ATTACHMENT C EVOSTC Annual Project Report Form

Form Rev. 8.30.18

1. Program Number: ***See,*** **Reporting Policy at III (C) (1).**

18100853

2. Project Title: ***See,*** **Reporting Policy at III (C) (2).**

Pigeon Guillemot Restoration Research in Prince William Sound, Alaska, FY11 Amendment

3. Principal Investigator(s) Names: ***See,*** **Reporting Policy at III (C) (3).**

Robert Kaler, U.S. Fish and Wildlife Service
Dr. David B. Irons, U.S. Fish and Wildlife Service (Retired)
Dr. Dan Roby, Oregon State University

4. Time Period Covered by the Report: ***See,*** **Reporting Policy at III (C) (4).**

February 1, 2018-January 31, 2019

5. Date of Report: ***See,*** **Reporting Policy at III (C) (5).**

April 2019

6. Project Website (if applicable): ***See,*** **Reporting Policy at III (C) (6).**

See EVOSTC Website, no website for this project only.

7. Summary of Work Performed: ***See,*** **Reporting Policy at III (C) (7).**

Mink Trapping

We trapped for five years (2014-2018) for American mink (*Neovison vison*) at the Naked Island Group, Prince William Sound (PWS), Alaska. The mink trapping season began in early March and ended in late April for a total duration of about 60 days per year. Very little snow was present during the first three years (2014-2016) making it difficult to track mink. During the five-year trapping effort, 76 mink were killed in 2014, 23 mink were killed in 2015, and 7 mink were killed in 2016. We caught no mink in 2017, but we found one set of mink tracks, which were consistent with the size of an adult male mink. Due to bad weather and outboard engine problems during the 2017 trapping season, effort was reduced to 139 traps for a total of 3,234 trap nights. However, unlike the three previous years, there was snowfall throughout the trapping season which allowed us to search for mink tracks and focus trapping efforts where tracks were observed, as well as in the high use areas where mink were caught during prior trapping seasons. No mink were trapped in 2018, during which 143 traps were set for a total of 4,107 trap nights. Similar to 2017, snow was present during the 2018 trapping season and we focused our efforts on searching for mink tracks, setting up motion/infrared triggered game cameras, and overall, determine if there were any mink remaining in the pigeon guillemot (*Cepphus columba*) nesting areas. No mink tracks were observed and no pictures of mink were detected on game cameras.

In summary, we trapped mink during March-April, 2014-2018, and removed 76, 23, and 7 mink in the first three years, respectively. The fourth year (2017) we caught no mink but found tracks of a mink and the fifth year (2018) no mink were caught and no tracks were seen. We trapped only in the pigeon guillemot nesting areas, but throughout the project found that during the mating season (March-April) male mink traveled greater distances in search of females as the mink population was reduced, thereby exposing themselves to traps. It is possible and perhaps likely that no mink remain on the Naked Island group. If this is the case the pigeon guillemots should be safe from mink predation for the foreseeable future. We will continue a smaller effort to look for mink with baited camera traps and to look for tracks in high quality areas. It is important to note that immature mink were only caught on Peak Island, where we caught four. It appears that after two years of trapping there was only one pregnant female on the Naked Island group to give birth in 2015. Total traps set for each of the first three years was about 400 for about 15,000 trap-nights. We used up to 30 motion/infrared triggered game cameras at Naked, Storey, and Peak islands during the trapping period to aid in searching for active mink. Each camera was out for one to four weeks.

All mink caught during this study had samples taken and were sent to the University of Alaska, Fairbanks Museum for archival of tissue samples and skulls. Prey samples were opportunistically collected and preserved.

Attached are figures showing the trapping zones and where the traps were set in 2018 (Fig. 1) and the locations of historical guillemot colonies (Fig. 2).

Pigeon Guillemot Summer Surveys and Nest Numbers

This project aimed to restore the population of pigeon guillemots (*Cepphus columba*) in PWS, which has declined by more than 90% at the Naked Island Group since 1989. A restoration plan for pigeon guillemots in PWS was prepared to address the species' lack of population recovery following injury by the 1989 *Exxon Valdez* oil spill. Predation on nests and adults by mink was the primary limiting factor for guillemot reproductive success and population recovery at the most important historical nesting site for guillemots in PWS (i.e., the Naked Island Group). Mink on the Naked Island Group are descended in part from fur farm stock and arrived at the island group during the 1980s. The goal of the project was to remove all mink from the pigeon guillemot nesting areas and allow for recovery to occur.

In June 2018, we counted 167 pigeon guillemots, about the same as 2017, 169 guillemots, and up from 58 guillemots in 2012, During the same time period, control islands did not have a similar increase (Table 1). We did not expect to see this large of increase in birds the first several years of trapping. The increase is almost certainly from immigration from other islands as it takes four years before a young guillemot will nest. We surveyed active nests and found 52 confirmed nests in 2018, and 51 nests in 2017, which has increased from 11 confirmed nests in 2014 (Fig. 3). Colonies are starting to form again with up to eight nests in one area. Productivity during the chick stage was high, around 80%-90%, indicating that the adults could find enough food for their chicks. In contrast, the black-legged kittiwakes (*Rissa tridactyla*) did poorly throughout PWS, as did common murres (*Uria aalge*) throughout the Gulf of Alaska.

We used up to 30 motion/infrared triggered game cameras at Naked, Storey, and Peak islands during the summer period to look for mink and pigeon guillemots. Each camera was out from four to eight weeks.We used up to five playback systems to play calls of pigeon guillemot with associated decoys. Each sound system was out from four to eight weeks.

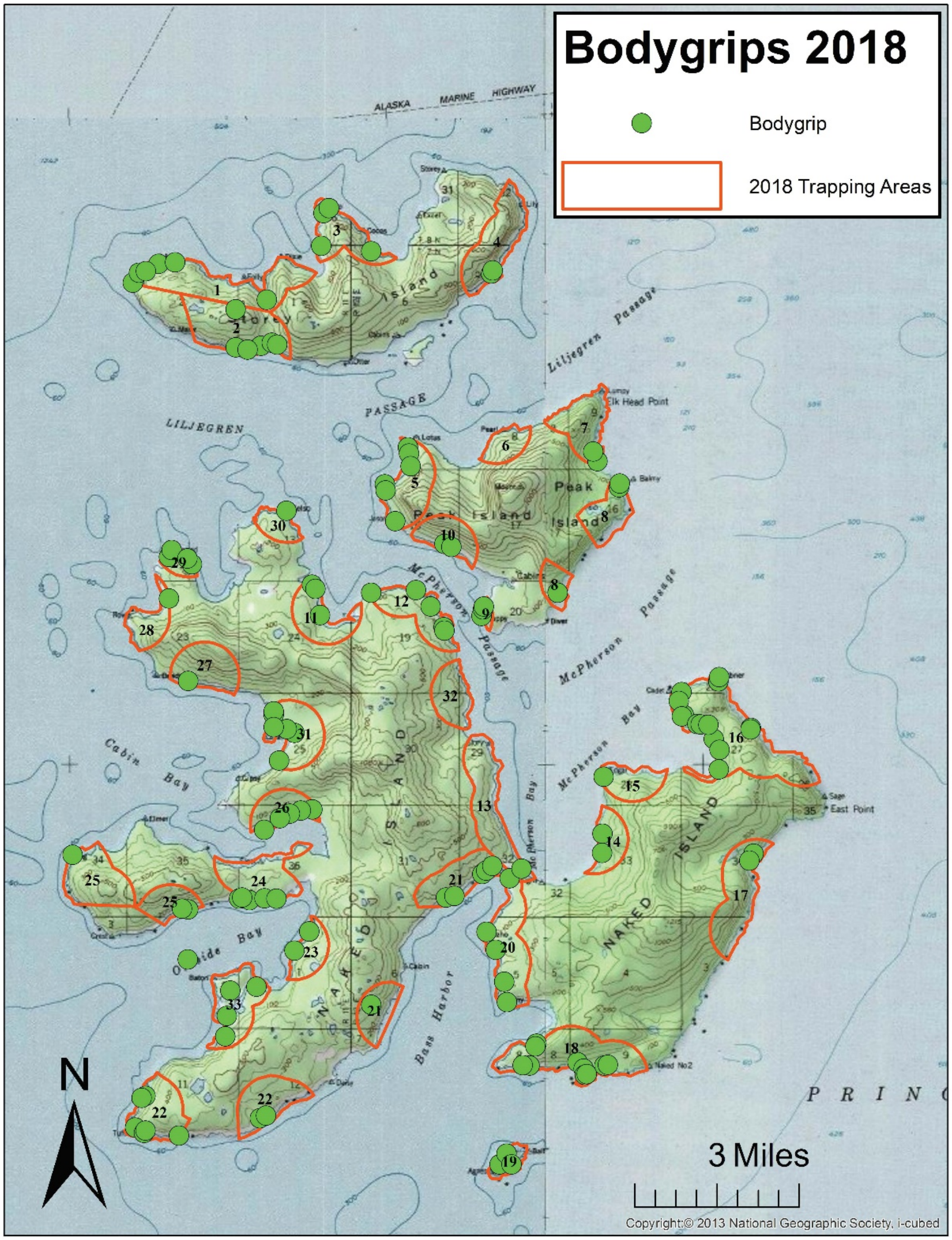

Figure 1. Map of trapping areas allowed by Alaska Department of Fish & Game in 2018 (outlined in orange) and locations of bodygrip traps set in 2018 (green circles). No mink were captured in 2018.

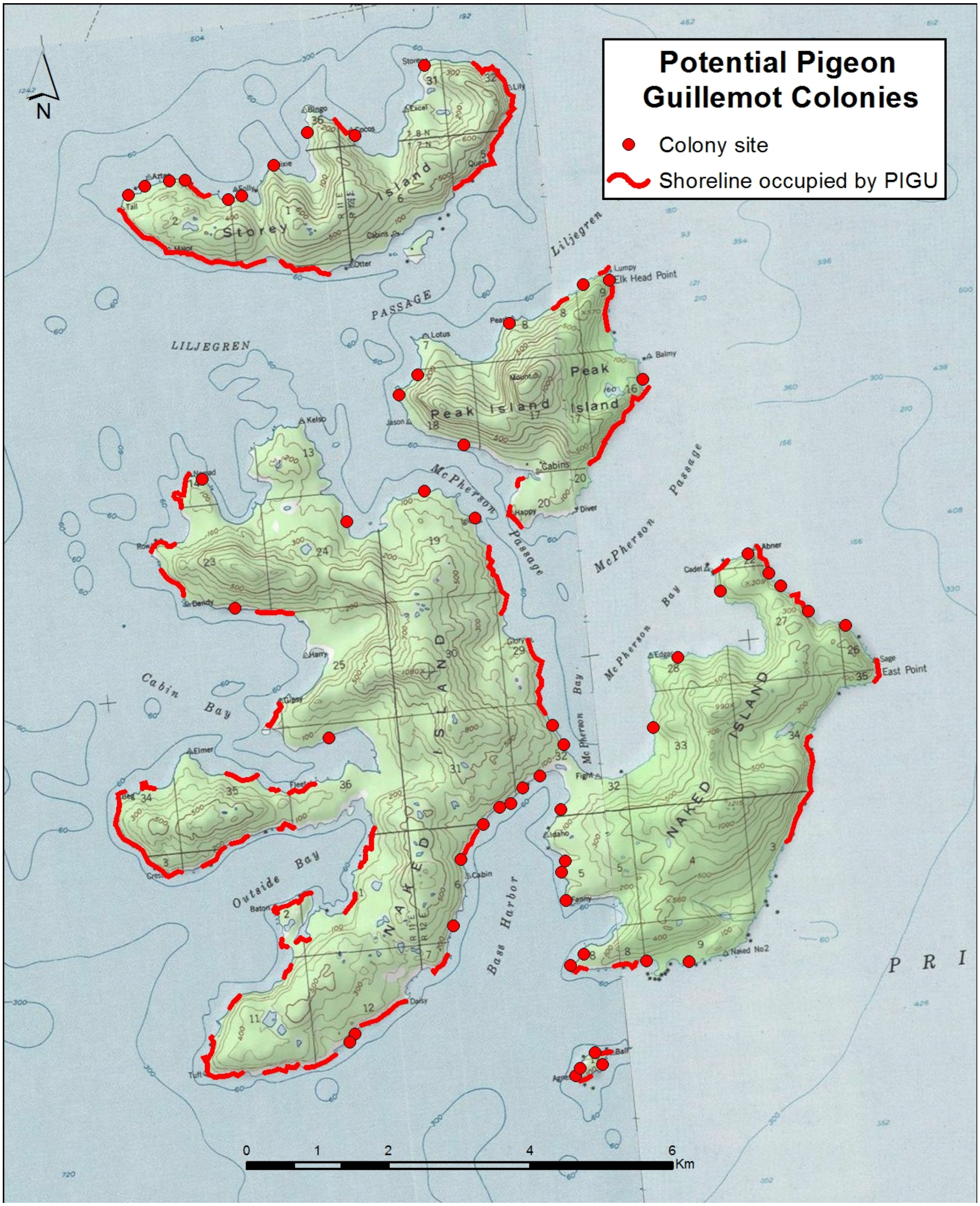

Figure 2. Map of potential pigeon guillemot colony sites on the Naked Island Group. These are a combination of historical colonies and current colonies.

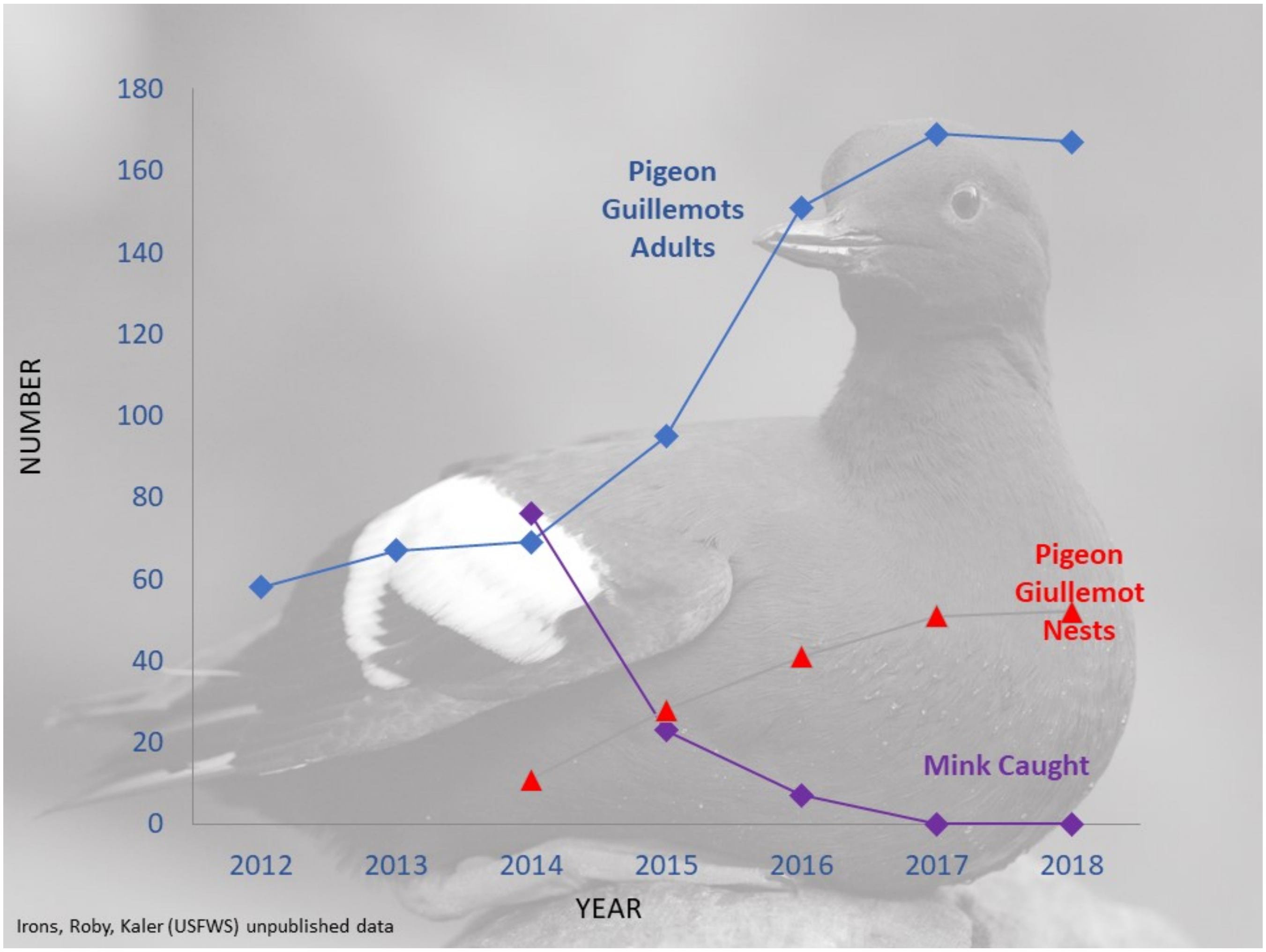

Figure 3. An illustration of the changes in Pigeon Guillemot adults, and nests at the Naked Island Group as the mink were trapped in 2014 -2018.

Table 1. Results of Pigeon Guillemots Surveys at the Naked Island Group, Control Island Group and Mink Trapping at the Naked Island Group, Prince William Sound, Alaska.											
YEAR	MINK TRAPPED	PIGEON GUILLEMOTS AT NAKED ISLAND GROUP				PIGEON GUILLEMOTS AT CONTROL ISLAND GROUP					PIGEON GUILLEMOT NESTS FOUND
	Naked Island Group Total	Naked Island	Peak Island	Storey Island	**Naked Island Group Total**	Smith Island	Little Smith	Seal Island	Fool Island	**Control Island Group Total**	**Naked Island Group Total**
2012	**-**	33	13	12	**58**	ND	ND	ND	31	**ND**	**ND**
2013	**-**	39	15	13	**67**	151	36	53	25	**265**	**ND**
2014	**76**	49	12	8	**69**	171	38	106	53	**368**	**11**
2015	**23**	59	18	18	**95**	178	27	54	56	**315**	**28**
2016	**7**	88	17	46	**151**	168	39	46	57	**310**	**41**
2017	**0**	101	11	57	**169**	189	32	47	57	**325**	**51**
2018	**0**	100	14	53	**167**	178	45	66	88	**377**	**52**

8. Coordination/Collaboration: *See,* Reporting Policy at III (C) (8).

A. Projects Within a Trustee Council-funded program

1. Within the Program
2. Across Programs

a. Gulf Watch Alaska

This project collaborates closely with the Gulf Watch Alaska program. Specifically, Continuing the Legacy: Prince William Sound Marine Bird Population Trends Project (Kaler and Kuletz; 19120114-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 shares field equipment, personnel, survey computers, and binoculars. Additionally, the forage fish project (Arimitsu and Piatt; 19120114-C) and Middleton Island seabird research led by Dr. Scott Hatch (Institute for Seabird Research and Conservation) provides background on forage fish availability in the northern Gulf of Alaska and PWS region.

Our data are available to all other EVOSTC-funded projects.

b. Data Management

Data will be entered into USFWS seabird databases.

c. Lingering Oil

Not Applicable

B. Projects not Within a Trustee Council-funded program

Not Applicable

C. With Trustee or Management Agencies

The FWS has acquired permits from ADF&G to remove mink and from the USFS to work on their land. 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.

Authority and Responsibility

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 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).

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.

9. Information and Data Transfer: *See,* Reporting Policy at III (C) (9).

A. Publications Produced During the Reporting Period

None this year. Two are proposed to be completed next year.

B. Dates and Locations of any Conference or Workshop Presentations where EVOSTC-funded Work was Presented

Stark, S., D.D. Roby, and D.B. Irons. 2019. Pigeon guillemots rebound as introduced mink are removed. Oral Student Presentation. The 46th Annual Meeting of the Pacific Seabird Group, Lihue, HI. 27 February – 2 March.

C. Data and/or Information Products Developed During the Reporting Period, if Applicable

Not Applicable

D. Data Sets and Associated Metadata that have been Uploaded to the Program's Data Portal

Not Applicable

10. Response to EVOSTC Review, Recommendations and Comments: *See,* Reporting Policy at III (C) (10).

The Science panels recommendations follow for FY18:

The Panel approves of the additional funding requested for a full field season to remove all mink from 70% of the shoreline where PIGU nested or currently nest. Again, the panel is very pleased with how quickly the population is increasing. As noted in past work plans, unless expanded trapping is permitted, the observed success will likely be temporary. A subsequent increase in the mink population resulting from only a partial eradication will probably, again, decimate the PIGU population over time. As noted in last year's work plan, population projections of both predator and prey may be useful to evaluate the merits and timeliness of future management agency decisions regarding predator controls.

During the first five years, we trapped mink during March-April, 2014-2018, and removed 76, 23, and 7 mink in the first three years, respectively. The fourth year (2017) we caught no mink but found tracks of a mink and the fifth year (2018) no mink were caught and no tracks were seen. From these data we infer no mink remain in pigeon guillemot nesting areas. We trapped only in the pigeon guillemot nesting areas, but throughout the project found that during the mating season (March-April) male mink traveled greater distances in search of females as the mink population was reduced, thereby exposing themselves to traps. It is possible and perhaps likely that no mink remain on the Naked Island group. If this is the case the pigeon guillemots should be safe from mink predation for the foreseeable future. However, we will not be sure of the status of mink or the status of pigeon guillemots unless monitoring continues. Numbers of pigeon guillemots at Peak, Naked and Story islands have more than doubled since 2014 (from 69 to 167 individuals in 2018, Table 1) and numbers of nests increased more than four times (from 11 to 51 nests)! From these data, we presume sufficient food was available to allow good breeding success the last three years. Numbers of pigeon guillemots counted at control islands did not show an increase. While the rapid increase in guillemots exceeded our expectations, ensuring continued population growth to the 1989 population size, adjusted for sound-wide changes since then, is the objective of this project.

Pigeon Guillemot Population Model, developed by Dr. Joel Schmutz, USGS Alaska Science Center.

Justification of the model parameters:

The observed rate of population change of pigeon guillemots at the Naked Island group shown in Bixler et al. (2010; see Bixler et al. Figure 3.3) for 1989 to 2008, equates to approximately a 12.7% annual decline. This is the maximum rate of decrease in pigeon guillemot numbers we have noted. Conversely, an example of the a possible maximum rate of increase for guillemots was noted by Byrd (2001) in the western Aleutian Islands where they removed foxes from two islands and observed an average increase of 13.6% annually for six years. Numbers of pigeon guillemots on nearby islands where foxes were not removed were little changed. Collectively, these steep rates of decline and increase are a product of changes in nest survival, adult survival, and immigration/emigration of breeding pigeon guillemots. It is well documented in seabirds that in late summer they prospect for good breeding sites (i.e., ones where chicks are evident), resulting in subsequent immigration to productive colonies and emigration from nonproductive ones (Boulinier and Danchin 1997).

Our modeling strategy is to use the best data available on various demographic parameters to quantify a matrix population projection model. In our pigeon guillemot model (Figure 1), we have assumed a maximum average adult survival rate of 0.9 under optimal conditions. Although there are no empirical estimates of adult survival for this species, this seems reasonable when examining the plethora of adult survival data across a range of different seabird species (Schmutz 2009). Further, it is very similar to the rate of 0.89 estimated for black guillemots (Frederiksen and Petersen 1999). To emulate the decline depicted by Bixler et al. (2010), we used the mean nest survival rate (i.e., productivity) from the set of study years at Naked Island during this time trend - thus, the mean of 1989, 1990, and 1994-1998, which is 0.35. Bixler et al. (2010) also noted that adult guillemots were killed at up to 10% of nest sites. This rate could be an underestimate if mink carry an adult carcass away from the nest site, as it would then appear to investigators that the nest had failed and the adults simply dispersed. Nonetheless, we used a maximum predation rate of adults in the presence of mink of 10% (thus base adult survival [i.e., without mink] of 0.9 multiplied by 0.9 (the % that survive predation in the presence of mink) equals 0.81. This nest survival rate of 0.35, on average, and adult survival rate of 0.81, on average, produced a rate of decline less steep than depicted in Bixler et al. (2010; see Bixler et al. figure 3.3). We then added in an adult emigration rate that was sufficient to produce the trend shown by Bixler et al. (2010). This emigration rate was 15%. If this trend were to continue, from a population size of 100 pigeon guillemots, their population would descend to seven pigeon guillemots in 20 years. This model reflects the No Mink Removal model.

To model the potential response of pigeon guillemots at Naked Island to the eradication of mink, we assumed an adult survival rate of 0.9, and nest survival rate equal to the maximum noted in Golet et al. (2002) of 0.61, and an immigration rate that equated to the emigration rate needed to model the decline of pigeon guillemots at Naked Island in the presence of mink, as described in the previous paragraph. With this set of parameters for the Mink Eradication model, the average rate of annual increase of pigeon guillemots, over 20 years, was 17%, which is nearly identical to the value noted by Byrd (2001) for Simeonof Island. The starting point of this projection is when there is assumed to be no mink. Additional model simulations could be done to characterize pigeon guillemot response to mink eradication (or culling) that is gradual in nature. To emulate a significant culling of mink (i.e., remove 90% of them), rather than an eradication, we used nest survival and adult survival rates that were 90% of the maximum values used eradication model. For the Mink Culling model, the average rate of annual increase of pigeon guillemots, over 20 years, was 16%.

The above model descriptions are deterministic, i.e., each model parameter has a singular value with no variation (e.g., if adult survival is 0.9, then it is maintained at that value throughout the 20 years of projection into the future). With these core model structures, we then ran stochastic models where we applied variability to the system. If biologically realistic values of variability in parameter values are used, then a stochastic model should be a more realistic representation of possible outcomes. For variability in nest survival (productivity), we used the data presented in Golet et al. 2002 for Naked Island. These data represent both ecologically real variability (i.e., 'process variation') and also variability due to the sampling process (e.g., the sampling error depicted by the reported Standard Error value). We used the variance decomposition procedures in Burnham et al. (1987) to extract an estimate of process variation in nest survival. Then assuming a normal distribution of this variability, we imposed this variability on the model by taking random draws from this distribution, and running the model 1000 times, where the 50th and 950th of the model runs, sorted by population growth estimates, reflect the confidence interval of this model projection. We also imposed stochastic variability on adult survival rates. This level of variability was taken by using the mean process variation in adult survival from 18 seabird populations listed in Schmutz (2009).

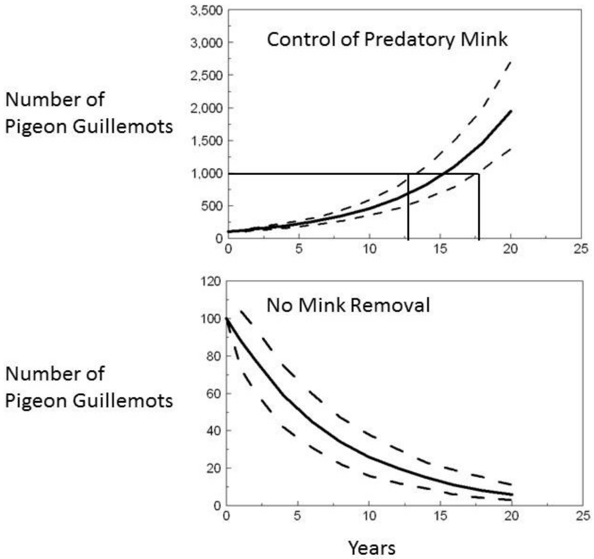

Figure 1. Population model with mink suppression (top) and no removal of mink (bottom) at the Naked Island group, Prince William Sound, Alaska.

With respect to the question about modeling the recovery of mink, at this point evidence leads us to conclude that no mink currently reside on the Naked Island group. If that conclusion turns out to be wrong and we evidence of mink then we will model the likely population increase.

As this was the final year in the original proposed project, the EVOSTC asked us to propose to continue monitoring for presence/absence of mink and to monitor the number of pigeon guillemots at the Naked Island group and the control islands. We submitted a proposal and it was funded so the scope of the project will be reduced but will be continued for another five years.

11. Budget: *See,* Reporting Policy at III (C) (11).

Budget Category:	Proposed FY 14	Proposed FY 15	Proposed FY 16	Proposed FY 17	Proposed FY 18	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$43,800.0	$43,800.0	$0.0	$0.0	$0.0	$87,600.0	$ 36,903.0
Travel	$1,914.0	$1,914.0	$3,712.0	$3,712.0	$3,712.0	$14,964.0	$ 7,147.0
Contractual	$275,190.4	$270,190.4	$134,585.7	$121,698.7	$107,698.7	$909,363.9	$ 993,180.0
Commodities	$40,000.0	$40,000.0	$0.0	$0.0	$0.0	$80,000.0	$ 33,871.0
Equipment	$3,000.0	$3,000.0	$3,000.0	$3,000.0	$3,000.0	$0.0	$ 35,826.0
SUBTOTAL	$363,904.4	$358,904.4	$141,297.7	$128,410.7	$114,410.7	$1,106,927.9	$ 1,106,927.0
General Administration (9% of subtotal)	$32,751.4	$32,301.4	$12,716.8	$11,557.0	$10,297.0	$99,623.5	
PROJECT TOTAL	$396,655.8	$391,205.8	$154,014.5	$139,967.7	$124,707.7	$1,206,551.4	
Other Resources (Cost Share Funds)	$173,000.0	$173,000.0	$113,000.0	$98,000.0	$98,000.0	$655,000.0	
NFWF Grant	$218,280.0	$198,280.0	$204,580.0	$215,580.0	$214,580.0	$1,051,300.0	

Owing to PI Dr. David Irons retirement from FWS in 2015, the majority of funds were spent by contractual agreements with the US Dept of Agriculture (for mink trapping) and the USGS Co-operative Wildlife Unit at Oregon State University (graduate student monitoring guillemot recovery post mink removal). This project has been funded, at a much lower level for the next five years. In 2019 we will start a new budget sheet.