

## EVOSTC **FY22** CONTINUING INDIVIDUAL PROJECT PROPOSAL

Proposals requesting **FY22** funding are due to [shiwai.wang@alaska.gov](mailto:shiwai.wang@alaska.gov) and [linda.kilbourne@alaska.gov](mailto:linda.kilbourne@alaska.gov) by **August 13, 2021**. Please note that the information in your proposal and budget form will be used for funding review. Late proposals, revisions or corrections may not be accepted.

### Project Number and Title

22110853 Pigeon Guillemot Restoration Program

### Primary Investigator(s) and Affiliation(s)

Robert Kaler, M.S., U.S. Fish and Wildlife Service; Kathy Kuletz, Ph.D., U.S. Fish and Wildlife Service; David Irons, Ph.D., U.S. Fish and Wildlife Service (Retired)

### Date Proposal Submitted

12 August 2021

### Project Abstract

Historically, the Naked Island Group had the largest breeding population of pigeon guillemot (*Cephus columba*) in Prince William Sound (PWS), Alaska, but it declined over 90% after the 1989 *Exxon Valdez* Oil Spill. Following the effects of the oil spill, predation of adults and their nests by introduced American mink (*Neovison vison*) was the primary factor limiting population recovery. During a 5-year pigeon guillemot restoration project, which included mink removal from guillemot nesting areas, counts of pigeon guillemots at Peak, Naked and Story islands have more than doubled from 2014-2018 (69 to 167 individuals) and numbers of known nests increased more than four times (11 to 51 nests). In 2019, we began a second 5-year monitoring effort (2019-2023) at the Naked Island Group. Our objectives were to: (i) search for evidence of mink in guillemot breeding areas, (ii) monitor the recovery of pigeon guillemots, and (iii) monitor relative food availability, using black-legged kittiwakes (*Rissa tridactyla*) as indicators.

Our 2021 effort to continue monitoring the population recovery of pigeon guillemots at the Naked Island Group was highly successful. No mink were recorded visiting bait stations and no mink tracks were observed at the 10 high-use areas identified during previous intensive trapping efforts. Guillemot population counts were conducted in early June 2021 and numbers of guillemots continued to increase at the Naked Island Group compared to previous years (2014-2019). Nest counts of black-legged kittiwakes were conducted and while results are pending, preliminary indications are that 2021 has been a “poor” year for fish availability in PWS. Together, these data will inform future management actions by determining if mink are absent from the islands, measure the rate of recovery of pigeon guillemots following the removal of mink, and provide an indicator for productivity patterns of ocean conditions, which will assist interpretation of pigeon guillemot population trends.

*\*The abstract should provide a brief overview of the overall goals and hypotheses of the project and provide sufficient information for a summary review as this is the text that will be used in the public work plan and may be relied upon by the PAC and other parties.*

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

FY19	FY20	FY21	FY22	FY23	TOTAL
\$69,500	\$69,500	\$68,500	\$47,400	\$48,600	\$303,500

Non-EVOSTC Funds to be used, please include source and amount per source: (see Section 6C for details)

FY19	FY20	FY21	FY22	FY23	TOTAL
\$28,600	\$28,600	\$28,600	\$28,600	\$28,600	\$143,000

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

## 1. PROJECT EXECUTIVE SUMMARY

*Provide a summary of the program including key hypotheses and overall goals, as submitted in your original proposal. Please include a summary and highlights from your FY21 work: preliminary results with figures and tables should be accompanied with interpretation and short discussion to assist with proposal evaluation. If there are no preliminary results to present, please explain why (i.e., lab analysis is still in progress). List any publications that have been submitted and/or accepted since you submitted your last proposal and other products in Section 7. If applicable, FY20 Annual Reports will be included with this proposal for review.*

Once the most important pigeon guillemot (*Cephus columba*) nesting site in Prince William Sound (PWS), the guillemot population at the Naked Island Group (Naked, Storey, and Peak islands) had declined more than 90% since 1989 (Irons et al. 2000, Golet et al. 2002). Following the Exxon Valdez Oil Spill, predation on nests and adults by American mink (*Neovison vison*) was the primary limiting factor for guillemot reproductive success and population recovery (Bixler et al. 2010). However, availability of forage fish was also suggested to have hindered recovery of pelagic feeding birds of PWS (Cushing et al. 2018). To restore the guillemot population to the Naked Island Group, the Exxon Valdez Oil Spill Trustee Council funded a 5-year (2014-2018) effort to remove mink from guillemot colonies. By 2018, no signs of mink were detected, but to confirm this result and ensure that reintroduction of mink has not occurred, we will continue to monitor the guillemot population at the Naked Island Group. In 2021, our objectives were three-fold: (i) search for evidence of mink in guillemot breeding areas, (ii) monitor the recovery of pigeon guillemots, and (iii) monitor relative food availability, using black-legged kittiwakes (*Rissa tridactyla*) as indicators.

*Mink Presence or Absence.* To search for evidence of mink, we focused efforts at 10 previously high-density mink areas in winter and spring and deployed bait stations (herring enclosed in bait containers) with two (2) time-lapse/motion triggered game cameras along game trails paralleling tidal beaches or headlands. Ten stations with two cameras operated from 16 May to 1 June 2021. Several images of deer and river otter were recorded, but no mink were detected. Additionally, checking for tracks along game trails resulted in no detection of mink tracks.

*Guillemot Recovery.* Following standard methods (Irons et al. 1988, Oakley and Kuletz 1996, Bixler et al. 2010), guillemot surveys were conducted 1-5 June 2021 at the Naked Island Group (Naked, Storey, and Peak Islands) and control islands also located in western PWS (Smith, Little Smith, Seal, and Fool Islands). Numbers of guillemots recorded along shoreline surveys at the Naked Island Group has more than tripled since mink removal efforts began in 2014, up from 69 in 2014 to 252 in 2021, while pigeon guillemot numbers at the control group has remained relatively stable, (Table 1, Figures 1 and 2).

*Food Availability Index.* Using productivity of black-legged kittiwake colonies (N=22) in PWS to derive an index of food available to breeding guillemots, we visited kittiwake colonies in August 2021. While field work nearly complete (the Icy Bay colony in southeast PWS will be visited 13 August 2021), productivity was “poor”, but it was higher compared to the nearly complete kittiwake breeding failures in PWS during 2016-2020.

Overall, the third year of the effort to continue monitoring the population recovery of pigeon guillemots at the Naked Island Group was successful. No mink were recorded visiting bait stations and no mink tracks were observed in the 10 high-use areas identified during intensive trapping efforts 2014-2018. Guillemot population counts were conducted and numbers of guillemots continued to increase at the Naked Island Group. Nest counts of black-legged kittiwakes were conducted and, although final results are pending, initial indications are that 2021 has been a “poor” year for fish availability in PWS.

Table 1. Number of individual pigeon guillemots recorded during spring shoreline surveys at the Naked Island Group (NIG) and control islands, Prince William Sound, Alaska, 2012-2021. Mink column in 2014-2018 are “number of mink trapped”, and in 2019-2021 are “number of mink observed”. \*In 2012, three of the four control islands were not surveyed due to weather.

Year	Naked Island Group				Control Group					Naked Island Group
	Naked	Peak	Storey	NIG Total	Smith	L. Smith	Seal	Fool	Control Total	Mink
2012	33	12	13	58	.	.	.	31	*	NA
2013	39	13	15	67	151	36	25	53	265	NA
2014	49	8	12	69	171	38	53	106	368	76
2015	59	18	18	95	178	27	56	54	315	23
2016	88	17	46	151	168	39	46	57	310	7
2017	101	11	57	169	189	32	47	57	325	0
2018	77	14	42	163	178	45	66	88	377	0
2019	101	20	64	185	217	21	53	33	324	0
2020	111	10	100	221	161	14	30	17	222	0
2021	167	23	62	252	123	91	44	40	298	0

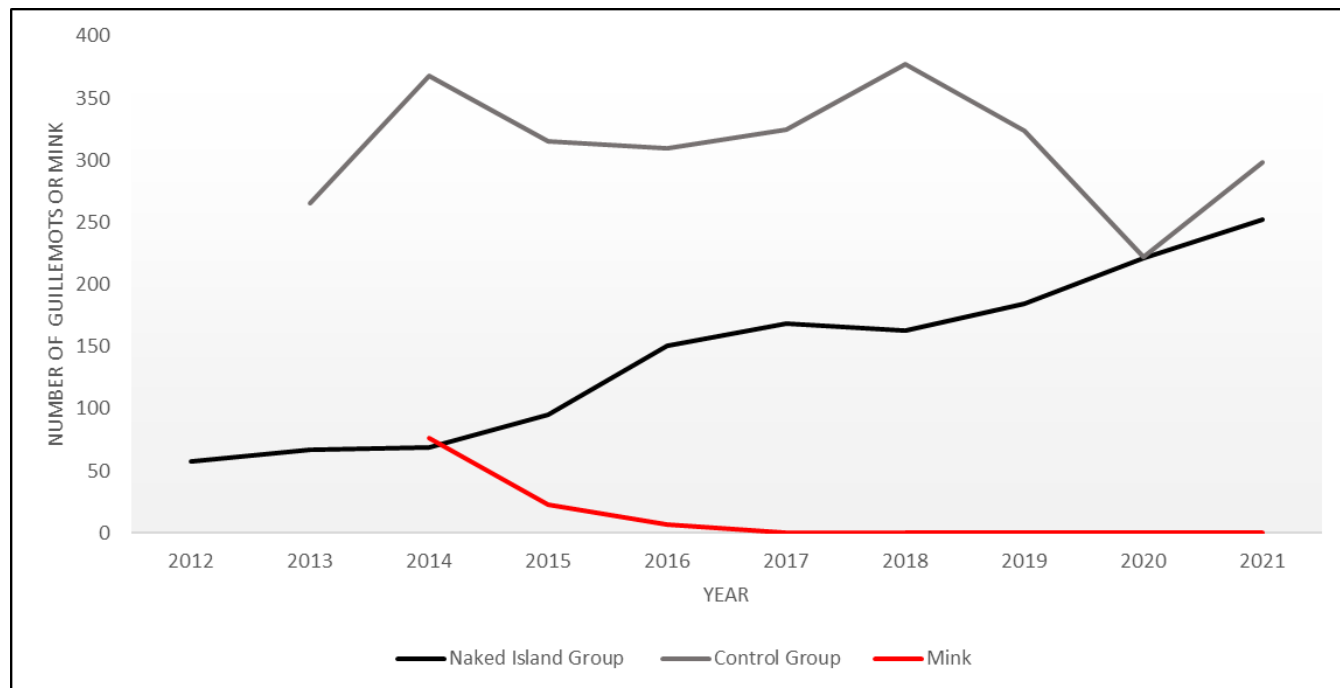


Figure 1. Number of individual pigeon guillemots recorded during spring shoreline surveys at the Naked Island Group (black line), control islands (gray line), and number of mink (red line) trapped (2014-2018) or observed (2019-2021), 2012-2021.

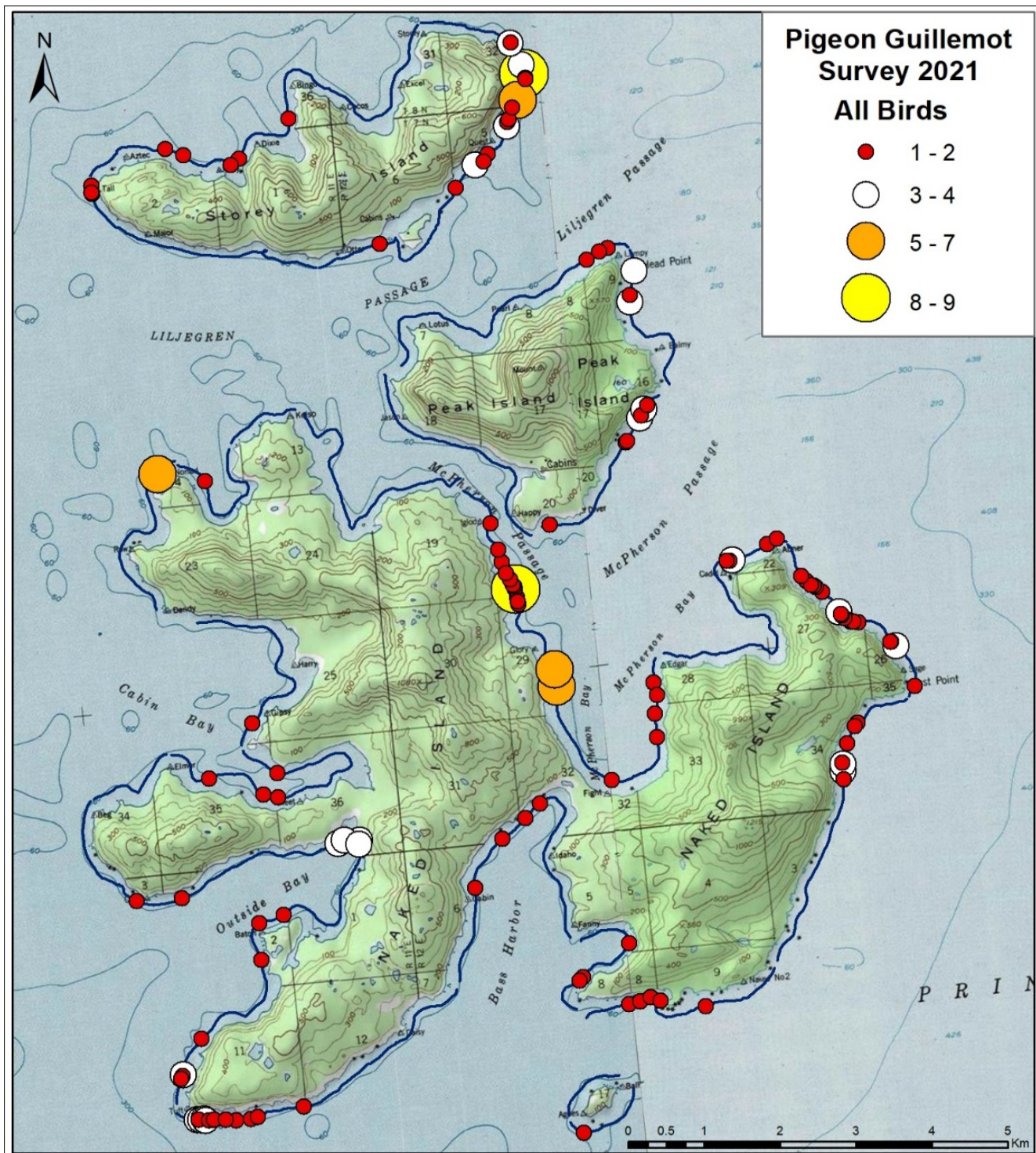


Figure 2. Location and number of pigeon guillemots detected at the Naked Island Group during the June 2021 survey, Prince William Sound, Alaska.

## 2. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

*Milestones are annual steps to meet overall project objectives.*

*Tasks are annual steps to meet milestones (for example, sample collection, data analysis, manuscript submittal, etc.)*

*For each milestone and task listed, specify by each quarter of each year their status (completed, planned), as submitted in your original proposal.*

*Reviewers will use this information in conjunction with annual program reports to assess whether the program is meeting its objectives and is suitable for continued funding.*

### A. Project Milestones and Tasks

Table 2. Project milestone and task progress by fiscal year and quarter, beginning February 1, 2019. C = completed, X = not completed or planned. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

Milestone/Task	FY19				FY20				FY21				FY22				FY23			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>Milestone /Task</b>																				
Survey pigeon guillemots		C				C				C				X				X		
Collect Data on Relative Food Availability		C	C			C	C			C	X			X	X			X	X	
Set up and Retrieve Mink Bait Stations and Camera Traps	C	C			C	C			C	C										
Mink Track Surveys	C	C			C	C			C	C										
Analyze Data				C				C				C				X				X
<b>Reporting</b>																				
Annual reports	C				C				C				X				X			
Annual PI meeting				C				X				X				X				X
FY work plan (DPD)			C				C				C				X				X	

### B. Explanation for not completing any planned milestones and tasks

*For each milestone and task listed in the table that has not been completed as scheduled, please provide an explanation and when you expect to complete it. If all milestones and tasks have been completed, write a complete sentence stating that.*

*Reviewers will use this information in conjunction with annual program reports to assess whether the program is meeting its objectives and is suitable for continued funding.*

All but two planned milestones and tasks has been accomplished: (1) visits to black-legged colonies for relative food availability will be completed by 13 August 2021 visits; (2) Principle Investigators (PI) will share updates at the Gulf Watch Alaska annual PIs meeting in November 2021.

### C. Justification for new milestones/tasks

*Please provide justification for any new milestones or tasks that are being proposed. If none are proposed, write a complete sentence stating that.*

*Reviewers will use this information in conjunction with annual program reports to assess whether the program is meeting its objectives and is suitable for continued funding.*

There are no new milestones or tasks for this project.

### **3. PROJECT COORDINATION AND COLLABORATION**

#### **A. Within an EVOSTC-funded Program**

*Provide a list and clearly describe the functional and operational relationships with any EVOSTC-funded Program (Herring Research and Monitoring, Long-Term Research and Monitoring or Data Management Programs). This includes any coordination that has taken or will take place and what form the coordination will take (shared field sites or researchers, research platforms, sample collection, data management, equipment purchases, etc.).*

##### Gulf Watch Alaska

The proposed project will collaborate closely with the Gulf Watch Alaska program. Specifically, Continuing the Legacy: Prince William Sound Marine Bird Population Trends Project (Kaler and Kuletz, project 21120114-M) produces a sound-wide estimate for pigeon guillemots, which will be used to monitor the population recovery at the sound-wide scale. Where possible, the two projects will share field equipment, personnel, survey computers, and binoculars. Additionally, the forage fish project (Arimitsu and Piatt, project 21120114-C) and Middleton Island seabird research led by Dr. Scott Hatch (Institute for Seabird Research and Conservation) will provide background on forage fish availability in the northern Gulf of Alaska and PWS region. Lastly, the Fall-Winter Marine Bird surveys (M. Bishop, project 21120114-E) to collect comparable marine bird data, allowing us to compare summer and winter seabird communities and distributions. The shoreline guillemot surveys of our project will also be complimentary to the Nearshore component of GWA (H. Coletti, project 20120114-H) and the pelagic surveys complimentary to the Environmental Drivers component and the Long-term Ecosystem Research Program along the Seward Line (R. Hopcroft and K. Kuletz). Integration of GWA marine bird datasets will allow for comparisons across marine habitats and regions.

##### Herring Research and Monitoring

This project provides relevant data on marine bird abundance, distribution, and foraging activities to the Herring Research and Monitoring program.

##### Data Management

This project will coordinate with the data management objectives submitting data and preparing metadata for publication as part of the Gulf of Alaska Data Portal, within the timeframes required.

#### **B. With Other EVOSTC-funded Projects**

*Indicate how your proposed project relates to, complements, or includes collaborative efforts with other proposed or existing projects funded by the EVOSTC that are not part of an EVOSTC-funded program.*

The data collected during this pigeon guillemot restoration project are available to all other EVOSTC-funded projects.

#### **C. With Trustee or Management Agencies**

*Please discuss if there are any areas which may support EVOSTC trust or other agency work or which have received EVOSTC trust or other agency feedback or direction, including the contact name of the agency staff. Please include specific information as to how the subject area may assist EVOSTC trust or other agency work. If the proposed project requires or includes collaboration with other agencies, organizations, or scientists to accomplish the work, such arrangements should be fully*

*explained, and the names of agency or organization representatives involved in the project should be provided. If your proposal is in conflict with another project, note this and explain why.*

The project supports the US Fish and Wildlife Service’s Migratory Bird Management mission to advance the conservation of migratory birds. The project will also inform other management agencies (US Forest Service, National Park Service, Alaska Department of Fish and Game) with lands and waters adjacent to our study area. Data on population trends are provided to the Alaska Maritime National Wildlife Refuge for inclusion in their annual report on status and trends of seabirds in Alaska.

Implementation of this plan requires coordination with state and federal agencies with authority and responsibility of the Naked Island Group and pigeon guillemots (see below). Monitoring of pigeon guillemots is being conducted by the U.S. Fish and Wildlife Service. Permits for working at the Naked Island Group are being obtained from the U.S. Department of Agriculture – Forest Service.

*The U.S. Fish and Wildlife Service.* The U.S. Fish and Wildlife Service mission is “to work with others to conserve, protect and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people.” Along with other Federal, State, Tribal, local, and private entities, the Service protects migratory birds, endangered species, certain fish species, and wildlife habitat. The Service is the primary agency responsible for the conservation of the pigeon guillemot and its habitat as authorized by the Migratory Bird Treaty Act. The U.S. Fish and Wildlife Service is responsible for seabirds in Alaska. They have a monitoring program to assess the status and trends of seabirds. They have also spent more than 30 years eradicating introduced predators from seabird islands in the Aleutian Islands and other places. Much of their work has taken place on lands they manage and thus little USFWS money has gone to PWS, although they have supported the EVOSTC work in PWS since the oil spill. The contact person is Dr. Kathy Kuletz (Alaska Region Seabird Coordinator), a Principle Investigator on this proposed project.

*U.S Department of Agriculture Forest Service.* The mission of the Forest Service is “to sustain the health, diversity, and productivity of the Nation’s forests and grasslands to meet the needs of present and future generations.” The Forest Service is responsible for the management of the 5.4 million-acre Chugach National Forest that includes the Naked Island Group, along with most of the rest of the land area of Prince William Sound. The contact person is Ron Britton (Chugach National Forest).

## **4. PROJECT DESIGN**

### **A. Overall Project Objectives**

*Identify the primary objectives for your project as submitted in your original proposal.*

#### **Project Objectives, 2014-2018**

**Objective 1.** Remove mink from pigeon guillemot nesting areas on Naked, Storey and Peak Islands.

**Objective 2.** Monitor guillemot population response to mink removal on the Naked Island Group.

### **B. Changes to Project Design and Objectives**

*If the project design has changed from your original proposal, please identify any substantive changes and the reason for the changes. Include any information on problems encountered with the research or methods, if any. This may include logistic or weather challenges, budget problems, personnel issues, etc. Please also include information as to how any problem has been or will be resolved. This may also include new insights or hypotheses that develop and prompt adjustment to the project.*

#### **Project Objectives, 2019-2023**

**Objective 1.** Search for evidence of mink in pigeon guillemot nesting areas on the Naked Island Group.

**Objective 2.** Monitor pigeon guillemot recovery on the Naked Island Group.

**Objective 3.** Monitor relative food availability, using kittiwakes as indicators.

## 5. PROJECT PERSONNEL – CHANGES AND UPDATES

Note any staffing changes to Primary Investigators or other senior personnel. Please provide CV's for any new personnel and describe their role on the project.

No changes to project personnel.

## 6. PROJECT BUDGET

### A. Budget Forms (Attach)

Summary Table

Budget Category:	Proposed FY 19	Proposed FY 20	Proposed FY 21	Proposed FY 22	Proposed FY 23	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$ -
Travel	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$ -
Contractual	\$47,850.0	\$47,850.0	\$46,910.0	\$43,450.0	\$44,550.0	\$230,610.0	\$ 142,610
Commodities	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$ -
Equipment	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$ -
Indirect Costs (will vary by proposer)	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$ -
<b>SUBTOTAL</b>	<b>\$47,850.0</b>	<b>\$47,850.0</b>	<b>\$46,910.0</b>	<b>\$43,450.0</b>	<b>\$44,550.0</b>	<b>\$230,610.0</b>	<b>\$ 95,700</b>
General Administration (9% of	\$4,306.5	\$4,306.5	\$4,221.9	\$3,910.5	\$4,009.5	\$20,754.9	N/A
<b>PROJECT TOTAL</b>	<b>\$52,156.5</b>	<b>\$52,156.5</b>	<b>\$51,131.9</b>	<b>\$47,360.5</b>	<b>\$48,559.5</b>	<b>\$251,364.9</b>	
Other Resources (Cost Share Funds)	\$28,600.0	\$28,600.0	\$28,600.0	\$28,600.0	\$28,600.0	\$143,000.0	\$85,800.0

This summary page provides an five-year overview of proposed project funding and actual cumulative spending. The column titled 'Actual Cumulative' must be updated each fiscal year as part of the annual reporting requirements. Provide information on the total amount actually spent for all completed years of the project. On the Project Annual Report Form, if any line item exceeds a 10% deviation from the originally-proposed amount; provide detail regarding the reason for the deviation.

Please provide completed budget forms (Excel workbook). Please note that costs associated with international travel for meetings, symposia, or presentations will not be considered for funding. Include a screen shot of the "Summary" worksheet.

### B. Changes from Original Project Proposal

If your FY22 funding request differs from your original proposal, provide a detailed list of the changes and discuss the reason for each change.

No new changes are requested for FY22 or FY23. As previously approved by the EVOSTC in October 2021, we changed the budget for FY21, FY22, and FY23. The FY21 total requested decreased \$1,024 due to combining the retrieval of time-lapse cameras at mink bait stations deployed in March with the May/June guillemot population survey. Additionally, flexibility in selecting a period of optimal weather has resulted in reducing the number of days necessary to complete the guillemot population survey. In 2021, the EVOSTC approved our request to increase funds for FY22 and FY23. The funds requested increased for two reasons: (i) the time needed for the relative food availability study using kittiwake productivity as a proxy was increased to ensure data are comparable with the 35 years of historical data; and (ii) to include a 3% increase to adjust for increased annual costs which were not included in the original project proposal. The changes to the food availability study uses



the standard technique of counting breeding effort (nests built) in June (cost \$7,750) and counting number of chicks in late summer (cost \$7,750). The original project proposal budgeted for a single late summer count of kittiwake chicks, but unfortunately, the single count is insufficient to provide comparable data. The annual ~3% adjustment resulted in the budget in FY22 and FY23 to increase \$1000 each year. The total approved increased the FY22 budget \$9,592 and increased the FY23 budget \$10,791.

### C. Sources of Additional Project Funding

*Identify non-EVOSTC funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal. Please attach documentation from additional project funding sources which confirms and describes matching funds, including date(s) the matching funds are/will be authorized.*

Annual in-kind contributions as cost share include:

Matching salary: Dr. Kathy Kuletz, 2 weeks/year, \$5.5K; Robert Kaler, 5 weeks/year, \$9.4K; Elizabeth Labunski, 3 weeks/year, \$4.7K.

Gear and Supplies: Field equipment and safety gear, computers and GPS receivers, \$5K/year; GSA leased truck, \$2K/year, warehouse space, \$2K/year.

Total annual FWS In-kind contribution in FY22: \$28.6K

## 7. PROJECT PUBLICATIONS AND PRODUCTS

*Products include publications (include in prep and in review), published and updated datasets, presentations, and outreach since the start of the project.*

### Publications

Dragoo, D., H. M. Renner, and R. S. A. Kaler. 2019. Breeding status and population trends of seabirds in Alaska, 2018. U.S. Fish and Wildlife Service Report AMNWR 2019/03. Homer, Alaska.

Dragoo, D., H. M. Renner, and R. S. A. Kaler. 2020. Breeding status and population trends of seabirds in Alaska, 2019. U.S. Fish and Wildlife Service Report AMNWR 2020/01. Homer, Alaska.

Stark, S., D.D. Roby, and D.B. Irons. 2020. Restoration of pigeon guillemot nesting habitat through removal of introduced predators. Master of Science Thesis, Oregon State University.

Stark, S., D.D. Roby, and D.B. Irons (*In prep.*). Seabird Population Responses After the Removal of an Introduced Predator. Journal of Wildlife Management

### Published and updated datasets

Robert Kaler and Elizabeth Labunski (USFWS) are working with Adrienne Canino (Axiom Data Science) to finalize metadata files and archive 2019, 2020, and 2021 counts of individual guillemots.

### Presentations

Kaler, R., 2020. Pacific Seabird Group Seabird Monitoring Committee, 2019 summary. **Oral presentation.** Portland, Oregon, 12 February 2020.

Kaler, R., 2020. Alaska's ocean sentinels: Seabirds as ecosystem indicators in Prince William Sound. **Invited presentation** at the Prince William Sound Natural History Symposium, 18 May 2020.

- Kaler, R. 2020. Population trends of marine birds in Prince William Sound, Alaska. **Oral presentation** at Chugach Regional Resources Commission Board Meeting, 7 December 2020.
- Kaler, R., 2021. Pacific Seabird Group Seabird Monitoring Committee, 2020 summary. **Oral presentation**. Virtual Meeting, 22 February 2021.
- Kaler, R. 2021. Summer marine bird population trends in Prince William Sound, Alaska, 1989-2018. Pacific Seabird Group Annual Meeting, **Virtual Poster Presentation**, 25 February 2021.
- Kaler, R. 2021. Marine bird research in Prince William Sound: status and trends, guillemot restoration, and social attraction at seabird colonies. **Invited presentation** at the Prince William Sound Natural History Symposium, 24 May 2021.
- Stark, S., D. Roby, and D. Irons. 2019. Pigeon guillemot recovery at the Naked Island Group. **Oral presentation**. 46<sup>th</sup> annual meeting of the Pacific Seabird Group, Kauai, HI.
- Stark, S., D. Roby, and D. Irons. 2020. Testing the use of artificial social attraction on two species of seabirds; Pigeon guillemots and parakeet auklets. **Oral presentation**. 47<sup>th</sup> annual meeting of the Pacific Seabird Group, Portland, OR.
- Whelan, S., S. Hatch, D. Irons, A. McKnight, K., Elliot. 2020. Increased summer food supply decreases migration distances in black-legged kittiwakes. **Oral presentation**. 47<sup>th</sup> annual meeting of the Pacific Seabird Group, Portland, OR.

### Outreach

- Irons, D., 2019. Prince William Sound Seabirds and Research. **Invited presentation** at the Prince William Sound Natural History Symposium, Whittier, Alaska, 4 May 2019.
- Kaler, R., 2020. Alaska's ocean sentinel seabirds as ecosystem indicators in Prince William Sound. **Invited presentation** at the Prince William Sound Natural History Symposium, 18 May 2020
- Kaler, R., et al., 2021. Alaska Seabird Update. Alaska Migratory Bird Co-management Council Spring Meeting, 5 April 2021. **Oral Presentation** via video conference.

## **8. LITERATURE CITED**

- Bixler, K. S., D. D. Roby, D. B. Irons, M. A. Fleming, and J. A. Cook. 2010. Pigeon Guillemot restoration research in Prince William Sound, Alaska. Exxon Valdez Oil Spill Restoration Project Final Report, 267 pp.
- Cushing, D.A., D.D. Roby, and D.B. Irons. 2018. Patterns of distribution, abundance, and change over time in a subarctic marine bird community. *Deep-Sea Research Part II: Topical Studies in Oceanography* 147:148–163.
- Dragoo, D., H. M. Renner, and R. S. A. Kaler. 2018. Breeding status and population trends of seabirds in Alaska, 2018. U.S. Fish and Wildlife Service Report AMNWR 2019/03. Homer, Alaska.
- Golet, G. H., P. E. Seiser, A. D. McGuire, D. D. Roby, J. B. Fischer, K. J. Kuletz, D. B. Irons, T. A. Dean, S. C. Jewett, and S. H. Newman. 2002. Long-term direct and indirect effects of the 'Exxon Valdez' oil spill on Pigeon Guillemots in Prince William Sound, Alaska. *Marine Ecology Progress Series* 241:287-304.
- Irons, D.B., S.J. Kendall, W.P. Erickson, L.L. McDonald, B.K. Lance. 2000. Nine years after the Exxon Valdez oil spill: effects on marine birds in Prince William Sound, Alaska. *Condor* 102:723-737.
- Irons, D.B., D.R. Nysewander, and J.L. Trapp. 1988. Prince William Sound waterbird distribution in relation to habitat type. U.S. Fish and Wildlife Service, Anchorage, AK.
- Oakley K. L., K. J. Kuletz 1996. Population, reproduction, and foraging of pigeon guillemots at Naked Island, Alaska, before and after the Exxon Valdez oil spill. *In* Rice S. D., R. B. Spies, D. A. Wolfe, B. A. Wright 1996. *Proc Exxon Valdez Oil Spill Symp. Am Fish Soc Symp* 18:759-769