

Study Title:

A Preliminary Summary of the Exxon Valdez Damage
Assessment Studies on the Pigeon Guillemot. (Not
a full report)

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Summary of NRDA Studies on the Pigeon Guillemot

This interim summary is not intended as a report, but is an outline of the results, preliminary conclusions and recommendations of the NRDA studies on the pigeon guillemot (Cepphus columba) from 1989 to 1991. A full report integrating all reports and information of relevance to guillemots will be made available.

INTRODUCTION

The pigeon guillemot is a nearshore diving seabird which is highly vulnerable to oil spills. There were 516 guillemot carcasses recovered following the Exxon Valdez oil spill, primarily from Prince William Sound and the Kenai Peninsula (many from the latter believed to have come from PWS). By extrapolation, an estimated 1,500 - 3,000 guillemots were killed in the spill zone. This represents 10% of the cataloged pigeon guillemot population in the Gulf of Alaska. Although the mortality estimate is low compared to other alcids, it is high compared to the 6,585 guillemots estimated from the July 1991 survey of Prince William Sound.

In 1989 NRDA Bird Study Number 9 was implemented to assess injury to pigeon guillemots from the oil spill (Oakley 1989). In 1990, some aspects of BS9 were continued as a supplement to Bird Study 2 (Boat Surveys). The preliminary results of this study were presented in 'Assessment of Injury to Nearshore Alcids from the Exxon Valdez Oil Spill: Effects on Marbled Murrelets and Pigeon Guillemots, 30 November 1990' (Kuletz 1990). This report was also presented as Appendix A in the 1990 Bird Study 2 report.

METHODS

The 1989 NRDA study utilized pre-oiling data available for the Naked Island area from 1978 to 1981. For guillemots, data included early June shoreline counts of Naked, Storey, Peak and Smith islands and counts from five transects on the west side of Naked Island. A census appropriate for guillemots was also conducted for the Smith islands in 1977. Data on guillemot reproductive success is available from 1978 - 1981, 1984, 1989 and 1990. There is also historic data on foraging patterns and prey use of guillemots for Naked Island, plus measurements and prey analysis for adults collected in 1978 and 1979.

The 1989 and 1990 guillemot studies followed methods established in pre-oil years by Kuletz (1983). Guillemots nest in small scattered colonies, are highly site tenacious and consistent in attendance patterns. This shoreline census is designed to catch guillemots at their colony during peak attendance, and has proven very reliable. For the 1989 and 1990 NRDA studies, we also collected five guillemot adults in 1989 and eight unhatched eggs from both years for contaminate analysis. The specific objectives and methods of the NRDA pigeon guillemot studies are presented in the 1989 and 1990 preliminary reports.

In 1991, USFWS personnel on Naked Island for a restoration study conducted a shoreline census of the Naked Island area. In addition, we initiated a stratified random sampling project which will provide an estimate of the local guillemot population out to 5km from Naked, Storey and Peak islands.

RESULTS

Naked Island Transects and Shoreline Census

The two transects with at least three years of pre-oil data showed no significant decline in guillemot counts in either 1989 or 1990. Since these transects were in Cabin Bay, which did not show a significant decline in the colony census, they would be unlikely to show a change.

Throughout the Naked Island group as a whole, post-oil surveys show a 40% decline in guillemots during peak colony attendance hours compared to pre-oil surveys. The decline varied among the islands. The decline is most extreme on Smith and Little Smith Islands, which were heavily oiled. The 1990 count was 43% and the 1991 counts 30% of counts from 1977, 1978 and 1979 (\bar{x} = 360 guillemots). Naked Island had variable oiling, with patches of moderate or heavily oiled shorelines on the north and east sides, and patches of lightly oiled shores on the west and south sides. Guillemot colonies are scattered around the island and the census is composed of shoreline sections, making it possible to look at oiling effects on a fine scale. A significant decline was found for Naked Island, and there was significantly greater decline in oiled shorelines compared to non-oiled shorelines. The 1991 counts were up slightly from 1989 and 1990, but still only 70% of the pre-oil count mean of 1,077 guillemots.

Storey and Peak Islands, which were surrounded by oil sheen but received very little oiling onshore, had some significant declines in 1989 but not in 1990 or 1991. However, the two islands together had a post-oil mean which was 62% of the pre-oil mean of 565 guillemots.

Reproductive Success

Guillemots can lay one or two eggs and are considered relatively stable in reproductive success compared to other seabirds. Guillemot reproduction and prey use were not investigated in 1991. The 1989 data was probably biased for successful nests, as most nests were located in the chick stage. With the exception of clutch size, all measures of guillemot reproductive success, over seven years with records, were lower in post-oil years, particularly in 1990. These include hatching success, nesting success, fledging success, fledging weight and chick growth rate. Although analysis is not complete, preliminary tests show that fledging weight, chick growth rate and nesting success (for nests found in the egg stage) were significantly lower in post-oil years.

The proximate cause of many nest failures in 1990 was predation, but the low chick growth and fledging weights suggest additional environmental pressures on the population. Weather, which when adverse did contribute to chick mortality in pre-oil years, was mild in 1989 and 1990. There were changes in prey fed to chicks, with extremely low use of sandlance and herring in 1990. Schooling fish averaged 43% of total prey deliveries to chicks in pre-oil years, 36% in 1989 and 13% in 1990. Low sandlance availability has been linked to low reproductive success in many seabirds, including guillemots. Another possible factor is contamination by petroleum hydrocarbons.

Petroleum Hydrocarbon Contamination

Two of five adult pigeon guillemots collected in 1989 showed contamination by weathered petroleum hydrocarbons. Three unhatched eggs collected in 1989 were also contaminated externally. Of five unhatched guillemot eggs collected in 1990, four showed definite external contamination and one was questionable. Apparently,

guillemots were still transferring oil to their eggs one year after the oil spill. Even low levels of external contamination of eggs is known to reduce hatching success in other bird species.

Other sources of mortality

A study of incidental take in the Prince William Sound gillnet fishery was initiated in 1991 (Pat Gould, pers. comm.). No guillemots were recorded as taken in the survey, in which observers monitored five percent of the fishery.

Guillemot eggs and chicks are subject to predation by corvids and Mustelidae. Direct weather related chick mortality has been observed at this study site due to burrow flooding, sloughing of cliff edges and waves in the lower talus. Bald eagles have been observed making attempts on adult guillemots at-sea, and guillemot remains were found below two bald eagle nests at this study site. In other areas, rare observations have been made of predation on adult guillemots by killer whales and octopus.

Boat Survey Evidence of a Decline in Guillemots

Throughout Prince William Sound, pigeon guillemots have declined significantly since surveys in 1972/73 and 1984/85 (Laing 1991). In July 1973, the population was estimated at 14,570 guillemots. July estimates for 1989, 1990 and 1991 were, respectively, 4047, 2965, 6585. Guillemots are one of five species which "declined more in the oiled area than in non oiled areas since the early 1970's" (Laing 1991).

Guillemots also declined significantly between 1984 shoreline surveys and post-oil counts nearshore, and again showed an oiling effect. The amount of change between the early 1970's and mid 1980's can not be fully determined because only shorelines were censused in the 1980's. The evidence suggests that guillemots were declining prior to the spill. However, the significantly greater decline in oiled areas indicates that the oil spill contributed in a significant manner to the decline in Prince William Sound. Surveys on the Kenai Peninsula and in Kodiak also show declines (no analysis available to date).

CONCLUSIONS

The pigeon guillemot population in Prince William Sound has declined significantly since surveys in 1972/73 and in the shoreline counts since 1984/85. In both cases, there was a significantly greater decline in oiled areas. The Naked Island study area, using a complete shoreline census designed to catch guillemots during peak colony attendance, also showed significant declines between 1978-1980 and 1989-1991. The decline among the four islands corresponds to the degree of oiling they experienced. On Naked Island, oiled shoreline sections had a significantly greater decline in guillemots than unoiled shorelines.

Guillemot reproduction on Naked Island was generally lower in 1989 and 1990 compared to 1978 - 1981 and 1984. Although not all analyses are complete, chick growth rate, chick fledging weight and nesting success (of nests found in egg stage) were significantly lower in post-oil years. In 1989 and 1990, predation was the primary proximate cause of nest failure. There is evidence that sandlance and herring were not as available in post-oil years as they had been historically.

Adult guillemots showed exposure to weathered oil, and eggs were contaminated externally in 1989 and 1990. The social and foraging behavior of guillemots make them particularly susceptible to onshore oiling long after initial impact. During the breeding season, guillemots gather daily at their colonies and perch on intertidal rocks. They forage near their colonies, probing into intertidal and subtidal recesses and kelp, potentially exposing them to submerged nearshore deposits of oil. Because their colonies are small and scattered and guillemots are highly site tenacious, affected colonies may be very site specific.

RECOMMENDATIONS

1. The boat surveys of Prince William Sound are useful for estimating the population of guillemots, and should be continued to monitor recovery or continued decline. However, the location and sizes of major guillemot colonies must also be determined by conducting censuses appropriate for counting guillemots at their colonies.
2. The location of important guillemot breeding areas should be mapped and colony size monitored. Guillemot colonies appropriate for conducting reproductive studies should be located to expand the data base on guillemot reproductive success. The potential for long-term impacts related to the oil spill exist, and will need to be investigated at a number of sites before restoration efforts begin. It may prove beneficial to re-institute beach cleaning efforts at sensitive colony sites.
3. The guillemot is an excellent indicator species for the nearshore marine environment, as they forage on a variety of prey. Where possible, guillemot studies should be paired with studies of nearshore environments, particularly those pertaining to bottom fish and crustacea.
4. Guillemot nests extend into the cliff-edge and forested shoreline, and restoration efforts should include agencies responsible for these uplands.
5. Restoration efforts would benefit by knowing the age structure of the guillemot population. It is possible that a base of information could be obtained by bone ageing the carcasses obtained during the EVOS.
6. Although guillemots prey on a variety of fish, sandlance availability appears to be linked to higher reproductive success. Guillemot recovery may depend on the availability of sandlance, capelin and herring. A comprehensive study of forage fish should be initiated soon.