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BEFORE THE HOUSE SUBCOMMITTEE ON
INSULAR AFFAIRS, OCEANS, AND WILDLIFE
REGARDING THE DEEPWATER HORIZON OIL SPILL
AND ITS EFFECTS ON MARINE MAMMALS

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Madam Chairwoman and members of the Subcommittee, thank you for inviting the Marine Mammal Commission to testify on the effects of the Deepwater Horizon oil spill on marine mammals. I am Tim Ragen, Executive Director of the Commission. Your questions to the Commission pertain to the effects of this spill and how to prevent such effects in the future.

I begin my testimony by noting that our current understanding of the effects of oil on marine mammals is in many respects rudimentary because of the difficulty and costs of studying the health of marine mammals at sea, particularly during an oil spill. Our understanding is based primarily on anecdotal information from other spills such as the Santa Barbara spill in 1969 and the Exxon Valdez spill in 1989, as well as a small number of focused studies involving captive animals. In addition, much of the existing information pertains to pinnipeds (i.e., seals, sea lions) and sea otters, which do not occur in the Gulf of Mexico. Unfortunately, the scientific foundation for evaluating the potential effects of the Deepwater Horizon spill on many marine mammals inhabiting the Gulf is weak. Almost all of those are cetaceans (whales, dolphins and porpoises), the exception being the manatee. However, there is considerable information on the effects of oil on other mammals, such as laboratory rodents and humans, so that information can be used to help anticipate how oil might affect the Gulf's marine mammals.

Short and Long-term Effects

Your first question to the Commission asked about the short- and long-term effects of the Deepwater Horizon spill on marine mammals. The potential short-term effects include those that result from direct contact with or ingestion of oil or inhalation of oil fumes. Direct contact of a marine mammal with oil may cause skin irritation, inflammation, and eventually necrosis. However, the limited information available from field observations and studies with captive dolphins suggests that the epidermis of at least some cetaceans may be highly resistant to such effects. The Commission knows of no studies of cetaceans exposed to oil for extended periods (i.e., days or weeks), so the long-term consequences of skin contact with oil are not clear at this point. Oil contact with eyes, mucous membranes, and respiratory tissues may cause more important effects. For example, harbor seals oiled by the Exxon Valdez spill developed conjunctivitis, and similar responses can reasonably be expected in cetaceans. Contact with respiratory tissues coupled with inhalation of fumes appears to have caused airway inflammation and pulmonary emphysema in sea otters, and, here too, a similar response can reasonably be expected in cetaceans. Cetaceans also may ingest oil either indirectly as they consume prey or the prey itself may be contaminated.

Manatees may ingest oil if it reaches the shallow waters of their range and coats the vegetation that they depend on for food. And if Bryde's whales or other baleen whales (although uncommon in the Gulf of Mexico) encounter oil, their feeding may be affected by fouling of their baleen (the comb-like array of keratinous plates they use to filter food from sea water). Some amount of ingestion may be tolerable but, depending on the amount and nature of the oil ingested (e.g., its composition, toxicity) and the animal involved (e.g., species, animal health and condition), ingestion may cause significant effects on vital systems (e.g., immune, reproduction, digestive) and organs (e.g., liver, kidneys, brain) ranging from generalized illness to death. Studies using captive polar bears showed that ingestion of even relatively small amounts led to kidney failure and death. Even when the immediate effects appear to be or are sublethal, they may affect the health and condition of animals and their ability to reproduce, with consequences for population status. Similarly, apparently sublethal effects may lead to long-term problems if, for example, the contaminants from the oil or dispersant are carcinogenic.

To date, the existing evidence suggests that at least some cetaceans are able to detect the oil, but they do not necessarily move away from it to avoid contact, inhalation, or ingestion. In previous small spills in the Gulf of Mexico, bottlenose dolphins have been observed moving under booms and surfacing and feeding in the oil. In fact, given the vast area affected by the spill, marine mammals that typically inhabit the central and eastern portions of the northern Gulf may not be able to avoid contact at the surface or in the water column. Their tolerance to oil, weathered oil, or dispersed oil likely depends on numerous factors such as its composition and toxicity, amount encountered, duration of contact, foraging patterns and physiology of the species involved, and health and condition of the affected individuals. In general, the more toxic components of spilled oil also are the more volatile and they tend to evaporate more quickly. After a short-lived spill, the period of exposure to those volatile components may be relatively brief. However, in a prolonged, continuous spill like the Deepwater Horizon, marine life in the spill area, including marine mammals and their prey, may be exposed to the more volatile components of the oil for days, weeks, or longer. Individuals in poor health or condition, or that are otherwise stressed may be more vulnerable to such effects (e.g., pregnant females that already are taxed physiologically may be less able to complete a pregnancy successfully). At this time of year, bottlenose dolphins are calving in coastal areas, which may add to their risk.

Cetaceans in the Gulf also may be affected by response activities. Large amounts of dispersants have been used, some of which have been applied in relatively new ways (i.e., at the ruptured wellhead), and EPA and the Coast Guard have directed British Petroleum (BP) to reduce the volume of dispersants used due to toxicity concerns. Scientists will gather evidence where they can, but may never be able to describe just how these dispersants affected the regional marine ecosystem, including marine mammals.

Response activities also have included and likely will continue to include a large number of vessels and aircraft in addition to the relatively high levels of activity characteristic of this region for decades. All of these vessels and aircraft may disturb animals by their presence and noise. Here, the primary concern involves behavioral effects, although ship strikes (i.e., collisions of ships and whales) also are possible when vessels are moving at

relatively high speeds, and animals may be entangled in response-related debris left in the water. Behavioral effects may include abandonment of important habitat, changes in foraging distribution or patterns, changes in movement patterns or migration, and disruption of social structures (e.g., pods, mother-calf pairs).

Short-term ecological effects may occur if the spill reduces the availability of prey species (e.g., fishes, various invertebrates) either by killing them or altering their productivity or distribution. In addition, cetaceans whose health or condition is compromised by the spill may be more susceptible to disease or parasites.

Long-term effects may include lower abundance of animals in any given population due to increased mortality or failure of reproduction (including congenital defects in the next generation that were exposed *in utero*), shifts or constriction in distribution, and negative impacts to the health and condition of individual animals and populations. Such changes will reflect the sum total of the immediate impacts of the spill and spill response, and the impacts that persist because the ecosystem has been altered through long-term contamination by oil and dispersants, loss of prey, and physical alteration of inshore ecosystems during response efforts (e.g., building of sand berms to keep oil out of wetlands). The persistence of such effects will depend on (1) the extent to which the oil released to the environment can be removed or is weathered and degraded to non-toxic forms, (2) the toxicity, persistence, and ecological effects of the dispersants, and (3) the nature and rate of recovery of other components of the Gulf ecosystems (e.g., prey populations). The complexity of the Gulf ecosystem and the large amount of oil spilled over a prolonged period may lead to an unprecedented variety, severity, and longevity of effects in the Gulf. For example, it remains to be seen how the oil, dispersants, and the products of their degradation interact with the factors that create hypoxic zones and harmful algal blooms, which have become important features of the northern Gulf ecosystem. At least harmful algal blooms are known to have potentially severe effects on marine mammals and other marine life. And, as marine scientists are learning from long-term monitoring elsewhere, in at least some cases highly perturbed marine ecosystems may take decades to fully recover, or may recover to alternative states (e.g., Prince William Sound).

Finally, all the above short- and long-term changes may be particularly significant for species or stocks listed as endangered or threatened (e.g., Florida manatee, sperm whale) or stocks with low abundance (e.g., inshore coastal bottlenose dolphins, Bryde's whales).

Assessment of Effects

The second question you asked the Commission to address is whether the effects of the spill and response activities can be fully assessed. The Commission begins its response by noting that the National Oceanic and Atmospheric Administration (NOAA), the Fish and Wildlife Service, the Gulf states, and a range of cooperating agencies are working diligently to assess effects to the extent possible. They are coordinating stranding teams to search for and respond to stranded marine mammals. They also are flying surveys to document the observed number of animals by species, their distribution, and their interactions with oil. They are attempting to biopsy animals in the field to assess important biological information

(e.g., contaminant levels). In addition, they have prepared to receive marine mammals in need of rehabilitation and to conduct necropsies and other analyses of animals found dead to determine cause of death. Thirty-three marine mammal carcasses had been found at the time this testimony was prepared.

All that being said, it will still be extremely difficult to assess the full effects of this spill because the needed information is difficult to collect on marine mammals in the wild, and because sufficient baseline information is lacking for most stocks. According to stock assessment reports prepared by NOAA (and described in the Marine Mammal Commission's 2008 annual report), the Gulf of Mexico is habitat for 21 marine mammal species comprising 58 stocks. NOAA has "adequate" abundance estimates, that is, abundance estimates that meet the agency's own standards, for only 6 of those stocks, largely because the resources needed to conduct such assessments have been directed toward other priorities. Simply put, in all but a few cases, the lack of adequate pre-spill information will hamper a detailed assessment of changes in stock status, including the most basic information on changes in abundance. The agencies will need to find alternative means for assessing the effects, but the utility of those alternative measures remains to be seen. This is particularly unfortunate because the changes that occur in marine mammal populations might otherwise have served as useful indicators of the health and recovery of the northern Gulf ecosystem over time. There are exceptions to this rule because the Minerals Management Service and NOAA have conducted extensive studies on one species (e.g., the sperm whale; see Jochens et al. 2008[1]) and also have supported some surveys for the cetaceans in the region. Similarly, the Fish and Wildlife Service and the state of Florida have conducted extensive studies on the Florida manatee. However, on balance, the information needed to characterize baseline conditions for the remaining stocks is limited. For that reason, it may be the most informative to focus comparisons on those few stocks for which scientists have the best information (e.g., sperm whale, manatee, several bottlenose dolphin stocks). However, there is no basis for assuming that those few well-studied stocks are representative of the others, as Gulf marine mammals exhibit a variety of life history and natural history traits (e.g., preferred prey, foraging depths), occupy different ranges and ecological niches, and will have been affected in varying ways and to varying degrees by the spill.

In the absence of better information, those responsible for assessment of effects may err in at least two basic ways. First, they may find dead animals and mistakenly attribute their deaths to the spill when, in fact, that is not the case. Scientists were on the verge of making this mistake with gray whales after the Santa Barbara spill in 1969 and the Exxon Valdez spill in 1989, when they initially assumed all stranded whales had stranded as a result of contact with oil. Second, observers will undoubtedly fail to encounter all of the affected marine mammals, as some are likely to die and sink—their loss being neither detected nor documented. This second type of error may well explain the loss of killer whales in the Prince William Sound area after the Exxon Valdez spill. Thus, any counts of dead animals

[1] **Jochens, A.**, D. Biggs, K. Benoit-Bird, D. Engelhaupt, J. Gordon, C. Hu, N. Jaquet, M. Johnson, R. Leben, B. Mate, P. Miller, J. Ortega-Ortiz, A. Thode, P. Tyack, and B. Würsig. 2008. Sperm Whale Seismic Study in the Gulf of Mexico: Synthesis Report. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2008-006. 348 pp.

may well underestimate the total number lost. The counts may be adjusted by applying a correction factor, but the basis for choosing such a factor is not clear. Here, again, it is worth noting that scientists were able to detect the loss of killer whales after the Exxon Valdez spill because they had gathered sufficient baseline information prior to the spill; in that case, the photo-documentation of individual whales. It is also worth noting that after virtually all such events, scientists have decried the general lack of baseline information but much of that information has not been collected before another event is upon us.

Likely Impacts of Oil and Gas Activities in the Gulf and Elsewhere

Your third question pertained to the likely impacts of oil and gas activities on marine mammals in the Gulf and elsewhere. The impacts of oil and gas activities can be considered in six main categories, as follows.

- Construction and decommissioning of infrastructure (e.g., platforms, pipelines) may disturb marine mammals by the presence, activities, and noise of multiple vessels and aircraft, and by the removal of some structures using explosives. These activities are relatively short-lived and the effects of their disturbance reasonably can be considered transient and can be held to insignificant levels if appropriate mitigation measures are taken to avoid adverse effects on marine mammals and other marine life.
- Seismic studies are vital to oil and gas operations in the marine environment and pose a number of potentially significant risks to marine mammals. They are required to locate and evaluate oil and gas reservoirs, study the surrounding seafloor, site offshore infrastructure (e.g., production platforms, wind turbines), guide drilling operations, and assess changes in reservoirs over time as production proceeds. The primary risk they pose to marine mammals is from the introduction of high intensity, pulsed noise (airguns) into the marine environment. The noise from seismic survey sound sources has been shown in some circumstances to cause significant behavioral effects (e.g., changes in bowhead migratory paths) and has the potential to cause physiological effects (e.g., hearing impairment and, at least hypothetically, development of gas emboli due to changes in dive behavior). On average, a dozen or more seismic surveys are conducted in the Gulf each month. The above-cited study by Jochens et al. (2008) suggests seismic studies have only limited effects on sperm whales (i.e., what appear to be relatively minor changes in foraging behavior). However, the existing evidence is not sufficient to conclude that seismic studies have no significant effects on other species. This topic is a matter of considerable scientific discussion at present.
- General operations (drilling and oil/gas extraction) are usually less disruptive once they have begun if they are carried out without major incidents. Sightings of marine mammals near production platforms suggest that at least some marine mammal species tolerate or habituate to the presence of oil and gas infrastructure and activities and, in fact, may be attracted to them because they often provide habitat for other marine life.
- Support activities involve vessel trips or helicopter flights to and from platforms to change crews, provide supplies, and remove wastes. These activities also pose risks

of disturbance because of the amount of activity involved and the noise created. Vessel traffic also poses a risk of vessel strikes that may injure or kill marine mammals. Here, too, the existing scientific information is not sufficient to characterize the effects of support activities on marine mammal stocks with confidence.

- Oil and gas transportation requires the use of vessels and/or pipelines to move crude oil and gas from the drill site to refineries. Tanker accidents have been a leading cause of oil spills in the marine environment. Pipelines appear to be considerably safer, but are not without risks themselves, as observed in 2005 when hurricanes Katrina and Rita destroyed a large number of pipeline segments in the Gulf.
- Habitat degradation and contamination may occur as a result of multiple activities or events. Drilling generates muds and cuttings that often, but not always, are injected back into the ground. These muds may introduce heavy metals and other toxic materials into the marine ecosystem. Vessels that visit or are stationed at platforms may cause spillage of fuels or other petroleum-based products that, unless completely recovered, may add to nearby contamination. As all of us have just been soundly reminded, drilling operations do fail on occasion, leading to severe consequences. As described earlier in my testimony, the release of large amounts of oil in the marine environment poses a number of risks to marine mammals.

At present, scientists are not fully capable of measuring all of the above effects. In many instances, the Commission believes that oil and gas operations are initiated before adequate study to characterize the potentially affected environment, its biological community, and its natural variation over time and space. Monitoring and mitigation measures may be employed, but almost always those measures are of limited utility and their shortcomings are not adequately described. Developing better measures is technically challenging, and progress has been slowed by lack of resources. The result is that regulators often are faced with uncertainty and must make assumptions and judgments that should be better informed.

Minimizing the Impacts of Oil and Gas Operations

Your final question sought advice on how the impacts of oil and gas operations on marine mammals and marine ecosystems might be minimized. I consider this question to be the most important. I will focus on three considerations: resources and the burden of proof; a more systematic approach to oil and gas management; and the need for a change in culture.

Resources and the Burden of Proof—The lack of information on marine mammals in the Gulf of Mexico is an impediment to management and, in this case, assessment of the effects of the spill. Even basic abundance estimates for most marine mammal stocks in the Gulf are out of date, unacceptably imprecise, or simply don't exist. The federal government should explore opportunities to leverage resources of the private sector for the purpose of assessing the elements of those ecosystems that they are placing at risk. That exploration should include a hard look at the fundamental question of what responsibility those exploiting marine energy resources have to support studies of the ecosystems that they are placing at risk rather than waiting until an accident occurs to then attempt such analyses

retrospectively. In the Commission's view, these companies not only bear the fiscal burden of demonstrating that their technologies are safe for use in the marine environment, but should support environmental research.

A More Systematic Approach to Oil and Gas Management—It appears that some of the lessons from previous spills have not been heeded and that a more systematic and rigorous evaluation of such projects is needed. The following problems exemplify the lack of rigor in our management process.

- *Baseline information*: As noted earlier, agencies have not collected the baseline information needed to (1) evaluate the resources at risk from oil and gas development and (2) assess the effects of a significant problem such as this spill. This was one of the major lessons derived from the Exxon Valdez spill in 1989.
- *Monitoring and mitigation*: Monitoring and mitigation measures are inadequate for many aspects of oil and gas production related to marine mammal protection. Federal agencies need to implement a systematic, well-considered strategy for evaluating and improving such measures over time.
- *Response measures*: The nature of response efforts to stop the Deepwater Horizon spill suggests the need for improved preparation for a serious accident at depth. Agencies must improve planning and capability for responding swiftly and effectively to a failure at such depth.
- *Worst-case scenarios*: Risk management requires accounting not only for the probability of a major spill, but also for the consequences if one occurs. Potentially catastrophic consequences must be considered even if the probability that they will occur is low. Proper assessment of risks requires recognition that they are a function both of probability and consequences.

These are just a few of the key areas for improvement related to oil and gas operations revealed by this tragic event. Clearly, a much more systematic and rigorous review is needed to improve oversight of the activities of the oil and gas industry in the marine environment and to minimize the probability and effects of such events in the future.

A Change in Culture—Finally, the Commission believes that all involved agencies and parties need to ask what went wrong in this particular case. Clearly, everyone is awaiting more specific information so that the immediate problems can be corrected. But responsible parties also must ask what conditions allowed things to go awry in so many ways. For example, multiple agencies are involved in reviewing matters related to offshore oil and gas exploration, development, and production, including the Marine Mammal Commission. The Commission believes that all agencies need to take a hard look to determine if and where our efforts might have fallen short.

Furthermore, society needs to consider how to respond to this tragedy. Our society has known for decades that fossil fuels are a diminishing resource, and our current dependence on them is not sustainable. But because of our dependence on fossil fuels, society, or its agencies, may be driven to take risks that otherwise would not be acceptable. To create management systems that truly minimize the risks of events like this oil spill,

society also needs to examine and address the roots of the problem—that is, the underlying factors that drive us to make risky decisions. Doing so is essential to achieve a sustainable future with acceptable environmental risks and a correspondingly secure future for marine mammals and marine ecosystems.

Thank you again for the opportunity to testify, and I will do my best to answer any questions you may have.