Major Steps, cont.

protection. Decades of research on the population shows that their population growth is very slow, and is greatly impeded by deaths caused by ship strikes and entanglements. Of all the right whales known to have died from 1970-1999, 35% of them were killed by ships.

By slowing ships down, the whales get three primary benefits:

- More time to move out of the way of a ship once they detect it. If a whale is focused on feeding and/or finding prey, or socializing with other whales it may not detect the approaching ship until it is too late. By cutting down the speed of most boats by 50%, the whale is given that extra time (and there are numerous known cases where whales have taken avoidance actions at the last minute).
- Models of collisions have shown that a secondary cause of whale deaths from ships comes from whales who avoid the bow of the boat, but can't escape the huge suction force of the ships' giant propellers. By cutting the speed, the draw from the propellers is also greatly reduced.
- While slower speeds may not mean the whale can survive a collision with a huge tanker, it would allow the animal to swim away from a collision with a smaller boat. Since fatalities have occurred with boats as small as 80 feet, this could be an important protection.

The proposed regulation to slow ships was held up for over a year by the office of Vice President Chaney, who tried to challenge the science behind it. However, several members of the House and Senate worked to move the rule forward over the last few months. Shipping companies were originally opposed to the regulation because of the increased time and cost it would introduce, but further analysis showed the increase to be less than 4/10 of 1%.

While we are encouraged by the rule, we were upset by two modifications to the originally proposed rule. The rule now applies only to ships within 20 miles of the coast, rather than the original 30 miles, despite the presence of whales in those extra ten miles. More importantly, in areas where whales show up outside of the well-known areas of aggregation, similar measures would only be voluntary (they were originally proposed to be mandatory), despite data which shows compliance with voluntary guidelines to be almost non-existent. Despite these limitations, we applaud NMFS for taking this important step, and hope it helps to save this species from extinction.

Article reprinted from the December 2008 issue of Flukeprints, newsletter of the Whale Center of New England.

Gray Whales' Responses to Environmental Change - What We Are Learning from the "Sentinels of the Seas" - by Steven L. Swartz, Ph.D.

Investigators expert on gray whales, the geologic history of the world's oceans, and the oceanography of the North Pacific and Arctic gathered in Monterey, California to participate in a workshop on "Gray Whales and Climate Change" as part of the American Cetacean Society's Biennial Conference. They discussed observations of gray whales in the context of environmental changes in the North Pacific, Bering Sea and Arctic Ocean, and examined the proposal that gray whales' response to environmental change made them "Sentinels of the Seas."

Distinct changes in gray whale migrations, distribution, behavior, and mortality documented in recent years appear to be direct responses to changes in the environment and/or responses to environmentally driven changes in the distribution and availability of gray whale prey. Recent research is building the case that gray whales are influenced by short-term environmental changes like the cyclic El Niño-Southern Oscillation phenomenon, the Pacific Decadal Oscillation and Arctic Oscillation, and longer term climate change that exerts its influence

A gray whale with her calf. Cetacean Research Associates © 2008.

over significantly longer time periods. Yet, as a species, gray whales managed to survive repetitive environmental changes over geologic time, as well as recent challenges. So, what is it about gray whales that allows them to be so successful in changing environments, and what can they tell us about climate-driven environmental change?

Their Ancestors Adapted With Available Prey

The day began with talks on the geologic time scales on which climate change operates, the evolutionary biogeography and paleontology of the modern gray whales' ancestors, and ocean basin oceanographic climate oscillations and cycles that influence marine life. Rises and falls of sea level associated with the earth's warming and cooling periods over geologic time scales resulted in the repeated exposure and submergence of continental shelf areas and the rise and fall of recognized prey for gray whales. Physical fossil evidence suggests that such dynamic conditions favored the evolution of gray whale adaptations that have allowed them to survive extreme changes in sea level and prey production. The evolution and shape of the gray whale ancestor's skull suggests an intermediate stage between skimmers (e.g. right whales) and gulpers (e.g., rorquels) that may have resulted in response to feeding on prey types. During periods of cooling and lower sea levels and minimial shelf prey communities, gray whales may have relied more on pelagic (upper, open ocean) prey and competed with other pelagic prey exploiters like rorquals (e.g., fin, blue, and humpback whales). During warming periods when continental shelf areas were submerged and covered by shallow seas, communities of benthic organisms (those at lower levels along the shelf) developed and provided opportunities for gray whales to exploit this prey, thus shaping the development and specialization of benthic suction feeding in the gray whale ancestors. Modern gray whales' ability to switch from benthic to pelagic prey suggest they may have relied on and exploited a more diverse variety of prey and resources than have been documented in recent historical times.

Gray Whales Delaying Southbound Migrations

A second series of presentations summarized observations of what appear to be gray whales' responses to recent physical and biological changes in their marine environment. Evidence is emerging that eastern North Pacific gray whales are delaying their southbound migration, expanding their feeding range along the migration route and northward to Arctic waters, and even remaining in polar waters over winter – all indications that North Pacific and Arctic ecosystems are in transition. Prior to 1980, the median southward fall migration date measured at Granite Canyon, California ranged from January 4-13, with an overall median date of January 8. But from 1985 to 2000, there has been a one-week delay in the migration, with median dates ranging from January 12-18, and an overall median date of January 15. This shift to a week later for the median migration date change occurred shortly after a major oceanographic regime shift in the North Pacific. Since 2000, median migration dates seem to be delayed even further, ranging from January 17-26, with a median date of January 22. Researchers suspect that this progressive delay in their migration timing may be related to gray whales having to range further and wider during their summer forage for food in the Bering Sea and Arctic Ocean.

Time in Breeding Lagoons Affected by Temperatures

The gray whales' utilization of their southern breeding range appears to be influenced by ocean temperatures. During winters with warmer than average sea surface temperatures associated with the El Niño cycle, gray whales spend less time within the breeding lagoons and coastal areas along the Pacific Coast of Baja California than in winters with average sea surface temperatures. Alternatively, during winters of below average sea temperature, or La Niña conditions, gray whales extend their winter distribution around the southern tip of Baja California and move into the Gulf of California, presumably in search of warmer water.

Feeding Patterns Changing

Gray whales are now more frequently seen utilizing feeding areas and prey types previously thought to be of lesser importance than the historic rich benthic amphipod communities found in the Bering Sea. Observations in the past few decades suggest that the once-extensive prey communities of the Chirikov Basin have declined significantly with ocean warming, so that gray whales no longer congregate there in large numbers during the summer. In contrast, more gray whales are seen feeding on alternative prey off of Kodiak Island, Alaska, feeding on benthic and pelagic prey in coastal areas and within bays in the Pacific Northwest and Vancouver Island, and migrating north of the Bering Straits into the Arctic Ocean to feed. Gray whale calls have also been recorded in the Beaufort Sea over winter, suggesting that some individuals are not migrating south to the historical breeding range, and are over-wintering in the Arctic. During the 1998-1999 El Niño-La Niña cycle, which coincided with a range-wide mortality of gray whales, the whales were observed attempting to feed within the Baja California breeding lagoons and along the coastal areas within the western Gulf of California. Under normal conditions, gray whales are not known to feed significantly during their winter occupation of the breeding range.

Spyhoppers - a family affair. Cetacean Research Associates © 2008.

Seasonal Ice Connection

Researchers have described a link between the timing of the retreat of seasonal ice in the Arctic, and estimates of northbound migrating gray whale calves the following season. Each fall, seasonal ice begins to form in the Arctic and eventually extends southward covering all of the primary feeding grounds for the majority of the eastern Pacific population of gray whales. In the spring, this processes is reversed and ice recedes north through the Bering Straits. In early spring, seasonal ice can block access to feeding grounds for pregnant females and limit the time and amount of food females can obtain in the summer. Short summers with limited feeding coincide with fewer pregnancies being carried to term, and thus fewer calves seen migrating north from the breeding range in the following year. In light ice years that present more time for females to feed, the reverse is seen – more northward migrating calves the following spring.

Analyzing Health and Vulnerability to Disease

The final series of presentations addressed the physiological and health impacts of reduced prey resources, and implications for gray whale body condition and nutrition. Health and vulnerability to disease were presented in the context of a range-wide mortality event in 1998-2000, and ongoing changes in the gray whales' feeding, migratory, and breeding habitats. For example, stranded juvenile gray whales had higher concentrations of organochlorine contaminants (OCs) than juvenile whales taken by subsistence fisheries. This is most likely a result of retention of these chemicals in the stranded animal's blubber as fat stores were depleted for energy use under stress from illness or disease, rather than from a difference in diet or feeding areas. Similarly, significantly higher fat levels were measured in the blubber of animals taken by subsistence hunters following summer feeding in the Bering and Chukchi Seas, compared to the blubber fat content in stranded animals. Such comparisons may help us detect and evaluate the impact of potential dietary changes associated with environmental variability.

Unfortunately, correlating reduced fat content in gray whale blubber and elevated contaminants with food resource limitations and declining nutrition is difficult.

During the 1998-2000 gray whale die-off, stranded whales appeared to be severely emaciated, but use of blubber lipid (fat) analysis was not useful because the body tissue had decomposed. Another technique has been tried that analyzes volatile lipid metabolites in exhaled breath. It has been used to evaluate metabolic status in humans, elephants, dolphins, and orca. In a preliminary study, researchers collected breath samples from free-ranging gray whale mothers and calves in San Ignacio Lagoon, Baja California Sur, Mexico. Preliminary analyses indicated that adult lactating females with calves are in a state of ketosis consistent with fasting, while samples from a lone adult engaged in feeding-like behavior and from suckling calves had metabolite profiles consistent with healthy, well nourished whales.

Environmental Signals Continue to be Revealed Through Whale Research

The coastal habits of the gray whale make it the only large cetacean that can be regularly observed from shore, and its lengthy annual migration is one of the world's most outstanding wildlife spectacles viewed by millions of people each year. As one of the most intensively studied great whales, the gray whale has and continues to contribute to our understanding of their biology and behavior, and the dynamics of the marine environments in which this and other species of large cetacean roam and live. Innovative approaches for investigating living, free-ranging gray whales like those discussed at the workshop will continue to expand our ability to interpret environmental signals from observations of living whales, and further our understanding of how whales are managing in the changing ocean environments.

Renewed Challenges Testing Ancient Adaptive Skills

In total, the workshop presentations suggest that gray whale ancestors evolved during periods of extreme geologic change in the earth's oceans and coastal areas, and that recent modifications of gray whale behavior and biology in response to environmental change and prey availability can be traced back to adaptations developed over millions of years. In retrospect, much of what had been learned about gray whales through the 1970s and 1980s and assumed to be "characteristic" of the species were the result of observations during periods of relatively mild climate changes, high rates of annual prey production, and the development of vast communities of benthic prey resources that fueled the rapid growth and recovery of the population from former depletion. In recent decades, shifts in the climate and oceanographic regimes in the northern seas have radically changed primary production rates in the Arctic, increased ocean temperatures and reduced seasonal ice cover. These changes are presenting renewed challenges to the "robustness" of gray whales, and testing their resilience as a species. Researchers are now obtaining a new look at how gray whales are responding to and dealing with environmental change over the short-term, and we are gaining a better understanding and appreciation of how this species' evolution over millions of years has prepared it to survive in a changing ocean environment.

The Workshop presenters are collaborating on an article that will summarize their findings and conclusions to be published in early 2009.

Do We Have Your Current Information?

ACS will be looking for more opportunities to communicate with you and get important information out quickly in 2009. Please be sure we have your current e-mail address in our records. To update your contact information,send a note to our national office at:

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