MEDICAL CONSIDERATIONS WHEN EXHIBITING MULTIPLE TAXA IN LARGE AQUARIUM SYSTEMS

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Abstract

Large multi-taxa aquatic systems are often challenging for both husbandry and veterinary personnel. A wide variety of diseases can afflict entire systems with potential medical considerations for all exposed taxa.

Largely for logistic reasons, the most common method of disease treatment is the addition of chemotherapeutics directly to the aquatic environment. However, the potential for species-specific toxicoses associated with some treatments exists. This can limit the choice of therapeutics used if the animals are to remain in the system during the treatment period. Consequently, it is of paramount importance that additional animal holding areas are available, and that separate water filtration and water treatment options be included in the planning of any multi-taxa system. A critical review of the collection plan, with disease concerns being included as part of the discussion, will help prepare the staff for future system health concerns.

At the Living Seas Pavilion at Epcot in Walt Disney World, a single large 21.6 million liter main tank (MT) maintains teleost fish, elasmobranchs, sea turtles and marine mammals. In addition, interactive guest programs are offered that expose human beings to the aquatic environment. Understanding which diseases are likely to occur among the various animal groups and how each situation should to be addressed, is critical to the success of the exhibit, as well as to animal and human health.

Historically, morbidity and/or mortality necessitating full system treatment at the Living Seas facility have been associated with external parasitism by protozoal organisms such as *Cryptocaryon irritans* and monogenes such as *Neobenedenia* sp. Copper sulfate is commonly considered the industry standard for both protozoal infestations and also has efficacy against monogenes. From 1985-1997, copper sulfate and organophosphates were the primary agents used for treatment of monogenes in the MT exhibit. More recently, Praziquantel (Sigma®, P.O. Box 14508, St. Louis, MO 63178) has become the treatment of choice for monogenes.

System treatment with either copper sulfate or organophosphates in multi-species exhibits can lead to significant morbidity and mortality. This is especially true with elasmobranchs (sharks, rays, chimeras and skates), which have a very low tolerance threshold for these chemical treatments. Even among the different species of elasmobranchs, there is wide variation in what concentration of copper sulfate or organophosphate may cause toxicity. In general, all

elasmobranchs should be removed from the system being treated. When this is not practical, it is important to know which species are most susceptible to toxicity.

In most cases, elasmobranchs are not susceptible to the same parasites that infest teleosts, and therefore can be removed from the system and isolated from other teleosts during treatment. These animals can then be returned to the exhibit when treatment is completed without risk of reintroducing parasites. There have been some concerns that while elasmobranchs cannot serve as permanent hosts for these parasites, they may harbor certain parasites and should potentially be sampled and/or given a fresh water dip treatment prior to being placed back in the exhibit.

Praziquantel has been successfully utilized in large multi-taxa systems with no known toxicity in teleosts, elasmobranchs, herptiles and mammals. A sustained low dose (2 ppm bath for 5-15 days) appears to be both efficacious and safe.

It should be noted that due to the large number of animals that are treated when chemotherapeutic agents are added to the system, we have developed several safety measures to ensure appropriate dosing and communication throughout the treatment. Members of the husbandry, veterinary and water quality team must all be involved with system treatments. Once a drug and concentration has been determined, the amount of drug being weighed out and added to the system is double checked by members of the veterinary or water quality teams. Appropriate communication between teams during treatment will ensure filtration modifications are made and that animals can be closely observed for any deleterious effect.

In order to keep therapeutic levels of different chemical treatments in the water, the following filtration modifications are commonly made:

- Remove all activated carbon from the system.
- Turn off all ozone to the system.
- Sand filtration systems are kept in operation during the treatment period. It should be noted that in some situations, copper treatments have been associated with stagnation and even degradation of the biologic filtration. When copper is being used, plans should be made to re-seed the biologic filtration and potentially add ammonia-binding agents, such as sodium hydroxymethanesulfonate (AmQuel®, Novalek, Inc., 2242 Davis Court, Hayward CA 94545-1114), or add nitrifying bacteria.

Suggested treatment protocols:

1. Protozoal Infestation (e.g., *Cryptocaryan sp.*)
    - Remove elasmobranchs from the system under treatment. Depending upon the species and size, manual or chemical restraint is commonly utilized.
    - Remove any activated carbon from the system.
    - Do not use ozone during treatment.
    - Treat the system with copper sulfate (target concentration of 0.18-0.2 ppm).

Note: Species-specific toxicity of copper sulfate in teleost fish is not uncommon. Closely monitoring levels of copper in the water is critical, along with removing copper sensitive teleosts as needed. System treatment with copper sulfate is complex and requires constant management. Maintaining levels in the therapeutic range (>0.18 ppm) without going into the toxic range (>0.2 ppm) can be very challenging. This is particularly true when the system has a large amount of

substrate for the copper to bind with. A system with variations in other water quality parameters (e.g., pH) can also cause significant changes in copper concentration. Multiple water samplings and dosing each day are often required for a successful treatment regime. This intensive sampling and dosing is critical and cannot be overemphasized.

- Closely monitor water quality parameters for indications of problems with the biologic filtration.
- Consider decreasing feeding of the animals during treatment and monitor for changes in ammonia levels.
- Teleost fish should be monitored for any evidence of secondary bacterial infections. These can be caused by immunosuppression associated with copper therapy, previous parasitism, or damage to the integument associated with increasing ammonia levels.
- At completion of the treatment, utilize activated carbon to remove copper sulfate from the system. The carbon may need to be changed several times in order to remove all the copper sulfate from the water. Expect an initial large reduction in copper levels over the first 48 hr followed by a persistent low level (0.02-0.04 ppm) as the copper is slowly released from the substrate.
- Monitor the system for evidence of protozoa or monogenes for several weeks to ensure efficacy of treatment before elasmobranchs are placed back into the exhibit.
- In general, elasmobranchs are not returned to the system until copper sulfate has been reduced to levels below 0.03 ppm. Exact safe levels for elasmobranchs have not been determined, and appear to be species specific.

2. Monogene Infestation

- Remove activated carbon, foam fractionator and ozone filtration prior to treatment.
- Since no toxicity has been reported with praziquantel at low dose continuous bath regime (2 ppm), all animals can be maintained in the system during treatment.
- Praziquantel, if used as a single treatment, has been known to be stable in the system for 7-18 days.
- Due to the life cycle of many monogenes, several treatments may be required.
- Resume ozonation and activated carbon filtration once the praziquantel treatment is complete.

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