Suggested Guidelines for Fishes Enrichment

Natural History / Taxonomy

Osteichthyes (bony fishes) and Chondrichthyes (cartilaginous fishes) are two different classes of fishes that can be found in aquariums and zoos. The bony fishes comprise a large and diverse group of animals. Most possess swim bladders, a bony skeleton, bony scales, and lepidotrichia (segmented tissue that forms the soft rays of the fins). Cartilaginous fish represent about 1,000 species (Camhi et al, 1998). Characteristics of this group include a cartilaginous skeleton, placoid scales, a spiral valve intestine, internal fertilization, osmoregulation through the use of urea, and the lack of a swim bladder (Moyle and Cech, 1988). The cartilaginous fishes consist of three major groups: sharks, skates/rays, and chimaeras.

Habitat

Fish behavior can be affected by conditions both above and below the surface of the water. Above the water, one contributing factor to take into account is climate. Changes in weather conditions over a period of time may have an effect on fish behavior. These weather changes include rainfall, sunshine, wind, temperature, humidity, and cloudiness (Charton, 2001).

Water depth, substrate, and objects below the surface can also affect behavior. Fish live in a variety of habitats ranging from fresh to brackish to saltwater, and may withstand water temperatures from below freezing to 109° Fahrenheit (Fenner, 2001). Fishes are found worldwide and reside in streams, lakes, reservoirs, caves, estuaries, bays, marshes, tropical reefs, and in coastal, open-ocean, deep-sea, and polar habitats. Some spend time hiding in logs, grasses, plants, tree roots, or coral heads, while others are pelagic swimmers. Some are dependent on water currents, swift or slow, for mobility and feeding. Depending on the habitat, climate, and the depth at which fishes are found in the wild, a variety of enrichment options are available to encourage natural behavior in aquaria.

Natural Behaviors

The following are common examples of fish behavior:

Feeding

Fishes comprise a diverse group of species that use different feeding strategies and feed on a large variety of food types. Fishes can be detritivores, herbivores, carnivores, or omnivores (Moyle and Cech, 1988). Each species of fish will exhibit different behaviors associated with its feeding strategy. Some of these behaviors include scavenging, grazing, and hunting. As examples, a flounder will lie still and camouflage itself with its surroundings in order to ambush prey, while some catfishes will actively search the substrate for food.

Breeding/Reproduction

Fishes differ widely in their methods of reproduction. The following are examples of reproductive strategies: egg-laying, mouth brooding, live birth, and nest spawning.

Breeding depends on a number of factors including sexual maturity, temperature, currents, photoperiod, and substrate (DeLoach, 1999).

Territorial Behavior
Fishes designate their territories by employing different behaviors such as digging, burrowing, fighting, chasing, displaying and nipping. The yellow-headed jawfish builds its own burrow to live in and defends it by chasing other jawfish away. Territories are generally established for breeding purposes or to gain proximity to food and/or shelter.

Schooling
This is perhaps the most impressive and interesting social behavior demonstrated by fishes. Schooling allows fishes to protect themselves from predation and to increase their swimming efficiency, the capture of food items, and reproductive success (Moyle and Cech, 1988).

Enrichment
There has been some discussion in the aquarium and zoo industry about two aspects of environmental enrichment for fishes: is it effective, and is enrichment simply good husbandry? It is believed that enrichment can be effective for fishes if it is done to accentuate and stimulate natural behaviors. By providing animals with unpredictable changes to their environment that encourage these behaviors, aquarists can better replicate the fishes' lives as they would be in the wild.

We also believe enrichment involves more than good husbandry techniques. Quoting the AAZK Enrichment Notebook (Stark, 1999), "Environmental or behavioral enrichment is achieved by adding to a captive animal's environment or by modifying that environment to stimulate behaviors resembling those of a healthy wild animal." In other words, items are often added or changed in an animal's habitat for behavioral reasons rather than for physiological needs.

Aquarists have many opportunities to provide enrichment for fishes. As described below, these can involve alterations to practically any aspect of their environment.

Exhibit / Novel Enrichment
One goal for fish exhibits is to replicate the natural environment as closely as possible. Most facilities display particular species as part of a theme. For instance, some exhibits represent a certain region, some highlight certain fish behaviors, and some showcase animal adaptations. Whatever the theme may be, all of these exhibit aspects are important when thinking about animal enrichment.

Lighting, décor, and novel items can be modified in a way that will provide enrichment. Lighting can be varied from the normal intensity to simulate sunny or cloudy days or varied seasonally to mimic changing photoperiods. Making periodic changes to the décor such as adding foliage to trees seasonally and logs, plants, and branches periodically, allows fish to seek out new hiding spaces, define new territories, explore a new environment, and change

their daily activity patterns. Novel items, objects that the fishes have not encountered previously, help create a changing environment for the fishes. These items can be naturalistic such as new rocks and shells or artificial such as PVC piping. Novel items are important because they allow fish to encounter different items to explore, defend, or swim through on a random basis.

Dietary Enrichment

Changing the way that food is offered to fishes is a good form of enrichment, particularly if it stimulates new foraging behaviors. This can include feeding at different times of the day, feeding from different areas of the tank (if possible), adding currents to the tank when feeding so the animals have to swim after the food, and creating different types of feeders for the animals. For example, brine shrimp feeders (a dark film canister with holes in it for the brine shrimp to swim out into the light) can be used with seahorses (Columbus Zoo and Aquarium) and other small fishes. Fishes can also be given sinking feeders such as a ball or tube with holes drilled in it filled with krill, shrimp, and small fish, which can encourage foraging behaviors.

Social Enrichment

In community exhibits, the presence of other fish of the same species can encourage species-typical behavior (schooling, foraging) and can stimulate reproduction. Species other than the type exhibited encourage interspecies interactions such as territorial displays and cleaning. However, it should be noted that some interactions could be detrimental and result in death or injury to fishes. Therefore, care should be taken in selecting fish for multi-species exhibits. Social enrichment can be thought of as providing fish with con-specifics or other animals to give them the opportunity to display positive interactive behaviors.

Training

Operant conditioning techniques can be employed to highlight fish behavior for visitors or to achieve a specific behavioral goal to enhance fish husbandry. Regardless of the reason, training can be used to stimulate behavior in fishes and thus can be considered enriching. In the past, it has been shown that goldfish can be trained to exhibit behaviors such as swimming through hoops, playing basketball, and retrieving rings (Johnson, 1995). At the Japanese Deer Park in California, Japanese koi have performed in shows in which they went through hoops, retrieved balls, touched targets, rang bells, and picked cards in a poker game. Given that these animals have shown an aptitude for learning, these same techniques could be used to condition husbandry or natural behaviors. For example, aquarists are using operant conditioning to better control feeding, gating, and examinations of fishes in aquarium environments. To reduce aggressive behavior and successfully feed a large sunfish in a community tank, aquarists at Monterey Bay Aquarium conditioned the ocean sunfish to feed in a certain area of its tank through “targeting” the animal to a particular object and then reinforcing it with food.

Sharks have been trained for experiments in discrimination, sight, hearing, chemoreception, and instrumental learning. In all of these cases, the sharks learned the behavior in 3 – 6 weeks and retained the behavior over time (Clark, 1959, 1975; Graeber, 1980; Wright,

1964). Sharks also can be trained to move from one pool to another, to get into a stretcher, to feed in a certain area, to press targets, and to allow blood to be taken without restraint.

Enrichment Examples

The following summarizes enrichment items that may be appropriate for fishes.

Exhibit / Novel Enrichment

- Periodic changes of lighting intensity
- Seasonal change of lighting photoperiod
- Periodic changes to exhibit décor (changing logs, plants, branches, etc.)
- Random Addition of novel items (shells, rocks, leaves, plants, etc.)

Dietary Enrichment

- Feedings at different times of day
- Feedings at different places in tank (if possible)
- Creation of currents during feedings
- Creation of feeders such as film canisters with holes for brine shrimp to swim out of.
- Sinking feeders – PVC pipe capped on each end or plastic ball with holes in it to allow for foraging

Social Enrichment

- Mixed species exhibits to encourage positive interspecies interactions
- Animals of the same species housed with same to encourage species-specific behaviors

Training

- Conditioning “station” behavior to successfully feed animals in large mixed species exhibits
- Conditioning animals to shift from one tank to another
- Conditioning animals to change swimming patterns
- Conditioning fish to target or to push paddles for food in order to station them for examination
- Conditioning large sharks and other fish to swim into a stretcher for blood sampling or examination

Safety Considerations

There are a few safety considerations when using enrichment for fishes.

- Enrichment items should be the large enough that they can not be ingested by any of the animals in the tank.
- Enrichment items should be durable enough so that they cannot be pulled apart and ingested.
- It is important to ensure that animals cannot become entrapped or entangled in enrichment items.
- Enrichment items should not contain materials that are toxic to fishes (i.e. ingesting, leaching chemicals into the water).
- All enrichment items should be disinfected prior to or after each use.

Fishes enrichment guidelines compiled by Jill Forsbacka, Aquarist, and Sue Hunter, Assistant Curator of Marine Mammals, National Aquarium in Baltimore.

Reviewed by the following staff at the National Aquarium in Baltimore:
Valerie Lounsbury - Science Resource Manager
Michele Martin - Medical Assistant and Animal Registrar
Alison Davidson - Curator of Fishes
Gus Stout – Aquarist
Alan Henningsen – Senior Aquarist
Jessica Spino – Senior Aquarist
James Walsh – Aquarist
Heather Johnson – Aquarist

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