Introduction to the "Special Issue of Technological Advances in the Study of Aquatic Mammals"

This issue of *Aquatic Mammals*, entitled "Special Issue of Technological Advances to Study Aquatic Mammals," rounds out a successful, productive year for the journal. This special issue presents a collection of papers on recent technological advances in the study or care of aquatic mammals. Technological advances and innovative use of those methods continue to evolve to unprecedented levels, collectively allowing science as a whole to glean more about the behavior, physiology, health, distribution, and ecology of marine mammals. There are many innovative ways to study marine mammals including (but not limited to) artificial intelligence (AI), satellite imagery, unmanned systems (e.g., drones, gliders), genomics, tagging, biologging, and passive acoustic monitoring. The methods are as diverse and interesting as the animals that are studied. This issue speaks to the diversity in topics and methods as we expand on our understanding and study of both *in situ* and *ex situ* aquatic mammals.

We open our special issue with an article by Keesing et al. discussing the use of remote underwater video footage to confirm dugong presence in a marine park. This short note provides information about how remote cameras were deployed to survey herbivorous grazers but wound up capturing footage on at least one dugong. The authors suggest that remote videos could be augmented by drone deployments to study remote areas for elusive aquatic mammals. Guizada Duran and Aliaga-Rossel present a comparative analysis of drone and boat monitoring techniques to study the endangered Bolivian river dolphin. Surveys with the drone consistently detected more individuals with larger group sizes than boat-based surveys. The authors caution that standardizing approaches is still required but the drone perspective offers a cost-effective alternative to studying potentially cryptic aquatic species. Another drone application that offers an alternative to traditional boat-based photo-identification is presented by O'Callaghan et al. in their article on aerial photo-identification of sperm whales. As the authors point out, photo-ID on sperm whales has decades of history, but unmanned aerial systems (drones) reshape classical image use by offering dorsal views of their flukes and dorsal fin scarring to promote recognition of individuals. These authors also compare the benefits of drone-obtained images to boat-based views.

Shifting away from drones in the next article, Ames et al. present how welfare of an individual dolphin could be effectively monitored while voluntarily participating in functional magnetic resonance imaging (fMRI). This five-year study focused on maintaining an elevated positive welfare level for the dolphin during the training and imaging portions of the program. The team included veterinarians, trainers, and researchers focused on better understanding brain structure and function while maintaining the well-being of the dolphin in their care. Their resulting protocol serves as a model for future studies requiring complex imaging and data collection.

Perkins-Taylor and his colleagues share with our readers how drones can be used effectively and non-invasively to assess body condition in a coastal dolphin population residing in an estuary that can be a challenge to the regular boat-based survey approach. Over the two years of data collected, body condition of 174 recognizable dolphins were assessed across season and age class to provide not only a baseline for dolphin body condition but also to offer insight into how environmental or anthropogenic stressors might impact different dolphin age classes.

Rodofili and Lecours used drones to automatically count Florida manatees. Thus, they not only accessed a new technological tool (i.e., a drone) but also computer tools (i.e., object-based image analysis) to reduce human effort and workflow for a standard population count. The workflow tool used by the authors is a free platform for researchers that captured most visible manatees. The authors discuss both false positives and false negatives; and they provide their code and offer recommendations for application to other aquatic species. Tofighi and Berea also present an agent-based model for human–whale interactions, with their target species the critically endangered North Atlantic right whale. The authors stress that their modeling method can highlight and assess potential future scenarios for anthropogenic interactions with right whales that could pose detrimental threats to not only individual but species survival.

Zoidis et al. developed and deployed a modified fitness tracker watch as a marine mammal tag, which was deployed on several humpback whales as proof of concept. Their tag proved useful as an inexpensive alternative to more costly

devices for collecting movement and acoustic data. They provide a discussion of these custom tags related to their application and modifications for future deployments. Kastelein et al. also share details about tag data with our readers that provided information about the exposure levels received by a free-swimming California sea lion (see photos below). Tones were played while the sea lion, wearing the D-tag, swam freely in the pool. This set-up allowed measurement of the sound exposure and pressure levels experienced by the sea lion, as well as facilitated a mapping of those levels at depth and near the surface by the researchers. Their study was conducted to potentially shed light on how this type of study might be conducted with wild animals in the future.

Our special issue wraps with an Historical Perspectives essay from Dr. Lisa Ballance. Dr. Ballance shares with our readers her perspectives and experiences working with NOAA for several decades, her work in Antarctica and other extreme locations, and her recent shift to academia. I thoroughly enjoyed not only Dr. Ballance's essay (a must read for any young, new marine mammalogist) but all the articles in this special issue. I hope you, our reader, will as well.

Happy reading!

Kathleen M. Dudzinski, Ph.D.
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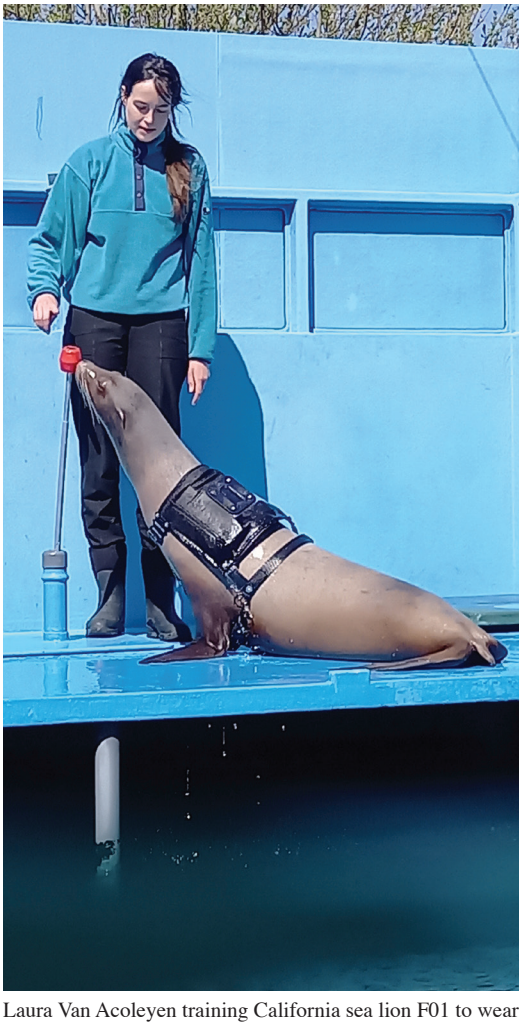

Laura Van Acoleyen training California sea lion F01 to wear a harness to which a sound recording tag (D-Tag) can be attached. (*Photo credit:* Ron Kastelein, SEAMARCO)

California sea lion F01 with the harness and the D-tag receiving a reward after having been exposed to a fatiguing sound. Study funded by the LMR program of the U.S. Navy. (*Photo credit:* Ron Kastelein, SEAMARCO)