The Undeniable Appeal of Puffers and Porcupines
By Jay Hemdal and Jeff Kurtz

Aquarists who are looking for a truly "pet-like" marine fish with loads of personality, a nimble brain (for a fish, anyway), wild coloration and patterning, and a body plan that borders on the bizarre, just might find the object of their search among the puffers or porcupinefishes. Given suitable aquarium conditions and proper husbandry, these hardy, long-lived fish will reward their keepers with years of fascination.

So named for their renowned ability to inflate their bodies to convince would-be predators that they're biting off more than they can chew—or, if caught by ambush, to encourage a predator to spit them out—puffers are a wonderful example of the many extraordinary adaptations exhibited by sea animals.

Of course, not all puffers are found in the sea. In fact, many are at home in brackish water, and some species even favor fresh water. However, puffers and/or porcupinefishes are represented in all tropical seas.

Puffer or Porcupine?

Though both the so-called true puffers (family Tetraodontidae) and the porcupinefishes (family Diodontidae) are shaped more or less like footballs with fins, there is a distinction between these two groups that is implied by the common name of the latter. The "true puffers," such as the aptly named dog-faced puffer (*Arothron nigropunctatus*) and guineafowl puffer (*Arothron meleagris*), have smooth, scale-less bodies whereas the porcupinefishes have spiny bodies. In some porcupinefish, e.g., the striped burrfish (*Chilomycterus schoepfi*), the spines are held constantly erect. Other species, such as the spiny puffer (*Diodon holocanthus*), can raise and lower their spines at will and typically keep them flat to their bodies unless provoked.

All Puffed Up and Nowhere to Go!

A puffer usually inflates itself in response to stress by rapidly swallowing water, which fills up a distensible section of the stomach called the diverticulum. In this case, once the danger has passed, the fish can evacuate the water from its diverticulum and go about its business with minimal difficulty. However, when removed from the water, a puffer is also able to inflate its body by swallowing air—a fascinating-yet-undesirable feat since the fish cannot expel air as readily as it can water.

Fatal Attraction

Along with their ability to inflate themselves to discourage predation, many puffer species have another, more potent, trick up their "sleeves" (fins?). That is, their viscera contain a poison called tetrodotoxin, which can be fatal to both predators and people. It's this same toxin that renders the bite of the Australian blue-ringed octopus so deadly. Ironically, puffer is considered a delicacy in Japan where some sushi devotees tempt their taste buds—and fate—by consuming raw puffer meat (see sidebar #3). This culinary "joy ride" can have disastrous consequences, though, if the puffer meat, known as fugu, is prepared improperly. All too often, a thrill-seeking diner discovers the potency of tetrodotoxin the hard way!

Aquarium Requirements

Potential "tankbusters" that, depending on the species, can range anywhere from one foot to three feet in adult length, puffers and porcupinefishes are best kept singly in a large species aquarium. A tank capacity of 100 gallons or more is recommended. While some puffer species will adapt to life in a large community aquarium, puffers are notorious fin-nippers and can do considerable damage to piscine tankmates with their powerful dental plates.

Not surprisingly, puffers also make poor mini-reef inhabitants. Like the closely related triggerfishes and filefishes, puffers won't hesitate to use those imposing dental plates to sample the resident invertebrates, which are a part of their natural diet.

This nibbling behavior may also extend to aquarium décor and equipment, so it's wise to place heaters, protein skimmers, and other devices out of the fish's reach, preferably in a separate sump. "Aquascaping" should consist of rockwork, with plenty of caves or overhangs where the puffer can seek refuge, as well as open sandy areas that the fish can pick through looking for tasty tidbits as it would in the wild.

Puffers for the Space-impaired

Aquarists who would like to experience keeping a puffer but simply don't have the room to accommodate a large aquarium need not despair! The so-called sharpnose puffers (a.k.a., the tobies), such as Valentini's sharpnose puffer (*Canthigaster valentini*) and the white-spotted toby (*Canthigaster jactator*), seldom exceed five inches in adult length. Many of the Asian brackish puffers are also just the right size for smaller systems. For example, the figure-eight puffer (*Tetraodon biocellatus*) grows to only about three inches in length, and the green-spotted puffer (*Tetraodon nigroviridis*) reaches its maximum size at about six inches.

Feeding

Puffers are omnivorous and, therefore, should be offered a variety of both meaty and plant-based foods. Fresh clams, fish, scallops, shrimp, muscles, oysters and frozen herbivore formulations are all excellent food items to introduce. To minimize the impact of these messy feeders on water quality, feed small portions two or three times daily rather than one large portion once a day. Promptly siphon or net out any portions of food left uneaten. Frequent partial water changes and vigorous protein skimming are also essential.

Puffers are notorious for "guilting" their owners into overfeeding by putting on a most endearing "hunger display" whenever the food provider (whom they quickly learn to recognize) comes into view. However, no matter how irresistible this begging behavior might be, aquarists must adamantly resist overfeeding lest they ultimately kill their puffers with kindness.

Hand feeding of puffers, though it might be tempting given their puppy-like demeanor, is also to be avoided as they may unwittingly "bite the hand that feeds them" in the process.

My, What Big Teeth You've Got!

One interesting aspect of puffer husbandry is the fact that the dental plates of some species grow continuously and must be worn down lest they impair the fishes' ability to feed properly. This can be achieved by routinely offering mollusks and crustaceans that

are still in the shell, which allows puffers to feed in a more natural fashion (after all, no one peels shrimp and "shucks" clams for them in the wild!). If this approach is not successful, however, it may be necessary for the aquarist to wear the puffer's teeth down by hand using a file.

Air ingestion

Puffers are well known for their ability to swallow water to increase their girth so that predators will be less able to swallow them. During shipping and subsequent handling, puffers can become stressed and will react by ingesting water or, if they are lifted out of the water, by swallowing air. A puffer that inflates its body with air, instead of water, may have difficulty releasing the gas once the traumatic event is over. The stress on the animal while floating at the surface—often upside down—may cause it to retain the air. One technique that may help is to hold the puffer underwater and give it a gentle squeeze. This will cause the fish to react by swallowing more water (rather than air). Give the fish a few more squeezes until it reacts by filling with water to its full capacity. Then, release the fish and observe it. Now that the fish has a mixture of air and water in its stomach, it may be able to expel both at the same time. The process may need to be repeated a few times. In stubborn cases, there may be a small amount of air remaining even after a week or so. Some aquarists have attempted to remove the residual air using a hypodermic syringe—but this is usually not completely effective.

Mimic filefish

Two species of filefish mimic toby puffers. *Paraluteres prionurus* is an excellent mimic of the Black-saddled toby, *Canthigaster valentini*. The Andaman filefish, *Paraluteres arquat*, mimics a more generalized "spotted toby." Up to 5% of a school of these puffers may actually be mimic filefish (FishBase 1999). It is supposed that these filefish gain protection from predators that normally avoid eating the potentially toxic toby puffers. However, there is one argument that both the toby and the filefish gain protection by resembling one another. Some predators are obviously able to prey on tobies, but filefish have their own anti-predator defense—sharp dorsal and anal spines. With a relatively high percentage (5%) of a school possessing sharp spines, most predators would pass on trying to make a meal of any fish in the group. In addition, the toby puffers that are supposed to be the "models" have some characteristics of the mimic, i.e., they have skin folds that resemble the filefish spines and they are thinner than other species of toby, more closely resembling thin filefish. This actually may be a rare case of two animal species that mimic each other for different reasons.

Fugu

Apocryphal stories abound of people eating fugu (raw pufferfish, such as *Takifugu rubripes*) and being poisoned because the fish was incautiously prepared by the sushi chef. The viscera of many pufferfish contain very high amounts of tetrodotoxin and, if not prepared with extreme precision, may poison the diner. References are made to the term "maki-maki," which is purported to translate from Japanese to English as "deadly death" in reference to the dangerous nature of this dish. It seems, though, that "maki" actually means "roll" (such as in a Sushi "roll"). So, while fugu-maki might be a

dangerous main course, “maki-maki” may simply mean “roll-roll”—not nearly as interesting a story!

Recently, Osamu Arakawa of Nagasaki, Japan, headed up a project in which Fugu puffers were raised in cages in the sea and in aquariums. His theory was that much of the tetraodotoxin produced by the fish was a result of them feeding on poisonous marine life (as has been seen with other toxic fishes, such as barracuda). His pufferfish were fed solely on mackerel and other “safe” foods and did not appear to end up containing dangerous amounts of the toxin. For some people though, it is the potential brush with death when eating Fugu that holds much of the allure, and this “safe” seafood may not be of much interest to them!

For the aquarist, the lesson here is, never ingest any species of pufferfish and never feed their flesh to any of your pets or other aquarium animals.

Symptoms of pufferfish poisoning generally appear between 20 minutes to three hours after ingesting the toxin. The following are the most common symptoms of pufferfish poisoning. However, each individual may experience a different set of symptoms.

Numbness of lips and tongue
Numbness of face and extremities
Sensation of lightness or floating
Dizziness
Headache
Vomiting
Extensive muscle weakness

These symptoms may progress to paralysis, loss of consciousness, respiratory failure, and can lead to death. If puffer poisoning is ever suspected, call emergency services (911) right away. If help is not available, vomiting should be induced if the victim is awake and alert and has eaten the fish within 3 hours. The victim may become paralyzed. Artificial respiration (rescue breathing) may keep the person alive until help arrives.

There is no known antidote for tetrodotoxin poisoning, so medical treatment consists of addressing the various symptoms as they progress.

Relative cost

The cost of pufferfish species varies greatly among species, but each species’ price seems to be relatively consistent among dealers. Toby puffers, such as *Canthigaster valentini*, are the least expensive species available, while the map puffer, *Arothron mappa,* is the rarest, most expensive species that is routinely available to home aquarists. A map puffer may cost more than thirty times that of a common toby puffer. Gold phase *Arothron meleagris* puffers vary in price depending on the quality of their yellow or gold coloration. Very fine examples of this species may even approach the map puffer in price

Tetraodontidae

White-spotted puffer/stars and stripes puffer
Arothron hispidus (Linnaeus, 1758)
Maximum size: 20", five pounds
Habitat: Shallow reefs, seagrass and brackish water
Range: Widespread, East Africa to Baja California
Notes: This species was commonly exported from the Philippines as a "filler fish"—a common fish that was not ordered by the importer, as opposed to a more highly sought-after species, such as a blue tang or angelfish, that all of the importers ask for. In recent years, as importers demanded that unordered specimens not be shipped, this species has not been as frequently seen.

Guineafowl puffer
Arothron meleagris (Lacepède, 1798)
Maximum size: 20"
Habitat: Coral reefs
Range: A huge range: from South Africa east through the Indo-Pacific to Mexico, the Galapagos and Ecuador
Notes: This species reportedly often feeds on the tips of branching *Acropora* corals (FishBase 1999). They also feed to a lesser extent on sponges, mollusks, bryozoans, tunicates, foraminiferans and algae. Their coral-feeding habit is sometimes difficult to break in captivity, and some individuals may refuse to feed for some time after being collected (an unusual occurrence for any species of puffer!). The coloration of this species varies between individuals from gray with white spots to jet black with bright white spots. Rare individuals are yellow or even bright gold in color. These brightly colored specimens are much more expensive.

Blackspotted puffer/dog-faced puffer
Arothron nigropunctatus (Bloch & Schneider, 1801)
Maximum size: 14"
Habitat: Coral reefs
Range: East Africa through the Indo-Pacific to Micronesia
Notes: Like *A. meleagris*, some individuals of this species are more rarely seen in a yellow or partially yellow color phase. Also, as with that species, they are reported to feed on the tips of *Acropora* coral. Dog-faced puffers rarely have trouble adapting to captive diets as they also feed on crustaceans, mollusks, sponges, tunicates and algae. Generally, they are one of the more commonly seen members of this genus in the pet trade. The related map puffer, *Arothron mappa,* is perhaps the most expensive member of this genus.

Caribbean sharpnose puffer
Canthigaster rostrata (Bloch, 1786)
Maximum size: 4"
Habitat: Reefs and seagrass beds
Range: South Carolina, south through Florida and into the Caribbean

Notes: Their diet in the wild consists of seagrass, sponges, crustaceans, snails, clams, worms, sea urchins, starfish, hydroids and algae. They are often seen swimming using their pectoral fins to scull through the water while their caudal fin is held curved to one side. Juveniles less than an inch in length can be found hovering next to Gorgonians, attempting to blend in with them. This species is very abundant in shallow reef areas and is a very slow swimmer. In combination, these attributes makes this species a very common target for neophyte fish collectors. The closely related *Canthigaster figueiredoi*, the southern Atlantic sharpnose puffer, may occasionally enter the aquarium trade from collection sites in Brazil.

Spotted sharpnose puffer
Canthigaster solandri (Richardson, 1845)
Maximum size: 4.5”
Habitat: Reef flats, lagoons and fringing reefs
Range: East Africa east through the Indo-Pacific, straying to Hawaii
Notes: Often found in pairs, sometimes in small groups. Feeds mainly on filamentous red and green algae but also on corals, tunicates, mollusks, echinoderms, worms and crustaceans. This (or related species) is often collected and shipped to the mainland from Hawaii. Most *Canthigaster* puffers are peaceful when kept in fish-only aquariums, but will occasionally nip at the other fishes’ fins, and they cannot be wholly trusted in aquariums with invertebrates present.

Valentini's sharpnose puffer
Canthigaster valentini (Bleeker, 1853)
Maximum size: 3.5”
Habitat: Coral reefs
Range: Red Sea and East Africa, north to Japan and east to Micronesia
Notes: Feeds mainly on filamentous green and red algae, tunicates, and on lesser numbers of corals, bryozoans, worms and mollusks. Forms schools of up to 100 fish, often in combination with the filefish *Paraluteres prionurus* (which make up about 5% of the school, mimicking *C. valentini* to protect it from predators). A staple species in the pet trade, Valentini puffers are compatible in most fish-only aquariums, as long as no large predators are kept with them. In reef aquariums, as with most puffers, they tend to nibble on various invertebrates.

Bullseye puffer
Sphoeroides annulatus (Jenyns, 1842)
Maximum size: 18”
Habitat: Soft-bottom areas
Range: East Pacific, California south to Peru, including the Galapagos
Notes: In the Galapagos Islands, these fish will swim up from the bottom to the surface near anchored boats, looking for scraps of food or offal discharged overboard. Their distinctive color pattern really does resemble a bullseye when viewed from above (Hemdal 1999). This species has been reared in captivity from adults that were artificially spawned using hormones. The eggs hatched after 72 hours at 81.5 degrees F. The larvae were fed microalgae (*Nannochloropsis* sp. and *Isochrysis* sp.) for the first eleven days,

with *Brachionus* sp. rotifers added at day four. Live *Artemia* nauplii were added at day 21. At 30 to 60 days, artificial foods were added to their diet (Garcia-Ortega, et-al, 2003). Active swimmers with very strong jaws, these puffers should only be kept in fish-only aquariums containing sturdy fish, such as groupers or large angelfish.

Southern puffer
Sphoeroides nephelus **(**Goode & Bean, 1882)
Maximum size: 15”
Habitat: Bays, estuaries and other coastal waters.
Range: Canada south to Northern Florida
Notes: Feeds primarily on invertebrates but may attack and eat small, slow-moving fish. This species has the habit of burying halfway into the substrate with only its head and the top portion of its body visible. Very similar in habit and coloration to the bandtail puffer**,** *Sphoeroides spengleri*, the northern puffer, *Sphoeroides maculatus*, and the checkered puffer, *Sphoeroides testudineus*. None of these fish is truly suitable for typical home marine aquariums housing invertebrates or more peaceful fishes. Most aquarists interested in these species catch them themselves and set up dedicated temperate-water aquariums to house them along with other sturdy fish, such as toadfish, grunts and sea catfish.

Diodontidae

Striped burrfish
Chilomycterus schoepfii (Walbaum, 1792)
Maximum size: 11”
Habitat: Seagrass beds and lagoons.
Range: Nova Scotia south through Florida, the Gulf of Mexico to Brazil.
Notes: Very common in seagrass beds in bays and coastal lagoons, they are also found on some shallow coastal reefs. The way to identify a burrfish from a porcupinefish is rather simple; the body spines of burrfish are always extended at right angles from their body, even when they are not inflated. The spines of porcupinefish lay flat against their body if the fish is not inflated. Burrfish (as well as some other pufferfish and porcupinefish) have earned the term “ick magnets” by some aquarists as they are commonly infected with the ciliated protozoan, *Cryptocaryon irritans* (a.k.a., “saltwater ick”). Luckily, members of this group of fish are very sturdy and will respond favorably to a treatment for this malady with amine-chelated copper at a concentration of 2.25 ppm for 21 days. The closely related, but much rarer, web burrfish, *Chilomycterus antillarum*, and the spotfin burrfish, *Chilomycterus reticulatus*, are infrequently seen in the pet trade.

Occasionally, burrfish and other puffers will refuse to feed when first acquired. Assuming that there is no underlying health issue with the fish, they just may not be willing to accept the foods offered them by the aquarist. To “jumpstart” a pufferfish’s feeding response, try offering it some live glass shrimp or small crabs. If those are not available, try fresh clams opened and offered “on the half shell.” Once feeding on these

foods, most puffers will readily begin to incorporate standard aquarium fare into their diets.

Long-spine porcupinefish
Diodon holocanthus Linnaeus, 1758
Maximum size: 24”
Habitat: Pelagic (open ocean) juvenile stage, adults are found on reefs and rocky areas.
Range: Circumtropical
Notes: Nocturnal species, often found in coral caves during the daytime. Feeds on mollusks, sea urchins and crustaceans. Reportedly used in Traditional Chinese Medicine (TCM) but no mention as to in what capacity (FishBase 1999). One odd use of this species is as dried curios, inflated and used as bizarre lampshades. This is the most commonly seen porcupine fish in the pet trade although the similar black-blotched porcupinefish, *Diodon liturosus,* is sometimes collected and shipped from tropical Pacific Ocean locations.

Spot-fin porcupinefish
Diodon hystrix Linnaeus, 1758
Maximum size: 36”
Habitat: Pelagic juvenile stage. Large adults often found in coral caves.
Range: Circumtropical
Notes: Juveniles up to about 8 inches are pelagic and rarely collected. Adults feed on hard-shelled invertebrates, such as mollusks, sea urchins and crustaceans. These adults are also solitary and nocturnal and are most often found hiding in caves during the day. Due to their huge adult size, they are not recommended for most home aquarists.

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