Dwarf and Pygmy Sperm Whale (*Kogia* Spp.) Best Practices

Executive Summary

These Dwarf and Pygmy Sperm Whale Best Practices highlight general procedures specific to responding to live and dead *Kogia* spp. Based upon findings from a previous *Kogia* workshop held in the Southeast United States there are common disease syndromes (*e.g.*, cardiomyopathy) in dwarf and pygmy sperm whales that make rehabilitation of certain age classes of these species extremely difficult. These Best Practices outline the appropriate field response to live dwarf and pygmy sperm whale strandings as well as suggestions for appropriate sampling of euthanized or dead stranded whales.

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1. Introduction

1.1 Background

In 1992, the Marine Mammal Health and Stranding Response Program (MMHSRP), under the National Marine Fisheries Service (NMFS), was established by Congress under Title IV of the Marine Mammal Protection Act (MMPA). The MMHSRP serves as the centralized coordination agency for marine mammal stranding response efforts in the United States. The MMHSRP works to standardize regional network operations and define national stranding response policy.

Nationally, strandings of dwarf (*Kogia sima*) and pygmy sperm whales (*Kogia breviceps*) are relatively rare (Table 1; nationally an average rate of 40 per year), but they are the second most commonly stranded marine mammal in the Southeast Region of the United States (U.S. Atlantic coast from Florida through North Carolina, Gulf of Mexico, Puerto Rico, and the U.S. Virgin Islands) and where they commonly live strand. Dwarf and pygmy sperm whales are rarely seen during aerial or ship-based surveys due to their deep-sea habitat and avoidance behavior towards vessels (Baird, 2005). In addition, unlike dolphins and porpoises that spend much of their time at the surface, dwarf and pygmy sperm whales have short surfacing periods and small dorsal fins, making it difficult to identify and differentiate between the two species at sea (Chivers *et al.* 2005; Waring *et al.* 2007). Because dwarf and pygmy sperm whales are difficult to differentiate at sea, or even during a stranding event, the two species are often grouped together for management purposes. The pattern of the "false gill slit" pigmentation pattern (Appendix A) is one of the ways that can help differentiate between the two but often can only be viewed up close such as during a stranding event (Keenan-Bateman *et al.* 2016).

The United States Marine Mammal Stock Assessment Reports (SARs) provide a best estimate of abundance for the California, Oregon and Washington *Kogia* stock of 4,111 (Carretta *et al.* 2017). The most recent SAR for the Hawaiian *Kogia* stock (Carretta *et al.* 2021) estimates an abundance of 53,421 for unidentified *Kogia* (*i.e.*, the estimate is a combination of dwarf and pygmy sperm whales). Atlantic *Kogia* stock of 7,750 (Hayes *et al.* 2020) animals and 336 (Hayes *et al.* 2021) animals for the northern Gulf of Mexico stock. Dwarf and pygmy sperm whales are not listed as endangered or threatened species, nor are they currently managed as strategic stocks under the Marine Mammal Protection Act (MMPA) due to human-caused mortality. Despite this, their significant level of strandings along the East Coast and in the Gulf of Mexico (annually, 37 animals) creates a need for additional information on dwarf and pygmy sperm whale life history, abundance, distribution, and causes of morbidity and mortality.

In 2009, NMFS held a Dwarf and Pygmy Sperm Whale Workshop focusing on these two species in the Southeast region, especially live stranded animals. The Workshop had five main goals:

1. To evaluate the current state of knowledge regarding *Kogia* health, disease, and population parameters;

2. To understand *Kogia* illness/strandings, with a focus on health/disease issues and population impacts;

3. To provide guidance to the Stranding Network for standardized tissue/data collection and distribution, and for beach decisions regarding live *Kogia* strandings;

4. To develop a research strategy for looking at causes of morbidity and mortality in *Kogia*, especially cardiomyopathy; and

5. To develop common case definitions with images and descriptions for each of the cardiomyopathic conditions, a common sampling regime, and analytical protocols.

Sections of these Best Practices present summary and updated data from that 2009 Workshop.

1.2 Legislation Pertinent to Cetaceans

There is a key piece of legislation that governs interactions with marine mammals in the United States that apply to dwarf and pygmy sperm whales.

> <u>Marine Mammal Protection Act (MMPA)</u>: The MMPA, signed into law in 1972, prohibits the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, which includes harassing or disturbing these animals, as well as harming or killing, unless such take is specifically exempted in the statute or authorized. The MMPA divides responsibility for marine mammal species between the Secretary of Commerce, who oversees NMFS, and the Secretary of the Interior, who oversees the United States Fish and Wildlife Service (USFWS). NMFS has jurisdiction over cetacean and pinniped species (with the exception of walrus), and USFWS has jurisdiction over walrus, polar bear, sea otters, and manatees. The 1992 amendments to the MMPA included Title IV of the MMPA, which established the MMHSRP under NMFS to collect and disseminate information about the health of marine mammals and health trends of marine mammal populations through the collection of stranding data.

1.3 Management Needs

In recent years, there has been a philosophical shift in management practices towards ecosystembased management, which considers various resources and species as interrelating parts of systems rather than as individual components to be managed separately. The general lack of knowledge available for dwarf and pygmy sperm whales provides multiple management challenges and concerns resulting in several key management questions. Generally, these questions can be grouped under three categories: 1) population and stock assessment, 2) life history and health, and 3) strandings.

Kogia species are grouped together and divided into the following stocks for management purposes: California, Oregon and Washington; Hawaiian; Western North Atlantic; and Gulf of Mexico. To adequately manage *Kogia* spp., their abundance, and geographic distribution is needed, as well as whether their distribution has changed over time. Additional data about morphological, genetic, and/or behavioral data is also needed to provide further information on stock delineation. In addition, information is needed about their mortality rates and whether their populations are decreasing, stable, or increasing. Finally, managers need to know the age structure of the population and whether there is other structure to the populations that must be taken into consideration with management strategies.

Little is known about the life history of *Kogia* spp. and the causes of their mortality. Stock assessment reports assume a population growth rate of no more than 4% (Waring *et al.* 2007). Based on this growth rate, stranding numbers suggest that at least some stocks might be declining. As a result, managers need to understand the stressors affecting *Kogia* spp. and leading to their stranding and mortality.

1.4 Intended Uses of Best Practices

NMFS and the Marine Mammal Stranding Network (the Stranding Network) have developed protocols and procedures for responding to live marine mammals that are stranded or otherwise in distress to ensure the health, welfare, and safety of both the human responders and animals. These protocols balance the need for standardized procedures while allowing flexibility to address specific needs of different situations for diverse species and habitats, as well as unforeseen circumstances. For more information on general stranded marine mammal rescue and rehabilitation, the reader should consult references such as Marine Mammals Ashore (Geraci *et al.* 2005) and the CRC Handbook of Marine Mammal Medicine (Gulland *et al.* 2018).

These Dwarf and Pygmy Sperm Whale Best Practices (Best Practices) highlight general procedures specific to responding to live and dead *Kogia* spp. Based upon findings from the 2009 *Kogia* workshop, there are common diseases (*e.g.*, cardiomyopathy) in dwarf and pygmy sperm whales that make rehabilitation of certain age classes of these species extremely difficult. These Best Practices outline the appropriate field response to live dwarf and pygmy sperm whale strandings as well as suggestions for appropriate sampling of euthanized or dead stranded whales.

These best practices have been developed to serve as guidance and recommendations. This document is not intended for independent use as a training manual and does not by itself qualify the reader for any actions or authorizations. In some situations, responders may choose a course of action not outlined in these documents, but consultation with NMFS is encouraged if the course of action will vary greatly from the best practices outlined in this document. These best practices are a "living document," and as such, we plan to periodically review and update them as new information becomes available. Responders should never stop striving for innovative and new methods and training to increase safety and success, and nothing in these best practices should prevent or limit advances in technology, techniques, and training.

1.5 Funding

The John H. Prescott Marine Mammal Rescue Assistance Grant Program provides funding for eligible members of the Stranding Network through an annual competitive grant process. These grants support the rescue and rehabilitation of stranded marine mammals (including small cetaceans), data collection from living or dead stranded marine mammals for health research, and facility operation costs. However, as these grants are competitive and limited and there is not enough funding to cover all costs of the Stranding Network, individual Stranding Network members must support many of the costs for normal operations.

2. Population Status and Historical Data from Previous Strandings

2.1 Population Status and Trends

2.1.1 *Kogia* species stock assessment, habitat use, and status - NMFS 2009 workshop summary by Lance Garrison

Under the MMPA, NMFS is required to develop annual stock assessment reports that include adequate evaluations of stock structure, estimates of abundance, and quantification of human-induced mortality. This includes recent (less than 5 years old) estimates of abundance that are both accurate and precise. There are significant challenges in the assessment of *Kogia* species status that limit the ability to develop adequate stock assessments. First, it is not possible to differentiate between the two species when they are encountered at sea. As a result, mortality and abundance estimates cannot be derived for each species. In the NMFS stock assessment reports, this is reflected by separate reports for the two species; however, the information contained in those reports is nearly identical. The *Kogia* assessments are separated into California, Oregon and Washington and Hawaiian stocks on the west coast and the Gulf of Mexico and Western North Atlantic stocks on the east coast; however, these divisions are an assumed one and do not reflect the results of a targeted study of population structure.

Developing accurate and precise abundance estimates is made difficult by the low encounter rate of *Kogia* during assessment surveys, their long dive times (dive depths at least 1,000 feet) with short surface intervals, and the difficulty in seeing them during less than optimal sighting conditions. As a result, available abundance estimates for California, Oregon and Washington, Hawaiian, Gulf of Mexico and Atlantic stocks are both highly variable and negatively biased. The current best estimate of abundance for *Kogia* in the California, Oregon and Washington Pacific ocean is 4,111 (Coefficient of Variation [CV] =1.12). For the Hawaiian *Kogia* stock, the current best estimate of abundance is 53,421 (CV=0.63) for unidentified *Kogia* (i.e., the estimate is a combination of dwarf and pygmy sperm whales). The current best estimate of abundance for *Kogia* in the Atlantic is 7,750 (CV=0.38), which is based on surveys conducted in 2016 between central Florida and the lower Bay of Fundy. For the Gulf of Mexico, the current best estimate of abundance for *Kogia* is 336 (CV=0.35) based on surveys conducted during the summer of 2017 and summer/fall of 2018.

Habitat studies based upon historical sightings (Figure 1) in the Gulf of Mexico indicate that *Kogia* are more frequently encountered in deep oceanic waters near areas with a high occurrence of surface frontal zones and increased concentrations of zooplankton. This suggests that they aggregate in areas where mesoscale physical processes tend to concentrate their prey (*e.g.,* cephalopods (*e.g.*, squid and octopus), crustaceans (*e.g.*, crabs and shrimp), and fish) such as the edges of loop current eddies in the Gulf of Mexico. Interactions between *Kogia* and commercial fisheries are apparently rare. There was one documented interaction with the east coast pelagic longline fishery that occurred in 2000. Based on this one interaction, Western North Atlantic *Kogia* were considered strategic stocks for several years. However, since there have been no additional observed interactions, the stocks currently are not strategic. For the Pacific region, historical sightings (Figure 2) have been rare; therefore, data is insufficient to identify habitat or delineate possible stock boundaries for that area.

Considerable research effort will be required to improve the assessment of *Kogia* stocks. Stock structure studies are currently underway from stranded animals that should allow evaluation of population structure within and between the western North Atlantic and Gulf of Mexico. However, extensive targeted survey effort will be required to improve abundance estimates and understanding of habitat use. In addition, tagging studies will be required to both evaluate dive/surface times and to distinguish potential differences in habitat preferences between the species. Developing adequate assessments for *Kogia* will require significant additional resources.

2.1.2 National Pygmy and Dwarf Sperm Whale Stranding Trends

The stranding data nationally for 2006-2018 from the NMFS National Marine Mammal Health and Stranding Response Database were analyzed. Dwarf and pygmy sperm whales strand nationally at an average rate of 40 per year (Figure 3; Table 1); approximately half of the cases are live strandings (Figure 4). Nationally, the majority of live-stranded dwarf and pygmy sperm whales are adults or calves.

From 2006 to 2018, 3,039 cetaceans live-stranded in the United States. Of these, the largest percentage (23%) were bottlenose dolphins (*Tursiops truncatus*), followed by short-finned pilot whales (*Globicephala macrorhynchus*) (21%), and *Kogia* species (10%), including unidentified *Kogia*. Despite being the third-most common species to live strand, stranded *Kogia* have a poor prognosis compared to other cetaceans that commonly strand alive. The majority of live-stranded *Kogia* (80%) were either euthanized or died at the stranding site or during transport. Approximately 3% were admitted to rehabilitation facilities; however, all Kogia either died or had to be euthanized during rehabilitation. In contrast, only 38.5% of bottlenose dolphins were either euthanized or died at the stranding site or during transport. Additionally, from 2006 through 2018, ~10% of live-stranded bottlenose dolphins were admitted to rehabilitation facilities. Of those bottlenose dolphins, approximately two-thirds survived rehabilitation and were either released or deemed non-releasable and retained in permanent captivity (generally dependent calves).

2.1.3 East Coast *Kogia* species stranding trends – NMFS 2009 workshop summary by Jenny Litz, Gina Rappucci, and Dan Odell

Stranding data for 1990-2018 from the NMFS National Marine Mammal Health and Stranding Response Database and the NMFS Southeast Regional Marine Mammal Stranding Database were analyzed. *Kogia*, particularly *Kogia breviceps*, are the second most commonly stranded cetacean species along the east coast United States with an average of 37 strandings per year (Table 2). One of the most striking characteristics of *Kogia* strandings is the proportion that strand alive. Over 58% of *Kogia*s are alive when they strand, compared to less than 13% of all cetacean species. *Kogia* strandings have been reported along the entire U.S. East Coast, the Gulf of Mexico, and even the Caribbean (Puerto Rico and the U.S. Virgin Islands). However, the highest number of *Kogia* strandings per mile of coastline occurs along the Atlantic coast between North Carolina and Florida. Unusually, the majority of *Kogia* strandings are adults. The majority of calves that do strand are dependent calves that strand in close association with an adult female.

For the majority of states, approximately 36% or more of the *Kogia* strandings were *K. breviceps*. Specific stranding data by state found that strandings of *K. breviceps* were the most common with the

K. breviceps vs *K. sima v*s unidentified *Kogia sp.* stranding proportions respectively as follows: North Carolina (60%, 33%, 7%), the Florida Gulf Coast (51%, 39%, 10%), Louisiana (50%, 33%, 17%), and Texas (55%, 26%, 19%). While the total number of strandings for *Kogia* varies by year, it also varies by state and year. Seasonal patterns of strandings were not apparent in the data, with the exception of calves. Calf strandings of both species were higher in the summer (Jun – Aug) and fall (Sept – Nov) than the winter (Dec - Feb) and spring (Mar - May).

From 2006 through 2018, 1,285 cetaceans and 716 marine mammals live-stranded in the Southeast Region of the United States. Of these, the largest percentage (46%) were bottlenose dolphins (*Tursiops truncatus*), followed by *Kogia* species (20%). The majority of live-stranded *Kogia* (83%) were either euthanized or died at the stranding site or during transport. In contrast, only 37% of bottlenose dolphins were either euthanized or died at the stranding site or during transport. From 2002 through 2007, 13% of live-stranded *Kogia* (18 individuals) were admitted to rehabilitation facilities. In general, *Kogia* calves tended to survive longer in rehabilitation than older animals (Figure 5).

However, all *Kogia* either died or had to be euthanized during rehabilitation. In contrast, from 2002 through 2007, 21% of live-stranded bottlenose dolphins were admitted to rehabilitation facilities. Of those bottlenose dolphins, approximately two-thirds survived rehabilitation and were either released or deemed non-releasable and retained in permanent captivity (generally dependent calves).

2.2 Historical Findings from Previous Rehabilitation Cases

Previous *Kogia* spp. rehabilitation efforts have predominantly failed mainly due to adult stranded animals that exhibit what has been classified as cardiomyopathy based upon gross and histological findings. In addition, the diet composition of *Kogia* is not understood and the diets provided in rehabilitation have been unsuccessful especially for calves. The only pygmy sperm whale that has ever been successfully rehabilitated and released was a sub-adult whale that stranded in New York. It was unclear if the release was successful based upon post-release tracking (Wells *et al.* 2013, Scott *et al.* 2001).

2.2.1 Cardiomyopathy

Cardiomyopathy is a disease of the heart muscle that makes it harder for the heart to pump blood throughout the body. It is a chronic, progressive disease that can lead to heart failure. In the stranding data, many animals had some form of myocardial degeneration (MCD) or cardiomyopathy (CMP). Approximately, 93% of stranded *K. breviceps* show evidence of myocardial degeneration or cardiomyopathy (Bossart *et al.* 2007). Harbor Branch Oceanographic Institute (HBOI) at Florida Atlantic University (FAU) has begun investigating the histopathological characteristics as well as biochemical markers of MCD and CMP from stranded *K. breviceps*. A heart dissection manual, by Hensley *et al.* 2005, was published by HBOI in order to standardize specimen sampling. Subsequent clinicopathological pilot studies have focused on relationships between various factors including serum chemistry parameters, hematological parameters, cardiac troponins, glucocorticoids, catecholamines, and different nutritional parameters (*i.e.*, selenium, thiamine, carnitine) in CMP and MCD in *Kogia*. The results of these preliminary studies indicated some potential trends, but due to small sample size and lack of availability of samples for both diseased and healthy animals, it is difficult to interpret these data or make any inference to CMP/MCD, and the *Kogia* population. Recommendations for further study include:

- Increased animal and sample sizes;
- Functional studies including cardiac ultrasound and 5-lead electrocardiogram (EKG) on live whales; and
- Sample banking for future analyses and defining baselines in stranded individuals.

2.2.2 Domoic acid and *Kogia* cardiomyopathy

Evidence of cardiac disease is frequently found in stranded adult *Kogia*. Other disease categories resulting in significant population morbidity and mortality are scarcely represented in stranding records to account for any sizable impact on the population. Many questions need to be answered to determine both the etiology and pathogenesis of CMP including a thorough investigation of mortality records (pathology reports). Domoic acid (DA) is one area of research into a potential cause of CMP that can be addressed without samples from healthy animals, as well as in determining the level of population exposure. However, interpreting the presence of DA in relation to exposure time, the pharmacokinetics, and route of exposure in the *Kogia* is difficult. Fire *et al.* (2009) found that 59% of dwarf and pygmy sperm whales tested between 1997-2008 were positive for DA exposure.

2.2.3 Gastrointestinal Issues - NMFS 2009 workshop summary by Charles Manire

Pygmy and dwarf sperm whales are regularly found stranded; however, there have been few animals that have been kept alive for more than a week or two. These stranded animals are usually either cow-calf pairs (recently post-partum with a severely emaciated cow and a relatively healthy calf) or individual adults (in poor condition). In an effort to expand the knowledge regarding maintaining these species alive in rehabilitation, the Dolphin and Whale Hospital at Mote Marine Laboratory in Sarasota, Florida has attempted to raise calves and rehabilitate adults. In the process, much information was gained regarding digestive limitations and gastrointestinal disorders that affect both species, as well as refined medical and husbandry techniques that have allowed the calves to be kept alive for up to 21 months.

Between 1994 and 2003, a total of ten pygmy sperm whales (five adults, one juvenile, and four calves) and three dwarf sperm whales (an adult, juvenile, and calf) were brought in alive to the Dolphin and Whale Hospital. The adults arrived in fair to very poor body condition and were kept alive from a few hours to a maximum of 40 days. All adults were ultimately found to have electrolyte imbalance, gastrointestinal issues, and/or cardiomyopathy. In contrast to the arrival condition of the adults, the calves generally arrived in fair to good body condition and were kept alive for 3-21 months.

The issues that caused the most problems, eventually becoming insurmountable, were those related to the gastrointestinal tract. Anatomically and physiologically, the gastrointestinal tract of the *Kogia* spp. is unique among marine mammals. First, the contents of the entire intestinal tract appear normally to be liquid. When there is any form to the contents, this is evidence of constipation. Unfortunately, drugs normally used to control constipation in other mammals, seem to have very little effect on the *Kogia* intestine. In our experience, enemas, stool softeners, saline cathartics, and most other drugs used to treat constipation have little or no effect on *Kogia*s. Keeping fluid intake high, usually through regular stomach tubing, seems to be the only preventative that has much effect. The effects of constipation on these mammals can be devastating, including sequelae such as intestinal volvulus, intestinal rupture, intestinal blockage, and impaction. One of these sequelae has been the ultimate cause of death of each of the *Kogia* calves that underwent rehabilitation at the Dolphin and Whale Hospital. Recent experience with pygmy killer whales has shown a similar set of problems, possibly related to inability to digest the food items being fed. With the *Kogia*, most of the intestinal problems were obvious when they were being fed solid squid, possibly also relating to an inability to digest the food.

3. Dwarf and Pygmy Sperm Whale Stranding Response

3.1 Authorization and Training

Marine mammal stranding responders need to be authorized to respond under both the MMPA and the Endangered Species Act (ESA). The Stranding Network consists of approximately 100 organizations that have applied for and received an authorization, called a Stranding Agreement (SA). The SA is issued under Section 112(c) of the MMPA and allows the take of marine mammals that are stranded for response and rehabilitation. For non-ESA species, a response can be conducted under a SA or by a government employee acting under MMPA Section 109(h). Therefore, only responders who have been authorized by NMFS and who have the training, experience, equipment, and support needed should attempt cetacean interventions. Authorized response efforts may also rely on partners at tribal, local, state, and federal agencies (including law enforcement agencies and the USCG), non-governmental organizations, fishermen, and other groups to assist with some responses.

Stranding Network members are trained or have experience in proper techniques for safe response to various stranded marine mammal species, as well as experience in species identification. Historically, training workshops have been offered to members of the Stranding Network. It would be beneficial for future training to also include other federal, state, local, and tribal partners who may be the first responders, especially for live stranded whales. Specific training issues or requirements may exist for certain activities (*e.g.*, rehabilitation) and are more appropriate to address at regional or state levels by working with your Regional Stranding Coordinator (RSC).

3.2 Decisions on the Beach

When responding to live-stranded marine mammals, decisions need to be made on the beach that are based on the most humane course of action for the animal, its likelihood of survival, and the investment of available resources. Public safety should also be considered when responding to live-stranded marine mammals, especially if the public are trying to render first aid to the animal.

As stranding statistics and previous rehabilitation efforts reveal, *Kogia* are not well suited for captive environments and have rarely survived in captivity long-term. Because little is known about the nutritional needs for these species, those animals that do survive in rehabilitation for an extended period tend to develop digestive complications. These digestive issues have been the main roadblock to the survival of *Kogia* calves in rehabilitation. However, even if these nutritional constraints were overcome, placement of dependent calves or other non-releasable rehabilitated *Kogia* would be an issue, as there are no other *Kogia* alive in public display. In addition, most adult *Kogia* are in some stage of the degenerative disease process of cardiomyopathy, decreasing their chance for long-term survival. There is also limited information available on the biology of *Kogia*, which can complicate rehabilitation efforts, but which also provides the opportunity to learn from these animals.

Given the poor prognosis for survival of *Kogia* in rehabilitation, current NMFS guidance recommends euthanasia for most live-stranded dwarf and pygmy sperm whales. **Euthanasia is the recommended option when dealing with live stranded *Kogia*s** for the following reasons:

- Many rehabilitation facilities in the Southeastern United States no longer accept live-stranded *Kogia* because of the difficulties of caring for these animals in rehabilitation. There are two main issues as to why rehabilitation for these species has always failed:
    - Little is known about the life history and nutritional requirements; and

    - For more than half of documented pygmy sperm whale strandings, signs of cardiomyopathy have been documented.

- The rehabilitation needs are costly, and the success rate of rehabilitated animals is poor.

- Additionally, attempts to rehabilitate dependent *Kogia* calves will not be considered. Rehabilitated, nutritionally dependent cetacean calves are considered non-releasable by NMFS, because they do not possess the necessary skills to survive in the wild.

However, in certain cases (*e.g.*, sub-adults) rehabilitation may be approved by NMFS on a case-by-case basis if the *Kogia* Stranding Network Plan is in place (see below, 3.2.1).

3.2.1 *Kogia* Stranding Rehabilitation Network Plan

If rehabilitation is to be considered, NMFS requires each Stranding Network to have a plan in place ahead of time for dealing with live-stranded *Kogia*. This includes understanding the samples that need to be collected, the appropriate team in place, rehabilitation facilities to call for pre-approval, and understanding the NMFS requirements/guidelines. This plan should be developed with and submitted to the NMFS RSC for review and approval. Rehabilitation, per 50 CFR 216.3, is defined as treatment of beached and stranded marine mammals taken under section 109(h)(1) of the MMPA or imported under section 109(h)(2) of the MMPA, with the intent of restoring the marine mammal's health and, if necessary, behavioral patterns. The purpose of an authorized marine mammal rehabilitation care facility is to provide treatment for a period of time with a goal of releasing the animal back to the wild.

The *Kogia* rehabilitation plan would also include, but not be limited to, answers to the following questions:

- If a facility intends to accept *Kogia* for rehabilitation, then what is their plan if an animal is deemed non-releasable?

- How will you determine whether an animal may be a good candidate for rehabilitation (*e.g.,* sub-adult, health status, etc.)?

- What kind of health assessment tools could and should be used on the beach to make those decisions?

- What can be learned from these animals if they were to be brought into rehabilitation, and do you have a protocol developed to address those questions?

- Although animal welfare takes priority over research objectives, research priorities should be identified, and plans made for *Kogia* in rehabilitation.

In addition, public awareness and communication needs to be included as part of this plan. NMFS can provide outreach products to distribute during a living-stranding event. These outreach products would provide information on *Kogia*, their health issues, difficulties with their rehabilitation, and euthanasia.

3.2.2 Facility Pre-Approval

For *Kogia* species to be further assessed or rehabilitated, the facility must have an existing SA for cetacean rehabilitation, be pre-approved by NMFS, and the animal to be rehabilitated must be a sub-adult. To receive approval, these facilities would need to have a plan for caring for and maintaining the *Kogia*, adequate resources, a post-release monitoring plan, and a long-term plan for placement of the animal if it were deemed non-releasable. It is emphasized that *Kogia* should not be rehabilitated, or even triaged, in pop-up pools, as *Kogia* have been known to collapse them. Facilities must also be willing to perform the following tests upon admission to rehabilitation, when the animal arrives onsite: i-STAT, physical exam, complete blood count, blood chemistry, cardiac ultrasound, and ECG testing. Diagnostic tests should be completed within a two-week time period, after which time a decision must be made to either euthanize the animal or continue rehabilitation.

3.2.3 Case Management Plan

If a veterinarian should determine a pygmy or dwarf sperm whale is a suitable candidate for rehabilitation and release, then a case management plan must be submitted to the NMFS RSC within 48-hours of admission. The case management plan will include preliminary diagnostic findings, such as blood results, a medical assessment, husbandry procedures, and a future diagnostic plan.

Additionally, the plan should detail the facilities' plan as previously outlined, if the animal is deemed non-releasable, as well as what knowledge can be gained regarding the rehabilitation of *Kogia*s, what tools can be developed, and what other research questions the facility would focus on, and why.

3.3 Sample Collection

In all pre- and post-mortem cases of stranded *Kogia*s, it is important to collect samples (Appendix B) to further our knowledge of these animals. As we learn more about the species, protocols for diagnostics, sampling, handling samples, and prioritization of samples will be further fine-tuned. At a minimum, basic samples should be collected which include, but are not limited to, weight (if available), morphometrics, photographs, skin and blubber biopsies, fecal and gastric samples, and blood samples from live whales, and full histopathology and biotoxin samples from dead whales.

Recent research has identified new data on parasites as well as gut microbiomes in *Kogia*; therefore, parasite and fecal collection is encouraged during necropsy (Keenan-Bateman *et al.* 2018, Denison *et al.* 2020).

4. Conclusion

There are many unanswered questions regarding stranded dwarf and pygmy sperm whales. Rehabilitation has proven extremely challenging and to date has been largely unsuccessful. This is due to the lack of knowledge of their basic biology, their inability to digest foods commonly fed to captive marine mammals, and the prevalence of cardiomyopathy in adult animals. **It is recommended in general to euthanize all live-stranded *Kogia* until more is learned about the species.**

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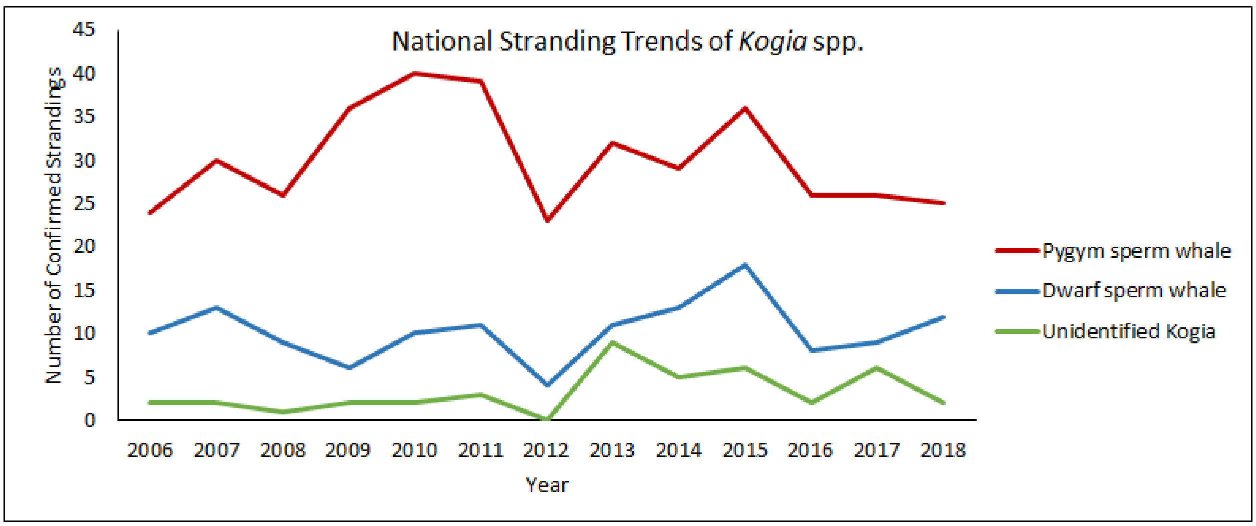
Tables and Figures

Figure 3.

National Stranding Trends of *Kogia* spp. Strandings from 2006-2018



Southeast Stranding Trends of *Kogia* spp. Strandings from 2006-2018

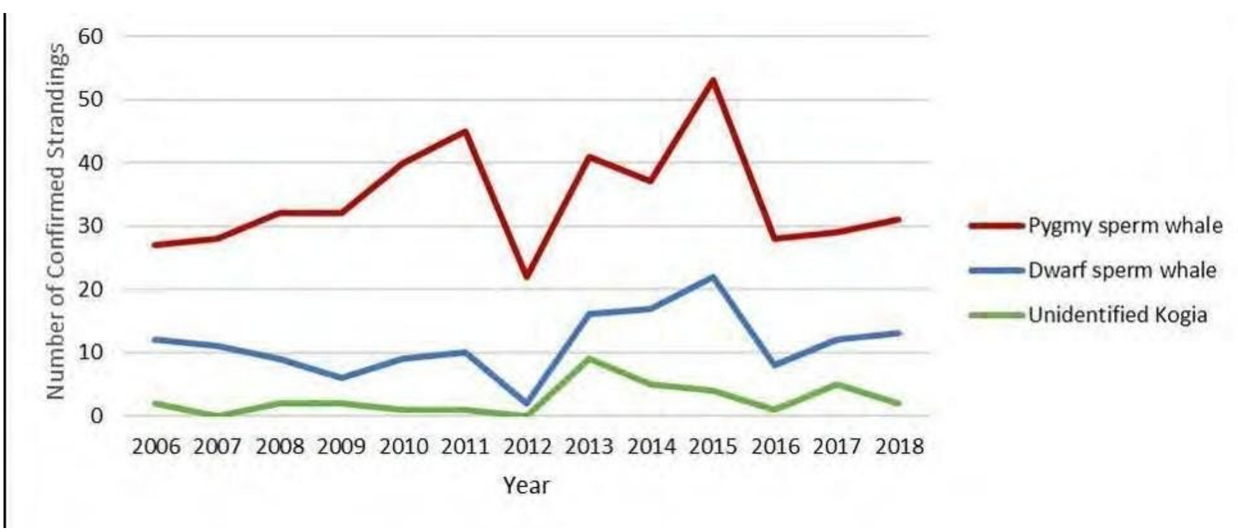
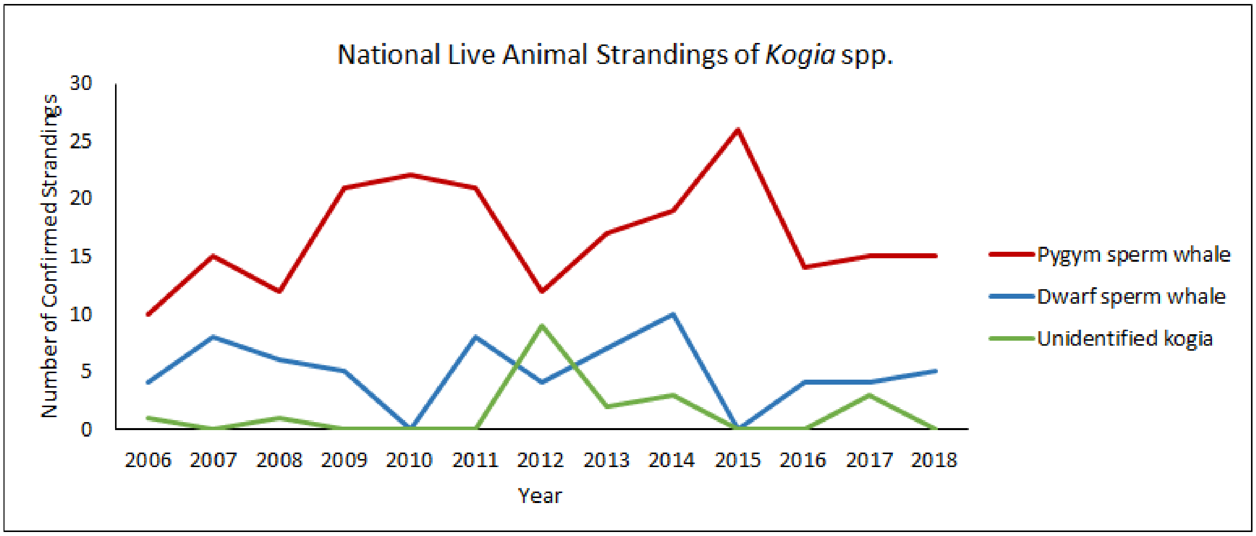


Figure 4:

National Live Stranding Trends of *Kogia* spp. Strandings from 2006-2018



Southeast Live Stranding Trends *Kogia* spp. Strandings from 2006-2018

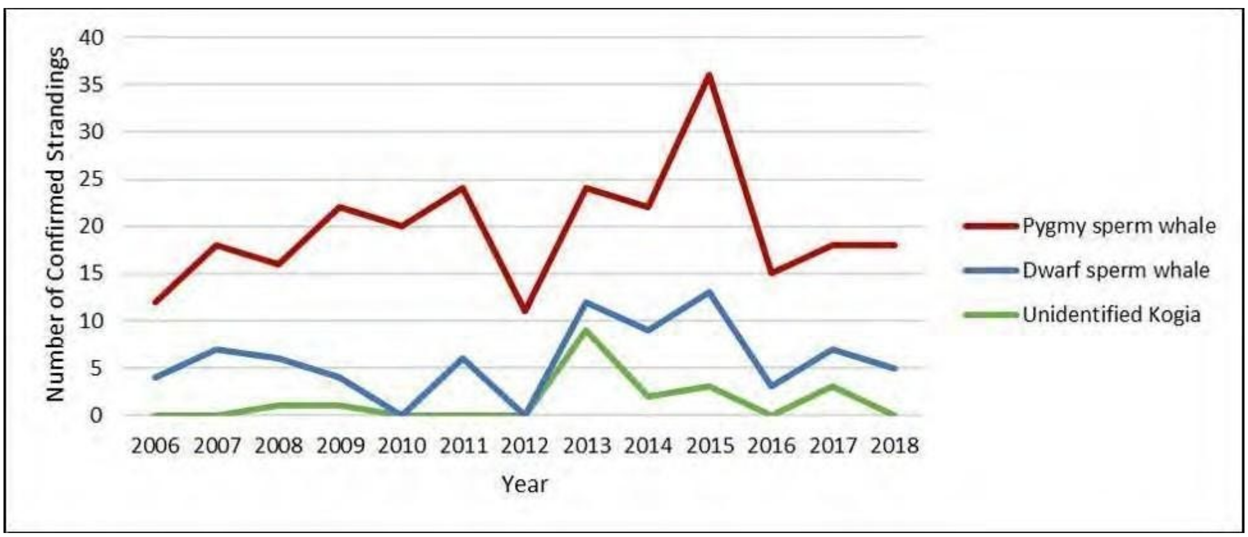
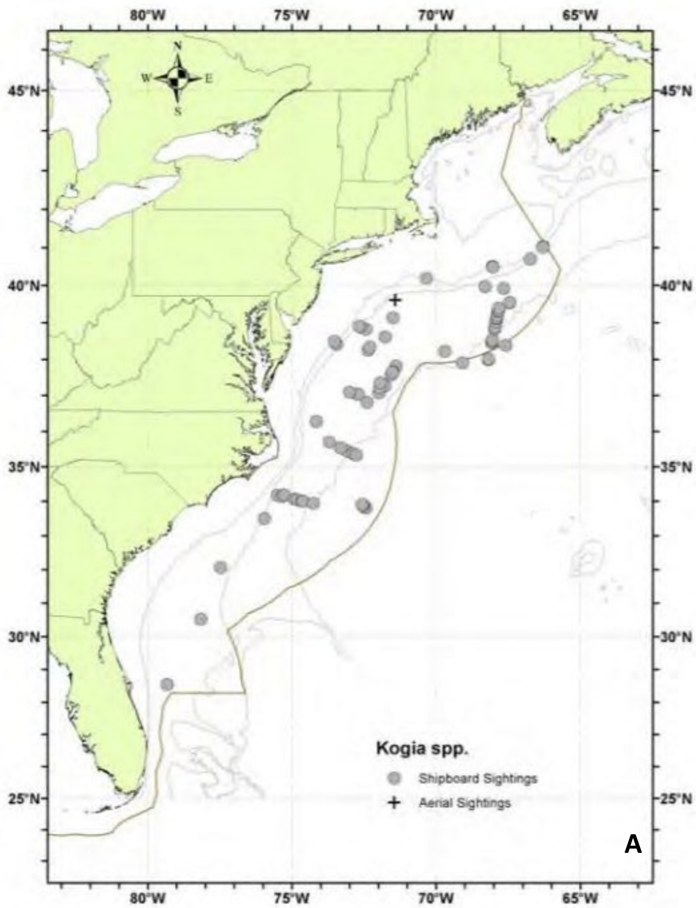


Figure 1. *Kogia* spp. sightings, A) 2004 and 2011 surveys in the Atlantic, and B) 1996-2001, 2003, 2004, and 2009 surveys in the Gulf of Mexico.



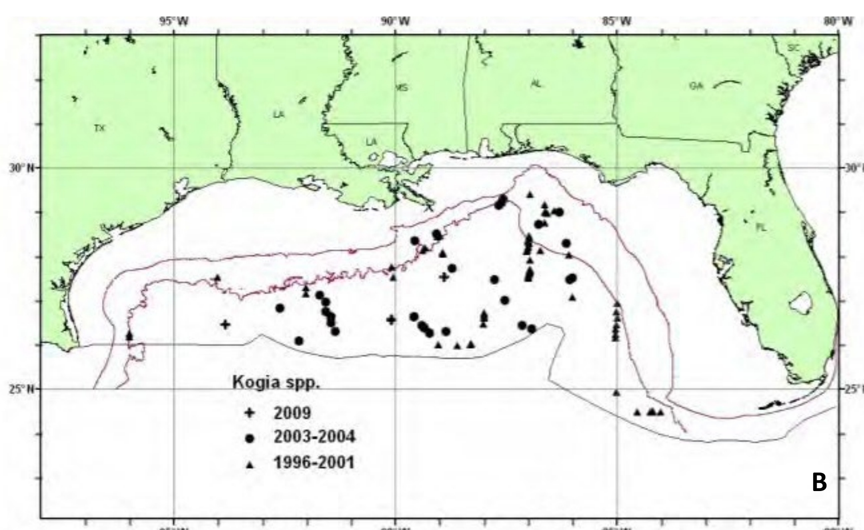


Figure 2. *Kogia* spp. sightings, A) 1994-2014 surveys off California, Oregon, and Washington, B) Dwarf sperm whale 2002 and 2012 surveys surrounding the Hawaiian Islands, and C) Pygmy sperm whales 2002 and 2010 surveys surrounding the Hawaiian Islands.

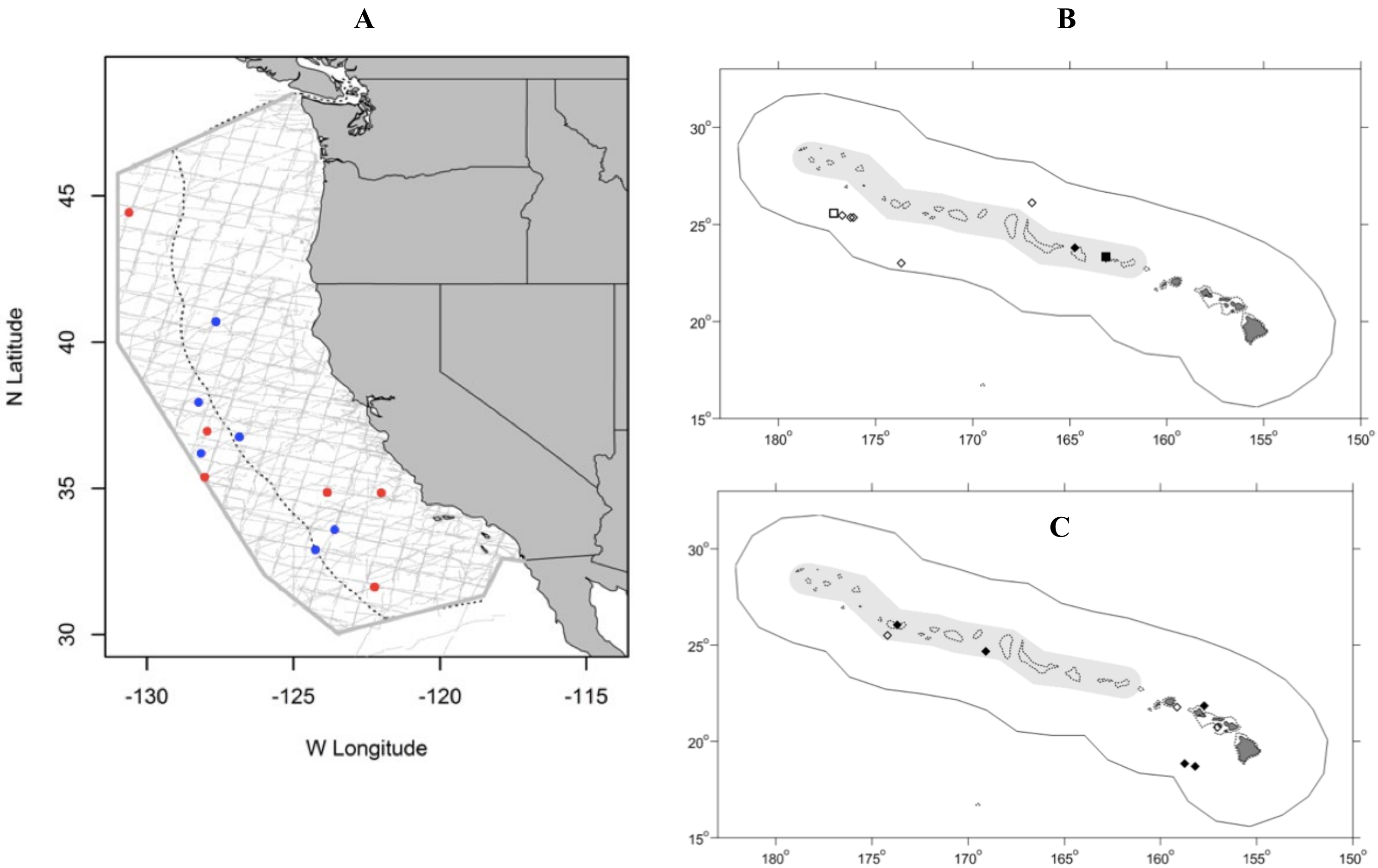


Figure 5. Number of days *Kogia* spp. survived in rehabilitation by species and age class between 1995 and 2007.

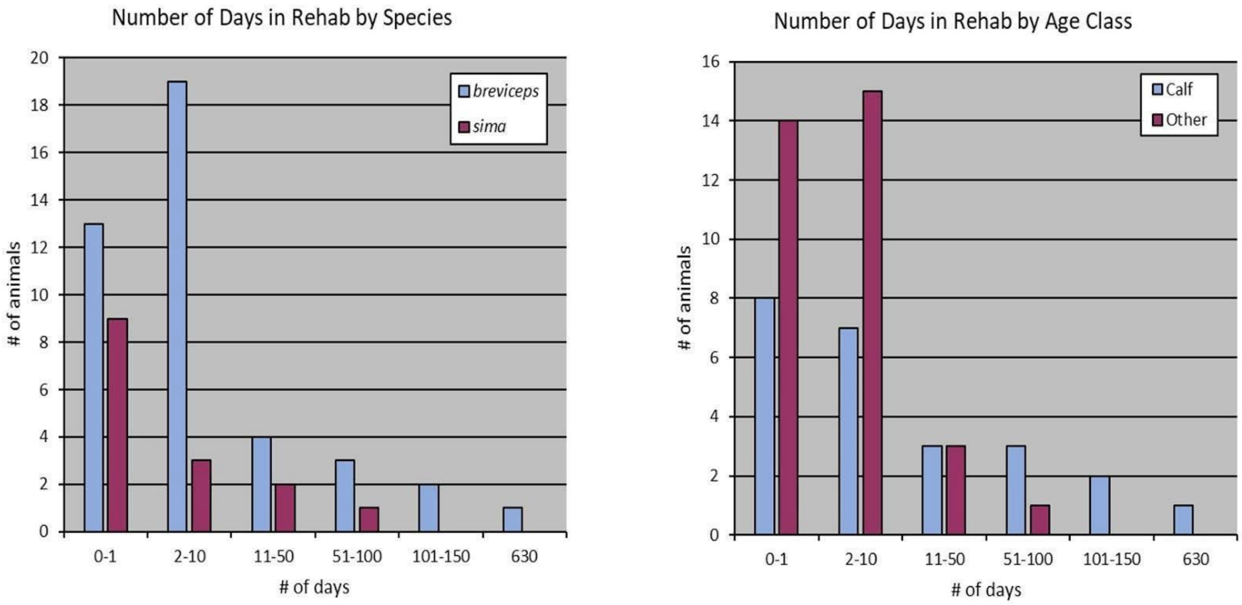


Table 1: National average *Kogia* strandings from 2006-2018.

Species	National Average
Dwarf	10.31 (+/-3.47)
Pygmy	30.15 (+/-5.89)
Unidentified *Kogia*	3.50 (+/-2.43)

Table 2: The average number of *Kogia* spp. strandings per year along the east coast of the United States by species and geographic region.

Region	All *Kogia*	K. breviceps	K. sima
Atlantic	30	22	6
Gulf*	7	4	2
Puerto Rico and the US Virgin Islands	<1	<1	<1

*Includes Florida Keys

Appendix A: Species Identification, “False gill slit” pigmentation pattern
(Keenan- Bateman *et al.* 2016)

Species-specific differences in the “false gill slit” pigmentation pattern among (a) *Kogia sima* and (b) *K. breviceps*.

Appendix B: Necropsy Sample List

GoMEX Sample Collection Checklist 2018

_____ Level A   Field # ______________

_____ Human Interaction form developed by CCSN and VAQS

_____ Morphometrics (code 1 - early 3)

Biotoxins:

Code 2 & early 3

Freeze -20, 5 ml or 10g:

_____ Liver

_____ Feces

_____ Urine

_____ Stomach contents/ gastrointestinal contents

Contaminants, POPs:

Code 2, adult & sub-adult males

Freeze -80 preferred, -20

Foil, dull side in

_____ Blubber

Viral (code 2 & early 3):

Cryovial, freeze at -80

_____ Lung

_____ Lung lympn node

_____ Brain

_____ Spinal cord

_____ Blowhole swab

_____ Rectal swab

Life History (code 2 & early 3):

Freeze, -20:

_____ Teeth for aging

_____ Teeth for stable isotopes

_____ Skin/muscle for stable isotopes

In DMSO or frozen:

_____ Skin (genetics)

Photographs

_____ Dorsal fin for photo-ID

Reproductive Data

_____ Testes measurements, see below

_____ Ovaries measurements, see below

☐ Pregnant?

_____ Length of fetus

_____ # CL _____ # CA

Brucella (code 2 & early 3):

5 ml cyrovial, Freeze at -80

_____ Joint lesion (swab or abscess tissue)

_____ Lung

_____ Brain (cerebellum inc. meninges)

_____ Spinal cord

_____ CSF

Live animals:

Life history

_____ Dorsal fin for photo-ID

_____ Skin biopsy in DMSO **or**

_____ Blood in EDTA vacutainer (-80)

Chemistry/Hematology

_____ 1-3 ml purple top K_3EDTA

_____ 6-10 ml red/gray tiger top SST tubes

_____ 1 green top sodium heparin tube

_____ 2 blood smears

Pathogen

_____ Blowhole Swab (-80)

_____ 1 ml Whole Blood (-80)

_____ 1 ml Serum (-80)

Special Case: Freshwater Exposure

Live Animal, Code 1

_____ Plasma for renin (-80)

_____ Urinalysis, dipstick

_____ Urine, specific gravity

_____ Remaining urine for chemistry (-80)

_____ Water salinity at site

Brown/orange material or skin lesions?

_____ Photos of lesions with measurement scale

_____ Skin scraping (glass slide)

_____ Skin lesion in formalin

_____ Skin lesion cryovial (-80)

_____ *Skin lesion VTM (-80) if avaiable*

_____ *Skin lesion RNA Later (-80) if available*

Code 2

_____ Serum from congealed blood (-80)

_____ CSF (-80)

Code 2 & early 3 (see full histology list)

_____ Water salinity at site

_____ Urinalysis, dipstick

_____ Urine, specific gravity

_____ Remaining urine for chemistry (-80)

_____ Vitreous (eye) (-80)

Brown/orange material or skin lesions?

_____ Skin scraping (glass slide)

_____ Skin lesion wedge w/ blubber (-20)

_____ Photos of lesions with measurement scale

Histology (code 2 & early 3):

**Priority samples

10% neutral buffered formalin, 10:1 formalin:tissue ratio

Samples fixed in formalin should be no more than 1 cm thick

_____ Blubber

_____ Skin and any skin lesions

_____ Muscle (specify location)

_____ Eye (L/R)

_____ **Lung

_____ **Trachea

_____ **Heart (all 4 chambers)

_____ Aorta

_____ Pulmonary Artery

_____ Thymus

_____ **Thyroid

_____ **Laryngeal Assoc. Lymph. Tissue

_____ Pharynx

_____ Tongue

_____ Esophagus

_____ **Liver

_____ Stomach (all chambers)

_____ Pancreas

_____ **Spleen

_____ Small Intestine (proximal, mid, distal)

_____ Colon

_____ **Kidney

_____ **Adrenal Gland

_____ Urinary bladder

_____ Gonads

_____ Mammary Gland

_____ **Uterus/Uterine horn

_____ Vagina & Cervix

_____ Prostate & Penis

_____ Spinal Cord (specify location)

_____ **Brain (cerebrum, cerebellum,stem,pituitary)

Lymph nodes/ additional histo (list tissue):

**Thoracic ______________

**Abdominal/Genital ______________

____

____

____

____

____

____

Field # ________________

Additional Samples Collected:

	Tissue	Preservative	Analysis/Comments

Reproductive Measurements

circle one: Ovaries / Testes

______ Right Length

______ Right Width

______ Right Diameter

______ Left Length

______ Left Width

______ Left Diameter

Appendix C: Dwarf and Pygmy Sperm Whale Questions and Answers

Q: What are Dwarf and Pygmy Sperm Whale and are these different species?

A: Dwarf (*Kogia sima*) and pygmy (*Kogia breviceps*) sperm whales are different species of medium-sized cetaceans within the Genus *Kogia*. They have a similar appearance, making it difficult to distinguish between them in the field, which is why they are often grouped together. They also have a similar distribution, living in temperate and tropical oceans around the world. Scientists can differentiate between the two by comparing body size, teeth, and the pigmentation directly behind the eye known as the false gill. Dwarf and pygmy sperm whales are toothed whales and, similar to the larger sperm whale (*Physeter macrocephalus)*, are named after the waxy substance, spermaceti, found in their heads that helps transmit and focus sound. Similar to squid, dwarf and pygmy sperm whales can release a dark, ink-like liquid that may help them escape from predators such as sharks and killer whales. Much about dwarf and pygmy sperm whales remains a mystery, as scientists rarely spot them at sea, making them difficult to study. What we do know is that dwarf and pygmy sperm whales spend very little time at the water's surface, are often alone or in small groups, and can dive to depths exceeding 1000 feet in search of prey, such as cephalopods (*e.g.*, squid and octopus), crustaceans (*e.g.*, crabs and shrimp), and fish.

Q: Where are Dwarf and Pygmy Sperm Whales located?

A: Dwarf and pygmy sperm whales have a wide distribution. They live in tropical, subtropical, and temperate waters in oceans and seas around the world. They are most common off coasts and along continental shelves (the edges of continents lying under the ocean).

In the United States, dwarf and pygmy sperm whales live off the coasts of Hawaii, the Pacific Northwest and California, the western North Atlantic, and the northern Gulf of Mexico. They may be more common off the southeastern coast of the continental United States (*i.e.*, South Carolina, Georgia, Florida), as more strandings have occurred there. Dwarf sperm whales are also the sixth most sighted toothed whale around the Hawaiian Islands.

Q: What is the natural history of Dwarf and Pygmy Sperm Whales?

A: Dwarf sperm whales have an estimated maximum length of 9 feet and reach sexual maturity when they are 2.5 to 5 years old. Females give birth after a gestation period that lasts about a year. Calves are around 3 feet long, weigh about 30 pounds, and are weaned after a year.

Pygmy sperm whales have an estimated maximum length of 11.5 feet and reach sexual maturity when they are 4 to 5 years old. Gestation lasts for about 9 to 11 months, and females can give birth in consecutive years. Calves are around 4 feet long, weigh about 110 pounds, and are weaned after a year.

Q: Who should people contact if they encounter a live cetacean floating or stranded on the beach and what can they do?

A: Immediately contact your local Stranding Network, local authorities, or the NOAA Fisheries 24-hour Stranding Hotline to report a live or dead-stranded marine mammal:

- For the Southeast Region, call 877-WHALE HELP (877-942-5343).
- For the Northeast Region, call (866) 755-6622
- For the West Coast Region, call (866) 767-6114
- For the Alaska Region, call (877) 925-7773
- For the Pacific Islands Region, call (888) 256-9840

Members of the public should NOT attempt to help live cetaceans themselves and should instead immediately call authorized professional responders. Only responders who have been authorized by NOAA Fisheries and who have the training, experience, equipment, and support needed should attempt to assist live marine mammals. Response efforts also rely on support from many state and federal agencies (including law enforcement agencies and the United States Coast Guard), non-governmental organizations, and others working together to respond to live marine mammals.

The NOAA Fisheries Office of Protected Resources coordinates marine mammal response efforts around the country through the National Marine Mammal Health and Stranding Response Program.

Regardless of the species, attempting to rescue marine mammals is dangerous, and should only be performed by trained professionals.

Here are the steps to follow:

- Stay in the boat or on the shore—***never get in the water*** to help a whale, dolphin, seal, sea lion, or sea turtle.
- Note the GPS coordinates of the location of the stranded marine mammal and direction of travel.
- Call your local responder via the national Stranding Network.
- Wait for trained, authorized personnel—do not attempt to free a marine mammal on your own.
- You can also download the Dolphin & Whale 911 Stranding App (iOS) to help report a stranding.
- Monitor the situation—if a response is possible, authorities may ask that you stand by and watch the marine mammal from a safe distance (greater than 100 yards and not directly behind the animal).
- Note the number of animals if possible and if there are animals swimming nearby.
- Document—if possible take photos and video of the animal from a safe and legal distance (*e.g.*, 100 yards). This can provide valuable information to Stranding Network responders.
- Do not touch the marine mammal.
- Don't allow pets to approach the cetacean.

Q: Why can't stranded Dwarf and Pygmy Sperm Whales be rescued and sent to a rehabilitation facility?

A: There are limited cetacean rehabilitation options available nationwide and species/individuals with a high likelihood of recovery and release are prioritized for those pools. Previous dwarf and pygmy rehabilitation efforts across the country have been unsuccessful. Key issues associated with the unsuccessful rehabilitation of dwarf and pygmy sperm whales have been the inability of these whales to appropriately digest food in a rehabilitation setting, resulting in gastric and intestinal stoppages and death, and a degenerative heart condition (see "cardiomyopathy," below).

Q: What is cardiomyopathy?

A: Approximately, 93% of stranded pygmy sperm whales show evidence of myocardial degeneration or cardiomyopathy (Bossart *et al*. 2007). Cardiomyopathy is a disease of the heart muscle that makes it harder for the heart to pump blood throughout the body. It is a chronic, progressive disease that can lead to heart failure.

Q: Why can't people try and push the whale back out into the ocean?

A: In some instances, trained and authorized responders may attempt to refloat other stranded dolphin and whale species. Depending on the biology of the species, environmental factors, and if a health assessment determines that the animal has no apparent abnormalities or illnesses, then refloating may be considered an option. Refloating of deep-diving pelagic species, like dwarf and pygmy sperm whales, is not recommended as there is more than likely an underlying condition that caused the whale to come ashore in shallow water. In addition, diseases of the heart muscle, known as cardiomyopathy (see "cardiomyopathy," above), are common in sub-adult and adult dwarf and pygmy sperm whales. Stages of cardiomyopathy have been documented in 93% of pygmy sperm whale strandings. If the animal is already compromised, it would be inhumane to push it back into the water, as it would most likely re-strand, experience further trauma, or drown.

Q: Why euthanasia?

A: The ultimate goal of euthanizing an animal is to humanely end or prevent further suffering as quickly and free of distress as possible. Euthanasia is considered when an animal is clearly suffering, and a veterinarian has determined it has little to no chance of recovery. It is also considered in cases where rehabilitation is not possible and immediate release is deemed inhumane or unlikely to succeed based upon the animal's condition and biology. The decision to euthanize an animal is not made lightly, and is done in consultation with licensed veterinarians, the Stranding Network, and NOAA Fisheries. The circumstances of each event are different, and each has its own aspects to consider.

When euthanasia is decided upon, it is our responsibility to humanely end the animal's suffering with the highest degree of respect and with an emphasis on making the death as painless and free of distress as possible. The technique used should take effect quickly and in the most humane way possible. In addition, animal handling and the euthanasia techniques should also minimize distress experienced by the animal prior to loss of consciousness.