



Feeding-area home ranges for gray whales: A comparison between stocks

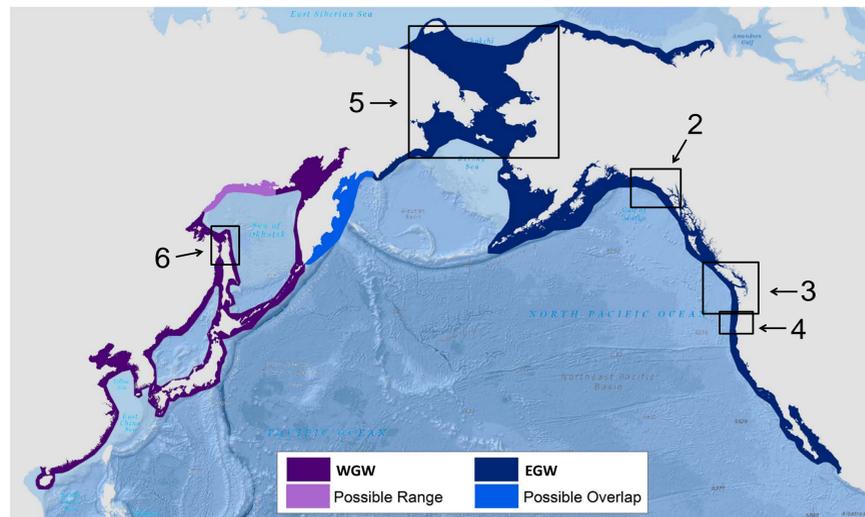
B.A. Lagerquist¹, M.H. Winsor¹, L.M. Irvine¹, and B.R. Mate¹

¹. Oregon State University Marine Mammal Institute, Hatfield Marine Science Center, Newport OR 97365
barb.lagerquist@oregonstate.edu



Background

There are currently two distinct population stocks of gray whales recognized in the North Pacific (Eastern Gray Whales, EGW, and Western Gray Whales, WGW) each with their own distinct feeding areas (NOAA 2014). Within the EGW stock, the Pacific Coast Feeding Group (PCFG) gray whales are recognized as a distinct feeding aggregation and their status as a separate population stock has been proposed (NOAA 2014). While the extent of each groups' distribution in feeding areas is generally well understood, specific home ranges and core areas of use have yet to be described for individuals. Such information is valuable when assessing exposure of gray whales to human activities in these areas and in the mitigation of potential risks to such activities.



Gray whale distribution in the north Pacific. Numbered boxes represent areas shown in the corresponding figures of home ranges and core areas.

Methods

Argos satellite-monitored radio tags were deployed on 59 gray whales from 2005 – 2013 (consisting of either Telonics ST-15 or Wildlife Computers SPOT-5 transmitters); 35 PCFG, 17 EGW, and 7 WGW whales.

A Bayesian switching state-space model (SSSM) was applied to Argos locations for each whale to create regularized tracks (with 2 locations per day) and estimate movement behavior. Migratory- and breeding-area locations, identified by visual inspection and behavioral mode classification from SSSM, were eliminated from the tracks. Local convex-hull utilization distributions were calculated for the remaining locations to determine feeding area home ranges (90% isopleths) and core areas (50% isopleths).

Results

Tracking periods ranged from 3–408 days (mean = 113 ± 103.7 days). Home ranges and core areas were calculated for 33 whales that provided > 50 SSSM locations in feeding areas. Locations were obtained from all months of the year for PCFG whales, for June–Nov for EGWs, and May–Dec for WGWs. Home ranges spanned a distance of over 2,500 km for PCFG whales, 900 km for EGW, and 180 km for WGW.

Home ranges were significantly larger for EGWs than for either PCFG whales or WGWs (Kruskal Wallis $p=0.02$). Core area sizes ranged from 11–12,934 km² for all whales and were not significantly different between the three groups (Kruskal Wallis $p=0.06$). Neither home range nor core area sizes were related to the number of days or number of SSSM locations used in the analyses (linear regressions p -values > 0.20).

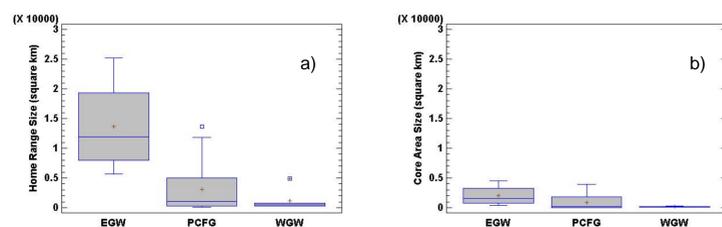


Figure 1. Box and whisker plots of home range (a) and core area (b) sizes for Eastern Gray Whales (EGW), Pacific Coast Feeding Group gray whales (PCFG), and Western Gray Whales (WGW) tracked with satellite-monitored radio tags.

Pacific Coast Feeding Group

Overlapping home ranges (top panels) and core areas (bottom panels) for 23 Pacific Coast Feeding Group gray whales tagged off Oregon and northern California during summer and fall of 2009, 2012, and 2013. Home ranges were located from northern California to Icy Bay, Alaska and ranged in size from 81 – 13,634 square km. Core areas ranged in size from 11 – 3,976 square km.

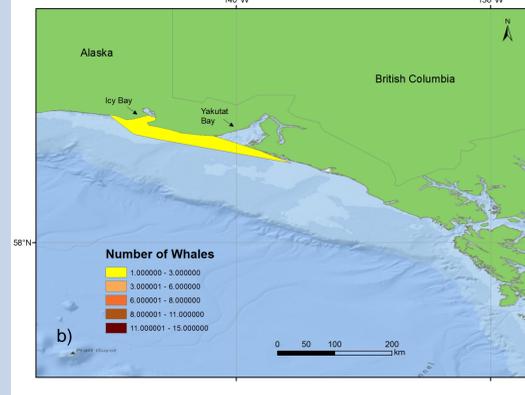
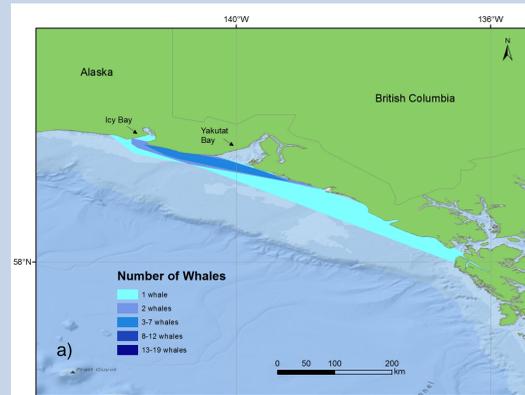


Figure 2. Overlapping home ranges (a) and core areas (b) of PCFG gray whales off Alaska.

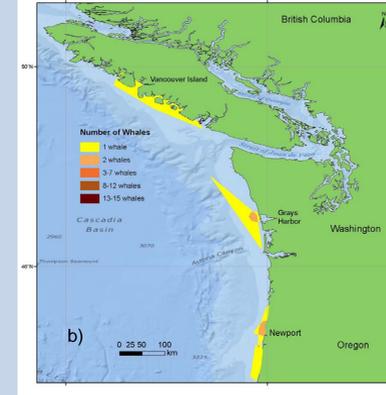
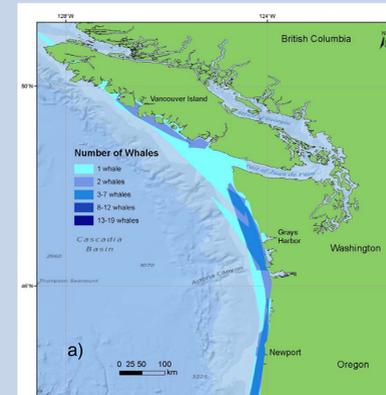


Figure 3. Overlapping home ranges (a) and core areas (b) of PCFG gray whales off British Columbia, Washington, and Oregon.

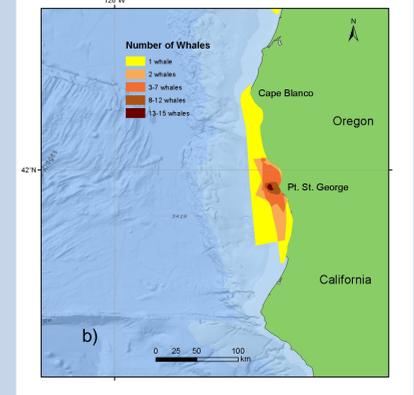
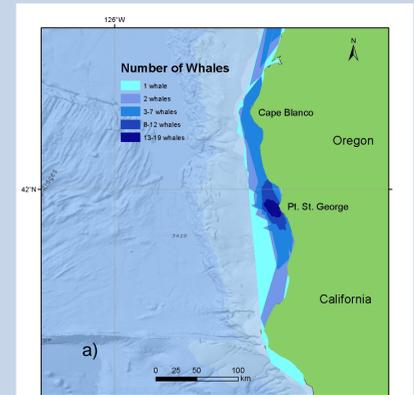


Figure 4. Overlapping home ranges (a) and core areas (b) of PCFG gray whales off southern Oregon and northern California.

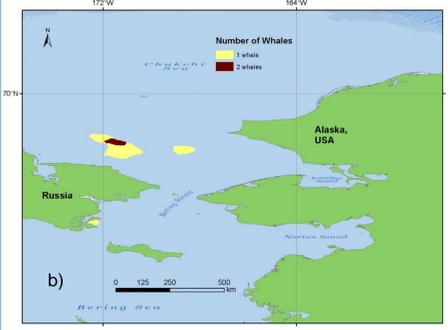
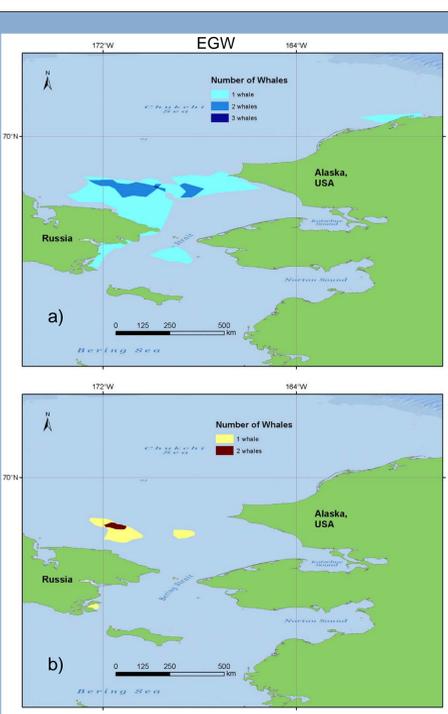


Figure 5. Overlapping home ranges (a) and core areas (b) for four Eastern Gray Whales tagged in Ojo de Liebre Lagoon, Baja California, March 2005. Home ranges varied in size from 5,656 – 25,147 square km. Core areas ranged in size from 383 – 4,569 square km.

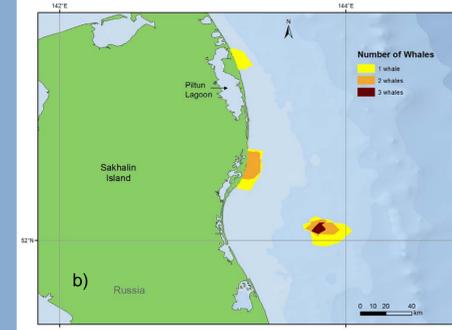
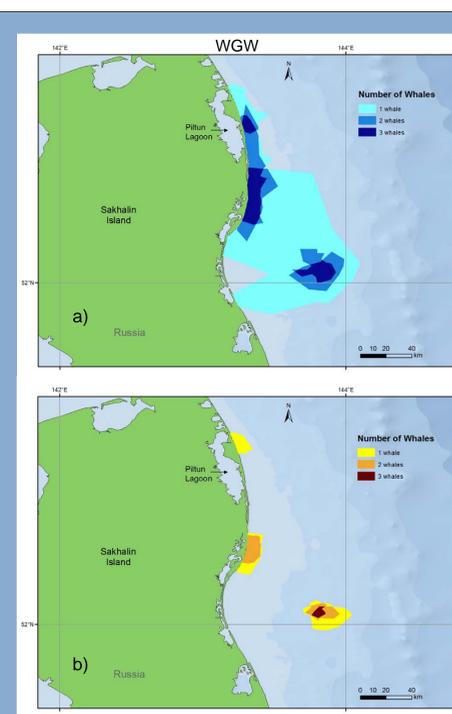


Figure 6. Overlapping home ranges (a) and core areas (b) for six Western Gray Whales tagged off Sakhalin Island in summer and fall, 2010 and 2011. Home ranges varied in size from 285 – 4,866 square km. Core areas ranged in size from 89 – 279 square km.

Conclusions

Both Pacific Coast Feeding Group (PCFG) gray whales and Western Gray Whales (WGW) had significantly smaller home ranges than Eastern Gray Whales (EGW), but the geographic extent over which these home ranges were found was much more widespread for PCFG gray whales than for the other groups.

The differences in home-range sizes may suggest differences in quality and/or quantity of food resources encountered by these three feeding groups and may also be a reflection of group demographics. The EGW stock is possibly at carrying capacity, which may cause whales in this stock to travel greater distances within their foraging grounds to find food than whales in smaller populations.

These results provide valuable information about high-use feeding areas for gray whales throughout the Pacific and highlight the need for further studies to help explain variations in home range size.

Acknowledgements

We thank the U.S. Navy Pacific Fleet Commander for funding as well as NAVFAC Pacific and HDR for project/contract management. This work was also funded by the International Whaling Commission, the IUCN, Sakhalin Energy Investment Corporation (SEIC), Exxon Neftgas Ltd, and donors to OSU Marine Mammal Institute. This work was conducted under NMFS permit #369-1757 and Oregon State University IACUC permit #s 3158, 3657, and 4118.