DELAYED BREEDING PHENOLOGY AND RESULTANT PRODUCTIVITY OF COMMON AND THICK-BILLED MURRES AT PUALE BAY, ALASKA, FOLLOWING THE *T/V EXXON VALDEZ* OIL SPILL.

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(SLIDE 1 - Map of Ak. Peninsula) The focus of this presentation is on the Pacific Coast of the Becharof National Wildlife Refuge on the Alaska Peninsula. Approximately 157,000 murres have been reported to breed along the Alaska Peninsula, with most of these birds (74,000 to 93,000) concentrated in colonies around Puale Bay.

(SLIDE 2 - Map of Puale Bay area) During the summers of 1989-1992, land-based productivity monitoring of common and thick-billed murres was conducted along the south side of Puale Bay, concentrating on Colony 013. This 4-year case study was one part of a coordinated damage assessment study on murres following the 1989 Exxon Valdez Oil Spill, as summarized in the previous presentation. Puale Bay was the only impacted site in the study where murre productivity was documented during the entire period from 1989 to 1992.

(SLIDE 3 - aerial view of Puale Bay) The shape and orientation of Puale Bay relative to the currents of Shelikof Strait made it an ideal point for catching and accumulating oil traveling down the strait. The beaches of Puale Bay were given the dubious honor of the being one of the most impacted areas outside of Prince William Sound.

(SLIDE 4 - water view of colony) The meeting of Shelikof Strait and the Aleutian Mountain Range provides a rugged coastline in and around Puale Bay, forming cliff habitat ideal for ledge-nesting seabirds. Cliff heights range from 170 to 300 meters above sea level.

(SLIDE 5 - volunteer observers) Portions of the Puale Bay colony viewable from the above plateau were divided into 3 general ledge systems, which were then subdivided into 10 productivity plots. Common murres dominated the larger, central ledges with the less abundant thick-billed murres most prominent on the peripheral ledges.

(SLIDE 6 - 1989 Phenology) During the summer following the oil spill, murre breeding phenology at Puale Bay was approximately one month later than for comparable colonies at the Semidi Islands and Cape Peirce, with the first eggs laid in mid- to late July and chicks fledging in late September. Lacking pre-oil spill information, we did not know whether or not this late phenology was a normal occurrence for the Puale Bay area.

(SLIDE 7 - murres on the water) When we set-up the first field camp in June of 1989, all the murres were still in rafts on the water without any sign of ledge visitation. We began to wonder if there would be any productivity to document that year.

(SLIDE 8 - 1992 phenology) This late murre breeding phenology turned out to be very consistent between years 1989 to 1991, but then shifted 1-2 weeks earlier during 1992.

(SLIDE 9 - COMU productivity table) Initially hatching success, fledging success and subsequent productivity was very low for common murres. Production during 1989 and 1990 was deemed negligible. Over the next 3 years, all the productive parameters increased but at varying rates. Note: the low number of eggs/incubating postures documented during 1991 was due to an accidental deviation in methodology by the field crew, but did not affect calculations of relative success rates.

(SLIDE 10 - eggshells) This was an all-too familiar sight during the summer of 1989. Hatching success was low, theorized to be due to the presence of oil residue on the eggs. We collected eggshell fragments from under the colony for hydrocarbon analysis during the entire study, but the results are still pending. ((((Vern- you could add something here if you want to))))

(SLIDE 11 - TBMU prod) Production trends for thick-billed murres closely paralleled that of the common murres, despite much smaller sample sizes.

(SLIDE 12 - productivity regressions) Overall, productivity steadily increased from negligible levels (5-10%) in 1989 and 1990 to 52-66% in 1992, testing significant using linear regression for both common and thick-billed murres. By 1991, murre productivity at Puale Bay approached that of comparable colonies such as the Semidi Islands, which averaged around 50%. After examining this production trend, we became interested in looking for any effects the late breeding period may have had on murre productivity. Not being permitted to collect birds for food habits analysis, we had to look at other aspects to develop theories from relationships we could measure.

(SLIDE 13 - Brooding regression) We decided to compare the length of brooding periods over the study period and found that the average age of successful fledging/jumping significantly increased from 16.2 days in 1989 to 22.6 days in 1992 paralleling increases in fledging success and productivity. Now came the research and speculation part... some authors have suggested that brood periods would lengthen as the result of lack of food and chicks growing slower... while other authors theorize that climate can dictate the brooding period, especially in the arctic.

(SLIDE 14 - table of dates) Given the lateness of the breeding phenologies observed at Puale Bay, we speculate that the climate and not food supply was the limiting factor. Winter storms with gale force winds and rough, high seas generally start to occur in late September along the Alaska Peninsula, potentially limiting the survival of late fledging chicks and parents remaining to brood. In 19 September 1990, after an early winter gale, many of the adult murres were found to have left the colony without the chicks. For example, in one plot, 24 chicks remained with only 5 adults, leaving the chicks vulnerable to predation by gulls. In 1990, mild weather seemed to allow the parents to remain longer with the chicks despite still being on a late schedule. This idea of a parental conflict is not original, but difficult to prove without being able to weigh and measure chick growth on the ledges. However, as the timing of breeding shifted earlier in 1992, the brooding period lengthened further and productivity increased due to higher chick survival. The evidence is circumstantial, but in the least, very interesting...

(SLIDE 15 - colony composition graph) Colony attendance was another aspect of Puale Bay that we examined. Attendance patterns, as recorded on the 1992 productivity plots, paralleled 1990 and 1991 patterns and that described for the murres in the Semidi Islands. Attendance was cyclic prior to egg laying, settling during the production period until gradual colony abandonment in mid- to late September. However, the relative percentage of birds involved in reproduction significantly decreased from 1990 to 1992, due to more non-breeders present in 1992. Increases in non-breeding birds may have been tied to local increases in food availability, suggesting that food supplies were good in 1992, during the longer brooding periods.

(SLIDE 16 - murres) Additionally, new birds (prospectors) likely came from waters outside of the Puale Bay area. Murres have been documented to first visit breeding ledges at 3 years old, so these new birds must have hatched during 1989 or before. Complete colony reproductive failures were recorded for the Puale Bay area in 1989 and 1990, necessitating that these new birds were more likely hatched before the oil spill, spending 1989 out at sea, away from the affected area of the spill.

(SLIDE 17 - red fox) One variable we were not able to measure was the compensatory effect of predation on murre production at Puale Bay. Red foxes, weasels, bald eagles, peregrine falcons, and glaucous-winged gulls were all common around the colony. In the future, studies should include an examination of predation effects.

At the present time, no funding was approved to continue the Puale Bay seabird study in 1993. Some oil spill restoration funds may be available to conduct some smaller scale surveys in 1994, and after that...? Murres appear to be on the road to recovery in the Puale Bay area colonies. Productivity has steadily increased since 1989, with an earlier reproductive phenology and longer chick brooding prior to fledging. However, timing of murre reproduction was still weeks later than similar colonies in Alaska. Continuing productivity monitoring will be the key to evaluate the long term effects of the oil spill to these populations. Four years of observing the murres of Puale Bay have given us some answers, but created a lot more questions than answers.

Thank-you!