisms for capturing prey. Most nocturnal invertebrate-eaters have large mouths that they open wide to create suction that draws in a lot of water and, hopefully, their intended prey. They close their mouths to expel the water and strain out the prey.

Grunts (Family Haemulidae) and snappers (Family Lutjanidae) hang around the reef in small groups during the day. At sunset, they form schools that travel to foraging areas up to half a mile away following trails along the bottom. When they reach their feeding grounds, they split up and forage solitarily for the rest of the night. Before sunup, they regroup and return home. Squirrelfish, bigeyes, and some cardinalfish also forage for invertebrates off of the reef at night, but they do not move as far as snappers and grunts.

Although there is a lot of invertebrate activity on the reef at night, the darkness makes it hard for the fish to see the invertebrates. Thus, there are not many fishes that feed on invertebrates at night on the reef (that's why the invert activity is highest at night).

Sponges are the simplest of all invertebrates. Because sponges are low in nutritive value, contain a lot of indigestible material, and are protected by chemical and physical means, they are not a particularly good food source for fishes. Only 11 species of Caribbean fishes regularly eat sponges. Species that feed on sponges have evolved relatively recently suggesting that competition forced them to evolve to eat a less-preferred food source.

Sponges make up the majority, 70 – 95%, of the diet of most angelfishes (Family Pomacanthidae). Angelfishes prefer to feed on the sponges with the lowest content of protective spicules. Sponge-feeding fishes have strong jaws that contain overlapping rows of tightly packed teeth that they use to teach through the tough sponge material. They secrete a thick layer of mucous around the pieces of food to protect their stomachs during digestion.



Gray Angelfish. "Reef Fish Identification", New World Publications © 1994.

The larger species of angelfishes are protected from predation because their large size and thin bodies make them a difficult mouthful for predators. They typically feed by following well-used paths through territories that are defended for mating, rather than feeding purposes. Gray Angelfish (*Pomacanthus arcuatus*) live as mated pairs in large territories. They move and feed slowly, taking 3-4 bites per minute. Sponges make up 70% of their diet with the rest of their diet consisting of gorgonian polyps, other invertebrates, and algae. Although algae make up only 10% of their diet, foraging for algae takes up about a third of their foraging time. French Angelfish (*Pomacanthus paru*) forage in a similar manner, but they consume less gorgonian polyps and algae. The diet of Queen Angelfish (*Holocanthus ciliaris*) is made up almost entirely of sponges, 97%, with the

balance made up of algae and invertebrates. Rock Beauties (*Holocanthus tricolor*) also eat mostly sponges, 96% of their diet, although half of their foraging time is spent scraping algae off of rocks.

Some fishes feed on corals. They can feed on corals in two ways. Pufferfishes, filefishes, triggerfishes, and butterflyfishes (Family Chaetodonidae) actively consume individual coral polyps. Surgeonfishes and parrotfishes remove coral polyps to get the algae or invertebrates that have bored into the coral skeleton.

Fishes That Eat Fish



French Grunt. "Reef Fish Identification", New World Publications © 1994.

The structure of the reef provides a lot of places for fish to hide from their predators. Thus, most fish don't stray too far from the reef. Because larger fish are generally able to swim faster than smaller fish, larger fish are able to move farther away from the reef than smaller fish. Piscivorous fishes use three foraging strategies, pursuit, stalking, or ambush.

Pursuit predators begin their attack on the move and may attack from long distances. They thus rely on speed to capture prey. Common pursuit predators include jacks (Family Carangidae), Great Barracudas (*Sphyrna barracuda*), and Yellowtail Snappers (*Ocyurus chrysurus*). These species rapidly swim long distances across the reef. Their torpedo-shaped streamlined bodies, thin caudal peduncle, and stiff distinctively-shaped tails allow them to swim rapidly.

Their large eyes provide them with good vision they use to identify their prey.

Pursuit predators are primarily silver in color. Bar Jacks (*Caranx ruber*) are common reef pursuit predators. They tend to hunt in groups, but they can also be observed shadowing rays foraging across the sandy bottom.



Trumpetfish. "Reef Fish Identification", New World Publications © 1994.

Moray eels (Family Muraenidae) may hunt for fishes and other prey at night either in the open or by using their long narrow bodies to travel into the protected crevices in the reef where other fishes are sleeping.

Stalking predators begin their attacks from a stationary position. They attempt to maneuver themselves into position and wait for prey to approach close enough to attack. Their bodies are thin and elongated in order to reduce the area exposed to prey. Their tails have large surface area needed to provide the power necessary for a rapid strike. Trumpetfish (*Aulostomus maculatus*) are classic stalking predators found on coral reefs. They use their expandable jaws to suck in fishes. They are capable of swallowing unexpectedly large prey so it is possible to observe a bulge in the stomach of a fish who has recently fed. Trumpetfish often orient

themselves vertically among sea fans or soft corals. Foraging trumpetfish may make 2-3 strikes per hour. Researchers have observed 8 successful strikes out of 45 attempts in 19 hours of investigation.

Ambush predators wait for prey to get close to them and then they grab them. Ambush predators are often well camouflaged and possess upturned mouths that they use to capture their prey. For example, the foraging strategy of groupers (Family Serranidae) is to sit, wait, and inhale. They capture their prey by the suction created by the rapid expansion of their jaws and the flaring of their gill covers. Nassau Groupers (*Epinephelus striatus*) tend to be somewhat territorial and can live in the same home range for a number of years. Their diet includes fishes, including parrotfish, grunts, and snappers, lobsters, and mollusks.

Fish make up 80% of the diet of Grasbys (*Cephalopholis cruentatus*). Their favorite food is Brown Chromis, but they also feed on Bicolor Damsel fish (*Stegastes partitus*), Blue Chromis, and Yellow Goatfish (*Mulloidichthys martinicus*). The remainder of their diet consists of invertebrates, mostly crustaceans. Coneyes (*Cephalopholis fulvus*) prefer to live on isolated patch reefs. Their diet is made up of an equal mix of small fishes and invertebrates.

Flounders (Family Bothidae) are the master of camouflage. They can change colors to match their surroundings and lie in wait until and unsuspecting prey passes by. Other ambush predators include scorpionfishes (Family Scorpaenidae), toadfishes (Family Batrachoididae), and lizardfishes (Family Synodontidae).

Further Reading

- Deloach, N. 1999. Reef Fish Behavior, Florida, Caribbean, Bahamas. New World Publications, Inc. Jacksonville, FL. ISBN: 1878348280



Great Barracuda. "Reef Fish Identification", New World Publications © 1994.



Peacock Flounder. Coral Reef Alliance Photobank.

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