

**Sustainability Considerations for  
Developing an Aquatic Invertebrate & Fish Collection Plan**

**AZA Position**

The Association of Zoos and Aquariums (AZA) believes that the acquisition of aquatic invertebrates and fishes should be conducted in a manner that maintains or, if warranted, increases the genetic diversity of these populations in the care of zoos and aquariums but does not reduce the long-term sustainability of these populations in their natural ranges. Therefore, it is recommended that AZA-accredited zoos and aquariums and certified related facilities (AZA member institutions) exhibiting these animals develop, implement, and maintain an Aquatic Invertebrate & Fish Collection Plan that assists curators in continuing to advance fish survivability and in making the most appropriate acquisition decisions possible to achieve these goals. By acquiring aquatic invertebrates and fishes in a sustainable manner, AZA member institutions will be able to continue fulfilling their important missions of conservation, education, and science with these animals long into the future and will set a leadership example for related industries.

**Rationale**

AZA-accredited aquariums and zoos are experienced in caring for and advancing the survivability rate of more than 3,500 species of fishes and aquatic invertebrates belonging to 15 different phyla. Three types of aquatic animal acquisition practices are typically utilized to maintain or increase their populations' taxonomic diversity, genetic and demographic health, and long-term sustainability including:

- Aquarium breeding
- Commercial breeding
- Wild-sourced acquisition

Each of these acquisition practices has potential advantages and challenges that may affect the long-term sustainability of aquatic animal populations in their natural ranges. In accordance with the Association's Policy on Responsible Population Management (RPM Policy), AZA member institutions should consider these advantages and challenges when developing, implementing, and/or adapting an aquarium collection plan to make certain that their aquatic invertebrates and fishes are acquired in a sustainable manner. "In general, aquaculture production of ornamental species should be pursued when species are difficult to obtain from the wild, breeding supports a conservation program, or there is some environmental benefit or elimination of environmental damage via the breeding program. Aquaculture production of ornamental species should be avoided when it would replace a harvest of wild animal that maintains habitat, a cultural benefit, or an economic benefit" (Tlusty, 2001). AZA support for Project Piaba is a classic example of the need to support a sustainably managed wild fishery to assure socio-ecological integrity and sustainable use of rain forest resources by local residents in lieu of sourcing these same species through aquaculture.

**Aquarium Breeding**

**Successes:** AZA member public aquariums have successfully bred or cloned more than 200 species of invertebrates (Aquatic Invertebrate Taxon Advisory Group [TAG] Regional Collection Plan [RCP]) and bred more than 108 marine species of fish (Marine Fishes TAG RCP) and 250 species of freshwater fish (Freshwater Fishes TAG RCP). The animals bred have been limited mostly to freshwater species, small sharks, rays, live bearing marine teleosts (e.g., *Embiotocidae*), and those marine teleosts that are nest layers and/or with relatively large larvae (e.g., *Pomacentridae*, *Gobiidae*, *Pseudochrominae*, *Cottidae*, *Syngnathidae*). While most marine species have proven to be difficult to breed, more than 57 ornamental fishes were listed in a survey as being purposely bred by public aquariums (Hall & Warmolts, 2003). This number is presumed to be an underestimate as only a small number of responses were received from those surveyed. More recently, there has been significant success in the propagation of jellyfishes and corals by public aquariums that have been distributed to other institutions.

Several AZA-accredited aquariums are expanding their ability to breed fishes and aquatic invertebrates by providing the adequate space, trained staff, and associated resources needed to establish stable long-term fish breeding programs. Many also are maximizing collaborations with universities and commercial aquaculturists to expand expertise and aquaculture facility space. For example, *Rising Tide* is a collaborative effort through which a number of AZA-accredited aquariums are working in conjunction with universities to develop methods to collect eggs and larvae from spawning fish populations in public aquaria and rearing them in a laboratory setting at a university. Building on initial successes, the *Rising Tide* program has expanded its focus and is now integrating efforts of display aquaria, the hobbyist industry, and academia to create a platform for the promotion and dissemination of information related to marine tropical fish aquaculture.

Over the last ten or more years, several AZA-accredited aquariums began expanding their efforts to breed and raise sawfishes and other species of large sharks using population management techniques typically utilized with terrestrial animals. Because these fishes can be individually-managed, rather than group-managed, studbooks have been developed for several elasmobranch species.

**Challenges:** In general, managed propagation is an important method of acquiring animals, but only if it makes logistical, ecological, and fiscal sense to do so. The majority of marine tropical species are broadcast spawners with small larvae that require specialized diets (e.g., protozoans, copepods, rotifers, *Artemia*) that change as they grow (Olivotto et al., 2011). The inability to supply properly sized and appropriate densities of food organisms that are required at each ontogenetic stage contributes significantly to our challenges in being able to raise these fishes. Successes have been sporadic and are often the result of opportunistic work with unplanned spawnings that are difficult to reliably replicate, although invaluable information is usually gained. The high concentration of food items tried during these different ontogenetic stages can result in poor water quality and disease outbreak, causing additional challenges for raising these fishes.

Managed propagation of aquatic invertebrates and fishes in aquariums requires that dedicated facilities, staff time and staff training be made available. Although most institutions provide limited resources to breed fishes and invertebrates, the costs associated with these efforts can easily supersede those associated with purchasing these species from commercial dealers.

### **Commercial Breeding**

**Successes:** Many tropical freshwater species of fishes are bred for the ornamental trade and are readily available through a long-established network of commercial breeders, which has significantly reduced the need to acquire many of these fishes from the wild. It is important, however, that AZA-accredited institutions select commercial breeders that utilize aquaculture methods that are environmentally friendly and thus sustainable.

**Challenges:** There are few well managed aquaculture facilities for aquatic invertebrates and fishes for the wide variety of tropical ornamental fishes and aquatic invertebrates. Poorly managed aquaculture facilities can oftentimes cause significantly more environmental issues, typically related to water quality discharge, the use of chemotherapeutics, habitat destruction, release of exotic species (Mohan, 2003), and genetic modification of fishes, than wild-sourced acquisitions.

Other challenges related to developing widespread conservation-oriented commercial breeding programs include: 1) the high taxonomic diversity in aquatic animals (fishes alone represent ~40% of all vertebrate species); 2) the resultant variety in their reproductive methods; 3) their diverse ecological, behavioral, physiological, and nutritional needs; and 4) the lack of specific knowledge on their husbandry and medical care (Thoney et al., 2003; Olivotto et al., 2011).

Olivotto et al. (2011) reviewed many of the challenges associated with marine ornamental aquaculture including spawning, larval rearing, plankton culturing for food, and rearing system design and there have been notable success. However, several companies that have attempted to raise marine fishes commercially have found this to be more costly than the lower costs associated with wild-sourced acquisitions of these animals (Koldewey and Martin-Smith, 2011).

### **Wild-Sourced Acquisition**

**Successes:** Several characteristics of wild aquatic fish and invertebrate populations make them suitable candidates for sustainable sources of acquisition. For instance, most marine teleosts are “r-selected” meaning that they have an extremely high fecundity. Additionally, many species are widely distributed, and have the ability to disperse over long distances (Thoney et al., 2003).

Wild-sourced acquisition practices of these species should be conducted with minimal impacts to the ecosystem and managed as sustainable fisheries to assure their long-term sustainability. Several fishery and harvest area management approaches could be incorporated to accomplish this, including the creation of refuges that supply propagules to harvested areas, the rotation of areas fished, the establishment of species-specific size limits and seasons, and the standardization of collecting, handling, and transportation techniques (Thoney et al., 2003).

*Challenges:* For AZA-accredited aquariums, direct acquisition of many wild-sourced aquatic fishes and invertebrates typically requires traveling to remote locations and collaborating with local residents. Logistics associated with efforts are difficult and are becoming more so with new legislation requiring additional governmental acquisition and import permits and procedures.

Indirect acquisition of wild-sourced aquatic fishes and invertebrates typically requires purchasing animals from commercial dealers. AZA-accredited aquariums and their curators should make certain that the commercial dealers they work with employ sustainable and environmentally safe acquisition methods including, but not limited to, making sure that animals are not overfished, and that they are acquired without damaging habitat, transported safely and appropriately, and quarantined properly to prevent potential disease outbreaks. The recommended aquatic animal supplier list that has been developed by the aquatic Taxon Advisory Groups provides a means to evaluate aquatic animal suppliers.

Complete chains of custody should be evaluated for these animals, from their point of acquisition by the commercial dealer to their final location with the aquarium, to be sure they were acquired in a sustainable and environmentally safe manner. These chains of custody can prove to be long and often complicated particularly when considering the international origin of most aquatic fishes and invertebrates; however they serve as valuable tools that allow curators to confirm that the animals have been acquired sustainably.

“In all likelihood, moderate levels of collecting have minimal impact, especially for abundant species..... The challenge is determining the level at which moderate becomes excessive” (Helfman, 2007). It should be noted that collections for public aquariums in themselves are typically far below the moderate levels of collecting published by Helfman (2007), which supports the need for aquariums to cooperate with sustainable fisheries.

## **Developing an Aquatic Invertebrate & Fish Collection Plan**

It is vitally important that aquarium and zoo visitors continue to be educated about, inspired by, and connected to genetically diverse populations of aquatic invertebrates and fishes. Therefore, AZA recommends that its accredited members who care for these species develop, implement, and maintain an Aquatic Invertebrate & Fish Collection Plan that identifies the ways in which their populations’ genetic diversity will be maintained or, if warranted, increased in a manner that does not reduce the long-term sustainability of the species’ populations in their natural ranges.

The advantages and challenges identified for aquarium breeding, commercial breeding, and wild-sourced acquisitions have important sustainability considerations that should be weighed carefully when developing this Collection Plan. It is further recommended that the following eight action items be incorporated into a decision-making process (e.g., decision tree) to help curators make the most appropriate acquisition decisions possible.

### **Actions Recommended for the Decision- Making Process**

- 1) Foster relationships between AZA-accredited zoos and aquariums and government entities toward the development of a regulatory framework that supports sustainable acquisition of fishes and invertebrates that are part of approved AZA Regional Collection Plans (RCPs) and/or conservation projects.
  - a. Provide input and/or support important causes that might affect your institution’s ability to sustainably acquire wild-sourced aquatic invertebrates and fishes.
  - b. Inform the AZA Government Affairs department of any regulatory proposals or changes that might affect the trade of aquatic invertebrates and fishes.
- 2) Promote the practice of acquiring sustainably bred aquatic invertebrates and fishes when available.
  - a. Evaluate commercial aquaculture breeding operations to assure that they do not cause environmental issues (i.e., do not release exotic species, destroy habitat, or disperse toxicants including antibiotics and nutrients).

- b. Develop methods to select and recruit an approved list of commercial breeders and empower your institution's curators to use the commercial breeders identified on the approved list (ie. Recommended Aquatic Animal Supplier List).
  - c. Develop a system to consistently monitor the approved commercial breeders to make certain they continue utilizing environmentally safe operational practices.
  - d. Continue and/or expand your institution's internal efforts to breed and rear aquatic invertebrates and fishes and communicate successes.
  - e. Collaborate with external aquatic invertebrate and fish breeding and rearing research projects (e.g., Rising Tide) to advance your institution's ability to acquire sustainably bred animals.
- 3) Advance your institution's participation in AZA's efforts to increase shark breeding as identified in the Marine Fish TAG RCP.
  - a. Determine if your institution is able to participate in the testing of methodologies that would evaluate what environmental parameters are required to trigger reproduction in specific species (e.g., seasonal photoperiod, temperature, and feeding, exhibit size).
  - b. Determine if your institution is able to participate in the testing of methodologies that would develop techniques that will increase our ability to breed large sharks and sawfishes (e.g., artificial fertilization).
  - c. Talk to experts in shark facility designing or the Marine Fishes TAG If your institution is designing a new, or renovating an older elasmobranch exhibit, to determine the best ways to make certain that it incorporates the habitat preference features of the species (and not only exhibition features) to increase the probability of successful reproduction.
  - d. Consider building a breeding center for elasmobranchs at your institution.
  - e. Support AZA's SAFE initiative for sharks.
- 4) Develop a process for evaluating collectors and/or distributors that supply wild-sourced aquatic invertebrates and fishes to make certain that their acquisition practices do not reduce the long-term sustainability of these populations in their natural ranges (ie. Recommended Aquatic Animal Supplier List).
  - a. Develop criteria for identifying suppliers who utilize sustainable practices.
  - b. Develop methods to select and recruit an approved list of suppliers and empower your institution's curators to use the suppliers identified on this list.
  - c. Develop a system to consistently monitor the approved suppliers to make certain they continue utilizing sustainable practices.
- 5) Develop a process to measure the results and outcomes of fish sustainability initiatives.
  - a. Develop criteria and databases to measure and track fish survivability rates in your institution and sustainability initiative outcomes.
  - b. Evaluate the feasibility and value of developing a "median life expectancy" database similar to what has been developed of terrestrial species
  - c. Develop a strategy to disseminate this information and encourage innovation in sustainability and welfare.
- 6) Support in-situ conservation efforts that advance sustainable wild acquisition practices of aquatic invertebrates and fishes to boost the livelihoods of local communities and/or efforts that prevent acquisition practices that negatively impact the sustainability of species in their natural ranges.
  - a. Identify these types of currently recognized in-situ conservation efforts (e.g., Project Piaba) and empower your institution's curators to acquire aquatic invertebrates and fishes from them.
  - b. Network with other aquariums, NGOs, and local fishers to establish these types of new in-situ conservation efforts, especially for priority aquarium species.
  - c. Build partnerships with NGOs working on aquarium fisheries to explore the potential of a sustainable aquarium trade as a viable livelihood option for local communities. This may involve training local peoples in sustainable catching practices, handling, and shipping fishes and on the economics of the trade.
- 7) Determine if it is a viable option for your institution to operate, or to collaborate with others who operate aquatic invertebrate or fish extractive reserves.
  - a. Determine if appropriate areas are available (should also be discussed in relation to 5 above).

- b. Establish a committee to review legislation and assess viability, develop a strategy, build local partnerships, and evaluate the logistics associated with establishing an extractive reserve.
  - c. Determine the potential conservation successes and challenges associated with each extractive reserve approach in partnership with academia, using sound scientific studies.
- 8) Make certain that fishes fed to the animals in your institution also are acquired in a sustainable manner.
  - a. Develop criteria for identifying vendors who utilize acquisition practices that do not reduce the long-term sustainability of these food-fish populations in their natural ranges (ie. Ocean Wise or Sea Food Watch).
  - b. Develop methods to select and recruit an approved list of food-fish vendors and empower your institution's curators to use the vendors identified on the approved list.
  - c. Develop a system to consistently monitor the approved vendors to make certain they continue utilizing sustainable practices.
- 9) Institutional commitment to *in situ* & *ex situ* objectives
  - a. Institutional commitment to give preference to animals from certified sources.
  - b. Each institution commits to providing resources or space in support of # 2 & 3.
  - c. Each institution commit to supporting an in situ conservation initiatives under # 4, 5, & 6.

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