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How to Work on a Non-endangered Species and Contribute to Cetacean Conservation: An Example by the Sarasota Dolphin Research Program

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The world's most endangered small cetaceans are found in countries many miles from Sarasota Bay and its common bottlenose dolphins (*Tursiops truncatus*). Information on the ecology and threats to many of these endangered cetaceans is often far more limited than that on bottlenose dolphins, with the IUCN Red Data List describing many species as "data deficient." In many developing nations where these rare species occur, resources for research and monitoring are scant, and logistical challenges further limit research into marine mammal health and population status and their threats. The Sarasota Dolphin Research Program (SDRP) has tackled this problem by using the bottlenose dolphin as a model for cetacean species in other parts of the world and using its resources to assist scientists working with more endangered species of cetacean. The celebration of 50 years of study by the SDRP exemplifies how using long-term data on known individuals can advance the fields of cetacean behavior, ecology, life history, physiology, toxicology, and medicine, all providing information for informing certain conservation actions. The Sarasota team has used their work to inform conservation policy both home and abroad.

Keywords: dolphin, conservation, collaboration, health assessment, tagging

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INTRODUCTION

The world's most endangered small cetaceans are found in countries many miles from Sarasota Bay and its common bottlenose dolphins (*Tursiops truncatus*) (Brownell et al., 2019). Information on the ecology and threats to many of these endangered cetaceans is often far more limited than that on bottlenose dolphins, with the IUCN Red Data List describing many species as "data deficient" (IUCN, 2019). In many developing nations where these rare species occur, resources for research and monitoring are scant, and logistical challenges further limit research into marine mammal health and population status and their threats. This is a challenge for conservation, as science is important for informed policy and management (Higgins et al., 2006; Parsons et al., 2015).

The Sarasota Dolphin Research Program (SDRP) has tackled this problem by using the bottlenose dolphin as a model for cetacean species in other parts of the world and using its resources to assist scientists working with more endangered species of cetacean. The celebration of 50 years of study by the SDRP exemplifies how using long-term data on known individuals can advance the

fields of cetacean behavior, ecology, life history, physiology, toxicology, and medicine, all providing information for informing certain conservation actions (Barratclough et al., 2019). The SDRP could have focused on the bottlenose dolphins of Sarasota alone, perpetuating the allegation of Jaric′ et al. (2014) that global marine mammal research is disproportionately directed toward less endangered species. The Sarasota team has risen to this challenge, using their work to inform conservation policy both home and abroad, and through international collaborations contribute to the conservation of endangered porpoises and dolphins in many other areas of the world.

FROM INDIVIDUAL PARAMETERS TO POPULATION DYNAMICS

One challenge to conservation of cetaceans is the limited data available on specific effects of anthropogenic activities on health, and how these translate into population level effects (National Academies of Sciences, Engineering, and Medicine, 2016). Typically, data are available on levels or amounts of the stressors, such as sound, oil exposure, organochlorines, biotoxins, or infectious diseases, yet we do not have data on how the health (body condition, hematology, organ function, reproduction, and survival) of the marine mammal changes with exposure to these stressors. Even more rarely do we have data on how health parameters collected at a single time point relate to reproductive success or survival. Thus when mitigation measures are developed, establishing "safe" or "permissible" levels that also accommodate military, economical, or human welfare concerns is difficult. The SDRP has used its long-term dataset to provide data on the associations between specific levels of blubber pollutants or oil exposure and bottlenose dolphin health, reproduction, and survival (Wells et al., 2005; Hall et al., 2018). These data from well-studies species build our ability to interpret information from difficult to obtain single samples from endangered cetaceans and apply them to assess the potential risks of various stressors to population health.

Exposure to persistent organochlorine pollutants (POPs) has been associated with reproductive failure, endocrine dysfunction, and impaired immunity in marine mammals (O'Hara and Hart, 2018). In two critically endangered cetacean species, exposure to persistent organic pollutants has been suggested as a cause for their population declines. The vaquita (*Phocoena sinus*) is the world's most endangered cetacean, with fewer than 10 animals likely alive today (Jaramillo-Legorreta et al., 2019). Despite abundant evidence for high mortality due to fisheries bycatch causing the rapid population decline, concerns have been raised over the potential for pollutants to play a role in the vaquita's decline. In Cambodia, the Mekong River dolphin (*Orcaella brevirostris*) population is now reduced to under 100 animals, and POPs were also suspected to have contributed to this population's low survival rate, although threats from dam construction and fisheries bycatch remain of greater concern (Brownell et al., 2017). By comparing levels of organochlorines measured at a single time point (at necropsy) in samples from these endangered species to measurements of organochlorines in samples from healthy bottlenose dolphins with well-documented reproductive histories, organochlorine exposure could be dismissed as a conservation concern for both the vaquita (Gulland et al., 2020) and the Mekong River dolphin (Reeves et al., 2009).

In 2010, the massive Deepwater Horizon Oil Spill (DWH) resulted in exposure of a variety of marine mammals to oil and oil-dispersing compounds. Funding for restoration and conservation post-spill was guided by the assessment of the extent of the damage to the ecosystem in the Gulf of Mexico, a challenging task. Damages to dolphins were assessed by comparisons of health and life history parameters in dolphins examined after the spill in the Gulf of Mexico to a "control" unexposed population. The long history of the SDRP provided not only a control population of dolphins, but also the techniques for health assessments of free-living dolphins (Wells et al., 2004). Health assessments of dolphins in heavily oiled areas, particularly Barataria Bay, Louisiana, performed as part of NOAA's Natural Resource Damage Assessment found significant lung pathology, impaired stress responses, reproductive failure, and altered immunity compared to dolphins from the un-oiled reference population, the SRDP animals (Schwacke et al., 2014).

TOOLS, TECHNIQUES, AND TECHNOLOGY TRANSFER

Tools and techniques developed over the 50 years of the SDRP have been useful for establishing population monitoring, health assessment, and tagging programs for cetaceans in other parts of the world. Tools and techniques perfected on bottlenose dolphins over the years can be shared and adapted for use with other species, reducing the time, effort, and funding that would have been needed if starting from scratch. The challenging effort to capture a few remaining vaquitas in 2017 provides an example of the SDRP's value and generosity. Experience from their bottlenose dolphin capture-release operations was vital to the development of the plan for vaquita captures in Mexico (Rojas-Bracho et al., 2019). The continued uncontrolled mortality in gill nets set illegally for totoaba (Jaramillo-Legorreta et al., 2019) led the International Committee for the Recovery of the Vaquita (CIRVA) to recommend capture and temporary holding of vaquitas to protect the few remaining individuals from entrapment in gillnets (CIRVA-9, 2017). Concurrent efforts to remove gillnets from the refuge, develop alternative fishing gear for legal shrimp and fin-fish fisheries, and outreach efforts continued. As vaquitas had never been captured before, the plan to capture them was developed through combined efforts of an international community of marine mammal scientists with experience in capturing other species of porpoises and dolphins. The 50 years of experience capturing and releasing bottlenose dolphins for health assessments gave the Sarasota team a solid base of experience from which to lead the small-boat-based team aiming to capture vaquitas safely (Rojas-Bracho et al., 2019). This experience

has also been integral to developing capture-release operations for tagging franciscana (*Pontoporia blainvillei*) in Argentina and Brazil, techniques that are enhancing understanding of franciscana habitat use and guiding management decisions about artisanal gillnet fisheries and coastal development (Bordino et al., 2008; Wells et al., In Review). Plans for engaging the SDRP expertise for capturing the last remaining baiji (*Lipotes vexillifer*) in the Yangtze River for translocation to a semi-natural reserve ended when surveys to locate baiji for capture efforts did not find any.

The experience of the SDRP is also applied frequently to rescuing individual dolphins, typically in response to situations caused by humans, such as entanglements (Wells et al., 2008). Wells et al. (2013) determined that expeditious interventions before animals strand improve success. Rescue operations, typically with the collaborative efforts of multiple organizations, can involve remote disentanglements without holding the dolphin using long handled cutting tools. Alternatively, they may involve captures for disentanglement or translocation to more appropriate habitat or rehabilitation facilities. Such individual rescues can have significant population level benefits, saved animals that reproduce contributing to future generations of dolphins (McHugh et al., 2021). In addition to leading or participating in rescue efforts in the south-eastern United States, the SDRP has consulted on plans for rescues of cetaceans in other countries including Australia, Cambodia, Cosa Rica, Ecuador, Egypt, and Slovenia.

A vital tool for monitoring dolphin populations is photoidentification, with various software programs existing to facilitate field efforts and data management. On the Mekong River in Cambodia, population monitoring of the endangered Irrawaddy dolphin population is conducted by WWF-Cambodia and the Cambodian Fisheries Administration (FiA) of the Ministry of Agriculture, Forestry and Fisheries (MAFF). This monitoring provides the basis for evaluating efficacy of programs to reduce bycatch in gillnets, especially the River Guard program. The SDRP, with support from the Marine Mammal Commission, the University of St. Andrews and the National Marine Fisheries Service, has worked on an adaptation of the photo-identification database "FinBase" for use with the Mekong River dolphin data, including translations of data forms into Khmer (Adams et al., 2006). Four Cambodian scientists working on the Mekong visited Sarasota for hands-on training on photo-identification and using the database with bottlenose dolphins, and scientists from the SDRP now support the team in Cambodia remotely as the database is used for critically endangered dolphins on the Mekong.

The SDRP has led the development of collaborative, cooperative regional photographic identification catalogs, where researchers contribute their individual identification catalogs to a curated, compiled online repository to archive images and facilitate matches of individuals across different projects and study sites. In 1996, the SDRP assisted with the establishment of the Mid-Atlantic Bottlenose Dolphin Catalog (Urian and Wells, 1996). Subsequent SDRP efforts have established the Gulf of Mexico Dolphin Identification System for (GoMDIS) bottlenose dolphins, which involves more than 35 catalogs from researchers around the Gulf, including Mexico and Cuba. Building on the design for GoMDIS, the SDRP worked with local researchers to establish the Pearl River Estuary Dolphin Identification System for Chinese white dolphins (*Sousa chinensis*) in an area where the species is heavily impacted by human activities, around Hong Kong and the nearby coast of mainland China.

Although the SDRP has been built around the ability to identify individual animals from photographs, the program has been engaged extensively in the development of telemetry tags for remote tracking of dolphins, focusing on designs to minimize tag impacts on the animals, including reducing fin surface coverage, tag size, number of attachment pins, and drag, while maximizing attachment duration (Andrews et al., 2019), and developing techniques for attaching tags without the need for catching animals. The ability to track animals and identify essential habitat, as well as individual animal survival after interventions (Wells et al., 2013; McHugh et al., 2021) has been an important addition to the marine mammal conservation toolkit. The development of tags for use on bottlenose dolphins in Sarasota thus has again benefited cetacean conservation beyond Florida waters.

COLLABORATIONS, PARTNERSHIPS, AND TRAINING

International partnerships are important for sharing knowledge, experience, and technology, the tools for conservationists globally. Such collaborations with the SDRP have involved marine mammal scientists visiting Sarasota from such places as Cambodia, Pakistan, India, Senegal, Kenya, Cuba, Mexico, Argentina, Peru, Australia, Spain, Italy, Colombia, Bangladesh, Costa Rica, Belize, Germany, China, Hong Kong, French Polynesia, Bermuda, Malaysia, Singapore, Guatemala, Denmark, South Korea, Chile, Taiwan, Tasmania, Brazil, and the United Kingdom. In turn, members of the Sarasota team have traveled to the home ranges of endangered cetaceans in places such as Argentina, Brazil, China, Mexico, Taiwan, and Cambodia and provided advice on research design, assistance in field work, and expertise on data management. The SDRP has also provided guidance, training, advice, and support for conservation of the endangered Taiwanese humpback dolphin (*S. chinensis taiwanensis*).

The numerous foreign scientists who visited Sarasota, many as interns and graduate students, have used their field experience on Sarasota Bay as the basis of academic theses, and as training for learning data collection, management, and statistical skills which are then may be applied in field research on more endangered cetacean species in their home countries. While the extent and sources of financial support for these scientists have varied over the years depending upon available resources, the intellectual, emotional, and moral support for visitors to SDRP has always been outstanding. As the current pandemic limits travel, these collaborations continue through the use of the internet, cell, and satellite phones.

DISCUSSION

Although the principal focus of SDRP over the past 50 years has been on the non-endangered bottlenose dolphin, the SDRP's work has contributed to understanding the impacts of major catastrophes (DWH), insidious hidden threats (POPS), and long-term environmental change (HABs) on impacted dolphin populations in the United States and, through its collaborative efforts to share knowledge, expertise, equipment, and training opportunities, enlightened and strengthened cetacean research and conservation efforts around the globe. As the threats to small cetaceans continue, we need to build upon this example, increasing international collaborations, and strengthening the flow of resources and exchange to studies of endangered populations around the world. Partnerships are vital to field conservation where capacity and funding are limited (Minton et al., 2017). Over the last year, the pandemic has strengthened our ability to collaborate across thousands of miles, and the Society for Marine Mammalogy has embraced the need to enhance training and support of interns from developing countries, the homes of many endangered cetaceans. Let us build on these efforts to increase cetacean conservation, following the example of the SDRP's work over the last 50 years.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

FG wrote this perspective.

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