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A Review of Animal Welfare and Current Enrichment Methods for Captive Marine Mammals

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by

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Introduction

Björn, an injured 8-year-old California sea lion, was rescued off the coast of Southern California by the Marine Mammal Care Center and brought in for rehabilitation in December of 2019 (PDZA, 2021). After assessing Björn, the center's staff found that, on top of being underweight and physically scarred from prior incidents, he had gone blind from the bullets discovered in his head (PDZA, 2021). It was decided by rehab staff that Björn was not fit for release into the wild due to his injuries and, after further rehabilitation, he was permanently transferred to Point Defiance Zoo and Aquarium in 2021 where he now receives specialized care and training to compensate for his disability (PDZA, 2021). Stories like Björn's are not uncommon. It is stories like these that make it crucial for animal care facilities such as zoos, aquaria, and marine mammal parks to ensure the health of the wild and captive-bred marine mammals within their care. Along with providing a safe and species-appropriate diet and habitat, many facilities utilize a variety of enrichments to stimulate the lives of their animals and deter stereotypic behaviors.

This review will assess the current standard of animal enrichment used to promote positive behaviors in captive marine mammals by providing a brief history of animal welfare, a field in which animal enrichment resides. It will also discuss what marine mammal enrichment looks like and how it is utilized today and touch on where enrichment practices may be headed based on current research.

Stereotypic behaviors, which are also referred to as stereotypies, are described for captive animals as voluntary, repetitive behaviors that provide no apparent benefits or purposes for a given animal or species (Fernandez & Timberlake, 2019). Enrichment is regarded as one way to combat stereotypies. According to Karolina Westlund (2014), in her article that discusses animal

training, enrichment is defined as an animal husbandry practice that alters an animal's environment. It also provides an animal with a broader variety of behavioral choices that bring out or develop species-specific behaviors and give the animal more control over its choices and habitat space.

Enrichment can take many forms, such as formal training with an animal trainer or keeper, who often uses operant conditioning through positive reinforcement (Westlund, 2014). It may also be an introduction of new or interesting stimuli, such as water currents and artificial kelp for young seals (Chudeau et al., 2019) or food-filled plastic toys for walruses (Fernandez & Timberlake, 2019). In many cases, enrichment can provide multiple benefits, particularly those involving formal training, where learning a behavior stimulates an animal's mind and body and actively assists in the animal's care (Ramirez, 2012). Examples include having an animal trained to lift a limb or open its mouth on cue to make veterinary procedures run more smoothly.

What is Animal Welfare?

The definition of animal welfare is, and has been, fluid, with some definitions calling animal welfare an organism's ability to cope with its surrounding environment (Westlund, 2014). Other definitions, such as the one provided by the Association of Zoos and Aquariums (AZA), state that animal welfare is "an animal's collective physical and mental states over a period of time, and measured on a continuum from good to poor." It is an accepted belief within the animal care community and supported by research-based evidence that stereotypic behaviors reflect a decrease in captive animals' physical and mental well-being and, therefore, their overall welfare (Fernandez & Timberlake, 2019; Chudeau et al., 2019).

Our understanding of animal welfare through the lens of marine mammals has also changed over the centuries that marine mammals have been in captivity. The earliest known confirmed case of a marine mammal in captivity is from the year 1060 which describes a polar bear being tended to by humans (Brando et al., 2018). However, some unconfirmed accounts from the year 879 BCE mention captive Mediterranean marine mammals, which are thought to have been dolphins or seals (Brando et al., 2018). Confirmed cetacean captivity was recorded in the 1860s with a beluga whale at the Barnum's Museum in New York City, and the first facility specializing in marine mammal care opened in 1938 at Marine Studios in Florida (Brando et al., 2018).

In the 1990s, North America had a total of 102 zoological facilities that housed marine mammals, 69 of which were categorized as zoos and the remaining 33 as either marine zoological parks or aquariums that focused on marine mammal display (Asper et al.,1990). Out of the 1,550 total marine mammals in human care, approximately 68% were one of fourteen pinniped species, 28% were one of ten cetacean species, 2% were sea otters, and another 2% were manatees (Asper et al.,1990). The California sea lion (*Zalophus californianus*) was the most numerous marine mammal in captivity with 665 individuals in 1990, with the bottle-nosed dolphin (*Tursiops truncatus*) following with 328 individuals (Asper et al.,1990). More recent global trends from 2016 showed similar patterns, where 71% of the 2,000 marine mammals kept in major zoos were pinnipeds, and 14% were cetaceans (Brando et al., 2018). Additionally, California sea lions and bottle-nosed dolphins continued to be the most numerous marine mammal species in captivity (Brando et al., 2018).

Accreditation Organization Missions and Their Impacts on Marine Mammal Enrichment

Though their missions regarding animal welfare may be similar, various accreditation welfare organizations have different focuses within their mission that can impact their members' accreditation requirements and care recommendations. This section will examine the missions and visions of the Association of Zoos and Aquariums (AZA), the World Association of Zoos and Aquariums (WAZA), and the Alliance of Marine Mammal Parks and Aquariums (AMMPA). Below, *Table 1* summarizes the mission statements and goals, or the equivalents thereof, of the AZA, WAZA, and AMMPA. Later, this section will discuss the accreditation requirements regarding animal husbandry and enrichment, specifically marine mammal care if any is present, of each association.

Table 1

Mission Statements and Visions of the Association of Zoos and Aquariums, the World Association of Zoos and Aquariums, and the Alliance of Marine Mammal Parks and Aquariums

Organization	Mission Statement	Vision	Citations
Association of Zoos and Aquariums	"The Association of Zoos and Aquariums helps its members and the animals in their care thrive by providing services advancing animal welfare, public engagement and the conservation of wildlife."	"The Association of Zoos and Aquariums envisions a world where all people respect, value and conserve wildlife and wild places."	*About Us: We Are AZA*. (n.d.).
World Association of Zoos and Aquariums	"WAZA is the voice of a global community of high standard, conservation-based zoos and aquariums and a catalyst for their joint conservation action."	"WAZA's vision is a world where zoos and aquariums maximise their conservation impact. Zoos and aquariums are at the fore-front of conservation efforts and comprise the largest global conservation network."	*About WAZA - WAZA*. (n.d.).

Alliance of Marine Mammal Parks and Aquariums	"The Alliance of Marine Mammal Parks and Aquariums is an international accrediting body for zoos, aquariums and marine parks dedicated to conservation through public display, education, scientific research, and the rescue and rehabilitation of animals in the wild."	"We, the members of the [AMMPA], are collectively committed to providing the highest standard of excellence in the service, environments, husbandry, and applied behavioral training techniques we can offer on behalf of the animals in our care. With a membership comprised of global experts and authorities on marine mammals, our commitment to these standards promotes exceptional welfare. Further, we pursue this optimal state of welfare by establishing animal lifestyles rooted in engagement and discovery which are uniquely and powerfully enriched through fostering the human-animal bond. …"*	*AMMPA Accreditation Standards and Guidelines*. (2020). *The first paragraph of the AMMPA's "Statement of Purpose."

The mission and vision statements of the AZA, as seen in *Table 1*, emphasize the broad constructs of animal welfare, engagement, and conservation of all wildlife. Given the all-inclusive nature of these statements, it is understandable that the accreditation requirements for animal care and enrichment found within the AZA's *Accreditation Standards and Related Policies* Handbook (2022) encompass all species an accredited facility may house. A facility must meet all requirements listed in the handbook to attain or maintain AZA accreditation. Many of the requirements found within Section 1 of the handbook, which discusses animal care and well-being, are not specific to any one species of animal. Some of these requirements include but are not limited to maintaining a process to assess animal wellness and welfare, housing animals in enclosures with social groups that match their social and welfare needs, and following species-specific enrichment and training programs that promote species-appropriate behaviors and overall well-being.

Some requirements written in the handbook are specific to or directed towards marine mammals. The first of these requirements instructs accredited facilities to follow a water quality monitoring program that ensures safe water parameters and documents long-term water quality. Additionally, any AZA-accredited facility that houses cetaceans must follow the "AZA Standards

for Cetacean Care and Welfare" in addition to the aforementioned accreditation requirements. The standards for cetacean care are listed within their own section in the AZA's *Accreditation Standards and Related Policies* Handbook (2022) and describe in detail the policies that surround the acquisition, transfer, conservation, husbandry, reproduction, environment, training, and transportation of cetaceans. Regarding enrichment, facilities are instructed to utilize a behavior management program where each cetacean engages in individual and group-based activities that utilize operant conditioning and positive reinforcement.

Compared to those of the AZA, the mission and vision statements of the WAZA are considerably broader as they highlight the global focus on conservation that the WAZA has. This focus continues through into the WAZA's Animal Welfare Strategy which, similar to the AZA's Handbook, provides a set of guidelines that members of the WAZA must uphold. Throughout nine chapters, the Animal Welfare Strategy describes how members should monitor and practice animal welfare within their facilities, promote species-appropriate behaviors and health through positive reinforcement-based enrichments and exhibits that accommodate each species, and how members need to educate their guests on the importance of conservation (Mellor, Hunt, & Gusset, 2015). There is little to no focus on the kinds or types of care that any one particular species, including marine mammals, should receive under the Animal Welfare Strategy, although brief case studies are provided as examples to show how specific species have been impacted by topics discussed throughout the document (Mellor, Hunt, & Gusset, 2015).

Unlike the two prior organizations, the Alliance of Marine Mammal Parks and Aquariums has no known public vision statement. Instead, the AMMPA has a mission statement and an extensive “Statement of Purpose,” both of which can be seen, at least in part, in *Table 1*. The mission statement does not specifically address marine mammals, though it does emphasize

the Alliance's international scale and focus on conservation, education, research, and, unlike the AZA or WAZA, rehabilitation (*AMMPA Accreditation Standards and Guidelines*, 2020). The Statement of Purpose draws attention to the animals that the AMMPA and their members have in their care with some focus being given solely to marine mammals. Here, the AMMPA goes into the importance of upholding animal welfare, following proper laws and regulations regarding marine mammal housing and care, and providing habitats, training, and enrichment that support species-specific behaviors and health (*AMMPA Accreditation Standards and Guidelines*, 2020).

The entirety of the Alliance's *Accreditation Standards and Guidelines* (2020) is directed toward the husbandry, transportation, and management of all types of marine mammals, those being: cetaceans, pinnipeds, sirenians, sea otters, and polar bears (*AMMPA Accreditation Standards and Guidelines*, 2020). In regards to training and enrichment, Section 2 of the document establishes the standards AMMPA members must adhere to, such as the qualifications and training of animal trainers, maintaining a "Behavior Development and Management Plan" to outline animal training procedures and achievements, and providing a stimulating environment for animals by utilizing some of the example enrichment programs (*AMMPA Accreditation Standards and Guidelines*, 2020).

Uses and Benefits of Animal Enrichment

The standards provided by the AZA, WAZA, and AMMPA regarding enrichment and training programs are, as discussed previously, largely in place because of data suggesting that implementation of varied training and enrichment improves animal welfare. What does the execution of these standards look like in practice? One example originates from the WAZA, which states that animals provided with enrichment appear less actively vigilant and more restful

in their space, especially when the enrichment poses a challenge or sense of choice to an animal, such as a puzzle or opportunity to socialize with a "social partner." (Mellor, Hunt, & Gusset, 2015). Incorporating food into enrichment, the WAZA continues, by varying the size, location, timing, or type of food or by placing the foodstuffs in a puzzle allows an animal to become more engaged with their environment (Mellor, Hunt, & Gusset, 2015). This can be observed in the research study led by Fernandez and Timberlake (2019) who observed three captive walruses (*Odobenus rosmarus*) and their behaviors before, during, and after interacting either with a food-based enrichment or a control (either no enrichment or a non-food focused enrichment). The data supported the conclusion that many of the stereotypies exhibited by the observed walruses, like flipper sucking, were likely caused by a lack of opportunities to express those behaviors properly. By providing the walruses a suitable replacement, such as sucking food out of small holes in a substrate instead of flipper sucking, the stereotypies were often mitigated (Fernandez & Timberlake, 2019).

The AMMPA lists interactive toys, multi-species habitats and training periods, live fish, tidal or water variation, and guest interactions as a few enrichment methods used for marine mammals specifically (*AMMPA Accreditation Standards and Guidelines*, 2020). In their review discussing captive marine mammal welfare and research, Brando et al (2018) emphasize the importance of variability for captive marine mammals, particularly regarding diet, so that the animals are not conditioned to expect a specific fish for a meal and are more accepting to change in case future fish populations are not as readily available. This idea is carried out further in a study focused on seal rehabilitation conducted by Chudeau et al (2019) which will be highlighted in the next section.

Regarding animal training and training programs, Westlund argues in her 2014 review on training as enrichment in zoo facilities that animal training practices that utilize operant conditioning should be considered environmental enrichment, provided that the training "gives animals control, choices and teaches them to deal with challenges in the environment, also stimulating species-appropriate covert behavior." Ken Ramirez (2012) summarizes some of the ways that training can be utilized for marine mammal welfare, particularly when it comes to medical care. It is stated that the training must be based on positive reinforcement, regularly practiced, and must not be rushed, or else the animal will not fully benefit from the training long term (Ramirez, 2012). Initial training often consists of a variety of "foundational behaviors" such as eating from a trainer's hand, desensitization techniques, and targeting, where an animal is taught to move their body or body part to a given object (Ramirez, 2012). These behaviors can then be improved upon and carried into medical care, where the animal in question can participate in their own husbandry by moving themselves to a different location, staying still for ultrasound exams, accepting blood sampling, opening their mouths for teeth cleaning, and much more (Ramirez, 2012).

The Future of Animal Enrichment

Given the impact that high-quality enrichment can have on a captive animal, it is understandably important to continue pressing forward with improvements in the field, but how are these advances being accomplished? One study by Chudeau et al (2019) highlighted the impact enrichment can have in captive and rehabilitation settings and reached similar conclusions as Fernandez and Timberlake (2019) did with walruses, but instead referring to rehabilitating Pacific harbor seal (*Phoca vitulina*) pups. Seal pups that went through a “fish

school," in which the pups practiced how to catch prey and interacted with a variety of tactile and food enrichments, expressed fewer stereotypies and were rehabilitated faster than pups without those enrichments (Chudeau et al., 2019). As noted by Chudeau et al. (2019), the ability to independently catch and consume prey is one of the key milestones a rescued pinniped must reach before reintroduction to the wild which can be negatively impacted by stereotypic behaviors, and, therefore, decreasing stereotypies would expedite the rehabilitation process. While this research supports the use of enrichment in rehab settings, the authors suggest that further research be done to examine the impacts of enrichment on the physiology and behavior of an animal throughout the rehabilitation process and that data should be collected on rehabilitated individuals after reintroduction for improved understanding of long term effects (Chudeau et al., 2019).

Clegg et al (2017) worked with eight Atlantic bottlenose dolphins (*Tursiops truncatus*) to conduct a cognitive bias test on captive zoo marine mammals. Based on short- and long-term data, the researchers found that the dolphins reacted quicker in training when "positive cues," those being food, applause, and eye contact, were presented by the trainers than neutral or "less-positive cues" such as a smaller or no fish reward and less applause. This supported the idea that dolphins that participated in synchronous swimming tended to make choices that favored positive cues and that a dolphin's social affiliations were likely linked to a positive affective state (Clegg et al., 2017), which is how likely a being is to experience or express feelings that are recognized, from the human perspective, as being happy or joyful.

Finally, Lauderdale et al (2021) conducted a collection of studies with the help of numerous common bottlenose dolphins (*Tursiops truncatus*), Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), beluga whales (*Delphinapterus leucas*), and Pacific white-sided dolphins

(*Lagenorhynchus obliquidens*) from 43 different accredited zoos and aquariums to identify indicators to positive cetacean welfare in captive facilities and to construct long-term monitoring tools for future research and care. The data collected on species-specific blood variables and fecal hormone metabolites coalesced into "ZooPhysioTrak," a free iOS application (Lauderdale et al., 2021).

Conclusions from this data suggest that some facets of social management, such as varying conspecific interactions, and environmental enrichment, such as training programs and floating toys, illicit behaviors that indicate increased positive welfare in Indo-Pacific and common bottlenose dolphins more than do variations in the physical habitat (Lauderdale et al., 2021). While the data from The Cetacean Welfare study is stated to be widely applicable and provides tools for increased cetacean welfare for future research and animals under professional care, the authors highlight the limitations of the study due to the non-experimental design and variations among facilities in management, enrichment, and habitat layout (Lauderdale et al., 2021). The authors recommend that future studies should investigate cetacean bioindicators of welfare and means of quantifying them, the relationships between cetacean social interactions and welfare, and refine identified patterns (Lauderdale et al., 2021).

Conclusion

By looking briefly at the history of marine mammal welfare and how specifics in animal care regulations vary as the scope of an accreditation facility shifts, it becomes apparent that standards regarding marine mammal enrichment have been subject to change. Conclusions from recent marine mammal enrichment studies suggest that there will continue to be an overall push towards decreasing prominent stereotypies and improving welfare. This will especially be the

case if collaborative studies such as those by Lauderdale et al. (2021) become more frequent due to the increased researchers, sample sizes, and facility types that collaborative studies allow. The fields of animal welfare and enrichment studies will surely persist in being interesting fields to pay attention to as animal ambassadors such as Björn the sea lion continue bringing attention to the importance of high quality care for marine mammals in human captivity.

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