FY20 EVOSTC NEW PROJECT PROPOSAL

Does this proposal contain confidential information? ☐Yes X No

Project Number and Title

20200129 Population trends and nesting ecology of the Marbled Murrelet in the Kodiak Archipelago

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Project Abstract
Marbled Murrelets (*Brachyramphus marmoratus*) are declining throughout most of their range, including Alaska, and are listed as Threatened from California to British Columbia. An estimated 12,800–14,800 murrelets were killed by the Exxon Valdez Oil Spill (EVOS) in 1989 and this species has not met its recovery objective of an increasing or stable population following the spill. The decline likely has resulted from the combined cumulative impacts of climate-related changes in the marine ecosystem and human activities including logging, fisheries bycatch, and chronic and catastrophic oil pollution. We are seeking funding to initiate a four-year study (2020-2024) of the nesting ecology of the Marbled Murrelet and relationships to foraging locations in the Kodiak Archipelago. Additionally, this study will determine summer population trends and an index of productivity for the species within the Kodiak Archipelago for comparison with long-term surveys conducted in other regions in the Gulf of Alaska, such as Prince William Sound and Cook Inlet. Regional comparisons of trends may shed light on why populations have been slow to recover from EVOS. We will attach transmitters to adult Marbled Murrelets to locate nests, evaluate habitat selection, and explore threats to nest survival. We will investigate two primary nesting habitats of the Marbled Murrelet in the archipelago: 1) old-growth Sitka spruce forest, and 2) steep-sloped treeless terrain. Locating and monitoring nests to quantify nesting propensity and survival will allow us to determine vital rates to improve population modeling, explore why the species has failed to recover, and identify how factors other than oil may be inhibiting recovery. Spatial data collected from transmitters will allow us to examine foraging associations that may explain the relationship between climate-related changes in the marine ecosystem and continued population declines.

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EVOSTC Funding Requested* ***(must include 9% GA)***

FY20	FY21	FY22	FY23	FY24	TOTAL
$736,964.3	**$678,515.2**	**$629,633.1**	**$70, 318.1**	**$0**	**$2,115,430.6**

Non-EVOSTC Funds to be used, please include source and amount per source:**

FY20	FY21	FY22	FY23	FY24	TOTAL
$139,210	**$92,500**	**$92,500**	**$0**	**$0**	**$324,210**

**If the amount requested here does not match the amount on the budget form, the request on the budget form will considered to be correct.*

***For sources and amount per source for non-EVOSTC contributions please see Sources of Additional Funding section and attached budget forms.*

1. PROJECT EXECUTIVE SUMMARY

The Exxon Valdez Oil Spill 1994 Restoration Plan established the need for research, recovery initiatives, monitoring, and marine and terrestrial habitat protection for the Marbled Murrelet following the 1989 oil spill (EVOS Trustee Council 1994). However, Marbled Murrelets are continuing to experience population declines throughout most of their range. The species is listed as Threatened in Oregon, Washington, California and British Columbia, and the global assessment of the IUCN Redlist of Threatened Species categorizes the Marbled Murrelet as Endangered (BirdLife International 2018). Using trend information from at-sea surveys spanning a wide geographic range in Alaska, Marbled Murrelet numbers declined significantly at five of eight sites, resulting in cumulative population decline of 70 percent over a recent 25-year period (Piatt et al. 2007).

Population declines are likely influenced by a combination of threats from both anthropogenic and environmental sources. Human activities have impacts in both terrestrial and marine habitats. The loss or alteration of mature forest habitat is considered to be a key factor in the decline of Marbled Murrelets in some areas. Documented sources of human-influenced marine mortality include bycatch in gillnet fisheries and oil spills. Gillnet fisheries occur widely in Alaska; Carter et al. (1995) suggested that many thousands of Marbled Murrelets may be killed annually in Alaskan fishing nets. Changes in climate and weather patterns that impact the marine ecosystem can influence seabird populations indirectly through disruption of lower trophic levels. For example, changes in oceanic conditions since the 1970s in the Gulf of Alaska (GOA) may have negatively affected the availability of forage fish for Marbled Murrelets. To raise chicks, they require energy-rich fish such as juvenile herring *(Clupea pallasi)* and adult sand lance

(*Ammodytes hexapterus).* In Prince William Sound (PWS), the crash of herring stocks in the early 1990s may have exacerbated the decline of Marbled Murrelets (Piatt et al. 2007).

Based on population estimates from at-sea surveys conducted by Kodiak National Wildlife Refuge (NWR), approximately 10–14% of the projected population of Marbled Murrelets in Alaska utilize nearshore habitat in the Kodiak Archipelago in June and approximately 8–32% in August (Corcoran 2016). The increased abundance of Marbled Murrelets in August may indicate the importance of the Kodiak Archipelago to the broader regional population of Marbled Murrelets as satellite telemetry studies in British Columbia have tracked murrelets dispersing into Kodiak waters (D. Bertram, Environment Canada, pers. comm.). The at-sea observations, combined with high inland flight activity documented on Afognak Island and throughout unforested areas of the archipelago (Kuletz et al. 1995, Cragg 2013), indicate the Kodiak Archipelago is an important breeding area for Marbled Murrelets in Alaska. However, the breeding and foraging ecology of Marbled Murrelets in the archipelago remain unknown. In total, only five Marbled Murrelet nests have been recorded in the archipelago, four tree nests (Naslund et al. 1995) and one ground nest (Tobish 2005, J. Withrow, pers. comm.). None of the nests were studied systematically and nest fate was never determined. The proportion of Marbled Murrelets that nest in each habitat within the archipelago has not been quantified.

Identifying both terrestrial and marine hotspots of abundance of Marbled Murrelets within the Kodiak Archipelago will provide valuable information to direct land acquisition and prioritize areas for management and restoration. We propose our study within the Kodiak Archipelago to accomplish three goals to understand why Marbled Murrelets have failed to recover following the Exxon Valdez Oil Spill:

Goal 1: Determine trends in summer Marbled Murrelet abundance and productivity within the Kodiak Archipelago. Compare to long-term surveys conducted in other regions, such as Prince William Sound.

In 2011, Kodiak NWR initiated at-sea surveys to estimate breeding population size and productivity of the most common nearshore marine bird species in the Kodiak Archipelago, including Marbled Murrelets. Due to the length of coastline covered (approx. 4500km), the archipelago is divided into three areas requiring three years to execute a complete survey. The first complete survey was conducted in 2011-2013, a second in 2014-2016, and a third will be completed in coordination with this proposed project in 2019-2021. The combined June 2011-2013 population estimate for Marbled Murrelet was 38,926 (95% CI: 33,704-44,148). The combined June 2014-2016 population estimate declined to 26,118 (95% CI: 17,708-34,528). The August 2011-2013 archipelago-wide population estimate was 85,269 (95% CI: 67,320-10,3218) but declined significantly to 20,366 (95% CI: 14,370-26,363) in 2014-2016.

The second survey, with notably lower abundance of Marbled Murrelets, coincided with the largest marine heat wave ever recorded in the northeastern Pacific Ocean, during which sea surface temperatures were as much as 3°C higher than average in the GOA (Bond et al. 2015, DiLorenzo and Mantua 2016). The marine heat wave in turn coincided with a massive seabird die-off (JF Piatt, USGS, unpub. data), primarily of Common Murres (*Uria aalge*). Kodiak nearshore marine bird surveys in 2015 documented a large scale in-shore movement by Common Murres, with the overall population estimate increasing from

5,063 in August 2012 to 64,039 in August 2015. Systematic surveys for beach cast carcasses and incidental reports of dead birds throughout the archipelago from Spring 2015 to Spring 2016 recorded at minimum 2,058 seabird carcasses washed ashore in the archipelago (Corcoran 2019). Seven Marbled Murrelet carcasses were found during systematic beach surveys along the Kodiak road system indicating the species was also impacted. In addition to direct mortality, reductions observed in murrelet abundance during the 2015-2016 field seasons could have resulted from a combination of low forage fish availability and increased competition for prey due to the large in-shore movement of Common Murres.

The only previous breeding population estimate for Marbled Murrelets in the Kodiak Archipelago was 21,900 (Piatt and Ford 1993). However, this estimate was based on the Outer Continental Shelf Environmental Assessment Program surveys generally conducted from large vessels operating opportunistically in outside waters, and thus some sheltered inside waters preferred by murrelets were not sampled.

Nearshore and pelagic surveys conducted in June 1992 on Afognak Island (Fadely et al. 1993, K. Kuletz, pers. comm.) will enable us to extend our time series for trend detection to 29 years for that study area. We will subset data from the 2011-2021 surveys to match the data from the more geographically limited surveys from 1992.

Goal 2: Determine nesting locations, quantify vital rates, and evaluate threats to habitat and nest survival within the Kodiak Archipelago.

Due to their dispersed secretive breeding behavior, it is challenging to assess habitat requirements of murrelets nesting in Alaska. By comparing habitat suitability and variability of forested and non-forested nesting sites, we can identify and address potential factors limiting breeding success across the landscape and explore factors that may be inhibiting population recovery of the species. The EVOS Trustee Council purchased lands within the spill area in the Kodiak Archipelago for protection with high value as Marbled Murrelet nesting habitat including 26,665 acres on Shuyak Island, and 41,549 acres of mature spruce forest on northeastern Afognak (now Afognak Island State Park) (Piatt et al. 2007). This study will help to evaluate the value of these land purchases to nesting murrelets and will identify productive nesting habitat for future land acquisition or protection.

Marbled Murrelets nest mostly in coastal old-growth forests, but an unknown proportion nest on the ground, particularly in western Alaska where large trees are not available. Prior to the use of radio-telemetry to locate nests, the proportion of ground-nesting Marbled Murrelets in Alaska was estimated at approximately 3% based on the proportion of the population observed offshore near unforested landscapes (Piatt et al. 2007). While the importance of old-growth forest to nesting Marbled Murrelets is well documented in other regions, recent radio-telemetry studies in Alaska have found that 49-53% of murrelets nest on the ground, even when forested habitat is available (Barbaree et al. 2014; unpub. data, M. Kissling, U.S. Fish & Wildlife Service). Only three studies, locating 40 nests, have attempted to identify the variety of habitat available to Marbled Murrelets in Alaska for nesting by targeting a randomly-marked sample (Quinlan and Hughes 1990, Whitworth et al. 2000, Barbaree et al. 2014).

Without an unbiased sample of marked individuals to assess nest habitat characteristics, studies may be biased towards nests accessible to observers.

The loss and alteration of nesting habitat are primary terrestrial threats to Marbled Murrelet populations. Anthropogenic landscape management can fragment available habitat and increase edge effects. Proximity to industrial forestry, particularly to hard-edges created through clear-cutting practices, increases risk of Marbled Murrelet nest depredation by avian predators (Malt & Lank 2009). The timber industry is an important segment of the Kodiak economy and in the 1990s the archipelago was the state's second largest timber producer after Southeast Alaska (Fried & Windisch-Cole 1999). In the early 1990s Afognak Island already was described as heavily logged, primarily as a result of clear cutting that began in the 1970s (Naslund et al. 1995). Based on land cover/vegetation classification of the Kodiak Archipelago resulting from Landsat ETM+ digital image analysis, approximately 16% of old growth forest available on Afognak Island had been logged by 1999-2000 (M.D. Fleming and P. Spencer, U.S. Geological Survey, unpub data). There has been over 40 million board feet harvested annually from Afognak since 2010 and a recent increase in production with approximately 120–150 million board feet harvested at the end of the Chiniak Highway on Kodiak Island from 2010-2016 (Kodiak Daily Mirror 7/29/2010, Alaska Daily News 09/28/2016). The majority of logging occurs on Native corporation and state lands on Afognak Island, and in the Chiniak area along the Kodiak Island road system, all in areas where Marbled Murrelet at-sea densities and inland flight activity are high.

The potential for Marbled Murrelets to nest in re-growth following logging is unknown. Most ground nests that have been described indicated preference for steep-sloped habitats and cliffs, but also included some form of vegetative cover, such as alder or willow (Kuletz and Marks 1997, Marks and Kuletz 2001). These features offer open flyways that facilitate easy access to sites for departures from the nest. One of our proposed study sites offers a mosaic of forest classes where old growth forest within Kodiak NWR borders land impacted by past and current logging operations. Given the variety of habitat types available for nesting, this area offers a unique opportunity to study nest site selection. Tagging birds at-sea will provide an unbiased sample of nest locations and will aid us in identifying important habitat types used for nesting within a range of stand age classes. Interestingly, the only Marbled Murrelet ground nest confirmed in the archipelago was on northern Shuyak Island, where forest habitat is readily available (Tobish 2005, J. Withrow, pers. comm.).

We hypothesize that nest site selection influences nest survival mediated through exposure to predation risk. We predict that tree-nesting Marbled Murrelets experience high predation pressure from avian predators, while ground-nesters are disproportionately impacted by mammalian predators on Kodiak. Eggs and chicks at nests are likely depredated by corvids (ravens and jays), owls, hawks, canids and mustelids, but information on nest predators is limited in Alaska. Kodiak is home to potential avian nest predators of Marbled Murrelet nests, particularly Common Raven (*Corvus corax*) and Black-billed Magpie (*Pica hudsonia*). Black-billed Magpie have been documented depredating ground-nesting Kittlitz's Murrelet (*Brachyramphus brevirostris*) nests on Kodiak (Knudson et al. 2017), but their role as nests predators of Marbled Murrelets within the Archipelago has not been quantified. Predation by terrestrial predators on Kodiak is an important factor causing nest failure for the ground-nesting Kittlitz's

Murrelet where 28% of nests monitored over nine years were depredated by Red Fox (*Vulpes vulpes*; Knudson et al. 2017). Terrestrial predators also may limit nest success of accessible ground-nesting Marbled Murrelets.

Adult Marbled Murrelets in Alaska are known to be susceptible to avian predators, including Bald Eagle (*Haliaeetus leucocephalus*), Peregrine Falcon (*Falco peregrinus*), Northern Goshawk (*Accipiter gentilis*), and Sharp-shinned Hawk (*Accipiter striatus*). Most analysis of rates of predation of adult Marbled Murrelets in Alaska include investigations of prey remains in nests of suspected predators, and few studies include direct observation of predation events (Piatt et al. 2007). For a long-lived species with small clutch size and low reproductive rate, such as the Marbled Murrelet, small changes in adult survival can have population-level impacts. Bald Eagle populations increased dramatically during the late 20th Century, and there is evidence that this recovery has contributed to seabird declines in some regions (Parrish et al. 2001, Kildaw et al. 2005, Hayward et al. 2010). On Kodiak Island the number of active Bald Eagle nests increased by a factor of 3.4 from 1963 to 2002 (Zwiefelhofer 2007). Bald Eagle populations potentially could continue to increase as a result of warmer winters promoting survival, particularly at northern latitudes. Even if eagle populations stabilize, changes in fisheries, particularly reduced salmon returns to spawning streams, could lead to higher rates of predation by eagles on secondary prey like seabirds and waterfowl (Elliott et al. 2011).

Other potential threats to murrelet chick survival are biotoxins produced during harmful algal blooms (HABS). Globally, HABS are increasing in magnitude, frequency, and duration, in part due to climate change (Dale et al. 2006, Moore et al. 2008) but the impacts of these blooms on marine wildlife are not well documented. In a study of Kittlitz's Murrelet nest survival on southwestern Kodiak Island, 7 of 8 chicks that died on the nest in 2011 and 2012 tested positive for saxitoxin at lethal levels (Shearn-Bochsler et al. 2014). Saxitoxin is a neurotoxin produced by marine dinoflagellates, most commonly in the genus *Alexandrium,* that results in paralytic shellfish poisoning. Nest camera data revealed that the nestlings died shortly after consuming Pacific sand lance, a fish species known to biomagnify saxitoxin (Robards et al. 1999). It is highly likely that marine bird deaths from paralytic shellfish poisoning are under reported. Marbled Murrelets on Kodiak often are seen on surveys holding sand lance in their bill, a behavior common in adult birds waiting for twilight conditions to return to the nest to feed a chick. By placing cameras on nests we will be able to quantify the importance of sand lance and other prey types in chick diets, and we will be prepared to collect and preserve all carcasses in case of chick death.

Due to the small clutch size and low reproductive rate of the Marbled Murrelet, small increases in the rate of predation may have detrimental impacts on population viability (Nelson & Hamer 1995). By investigating nesting ecology of Marbled Murrelets, we can quantify demographic parameters in the Kodiak Archipelago and combine these vital rates with at-sea population trends to identify which life stages are most influenced by environmental or anthropogenic stressors. By comparing vital rates across the variety of habitat types used by Marbled Murrelets, we can better understand the influence of habitat quality on the species' failure to recover following the 1989 spill.

Goal 3: Determine drivers of nesting and foraging habitat selection at the individual and population levels.

Knowledge of spatial relationships between terrestrial nesting sites and marine foraging sites is vital for local conservation planning. We predict Marbled Murrelets captured adjacent to steep-sloped unforested habitat on the southeastern side of Kodiak Island will nest on the ground, most likely on cliff ledges. Conversely Marbled Murrelets captured in bays adjacent to old-growth sitka spruce on Afognak Island will primarily nest in trees. Previous radio telemetry studies in Southeast Alaska provided direct evidence that Marbled Murrelets can travel round trip up to 250 km daily between inland sites and at-sea foraging areas (Whitworth et al. 2000). With no land in the Kodiak Archipelago greater than 24 km from the coast, we predict shorter distances between nests and foraging sites.

Previous studies of marine space use by Marbled Murrelets in Alaska have observed high levels of inter-annual variation, identifying hot spots that shift yearly based on ocean conditions (Barbaree et al 2015). The marine habitat of the northern GOA is complex with numerous forested islands, fjords, inlets and estuaries providing sheltered stratified waters favored by murrelets (Piatt et al. 2007). Most murrelets occur within 5–10 km of shore in these regions (Burger 1995, Piatt and Naslund 1995), often in association with areas of local upwelling created by underwater shelves, mouths of bays, and island passes and wakes, which may serve to aggregate prey (Carter 1984, Sealy and Carter 1984, Day and Nigro 2000, Day et al. 2003, Kuletz 2005). A combination of systematic at-sea surveys and marine home range delineation using VHF transmitter data will more accurately identify and track shifts in marine hotspots.

The 1977-1978 climate regime shift in the GOA resulted in changes in primary and secondary productivity with populations of small forage species (e.g. capelin, shrimp, and sand lance) declining. Marbled Murrelet diet also changed during this time frame. Stomach content analysis from murrelets collected along the Alaska Peninsula and around Kodiak Island in the 1970s-1980s indicated they were feeding primarily on capelin. However, capelin were nearly absent from Marbled Murrelets collected in the same areas during the 1990s (Piatt et al. 2007). It is likely that changes in the marine environment contributed to widespread declines in murrelet populations during this time period. We can compare prey delivered to chicks using nest cameras in this study to the previous murrelet diet research in the region to determine if prey fed to chicks differs from prior adult diet. We also can compare prey delivered to chicks to forage fish surveys currently conducted in PWS and lower Cook Inlet for the Long Term Monitoring Program examining forage fish distribution, abundance, and body condition (Arimitsu et al. 2018, EVOSTC Project 16120114-O, continuing as 19120114-C) to assess the relationship between prey availability and prey selection by Marbled Murrelets.

2. PROJECT HISTORY

In 2011, the existing summer coastal bird survey on Kodiak National Wildlife Refuge was modified based on widely used and published methods to monitor marine birds in Prince William Sound, Kachemak Bay, and Cook Inlet, with transect selection and survey protocols directly comparable to National Park Service

surveys conducted at Katmai and Kenai Fjords National Parks, and western Prince William Sound. Our goals for this survey program were 1) to determine archipelago-wide population estimates, long-term trends, and an index of annual nesting productivity for key marine bird species relevant to Refuge management objectives and 2) to contribute data to regional monitoring programs for birds throughout the GOA, including the Gulf Watch Alaska Program. The survey included systematic sampling from a random start point and transects surveyed represented 19–21% of the nearshore survey zone and 4–8% of the offshore survey zone. The Kodiak Archipelago was divided into three survey areas for logistical reasons: East Kodiak, Afognak, and West Kodiak. Surveys took a minimum of 2–3 weeks to complete for each area during each survey period (June and August), thus there was not enough time to survey the entire archipelago in one season. Monitoring began in June 2011 and the first survey was completed in 2013, with a second conducted from 2014-2016. We resumed the survey cycle in 2019 which will conclude in 2021, providing valuable information on at-sea trends for Marbled Murrelets during the course of this proposed study.

Marbled Murrelets were one of the most commonly seen breeding seabird species in the Kodiak Archipelago during the nearshore marine bird surveys 2011-2016. Marbled Murrelets were recorded on 68% of all transects in June, and 78% of transects in August. In general, Marbled Murrelet density was higher in the offshore survey zone > 500 m from shore than in the nearshore zone within 400 m of the tide line. However, in August 2011-2013, we identified 268 hatch-year Marbled Murrelets and most (68%) were on nearshore transects. In August 2014-2016, we identified only 82 hatch-year Marbled Murrelets and again most (86%) were on nearshore transects (Figure 1).

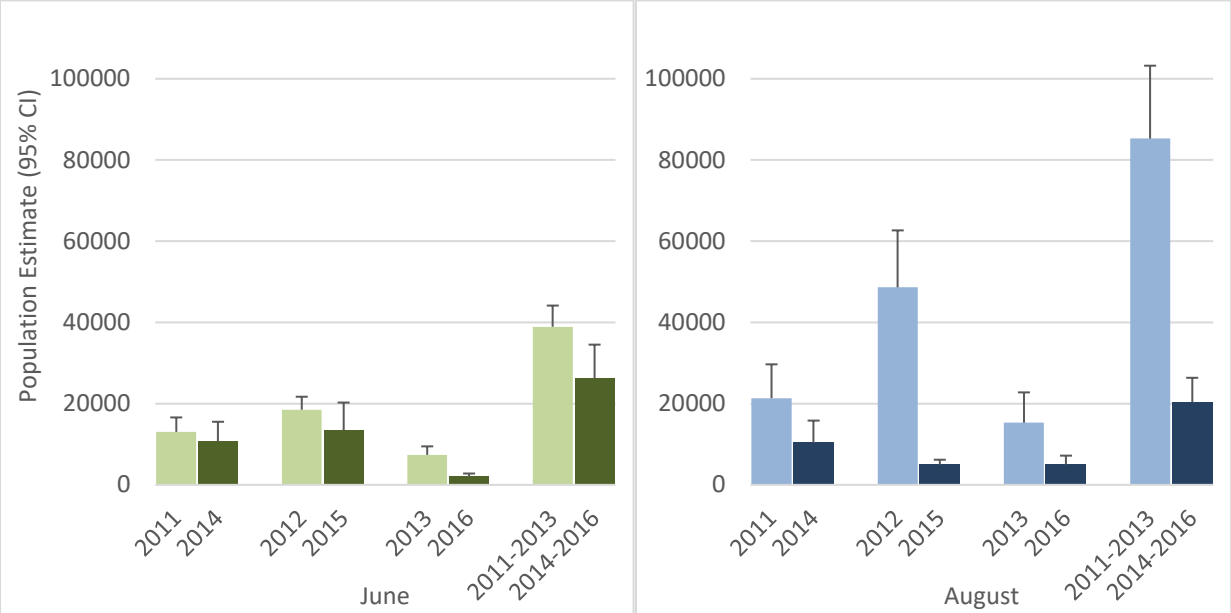

Figure 1. Population estimates and 95% confidence intervals (CI) of Marbled Murrelets surveyed in June and August on East Kodiak (2011 & 2014), Afognak (2012 & 2015), and West Kodiak (2013 & 2016) on the Kodiak Archipelago, Alaska.

An index of productivity as measured by the ratio of hatch-year to adult birds counted on August surveys ranged from 0.024 to 0.086 in the Kodiak Archipelago from 2011 to 2016. The range in Marbled Murrelet productivity on Kodiak was similar to murrelet production at six sites in PWS based on the core survey period from late July to late August 1995 which ranged from 0.020 to 0.118, averaging 0.075 across all sites (Kuletz and Kendall 1998). However, in PWS adult numbers peaked in surveys in late July and declined throughout August, a trend not observed in Kodiak. Because adult numbers decreased in PWS in August, the percentage of hatch year birds increased, perhaps inflating productivity estimates in comparison to Kodiak. Where June survey data exists it maybe more informative to compare hatch-year numbers from August surveys with numbers of adults in June. Sequential surveys that establish a baseline count during incubation, followed by surveys during the fledging period, may provide the most accurate estimate of the ratio of newly fledged juveniles to breeding adults and will be less sensitive to post-breeding migration patterns of adults that vary regionally. Comparing hatch-year to adult estimates in a consistent manner across the species range within the GOA (PWS, Kenai Peninsula, Kodiak Archipelago) could identify regions of low and high productivity within the spill zone. We plan to coordinate survey methods with monitoring conducted simultaneously in these areas to improve our ability to identify causes of declines that might vary by region.

Kodiak NWR will continue to fund the nearshore marine bird surveys to expand our current dataset monitoring summer Marbled Murrelet populations and relate these estimates to new investigations of nest survival. This is the highest priority avian monitoring program currently conducted on the refuge (USFWS 2014).

3. PROJECT DESIGN

Goals and Objectives

Goal 1: Determine trends in summer Marbled Murrelet abundance and productivity within the Kodiak Archipelago. Compare to long-term surveys conducted in other regions, such as Prince William Sound.

Objective 1: Quantify annual changes in at-sea abundance of Marbled Murrelets during June and August in the Kodiak Archipelago.

Objective 2: Measure an index of productivity as the ratio of juvenile (hatch-year) Marbled Murrelets to adults during August at-sea surveys.

Goal 2: Determine nesting locations, quantify vital rates, and evaluate threats to habitat and nest survival within the Kodiak Archipelago.

Objective 3: Compare the body condition and vital rates of Marbled Murrelets captured adjacent to forested and treeless habitats.

Objective 4: Locate Marbled Murrelet nests and characterize nest site habitat selection in the Kodiak Archipelago.

Objective 5: Document and evaluate nest activities including phenology, causes of nest failure, important forage fish provisioned to chicks, and adult and chick behavior.

Objective 6: Investigate depredation rates of adult Marbled Murrelets.

Goal 3: Determine drivers of nesting and foraging habitat selection at the individual and population levels.

Objective 7: Identify marine hotspots of breeding and non-breeding Marbled Murrelets.

Procedural and Scientific Methods

Objective 1: Quantify annual changes in at-sea abundance of Marbled Murrelets during June and August in the Kodiak Archipelago.

The survey design will consist of a series of transects along the shoreline such that a minimum of 20% of the Archipelago shoreline will be surveyed (Figure 2). Nearshore transects will be systematically selected beginning at a random starting point from the pool of contiguous 2.5–5.0 km transects that are adjacent to the mainland or islands, including the lengths of transects that are associated with islands or groups of islands with less than 5 km of shoreline. Transects will be generally 5 km long and nearshore transects will be 100 m from shore (mean high tide) and parallel to the shoreline. Because several abundant marine bird species use both the intertidal zone and shallow nearshore waters between 10 and 50 m deep to forage, we will add offshore transects. Offshore transects start at the end of nearshore transects, 500 m offshore and perpendicular to the prevailing shoreline for a distance of approximately 5 km.

Transect width will be 400 m for nearshore transects (100 m towards shore and 300 m for the observer looking offshore) and 600 m for offshore transects (300 m on either side of the skiff). The survey skiff is 6 m in length and will travel at approximately 5 knots. Birds seen above the tide line will be counted, primarily Black Oystercatchers, Bald Eagles, and nesting gulls and Alcids at colonies. Observers also will count birds seen 300 m forward of the skiff when birds are flushed from the water. On Kodiak, however, marine birds flushing in response to the skiff traveling at survey speed are rare. In previous survey years, with the exception of cormorant species, we observed little aversive movement by birds or marine mammals on the water in response to the skiff during the survey (Corcoran 2016). We suspect the birds are acclimated to the presence of slow-moving skiffs by the high level of fishing activity close to shore in the archipelago, particularly salmon seining and commercial and subsistence gill-net fishing.

The survey crew will consist of four personnel including two designated observers, a data entry/secondary observer, and a skiff operator. Typically, two observers will search each side of the vessel counting all marine birds and mammals and estimating distance to all birds and sea otters seen on the water with aid of a laser range finder. In the case of flocks of birds and large groups of sea otters, distance will be estimated to the center of the flock or group. Flying, transiting birds will be recorded continuously with behavior noted as flying to distinguish these observations from those of birds on the water. For foraging flocks, the distance to the center of the flock will be estimated and all birds will be considered on the water, though

at any given time some could be diving. We will record sea conditions including degree of chop and swell height at the start of each transect or as conditions change. Sea state will be described as calm (1), light chop (2), or moderate to heavy chop (3). Swell of over 0.5 m will be noted as well, and we will not conduct surveys if weather conditions are unacceptable (Beaufort scale >3). Observations will be recorded on a rugged laptop with a GPS using software developed for bird surveys (dLOG3, Ford 2009).

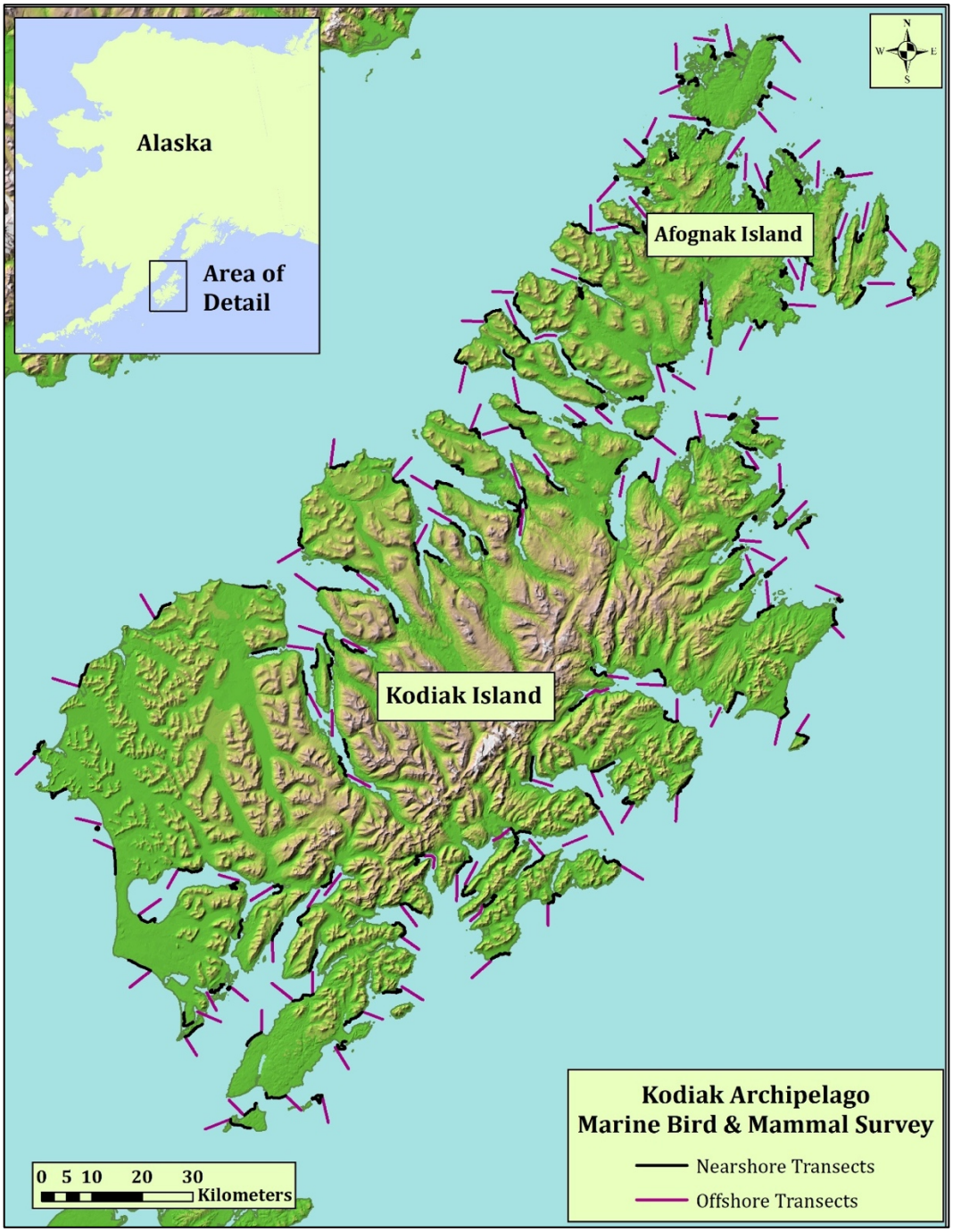

Figure 2. Map of the nearshore and offshore marine bird and mammal transects surveyed in the Kodiak Archipelago, Alaska by the U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge 2011-2016.

Objective 2: Measure an index of productivity as the ratio of juvenile (hatch-year) Marbled Murrelets to adults during August at-sea surveys.

The ratio of juvenile (hatch-year) to adult (after hatch-year) individuals is often used as a measure of avian productivity in species with distinct juvenile plumages. This ratio can be a cost-effective metric because it does not require monitoring individual breeding sites and often can be estimated across large geographic and temporal scales. This approach is particularly helpful for species for which it is difficult or impossible to monitor nest sites, such as the Marbled Murrelet. It has been used to monitor changes in reproductive success of Marbled Murrelets in several regions (Kuletz and Kendall 1998, Kuletz and Piatt 1999, Lougheed et al. 2002, Peery et al. 2007, Wong et al. 2008).

Objective 3: Compare the body condition and vital rates of Marbled Murrelets captured adjacent to forested and treeless habitats.

Prior to the initial capture season (May 2020), pre-capture at-sea surveys will be conducted from the M/V Ursa Major II. Surveys will be conducted during twilight hours to locate adult Marbled Murrelets on the water and increase effectiveness of night captures. We propose to capture Marbled Murrelets at night on the water during the pre-laying period (mid-May) and attach VHF radio transmitters (n=40) to adults during Spring 2020. The following two field seasons (2021, 2022) will build upon our pilot year, and we will increase our sample size (n=80), if feasible.

We will obtain approval from an Institutional Animal Care and Use Committee prior to captures. Using an inflatable skiff, the capture team will use a high-powered spot-light to locate and dip-net (Whitworth et al. 1997). Captured birds will be placed in waterproof pet-carrier boxes that will be covered with plastic to catch fecal samples and transported to the M/V Ursa Major II for processing. Once aboard, we will collect morphometric measurements. Exposed culmen, tarsus, and flattened wing-chord will be measured to the nearest 1 mm. Birds will be placed in a mesh bag and weighed using a 500 g spring scale. Brood patch will be scored to estimate development (Sealy 1974). Breast and secondary feathers will be collected for diet analysis. Each Marbled Murrelet will be banded with a U.S. Geological Survey stainless steel leg band. Transmitters will be attached to captured birds following the collection of morphological measurements and banding. Birds weighing less than 200 g will not be outfitted with a transmitter and will be released following banding. We will attach a 2.5g VHF radio transmitter to captured individuals using a subcutaneous anchor and one suture (Newman et al. 1999). Captured individuals will not be held in captivity for greater than 60 minutes from time of capture to time of release to minimize stress. Individuals will be released within 1 km of capture locations.

Objective 4: Locate Marbled Murrelet nests and characterize nest site habitat selection in the Kodiak Archipelago.

We will measure nest site selection in two distinct habitats by focusing captures in Foul Bay near old growth forests, and in Three Saints Bay at the treeless southeastern corner of Kodiak Island. Ground-based field crews will operate out of a USFWS public-use cabin or field camp located coastally within each capture area.

Fixed-wing aerial telemetry flights will be conducted immediately following transmitter deployment (mid-May). Flights will be conducted daily along the coastline of the study areas until August 31. One aerial telemetry technician will conduct all telemetry during survey flights. The receiver will be programmed to scan for each frequency for approximately 3 seconds. The main objective of the coastal telemetry flights will be to document presence or absence of tagged individuals on the water.

When a tagged individual exhibits a 24-hour pattern of presence and absence on the water, inland transect surveys will be conducted to obtain an inland location. Aerial transect surveys will be conducted immediately following daily coastal surveys. Transects will be parallel to coastline, beginning nearest to the coast and moving inland, with transect lines 5 km apart. When the signal of the nesting bird is detected, "boxing" techniques will be used to record a specific location. "Boxing" techniques involve comparing the relative signal strengths received by each wing-mounted antenna to circle the location of the strongest signal (Barbaree 2014). Location coordinates will be communicated to the field crew using satellite phones.

After an inland signal is located, a crew of biologists will hike to the location and use ground-based radio telemetry to narrow the nesting location to a single tree, small stand of trees, or cliff-face depending on the surrounding topography. The crew then will establish a base-camp at a minimum of 200 m from the nest site to minimize disturbance. The crew will camp at this location. Nests may be identified without the need for follow-up surveys if the adult can be seen incubating using binoculars.

The field crew will conduct dawn watch audio-visual surveys daily at suspected nest sites following survey protocols established for the Pacific Seabird Group Marbled Murrelet Technical Committee (Evans et al. 2003). Surveys will be conducted during hours of peak detections by automated acoustic recording units and past audio-visual surveys on Kodiak Island, beginning 90 minutes before official sunrise and ending 60 minutes after official sunrise (Cragg 2013). All auditory and visual detections of Marbled Murrelets will be recorded and described using digital voice recorders. Surveys will be focused on identifying canopy gaps or areas of open sky to obtain a visual of one of the Marbled Murrelet pair (tagged or untagged individual) arriving or departing from the nest. Dawn watch surveys will be conducted until the nest platform or ground-nesting location has been identified.

After August 1, nest searching will conclude, and biological teams will focus on nest monitoring and measuring habitat characteristics associated with nest sites. Habitat characteristics will be measured post-failure or fledge. At all nest sites, field technicians will record elevation, aspect, and slope of the nest site. All nest sites will be photo-documented in each cardinal direction. Nest site habitat measurements will be recorded within a 25 m circular plot with the nest at the center (see below). Topographic maps will be used to identify the nearest river drainage, closest distance to ocean, and possible flight-paths to the nest site. Imagery (e.g., Landsat) will be used to estimate distance from edge.

At ground nests, crews will estimate extent of ground cover and cover type in the nest plot. Percentages of cover types will be estimated within each plot, including soil, rock <10 cm, rock 10-30 cm, rock >30 cm, and vegetation. Vegetated cover will be classified into six categories (lichen, orange crustose lichen,

moss, grass, forb, and shrub) and percentages will be estimated. If the nest bowl is accessible, crews will measure the depth and diameter of the bowl and collect any available samples (e.g., feathers, guano, bones) that remain.

At tree nests, crews will estimate dominant overstory species, number of canopy layers, and use spherical densiometers to estimate canopy cover. Vegetated understory cover will be classified into four categories (moss, grass, forb, and shrub) and percentages will be estimated. Nest tree measurements will include: tree species, condition, canopy dominance, defects, number of suitable nesting platforms (>10 cm in diameter), height, diameter-at-breast height (DBH), crown diameter and condition of treetop. Nest limb measurements will include: height, length, aspect, angle of repose, and condition. Within the nest plot, crews will measure DBH, record the species, and record the number of available nest platforms in all trees.

For each nest, four near-nest control plots will be randomly generated to investigate habitat variables of sites not used by Marbled Murrelets. Near-nest plots will be assigned by randomly generating Global Positioning System (GPS) locations within 1 km of the nest site. For near-nest plots within tree habitat, a "potential nest tree" will be assigned by selecting the tree with DBH ≥ 120 cm closest to the randomly generated GPS coordinates (Baker et al. 2006).

Objective 5: Document and evaluate nest activities including phenology, causes of nest failure, important forage fish provisioned to chicks, and adult and chick behavior.

After a nest location has been identified using dawn watches, cameras will be installed to document nest events and feedings. During camera installation, crews will record nest location based on GPS. Motion-triggered digital game cameras (Reconyx Ultrafire Camera Trap) will be mounted on stakes at ground nests. Cameras will be spray-painted prior to deployment and camouflaged with rocks and woody debris to blend in with the surrounding environment. Use of camouflaged digital game cameras at Kittlitz's Murrelet nests on Kodiak NWR showed no effect on rates of nest depredation and nests with cameras had higher fledging rates (0.21 with cameras, 0.10 without). Digital game cameras will take photos at 3-minute intervals to capture photo-evidence of over 99% of prey deliveries to chicks (Lawonn 2012). At tree nests, we will contract a local tree climbing service to install waterproof security cameras with high-definition remote zoom (Axis Bullet HD Video Camera). Cameras will be zip-tied to an adjacent tree approximately 30 m from the nest site at similar height to the nest limb and will be camouflaged with moss and woody debris to blend in with the surrounding environment. These security cameras will provide 24-hour video surveillance of nests. A team of technicians will return to the nest site to replace camera batteries and SD cards or hard drives as necessary.

For a subset of discovered nests in our pilot year (2020) we will deploy autonomous acoustic recording units to record audio detections near the nest site. We will collaborate with the Province of British Columbia, Ministry of Forests, Lands, Natural Resource Operations and Rural Development to use these units as a tool to inform acoustic indices of murrelet nesting behavior. Province of British Columbia will

provide autonomous acoustic recording units, analyze recordings, and provide these data to our project (see Sources of Additional Funding).

If nests are inaccessible to ground-based field crews or tree climbers, we will establish an automated telemetry station at a fixed location. The station will include a data-logging receiver that will automatically turn on at a fixed time interval and scan for the frequency of the transmitter attached to the nesting bird. We plan to borrow a minimum of two of these receivers from Michelle Kissling (see Sources of Additional Funding). We will use these data to evaluate movement patterns of the tagged-bird and infer nest success (following Kissling et al. 2015).

Objective 6: Investigate depredation rates of adult Marbled Murrelets.

Ground-based field crews will record daily observations of predators following methods established in Sargeant et al. (1993) to estimate an index of relative abundance at each study site. The aerial telemetry technician and field crews also will opportunistically locate downed-tags as soon as possible. If the field crew or aerial technician obtains an inland location not-indicative of nesting, the field crew will use ground-based telemetry to locate the transmitter. If possible, the crew will retrieve the transmitter and carcass, recording photographs in-situ of the carcass, transmitter, and surrounding landscape. The carcass will be collected and necropsied to determine cause of death. If the crew is unable to retrieve the transmitter due to inaccessibility (e.g., transmitter is located in an inaccessible nest of a predator species), the crew will monitor the site and record predators observed.

Objective 7: Identify marine hotspots of breeding and non-breeding Marbled Murrelets.

The secondary objective of aerial telemetry flights will be to determine at-sea locations of individuals, linking marine and terrestrial habitat. When a signal is detected on the water, the aerial technician will use "boxing" techniques to narrow the possible area of occurrence to obtain a GPS-based location estimate. When the plane is unable to fly due to weather constraints, the field crew will conduct coastal and skiff-based telemetry (weather permitting) to identify presence or absence of tagged individuals on the water. During coastal and skiff telemetry, receivers will scan for each frequency. If an individual is aurally detected by the field crew, the field crew will use a compass to record a bearing in the direction of the strongest signal. Subsequent bearings will be used to biangulate or triangulate to obtain an approximate location. Combined with aerial at-sea locations, skiff-based biangulations and triangulations will increase our understanding of marine habitat use by the Marbled Murrelet.

4. DATA ANALYSIS AND STATISTICAL METHODS

Objective 1: Quantify annual changes in at-sea abundance of Marbled Murrelets during June and August in the Kodiak Archipelago.

Nearshore marine bird data will be analyzed using methods consistent with those used for other long-term marine bird monitoring surveys in the region so that results are directly comparable.

We will use transect densities (birds/km^2 for species recorded on nearshore and offshore transects) to calculate mean density and standard error (SE) for each area and survey. We will use a ratio estimator (Cochran 1977, Williams et al. 2002) to estimate population sizes and variances (Klosiewski and Laing 1994, Agler et al. 1994). Population estimates will be calculated for the species of interest using the formula:

$$\widehat{N}_r = \frac{\bar{y}}{\bar{a}} A$$

where:

$\widehat{N}_r$ = population estimate for a region.
A = total area of the region
$\bar{y}$ = sample mean of birds counted on transects for the region.
$\bar{a}$ = sample mean of the transect area or length for the region.

The variance for the population estimate will be calculated as follows:

$$\widehat{var}\left(\widehat{N}_r\right) = M^2 \frac{(1 - m/M)}{m} (s_y^2 + \widehat{D}^2 s_a^2 - 2\widehat{D} s_{ay})$$

where:

$\widehat{var}\left(\widehat{N}_r\right)$ = estimated variance of $\widehat{N}_r$.
M = total number of sampling units in the region.
m = number sampled units (transects) in the region.
$\widehat{D} = \bar{y}/\bar{a}$ = an estimate of population density.
s_y^2 = estimated variance for the bird counts.
s_a^2 = estimated variance of the transect areas or lengths.
s_{ay} = estimated covariance between the counts and the areas/lengths.

$$s_{ay} = \frac{\sum_{i=1}^{m} (y_i - \bar{y})(a_i - \bar{a})}{m - 1}$$

The approximate 95% confidence limits for abundance will be estimated by:

$$\widehat{N_r} \pm 1.96 \sqrt{\widehat{var}(\widehat{N_r})}$$

Objective 2: Measure an index of productivity as the ratio of juvenile (hatch-year) Marbled Murrelets to adults during August at-sea surveys.

We will estimate the ratios of hatch-year (HY) to after hatch-year (AHY) Marbled Murrelets using the methods of Peery et al. (2007). To evaluate the effect of age-specific differences in spatial distribution on HY:AHY ratios, we will compare the distributions of HY and AHY murrelets characterized with at-sea surveys in two different ways. First, using a chi-square test, we will evaluate the null hypothesis that the proportion of HY and AHY individuals is equal in four bands that differ in relation to their distance from shore. Second, using a chi-square test, we will compare the proportion of HYs and AHYs along 10 km

segments of coastline to test the null hypothesis that HY and AHY individuals are distributed similarly along the coast.

Objective 3: Compare the body condition and vital rates of Marbled Murrelets captured adjacent to forested and treeless habitats.

We will use logistic regression to assess the relationship between morphometrics, body mass, breeding propensity, and nest site type where possible. We will use univariate analyses (t-tests) to examine morphological differences between ground nesting Marbled Murrelet and tree nesting Marbled Murrelet. Previous morphological comparisons finding slight differences in wing-length lumped all Kodiak Marbled Murrelet specimens as tree nesters (Pitocchelli et al 1995). By using data collected from individuals of known nest site type we can improve comparative analyses.

Two breast feathers (pre-breeding diet) and the tip of the fifth secondary feather (post-breeding diet) will be removed and collected and archived for diet analysis (Becker et al. 2007). Fecal samples will be archived for explorations of temporal variation in diet and for comparisons with Marbled Murrelet in other regions (see Coordination and Collaboration). Samples can be analyzed using PCR amplification to identify DNA of potential prey types (Deagle et al. 2007). This type of analysis can provide both quantitative and qualitative assessment of diet composition.

Objective 4: Locate Marbled Murrelet nests and characterize nest site habitat selection in the Kodiak Archipelago.

To investigate habitat preference, we will compare habitat characteristics observed at nest sites with those observed at near-nest random plots. First, we will look for associations between large scale habitat metrics (e.g., elevation, aspect, slope, and distance from ocean) and nest sites within both forested and treeless habitats. Here we will use logistic regression to evaluate the probability of use. Then we will follow-up with finer scale and habitat-specific analyses. In forested habitats, we will examine relationships between nest location and average DBH of overstory trees, canopy cover, number of canopy layers, average number of available nesting platforms, and percentages of different types of vegetation cover (e.g., moss, grass, forb, and shrub). In open, treeless habitats (i.e. for ground nests), we will examine the relationships between nest locations and percentages of soil, rock <10 cm, rock 10-30 cm, rock >30 cm, and different types of vegetation cover (e.g. lichen, orange crustose lichen, moss, grass, forb, and shrub). We will then use logistic regression to compare habitat associations for both groups and evaluate the best models using Akaike's information criterion (AIC) to compare the models (Burnham and Anderson 2002). We plan to compare these analyses with mixed-model analyses of covariance to pair nest and near-nest plots and control for biased effects (Baker et al. 2006).

We will combine our nest site habitat data with that from past studies of Marbled Murrelet habitat requirements (Baker et al. 2006, Grenier and Nelson 1995, Naslund et al. 1995) to calculate a habitat suitability index and generate a map for this index across the Kodiak Archipelago. Mapping this index will allow us to estimate species distribution and carrying capacity of nesting habitat for the Archipelago.

Objective 5: Document and evaluate nest activities including phenology, causes of nest failure, important forage fish provisioned to chicks, and adult and chick behavior.

At the conclusion of each field season, volunteers and technicians will review camera footage and record the timing of incubation switches, prey deliveries, and depredation events. Prey species delivered to chicks and predator species visible on the cameras will be identified and quantified. We will calculate meal delivery rates per nest (where possible) and use univariate analyses to evaluate yearly differences in provisioning rates.

We will use program MARK (Rotella et al. 2004) to model daily nest survival rate (if sample size is sufficient) and compare models examining the effects of year, nest site type, and other factors, and evaluate model support using AIC.

Objective 6: Investigate depredation rates of adult Marbled Murrelet.

We will calculate rates of predation on adult Marbled Murrelets based on recovery of transmitters from predator nests as well as rates of predation on nestlings documented by cameras. We will use univariate analyses to examine differences in yearly rates of predation and predator abundance within study areas.

Objective 7: Identify marine hotspots of breeding and non-breeding Marbled Murrelet.

To investigate marine space use, we will employ a variety of statistical approaches to evaluating marine home range for comparison with similar studies. We plan to estimate 95% kernel ranges using both least squares cross-validation as a bandwidth estimator and using the plugin bandwidth estimator. We will compare these approaches with 95% minimum convex polygons to investigate broad-scale home range (Lorenz et al. 2017). To evaluate the areas of most frequent or highest density use by Marbled Murrelet, we will estimate core range using 50% kernel ranges. We will use general linear models to determine the influence of breeding status and year on marine home and core range size (Barbaree 2015). We will conduct spatial comparisons of marine home ranges of telemetered birds and marine hotspots observed by at-sea surveys. We will use topographic and land cover maps in ArcGIS to run least cost path analysis to determine likely flight corridors for Marbled Murrelets. From this analysis we will calculate commuting distance from foraging locations determined by aerial points and nest locations.

5. DESCRIPTION OF STUDY AREA

We will capture and tag Marbled Murrelets at-sea in two bays within the Kodiak Archipelago: Foul Bay within the Sitka spruce forests of Afognak Island, and Three-Saints Bay in treeless habitat on southeastern Kodiak Island (see Figure 3). In the Kodiak Archipelago some of the largest Marbled Murrelet populations sampled by marine radar during the breeding season were in unforested steep slope habitats along the east side of Kodiak Island (Cragg 2013). Our study will occur entirely within the 1989 EVOS area of impact.

The Kodiak Archipelago is located in the northern GOA, 50 km east of the Alaska Peninsula and 140 km southwest of the Kenai Peninsula. The archipelago is influenced by a maritime climate with an annual mean temperature of about 4°C. Total annual precipitation varies from 250 cm along the eastern coast to 60 cm over the western areas adjacent to Shelikof Strait. Mountains, several with peaks more than 1000 m, traverse more than half the length of Kodiak Island and dominant vegetation types range from Sitka spruce (*Picea sitchensis*) forest on the northern end of the archipelago to treeless tundra on the southern end. The area is characterized by approximately 4,500 km of rocky irregular coastlines with numerous

glacially scoured straits, inlets, bays, and fjords with branching arms. Sea bluffs are generally steep and rocky and numerous offshore rocks and islets occur along the coast (USFWS 2008).

The shores along the Kodiak Archipelago are considered among the most biologically significant areas in the GOA, providing breeding, nesting, feeding, and rearing habitat for a diverse array of wildlife species (USFWS 2012). The USFWS is the largest single land owner in the archipelago, with Kodiak NWR comprising some 1.8 million acres or approximately two-thirds of the archipelago. State lands include the islands' extensive tidelands, plus almost all of Shuyak Island (47,000 acres), managed as Shuyak Island State Park. Approximately 20% of archipelago lands are private, owned and managed primarily by Koniag Alaska Regional Native Corporation and other village corporations. Alaska Maritime NWR's GOA Unit manages many of the offshore islands, islets, rocks, and spires with nesting seabirds and includes about 395,500 acres of submerged lands off Afognak Island, 7,000 acres along the Karluk coastline, and 4,500 acres in Women's Bay (USFWS 2011).

Coastal marine habitats were identified as a special value of the refuge in the Revised Comprehensive Conservation Plan for the Kodiak National Wildlife Refuge (USFWS 2008). The GOA coastal ocean currents and the upwelling of nutrient-rich marine waters surrounding the Kodiak Archipelago continually inject large amounts of marine-derived nutrients into coastal habitats in the region. Nearshore habitats in the archipelago support resident and migratory marine bird and mammal populations and provide key habitat during portions of the life cycles of many commercially or biologically valuable pelagic and forage fish species.

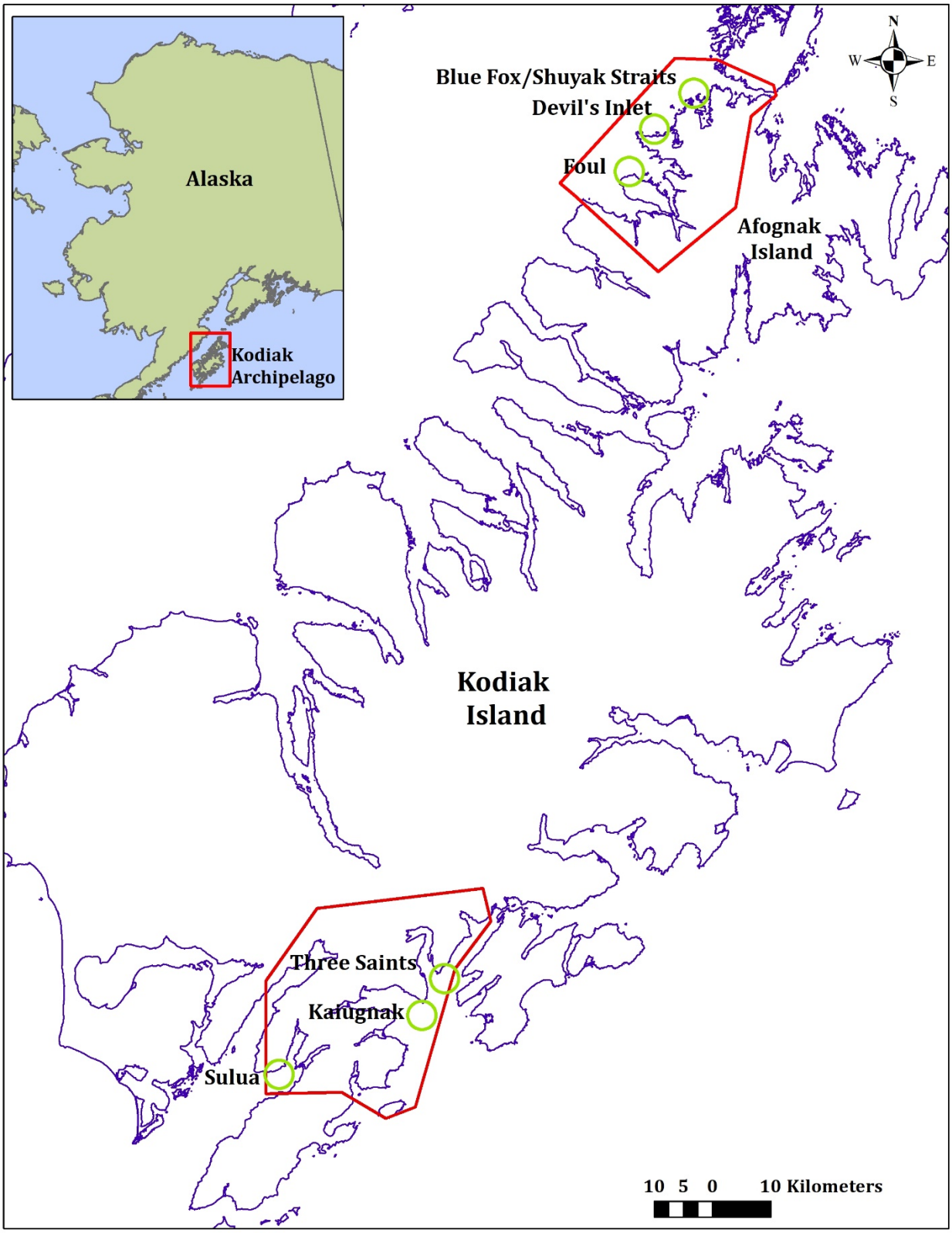

Figure 3. Research sites for Marbled Murrelet nesting ecology studies in old-growth Sitka spruce forest on Afognak Island and steep-sloped treeless terrain in Three Saints Bay, Kodiak Archipelago, Alaska. Study areas in each location outlined in red; potential at-sea capture locations indicated by green circles.

6. COORDINATION AND COLLABORATION

Within an EVOSTC Funded Program

Gulf Watch Alaska

While not formally part of Gulf Watch Alaska, the current nearshore marine bird survey on Kodiak is based on widely used and published methods to monitor marine birds in Prince William Sound, Kachemak Bay, and Cook Inlet, with transect selection and survey protocols directly comparable to National Park Service surveys conducted at Katmai and Kenai Fjords National Parks, and western Prince William Sound.

History of nearshore monitoring plans in Gulf of Alaska -The Southwest Alaska Network (SWAN) and the Exxon Valdez Trustee Council (Trustee Council) simultaneously engaged in planning long-term monitoring programs for the marine nearshore in the GOA during 2001-2005. Marine nearshore monitoring is part of a larger integrated National Park Service (NPS) Program known as Vital Signs Inventory and Monitoring. Planning by the Trustee Council was part of a larger GOA restoration monitoring effort related to the Exxon Valdez Oil Spill (EVOS) restoration effort. Because of overlapping objectives and geographic scopes of interest within the nearshore, NPS and USGS staff responsible for planning the SWAN and EVOS programs collaborated in some aspects of the design with the intension of creating a monitoring protocol that could be used by both programs. The Kodiak Archipelago was included in the GOA planning efforts but implementation of the monitoring program by the Trustee Council was delayed, and as a result, the SWAN monitoring program was modified to be a stand-alone product that reflected the near-term need to implement sampling in the National Parks of the Alaska and Katmai Peninsulas. In 2011 we developed a survey using nearshore transects selected for this larger monitoring effort and implemented protocols from the SWAN program for monitoring nearshore marine birds to the Kodiak Archipelago as originally envisioned by the Nearshore Restoration and Ecosystem Monitoring (N-REM) Program (Dean and Bodkin 2011).

Herring Research and Monitoring

We currently do not have plans to coordinate with this program.

Data Management

We will provide Gulf Watch Alaska with the nearshore marine bird survey data from Kodiak.

With Other EVOSTC-funded Projects

Through collaboration with Tuula Hollmen of the Alaska SeaLife Center, we plan to share results with FY20 proposed project "Status and trends of Kittlitz's murrelet, marbled murrelet, and pigeon guillemot in a changing Northern Gulf of Alaska ecosystem." With study-designs emphasizing marine surveys and nest monitoring, both projects will contribute to a geographically broad examination of stressors influencing Marbled Murrelets within the EVOS zone. Specifically, we plan to share post-hoc evaluations

of raw data collected from nest-monitoring cameras and population trends between projects. Nest-monitoring methods will use cameras to evaluate incubation behavior and investigate both timing and rates of hatch and fledge, allowing us to assess the synchrony of phenology across the region for the species. By comparing population trends observed in Kenai and the Kodiak Archipelago we can determine which stressors are unique to the Kodiak environment and which are influencing murrrelets at broader scale. Additionally, archives of samples collected from adults (collected during at-sea captures) and nestlings (opportunistically collected at nest sites) can be used for diet estimation and comparison among sites. This collaboration will provide valuable information on region-wide status of Marbled Murrelet and help identify the scale of threats to the species.

With Trustee or Management Agencies

Information from this project will be provided to the North Pacific Pelagic Seabird Database maintained by the U.S. Geological Survey.

With Native and Local Communities

We will be contracting a local flight service for telemetry flights (North River Air, Inc.) and a tree climbing service (Jere's Tree Service, Inc.) for placing nest cameras. We will also work with the refuge Outreach Specialist and Environmental Educator to design materials and educational programs to inform native communities in the archipelago (Akhiok and Old Harbor) about the project.

7. DELIVERABLES

Data analysis will occur in coordination with Oregon State University and will result in a dissertation in partial fulfillment of the requirements of a Doctor of Philosophy Degree. The dissertation will include the preparation and submission of a minimum of two manuscripts to peer reviewed journals. Candidate journals include Marine Ornithology, The Journal of Wildlife Management, The Condor, and Conservation Biology.

In conjunction with the annual report submitted to the Exxon Valdez Oil Spill Trustee Council, an annual progress report will be available for download on the website of Kodiak NWR.

Annual presentations will be delivered to the local community through the visitor center of Kodiak NWR. A yearly update will be presented at the Pacific Seabird Group Marbled Murrelet Technical Committee Annual Meeting, and yearly update posters as well as a final presentation will occur to the general attendees of the Pacific Seabird Group Annual Meeting.

In collaboration with the Outreach Specialist of Kodiak NWR, we will produce a three-part film series communicating the goals and results of the project to the general public. This film series will be available on the website of Kodiak NWR.

8. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

Project milestone and task progress by fiscal year and quarter, beginning February 1, 2020. Yellow highlight indicates proposed fiscal year Work Plan. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

	FY20				**FY21**				**FY22**				**FY23**				**FY24**			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone 1: Data Collection																				
Contracting	X				X				X											
Hire Staff/Purchases	X				X				X											
Surveys/Field Work		X	X			X	X			X	X									
Milestone 2: Data Processing																				
Database mgmt./QAQC			X	X	X		X	X	X		X	X								
Nest photograph review/analysis			X	X	X		X	X	X		X	X								
Data processing/analysis			X	X	X		X	X	X		X	X	X	X	X	X	X			
Reporting																				
Annual reports				X				X				X								
FY work plan*			X				X				X				X					
Final report																	X			
Deliverables																				
Peer reviewed paper 1																	X			
Data posted online				X				X				X				X				

**Detailed FY20 Work Plan will be developed commensurate with notification of funding (Oct/Nov 2019).*

9. BUDGET

Budget Forms Attached

Budget Category:	Proposed FY 20	Proposed FY21	Proposed FY22	Proposed FY23	Proposed FY24	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$104,908.0	$107,128.0	$109,432.0	$64,512.0	$0.0	$385,980.0	
Travel	$23,260.0	$23,260.0	$23,260.0	$0.0	$0.0	$69,780.0	
Contractual	$409,251.0	$409,251.0	$409,251.0	$0.0	$0.0	$1,227,753.0	
Commodities	$60,112.0	$21,412.0	$21,412.0	$0.0	$0.0	$102,936.0	
Equipment	$78,583.0	$61,440.0	$14,290.0	$0.0	$0.0	$154,313.0	
Indirect Costs (*will vary by proposer*)	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	
SUBTOTAL	$676,114.0	$622,491.0	$577,645.0	$64,512.0	$0.0	$1,940,762.0	
General Administration (9% of subtotal)	$60,850.3	$56,024.2	$51,988.1	$5,806.1	$0.0	$174,668.6	
PROJECT TOTAL	**$736,964.3**	**$678,515.2**	**$629,633.1**	**$70,318.1**	**$0.0**	**$2,115,430.6**	
Other Resources (Cost Share Funds)	$139,210.0	$92,500.0	$92,500.0	$0.0	$0.0	$324,210.0	N/A

Sources of Additional Funding*

The U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, will contribute significantly to the implementation of this project in the form of salaries, travel, equipment, and housing. Annual estimated contributions total $89,000 including costs associated with marine bird surveys at $28,000, Principle Investigator salary at $52,000 (50% time), and Vessel Captain base salary at $9,000 (240 hours).

Province of British Columbia, Ministry of Forests, Lands, Natural Resource Operations and Rural Development, will contribute an estimated $27,210 in FY20 including $12,210 for costs associated with deployment and analysis of autonomous acoustic recording units and $15,000 for capture advising.

The U.S. Fish and Wildlife Service, Michelle Kissling, will contribute an estimated $23,000 in FY20 including $16,000 for stationary telemetry and capture equipment and $7,000 for capture advising. In FY21 and FY22 the U.S. Fish and Wildlife Service, Michelle Kissling, will contribute $3,500 per year for capture advising. Contributions FY20-FY22 will total $30,000.

**Letters of documentation for sources of additional funding are attached.*

10. LITERATURE CITED

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11. PROJECT PERSONNEL

Project Co-PIs (CVs attached)

Robin Corcoran, U.S. Fish & Wildlife Service, Kodiak National Wildlife Refuge
Donald Lyons, Oregon State University

Project Manager (CV attached)

Katelyn Stoner, Oregon State University

Project Advisors

Jenna Cragg, Province of British Columbia
Michelle Kissling, U.S. Fish & Wildlife Service
Kim Nelson, Oregon State University
John Piatt, U.S. Geological Survey
William Pyle, U.S. Fish & Wildlife Service

ROBIN M. CORCORAN

Wildlife Biologist/Ornithologist, Kodiak National Wildlife Refuge (NWR), 1390 Buskin River Road, Kodiak, AK 99615; Phone: 907-487-0229, Email: robin_corcoran@fws.gov

WORK EXPERIENCE:

Wildlife Biologist/Ornithologist, Kodiak NWR, Kodiak, AK: 5/09-present

As the refuge bird biologist I design and conduct wildlife censuses and monitoring field studies focusing on breeding, migrating, and wintering birds.

Wildlife Biologist, Sonny Bono Salton Sea NWR., Calipatria, CA; 9/07-4/09

I served as the Senior Wildlife Biologist for the refuge complex, coordinating the biological program on two refuges. I designed and conducted wildlife censuses and wetland monitoring field studies focused on breeding, migrating, and wintering waterbirds including two endangered bird species, Yuma clapper rails and California brown pelicans. Diverse habitats on the refuges included open saline lake, fresh water impoundments, farming units, and native desert scrub and blow-sand dunes

Wildlife Biologist, Innoko National Wildlife Refuge, McGrath, AK; 5/05-9/07.

Responsible for planning and conducting avian research, inventory, and management on the refuge including: (1) annual breeding bird and Alaska landbird monitoring surveys; (2) inventory and management of greater-white-fronted geese including aerial surveys, aerial telemetry, and banding over 1000 molting geese on the refuge annually; (3) northern pintail avian influenza sampling; (4) demographic research on riparian songbirds focusing on causes of declines in species of conservation concern, (5) writing grant applications independently and in collaboration with other researchers (e.g. USGS Science Support Proposal for white fronted goose grazing studies, and Pacific Coast Joint Venture Discretionary Funding for riparian songbird demography study); (6) writing annual work plans and summary reports for granting organizations.

Graduate Research Assistant, Department of Zoology, University of Wyoming, 5/01-5/05.

I planned, designed, and conducted a graduate thesis project studying lesser scaup nesting ecology on Yukon Flats National Wildlife Refuge, AK in an effort to identify factors related to long-term population declines. In addition to locating and monitoring nests, and radio-tagging and tracking hen and duckling movements, I collected and analyzed water chemistry and aquatic invertebrate samples for a change detection study. Statistical analysis included modeling nest survival in relation to wetland habitat types, multivariate analysis of water chemistry and invertebrate data, and wetland area change detection using GIS.

Research Assistant, USGS-Biological Resources Division, Fort Collins, CO; 5/91-04/01.

I assisted with diverse research projects for the Fort Collins Science Center, Alaska Biological Research Center, and Northern Prairie Wetland Research Center. I worked independently selecting study sites and modifying protocols and techniques as necessary to successfully complete each project, entered and analyzed data, and submitted written project summaries.

Biological Technician, Alaska Biological Research, Inc., Fairbanks, AK; 6/99-7/99 & 4/00-9/00.

Two field seasons assisting with various projects as assigned by principal investigators at a private biological consulting firm.

Research Assistant, Colorado Bird Observatory; 5/95-9/95 & 5/96-9/96.

Seasonal position for two summers as project manager on a high-elevation riparian songbird monitoring project to determine the impacts of elk browse on nesting cover at several sites in Rocky Mountain National Park, using Breeding Biology Research and Monitoring Data Base and Monitoring Avian Productivity and Survivorship protocols.

Research Assistant, National Audubon Society, Tavernier, FL; 7/89-4/91.

I assisted on studies of wading bird ecology in Everglades National Park for two nesting seasons focusing on Great White Herons and Roseate Spoonbills. Responsibilities included trapping birds, banding and radio-tagging herons and spoonbills, aerial surveys of wading birds, daily aerial telemetry flights to monitor bird locations, fish and invertebrate sampling, collecting blood, fecal, and regurgitant samples from nestlings, necropsy of birds, care of captive wading birds, training and supervising assistants and interns, and data entry and input of habitat base maps on a Computer Aided Mapping and Inventory System (GIS).

EDUCATION:
University of Wyoming, Laramie, WY. Master's Degree, 5/2005. Major: Zoology
Cornell University, Ithaca, NY. Bachelor of Science, May 1989. Major: Natural Resource Management.

AFFILIATIONS:

- American Ornithological Society
- Wilson Ornithological Society
- Pacific Seabird Group

RECENT PROFESSIONAL PUBLICATIONS:

Knudson, T.W., J.R. Lovvorn, M.J. Lawonn, **R.M. Corcoran**, D.D. Roby, J.F. Piatt, and W.H. Pyle. 2019. Can oceanic effects on growth and time to fledging mediate terrestrial predator limitation of an at-risk seabird? Ecosphere, submitted manuscript.

Lawonn, M.J., D.D. Roby, J.F. Piatt, W.H. Pyle, **R.M. Corcoran**. 2018. Breeding ecology of Kittlitz's Murrelets on Kodiak Island, Alaska. Journal of Field Ornithology 89: 348–362.

Lawonn, M.J., D.D. Roby, J.F. Piatt, W.H. Pyle, **R.M. Corcoran**. 2018. Nest-site selection by Kittlitz's Murrelets *Brachyramphus brevirostris* on Kodiak Island, Alaska. Marine Ornithology 46: 33–42.

Corcoran, R.M., S. Studebaker, and R.A. MacIntosh. 2018. Aleutian Tern *Onychoprion aleuticus* colony abandonment in response to Bald Eagle *Haliaeetus leucocephalus* nest predation. Marine Ornithology 46: 113–115.

Shearn-Bochsler, V., E.W. Lance, **R. Corcoran**, J. Piatt, B. Bodenstein, E. Frame, and J. Lawonn. 2014. Fatal paralytic shellfish poisoning in Kittlitz's murrelet (*Brachyramphus brevirostris*) nestlings, Alaska, USA. Journal of Wildlife Diseases 50(4): 933-937.

RECENT COLLABORATORS:

Erin Cooper, U.S. Forest Service, Chugach National Forest; **David C. Duffy**, University of Hawaii, Manoa; **Michael I. Goldstein**, U.S. Forest Service; **Leah Kenney**, U.S. Fish and Wildlife Service, Alaska Region; **Timothy W. Knudson**, U.S. Fish and Wildlife Service, Alaska Region; **M. James Lawonn**, Department of Fisheries and Wildlife, Oregon State University; **James R. Lovvorn**, Department of Zoology, Southern Illinois University; **Donald E. Lyons**, National Audubon Society & Department of Fisheries and Wildlife, Oregon State University; **Trent McDonald**, Western EcoSystems Technology, Inc.; **Kelly Nesvacil**, Alaska Department of Fish and Game; **Susan Oehlers**, U.S. Forest Service, Tongass National Forest; **John F. Piatt**, U.S. Geological Survey, Alaska Science Center; **Sanjay Pyare**, University of Alaska Southeast; **Martin Renner**, Tern Again Consulting, Inc.; **Daniel D. Roby**, Department of Fisheries and Wildlife, Oregon State University; **Paul Schuette**, Alaska Center for Conservation Science (ACCS), University of Alaska Anchorage; **Patricia Szczys**, Eastern Connecticut State University.

Donald E. Lyons, Ph.D.

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EDUCATION

Ph.D. in Wildlife Science, Oregon State University, 2010.
M.S. in Wildlife Science, Oregon State University (Statistics Minor) 2004.

CURRENT RESEARCH PROJECTS

Integrate Seabird Monitoring Data into Ecosystem Assessments of Large Marine Ecosystems [PI]
Integrate seabird monitoring data into annual assessments of Gulf of Maine ecosystem status.
Sponsor: National Audubon Society ($30,000)

Atlantic Puffin Foraging Ecology [PI]
Relate foraging locations obtained using GPS loggers to prey types delivered to chicks.
Sponsor: National Audubon Society ($30,000)

Common and Arctic Tern Foraging Ecology [Co-PI]
Describe foraging and post-breeding movements in the Gulf of Maine.
Sponsors: U.S. Fish and Wildlife Service ($50,000), National Audubon Society ($15,000)

Prioritizing Forage Fish for Seabird Conservation [PI]
Conduct meta-analysis to prioritize forage fish important for seabirds in continental U.S. waters.
Sponsor: Gordon and Betty Moore Foundation ($150,000)

Aleutian Tern Ecology and Conservation [PI]
Characterize Aleutian Tern ecology to investigate causes of possible decline at Alaskan colonies.
Sponsors: Alaska Department of Fish and Game ($99,686), U.S. Fish and Wildlife Service ($41,000), National Fish and Wildlife Foundation ($204,600)

Mapping Physical Characteristics of Coastal Habitats Using Transmittered Diving Waterbirds [PI]
Use diving waterbirds as sensor platforms to measure physical oceanographic parameters.
Sponsor: Office of Naval Research ($389,244)

Evaluation of Caspian Tern Response to Loss of Nesting Habitat using Satellite Telemetry [Co-PI]
Examine colony site fidelity, breeding dispersal, movements throughout the annual cycle.
Sponsor: Grant County (WA) Public Utility District ($334,191)

Conservation of the Critically Endangered Chinese Crested Tern [Co-PI]
Provide technical assistance to researchers in Asia regarding tern restoration and research.
Sponsor: U.S. Fish and Wildlife Service ($20,000), BirdLife Asia ($5,000), Zhejiang Museum of Natural History ($75,000)

Oregon Coast Seabird Colony Legacy Database Development [PI]
Count legacy colony photos of Common Murres and cormorant spp. Automate counts as feasible.
Sponsor: U.S. Fish and Wildlife Service ($257,170)

Seabird Monitoring at Yaquina Head Outstanding Natural Area [PI]
Monitor reproductive success of Common Murres, Brandt's Cormorants, and Western Gulls.
Sponsor: Bureau of Land Management ($25,000)

Recent Relevant Publications

Pearson, J., J. Dunham, J. Bellmore, and **D.E. Lyons**. *In Press*. Modeling control of Common Carp (Cyprinus carpio) in a shallow desert lake. Wetlands Ecology and Management.

Loredo, S.A., R.A. Orben, R.M. Suryan, **D.E. Lyons**, J. Adams, S.W. Stephensen. 2019. Spatial and temporal diving behavior of non-breeding common murres during two summers of contrasting ocean conditions. Journal of Experimental Marine Biology and Ecology 517: 13-24.

Lyons, D.E., A.G.L. Patterson, J. Tennyson, T.J. Lawes, and D.D. Roby. 2018. The Salton Sea: Critical migratory stopover habitat for Caspian Terns (*Hydroprogne caspia*) in the North American Pacific Flyway. Waterbirds 41(2).

Peck-Richardson, A.G., **D.E. Lyons**, D.D. Roby, D.A. Cushing, and J.A. Lerczak. 2018. Evaluating three-dimensional foraging habitat use and niche partitioning in two sympatric seabird species, *Phalacrocorax auritus* and *P. penicillatus*. Marine Ecology Progress Series 586:251-264.

Collar, S., D.D. Roby, and **D.E. Lyons**. 2017. Top-Down and Bottom-Up Interactions Influence Fledging Success at North America's Largest Colony of Caspian Terns (Hydroprogne caspia). Estuaries and Coasts 40:1808-1818.

Other Selected Publications

Adkins, J.Y., D.D. Roby, **D.E. Lyons**, K.N. Courtot, K. Collis, H.R. Carter, W.D. Shuford, P.J. Capitolo. 2014. Recent population size, trends, and limiting factors for the double-crested cormorant in Western North America. Journal of Wildlife Management 78: 1131-1142.

Patterson, A.G.L., A.S. Kitaysky, **D.E. Lyons**, D.D. Roby. 2014. Measuring corticosterone in feathers of nutritionally stressed Caspian Tern chicks – a cautionary tale. Journal of Avian Biology 45: 1-7. [F, W]

Lyons, D.E., D.D. Roby. 2011. Validating growth and development of a seabird as an indicator of food availability: captive-reared Caspian Tern chicks fed ad libitum and restricted diets. Journal of Field Ornithology 82: 88-100.

Lyons, D.E., D.D. Roby, K. Collis. 2005. Foraging ecology of Caspian Terns in the Columbia River Estuary, USA. Waterbirds 28: 280-291.

Roby, D.D., D. E. Lyons, D.P. Craig, K. Collis, G.H. Visser. 2003. Quantifying the effect of predators on endangered species using a bioenergetics approach: Caspian Terns and juvenile salmonids in the Columbia River estuary. Canadian Journal of Zoology 81: 250-265.

Recent Collaborators

Adams, Josh. U.S. Geological Survey; Bellmore, James. U.S. Forest Service; Chan, Simba. Birdlife International (Asia); Chen, Shuihua. Zhejiang Museum of Natural History; Collar, Stefanie. Oregon State University; Corcoran, Robin. U.S. Fish and Wildlife Service; Cushing, Daniel. U.S. Fish and Wildlife Service; Dunham, Jason. U.S. Geological Society; Kress, Steve. National Audubon Society; Lawes, Timothy. Oregon State University; Lerzcak, James. Oregon State University; Loredo, Stephanie. Oregon State University; Nesvacil, Kelly. Alaska Department of Fish and Game; Oehlers, Susan. U.S. Forest Service; Orben, Rachael. Oregon State University; Patterson, Allison. McGill University; Pearson, James. U.S. Fish and Wildlife Service; Peck-Richardson, Adam. Oregon State University; Renner, Heather. U.S. Fish and Wildlife Service; Renner, Martin. Tern Again Consulting; Roby, Daniel. Oregon State University; Stephenson, Shawn. U.S. Fish and Wildlife Service; Suryan, Robert. NOAA Fisheries; Suzuki, Yasuko. BirdLife International (Asia); Tennyson, James. Real Time Research, Inc.; Yu, Yat-tung. Hong Kong Bird Watching Society.

Katelyn Stoner

13018 Knaus Rd • Lake Oswego, OR, USA 97034 • +1-503-201-9148 • kastoner@comcast.net

EDUCATION:

University of Vermont

Burlington, Vermont, Aug 2012-May 2016

- Bachelor of Science. Summa Cum Laude. Honors College Scholar. GPA: 3.97
- Wildlife Biology and Natural Resource Ecology double major, Political Science minor.
- Honors College thesis investigating Kittlitz's Murrelet incubation constancy.

ACADEMIC HONORS:

- Phi Beta Kappa 2016.
- The Holcomb Natural Resources Prize 2016.
- Wildlife and Fisheries Biology Achievement Award 2016.
- Wildlife Bio-Ecology Achievement Award 2016.
- Udall Scholarship Honorable Mention 2014 and 2015.
- University of Vermont Rubenstein School Dean's List.
- University of Vermont Presidential Scholarship.

REPORTS, PRESENTATIONS, AND PUBLICATIONS:

Stoner, K.A., T.W. Knudson, R.M. Corcoran, J.R. Lovvorn, M.J. Lawonn, J.F. Piatt, W.H. Pyle. Kittlitz's Murrelet (*Brachyramphus brevirostris*) nesting ecology on Kodiak Island, Alaska. Poster Presentation. Pacific Seabird Group Annual Meeting 2017. Received Best Student Paper Award for Undergraduates.

Knudson, T.W., R.M. Corcoran, **K.A. Stoner**, M.J. Lawonn, J.R. Lovvorn, J.L. Piatt, and W.H. Pyle. 2017. Breeding Ecology and Behavior of Kittlitz's Murrelet in Kodiak National Wildlife Refuge, Alaska: 2016 Progress Report. Refuge report 2017.3, Kodiak National Wildlife Refuge, U.S. Fish and Wildlife Service, Kodiak, AK.

Stoner, Katelyn Anne. "Effect of variation in ocean temperature on nest attentiveness of a rare seabird, the Kittlitz's Murrelet (*Brachyramphus brevirostris*)" (2016). *UVM Honors College Senior Theses*. 208. https://scholarworks.uvm.edu/hcoltheses/208.

PROFESSIONAL EXPERIENCE:

Oregon Marbled Murrelet Project Crew Leader

Oregon State University, Newport, Oregon, April 2019-Present

- Trained, managed, and planned schedules of ten technicians and interns.
- Coordinated daily tasks of a five-person research crew.
- Assisted at-sea captures to attach transmitters to Marbled Murrelets.
- Conducted coastal telemetry for VHF radio transmitters attached to Marbled Murrelets.
- Planned forest access routes to search for inland nest locations.
- Installed and maintained playback recording devices, fixed-telemetry units, and cameras to document breeding behavior.
- Created trails to access survey sites and nest locations.
- Conducted dawn nest watches following PSG survey protocol to locate nest tree and platform.
- Monitored and ensured data quality.
- Produced weekly reports detailing crew outcomes.

Adélie Penguin Population Ecology Intern

Point Blue Conservation Science, Ross Island, Antarctica, October 2018-March 2019

- Banded, fish-tagged, pit-tagged, and collected morphometric measurements of chicks.
- Contributed and managed observations in multi-decade database (FoxPro).
- Processed and analyzed results using R Studio.
- Presented preliminary analysis at the Pacific Seabird Group Annual Meeting 2019.

Kaua‘i Endangered Seabird Recovery Project Field Technician

Kaua‘i Endangered Seabird Recovery Project, Hanapepe, Hawaii, April 2017-October 2018

- Monitored burrows of endangered seabirds such as Newell’s Shearwater and Hawaiian Petrel.
- Banded, translocated, attached geolocators, and assisted attachment of dataloggers and satellite tags to Hawaiian Petrel, Newell’s Shearwater, and Wedge-tailed Shearwater.
- Produced reports detailing season outcomes and yearly comparisons.

Wild Turkey Research Assistant

Tall Timbers Research Station, Tallahassee, Florida, Jan-April 2017

- Processed, banded, and attached radio transmitters to turkeys.
- Conducted radio telemetry using triangulation to determine locations of radio-tagged turkeys.
- Processed, banded, and attached radio-tags to Northern Bobwhite.

Biological Science Technician GS-04 (Avian Crew Leader)

U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, Kodiak, Alaska, May-Nov 2016

- Led team of three research assistants in nest searching for the Kittlitz’s Murrelet.
- Prepared field gear, hired field assistants, and coordinated field data collection.
- Compared annual results to determine patterns in reproductive success and breeding behavior.
- Received Special Thanks for Achieving Results (STAR) Award.

Kittlitz’s Murrelet Nesting Ecology Research Assistant

U.S. Fish and Wildlife Service, Kodiak National Wildlife Refuge, Kodiak, Alaska, May-Aug 2015

- Installed digital game cameras to monitor nest events.
- Completed habitat sampling on nest plots and random points.

PROFESSIONAL MEMBERSHIPS:

Pacific Seabird Group (2017-Present)
Audubon Society of Portland (2012-Present)

COLLABORATORS SINCE 2015:

Robin Corcoran (U.S. Fish & Wildlife Service)
Timothy Knudson (U.S. Fish & Wildlife Service)
James D Murdoch (University of Vermont)
William Pyle (U.S. Fish & Wildlife Service)
Allan Strong (University of Vermont)

United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE
Kodiak National Wildlife Refuge
1390 Buskin River Road
Kodiak, Alaska 99615-0323
(907) 487-2600

IN REPLY REFER TO

June 12, 2019

RECEIVED
AUG 16 2019
EXXON VALDEZ OIL SPILL
TRUSTEE COUNCIL

Exxon Valdez Oil Spill Trustee Council
Grace Hall Building
4230 University Drive, Ste. 220
Anchorage, AK 99508-4650

To Whom It May Concern:

I am writing this letter to affirm Kodiak National Wildlife Refuge's support for the proposed study, "Population trends and nesting ecology of the Marbled Murrelet in the Kodiak Archipelago," requesting funds from the Exxon Valdez Oil Spill Trustee Council for FY 2020-2023. This research is needed to advance understanding of murrelet requirements in the Gulf of Alaska region, and to support decisions of the Trustee Council regarding murrelet recovery status within the area impacted by the Exxon Valdez Oil Spill.

The Kodiak National Wildlife Refuge will contribute matching funds of $89,000 annually during FY 2020-2022, following Council approval of this research project. These annual funds include $28,000 to conduct marine nearshore bird surveys, salary of the Principle Investigator at $52,000, and salary of the M/V Ursa Major II boat skipper at $9,000.

Thank you for your consideration.

Sincerely,

Michael Brady
Refuge Manager

File: 39000-01/LOS

Date: August 13, 2019

Exxon Valdez Oil Spill Trustee Council
Grace Hall Building
4230 University Drive, Ste. 220
Anchorage, AK 99508-4650

To Whom It May Concern:

Please accept this letter of support for the Kodiak National Wildlife Refuge (KNWR) proposal titled "Population trends and nesting ecology of the Marbled Murrelet in the Kodiak Archipelago" on behalf of the Province of British Columbia, Ministry of Forests, Lands, Natural Resource Operations and Rural Development. We strongly support the research objective of this proposal to explore the failure of Marbled Murrelet populations in the Kodiak Archipelago to recover following EVOS. The outcomes of this research will undoubtedly provide valuable information to improve population recovery efforts in British Columbia. As a Provincial Marbled Murrelet biologist, I propose to support this project through collaboration including 1) serving as a project advisor, 2) providing advice and assistance with murrelet capture in Year One of the project, 3) providing autonomous acoustic recorders to collect recordings of vocal activity at active nests located through radio-telemetry and analysis of these recordings. The estimated value of in-kind contribution of my time is approximately $15,000.

The collection of autonomous acoustic recordings at active nest sites supports the Ministry objective of developing acoustic indices of murrelet nesting behaviour, an ongoing research project initiated in 2016 that aims to improve the identification of suitable nesting habitat and effectiveness monitoring of protected habitat to support population recovery. The Ministry will provide equipment to collect recordings (10 SM4 Song Meters, Wildlife Acoustics, Inc.; SD cards) and analyse recordings for murrelet vocalizations; these data, and the resulting research outcomes describing acoustic indices of nesting murrelets will be provided to KNWR. The estimated value of equipment to be provided is $8,810; in addition to software licence costs of $399 per year. In-kind contribution of staff time for acoustic analysis is estimated to be approximately $3,000. The total estimated value of in-kind contributions including staff time, equipment, and software is $27,210.

The Ministry support of this project is contingent upon receiving travel approval, which will be requested upon confirmation of the project funding.

Sincerely,

Jenna Cragg, M.Sc., R.P.Bio, Ecosystems Biologist
Ministry of Forests, Lands, Natural Resource Operations and Rural Development

Ministry of Forests, Lands, Natural Resource Operations & Rural Development
West Coast Natural Resource Region
Location: 2080 Labieux Road Nanaimo, BC V9T 6J9 CANADA
Mailing Address: 2080 Labieux Road Nanaimo, BC V9T 6J9
Tel: 250-751-7220
Fax: 250-751-7224

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3000 Vintage Blvd., Suite 201
Juneau, Alaska 99801

August 14, 2019

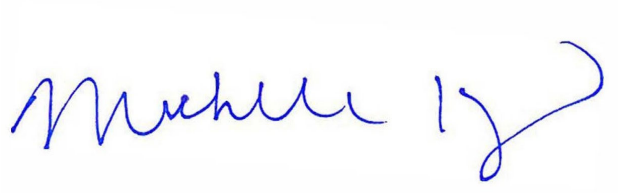
Exxon Valdez Oil Spill Trustee Council (EVOSTC)
4230 University Dr.
Suite #220
Anchorage, AK 99508-4650
907-278-8012

Dear EVOSTC:
I am writing in support of a proposal titled "Population trends and nesting ecology of the Marbled Murrelet in the Kodiak Archipelago" and submitted to you by Donald Lyons, Oregon State University, and Robin Corcoran, U.S. Fish and Wildlife Service. The proposed work will be informative not only to understanding limitations to recovery of Marbled Murrelet populations after the Exxon Valdez Oil Spill, but also to assessing the status and viability of the species across its range. I have known and worked with the Primary Investigators and Project Manager for many years and have tremendous confidence in their professional abilities and expertise to complete the project successfully.

As a collaborator on the proposal, I intend to participate in the project by assisting and training with murrelet capture and tagging during the first year of the study (2020; 1.0 months @ $7,000/month), consulting as needed during the second and third years of the study (2021 and 2022; 0.5 months @ $7,000/month), and by two datalogger systems for base-station tracking during all years of the study (2020–2022; $6,000 each). I also will lend other capture and tagging related equipment as needed and available ($4,000), as well as assist with preparing necessary research permits. Thus, I estimate that my in-kind contributions total approximately $30,000.

If you have questions or concerns, feel free to contact me by phone at 907-780-1168 or by email at michelle_kissling@fws.gov. Thank you!

Sincerely,



Michelle L. Kissling

United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE
Kodiak National Wildlife Refuge
1390 Buskin River Road
Kodiak, Alaska 99615-0323
(907) 487-2600

IN REPLY REFER TO

June 12, 2019

Exxon Valdez Oil Spill Trustee Council
Grace Hall Building
4230 University Drive, Ste. 220
Anchorage, AK 99508-4650

To Whom It May Concern:

I am writing this letter to affirm Kodiak National Wildlife Refuge's support for the proposed study, "Population trends and nesting ecology of the Marbled Murrelet in the Kodiak Archipelago," requesting funds from the Exxon Valdez Oil Spill Trustee Council for FY 2020-2023. This research is needed to advance understanding of murrelet requirements in the Gulf of Alaska region, and to support decisions of the Trustee Council regarding murrelet recovery status within the area impacted by the Exxon Valdez Oil Spill.

The Kodiak National Wildlife Refuge will contribute matching funds of $89,000 annually during FY 2020-2022, following Council approval of this research project. These annual funds include $28,000 to conduct marine nearshore bird surveys, salary of the Principle Investigator at $52,000, and salary of the M/V Ursa Major II boat skipper at $9,000.

Thank you for your consideration.

Sincerely,

Michael Brady
Refuge Manager