The Elasmobranch Husbandry Manual:

Captive Care of Sharks, Rays and their Relatives

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Chapter 32
Husbandry of Tiger Sharks, *Galeocerdo cuvier*

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Abstract: Tiger sharks (*Galeocerdo cuvier*) have rarely been kept successfully in captivity. Some of the important factors to consider when keeping this species, as for most elasmobranchs, include exhibit size and design, diet, and medical care. This article presents a brief overview of the husbandry requirements for tiger sharks, based on information drawn from the experiences of several institutions that have attempted to maintain this species.

Tiger sharks (*Galeocerdo cuvier*), have rarely been kept in captivity, and very few have been maintained with any long-term success. Recent advances in aquarium science are now making it possible to maintain this delicate species for longer periods of time. The key factors to successfully exhibiting tiger sharks include an understanding of their unique captive and natural behavior, and recognition of their special needs related to exhibit and habitat design, specimen acquisition, daily husbandry, and medical care.

This article should serve as a general guideline for maintaining tiger sharks in captivity. Since only a few tiger sharks have been kept for an extended period of time, it is important to note that this guideline reflects a good deal of extrapolation based on scant information obtained during past attempts to keep this species. The record for maintaining a tiger shark in captivity is 4.5 years, and counting, at the Acuario de Veracruz, Veracruz, Mexico (Marin-Osorno, pers. com.). Four other institutions have been able to keep tiger sharks in an exhibit for over two years: Sea World, Orlando, USA; Epcot Center's Living Seas Pavilion, Orlando, USA; Atlantis Resort, New Providence, Bahamas; and the Henry Doorly Zoo, Omaha, USA (Crow and Hewitt, 1988; Davis, pers. com.; Kaiser, pers. com.).

CAPTIVE BEHAVIOR

Tiger sharks are notable for their unique behavior in captivity. Once in a captive environment, most specimens quickly develop a pattern of swimming along the perimeter of the display (Crow and Hewitt, 1988; Seligson and Weber, 1990; Dehart and Stoops, 1998). Some specimens orient their body parallel and adjacent to smooth sections of the exhibit, such as the acrylic windows or concrete walls. These individuals may rub their pectoral fins, the lower portion of their rostrum, and the bottom of their caudal fins, on the smooth surfaces. A specimen kept at the Henry Doorly Zoo was observed to spend substantially more time rubbing the walls of the display while the aquarium was open and crowded with people (Dehart & Stoops, 1998). In addition to the tiger shark, the 1,710 m^3 Atlantic coral reef display, complete with a tunnel bisecting the tank, contained a lemon shark (*Negaprion brevirostris*), six sandbar sharks (*Carcharhinus plumbeus*), and a number of Caribbean teleosts. It is believed that increased rubbing of the walls during visiting hours was the result of excess noise generated by the public as they moved through the tunnel. The tiger shark maintained at Epcot Center's Living Seas Pavilion spent nearly 60% of its time adjacent to the perimeter of the exhibit (Seligson and Weber, 1990).

Tiger sharks typically avoid other species of sharks and appear to require larger areas of individual swimming space within an exhibit (Crow and Hewitt, 1988). Atlantis Resort maintained three tiger sharks in a 5,206 m^3 display with multiple elasmobranch and teleost species. More than any other species within the exhibit, the tiger sharks tended to stay away from their own species (Kaiser, pers. com.). Acuario de Veracruz, however, has successfully maintained two tiger sharks together for over a year and both continue to do well (Marin-Osorno, pers. com.). Tiger sharks appear to be indifferent or oblivious to divers in the water. At both the Henry Doorly Zoo and Epcot Center's Living Seas Pavilion tiger sharks have been known to bump divers, seemingly unaware of their presence (Davis, pers. com.).

SYSTEM DESIGN

Exhibit size, shape, and structure are all critical for tiger sharks. Tiger sharks tend to swim at the surface so depth is not an important factor for these sharks, but adequate surface area is critical. One of the specimens kept at Atlantis Resort would spend a large portion of the day in a shallow lagoon area of the exhibit, having dimensions: 30 m x 15 m x 1.5 m deep (Kaiser, pers. com.). The exhibit should be of an irregular shape, with no corners more acute than 135°.

All exhibit surfaces should be covered with display elements, such as rockwork or artificial coral, to prevent the shark from swimming too close to smooth surfaces. At the Henry Doorly Zoo, half of the exhibit was covered with rockwork, while the other half was a smooth, black, concrete wall. When the shark swam near artificial rockwork she did not rub her fins or body. However, rubbing was observed adjacent to smooth concrete walls. The décor at Atlantis Resort was one continuous wall of angular rockwork, with no smooth areas. In this display, tiger sharks stayed away from the perimeter and no problems of continuous rubbing were observed (Kaiser, pers. com.). A brief description of the five facilities that have successfully maintained tiger sharks for over two years has been summarized in Table 32.1.

Catwalks or other structural items should be located >60 cm above the surface of the exhibit, to prevent tiger sharks from rubbing their dorsal fin on these structures. Reducing stocking density will lower stress imposed on tiger sharks and promote long-term survival of this species.

Table 32.1. A summary of the basic exhibit parameters for five institutions that have successfully maintained tiger sharks, *Galeocerdo cuvier*, showing: exhibit shape, exhibit dimensions, exhibit volume, water systems, and specimen longevity.

Aquarium	Exhibit shape	Dimensions (meters)	Volume (m3)	Water system	Longevity
Acuario de Veracruz (Veracruz, Mexico)	Kidney shaped	27 x 16 x 4.5 deep	919	Natural supply closed system	4.5 + years
Disney's Living Seas (Orlando, Florida, USA)	Circular	61 diameter x 8 deep	21,660	Artificial supply closed system	3.3 years
Sea World of Florida (Orlando, Florida, USA)	Dumb-bell	38 x 12 x 5.5 deep	2,300	Artificial supply closed system	3.25 years
Atlantis (New Providence, Bahamas)	Circular tank + shallow lagoon	Exhibit: 45 x 27 x 4 deep Lagoon: 30 x 15 x 1.5 deep	5,206	Natural supply open system	2.5 years
Omaha's Henry Doorly Zoo (Omaha, Nebraska, USA)	Square	21 x 17 x 5 deep	1,710	Artificial supply closed system	2.25 years

SPECIMEN ACQUISITION

Acquisition of appropriately sized specimens, followed by a carefully planned transport, are key factors in successfully keeping tiger sharks. Smaller specimens seem to acclimate better to captivity. Four of the institutions listed in Table 32.1 acquired new specimens measuring between one and two meters total length (Crow and Hewitt, 1988; Davis pers. com.; Kaiser pers. com.)

Tiger sharks appear to be less resistant to transport conditions than other carcharhinids and every attempt should be made to limit transport time to five hours or less, and certainly not more than 12 hours. It is important to fast specimens for five days prior to shipping. A tiger shark acquired by the Henry Doorly Zoo regurgitated food into its transport container during shipping and polluted the water. It is advisable to handle this species as little as possible, so as not to compromise their protective mucous layer.

Two specimens that are now successfully being held at the Acuario de Veracruz were brought back to a holding, or staging, pen immediately after capture by long-line. These animals were allowed to acclimatize to captivity for two to eight months in the staging pen, before they were successfully moved into the exhibit (Marin-Osorno, pers. com.).

DAILY HUSBANDRY

Dietary planning, feeding, and water chemistry are all important factors to consider for the daily husbandry of tiger sharks.

Long-term success maintaining tiger sharks depends on a successful feeding strategy. For tiger sharks, in mixed species exhibits, a separate feeding station is recommended and specimens should be fed at the end of feeding sessions. Many of the specimens held in captivity began eating shortly after acquisition, but some refused food for extended periods. While fresh or frozen fish is the typical diet for this species in captivity, evidence from a specimen held at the Durban Aquarium suggests that mammalian or avian flesh might elicit a feeding response when a diet of fishes fails (Van De Elst et al., 1983).

Because tiger sharks are timid, they will often refuse to eat at the main feeding station with other sharks. A dedicated feeding station makes it possible to condition tiger sharks to accept food when other sharks are not eating. Although the quantity of food and method of feeding is different for every institution, it is believed that this species should be fed more frequently, and fed a higher percentage of food per body weight, than other species (Crow and Hewitt, 1988). It would not be unusual to feed these sharks 10-20% of body weight week^{-1}. As with other species of elasmobranchs, vitamin supplements (e.g., Mazuri® Vita-Zu Sharks/Rays vitamin supplement tablets, PMI Nutrition International, Missouri, USA) are important. In addition to vitamin supplementation, the tiger shark held at the Henry Doorly Zoo was given 400 IU of vitamin E and 10-15 fish oil caplets (i.e., menhaden or cod liver oil) every feeding session. Many of the tiger sharks in captivity have demonstrated feast or famine behavior, gorging themselves for a long period of time only to cease eating entirely for an extended period (Davis, pers. com.; Kaiser, pers. com.).

Adequate life support systems and optimal water chemistry are essential to successfully maintain tiger sharks. According to Crow and Hewitt (1988) the optimal temperature range for this species is 23-29 °C, with a mean of 26 °C. Dissolved oxygen (DO) seems to play a critical role in the longevity of this species. The swimming behavior of a specimen maintained at the Henry Doorly Zoo markedly improved when DO was elevated to 105-110% saturation (Dehart and Stoops, 1998). Elevated dissolved oxygen levels were achieved by using pure oxygen, as opposed to atmospheric air, to feed the exhibit's ozone generator; decreasing the risk of gas bubble disease that may have resulted from hyper-aeration.

MEDICAL ISSUES

Abrasion from rubbing against the walls of an exhibit is a constant concern for tiger sharks. Abrasions can become an entry point for bacterial or fungal infections. Bacterial infections have been combated with enrofloxacin (Baytril®, Bayer Corp., USA) at a dosage of 5 mg kg^{-1} daily (SID) administered in food (PO). If the specimen will not eat every day, 10 mg kg^{-1} every other day (EOD) will suffice.

Fungal infections are typically harder to treat. A *Fusarium* spp. infection of a specimen maintained at the Henry Doorly Zoo was treated with ketoconazole (e.g., Nizoral™, Janssen Pharmaceutica Products, Titusville, USA) at a dose of 5 mg kg^{-1} SID PO, with moderate success (Dehart & Stoops, 1998). Early detection and treatment of these problems will help prevent systemic complications.

CONCLUSIONS

The information given in this paper represents observed trends for the few attempts at maintaining tiger sharks in captivity. Few of these attempts have had long-term success and there is still much to learn. This species represents a challenge to the aquarium community but its future is promising, provided the needs for swimming space, diet, and medical care can be adequately met. It is important to understand that a facility interested in maintaining this species must dedicate a great deal of resources to this animal. An aquarium should not try to keep this species on the basis that one is available. Tiger sharks are best suited to large systems with a large surface area for the animal to swim freely. A low stocking density and low numbers of other large shark species will increase the chances of successfully keeping this species.

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