

The Elasmobranch Husbandry Manual: Captive Care of Sharks, Rays and their Relatives

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Chapter 33

Husbandry of Spotted Ratfish, *Hydrolagus colliei*

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Abstract. Most holocephalans occur in the deep waters of the continental shelf and slope, and as a result are unlikely candidates for captivity. The spotted ratfish (*Hydrolagus colliei*) is one notable exception occurring in near-shore waters, in the northern part of its range, off the western coast of Canada and the USA. In recent years new knowledge on the biology of this species, as well as increased experience in techniques for capture and captive care, has resulted in an increasing number of spotted ratfish in public aquariums. As with any animal in captivity, optimal success with this species occurs when habitats, diets, and tank-mates are matched to conditions in their natural environment. Exhibit temperature for ratfishes should have the range 8-12 °C. Ratfish are quite tolerant of low salinity, but prefer 28-33 g l⁻¹. Ratfish are quite sensitive to ammonia and nitrite. Low lighting, low-profile substrates of rock, mud, or sand, and rounded walls, are all required for ratfish. Ratfish eat a wide variety of foods including live clams and shrimp, fresh and frozen prawns, crabs, fish, and squid, and even gel food. Protocols for keeping the spotted ratfish may be used when keeping related species (e.g., the ghost shark, *Callorhinchus milii*, and the cape elephantfish, *Callorhinchus capensis*).

Living holocephalans (Subclass: Holocephali) are the closest relatives of sharks, skates, and rays, and are comprised of three families (Callorhinchidae, Rhinochimaeridae, and Chimaeridae), each distinguished by a unique snout morphology. Holocephalans, commonly referred to as chimaeroid fishes or ratfishes, are an ancient lineage that evolved over 300 million years ago and the morphology of living representatives differs little from their fossil ancestors. Biologically and evolutionarily the chimaeroid fishes are an exciting lineage, almost 'living fossils'. While

aquariums display ever increasing numbers of shark and ray species, members of the Chimera family have been placed largely on the side-lines as display animals. Much of the bias against keeping captive holocephalans is their typically deep-water habitat, and the relative lack of information about their collection and transport. The spotted ratfish (*Hydrolagus colliei*) is one notable exception, occurring in relatively shallow water in the most northerly parts of its range. In addition, three species of elephantfishes of the Family Callorhinchidae, a monogenetic family

restricted to the Southern Hemisphere, occur in shallow water during part of their life cycle and have been successfully kept in captivity.

GENERAL BIOLOGY

Most holocephalans are found in coldwater habitats on continental shelves and slopes, but the spotted ratfish, ranging from Southeast Alaska to Baja California, including the northern Gulf of California, can be found in quite shallow water (i.e., 6.0-18.5 m) in the northerly areas of its range. In British Columbia the depth of spotted ratfish is seasonal, remaining mostly below the thermocline (7.2-8.9 °C), except during the spring when animals move up into the shallows to feed at night. In Puget Sound, smaller ratfish move from deep water by day to much shallower water at night (Quinn et al., 1980). Several hypotheses have been suggested to explain this diel migration, including predator avoidance and exploitation of food resources in shallow water. Alternatively, it may be a means to regulate ambient light conditions, as ratfish have an all-rod retina and no means to regulate the amount of light entering their eyes (Quinn et al., 1980). Spotted ratfish prefer low relief habitat and are often found over rocky, mud, and gravel bottoms. Spotted ratfish occur singly or in aggregations, with sexes often aggregating separately as has been observed in the Gulf of California (Mathews, 1975). During mating events aggregations can be large.

The spotted ratfish is distinguished by a body that is reddish-brown to silver ventrally, and marked with distinct white spots on the head, trunk, and tail. The lateral line shines an iridescent gold and the eye is a striking green color. The head is blunt with a slightly protuberant snout and the body tapers to a whip-like tail. As with all holocephalans, the spotted ratfish possesses three pairs of tooth plates, two pairs in the upper jaw and a single pair in the lower jaw. The first dorsal fin is preceded by a stout venomous spine that can inflict a serious wound (Halstead and Bunker, 1952). A single gill opening, on each side, is located just anterior to the base of the pectoral fin. Spotted ratfish are a relatively small, slender species compared to other holocephalans. Females grow larger than males reaching a total length of ~97 cm. There is no reliable method to age spotted ratfish and there is little maturation data available. Females and males become sexually mature at ~25.5 cm and ~20.5 cm, snout-to-vent length, respectively (Love, 1996). Snout-to-vent is used to measure length, as wild ratfish often have broken tails.

In addition to the prerequisite claspers, males have a small club-like structure on their forehead, called the tenaculum (Figure 33.1), used during mating to grasp the female's pectoral fin, with its opposable tip and cluster of sharp denticles, while the pelvic clasper is inserted into her cloaca (Powell, pers. com.). In addition, males have a pre-pelvic tenacula, a blade-like structure armed with a row of sharp denticles, located in a pouch

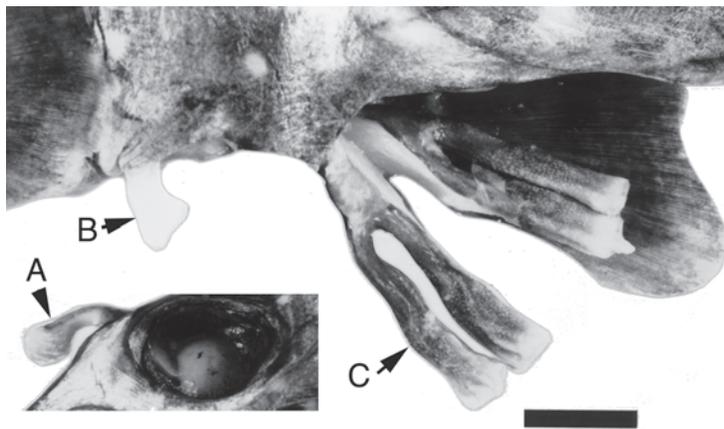


Figure 33.1. Images of a male spotted ratfish (*Hydrolagus colliei*) showing the following clasper organs: (A) the frontal tenaculum (inset); (B) the pre-pelvic tenaculum, shown everted from its pouch; and (C) the bifurcate pelvic clasper.

anterior to the pelvic girdle. This structure is probably used for grasping and positioning the female during copulation (Figure 33.1). Female ratfish can spawn year round, probably peaking in the summer and fall (Sathyanesan, 1966). Regardless of size or age, females will only produce two egg cases at a time. The egg cases are violin or spindle shaped with ridges and stiff hair-like structures jutting out along the edges of the case (Figure 33.2). Based on observations in aquariums, egg extrusion seems to be a long process (i.e., 18-36 hours) and the eggs can remain attached to the female via long filaments for two to six days (Sathyanesan, 1966). Once deposited on the ocean floor, embryos may remain within the egg case for up to a year. On hatching, young ratfish are a miniature version of their parents.



Figure 33.2. Violin or spindle-shaped egg cases being extruded from the cloaca of a female spotted ratfish (*Hydrolagus colliei*).

At all life stages ratfish seem to be opportunistic feeders, with no single food making up more than 25% of their diet. Common food items include shrimp, clams, worms, fishes, brittlestars, cephalopods, nudibranchs, amphipods, and seastars (Johnson and Horton, 1972; Quinn et al., 1980; Macpherson and Roel, 1987). Food is detected using both olfaction and weak electroreception, via sensory pits on the head (Hart, 1973; Fields and Lange, 1980).

CAPTURE AND TRANSPORTATION

Ratfish are more active during the night and twilight, so these represent the best times for collection. Ratfish are sensitive to net trauma, so

wherever possible they should only be corralled with nets and then collected on SCUBA using plastic bags. If a net is used to move ratfish, it should be soft and knotless. Careless use of nets can damage the dorsal spine and males can entangle and damage their frontal tenaculum on fiber nets.

Transportation of ratfish is best achieved by using a large cooler, 90% filled with chilled seawater. Reduced surge and a dark environment appear to be important considerations. A hole drilled into the lid of the cooler permits the addition of an airstone for aeration. Avoid using unlined Styrofoam containers as startled ratfish may impale their dorsal spine in the lid and remain out of the water for extended periods (Bruecker, pers. com.). During longer transports water quality may deteriorate and should be replaced with chilled seawater to dilute metabolic toxins and maintain optimal water temperatures. To prevent a build-up of nitrogenous wastes, ammonia sponges (e.g., AmQuel®, Novalek Inc., USA) may be added to the transport container when fresh seawater is not available. To buffer subsequent drops in pH, sodium bicarbonate, at a dose of 100 mg l⁻¹, may be used (Correia, 2001).

Handle ratfish with care as the dorsal spine can inject a weak venom known to cause pain and swelling for up to a week (Boyle, pers. com.). Poorly handled ratfish may exhibit a serious condition called “bloody eye”, the result of a trauma to the efferent pseudo-branchial artery, a major blood vessel to the brain that runs directly below the orbit of the eye (Didier, 1994; Didier, 1995). If the eyes are badly blood-shot, it is likely that the ratfish will die within a few days. If the damage is mild, keeping the animal in a calm and quiet environment may allow it to recover and thereafter survive for a long time.

EXHIBITION AND CAPTIVE CARE

Ratfish are cruisers, using their large pectoral fins, like wings, to propel themselves through the water. Thus, ratfish need room to glide and turn. An exhibit of 1.5 m x 1.5 m x 1.0 m (depth) should provide three to four adult ratfish plenty of room. Ratfish do not have scales, so exhibit walls should be smooth to prevent abrasion. In addition, ratfish prefer rounded or curved walls, as they are less likely to collide with gently-curving surfaces (Travers, pers. com.; Godsell, pers. com.). However, cylindrical tanks should be avoided as the resultant spiral flow causes fish to turn into

the side and suffer abrasions of the pectoral fins and snout. In the wild, spotted ratfish are found in relatively low current areas, so exhibit water currents should be slow, otherwise specimens will start to spiral. Ratfish have been known to leap out of tanks, so jump-screen should always be provided. Substrate should be low-profile sand, gravel, or rock.

Exhibit temperature should have the range 8-12 °C. Ratfish can tolerate temperatures a couple of degrees higher than 12 °C, once acclimatized, but longevity may be compromised. Ratfish are quite tolerant of low salinity, but prefer 28-33 g l⁻¹ (parts per thousand). Ratfish are sensitive to ammonia and nitrite, so biological filtration must be adequate to keep these nutrients in check.

Light is probably the single most important factor in controlling ratfish behavior. As ratfish have all-rod retinas, the eye is susceptible to high illumination, the optical signals from dazzled animals overwhelming their brain and leading to aberrant behavior. If light levels are too high, ratfish will exhibit unusual behavior such as spy-hopping or spiraling at the surface. Artificial light should be muted using filters or screens over the exhibit. If ambient light is used, the tank should never be exposed to direct sunlight.

Intraspecific aggression is a problem in overcrowded exhibits. Examples of fin-nipping, and larger ratfish charging and crowding smaller animals during feeding have been observed. In addition, tail-biting and pectoral nipping are exhibited by males during courtship and mating. Females are usually larger than males and will often exhibit dominance in a captive group, out-competing tank-mates for food. A highly dominant female may need to be removed if she compromises the health of the other individuals in an exhibit.

If exhibit conditions are appropriate, ratfish should settle down quickly and start eating within two to five days. Food items can include live clams and shrimp, fresh and frozen prawns, crabs, fish, and squid, and even gel diet. A vitamin supplement (e.g., Mazuri® Vita-Zu Sharks/Rays vitamin supplement tablets, PMI Nutrition International, Missouri, USA) is recommended if dead or frozen food is to be a staple diet. Ratfish can be fed at any time of the day, but are generally nocturnal and crepuscular feeders. Ratfish prefer to eat from the bottom but may take a while to find food items, so competitive, gluttonous tank-mates should be avoided.

Ratfish do well with tank-mates that they don't normally eat or that won't eat them. Less potent anemones (e.g., *Metridium* spp.) chitons, unpalatable starfishes (e.g., leather stars, *Dermasterias imbricata*), large crabs, orange seapens (*Ptilosarcus gurneyi*), and smaller fishes can all make good tank-mates for ratfish. Fishes such as the kelp greenling (*Hexagrammos decagrammus*) and large bottom-dwelling sculpins (e.g., the buffalo sculpin, *Enophrys bison*) should be avoided, as they tend to out-compete ratfish for food. Elasmobranchs, even small bottom-dwelling sharks, should be avoided as they will prey on ratfish (Didier, 1994).

Ratfish are quite hardy and not prone to disease. Regardless, prophylactic antibiotics are recommended, to prevent secondary infections of the skin and fins, following difficult transports. Ratfish should not be treated with drugs or chemicals unsuitable for scale-less fishes or elasmobranchs. Ratfish carry a species-specific gut-parasite (Simmons and Laurie, 1972; Billin, pers. com.). If a new animal fails to thrive following acclimatization and introduction, a worming treatment may be advised.

Although it is not possible to age ratfish with any certainty, they are a relatively long-lived species. Several facilities have successfully maintained wild-caught ratfish for up to eight years. In some cases captive ratfish have mated, produced eggs, and, at least in one case, produced viable offspring (Amemiya, pers. com.; Sasanuma pers. com.).

OTHER CHIMAEROIDS

In general, the methods described above can be applied to other species of shallow water holocephalan (e.g., members of the Family: Callorhynchidae). Both the ghost shark (*Callorhynchus milii*) and cape elephantfish (*Callorhynchus capensis*) have been successfully kept in captivity using similar protocols. If done with extreme care it is possible to capture these ratfishes in nets—e.g., trawling, etc. (Didier, 1994). Alternatively, egg capsules may be obtained in trawl nets or from gravid females and hatchlings reared in captivity (Duffy, pers. com.). Netting may be the only method to capture ghost sharks in New Zealand, as they are rarely observed by divers, while cape elephantfish have been caught on SCUBA in South Africa. *Callorhynchus* spp. tend to be more selective

feeders than the spotted ratfish. For example, the ghost shark was observed to feed almost exclusively on the surf clam (*Maorimactra ordinaria*), or related bivalves, despite the presence of other food items. Examining the gut contents of commercially caught fishes will help better understand the normal diet of a given species.

CONCLUSION

With increasing experience and research, ratfish are now no harder to obtain and maintain than their elasmobranch cousins. Ratfishes have many odd anatomical features and weirdly endearing behaviors to enthrall even the most jaded visitor. In addition, ratfishes are surrounded with sufficient mystique and folk-lore to appeal to even the most demanding of marketing departments. Aquarists responsible for ratfish grow attached to them and their weird ways, and thoroughly enjoy taking care of them. Ratfish are well worth investing some in-house research as a potential for an interesting and unusual display.

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