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# A SEABIRD DIE-OFF ON THE WASHINGTON COAST IN MID-WINTER 1976

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During the last week of February and the first two days of March 1976, large numbers of dead seabirds, particularly Northern Fulmars *(Fulmarus glacialis)*, Black-legged Kittiwakes *(Rissa tridactyla)* and Common Murres *(Uria aalge)*, washed up on the Pacific coast beaches of Washington and northern Oregon. Lesser numbers of fulmars and kittiwakes were recorded on beaches south into southern California (DeSante 1976). This event received considerable news coverage and the concern of biologists, naturalists and others.

## METHODS

Eleven beached bird censuses were received from observers who walked sections of beach of known distance, who were competent at identifying beached bird specimens and who submitted reliable data on oiling. The censuses covered 22 km of beach, representing 7.3% of the coast line. Sunrise Beach, Clatsop Co., the only Oregon beach covered, was censused on 6 March 1976. In Washington, six censuses were taken along Grays Harbor Co. beaches, 2-6 March. Three of these were in the Westport area; the others were taken at Ocean Shores, Pacific Beach and Grenville Bay. The beach at North Cove, Pacific Co., was censused on 6 March. Two censuses were taken at Kalaloch, Jefferson Co., 6 and 7 March, and one on 7 March at Beach Trail No. 6, Olympic National Park, Clallam Co.

On 6 March I picked up 71 birds from a 1.6 km stretch of beach south of the Westport jetty. On 9 March these carcasses were autopsied. Each was checked for fat deposits, stomach contents and for oil or parasites in the digestive tract. The livers were retained for pesticide analysis, and the left wings of all fulmars were retained for molt analysis.

I used a two-criteria analysis of variance to test differences of relative percentage of species involved and percent of each species affected by oil. Fulmar weights were analyzed using the non-parametric rank-sum test. All significant relationships were tested at the 95% level.

## RESULTS

### MAGNITUDE OF MORTALITY

Counts averaged 42.5 dead birds per km (range 17-93) over the 11 beaches censused. This figure is much higher than the mean number of carcasses per km ($\bar{x}$=8.5; range=1.3 to 28.1) calculated from censuses in the Grays Harbor region during the months of January through March over a five year period, 1974-1978 (Harrington-Tweit unpubl. data). Two beach censuses taken in the Grays Harbor region during mid February 1976 resulted in values of 6.3 and 6.6 carcasses per km (Jack Smith pers. comm.).

The number of birds killed in this die-off is unknown. Coulson et al. (1968) and Hope Jones et al. (1970) speculated that only 20 to 25% of the individuals dying offshore wash in to the beach, even when the mortality occurs fairly close (within 20 km) to shore. Birds that were part of this die-off continued washing up on the beaches in much reduced numbers through 10 March (David DeSante pers. comm.).

### SPECIES AFFECTED

Most of the dead birds found were Northern Fulmars. They averaged 63% of the carcasses recovered, significantly higher than any other species (Table 1). Kittiwakes and murres averaged 16% and 10% on the beach censuses; their numbers were never significantly different from each other. Table 2 shows the number of carcasses tallied for all species observed. Of these, only the White-winged Scoter *(Melanitta deglandi)* was found in large enough numbers (22) to be considered in any detail. Table 3 shows data on the incidence of oiling for the major species.

#### Northern Fulmar

Oil was found on the plumage of 43% of the fulmars examined. Terence Wahl (pers. comm.) noted on his censuses of northern beaches, where the highest percentages of oiled fulmars were recorded, that the pattern of oiling on many fulmars suggested they were dead when oiled. Patches of oil adhered to the uppersides, with tiny spots all over the plumage, indicating that they floated through oil upside down. Since virtually no oiling was evident among the large sample of Oregon birds, this figure is likely an overestimation of oiling mortality.

All fulmars autopsied were finishing wing molt. Of the 35 wings examined, 80% had fresh primaries and the remainder were growing the outer 2 or 3 primaries; 69% had replaced over half their secondaries, 86% had fresh tertiaries and 71% had retained less than a third of their old wing coverts. Light phased birds constituted 4% of the sample. I was unable to find any mention of a molt at this season in literature. There was a significant sexual dimorphism in weight. Males were heavier ($\bar{x}$=609.25 gm, s=±77.9, range=485 to 727 gm, n=16) than females ($\bar{x}$=479.1 gm, s=±50.0, range=395 to 582 gm, n=29). Average post-

breeding weight for males of this subspecies *(F. g. rodgersii)* is 671.3 gm; this value seems to be unknown for females as is prebreeding weight for either sex (Palmer 1962). No fat deposits were noted on any of the birds.

Of the 33 stomachs examined, 61% held either squid beaks or lenses. A few held as many as five beaks. Other items included variously colored plastic chips (irregular rectangles approximately 5 mm on a side and 1 mm thick), found in 39% of the stomachs, pebbles of approximately the same size, feathers and small pieces of bone. Only two stomachs contained oil or internal parasites. More females than males were in the autopsied sample (females=54.7%, males=30.2% and 15.1% were unknown, n=35). All of the females had developing ovaries.

A few fulmars were apparently wrecked inland during the die-off. On 29 Feburary a live fulmar was found in Montesano, Grays Harbor Co., about 40 km inland (Jack Smith pers. comm.). In addition, I found a long-dead fulmar on 17 April at Elma, Grays Harbor Co. (about 56 km inland), which I assume was blown inland in late February. Five fulmars were seen from shore at the mouth of Grays Harbor on 28 February (Glen and Wanda Hoge pers. comm.), along with three other species of tubenoses: 30 Sooty Shearwaters *(Puffinus griseus)*, 1 Mottled (Scaled) Petrel *(Pterodroma inexpectata)* and 6 Fork-tailed Storm-Petrels *(Oceanodroma furcata)*. Tubenoses of any species are very rarely observed in winter from shore in Washington.

### Black-legged Kittiwake

Kittiwake numbers fluctuated greatly between censuses (note the very high standard deviation in Table 1), as did the percentage of oiling observed (Table 3). At least some appeared to have been oiled after death; the value of 66% (Table 3) is thus a high estimate of oil-caused mortality. Autopsy data were inconclusive as the sample size was too small. The only data on age and molt were recorded on the Oregon beach where Harry Nehls (pers. comm.) found that of 31 birds, 9.7% were first winter, 74.2% were second winter and the remaining 16.1% were adults. Most of the birds were replacing outer primaries; the remainder had completed molt.

### Common Murre

Murre carcasses were evenly distributed along the coast. A high percentage (95%) were oiled (Table 3); this is significantly higher than for any other species analyzed except White-winged Scoter. A minority (33.8%) of the 74 murres checked were still in winter plumage; the majority had finished the prenuptial molt. I have no useful autopsy data on these birds.

### Other species

Aside from the 22 badly oiled White-winged Scoters, only small numbers of other species were found. The numbers recorded for each

Table 1. Mean, standard deviation and range of the percentages of fulmars, kittiwakes and murres recorded on 11 beach censuses taken on the northern Oregon and Washington coast in early March 1976 following a seabird die-off.

| | % NORTHERN FULMAR | % BLACK-LEGGED KITTIWAKE | % COMMON MURRE |
|---|---|---|---|
| Mean ($\bar{x}$) | 63.0 | 16.4 | 10.1 |
| Standard deviation (s) | ±20.4 | ±20.3 | ±6.9 |
| Range | 83.5-10.2 | 69.2-0 | 22.2-3.7 |

Table 2. Summary of carcasses found on 11 beach censuses taken on the northern Oregon and Washington coast in early March 1976 following a seabird die-off. Total number includes individuals for which presence or absence of oil was not recorded.

| SPECIES | Oiled | Unoiled | Total |
|---|---|---|---|
| Arctic Loon *(Gavia arctica)* | 1 | 2 | 3 |
| Red-necked Grebe *(Podiceps grisegena)* | 1 | | 1 |
| Western Grebe *(Aechmophorus occidentalis)* | 4 | 9 | 13 |
| Northern Fulmar *(Fulmarus glacialis)* | 157 | 263 | 570 |
| Mottled (Scaled) Petrel *(Pterodroma inexpectata)* | 1 | 1 | 2 |
| Fork-tailed Storm-Petrel *(Oceanodroma furcata)* | | 1 | 2 |
| Leach's Storm-Petrel *(O. leucorhoa)* | | | 1 |
| Storm-Petrel (sp.) | 1 | | 1 |
| White-winged Scoter *(Melanitta deglandi)* | 22 | | 22 |
| Surf Scoter *(M. perspicillata)* | 1 | 2 | 3 |
| Duck (sp.) | 1 | | 1 |
| Glaucous-winged Gull *(Larus glaucescens)* | 1 | 1 | 2 |
| Western Gull *(L. occidentalis)* | | 2 | 2 |
| Mew Gull *(L. canus)* | 4 | 1 | 5 |
| *Larus* sp. | 6 | 1 | 7 |
| Black-legged Kittiwake *(Rissa tridactyla)* | 64 | 22 | 105 |
| Common Murre *(Uria aalge)* | 85 | 5 | 90 |
| Cassin's Auklet *(Ptychoramphus aleuticus)* | 4 | | 4 |
| Rhinocerous Auklet *(Cerorhinca monocerata)* | 5 | | 5 |
| Tufted Puffin *(Lunda cirrhata)* | 4 | | 4 |
| Unidentified birds | 8 | | 13 |

Table 3. Mean, standard deviation and range for the percentage of individuals with oil on their plumage of fulmars, scoters, kittiwakes and murres found on 11 beach censuses taken on the northern Oregon and Washington coast in early March 1976 following a seabird die-off.

| | NORTHERN FULMAR | BLACK-LEGGED KITTIWAKE | COMMON MURRE | WHITE-WINGED SCOTER |
|---|---|---|---|---|
| Mean ($\bar{x}$) | 43.2 | 66.0 | 95.3 | 90.0 |
| Standard deviation (s) | ±35.8 | ±35.5 | ±10.1 | ±31.6 |
| Range | 100-10 | 100-0 | 100-72.7 | 100-0 |

are listed in Table 2. As explained for fulmars and kittiwakes, it appeared that not all were oiled when alive. The majority, especially the loon, grebes and gulls, were probably not involved in the die-off, as they are found in comparable numbers on winter beached bird censuses (Harrington-Tweit unpubl. data).

PESTICIDE LEVELS

Eight livers were saved for pesticide analysis. The four fulmar livers had DDE levels ranging from 0.50 to 3.2 ppm (all measurements are wet weight). DDE levels for the two murres were 4.4 and 5.0 ppm, for the Arctic Loon *(Gavia arctica)* 1.1 ppm, and the Western Grebe *(Aechmophorus occidentalis)* 3.4 ppm. PCBs were present in all specimens with the highest level, 19.0 ppm, in the grebe and the lowest, 2.0 ppm, in a fulmar. There is no indication that pesticide residues are physiologically harmful at these levels (Steve Herman pers. comm.). For information on concentrations found in other seabirds in the north Pacific see Risebrough et al. (1967, 1968) and Fisher (1973); see Bogan and Bourne (1972) for information relating to Atlantic seabirds.

ENVIRONMENTAL DATA

Consistently strong onshore winds occurred throughout February and were strongest late in the month. The wind blew southwesterly on 71.4% of the days at an average 30 km/h. Daily wind velocity during the last week of February averaged 38.3 km/h (range 29 to 47 km/h) predominantly from the southwest (National Weather Service data, U.S. Coast Guard reporting station, Westport, Grays Harbor Co., WA). These strong winds differed from the usual February weather. Values for February averaged over a 5-year period (1953 to 1958) at Hoquaim, Grays Harbor Co., indicate that winds are southwesterly (including WSW and SSW) 20.3% of the days at a velocity of 26.2 km/h (Pacific Northwest River Basins Commission 1968).

Sea surface temperatures over the continental shelf off the Washington coast average 9°C during January and February (calculated for the years 1961-1974). In early January 1976 the sea surface temperature in this area was 9°C, until a mass of colder water started pushing south along the coast. This 8°C water reached the mouth of the Columbia River by the end of January, and was bounded on the west by warmer water at the edge of the shelf. This situation remained unchanged until late February, when the colder water pushed further west (data from Southwest Fisheries Center, National Marine Fisheries Service, NOAA). However, this summary may not be entirely accurate. David G. Ainley (pers. comm.) found that off central California there was a brief period of higher sea surface temperatures in late February which was not reflected in the NOAA data.

On 2 March two observers from the Ecological Services Division, U.S. Fish and Wildlife Service, flew the coastline from Ilwaco, Pacific Co., Washington, north to LaPush, Clallam Co. They reported fairly heavy, broken patches of crude oil within a mile of shore from Ilwaco to Copalis, Grays Harbor Co. (Gary Shaw pers. comm.). North of Copalis the patches were fewer and smaller. I found very few traces of oil on the beach during the three censuses I conducted in the Westport area on 6 March. The amount of oil further offshore at this time is unknown.

## DISCUSSION

Periods of high seabird mortality, often in conjunction with storms, have been reported fewer than 10 times in the last 80 winters along the Washington coast (Harrington-Tweit in prep.). But winter storms with wind velocities of 80 to 110 km/h are reported almost every winter in this area (U.S. Department of Agriculture 1972). Obviously not every winter gale triggers a die-off of the magnitude reported here. Seabirds that winter on the north Pacific must be able to cope with high winds. Therefore other factors, possibly in conjunction with winter storms, must be involved in the die-offs. These could be environmental pollutants, food suppy and/or a bird's physiological state.

In this instance, mortality of fulmars and at least half that of kittiwakes was not due to oil. The White-winged Scoter and alcid mortality is definitely attributable to oil. The effect of pesticide residues present in these birds was probably negligible. All of the fulmars and kittiwakes had either just completed or were undergoing a molt; female fulmars, possibly some kittiwakes and most male fulmars were also developing into breeding condition.

Sea surface temperatures can be used as a crude indicator of food availability. Both the kittiwakes and the fulmar are cold water feeders (Ainley 1976); they should not have been affected by the sea surface temperatures reported, if accurate, during this time. Ainley established that the brief period of higher surface temperatures, not shown by the NOAA data, coincided with the die-off (pers. comm.). Researchers at the Moss Landing Marine Laboratories found that captured prey species diversity declined during the die-off, and that a majority of the carcasses examined had empty stomachs (Lynne Krasnow pers. comm.). From this Ainley inferred that the warming spell reduced the amount of food available to fulmars and kittiwakes, causing the die-off. Similar circumstances may have prevailed off Oregon and Washington.

As Kinsky (1968) points out, seabird mortality can occur very selectively, affecting only some of the species or populations found offshore at the time. He observed discrepancies between the size and species composition of the known offshore population and the sample of birds wrecked by a severe cyclone. Most of the discrepancies hinged upon whether or not a population or species was molting at the time of

the wreck. Mortality was selective in this die-off. Both Sooty and Short-tailed shearwaters *(Puffinus griseus* and *P. tenuirostris)* occur offshore in winter (Ainley 1976, Wahl 1975), and Glaucous-winged and Herring gulls *(Larus glaucescens* and *L. argentatus)* are common offshore (Sanger 1973), yet none of these were involved in the die-off.

Both physical and behavioral differences could account for the selectivity. Kittiwakes and fulmars were molting and many individuals were entering breeding condition. Wintering shearwaters are all non-breeding individuals and are not in molt at this time (Palmer 1962). Adult gulls may be entering breeding condition in February, but there should be no gulls in molt at this time (Dwight 1925). Fulmars and kittiwakes are both surface feeders, whereas Sooty Shearwaters are capable of diving under the surface (Terence Wahl pers. comm.), and gulls are able to feed in the littoral zone and inland when they cannot find surface food in the pelagic zone. It is still quite unclear how these behavioral and physiological differences interact with environmental conditions to produce selective mortality.

The species affected by oiling present a different problem. Oiled grebes and diving ducks, two groups usually affected by coastal oil spills (Smail et al. 1972), were relatively scarce. Instead, most of the birds affected were offshore species, the alcids. The oil observed onshore on 2 March had little affect on the birds in this zone; certainly very few appeared on the beaches. Oil was apparently spilled or dumped in late February in an area used primarily by murres. The consistent onshore winds may have served to blow more carcasses ashore than would have otherwise appeared on the beaches. This factor makes it difficult to assess the number of birds affected, but it was obviously substantial. The high number of oiled White-winged Scoters compared to other inshore feeders is another case of selective mortality, currently inexplicable.

## SUMMARY

Results of 11 beached bird censuses taken on the coast of northern Oregon and Washington after a seabird die-off in late February 1976 are summarized. Northern Fulmar, Black-legged Kittiwake and Common Murre were the most numerous species found. Several other seabirds that winter offshore were not involved. Some behavioral and physiological differences that could account for the selective mortality are discussed. Murre mortality was caused by oiling; the source of the oil is unknown. Beached bird counts averaged 42.5 per kilometer, of which 63% were fulmars, 16% were kittiwakes and 10% were murres. Data obtained from autopsying fulmar carcasses provided information on completion of a primary molt at this season, a sexual dimorphism in weight and occurrence of plastic particles in the digestive tract. Pesticide residue levels are summarized for four species of seabirds found dead on the beaches.

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