

Marbled Murrelet Breeding and Over-wintering Status and Trends

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Washington Department of Fish and Wildlife



Outline

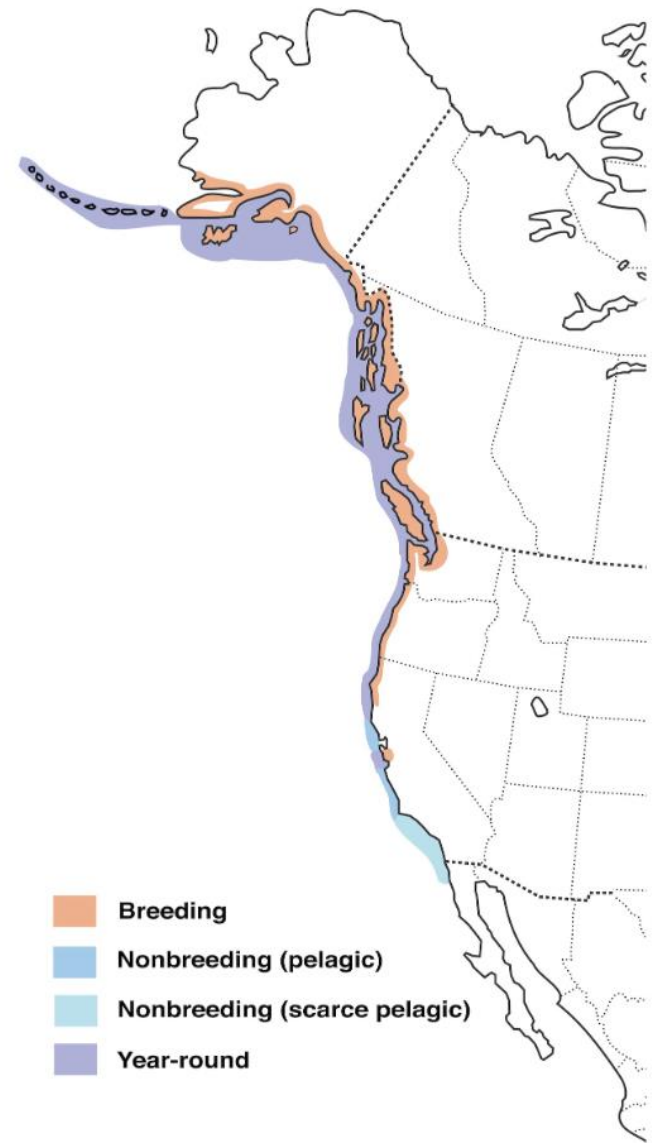
- Natural History
- NW Forest Plan Effectiveness Monitoring
- Navy Monitoring
- Other uses of the data



Joe Evenson, WDFW

Natural History

- Family Alcidae
- Range: Pacific coast of North America
- Found in marine waters adjacent to nesting areas year-round



Natural History (Washington Specific)

- Nests primarily in older forests between Apr and late Aug
- Females lay 1 egg
- Both sexes incubate in alternating 24-hour shifts for 20-30 d.



Adult marbled murrelet on nest. Photo credit:
Nick Hatch, U.S. Forest Service

Natural History (Washington Specific)

- Provisioning lasts for 27-40 d
- Adults establish long-term pair bonds and appear to return to same forest each year
- Life span around 10-15 years and first breed at age 2-3



Adult marbled murrelet on nest. Photo credit: Nick Hatch, U.S. Forest Service

Natural History

- Feeds within 2-3 miles of coast
- Typically in water <100 feet deep
- Small schooling fish and invertebrates
- Uses compact wings to swim in pursuit of underwater prey.



Adult marbled murrelet with Pacific Sand Lance. Photo credit: Scott Pearson



CHARACTERIZING THE DIET OF A THREATENED SEABIRD, THE MARBLED MURRELET *BRACHYRAMPHUS MARMORATUS*, USING HIGH-THROUGHPUT SEQUENCING

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ABSTRACT

FOUNTAIN, E.D., KULZER, P.J., GOLIGHTLY, R.T., RIVERS, J.W., PEARSON, S.F., RAPHAEL, M.G., BETTS, M.G., NELSON, S.K., ROBY, D.D., KRYSHAK, N.F., SCHNEIDER, S. & PEERY, M.Z. 2023. Characterizing the diet of a threatened seabird, the Marbled Murrelet *Brachyramphus marmoratus*, using high-throughput sequencing. *Marine Ornithology* 51: 145–155.

Understanding prey consumption patterns is critical to understanding the ways in which seabirds cope with a changing ocean. However, characterizing the dietary habitats of seabirds can be challenging. In this study, we investigated the diet of the Marbled Murrelet *Brachyramphus marmoratus* population that lives in waters off California, Oregon, and Washington, USA, using fecal DNA, custom metabarcoding, and high-throughput sequencing. Murrelets were captured at sea by dip-netting at night. Across this region, murrelets consumed highly diverse prey types including 17 fish species and 10 invertebrate species, in accord with previous work indicating the species' forage on a wide range of prey. Pacific Herring *Clupea pallasii* was the most common prey in Washington and Oregon (frequency of occurrence = 0.84 and 0.69, respectively), replaced by Northern Anchovy *Engraulis mordax* in California (frequency of occurrence = 0.77). In Oregon, where our sample size was sufficient, diet composition differed between the 2017 and 2018 breeding seasons, with an apparent decline in the proportional consumption of energy-dense prey. Common and energy-dense prey were consumed in equal proportions by males and females, perhaps because of foraging in the same habitat. Diet did not vary between breeders and non-breeders. Our study offers the first detailed report on the diet of adult Marbled Murrelets in waters where they are listed as Threatened by the US federal government. This indicates that managing fisheries and conserving spawning habitat for high-occurrence prey species could benefit murrelet populations.

Key words: metabarcoding, fecal DNA, Illumina MiSeq, climate change, prey



Northwest Forest Plan
Interagency Regional
Monitoring Program

Status & Trend of the Marbled Murrelet in the Pacific Northwest





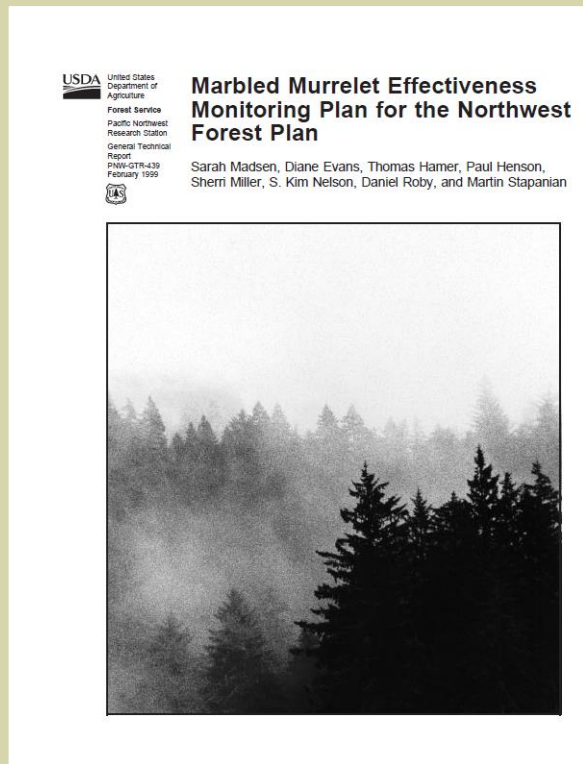
Northwest Forest Plan
Interagency Regional
Monitoring Program

Northwest Forest Plan

- Plan Goals:
 - Viable murrelet population
 - Maintain and increase nesting habitat
- How to evaluate?
 - Monitor murrelet populations
 - Monitor nesting habitat



**NORTHWEST
FOREST PLAN**





Northwest Forest Plan
Interagency Regional
Monitoring Program

NWFP Effectiveness Monitoring - Population Team

Monique Lance - WDFW
Scott Pearson - WDFW
Katherine Fitzgerald - USFWS - Lacey WA
Martin Raphael - USFS - PNW (retired)
Adam Duarte - USFS - PNW
Kim Nelson - Oregon State University
Craig Strong - Crescent Coastal Research
Jim Baldwin - USFS - PSW (retired)
William McIver - USFWS - Arcata, CA (lead)

Funding Sources



**NORTHWEST
FOREST PLAN**

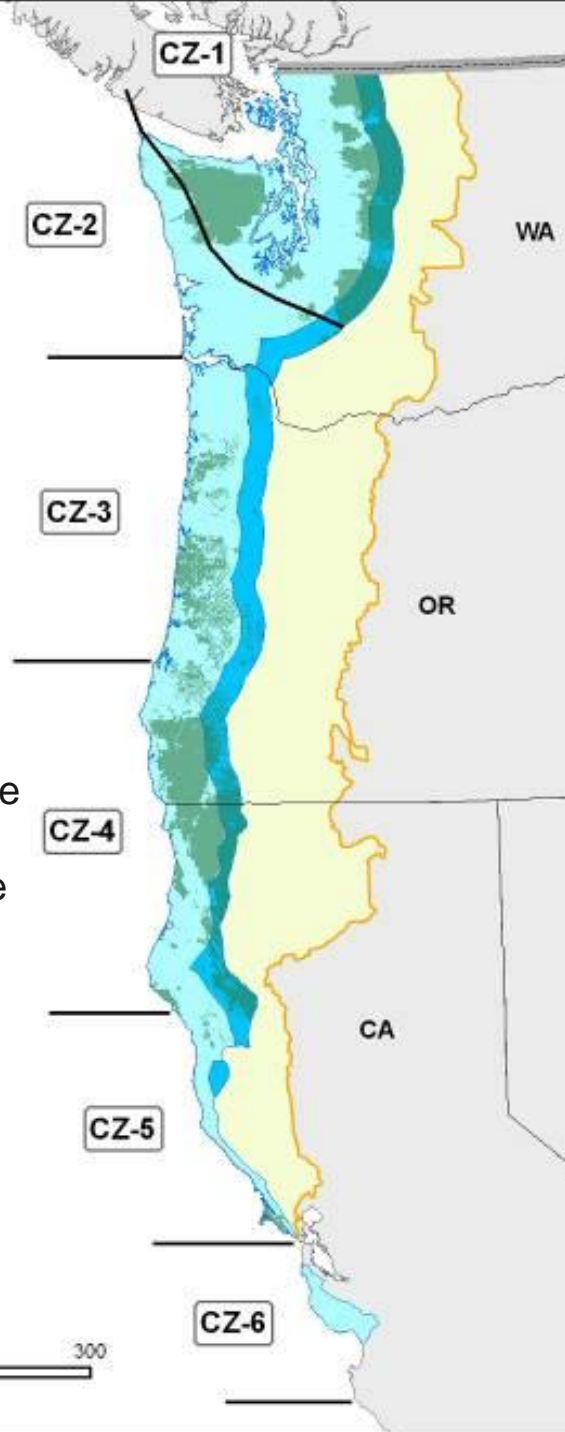
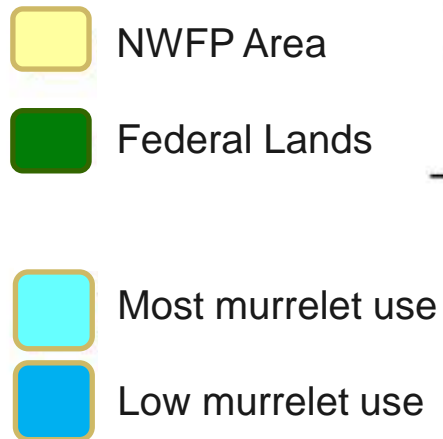


Population Monitoring Objectives

**Is the population stable or increasing?
(1994 NWFP Record of Decision)**

- Estimate population size
- Estimate population change over time (since 2000-2001)




Population Methods



- Ongoing since 2000
- Estimate for:
 - NWFP Area
 - 5 Conservation Zones
 - 3 States
- Survey at sea during nesting season
- Standardized protocol

Population Methods



-  NWFP Area
-  Federal Lands
-  Most murrelet use
-  Low murrelet use



United States
Department of
Agriculture

Forest Service

Pacific Northwest
Research Station

General Technical Report
PNW-GTR-716
May 2007



Regional Population Monitoring of the Marbled Murrelet: Field and Analytical Methods

Martin G. Raphael, Jim Baldwin, Gary A. Falxa, Mark H. Huff,
Monique Lance, Sherri L. Miller, Scott F. Pearson, C. John Ralph,
Craig Strong, and Chris Thompson



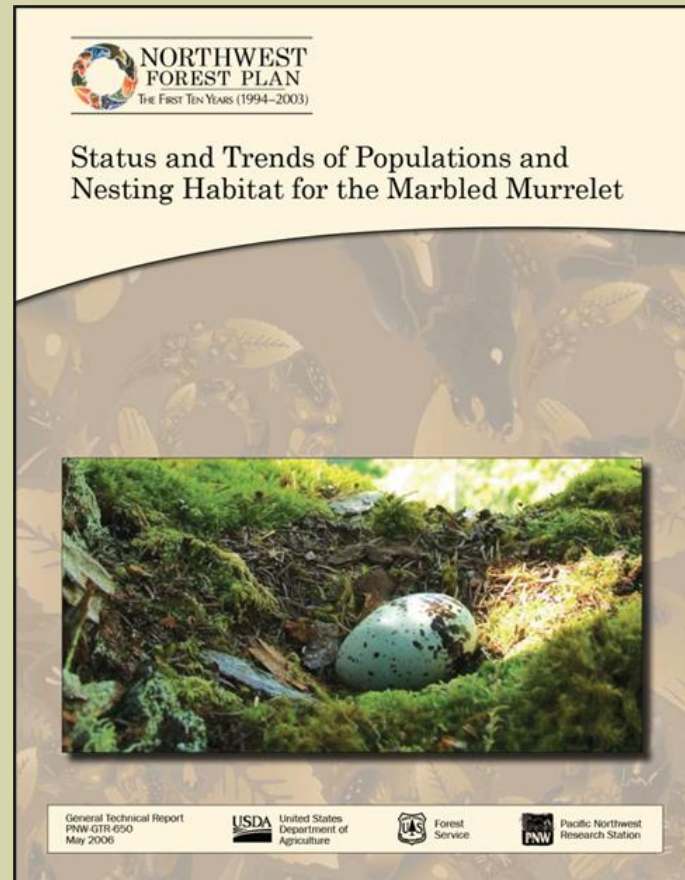
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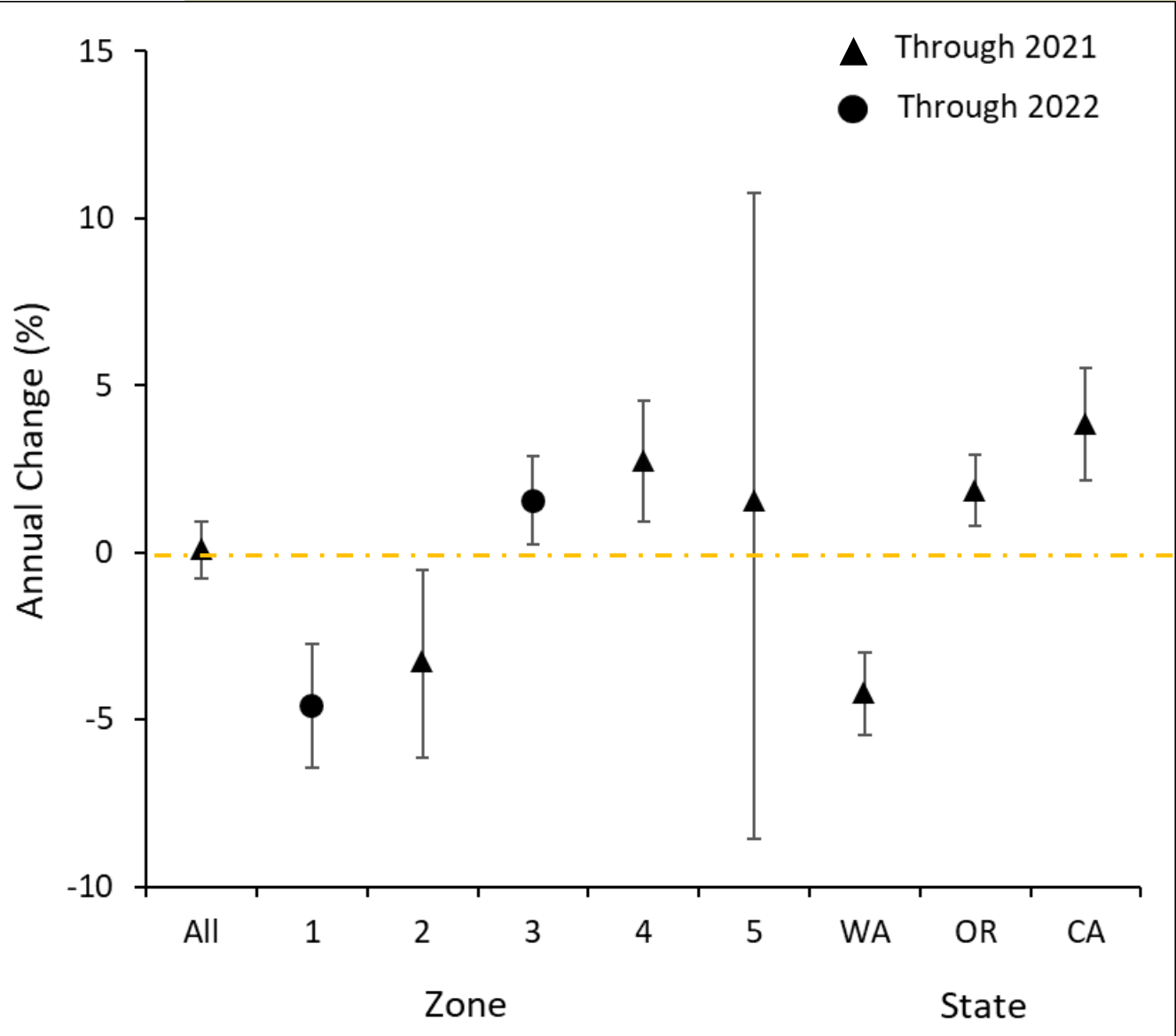
Results

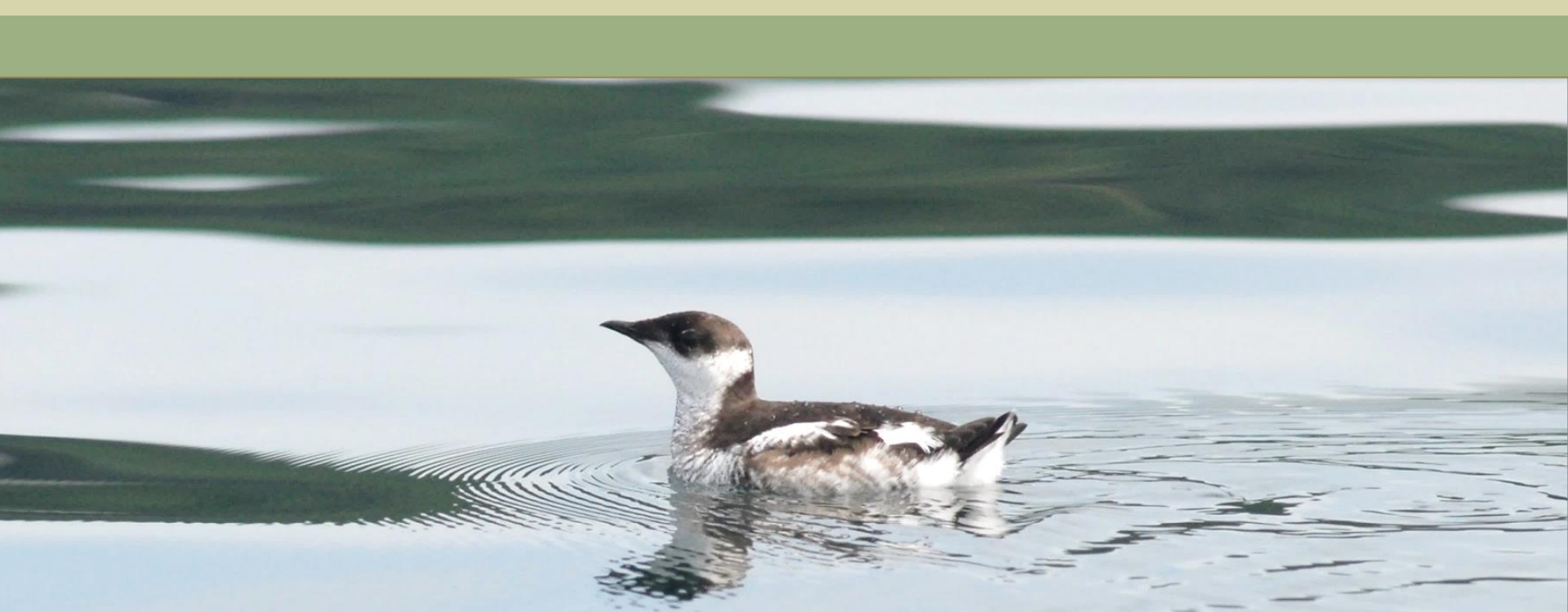
- Results reported annually
 - Range-wide scale
 - Conservation zone scale
 - Stratum scale
- Five-year reports





Results (example)



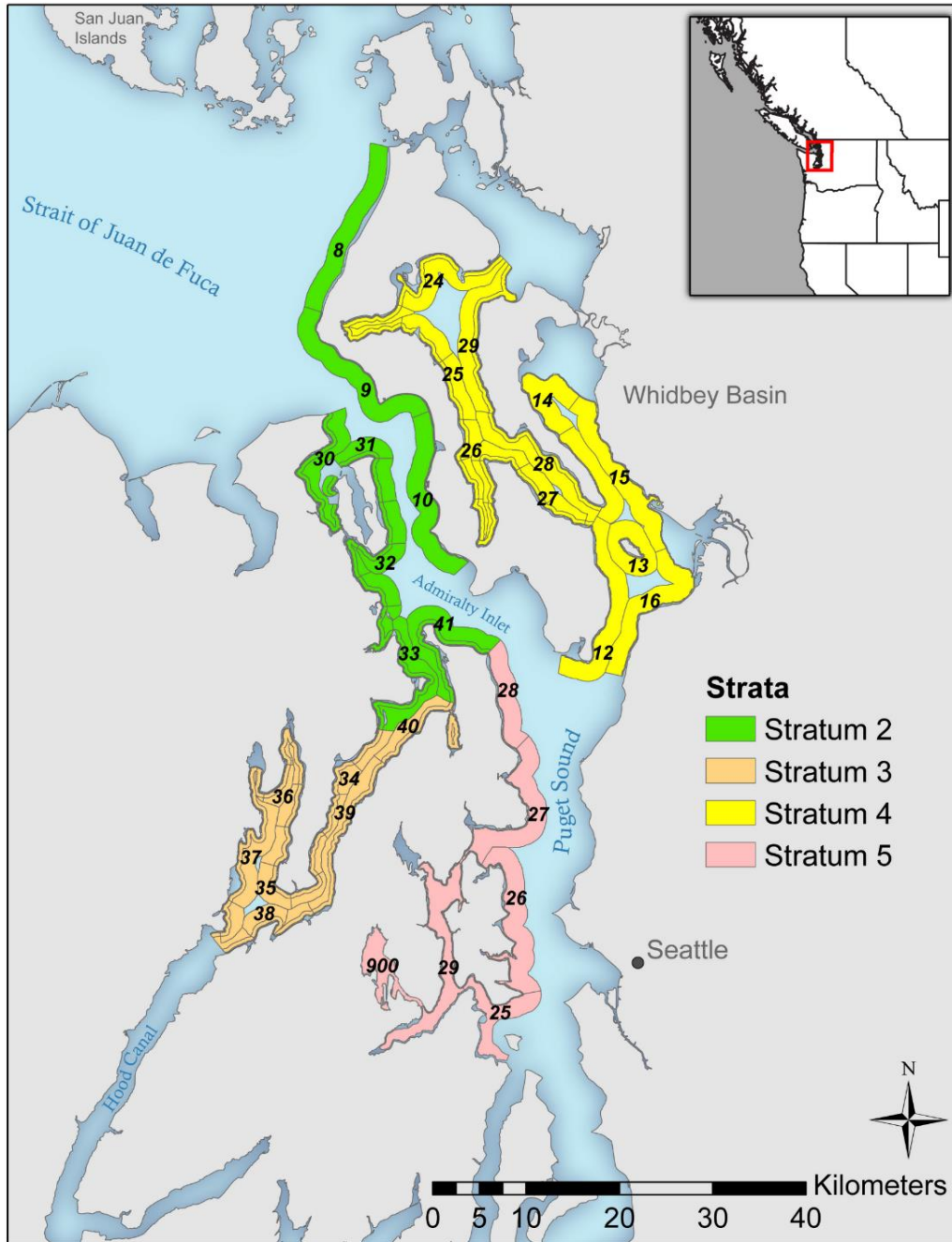


**NON-BREEDING CHANGES IN AT-SEA DISTRIBUTION
AND ABUNDANCE OF THE THREATENED MARBLED
MURRELET (*BRACHYRAMPHUS MARMORATUS*) IN A
PORTION OF ITS RANGE
EXHIBITING LONG-TERM BREEDING SEASON DECLINES**

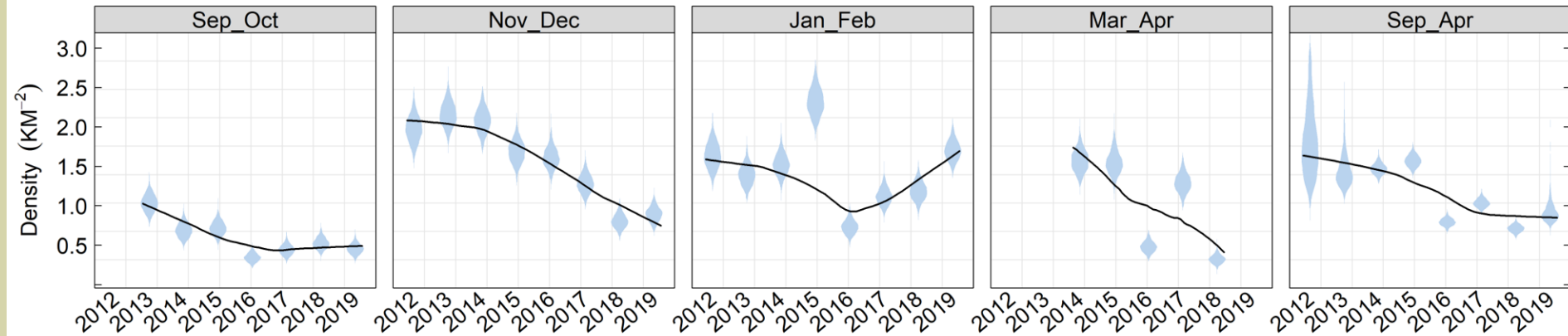
Scott F. Pearson, Ilai Keren, Monique
M. Lance, and Martin G. Raphael

Little information on murrelet abundance, distribution, and population trends during the non-breeding season

- We assessed non-breeding (Sep – Mar) at-sea murrelet abundance patterns and population trends over 8 years in Puget Sound
- Integrated our non-breeding abundance information with breeding season information to assess year-round patterns of abundance
 - Do murrelets move into the relatively protected waters of Puget Sound during the non-breeding season?

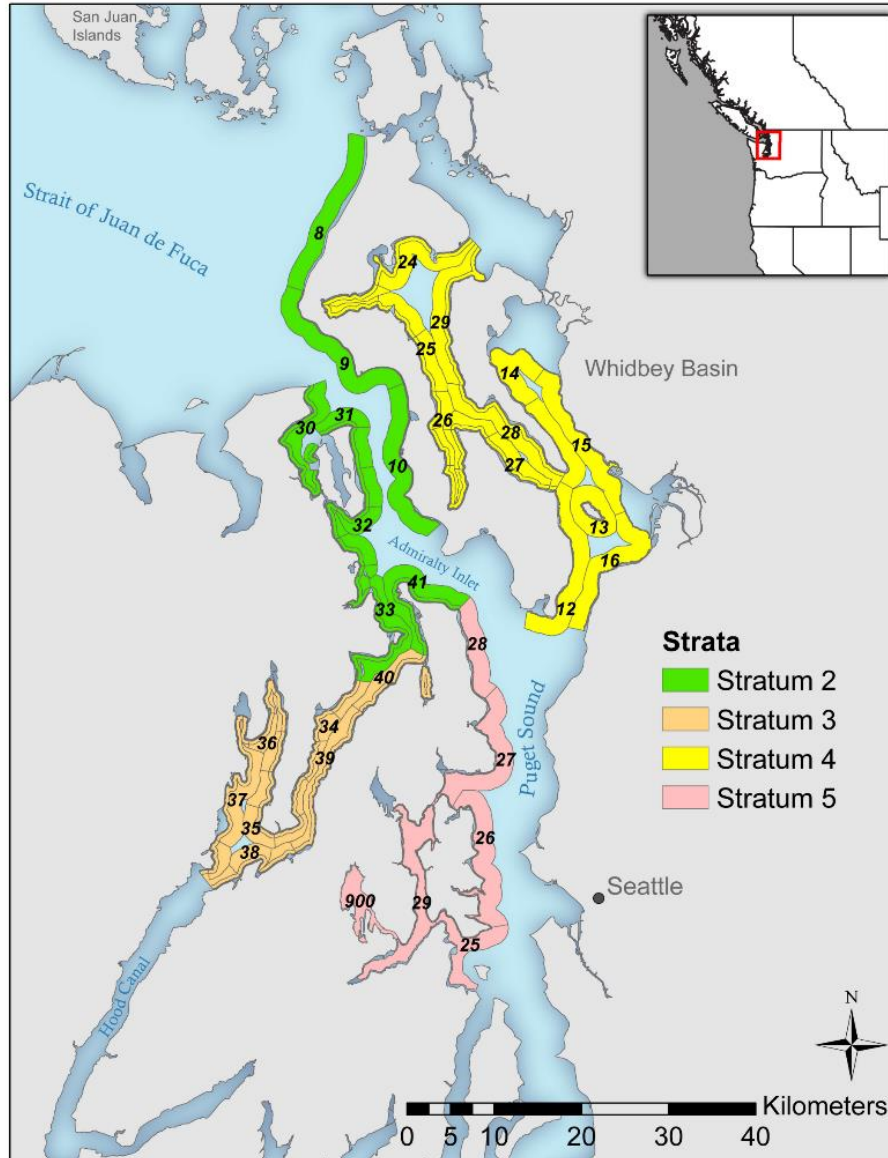


Trends by survey window

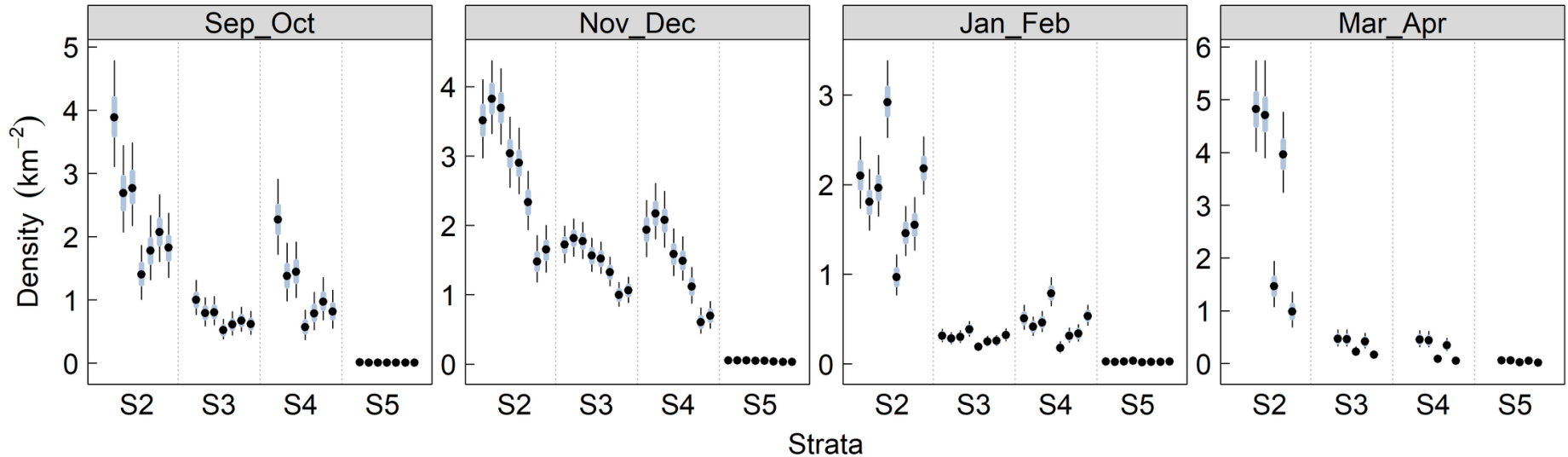


- Decline in Murrelet density across the entire non-breeding period (Sep - Apr)
- Declines most pronounced in the fall and early winter (late Sep - Dec) survey windows when birds molt and in the spring just prior to breeding (Mar-Apr)
- Despite declines, there was no change in murrelet density in mid-winter (Jan-Feb)

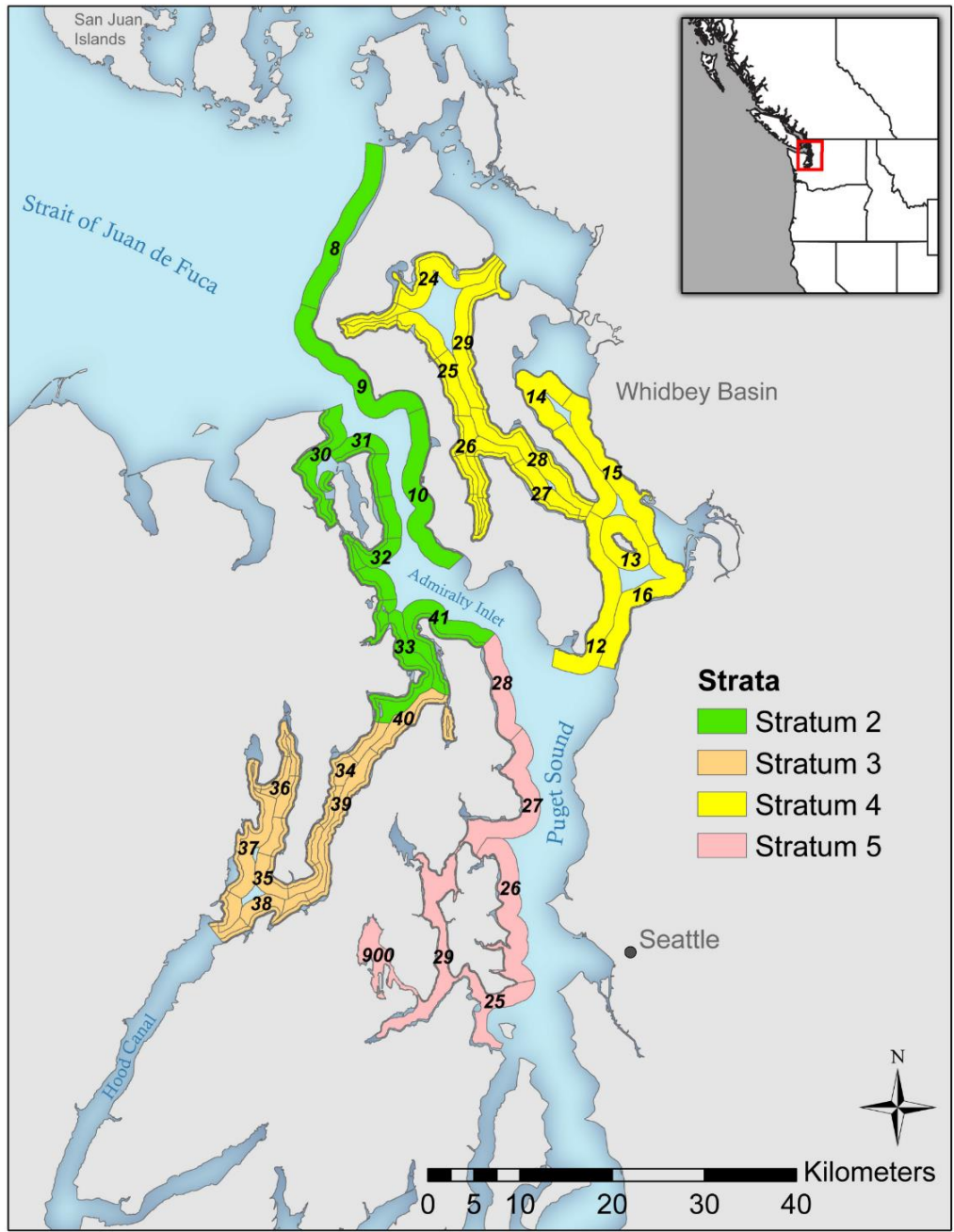
Comparing density among strata and non-breeding “seasons”



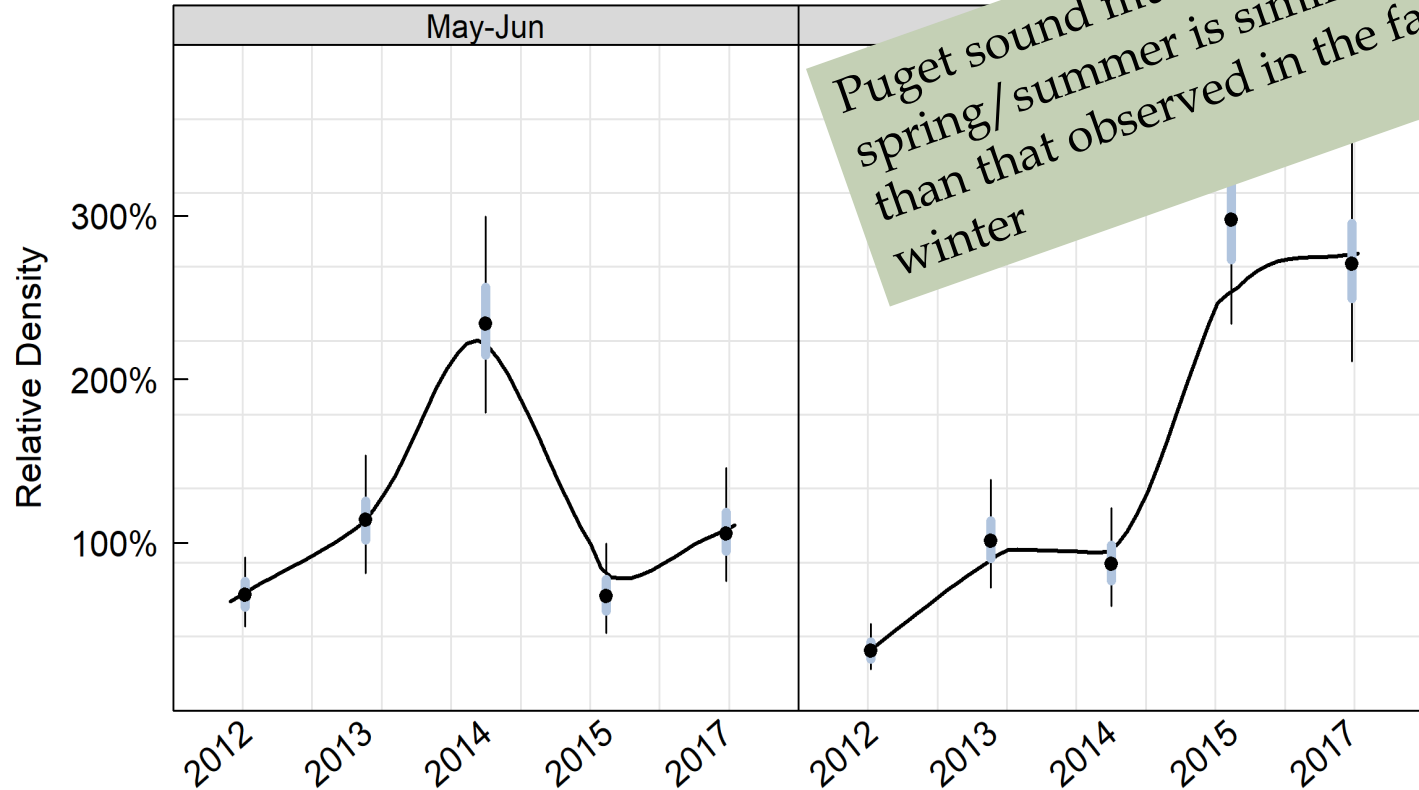
Change in density by strata and 2-month survey windows / "Seasons"



- The Admiralty Inlet region (S2) had the highest densities throughout the non-breeding season
- Essentially no birds observed in central Puget Sound (S5)
- Density in Hood Canal (S3) and Whidbey basin (S4) is higher in the fall (Sept-Dec) than in winter and early spring.

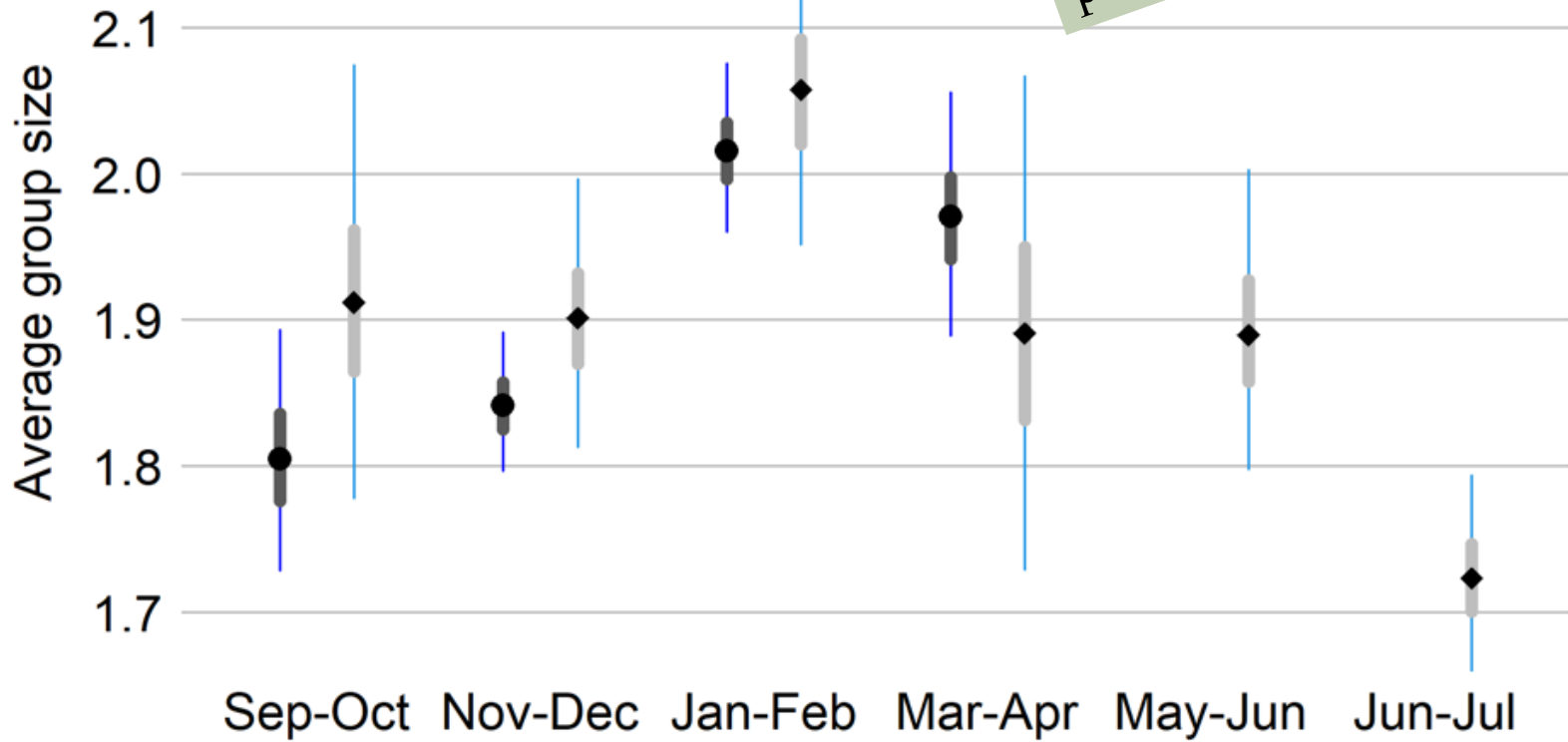


Murrelet density during 2-month breeding-season survey intervals relative to the non-breeding season



Group size

Murrelets appear to remain in pairs year-round



Summary

- Evidence of non-breeding season declines in Puget Sound
 - Except for mid-winter
- No evidence that murrelets are moving into the relatively protected waters of Puget Sound during the non-breeding season
- Admiralty inlet is a region of high murrelet density in the non-breeding season
- Apparent N-S change in murrelet density that parallels changes in forage fish abundance
- Additional evidence that murrelets maintain year-round pair bonds



Other Products

Land-Sea Modelling (Raphael et al. 2015, Journal Marine Systems)

- Question: What marine and terrestrial factors best explain marbled murrelet distribution and trends at sea?



- Key Finding:
 - Terrestrial factors, particularly the amount and pattern of nesting habitat, best predict murrelet distribution and trends at sea.
 - Marine factors become more important in the Salish Sea



Other Products

Bird Conservation
International

www.cambridge.org/bci

Research Article

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Keywords: Endangered species; Conservation; Population trends; Tufted Puffin; *Fratercula cirrhata*

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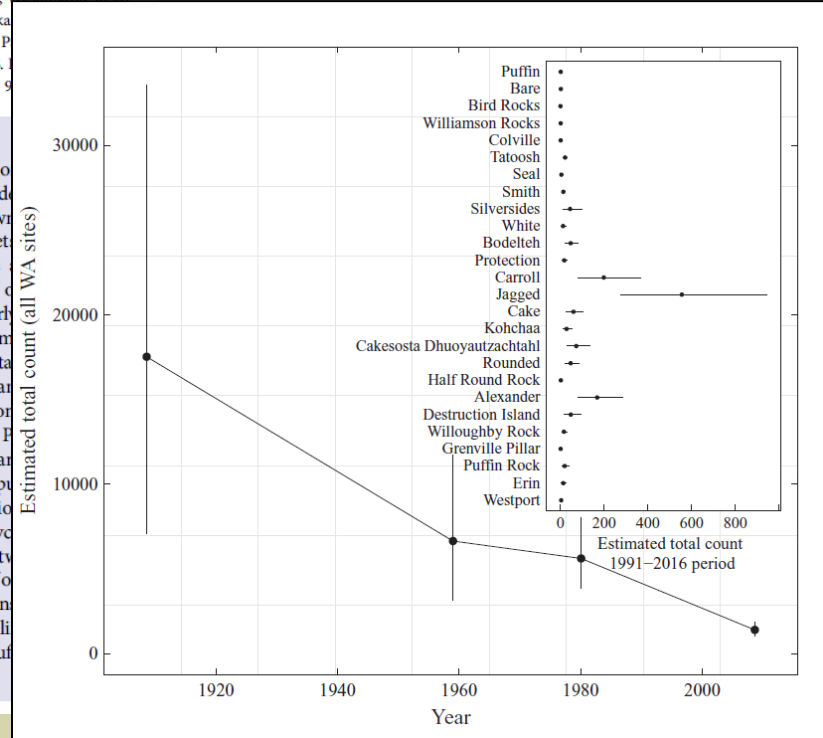
Range-wide changes in the North American Tufted Puffin *Fratercula cirrhata* breeding population over 115 years

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Summary

Regional and local studies suggest that the Tufted Puffin *Fratercula cirrhata* in North America is declining in portions of its range. However, whether the overall population is declining or contracting with little change to the overall population size, is unknown. To assess population trends throughout its North American range, we assembled 11 datasets from 115 years (1905–2019) and included at-sea density and encounter estimates of burrow and bird counts. We assessed trends for the California Current, Gulf of Alaska, and Bering Sea/Aleutian Islands large marine ecosystems (LME). We found: (1) nearly all colonies surveyed, (2) declining trends at two large colonies and in one at-sea data point in the Gulf of Alaska LME, with the fourth smaller colony exhibiting no significant trend, and (3) trends at four out of five colonies in the Bering Sea/Aleutian Islands ecosystem corresponded to a detectable trend at the fifth very large colony. The general pattern of Tufted Puffin declines across the California Current and Gulf of Alaska LMEs may be attributable to a variety of factors, but additional study is needed to evaluate the relative influence of potential population drivers both independently and synergistically. Potential mechanisms driving population declines in the Bering Sea/Aleutian Islands ecosystem include reduced depredation and bycatch, reduced population growth, and immigration. We found strong evidence for declines in two of the LMEs evaluated representing approximately three quarters of the species' North American range. This region of decline includes the Gulf of Alaska LME, which contains the largest portion of the species' estimated total North American population. Despite data limitations, our analysis coupled with more focused and local studies indicates that the Tufted Puffin is a species of conservation concern.

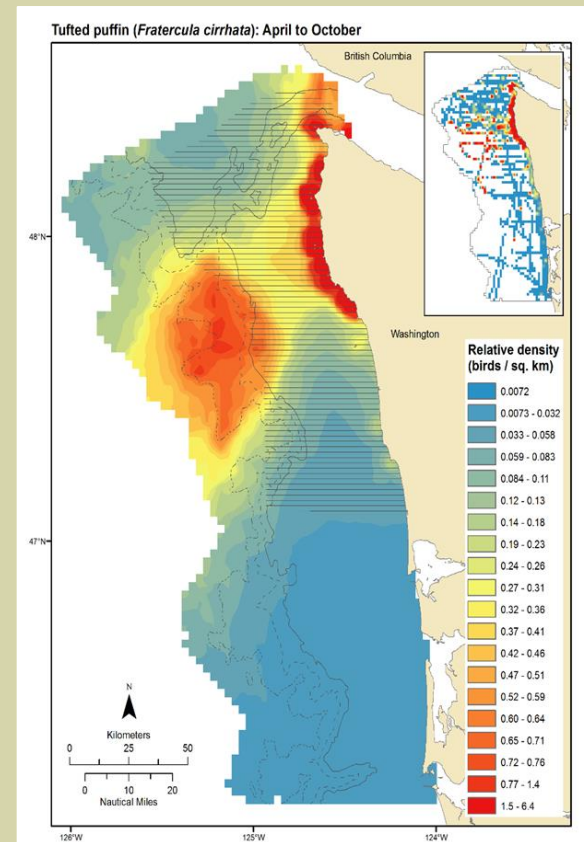




Other Products

Menza et al. 2016 (NOAA Technical Memorandum NOS NCCOS 210)

- Predictive mapping of seabirds, pinnipeds and cetaceans off the Pacific Coast of Washington





Other Products

Pearson, Gardner, and Gillman (in process)

- Hierarchical distance models (new class of models)
 - Integrate Navy funded surveys with NWFPEM surveys
 - Predictive density surfaces
 - Identifies hotspots/coldspots (seasonal? Change over time and space?)
 - Factors driving trends – should help set conservation priorities.



Other uses

- Assess population trends and recovery under the ESA and the effectiveness of the NWFP
- Section 7 consultations (e.g., alternative energy, Navy) and marine spatial planning generally
- Continues to engage research scientists in marbled murrelet conservation

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- Funding: US Navy



Questions?

