**Supplementary Information**

**Range-wide comparison of gray whale body condition reveals contrasting sub-population health characteristics and vulnerability to environmental change**

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**ASAMM Aerial Images of Gray Whales for Body Condition Assessment**

The Aerial Surveys of Arctic Marine Mammals (ASAMM; Clarke et al., 2020) project obtained aerial images of gray whales encountered during surveys in the northeastern Chukchi Sea (67°–72°N, 157°–169°W) in July–October 2014-2019 (no earlier [2009–2013] images qualified for review). Images were obtained using a Canon 1DX or 7D DSLR camera with a 100–400 mm zoom lens. While circling whales, an observer used an open window located on the port side of the aircraft to obtain images. These types of images inherently have many variables to consider for use in assessing gray whale body condition, including variable altitudes (~1000–1500 ft.), oblique image angles, and variable image quality. To address these factors, the following methodology was developed to select standardized, high quality images for body condition assessment.

1. Conduct photo analysis of images taken each flight to identify individual whales. Label unique whales with a letter A-Z (e.g, Er-A) and list all images associated with that whale.

2. Select the best representative (and supplementary, if applicable) image for each whale. An ideal image would be taken straight down, with the whale elongated (not diving) at the water’s surface.

3. Rate obliqueness of each image (Fig. S1). Obliqueness refers to the angle of the whale’s body relative to the aircraft’s position in the photo pass. “Plumb” or top-down images receive the lowest (1 = best) score representing nadir or near-nadir images (~90° angle to whale). Only images rated as a 1 were included in the comparative body condition analysis presented in Torres et al.

4. Rate the overall image quality that may obstruct evaluation of the whale’s body contour. Quality metrics include camera focus, sea state, mud plumes, and glare. Images were rated 1, 2, or 3, with the best quality images receiving a score of 1. Only images rated as a 1 were included in the comparative body condition analysis presented in Torres et al.



Figure S1. Illustration of methods for categorizing obliqueness of aerial gray whale images captured by survey plane during ASAMM flights. Only images rated as a 1 (“plumb”) were included in the comparative body condition analysis presented in Torres et al.

**References**

Clarke, J.T., Brower, A.A., Ferguson, M.C., Willoughby, A.L., and Rotrock, A.D. (2020). "Distribution and relative abundance of marine mammals in the Eastern Chukchi Sea, Eastern and Western Beaufort Sea, and Amundsen Gulf, 2019", in: *Annual Report, OCS Study BOEM 2020-027.* (Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, F/AKC3, Seattle, WA 98115-6349).