PINNIPED EXHIBIT DESIGN ISSUES

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Overview

One of the most challenging and expensive zoological exhibits to build today are those designed for marine mammals. In addition to creating an attractive functional exhibit, a sophisticated life support system designed to maintain excellent water quality must also be present. Historically cetaceans have required more stringent water quality parameters than pinnipeds, but it is clear that with the number of chronic pinniped eye problems seen in zoos and aquariums today, that water quality should be assigned a higher priority than it has been in the past. Life support systems should be designed to maximize the cleansing of the water while minimizing the amount of caustic chemical additives. Chlorine spikes and residual ozone levels have been blamed for the majority eye problems seen in captive pinnipeds. Bright reflective pool colors and a lack of shade may exacerbate existing eye problems caused by chemical spikes or other etiologies. Pinniped exhibit design should include plans for shading at least a portion of an exhibit to offer animals with eye problems or other health issues relief from bright sunny conditions. Light reflective pool colors are often selected to enhance the public viewing of the animals as well as improve the appearance of the water, however this color choice may result in exacerbating or even causing some of the more common eye problems seen in captive pinnipeds today.

Pinniped exhibit design is often a balance between functionality, practicality, appearance, and budget. Architects or building contractors with little marine mammal experience may err by designing an exhibit that has a pleasing appearance but does not result in an optimal living situation for the animals. Pinnipeds such as California sea lions (*Zalophus californianus*) or harbor seals (*Phoca vitulina*) have specialized physiology which requires careful planning when designing their exhibit. The use of gunite, especially hollow gunite-covered walls in the exhibit construction may render areas unusable to the animals on warm or hot days. The color of the walls may be chosen because it has a pleasing appearance, however some colors are more solar-reflective, and will reflect longwave and shortwave radiation back into the exhibit, causing the exposed and shaded beach areas to exceed the upper critical temperature for sea lions, which is defined as the temperature which requires heat loss for a species[1].

UV Light

While pinnipeds typically come from a bright and sunny environment, they are not adapted to dealing with bright, reflective surfaces when diving. Noting that clear water absorbs very little UVA light and UVA light energy is very effectively reflected by light blue or light green surfaces, it stands to reason that pinnipeds housed in pools painted with these reflective colors will be exposed to a higher daily ocular level of potentially damaging UVA light than their wild counterparts. Over time, this exposure could lead to cumulative oxidative damage to the cornea or the endothelial layer of the cornea. [1]

Animals that are trained to accept fish at a set station may be forced to look directly into the sun at certain times of the day to accept their food. Keepers and trainers should be aware of this issue and either alter the feeding locations based on the position of the sun, or provide shade to prevent discomfort and potential eye damage during feeds.

Thermoregulation

Otariids in general and California sea lions in particular appear to be limited in their ability to thermoregulate at high ambient temperatures while they are on land. This may be in part because of their adaptations to living in an aquatic environment, and their ability to limit heat loss in water. California sea lions are sensitive to higher ambient temperatures and when compared to most other terrestrial animals, are reported to have a very low upper critical air temperature of approximately 22 degrees C. This suggests special exhibit design considerations should be made for them in captive situations. In natural habitats, sea lions use a variety of behavioral options to maintain a balance between heat loss and heat gain. When pinnipeds are housed in captive situations their choices of how to thermoregulate may be limited by the health of the animal, the exhibit design and construction, housing constraints imposed on the animal, or social interactions with other animals in the exhibit. During periods of time when ambient temperatures reach over 30^{o} C extra caution should be taken to ensure sea lions do not become hyperthermic. Measurements of wet California sea lion coats indicate they absorb 91.6% of all types of shortwave radiation, making a wet sea lion very efficient at rapidly warming its body temperature. Dry sea lion coats are less solar-absorbent. The thermal properties of materials, shortwave and longwave reflectance of different colors painted on the walls, and the amount and quality of the shade should be considered carefully in planning captive habitats for sea lions.

Providing full shade and a constant water spray to sea lions without access to pools may help to prevent hyperthermia. Adding shade to an existing exhibit, and/or altering the gunite surfaces to decrease both the surface temperature and the reflectance of shortwave radiation, as well as desiging the interior of the gunite structures to optimize their properties of heating and cooling should be considered to help minimize the thermal burden on the sea lions[2]. More study needs to be done with harbor seals to determine their upper critical temperature and thermoregulatory abilities.

Hollow gunite rockwork has been utilized to create attractive underwater rock outcroppings and arches. On warm or hot days, the gunite will absorb the radiant energy and transfer that heat directly into the water, causing the water temperature to rise and placing more heat burden on the water chilling system, or if that is lacking, then on the animals themselves.

Animal Comfort

Other design features rendering the ease of use of the exhibit for the animals should also be considered. Sloping beaches are optimal to allow young harbor seal or sea lion pups or geriatric animals to easily exit the pool. Several separate haul-out areas help to minimize

male aggression. A visual block whereby one animal may rest out of view of another may also mediate male aggression during breeding season. Exhibits, especially walrus enclosures, should be designed so the public cannot drop or throw items into the pool.

Back Areas

Back areas should be designed to permit multiple functions. Large flat dry areas may be utilized for training purposes or medical procedures. Fully shaded flat pens with a built-in shallow pool are useful for housing mothers with young pups or allowing debilitated animals unsupervised access to water. Back areas should be large enough to accommodate specialized equipment necessary to move the larger pinnipeds. Dry haul-out areas and back areas should be designed to be washed down and disinfected directly into sewer drains rather than into the pool.

Walrus Exhibits

Walrus exhibits require more planning and careful design than those for other species of pinnipeds. Due to their large size they must have reinforced gates or doors to their exhibit. Walruses are capable of disassembling nuts and bolts and are notorious for damaging or consuming window sealant material from around underwater viewing windows. Walruses may also cause damage to the exhibit when using their tusks. Walruses are more apt to consume foreign objects than other pinnipeds, possibly resulting in surgical intervention or death.

LITERATURE CITED

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