RANGE-WIDE GRAY WHALE SCIENCE SYMPOSIUM: TAKE HOME POINTS

by
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From September 9-10, 2026, Gray Whale Research in Mexico (GWRM) scientists Lorena Viloria-Gomora, Sergio Martínez-Aguilar, Jorge Urban-Ramírez (virtually), and Steven Swartz joined scientists from Mexico, United States, Canada and Russia to attend the "Range-Wide Gray Whale Science Symposium" convened by the U.S. Marine Mammal Commission at Oregon State University's Hatfield Marine Science Center in Newport, Oregon. This Symposium was convened in response to 10-years (2018-2026) of significant range-wide mortalities and decline of Eastern North Pacific (ENP) gray whale population. While such declines have generally been followed by periods of increasing abundance, the duration and magnitude of the most recent decline raises concerns that continued environmental changes in the Arctic and sub-Arctic feeding areas could be impacting the population's resilience.

The symposium brought together researchers from across the gray whales' range to share current scientific information, discuss key knowledge gaps, and identify priorities for future research and collaboration. Climate Change and Arctic environmental experts provided background on the rapid changes that Arctic ecosystems are experiencing. We were hopeful this symposium would alleviate concerns about the future of ENP gray whales, but instead the information presented and ensuing discussions further reinforce the severity and significance of the impact that climate change and other anthropogenic threats that are facing the gray whales throughout their range.

In recent years hundreds of gray whales have washed ashore dead from Baja California Sur, Mexico to Alaska, and skinny emaciate whales are seen throughout their range. From 2018 to 2026 more than 1,200 gray whales have stranded dead along the Pacific coast of North America. The U.S. National Oceanic and Atmospheric Administration (NOAA) estimates that the ENP population has declined from an estimated 27,000 whales in 2015/2016 to an estimated 12,900 to 17,750 whales in 2025 and 2026, respectively, a 30%+ decrease in abundance (Fig. 1). During this period scientists documented the declining of reproduction in the wintering breeding and calving lagoons of Baja California Sur, Mexico from 2018 to 2026 (Fig. 2), and the estimate of 85 calves reported by NOAA during the 2025

spring northward migration was based on only 17 sightings, the lowest annual calf count recorded since the time series began in 1994 (Fig. 3). These numbers are too few to replace mortalities and without an increase in reproduction, the recovery of the population is in question.

While the United States NOAA declared an "Unusual Mortality Event" for gray whales from 2019-2023, these downward population trends are continuing. Rapid "Climate Change" appears to be disrupting the seasonal abundance of the benthic invertebrates, the principal food that the whales seek during their summers in the Arctic feeding areas. Arctic temperatures are rising at more than four times the global rate of warming, highlighting growing concerns about the rapid pace of environmental change affecting all species in the higher latitudes.

Point 1. Climate Change isn't going away - it will get warmer.

The geographic range of gray whales has been extensively reshaped by paleo-climatic forces over hundreds of thousands of years. The fossil record suggests that gray whales evolved during the Pleistocene epoch that occurred from 2.6 Ma to 11.7 ka ago during which the planet experienced multiple periods of global glaciation and inter-glacial warming that resulting in sea level decreases and rises that repeatedly exposed and then covered the earth's continental shelf areas (Fig. 4). Over the last 800,000 years periods of shelf submergence resulted in the development of extensive benthic invertebrate communities in shallow seas that became one of the most productive marine ecosystems persisting into the present. These seasonally abundant resources provide the primary food for gray whales and other species of large pelagic and nearshore vertebrates. In contrast, during cold periods of global glaciation sea levels fell 300 ft or more exposing much of the continental shelf areas. Thus, gray whales periodically did not have access to the productive Arctic continental shelf sea ecosystems that ultimately became their primary feeding habitat, and that are currently deteriorating due to ocean warming. It was during these events that gray whales are believed to have evolved specific morphology and bottom-feeding behavior to specialize in the exploitation of available benthic invertebrates that occurred within these shallow continental shelf seas.

Approximately 15,000 years ago the most recent global "Glaciation Maximum" began to warm, and sea levels began to rise re-submerging the continental shelf areas (Fig. 5). In contrast to previous warming periods that occurred over hundreds of thousands of years of earth history, the current global warming trend is occurring in tens of decades and is driven by the rapid increase in global temperature resulting from increasing levels of atmospheric

carbon dioxide, a green-house gas, from the advent of burning fossil fuels that began with the human industrial revolution (Fig. 6). Global average temperatures have risen 2-4 ºC in decades during the recent "post-industrial revolution" or what now is referred to as the "Anthropocene Epoch" or the time during which humans have had a substantial impact on the earth's climate. Rather than having thousands of years to gradually adapt to such environmental changes, gray whales and their prey are having to rapidly change their behavior and seek alternatives to survive. While they may not thrive in today's rapidly changing ocean environment, their future population may persist but likely in lower numbers and occupy augmented ranges than those we've observed historically.

Point 2. Eastern North Pacific Gray Whale Current Status

While NOAA declared an "Unusual Mortality Event" for gray whales from 2019-2023, the range-wide elevated mortality rate, malnourished emaciated whales, and low calf counts in the wintering lagoons and during migrations are continuing.

Beginning in 1967 ENP gray whale population estimates have been developed by the NOAA Fisheries Service from periodic shore-based observer counts during the fall southward migration past Granite Canyon, California (Fig. 1). These estimates indicate previous periods of major and more subtle declines, and typically recoveries follow shortly after each decline, although this does not appear to be happening with the current decline.

While these surveys are reasonable indicators of population abundance trends, the survey estimates alone can represent biologically implausible rates of increase or decrease. Survey estimates are subject to challenges and limitations of weather, field logistics, observer effects, whale behavior, and other factors that make "absolute abundance estimates" difficult to derive. They do, however, inform "*integrated population models*" that in addition to observer counts incorporate input from additional biological parameters for vital rates like births, mortalities, and body condition. Such models may also incorporate environmental variables like prey biomass, annual sea ice coverage, number of days the feeding areas are available to the whales, and Arctic warming rates that are changing the carrying capacity of the whales' high latitude summering areas.

These "*integrated population models*" allow estimation of the most likely "*long-term carrying capacity*" for the gray whale population, which is presently estimated at around 21,000 whales. The Marine Mammal Protection Act (MMPA) defines a population as "depleted" when its abundance falls below its *Optimum Sustainable Population* (OSP), which is 60% of its *long-term carrying capacity*, which is currently approximately 12,600 for NEP gray whales (Fig. 7). This formulation assumes that the carrying capacity of the

environment is relatively stable over long periods of time, which is not what we are currently witnessing with the Arctic areas currently frequented by gray whales, and the Arctic represents one of the most rapidly warming and changing regions on the earth. Models that are more inclusive of information on changing environmental conditions are needed to more accurately reflect the status of the ENP gray whale population during the current period of rapid environmental change.

Point 3. Gray Whale Energetics & Migrations

Surveys for invertebrate biomass are indicating that the warming of the Arctic is impacting the production of the gray whales' historical prey species and causing a redistribution and availability of their principal foods. The biomass of benthic amphipods in historical gray whale summer feeding areas has diminished significantly due to changing ocean conditions. While gray whales are capable, to a degree, of switching feeding modes from benthic "sucking" of prey within sea-floor bottom sediments to "gulping" prey in the water column like blue whales and "skimming" like Right whales, it is not clear how efficient they are with catching swimming rather than relatively stationary benthic prey, or if there are nutritional tradeoffs for feeding on krill, crab larvae, herring eggs, mysids, and other alternative food sources found within their range (Fig. 8).

Photographic identification records shared during the symposium indicate that some proportion of the gray whale population may not be making the annual migrations to and from the wintering breeding and calving areas along the Baja California peninsula. Instead, they appear to seek out alternative sub-Arctic feeding areas during the summer/fall/winter months. Such changes in migratory behavior could have implications for the shore-based observer counts that are the basis of annual population estimates. Subgroups and locations of whales utilizing feeding areas in lower-latitude North American nearshore coastal waters include: Kodiak and Sitka, Alaska; Vancouver Island, British Columbia, Canada; the "Sounders" that summer along Puget Sound and the Washington coast; the "Pacific Coast Feeding Group" that feeds between northern California and British Columbia; and whales that feed in other specific locations like San Francisco Bay and the California Channel Islands archipelago. Ongoing research will likely discover additional gray whale feeding locations and available prey.

We know that breeding females of large mammals like whales may forgo reproduction if they are lacking the energy reserves to successfully conceive, gestate, birth, and lactate sufficiently to rear a calf. If food resources are a limiting factor for reproducing whales, such individuals may not make annual migrations and instead remain in areas

where food is available until they have sufficiently recovered their energy-condition reserves from previous reproductions before resuming reproducing. Such non-migratory individuals may account for annual variations in the number of gray whales observed in various portions of their range.

Point 4. What can we do?

Well, we cannot stop climate change and the warming the planet particularly in the Arctic where gray whales and other northern marine and terrestrial species reside. What we can do is to minimize anthropogenic activities that would exacerbate the stress that gray whales (and likely other baleen whales) are experiencing and that would slow their recovery.

For example, directed harvests and catches of gray whales for subsistence and cultural needs should be minimized until such time that gray whale reproduction catches up with and exceeds mortalities to promote recovery of the population.

While numerically modest, detrimental actions such as ship strikes, fishing gear entanglements, and low-frequency sonars and fossil fuel explorations and at sea production should be minimized in areas frequented by gray whales. Seasonal area closures and fishing gear restrictions should be activated when gray whales are present in specific locations to feed and breed and rear their calves.

Public outreach and educational opportunities should be expanded to inform people about climate change and the factors that are stressing gray whales and other marine life, and encourage public advocacy for protection of the whales, their essential habitats and the ocean environment for everyone.

Point 5. What does this all mean for our GWRM program?

Our GWRM program holds the longest time series of abundance and photographic identification data for ENP gray whales that dates from the 1970's when Mary Lou Jones and Steven Swartz began research in Laguna San Ignacio. This is an immensely valuable and powerful source of information that has the potential to lead us to a better understand the population's status today. GWRM program is making this information available to other gray whale researchers throughout the species range for comparison with historic and recent trends in gray whale abundance, movements, reproduction and body condition.

The symposium discussions spoke volumes relevant to addressing specific uncertainties about gray whales and emerging threats that they face which underscore their

uncertain future. These discussions encouraged the pursuit of collaborative research and monitoring to address these information needs and point the way to specific actions to conserve the species and protect their essential habitats, their prey species, and the resources gray whales will rely on if they are to recover. Because reproduction is essential for the gray whale population's recovery, the GWRM teams will concentrate on documenting and photographically identifying the number and body condition of female-calf pairs observed in the gray whales' wintering calving areas and lagoons in the Baja California peninsula of México and collaborate with other research groups to document the number and identification of calves observed throughout the gray whales' range.

For 2027 and beyond our GWRM research teams will continue data collection on gray whale abundance, reproduction, body condition and seasonal utilization of the wintering and breeding lagoons within the Baja California peninsula.

Our post-symposium activities for 2027 include reaching out to our colleagues to initiate collaborative research that will utilize the GWRM program's data holdings to better understand the current movements and behaviors of the whales throughout their range. Our scientists are also continuing public outreach programs with webinars and lectures to eco-tourism groups that visit the gray whales' winter breeding and calving areas, Marine Mammal associations, academic institutions, ocean advocacy organizations, federal marine conservation agencies in the United States and Mexico, and to the Scientific Committee of the International Whaling Commission. Our researchers will be presenting our gray whale research findings at the Society for Marine Mammalogy International Conference in Puerto Rico in October 2026 and future meetings of the Mexican and South American Marine Mammal Societies.

Point 6. What You Can Do - Consider Supporting Gray Whale Research

Our GWRM program is a 501(c)(3) non-profit research project of **The Ocean Foundation** based in Washington, D.C. in the United States. We work in collaboration with the **Autonomous University of Baja California Sur, La Paz, B.C.S., Mexico**. All our gray whale research and our graduate student mentoring programs are supported by non-government funding from sponsoring individuals and organizations. *We welcome the opportunity to invite you to become a sustaining member of our family of supporters*.

You can support our GWRM program by visiting our website's donation page and making a monthly donation pledge. Make a commitment to support gray whale conservation research today! Please take the opportunity to visit our website at:

https://altfktpj.donorsupport.co/page/Donate-to-GWRM

Watch a video on the challenges facing the gray whales:

https://vimeo.com/1233142246?share=copy&fl=cl&fe=ci

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Reference Figures

Figure 1. NOAA Eastern North Pacific gray whale population estimates 1967 to present. From Stewart et al. 2025. Grey line represents estimated "optimal sustainable population" levels from "integrated population models." Black-bars are abundance estimates with 95% CIs derived from shore-based observer counts of gray whale fall migrations past Granite Canyon, California. Red and green arrows indicate major and minor decreases and increases in abundance over time. From Steward & Weller, 2026.

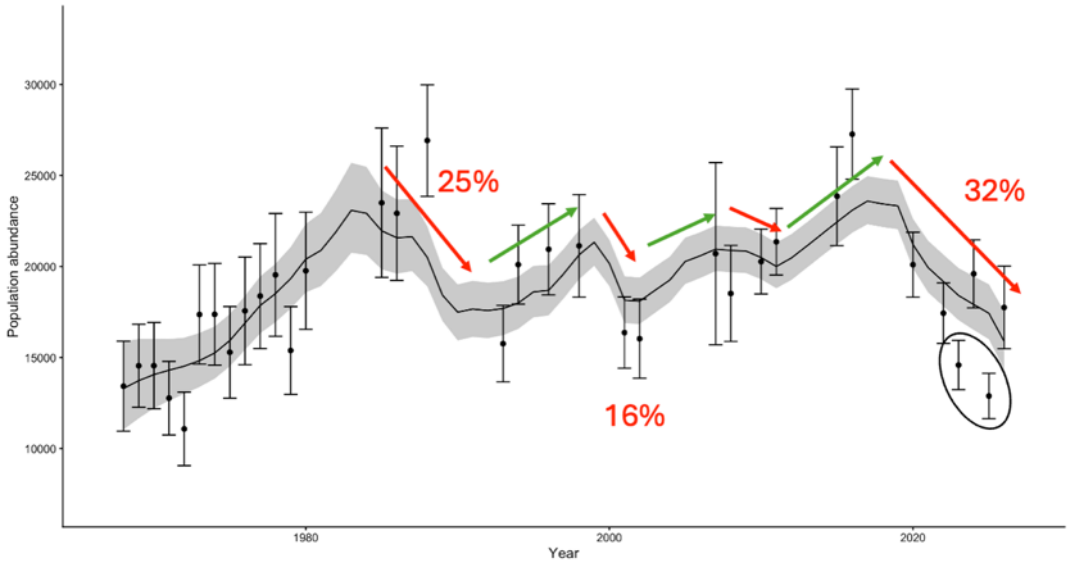

Figure 2. Annual gray whale female-calf pair boat-based counts in Laguna San Ignacio. From Martinez, et al. 2026.

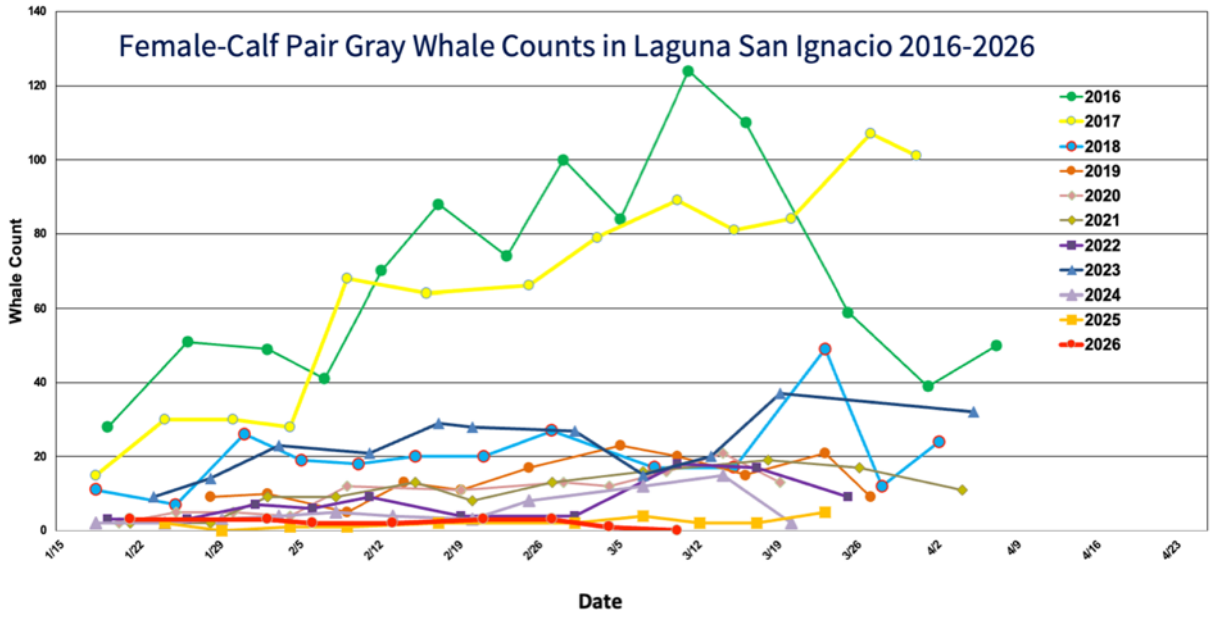

Figure 3. Estimated means and 95% CIs of the number of gray whale mother-calf pairs migrating north off Piedras Blancas, California between 1994 and 2025. Years when the population was experiencing a UME are highlighted in yellow. From: Lang et al. (2025), Eastern North Pacific Gray Whale Calf Production 1994–2025, NOAA -TM-NMFS-SWFSC-725.

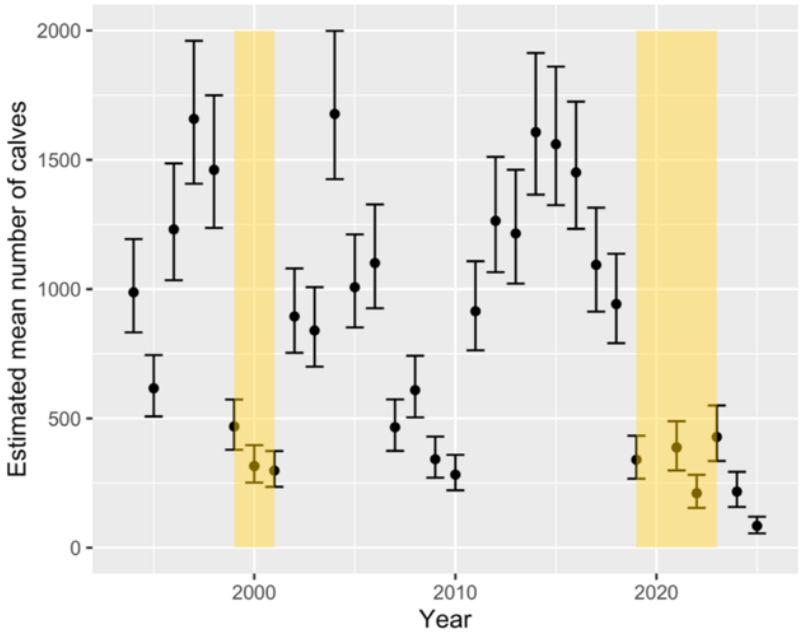

Figure 4. Sea Level Rise & Fall during the Last Glacial Maximum. From: Swartz, 2026 Webinar presented to the San Francisco chapter of the American Cetacean Society January 2026.

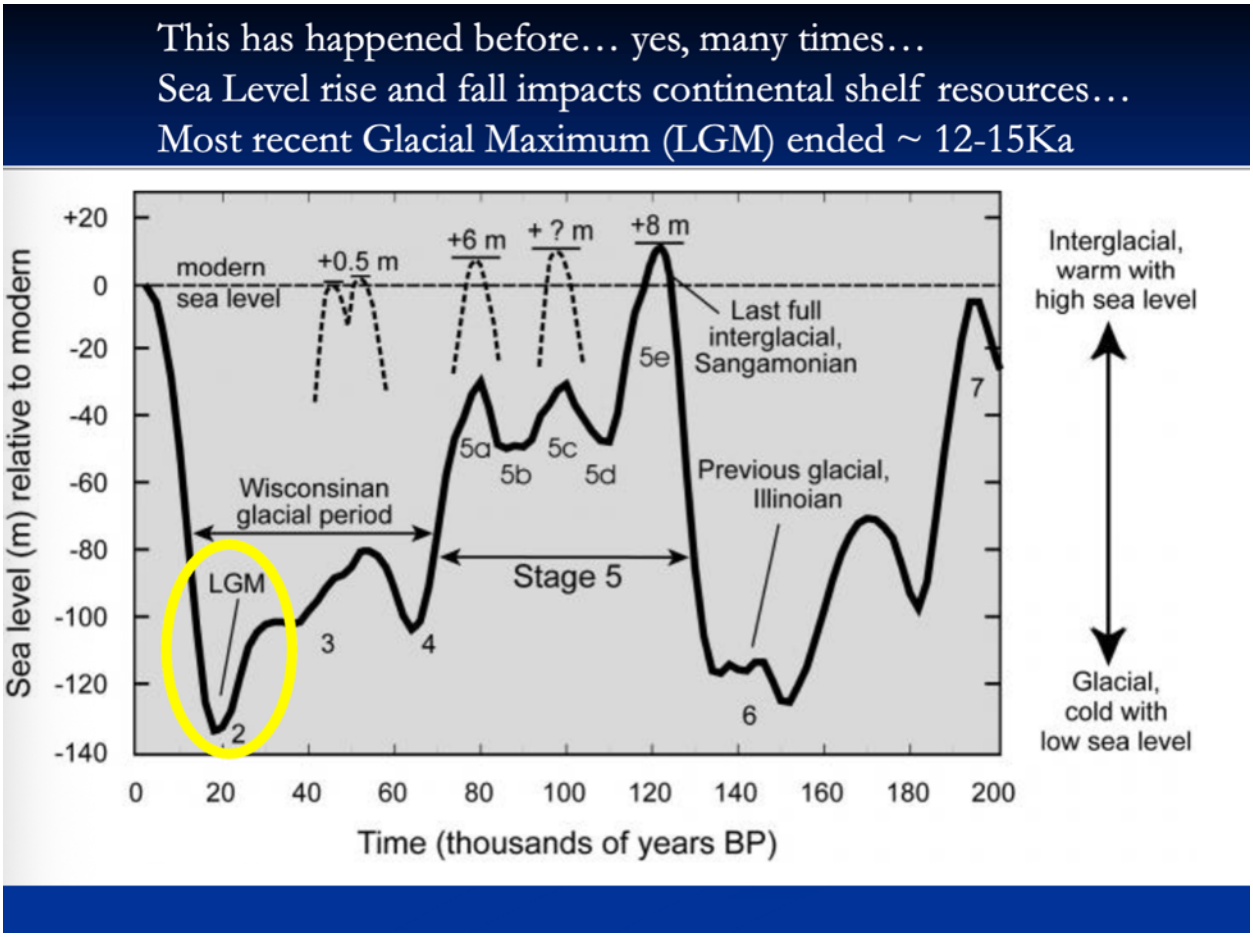

Figure 5. Beringia Land Bridge 21,000 years ago. From: Swartz, 2026 Webinar presented to the San Francisco chapter of the American Cetacean Society January 2026.

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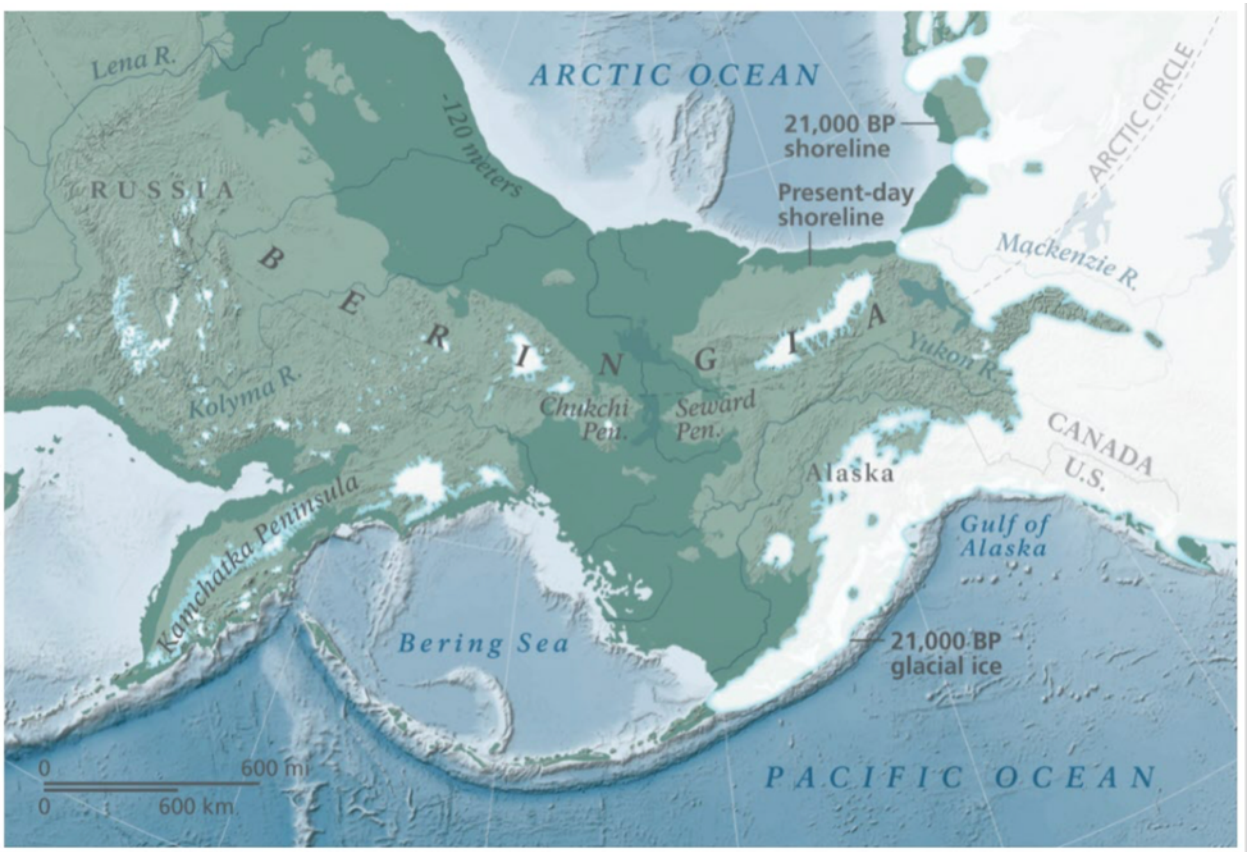

Figure 6. Atmospheric Carbon Dioxide levels during the past 800,000 years. From: Swartz, 2026 Webinar presented to the San Francisco chapter of the American Cetacean Society January 2026.

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Figure 7. Eastern North Pacific gray whale Optimal Sustainable Population (OSP) levels as defined in the Marine Mammal Protection Act of 1972. *Long-term carrying capacity* 21,000 whales. *OSP threshold is 60% of Long-Term Carrying capacity*, or approximately 12,600 whales. From Stewart & Tinker, 2025.

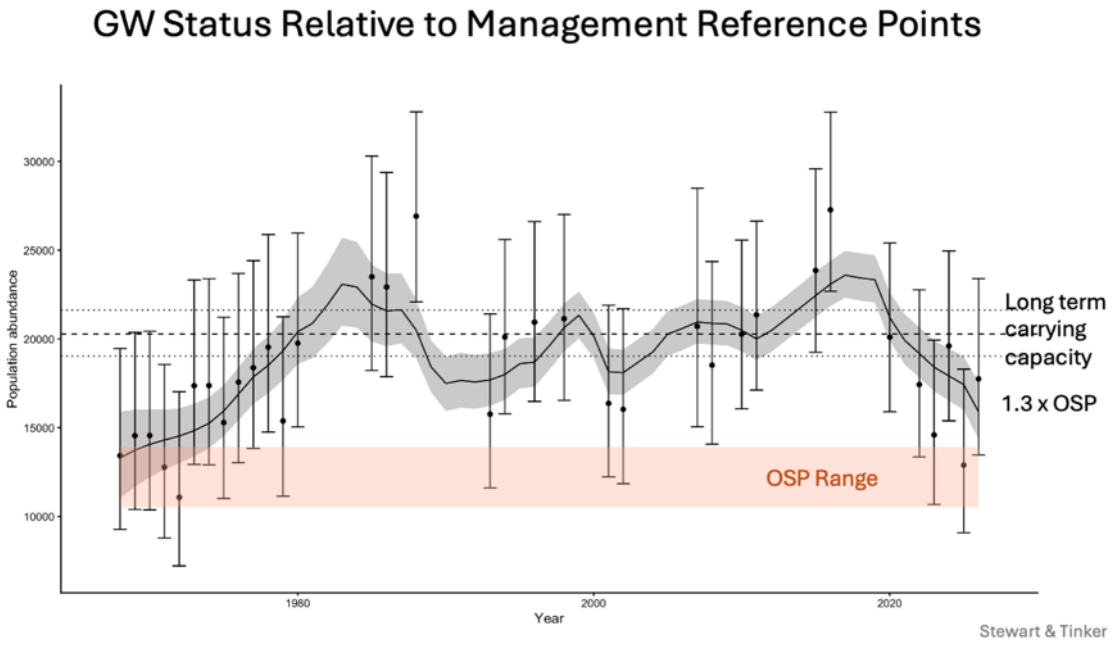
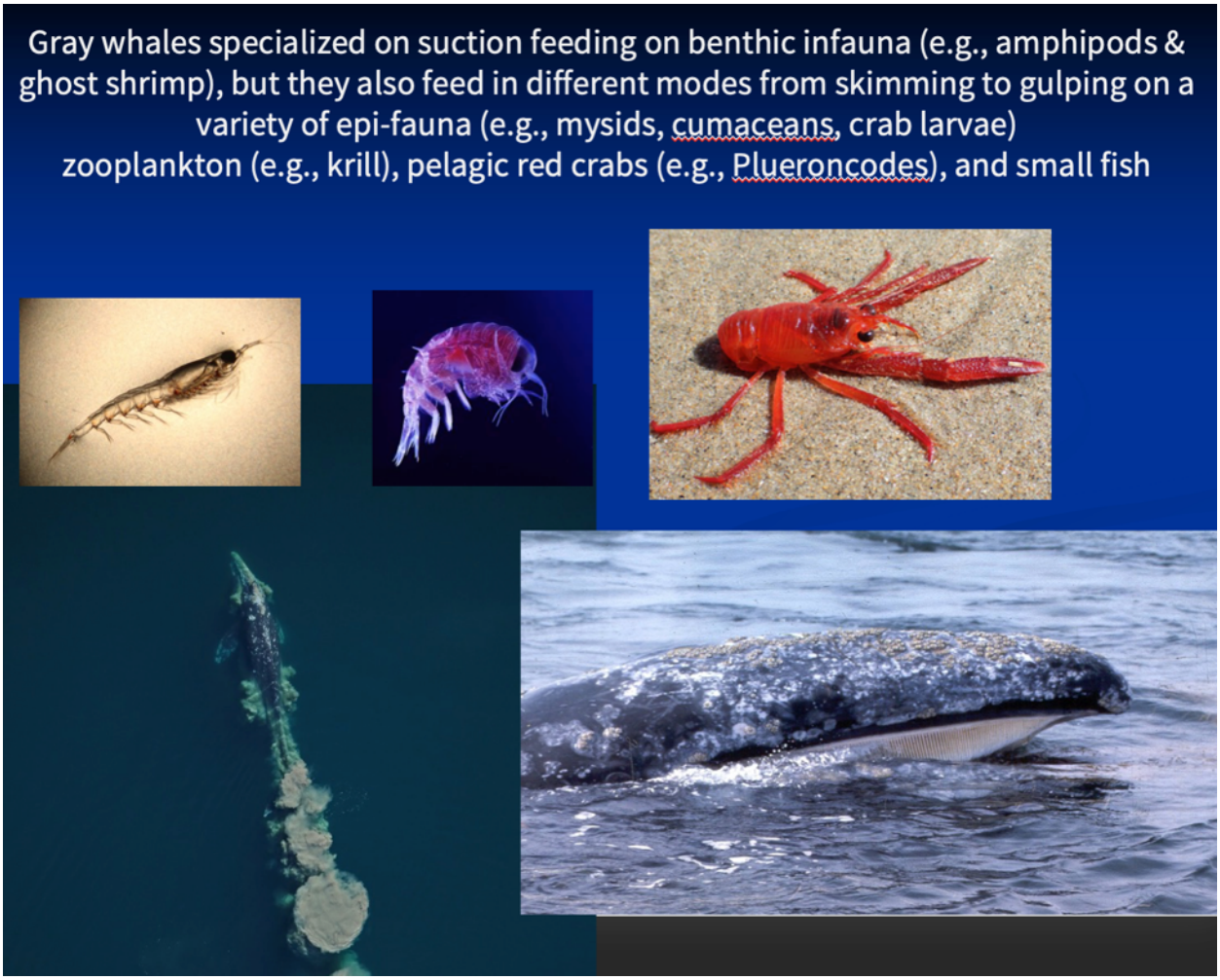


Figure 8. Gray whale feeding modes and alternative prey items. From: Swartz, 2026 Webinar presented to the San Francisco chapter of the American Cetacean Society January 2026.

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