

Understanding sea otter population change in Southeast Alaska



Joseph M. Eisaguirre^a, Toshio D. Matsuoka^a, George G. Esslinger^a, Benjamin P. Weitzman^b, Jamie N. Womble^c, and Paul A. Schuette^b

^aUS Geological Survey (USGS), Alaska Science Center, Anchorage, AK; ^bUS Fish and Wildlife Service (USFWS), Marine Mammals Management, Anchorage, AK; ^cNational Park Service (NPS), Southeast Alaska Inventory and Monitoring Network and Glacier Bay Field Station, Juneau, AK



- The Southeast Alaska (SE) Stock of northern sea otters (*Enhydra lutris kenyoni*) ranges from Cape Yakataga (north) to Dixon Entrance (south; Figure 1).
- Sea otters were harvested to extinction in SE by 1900 and were unlikely to naturally repopulate the region¹.
- During the decades that sea otters were absent, their prey (e.g., clams, sea urchins, crabs) increased in size and number, setting the stage for rapid sea otter population growth if sea otters returned.
- Between 1965 and 1969, the Alaska Department of Fish and Game (ADFG) and Atomic Energy Commission (AOC) reintroduced 413 sea otters from Amchitka Island and Prince William Sound to seven sites along the outer coast of SE (Figure 2).
- Since the reintroductions, surveys from boats and aircraft have estimated sea otter abundance and range expansion (Figure 3).
- Early surveys (1975-1994) consisted of minimum counts or crude estimates because it wasn't known how many sea otters were hidden from view when surveyors went by. Recent surveys (2002-2022) included additional search effort to estimate the percentage of sea otters not detected, improving the accuracy of abundance estimates.

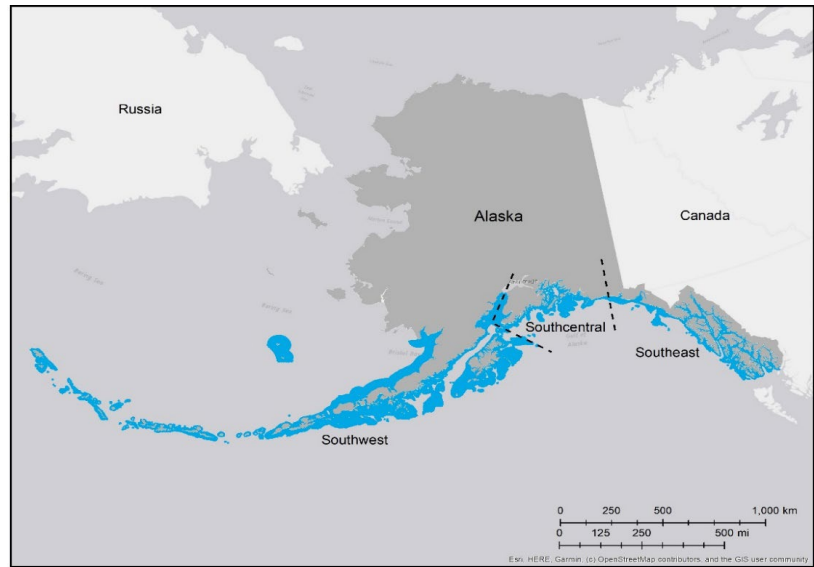


Figure 1: Map of northern sea otter stock regions, shown within the 100-m depth contour (blue), managed by the US Fish and Wildlife Service in Alaska

- Glacier Bay has been surveyed regularly by USGS and NPS from aircraft beginning in 1993, revealing approximately one third of all sea otters in SE may live in the Bay²⁻⁷.

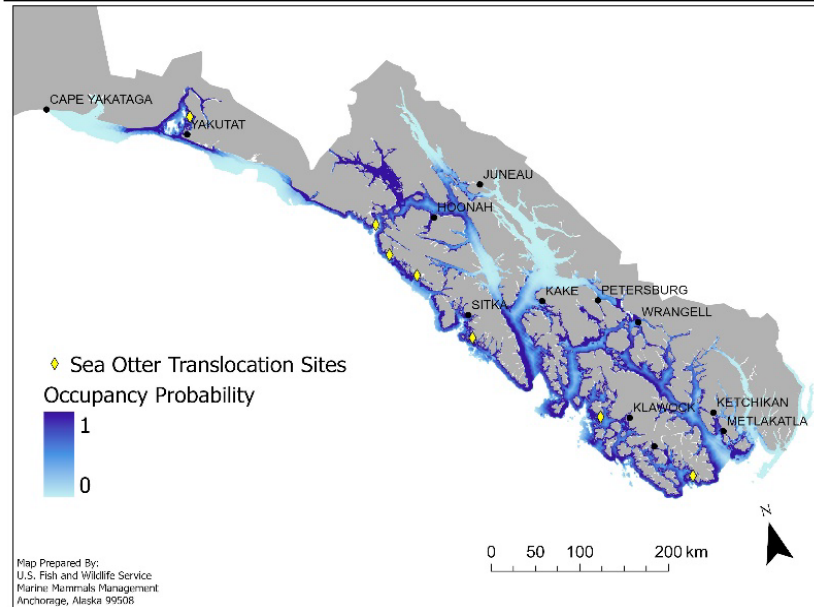


Figure 2: Map of Southeast Alaska sea otter stock region adapted from the 2023 USFWS report⁸ showing sea otter occupancy probability and translocation sites.

- Over the years, advances have been made in the statistical methods used to develop a population estimate from the survey counts²⁻⁷ (Figure 3). Uncertainty remains, and each analysis may give different results depending on the methods and data used. For example, many historical estimates relied on only a single year of data, whereas contemporary methods can use data from multiple or even all years.
- The USFWS 2023 report⁸ used all aerial survey data collected through 2022 and recently developed statistical methods to provide an updated understanding of sea otter population change since reintroduction (Figure 3).

➤ Next steps

- Continue improving statistical modeling, including using harvest data directly in estimating abundance, as well as including other types of survey data, such as boat and drone based.
- Adapt monitoring plan to accommodate localized survey efforts that may occur more regularly.
- Develop workflow to update abundance estimates efficiently as localized surveys occur.

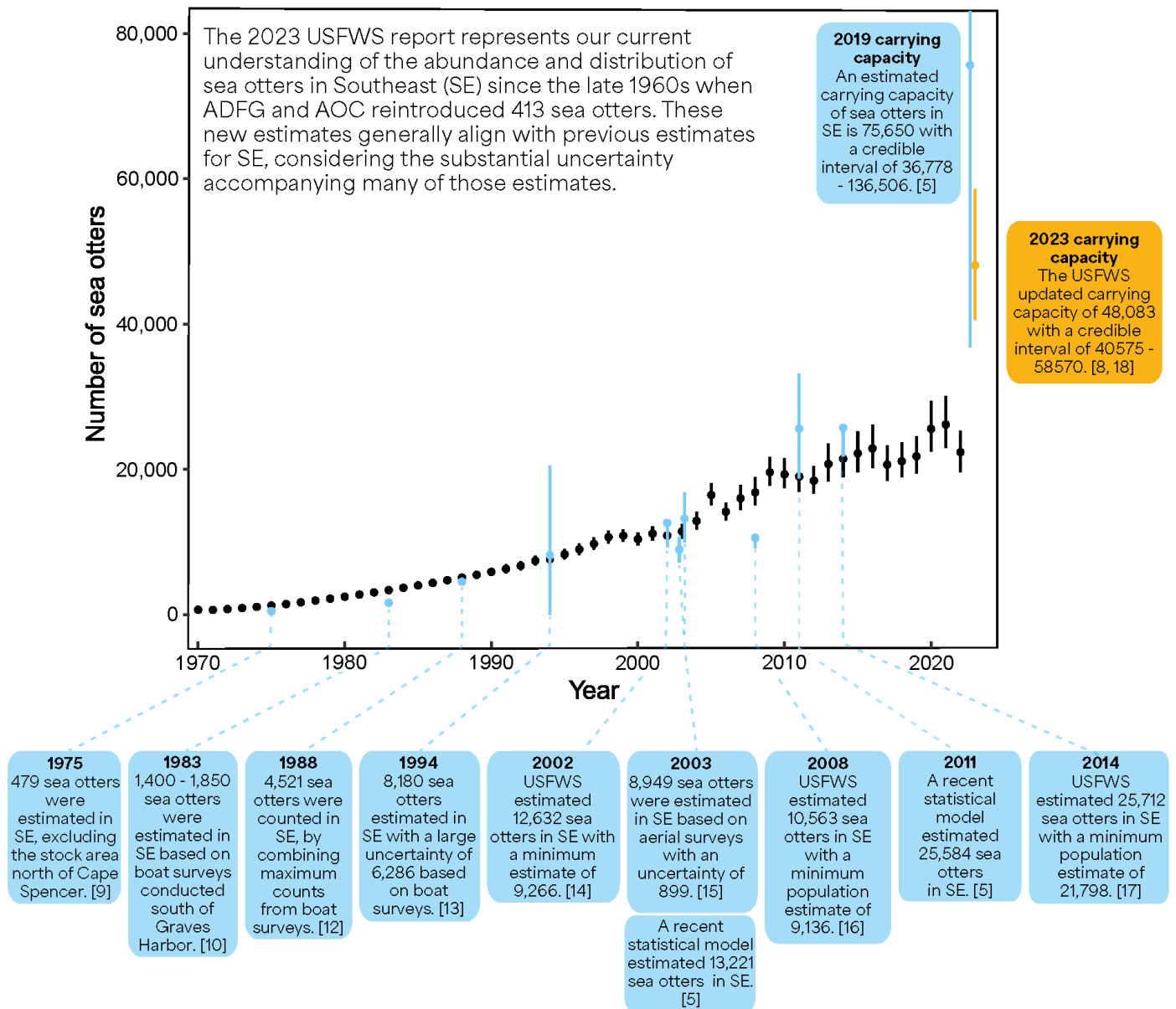


Figure 3. Figure adapted from the USFWS 2023 report⁸ showing current (black) and historical (colors) estimates of sea otter abundance in SE. Error bars represent different measures of uncertainty depending on the type of estimate and are shown only to provide a general idea of the uncertainty around estimates. Not shown are years where smaller-scale surveys occurred, such as NPS/USGS Glacier Bay surveys in most years beginning in 1993.

- Kenyon, K.W. 1969. The sea otter in the eastern Pacific Ocean: Washington, D.C., U.S. Fish and Wildlife Service, North American Fauna 68, 352 p.
- Williams, P.J., Hooten, M.B., Womble, J.N., Esslinger, G.G., Bower, M.R., and Hefley, T.J. 2017. An integrated data model to estimate spatiotemporal occupancy, abundance, and colonization dynamics. *Ecology* 98:328-336. <https://doi.org/10.1002/ecy.1643>
- Williams, P.J., Hooten, M.B., Esslinger, G.G., Womble, J.N., Bodkin, J.L., and Bower, M.R. 2019. Diversity and Distributions 25:895-908. <https://doi.org/10.1111/ddi.12908>
- Lu, X., Williams, P.J., Hooten, M.B., Powell, J.A., Womble, J.N., and Bower, M.R. 2019. Nonlinear reaction-diffusion process models improve inference for population dynamics. *Environmetrics* e2604. <https://doi.org/10.1002/env.2604>
- Tinker, M.T., Gill, V.A., Esslinger, G.G., Bodkin, J., Monk, M., Mangel, M., Monson, D.H., Raymond, W.W., and Kissling, M.L. 2019. Trends and carrying capacity of sea otters in Southeast Alaska. *The Journal of Wildlife Management* 83:1073-1089. <https://doi.org/10.1002/wjmg.21685>
- Eisaguirre, J.M., Williams, P.J., Lu, X., Kissling, M.L., Beatty, W.S., Esslinger, G.G., Womble, J.N., and Hooten, M.B. 2021. Diffusion modeling reveals effects of multiple release sites and human activity on a recolonizing apex predator. *Movement Ecology* 9:34. <https://doi.org/10.1186/s40462-021-00270-w>
- Eisaguirre, J.M., Williams, P.J., Lu, X., Kissling, M.L., Schuette, P.A., Weitzman, B.P., Beatty, W.S., Esslinger, G.G., Womble, J.N., and Hooten, M.B. 2023. Informing management of recovering predators and their prey with ecological diffusion models. *Frontiers in Ecology and the Environment*: in press. <https://doi.org/10.1002/fee.2673>
- Schuette, P., Eisaguirre, J., Weitzman, B., Power, C., Wetherington, E., Cate, J., Womble, J., Pearson, L., Melody, D., Merriman, C., Hanks, K., and Esslinger, G. 2023. Northern Sea Otter (*Enhydra lutris kenyoni*) Population Abundance and Distribution across the Southeast Alaska Stock: Summer 2022. USFWS Region 7 Technical Report MMM-2023-01, 41 p. <https://www.fws.gov/media/usfws-region-7-technical-report-mmm-2023-01-march-2023>
- Jameson, R.J., Kenyon, K.W., Johnson, A.M., and Wight, H.M. 1982. History and status of translocated sea otter populations in North America. *Wildlife Society Bulletin* 10:100-107. <https://www.istor.org/stable/3781726>
- Johnson, A., Jameson R., Schmidt, T., and Calkins, D. 1983. Sea otter survey, Southeast Alaska, 1983. U.S. Fish and Wildlife Service, Anchorage, Alaska, 10 p.
- Simon-Jackson, T., and Hodges, J. 1986. Sea Otter Survey, Southeast Alaska - 1986. US Fish and Wildlife Service report. <https://ecos.fws.gov/ServCat/DownloadFile/49962?Reference=49418>
- Pitcher, K.W. 1989. Studies of southeastern Alaska sea otter populations: Distribution, abundance, structure, range expansion, and potential conflicts with shellfisheries. U.S. Fish and Wildlife Service Cooperative Agreement NO. 14-16-0009-954 Final Report. https://www.adfg.alaska.gov/static/home/library/pdfs/wildlife/federal_aid/89_seott_se_pitcher.pdf
- Aglar, B.A., Kendall, S.J., Seiser, P.E., and Lindell, J.R. 1995. Estimates of marine bird and sea otter abundance in Southeast Alaska during summer 1994: U.S. Fish and Wildlife Service, Anchorage, Alaska, 102 p
- US Fish and Wildlife Service [USFWS]. 2002. Northern Sea Otter (Southeast Alaska) Stock Assessment Report.
- Esslinger, G.G., Bodkin, J.L. 2009. Status and trends of sea otter populations in Southeast Alaska, 1969-2003. Scientific Investigations Report 2009-5045. <https://pubs.usgs.gov/sir/2009/5045/pdf/sir20095045.pdf>
- USFWS. 2008. Northern Sea Otter (Southeast Alaska) Stock Assessment Report.
- USFWS. 2014. Northern Sea Otter (Southeast Alaska) Stock Assessment Report. <https://www.fws.gov/media/northern-sea-otter-southeast-alaska-stock-assessment-report>
- USFWS. 2023. Northern Sea Otter (Southwest Alaska) Stock Assessment Report. <https://www.fws.gov/media/northern-sea-otter-southwest-alaska-stock-assessment-report-0>