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The Importance of Behavioral Research in Zoological Institutions: An Introduction to the Special Issue

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Behavioral research within zoological institutions (zoos and aquariums) has a long history that has helped to increase basic scientific knowledge and to facilitate the ability of institutions to make informed animal management decisions. Kleiman (1992) stated that "behavior research in zoos has enormous potential to contribute positively to the science of animal management, long-term breeding programs, conservation biology, and the advancement of scientific theory" (p. 309). As evidenced by the papers in this issue, behavioral research in zoos continues to be important. The purpose of this special issue is to highlight some of the behavioral research being conducted within zoos and aquariums and to demonstrate the importance of such work to zoological institutions and the greater scientific community. With a better understanding of the importance of behavioral research, we hope to inspire more zoological facilities to become involved either through funding/conducting research or by actively promoting the use of their animal collections for behavioral research to both the zoological and academic communities.

Historically, most of the behavioral research in zoos and aquariums was intended to increase basic scientific knowledge. More recently, there has been a shift in focus to applied topics in order to help solve animal management issues (Hutchins & Thompson, 2008; Kleiman, 1992; Stoinski, Lukas, & Maple, 1998). Such issues range from reproduction and behavioral development of species that are difficult to breed to determining the effects of environmental or management factors on the welfare of individual or groups of animals. The abstracts submitted for consideration for this special issue reflect this trend towards applied research in zoos and aquariums. Applied research represented approximately 76% (n = 50) of the abstracts that were submitted for the special issue. While not necessarily representative of behavioral research as a whole throughout zoological institutions around the world, the numbers nonetheless suggest that applied research comprises the majority of the behavioral research focus within zoos and aquariums.

We would like to thank our friends and colleagues who reviewed the articles in this issue to ensure the best possible final products. We would also like to acknowledge the researchers throughout the world who submitted abstracts to be considered for this issue. The large number of excellent submissions made it difficult to decide which research to include, but also demonstrated that there are many important research projects being conducted at zoological institutions throughout the world. Finally we would like to thank our individual institutions (San Diego Zoo Global, Disney's Animal Kingdom, and The University of Southern Mississippi) for allowing us to spend the time to put together this special issue. Correspondence concerning this article and this issue should be addressed to Lance Miller, Institute for Conservation Research, San Diego Zoo Global, 15600 San Pasqual Valley Rd. Escondido, CA 92027, U.S.A. (lmiller@sandiegozoo.org).

One of the many issues facing zoos and aquariums is sustainability of animal collections. Unfortunately many of the species currently exhibited within zoological institutions are conservation dependent and are not self-sustaining (e.g., Lees & Wilcken, 2009). While there are many different factors that can lead to low reproductive success that may not be addressed through behavioral research alone (e.g., infertility, pseudo-pregnancy), many of the other factors can be examined through behavioral research. Gaalema (2013) highlights the use of sexual conditioning in the dyeing poison dart frog (*Dendrobates tinctorius*) as a method to improve breeding behavior. While not the only way to increase reproduction, these efforts highlight one of the many uses of behavioral research within zoos and aquariums to increase breeding efforts for endangered populations. Miller and Andrews (2013) offered a different approach by examining behavioral development in African elephant calves. This work determined behavioral norms to assist other institutions' efforts to raise African elephants since elephant calves have a high infant mortality rate within zoos (Wiese & Willis, 2006). Although these two studies are examined the opposite sides of reproductive success, they are both good examples of efforts that can help zoological institutions maintain sustainable collections. Such efforts are important for wild populations as well as those in zoos and aquariums. Throughout the world, due to mostly anthropogenic factors, wild animal populations are in decline (e.g., Brooks et al. 2002; Relyea & Mills, 2001) and animals within zoological institutions can be a safety net for wild populations.

While animals within zoological institutions do not face many of the challenges that confront their wild counterparts (e.g., drought, predation, etc.), these animals are sometimes put into atypical social situations due to circumstances that arise in zoos and aquariums. Some examples of these situations include surplus male animals, multiple groups of the same species due to genetics and attempts to prevent inbreeding, or separating animals due to aggression. While some studies have been conducted with tigers (e.g., De Rouck, Kitchener, Law, & Nelissen, 2005; Miller, Bettinger, & Mellen, 2008) there have been relatively few studies on the effects of atypical social settings on other species in zoological institutions. In this issue, Grand et al. (2013) explored the effects of neighboring gorilla groups on behavior. The results from this study suggest that the ability to view the neighboring adult male had an effect on non-contact aggression for the bachelor group, but that aggression that could cause injury was not influenced by his presence. Situations in which neighboring animals share nearby exhibits will likely be a topic of increased research in the near future in order to better understand the effects of such proximity on animals.

The next four studies in this special issue illustrate the different environmental and management factors that can affect behavior. The first of these studies illustrates the importance of looking at the behavior of animals over a twenty-four hour period. Posta, Huber, and Moore (2013) examined both diurnal and seasonal differences in African elephants and found that behavior of the elephants during the day was not representative of the behavior of elephants during the night. Many studies currently conducted within zoos and aquariums focus on daytime hours due to convenience, but to ensure high levels of welfare for animals under our care, it is essential that we examine the entire behavioral repertoire of animals over a twenty-four hour period. The second of these articles examined pacing in sloth bears and highlights the importance of longitudinal research to understand the complexity of behavior. Bauer, Babitz, and Hellmuth (2013) examined social situations, enrichment, and pharmacological treatment as potential ways to alleviate pacing observed in the bears. While further research is still needed to fully understand this behavior, these efforts provide an important foundation for future studies.

Tate, Anderson, Huber, and Berzins (2013) is the only study in this special issue that comes from research within an aquarium, and demonstrates the potential benefit of behavioral research for these facilities. It will hopefully increase the amount of behavioral research

conducted in aquariums similar to the efforts highlighted in the two special issues of the International Journal of Comparative Psychology on the importance of research with marine mammals (Kuczaj, 2010a,b). Tate et al. (2013) found that exhibit design for sand tiger sharks likely contributes to spinal deformities. Exhibit design in both aquariums and zoos can be enhanced by studying the behavior of animals to encourage species-appropriate behavior and activity patterns. This study is the perfect example of solving a real-world problem through the use of behavioral research in a zoological institution. Regularly monitoring the behavior of animals can lead to new information ultimately benefiting the species. In another example, Szokalski, Foster, and Litchfield (2013) examined the effects of education programs on large felid behavior. This study looked at three different species in two different types of programs varying in contact with the animals. Results suggest that although the programs alter behavior, these programs do not compromise well-being. Again, the small sample size should be considered but this is another excellent example of applied behavioral research that can benefit the care of animals within zoological institutions.

The final article in the special issue demonstrates one of the many strengths of zoological institutions which have the ability to further our knowledge about a diversity of animals. Perdue, Snyder, and Maple (2013) examined spatial memory in Asian small-clawed otters and contributed to a limited literature on the cognitive abilities of these animals. There are many other species found within zoos and aquariums that cannot be found in academic research labs. Additional behavioral research on these species would benefit both the animals and the scientific community. While cognition studies can be conducted in the wild, zoos and aquariums offer a more controlled environment to examine a diversity of species. Although many institutions find it difficult to justify basic research due to limited budgets, mission statements, and the need to solve real-time problems to improve animal management, basic behavioral research can be a component of all institutions' research plans. Increasing collaborations with academic universities and finding ways to combine projects that answer questions about both animal management and basic knowledge will continue to add important information to the scientific literature on a diversity of species.

The articles that follow provide a sampling of the research efforts that are currently being conducted throughout the world. Through continued research on the behavior of animals in zoological institutions we can solve applied problems while also contributing to the general scientific literature. We hope this special issue will increase discussions about how to increase research efforts and collaborations both within and outside of the zoological community.

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