

Marine Winter Bird Surveys in Prince William Sound

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The opinions expressed in this PWSRCAC-commissioned report are not necessarily those of PWSRCAC.

Executive Summary

This project provided funding for at-sea marine bird and marine mammal surveys in under-surveyed areas in and around the tanker escort zone in Prince William Sound (PWS), Alaska. It complements the Exxon Valdez Oil Spill Trustee Council (EVOSTC)-funded Gulf Watch Alaska surveys conducted by the PWS Science Center. Marine bird and mammal distribution and density around much of the tanker lane, Valdez Arm, and Port Valdez is largely unknown as current surveys do not cover these regions and many of these areas have not been surveyed in over a decade.

At-sea surveys were conducted 1-6 and 16 March 2021, during daylight hours from the PWS Science Center's research vessel, the R/V New Wave. All marine birds and marine mammals observed within a 300-meter (m) survey strip in a series of transects varying in length from 7.3 kilometers (km) (Rocky Bay) to 25.7 km (Valdez Arm), for a total of 184.5 km, were recorded. Across all transects, 707 birds representing 21 species were counted. Marine bird observations were dominated by marbled murrelet (*Brachyramphus marmoratus*), followed by common murre (*Uria aalge*), pelagic cormorant (*Phalacrocorax pelagicus*), black-legged kittiwake (*Rissa tridactyla*), and glaucous-winged gull (*Larus glaucescens*). Additionally, 168 marine mammals of 6 species were recorded (including individuals observed beyond the 300-m survey strip). Marine mammal observations were comprised primarily of sea otter (*Enhydra lutris*) and harbor seal (*Phoca vitulina*).

It is challenging to draw conclusions from a single survey. However, the results of this survey emphasize the importance of protected nearshore habitat for marine birds and mammals during the winter. The results suggest priority areas for safeguarding in the event of anthropogenic disturbance, including the areas around Hinchinbrook Entrance (Port Etches and Zaikof Bay), the head of Port Valdez between the Valdez Container Terminal and the outflow of Valdez Glacier Stream, and nearshore areas in southeastern Port Fidalgo. While these surveys do not include all areas that potentially may be impacted by an oil spill, nor do they capture all marine bird winter habitat, continued monitoring efforts in and around the tanker escort lane are important for understanding marine bird and mammal vulnerability to environmental change and anthropogenic disturbance and could be used to refine oil spill response efforts during the nonbreeding season.

Introduction

In Alaska, and specifically Prince William Sound (PWS), most studies on marine birds are conducted during the breeding season when marine birds congregate at or near colonies to nest and forage. However, breeding season dynamics are not representative of the community composition or spatial distribution during the winter. The non-breeding season is a critical period of survival for marine birds overwintering

at higher latitudes as food tends to be relatively scarce or inaccessible, the climate more extreme, light levels and day-length reduced, and water temperatures cooler.

As part of the Exxon Valdez Oil Spill Trustee Council (EVOSTC)-funded Gulf Watch Alaska (GWA) program, Dr. Mary Anne Bishop (PWS Science Center) has been conducting marine bird surveys in PWS during fall and winter since 2007. During this time, consistent temporal and spatial patterns in abundance and distribution for the most abundant marine bird species have been documented, including common murre (*Uria aalge*), marbled murrelet (*Brachyramphus marmoratus*), black-legged kittiwake (*Rissa tridactyla*), and large gulls (*Larus* spp; Schaefer et al. 2020, Stocking et al. 2018, Dawson et al. 2015, Zuur et al 2012). However, many regions of PWS remain under-surveyed during winter, including the areas in and around the Alyeska Pipeline Service Company's Valdez Marine Terminal and the associated tanker escort zone. Marine bird distribution and density around much of the tanker lane, Valdez Arm, and Port Valdez is largely unknown as current surveys do not cover these regions and many of these areas have not been surveyed since 2010.

This report describes the density, distribution, and community composition of marine birds and marine mammals in and around the tanker escort zone in PWS as observed during March 2021 at-sea surveys. The report also provides recommendations for prioritizing oil spill response efforts in and around the tanker escort lane.

Methods

At-sea marine bird and mammal surveys were conducted during daylight hours along fixed transects in and around the tanker escort zone in PWS and followed established U.S. Fish and Wildlife Service (USFWS) protocols (USFWS 2007). One observer using 10x binoculars recorded the number, species, and behavior of all marine birds and mammals occurring within a 300-meter (m) fixed-width strip (150-m both sides and ahead of boat) from a clear observation platform ~3 m above the water line while the vessel traveled at a constant speed between 5 and 10 knots. Noteworthy observations (e.g., marine mammals, forage flocks) were recorded out to 1 kilometer (km). For this study, a forage flock is defined as an aggregation of greater than 10 individuals of one or more species actively foraging or flying but showing a clear interest in the water surface by either circling or hovering (Anderwald et al. 2011). Observations were recorded into a laptop computer integrated with a global positioning system (GPS) using the program dLOG (Ford 1999). Location data (latitude, longitude) were automatically recorded at 15-second (s) intervals and for every entered observation. Additionally, sea and weather conditions were tracked on-site by the observer.

We divided each transect into 3-km segments and aggregated marine bird observations within each segment for summary. We grouped taxonomically similar species into 14 groups (Table 1) and calculated relative density (birds/km²) for each 3-km segment. Data processing was performed using QA/QSea (ABR, Inc) and program R, and mapping was performed using ArcMap 10.8.1. Marine mammals were not aggregated by 3-km segment, but are presented as recorded along the transect and in some instances beyond the survey strip out to 1-km.

Table 1. Taxonomically similar species combined for density analysis and mapping, Prince William Sound, March 2021.

Species group	Common Name(s)
Cormorants	Double-crested, Pelagic
Grebes	Horned, Red-necked
Guillemots	Pigeon
Harlequin Ducks	Harlequin
Inshore Ducks	Barrow's Goldeneye, Common Goldeneye, Bufflehead
Kittiwakes	Black-legged
Large Gulls	Glaucous-winged, Herring
Loons	Common, Pacific
Long-tailed Ducks	Long-tailed
Mergansers	Common, Red-breasted
Murrelets	Marbled
Murres	Common
Scoters	Surf, White-winged
Small Gulls	Mew

Results & Discussion

At-sea marine bird and mammal surveys were conducted in and around the tanker escort zone in PWS 1-6 and 16 March 2021 from the PWS Science Center's research vessel, the R/V New Wave (Fig. 1). Data from this survey have been uploaded to the Alaska Ocean Observing System (AOOS) data portal and are available at https://gulf-of-alaska.portal.aos.org/#metadata/771492cd-94b6-47ab-952a-02b152a535cf/project/folder_metadata/2660866. Overall, we surveyed along 184.5 km of transects (Table 2). Sea conditions during surveys were mostly calm (sea state 1: ¼ foot (ft) waves) but ranged up to Beaufort sea state 3 (2 ft waves) (Table 2). Surveys are not conducted when sea states are greater than sea

state 3, which presented a challenge when trying to complete the Valdez Arm transect. Due to a persistent 25-35-knot wind and small craft advisories, sea conditions in this area were unfavorable until March 16, a full 10 days after the rest of the survey had been completed. During the survey, the weather was mostly clear or partly cloudy (weather state 0), but we also experienced overcast skies (weather state 1) and snow (weather state 7) (Table 2).

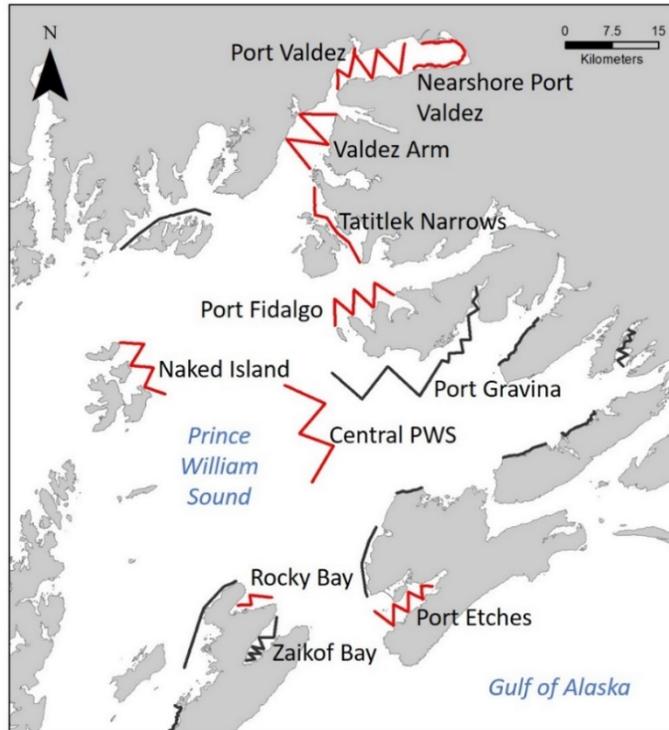


Figure 1. Map of marine bird and marine mammal transects in and around the tanker lanes surveyed in Prince William Sound, March 2021. The black lines indicate the areas around the tanker lanes surveyed each March and November as part of EVOSTC Gulf Watch Alaska-funded surveys. The red lines show the transects completed for the Prince William Sound Regional Citizens' Advisory Council (PWSRCAC) during March 2021.

Table 2. Transects surveyed for PWSRCAC in PWS during March 2021. Sea conditions were mostly calm (sea state (SS) 1: ¼ ft waves) but ranged up to SS 3 (2 ft waves). The weather was mostly clear (weather state (WS) 0), but we also experienced overcast skies (WS 1) and snow (WS 7). The mode for SS and WS on each transect is reported.

Transect Name	Length (km)	Area Sampled (km²)	Sea State	Weather State	Bird density (birds/km²)	# Mammals (within 1 km)
Central PWS	25.0	7.79	3	0	0.8	2
Port Etches	19.7	5.91	1	7	39.3	27
Port Fidalgo	23.9	7.17	1	0	18.3	8
Naked Island	18.4	5.53	1	0	9.5	4
Nearshore Port Valdez	18.2	5.46	1	0	26.3	78
Port Valdez	30.8	9.23	1	0	4.6	7
Rocky Bay	7.3	2.19	1	0	8	6
Tatitlek Narrows	15.4	4.63	1	1	12	21
Valdez Arm	25.7	7.71	2	1	0	15

Marine Birds

We recorded 707 birds representing 21 species within the 300-m survey strip (Table 3). The avian community was dominated by murrelets (31.1%; marbled and unidentified *Brachyramphus*), followed by common murre (12.4%), pelagic cormorant (*Phalacrocorax pelagicus*; 11.9%), black-legged kittiwake (10%), and glaucous-winged gull (*Larus glaucescens*; 8.5%). The marine bird community during the March EVOSTC GWA transects was also dominated by murrelets (21%), followed by Barrow’s goldeneye (*Bucephala clangula*; 13%), surf scoter (*Melanitta perspicillata*; 12%), common murre (10%), and mew gull (*L. canus*; 9%). Murres have historically been the dominant species group during March surveys (Stocking et al. 2018, Dawson et al. 2015). However, since experiencing a die-off event beginning during the winter of 2014/15 and ending in the spring of 2016 (Piatt et al. 2020), murre densities have remained below the long-term average (Bishop, unpublished data). Two additional species, mallard (*Anas platyrhynchos*) and trumpeter swan (*Cygnus buccinator*), were only observed beyond the survey strip. Observations beyond the 300-m survey strip are not recorded consistently, thus any inference from these observations should be limited. The mallards and swans were both observed at the head of Port Valdez between the Valdez Container Terminal and the outflow of Valdez Glacier Stream. In this area,

our vessel remained 500-800 m from the shoreline due to the extended shallow mudflats emanating from the Lowe and Valdez Glacier rivers.

Areas of high marine bird densities on the PWSRCAC transects included the nearshore transect at the head of Port Valdez, Shoup Bay, the head of Port Etches, and nearshore Port Fidalgo (Table 2). Other areas in and around the tanker escort zone with high marine bird densities that were also surveyed in March 2021 as part of the EVOSTC GWA program included the head of Zaikof Bay, near Red Head in Port Gravina, northern Hinchinbrook Island, and Hawkins Island. Refer to Appendix I for distribution maps of each species group.

Areas with relatively low marine bird concentrations included Valdez Arm, Port Valdez (excluding Shoup Bay), and central PWS. Surprisingly, no birds were observed on the Valdez Arm transect. The most common sea state conditions reported during the Valdez Arm transect was sea state 2 (1/2 ft waves; Table 2) but varied up to sea state 3 (2 ft waves) at times. Marine birds may have been taking shelter in more protected areas with calmer waters. Unfortunately, previous surveys by PWS Science Center and USFWS have not covered this area, so it is challenging to know if these low-density conditions are unusual.

Only two forage flocks were observed in and around the tanker escort zone and both occurred in Port Etches. One flock consisted of 35 birds total and included glaucous-winged gulls, black-legged kittiwakes, common murre, and marbled murrelets. The second flock was comprised of 13 birds total, including black-legged kittiwakes, glaucous-winged gulls, and pelagic cormorants. Only a single other forage flock was observed in PWS during March 2021 EVOSTC GWA surveys. The flock consisted of 15 black-legged kittiwakes and was recorded in Elrington Passage.

Table 3. Total number of birds observed by species on PWSRCAC transects within and beyond the 300-m survey strip, March 2021, Prince William Sound, AK.

Common name	Scientific name	Count (within 300 m strip)	Count (including observations beyond 300 m)
Bald Eagle	<i>Haliaeetus leucocephalus</i>	3	4
Barrow's Goldeneye	<i>Bucephala islandica</i>	5	11
Black-legged Kittiwake	<i>Rissa tridactyla</i>	71	73
<i>Brachyramphus</i> Murrelet		67	78
Bufflehead	<i>Bucephala albeola</i>	5	44

Common Goldeneye	<i>Bucephala clangula</i>	6	7
Common Merganser	<i>Mergus merganser</i>	12	12
Common Murre	<i>Uria aalge</i>	88	109
Common Raven	<i>Corvus corax</i>	2	2
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	2	2
Glaucous-winged Gull	<i>Larus glaucescens</i>	60	61
Harlequin Duck	<i>Histrionicus histrionicus</i>	2	2
Horned Grebe	<i>Podiceps auritus</i>	16	16
Long-tailed Duck	<i>Clangula hyemalis</i>	6	10
Mallard	<i>Anas platyrhynchos</i>		85
Marbled Murrelet	<i>Brachyramphus marmoratus</i>	153	156
Mew Gull	<i>Larus canus</i>	13	13
Pacific Loon	<i>Gavia pacifica</i>	1	1
Pelagic Cormorant	<i>Phalacrocorax pelagicus</i>	84	104
Pigeon Guillemot	<i>Cephus columba</i>	13	14
Red-breasted Merganser	<i>Mergus serrator</i>	3	3
Surf Scoter	<i>Melanitta perspicillata</i>	36	36
Trumpeter Swan	<i>Cygnus buccinator</i>		3
Unidentified Cormorant		5	48
Unidentified Duck			105
Unidentified Goldeneye		36	42
Unidentified Grebe		4	4
Unidentified Loon		1	7
Unidentified Merganser		10	10
Unidentified Murre		2	2
Unidentified Scoter		1	14
Unidentified Small Gull			1
White-winged Scoter	<i>Melanitta fusca</i>		3
Grand Total		707	1082

Marine Mammals

In addition to marine birds, we also recorded marine mammals within the 300-m strip during the surveys. When possible, we recorded mammal observations out to 1 km, but this is not uniform across all species as whales are much easier to observe at longer distances compared to sea otter (*Enhydra lutris*), harbor seal (*Phoca vitulina*), Steller sea lion (*Eumetopias jubatus*), or porpoises (*Phocoenoides dalli* or *Phocoena phocoena*). Observations recorded beyond the 300-m strip should be considered minimum counts for these species in these areas.

Sea otter was the most abundant marine mammal observed during the survey and occurred in most nearshore areas (Table 4). We counted 51 harbor seals at a haul-out at the head of Port Valdez south of the Mineral Creek Islands (Table 4). Small numbers of harbor seal were also observed in Port Etches, Port Fidalgo, and St. Matthews Bay. We counted 17 porpoises total on the PWSRCAC transects, most of which (15) could be identified as Dall’s porpoise (*Phocoenoides dalli*; Table 4). Porpoises were observed primarily in Port Valdez and Valdez Arm, but also recorded in Port Etches, St. Matthews Bay, and Zaikof Bay. Steller sea lions were observed at a haul-out in Port Etches, as well as in Zaikof Bay and along the western shore of Hawkins Island. Two killer whales (*Orcinus orca*) were observed on the central PWS transect heading from the entrance into PWS. Only one humpback whale (*Megaptera novaengliae*) was recorded during this survey, which was observed near the head of Port Etches (Table 4). Please refer to Appendix II for distribution maps of each species.

Table 4. Total number of marine mammals observed by species on PWSRCAC transects within and beyond the 300-m survey strip, March 2021, Prince William Sound, AK.

Common name	Scientific name	Count (within 300 m strip)	Count (including observations beyond 300 m)
Dall’s Porpoise	<i>Phocoenoides dalli</i>	15	15
Harbor Seal	<i>Phoca vitulina</i>	3	56
Humpback Whale	<i>Megaptera novaengliae</i>		1
Killer Whale	<i>Orcinus orca</i>		2
Sea Otter	<i>Enhydra lutris</i>	54	72
Steller Sea Lion	<i>Eumetopias jubatus</i>	3	20
Unidentified Porpoise		2	2
Grand Total		77	168

Conclusions

It is challenging to draw conclusions or make large inferences from the results of a single survey. Species composition and density can vary widely across years, so multiple years of surveys are necessary to understand natural variation during the non-breeding season. However, the patterns observed during this survey are consistent with patterns reported previously for PWS during the non-breeding season. Marine birds tend to prefer shallow and protected habitats that are nearer to shore compared to deep offshore habitats (Schaefer et al. 2020, Stocking et al. 2018, Dawson et al. 2015). During this survey, the highest densities of birds were indeed observed in bays and nearshore areas (e.g., head of Port Valdez), while the lowest densities were observed in more exposed habitats that were farther from shore (e.g., Valdez Arm, central PWS).

Based on observations from this survey, the region around the Hinchinbrook Entrance could warrant prioritization for protection in the event of a perturbation, such as an oil spill. Importantly, Port Etches and Zaikof Bay were high density areas for both birds and marine mammals, including kittiwakes, large gulls, murrelets, murres, sea lions and humpback whales. Port Etches was also one of the only areas in PWS with observations of foraging activity, indicating the presence of forage fish. Age-1 herring (*Clupea pallasii*) have consistently been documented in Port Etches during aerial surveys conducted during June (Pegau 2020) and are an important prey source for murres (Ainley et al. 1996), murrelets (Nelson 1997), kittiwakes (Hatch et al. 2009), and glaucous-winged gulls (Hayward and Verbeek 2008).

Porpoise Rocks, located at the mouth of Port Etches, hosts breeding colonies for black-legged kittiwake, glaucous-winged gull, and common murre (see North Pacific Seabird Data Portal <https://axiom.seabirds.net>) and is a haul-out site for Steller sea lions. Murres tend to return to nearshore areas well before breeding (Ainley et al. 2002), while kittiwakes tend to return to PWS in March and April, so kittiwake densities can fluctuate widely this time of year (Stocking 2018). Gulls, murres, and kittiwakes observed in Port Etches may be staging near their colonies in preparation for the upcoming breeding season.

Further, high numbers of marbled murrelets and pigeon guillemots, two species that were initially injured by the Exxon Valdez oil spill and whose populations have not yet recovered (EVOS 2014), were also observed in Port Etches and Zaikof Bay. Murrelets were also present in high numbers in Port Fidalgo and the head of Port Valdez, while guillemots were also recorded in Port Fidalgo and Tatitlek Narrows.

While these surveys do not include all areas that potentially may be impacted by an oil spill, nor do they capture all marine bird winter habitat, continued monitoring of marine birds in and around the tanker escort lane during late winter will help determine marine bird and mammal vulnerability to environmental

change and future perturbations, including oil spills. In addition, these surveys could be used to guide and refine oil spill response efforts in and around the tanker escort lane during the nonbreeding season.

Recommendations

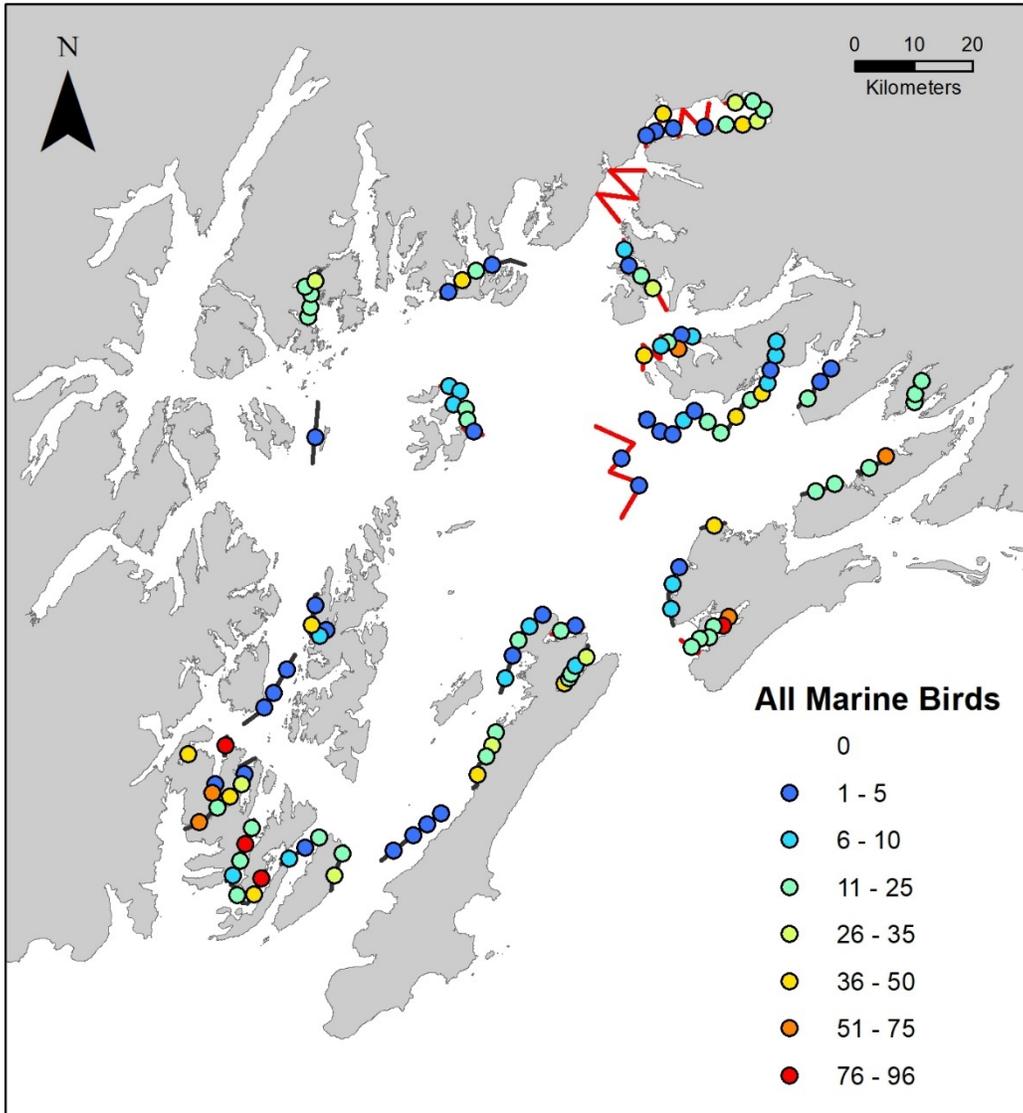
Due to the high numbers of marine birds and marine mammals, including species that have yet to recover from the oil spill, and evidence of forage fish presence, we suggest the areas around Hinchinbrook Entrance for special protection in the event of a perturbation. Fortunately, there is already an oil spill response barge staged in Port Etches, which should facilitate rapid and efficient response in the event of a spill. Based on our surveys, other areas with high densities of marine birds that could warrant priority protection include the head of Port Valdez and nearshore areas of southeastern Port Fidalgo. Continued monitoring of marine birds in and around the tanker escort lane during winter will help determine marine bird and mammal vulnerability to environmental change and future perturbations, including oil spills, and can be used to guide and refine spill response efforts.

Literature Cited

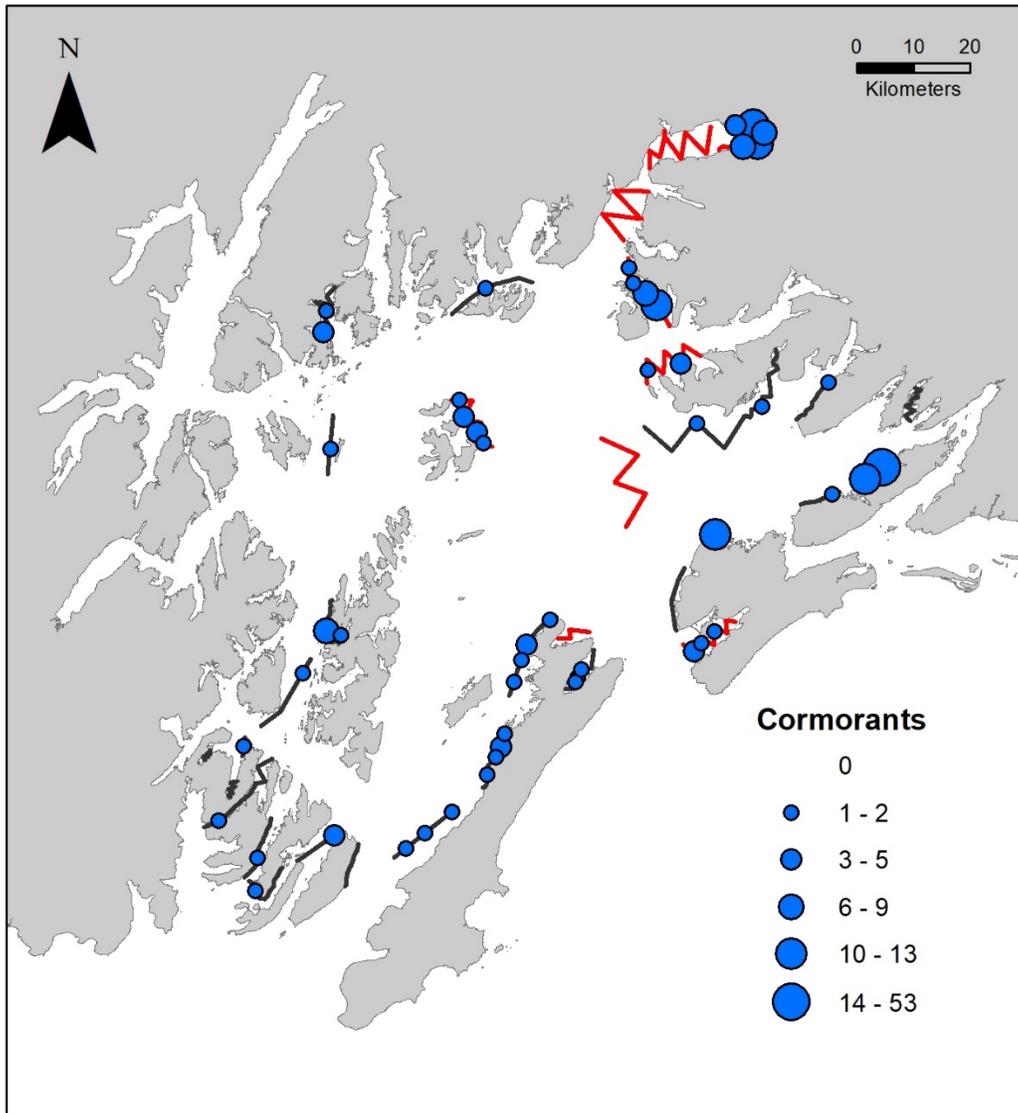
- Ainley, D. G., D. N. Nettleship, H. R. Carter, and A. E. Storey. 2002. Common Murre (*Uria aalge*). In P.G. Rodewald (Ed.), *The Birds of North America*. Ithaca, NY: Cornell Lab of Ornithology.
- Ainley, D. G., L. B. Spear, S. G. Allen, and C. A. Ribic. 1996. Temporal and spatial patterns in the diet of the common murre in California waters. *The Condor* 98: 691-705.
- Anderwald, P., P. G. H. Evans, L. Gyax, and A.R. Hoelzel. 2011. Role of feeding strategies in seabird-minke whale associations. *Marine Ecology Progress Series* 424:219-227.
- Dawson, N.M., M.A. Bishop, K.J. Kuletz, and A.F. Zuur. 2015. Using ships of opportunity to assess winter habitat associations of seabirds in subarctic coastal Alaska. *Northwest Science* 89: 111–128.
- Exxon Valdez* Oil Spill Trustee Council. 2014. 2014 Updated injured resources and services list. Anchorage, Alaska.
- Ford, R. G. 1999. dLog: data entry and real-time mapping program. Software and documentation for integration of GPS location and observer data. Portland, OR: RG Ford Consulting Company.
- Hatch, S. A., G. J. Robertson, and P. H. Baird. 2009. Black-legged Kittiwake (*Rissa tridactyla*). In P.G. Rodewald (Ed.), *The Birds of North America*. Ithaca, NY: Cornell Lab of Ornithology.
- Hayward, J. L. and N. A. Verbeek. 2008. Glaucous-winged Gull (*Larus glaucescens*). In P.G. Rodewald (Ed.), *The Birds of North America*. Ithaca, NY: Cornell Lab of Ornithology.
- Nelson, S. K. 1997. Marbled Murrelet (*Brachyramphus marmoratus*). In P.G. Rodewald (Ed.), *The Birds of North America*. Ithaca, NY: Cornell Lab of Ornithology.

- Pegau, W. S. 2020. 2020 Prince William Sound forage fish observations. Final Report to Prince William Sound Regional Citizens' Advisory Council. Prince William Sound Science Center, Cordova AK.
- Piatt, J.F., J.K. Parrish, H.M. Renner, S.K. Schoen, T.T. Jones, M.L. Arimitsu, K. J. Kuletz, B. Bodenstein, M. Garcia-Reyes, R.S. Duerr, and R.M. Corcoran. 2020. Extreme mortality and reproductive failure of common murrelets resulting from the northeast Pacific marine heatwave of 2014-2016. *PLoS one*, 15(1), p.e0226087.
- Schaefer, A., M.A. Bishop, and R. Thorne. 2020. Marine bird response to forage fish during winter in subarctic bays. *Fisheries Oceanography* 29: 297-308. <https://doi.org/10.1111/fog.12472>.
- Stocking, J., M.A. Bishop, and A. Arab. 2018. Spatio-temporal distributions of piscivorous birds in a subarctic sound during the non-breeding season. *Deep-Sea Research Part II* 147: 138-147.
- USFWS. 2007. North Pacific pelagic seabird observer program observer's manual, inshore/small vessel version, November 2007. U.S. Fish and Wildlife Service, Migratory Bird Management Nongame Program, Anchorage, Alaska. Unpublished protocol manual, 25 pp.
- Zuur A.F., N. Dawson, M.A. Bishop, K. Kuletz, A. A. Saveliev, and E.N. Ieno. 2012. Two-stage GAMM applied to zero inflated common murre density data. Pages 149-182 in A.F. Zuur, A.A. Saveliev and E.N. Ieno, editors. *Inflated and generalized linear mixed models with R*. Highland Statistics Ltd. Newburgh, UK.

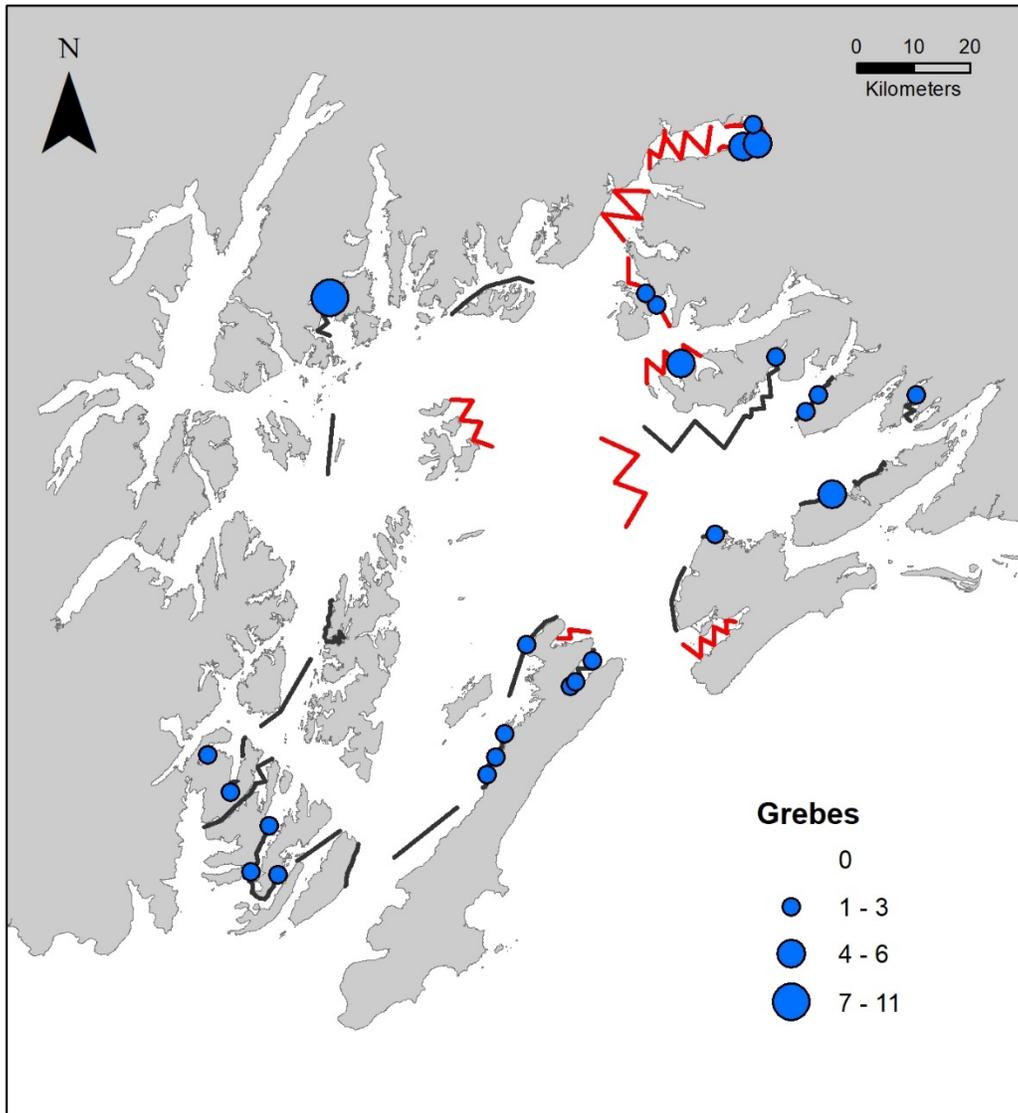
Appendix I: Marine bird density and distribution in Prince William Sound, AK, March 2021.



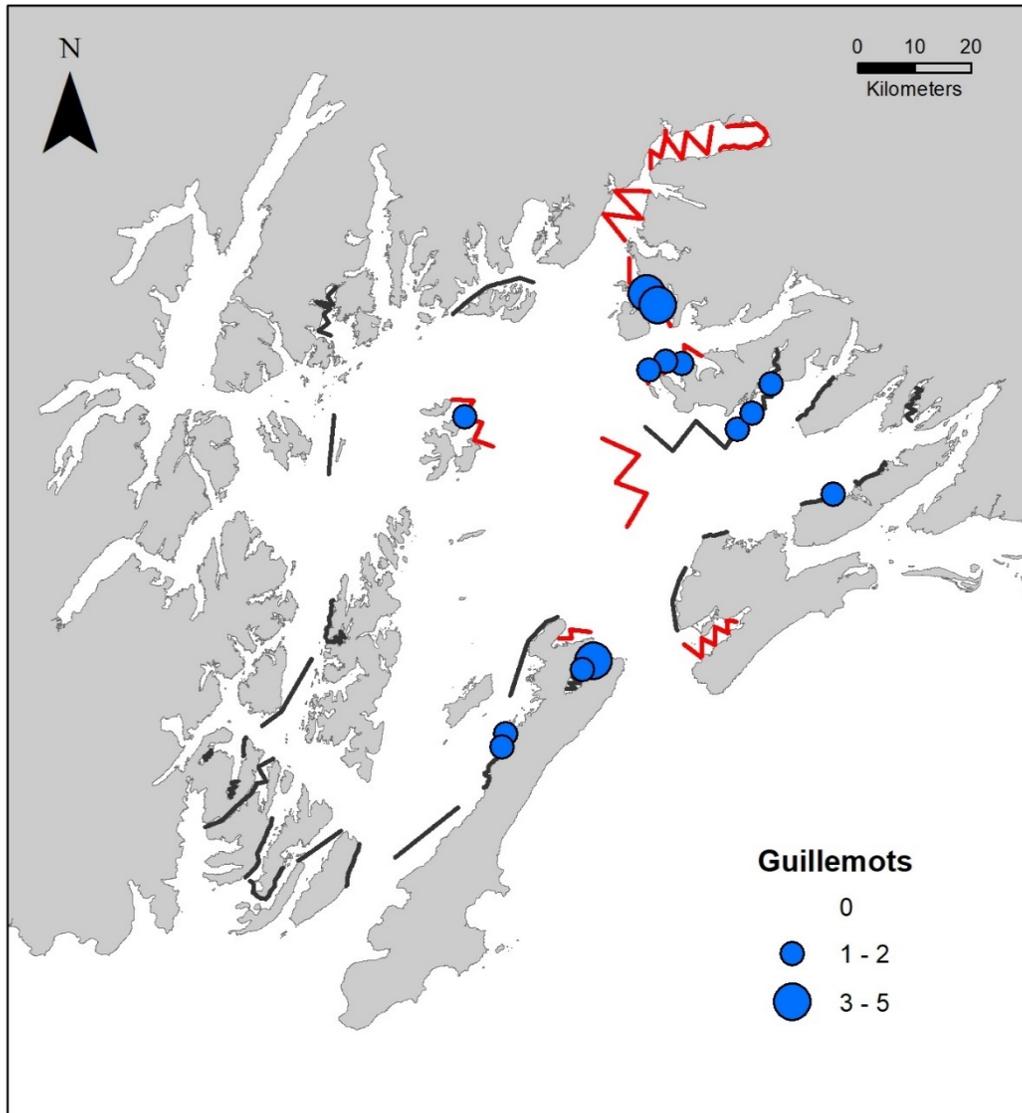
Total marine bird distribution and density (birds/km²) observed in the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



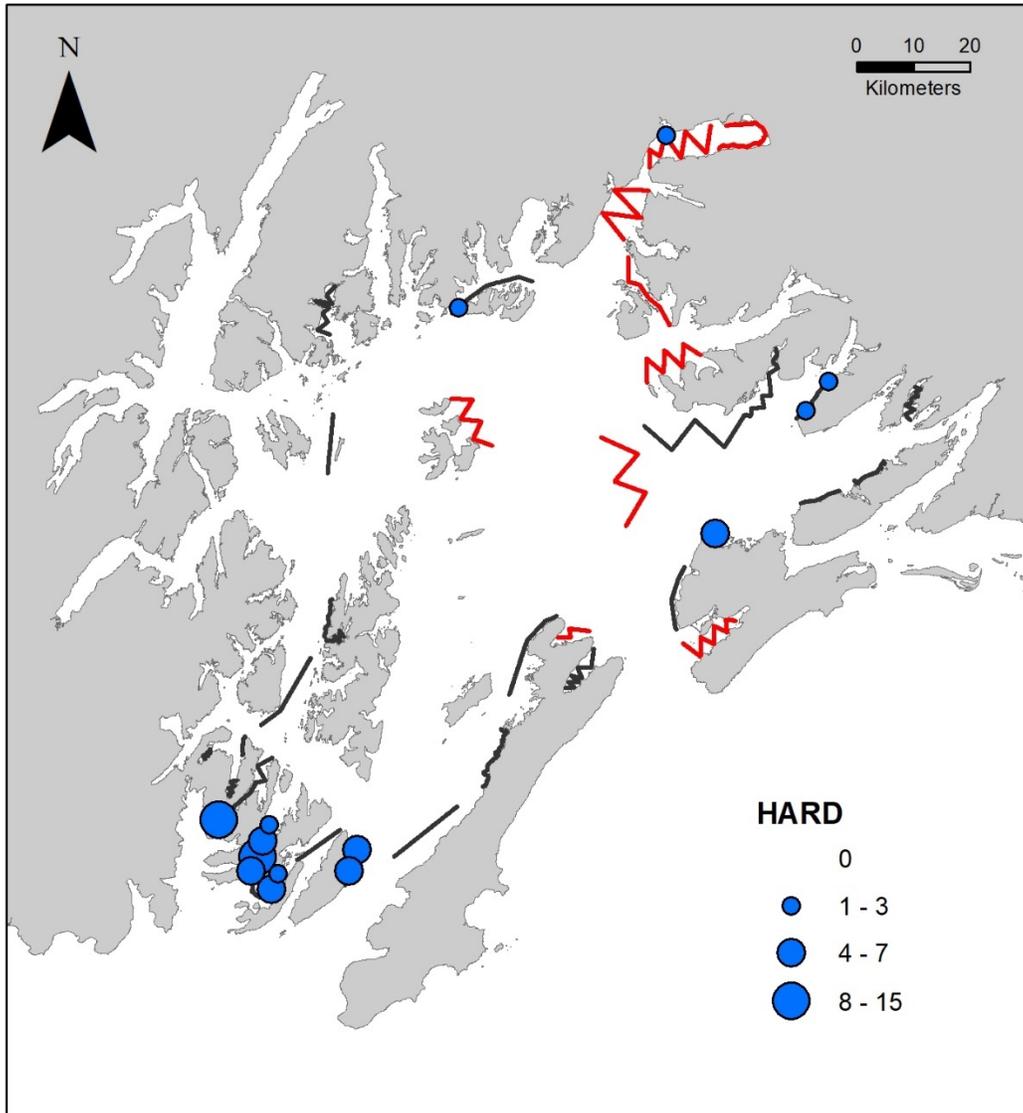
Distribution and density (birds/km²) of cormorants (double-crested, pelagic, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



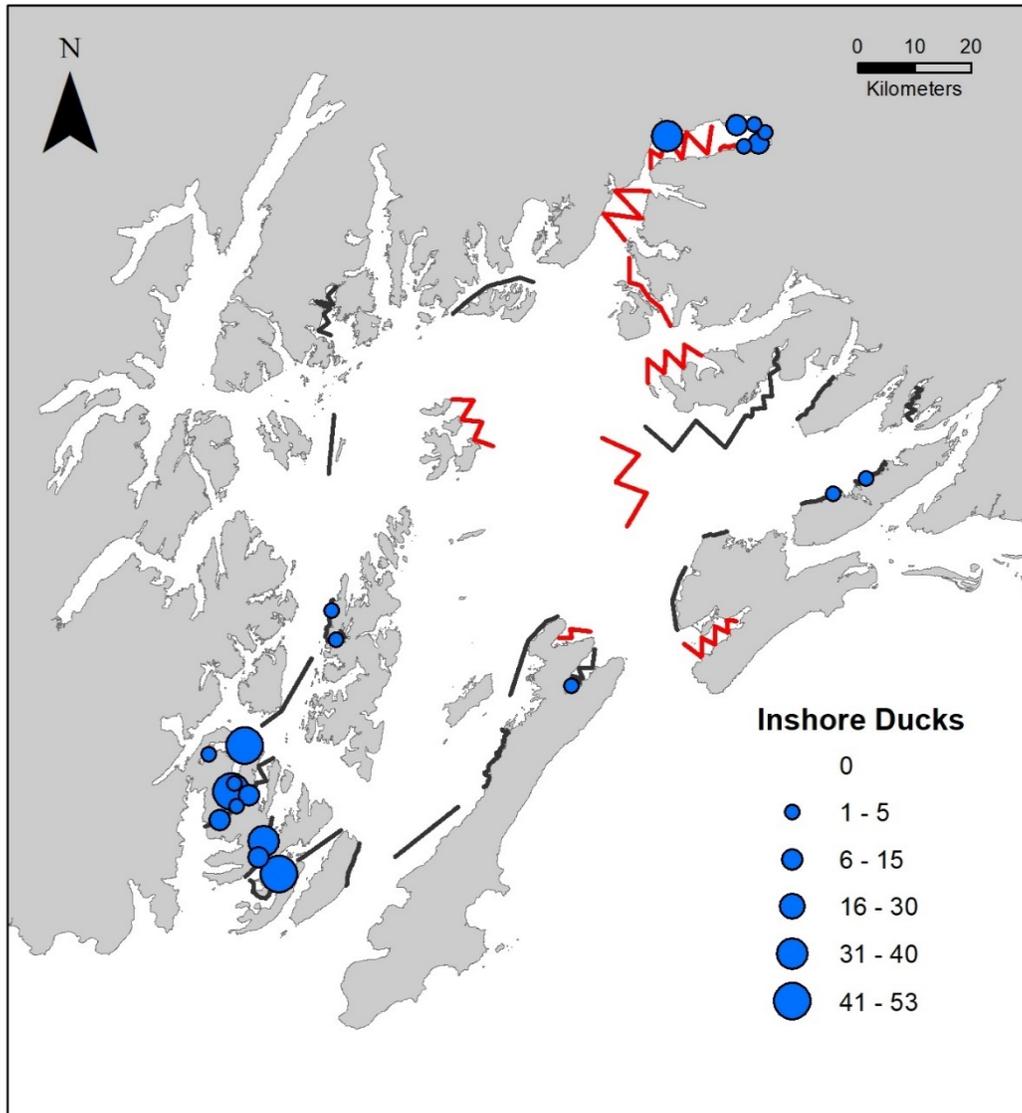
Distribution and density (birds/km²) of grebes (horned, red-necked, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



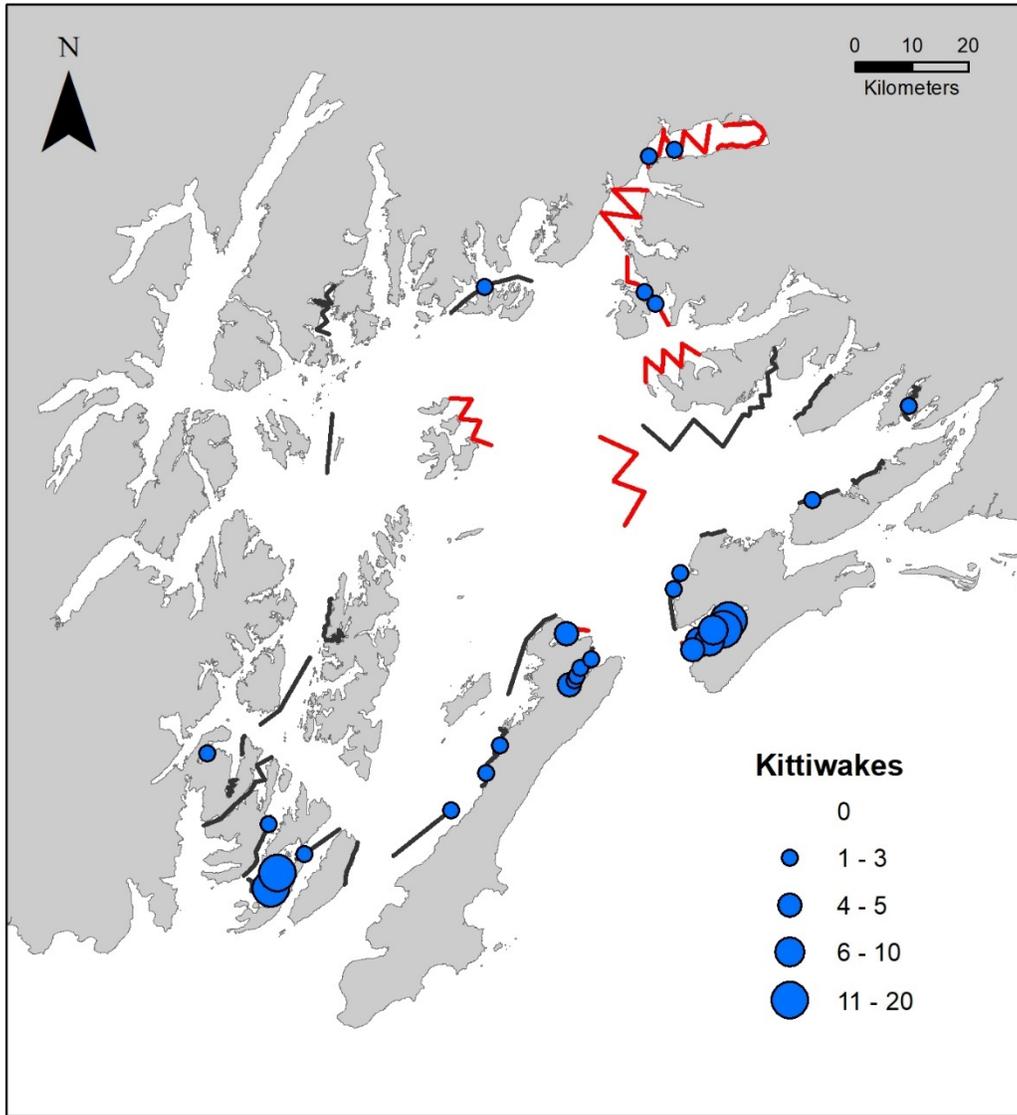
Distribution and density (birds/km²) of pigeon guillemots observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



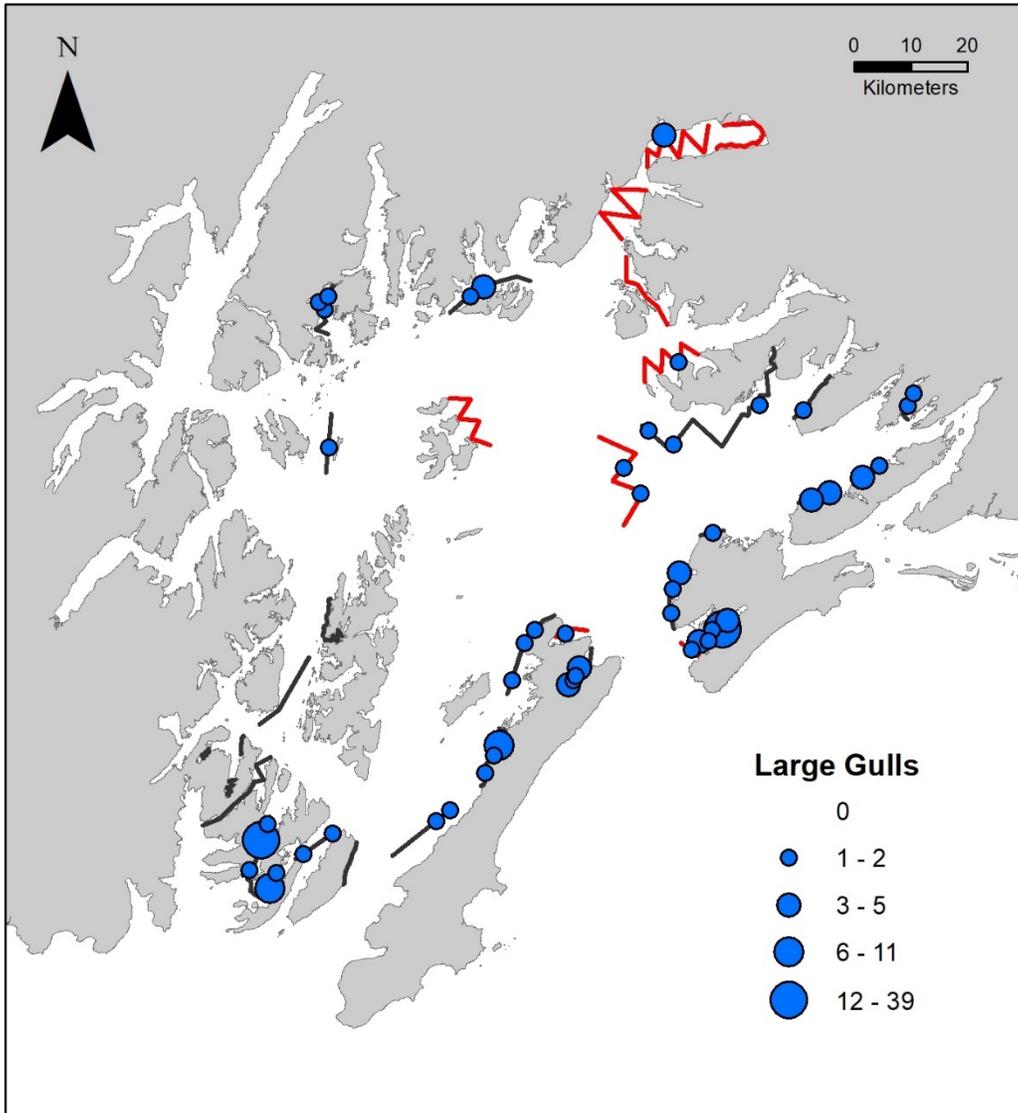
Distribution and density (birds/km²) of harlequin ducks (HARD) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



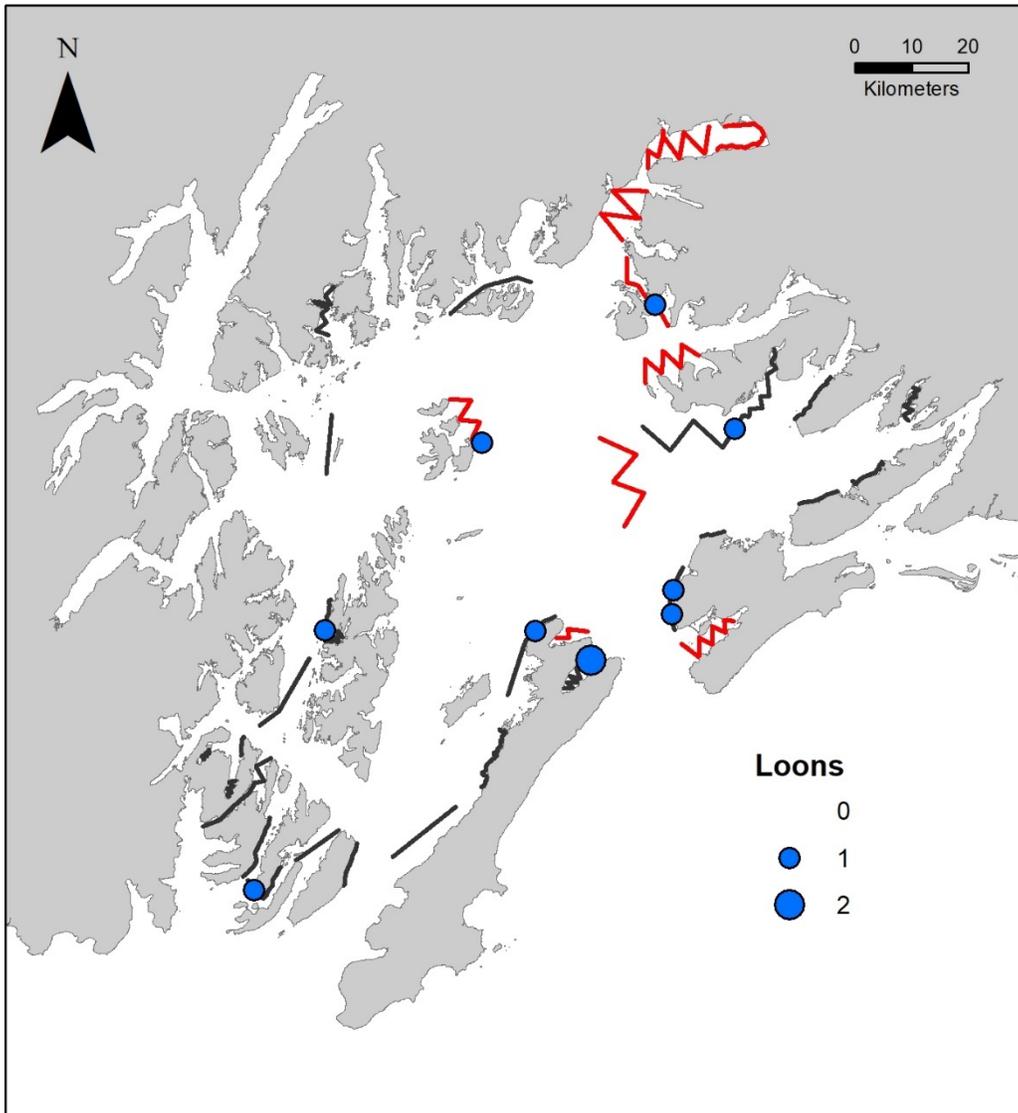
Distribution and density (birds/km²) of inshore ducks (Barrow's goldeneyes, common goldeneyes, unidentified goldeneyes, buffleheads) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



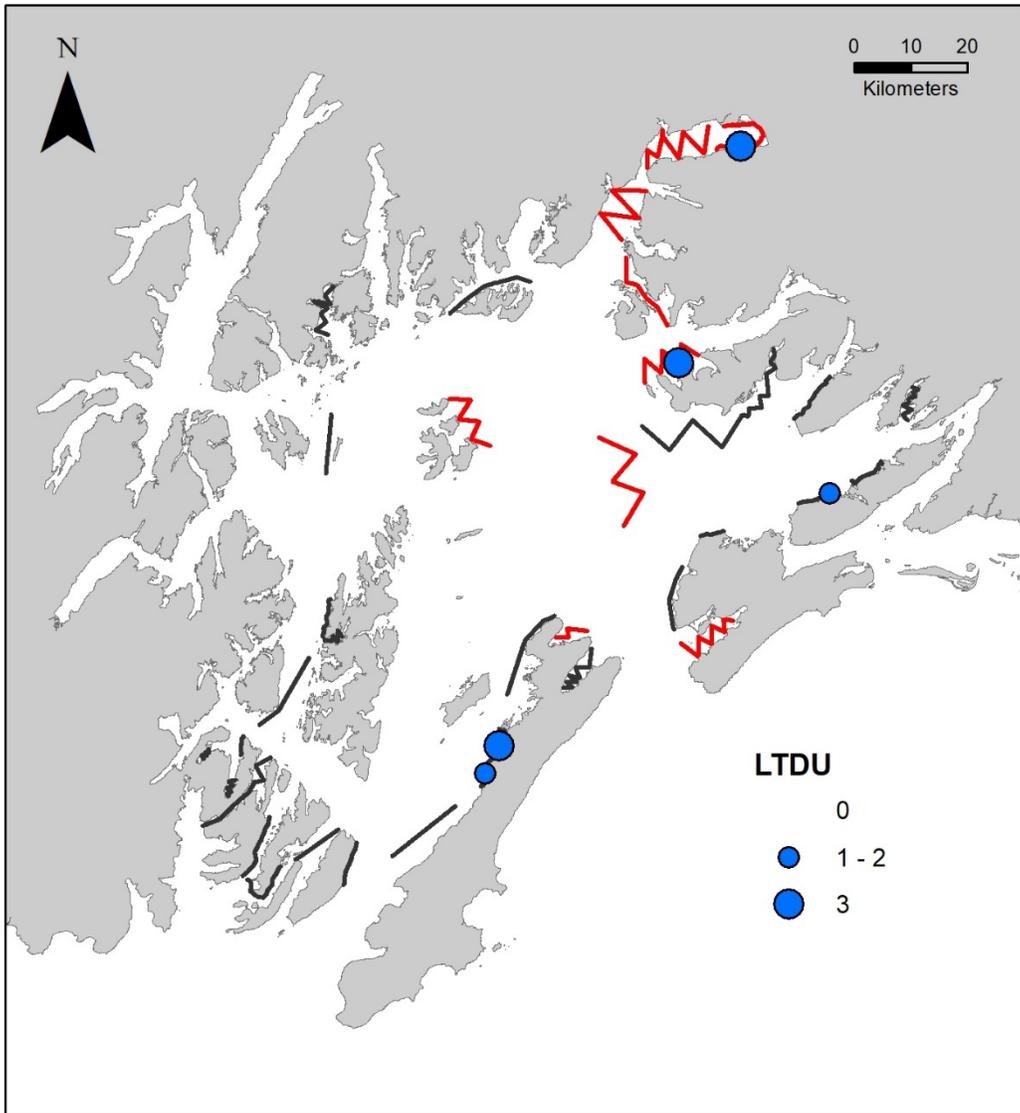
Distribution and density (birds/km²) of black-legged kittiwakes observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



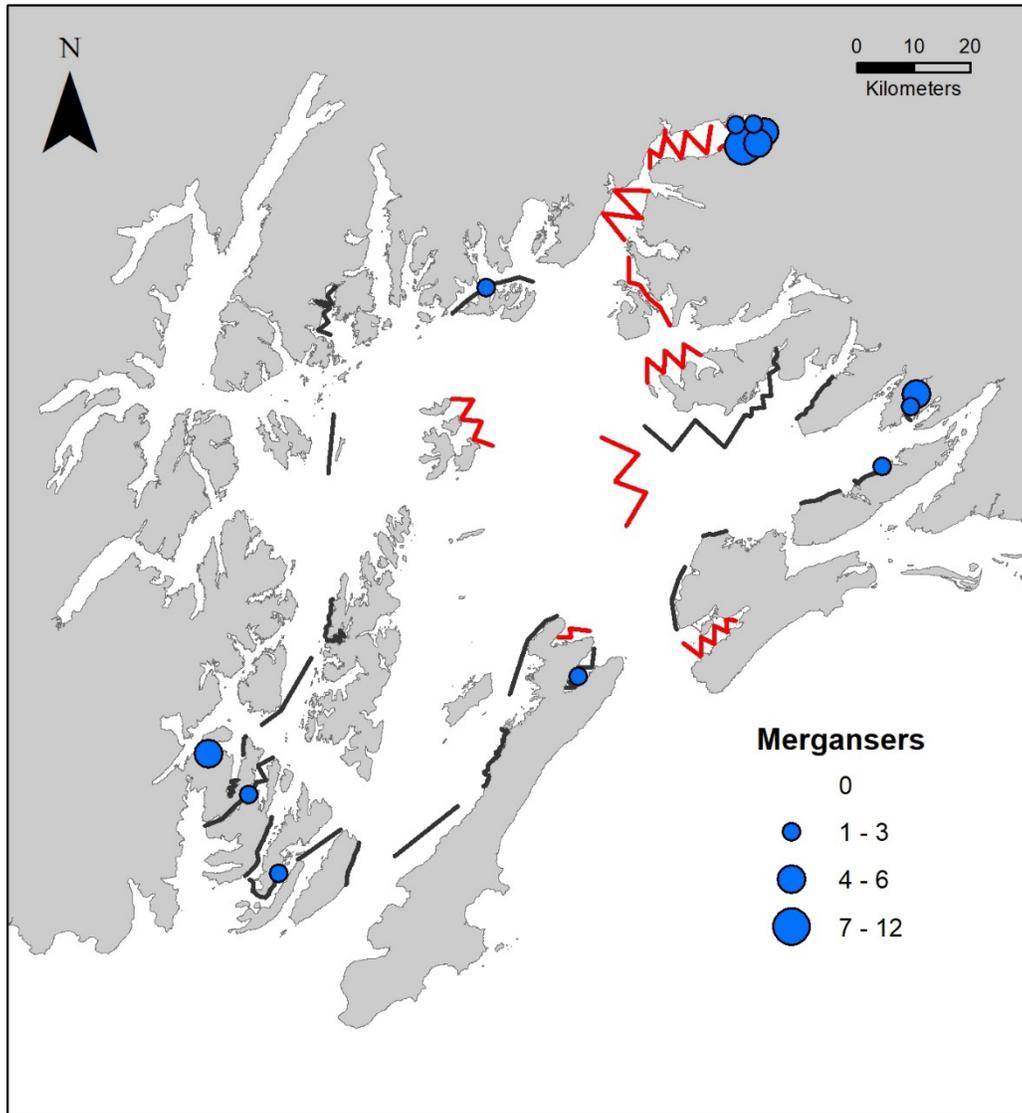
Distribution and density (birds/km²) of large gulls (glaucous-winged, herring, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



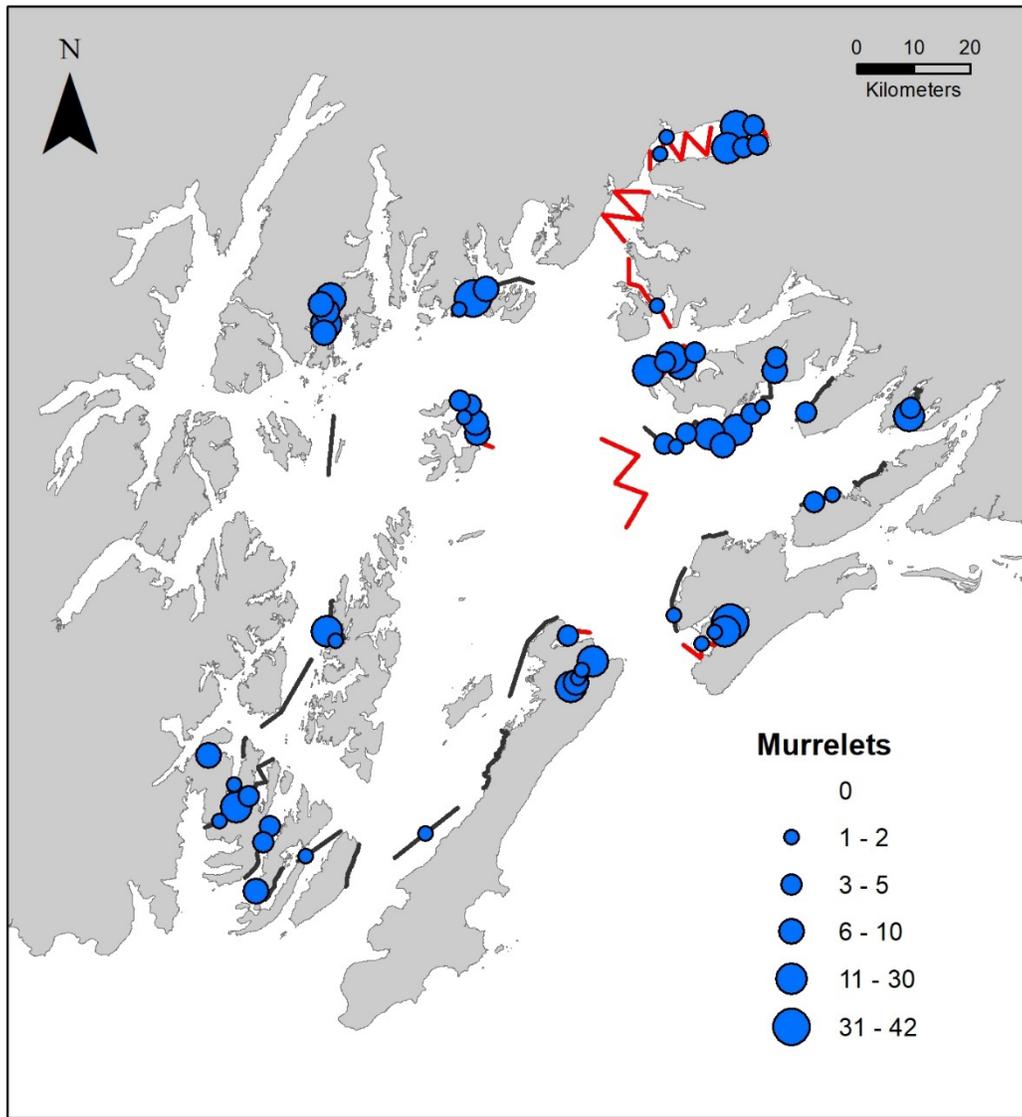
Distribution and density (birds/km²) of loons (common, Pacific, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



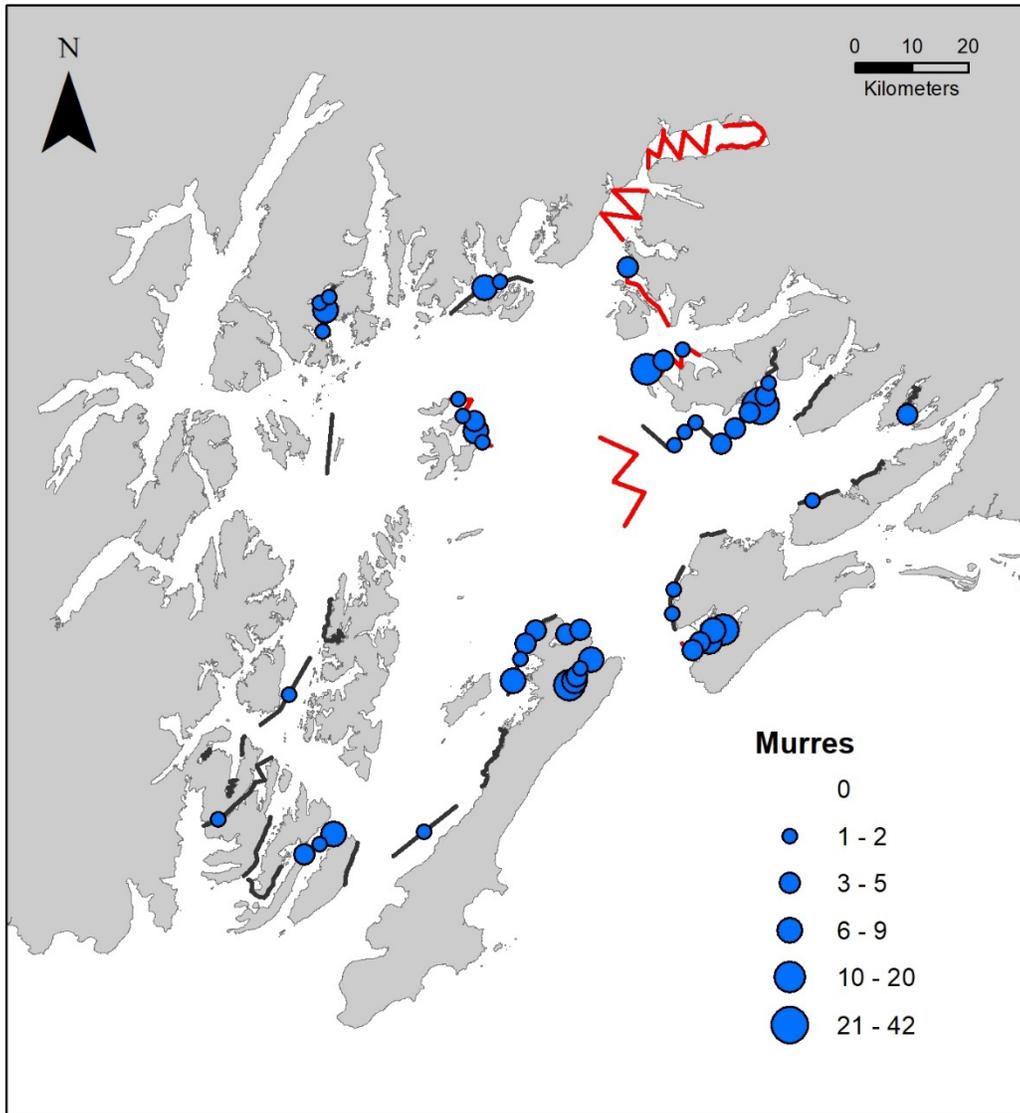
Distribution and density (birds/km²) of long-tailed ducks (LTDU) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



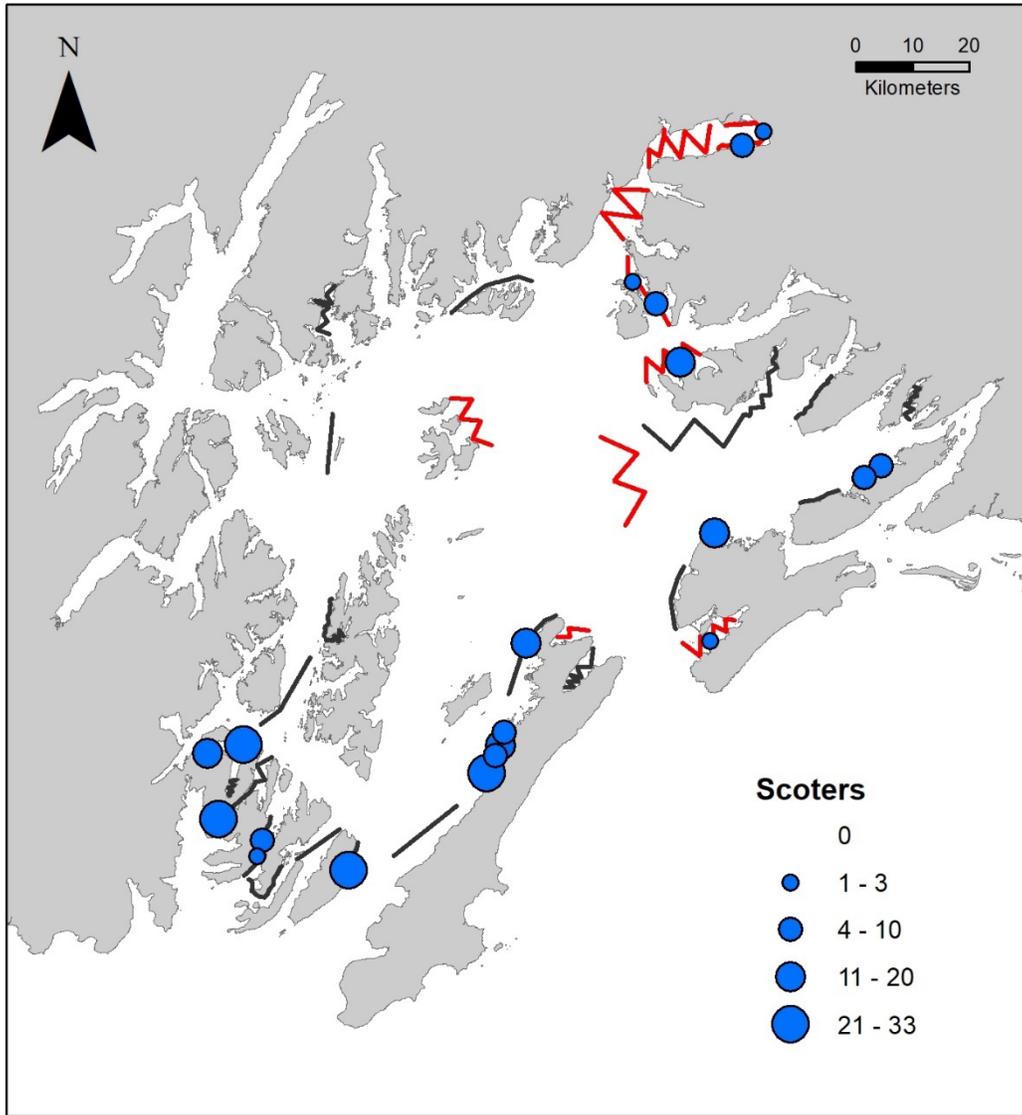
Distribution and density (birds/km²) of mergansers (common, red-breasted, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



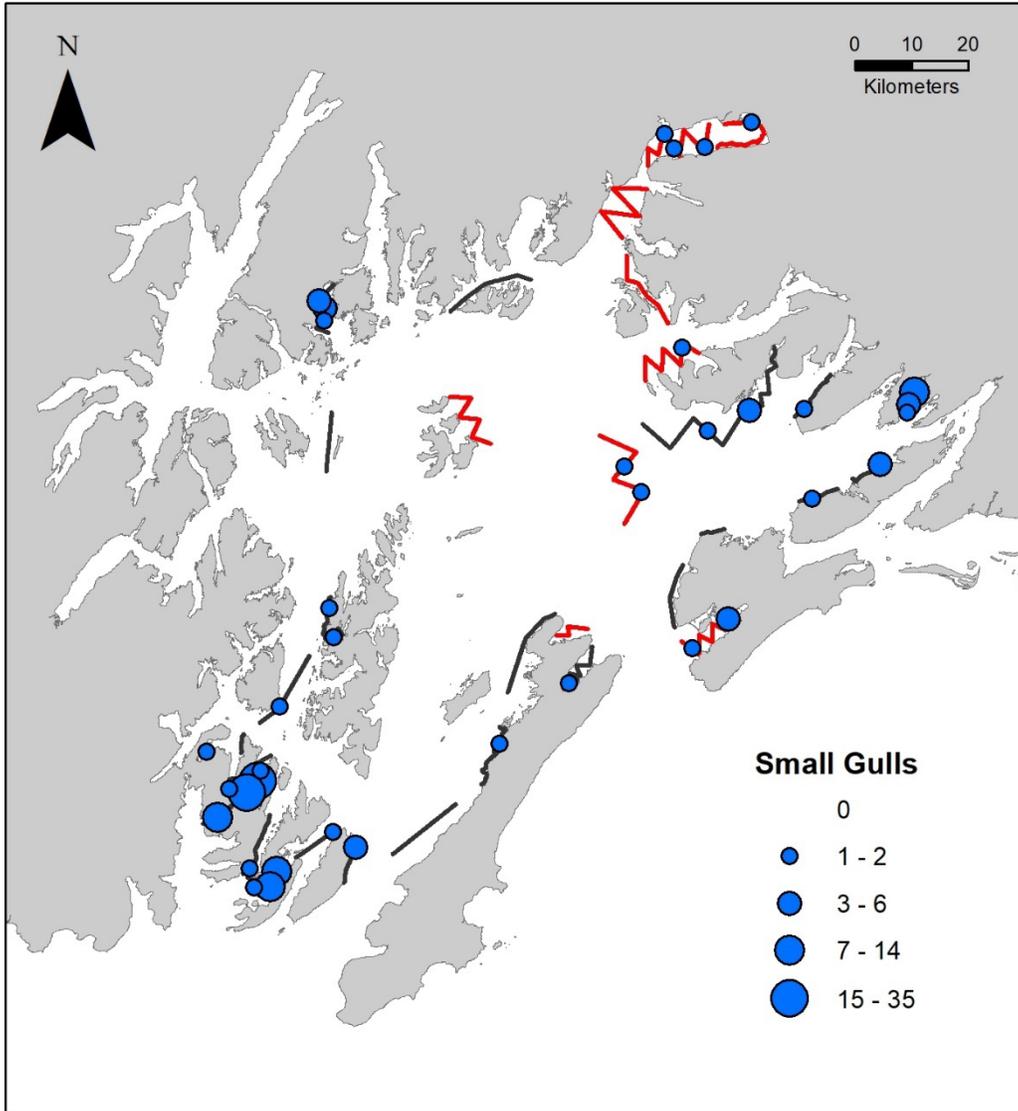
Distribution and density (birds/km²) of murrelets (marbled, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



Distribution and density (birds/km²) of common murres observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.

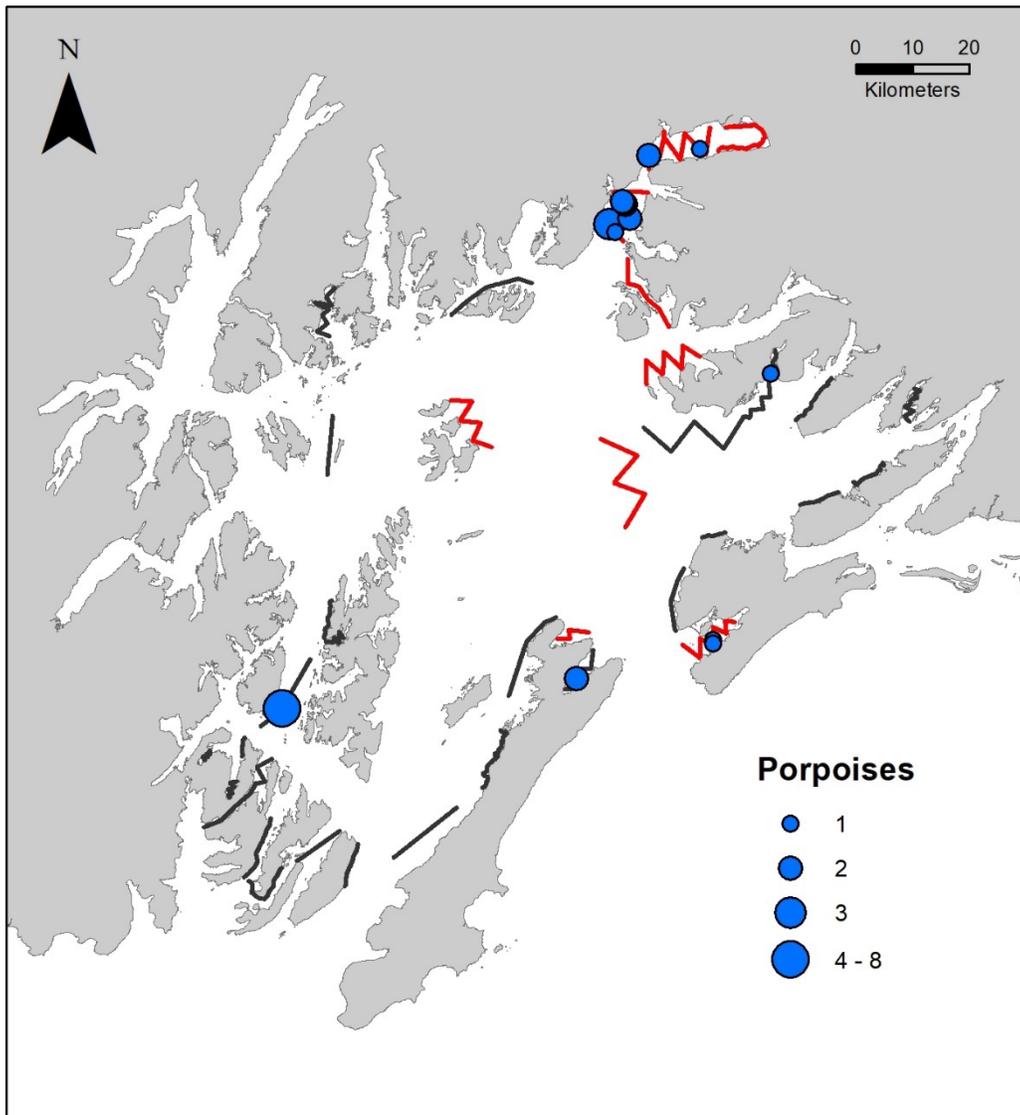


Distribution and density (birds/km²) of scoters (surf, white-winged, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.

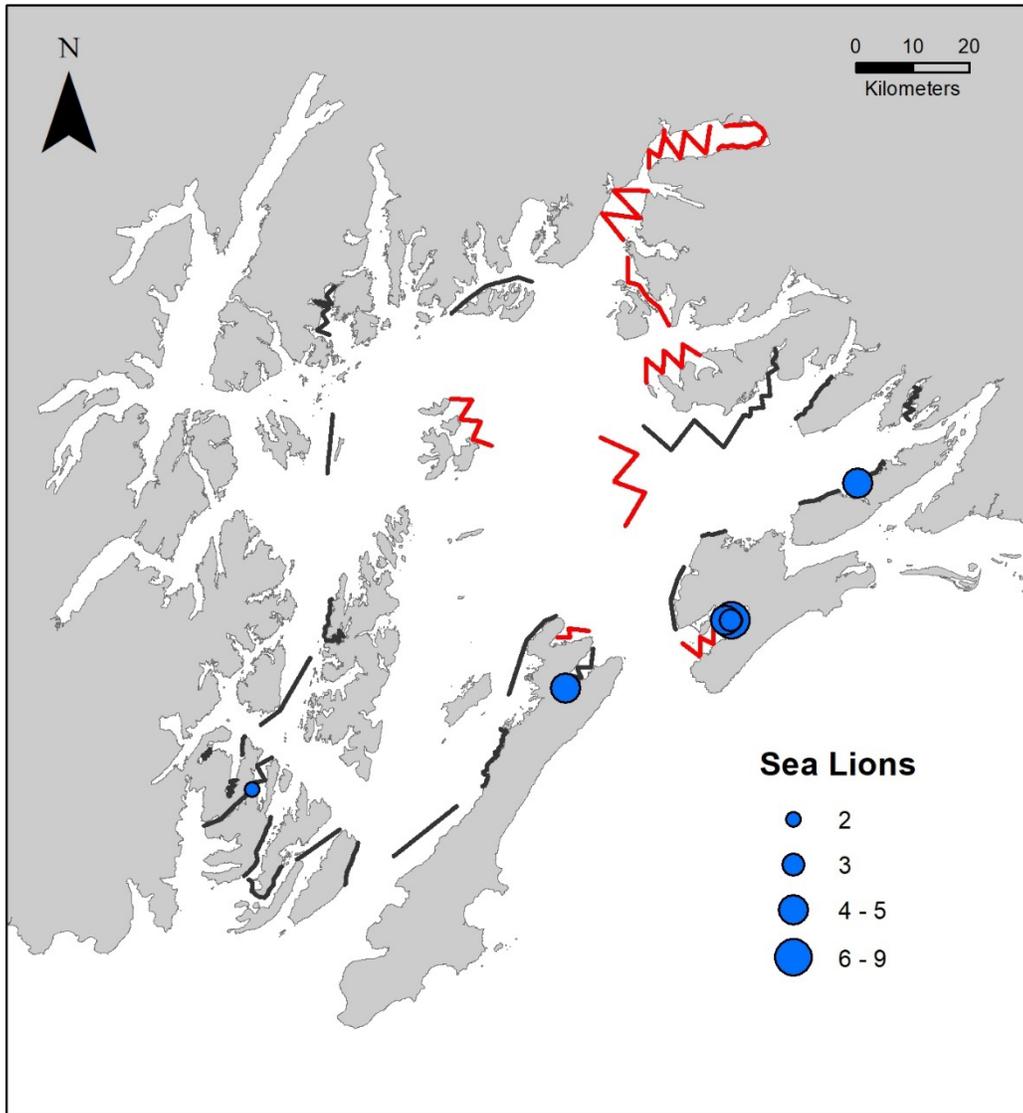


Distribution and density (birds/km²) of small gulls (mew, unidentified) observed within the 300 m survey strip in Prince William Sound, AK, March 2021. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.

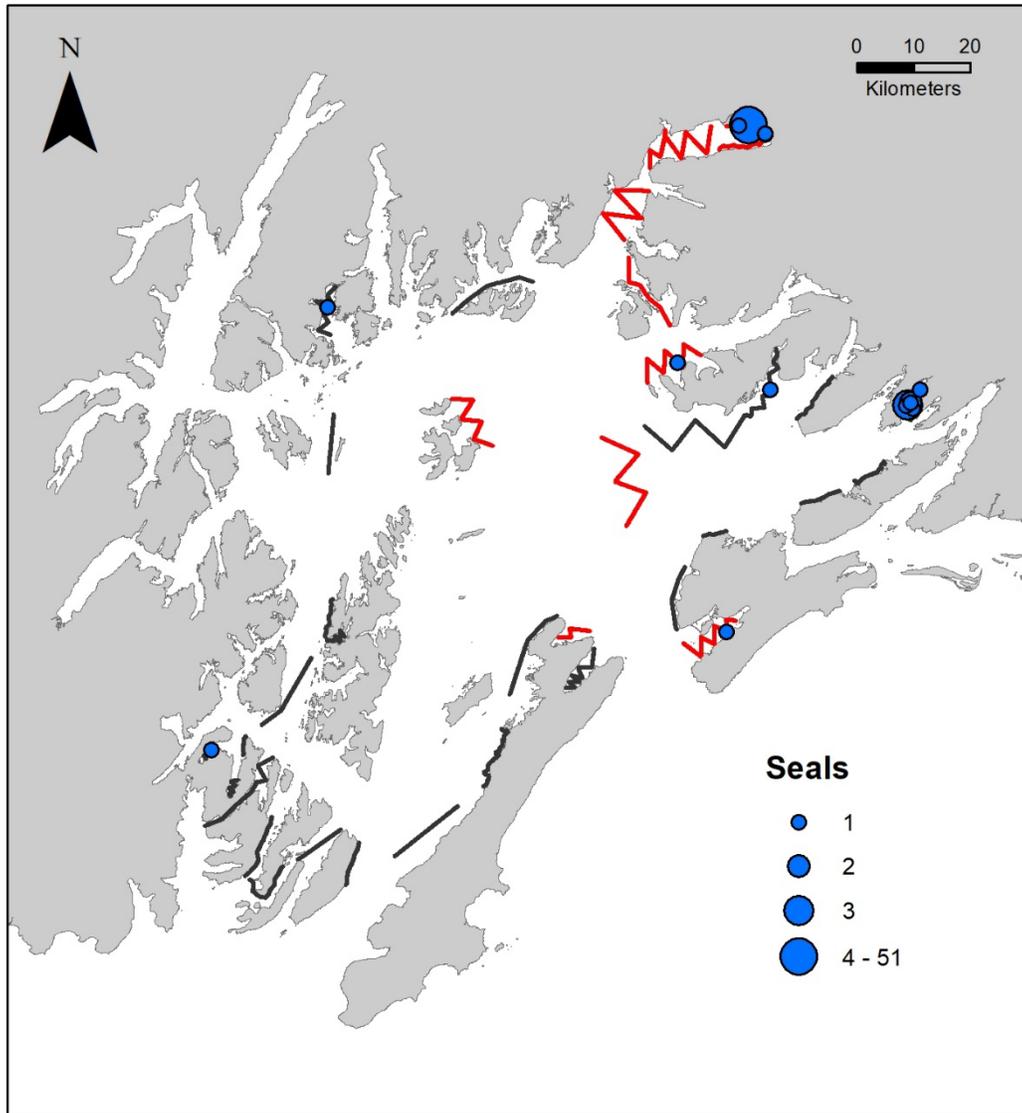
Appendix II: Marine mammal counts and distribution in Prince William Sound, AK, March 2021.



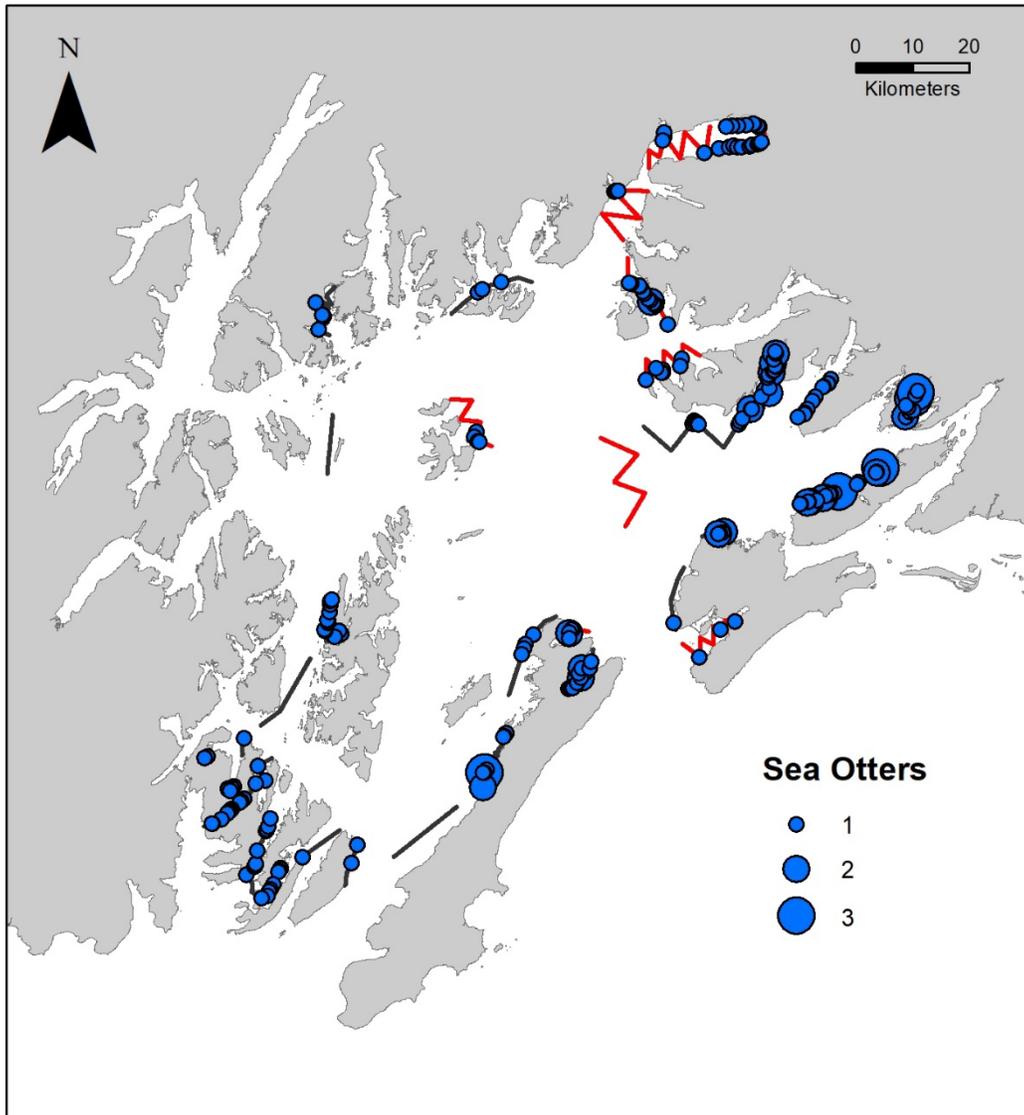
Distribution and number of porpoises (Dall's, unidentified) observed in Prince William Sound, AK, March 2021 (including beyond the 300 m survey strip). The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



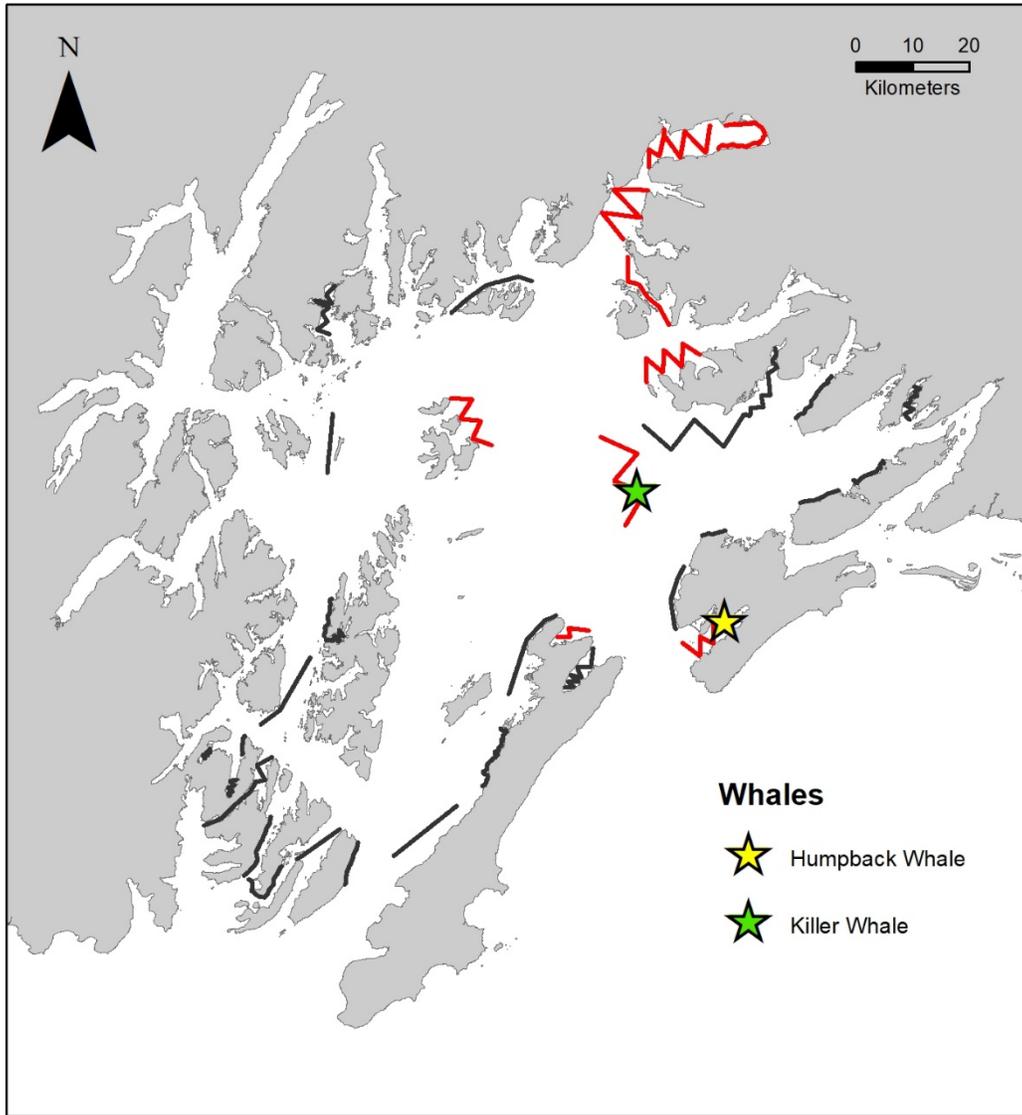
Distribution and number of Steller sea lions observed in Prince William Sound, AK, March 2021 (including beyond the 300 m survey strip). The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



Distribution and number of harbor seals observed in Prince William Sound, AK, March 2021 (including beyond the 300 m survey strip). The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



Distribution and number of sea otters observed in Prince William Sound, AK, March 2021 (including beyond the 300 m survey strip). The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.



Locations of humpback and killer whales observed in Prince William Sound, AK, March 2021. One humpback and two killer whales were recorded. The black lines indicate the areas around the tanker lanes surveyed as part of the EVOSTC Gulf Watch Alaska surveys. The red lines show the transects completed for PWSRCAC.