

Chapter 9

**ABUNDANCE, DISTRIBUTION, AND VULNERABILITY TO IMPACT OF
BIRDS AND MAMMALS: A SYNTHESIS**

by

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SUMMARY

The Unimak Pass area supports large numbers of marine birds and lesser numbers of marine mammals. The various species studied exhibited marked differences in temporal and spatial distribution.

Both birds and mammals peaked in abundance in fall. Of the birds, short-tailed Shearwater was the most numerous species in fall and spring, and Crested Auklets were numerically dominant in winter. Dall's porpoises were in all seasons the most numerous mammals, northern fur seals were the second most numerous in fall, and sea otters were the only other relatively abundant marine mammals.

Euphausiids predominated as potential food for birds and mammals in the water column. Forage fishes were relatively uncommon and probably had less value as forage than did the euphausiids.

Prey availability appeared to play a major role in determining bird distribution. Virtually all key species studied—shearwaters, auklets, and murre—preyed predominantly on euphausiids and distributed themselves so as to benefit from euphausiid distribution. Some of these species, e.g. Common Murre, reportedly feed on fish in other areas.

In the fall, birds and their euphausiid prey were most common north of the Krenitzin Islands and northwest of Unimak Pass in areas considered to be Shelf Break Water (SBW) and Gulf of Alaska Water north (GAWn). Spectacular concentrations occurred in the northwest corner of Unimak Pass off Akun Island in an area of relatively high salinity that may have been caused by local upwelling.

During winter the euphausiid concentrations were farther east, to the north of Unimak Island within the Alaska Coastal Water north (ACWn). The major bird concentrations, composed mostly of Crested Auklets and Common Murres, were also present in this area. In spring there were no major concentrations of birds and prey but the highest densities of both were in the ACW.

Some species, including the Whiskered Auklet, did not clearly follow the prey concentrations on a seasonal basis. This species was always associated with the Krenitzin Islands and the Tidally Mixed Water (TMW), where sampling showed euphausiids to be present but not extremely abundant. It may be that zooplankton availability increased during periods of high tidal flux when the birds appeared to be most active in the passes but when sampling was impossible. Birds collected in the passes were found to have been successful in procuring euphausiids.

We found that Whiskered Auklets ventured much further from the passes than previously believed. Relatively large numbers were found at sea (5-10 nm) both north and south of the islands, especially in fall and spring, but even at sea they were most concentrated opposite passes.

Our results tend to support the hypothesis that very little upwelling or influx of nutrients or prey occurred due to water movement from the south through Unimak or other nearby passes. Rather, upwelling seemed to occur to the west of our study area through deeper passes, and the nutrients (or subsequent trophic products) were apparently transported east along the north side of the eastern Aleutians and into the North Aleutian Shelf area. Some evidence of local upwelling north of Akun Island was found during fall.

Not only did areas where birds concentrated generally correspond to areas of high euphausiid abundance, food habits analyses confirmed that euphausiids were the predominant prey of most birds. Seasonal shifts in bird distribution followed shifts in prey availability. The extent to which marine mammals were distributed in accordance with the distribution of their prey was not clear, because no food habits analyses were conducted for mammals. However, there were clear associations between most mammal species and certain water masses. High numbers of several species were found in fall in an upwelling area northeast of Akun Island.

The bird species judged to be the most vulnerable to adverse effects of oil should it be spilled in the study area were Tufted Puffin, Short-tailed Shearwater, Common Murre, Whiskered Auklet, and Crested Auklet. Major concentrations of these species were found in Akutan Pass, Derbin Strait, western parts of Unimak Pass (off Akun Island), and north of Unimak Island.

Tufted Puffin concentrations were largely of locally-breeding birds, thus mortality of large numbers could severely reduce local colonies. In contrast, concentrations of other species seemed to be primarily of wintering and other nonbreeding birds, potentially from several breeding populations, and local mortalities probably would have less drastic effects on any one breeding population.

Of the birds present mostly as non-breeders, the two auklets are probably the species at greatest risk because of their restricted distributions and large concentrations in the study area. Given prevailing currents in the study area, the auklet concentration area north of Unimak Island would probably be at greatest risk from a spill. This area supports very few Whiskered Auklets but hundreds of thousands of Crested Auklets may be present for much of the winter.

Among the mammals, northern fur seals and sea otters are more sensitive to contact with oil than are the other species because they are insulated with fur, which loses its insulative value when heavily oiled. Fur seals are judged to be highly vulnerable also because a large proportion of the Bering Sea population migrates twice annually through the Unimak Pass region; regional sea otter populations are less vulnerable because only a small proportion occupies the Unimak Pass area. Steller seal lions may be more vulnerable than at first suspected because large numbers congregate at haul-outs in the area and the population is already declining for other reasons, which could exacerbate adverse reactions to oil. Populations of other mammals are probably relatively invulnerable.

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INTRODUCTION

Unimak Pass is the major shipping passage linking the northeastern Pacific Ocean to the eastern Bering Sea. Commercial cargo vessels, fishing boats, warships, and oil industry vessels supporting activities in western and northern Alaska transit the pass. Portions of the Bering Sea—St. George Basin, North Aleutian Shelf, Navarin Basin, Norton Sound—could be eventually subject to petroleum exploration. In the event of a major oil discovery off western Alaska, tanker and support vessel use of the passage is expected to intensify, increasing the probability of accidents that could result in oil spillage and damage to regional biota.

The Unimak Pass area receives intensive use by seabirds and marine mammals. In summer, well over one million seabirds nest on islands in the area (Sowls et al. 1978). During spring and fall millions of birds and thousands of marine mammals migrate through the pass. The large numbers of these apex predators that feed in the area throughout the year suggest that the area has high and sustained productivity. Although spatially removed from the actual lease areas, the Unimak Pass area has a fauna of sufficient biological importance to be considered "at risk" from OCS activities. A lack of quantitative information on the nature and extent of use of the Unimak Pass area by marine birds and mammals prompted NOAA and MMS to obtain additional data. To this end they funded the research reported in preceding chapters. Following is a synthesis of findings related to the abundances and distributions of key species of birds and mammals and their prey, and an assessment of the vulnerability to oil spills of birds and mammals in the Unimak Pass area.

Study Area

The study area encompassed Unimak Pass and adjacent waters within a distance of approximately 50 km, including the Krenitzin Islands group. The area of interest was bounded by latitudes 53°30'N and 55°00'N and longitudes 164°00'W and 166°30'W (Fig. 1).

Resources of Concern

The species of interest fell into three groups—those that were numerous in the area, those that were very rare, and those of uncertain status. Several species were known prior to our investigations to be abundant; these included Short-tailed Shearwaters, Tufted Puffins, and Crested Auklets. Several endangered species were known to occur (or to have formerly occurred) in the Unimak Pass area; these included several of the great whales (right, gray, blue, humpback, and fin) and the Short-tailed Albatross. Species of uncertain status included northern fur seal, Whiskered Auklet, and

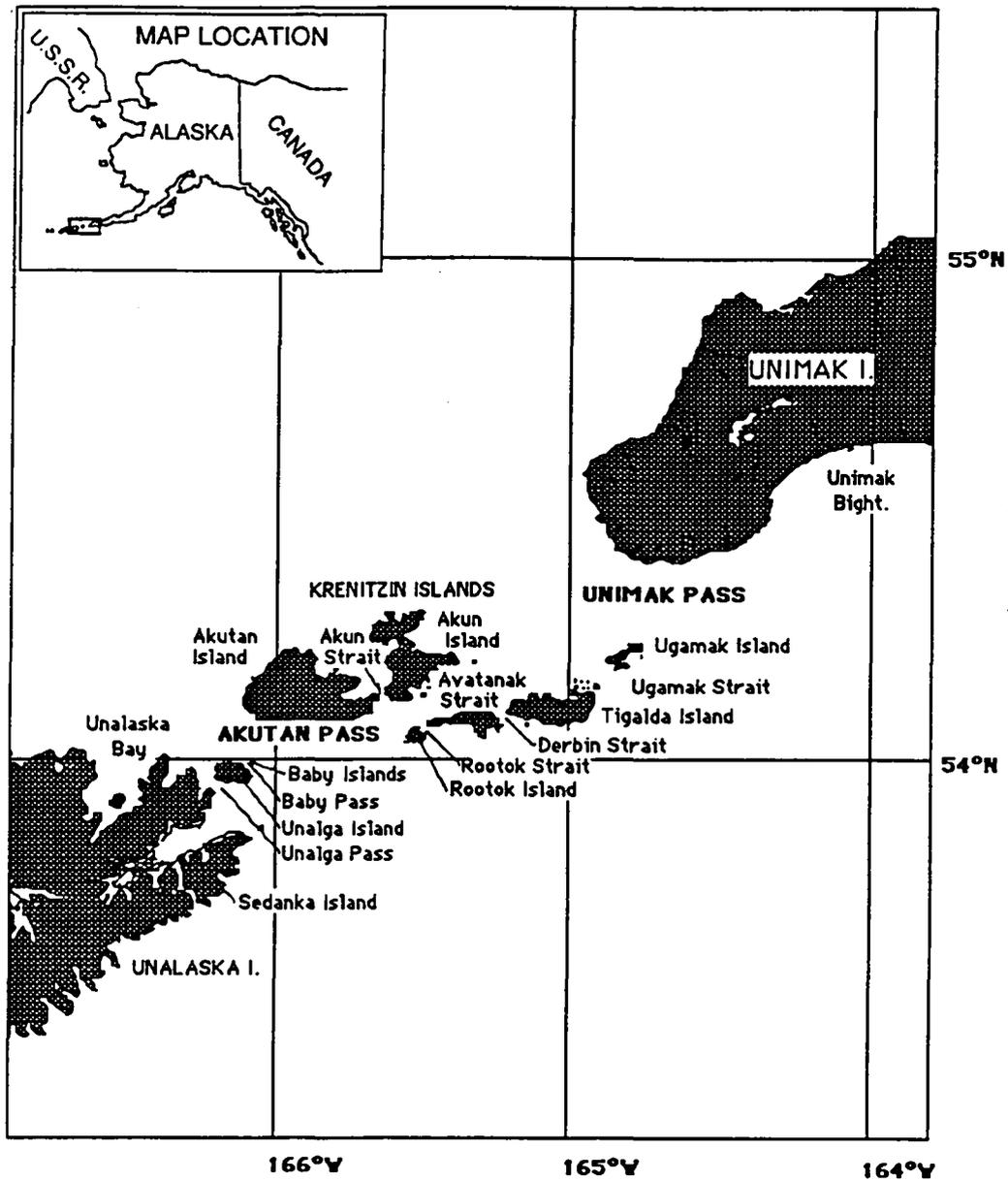


Figure 1. The Unimak Pass study area, Alaska.

seaducks; their distribution in and actual use of the pass area needed additional quantification.

METHODS

Three cruises, all using the NOAA ship R/V *Miller Freeman* (MF), were taken during this study. These cruises were as follows:

MF-86-10	18 Sept. – 7 Oct. 1986	fall
MF-87-02	14 Feb. – 9 March 1987	winter
MF-87-05	21 April – 14 May 1987	spring

Marine Birds and Mammals

Surveys for birds and mammals were made from the flying bridge while the ship was at full steam. Many survey lines were repeated each cruise to ensure sampling of all major depth classes and oceanographic domains (e.g., Gulf of Alaska and Bering Sea sides of the Aleutians and all passes and straits within the Krenitzin Islands). Transects were 300 m wide and of 10-minute duration as is the customary protocol for conducting marine bird surveys in Alaska.

Oceanographic Features and Prey Resources

Sampling to characterize oceanographic conditions and prey availability were undertaken, usually at night, along transects just censused. This sampling included bongo net deployment for zooplankton, CTD casts for temperature and salinity, and Marinovich mid-water trawls for forage fish. Most sample stations were reoccupied on each cruise.

RESULTS

Abundances and Distributions of Birds and Mammals

Fall

Most bird species peaked in abundance during fall (Table 1). This was particularly true of procellariids, larids, and puffins. Although many species were relatively common during this season, the total density of marine birds was not as high in fall as was observed during the winter, but was considerably higher than during spring.

Short-tailed Shearwater was overwhelmingly the most numerous species, accounting for almost two-thirds of all birds. Next in abundance was Black-legged Kittiwake, which accounted for an additional 15% of all sightings. Three additional species were common (occurring at densities ≥ 10

Table 1. Densities (#/km²) of marine birds by cruise, Unimak Pass area, Alaska, 1986-87.

SPECIES	Fall	Winter	Spring
Northern Fulmar	9.9	5.3	5.1
Short-tailed Shearwater	186.3	0.0	39.1
Black-legged Kittiwake	42.1	2.4	1.7
Murre	0.1	14.2	4.7
Whiskered Auklet	16.3	11.0	15.3
Crested Auklet	0.1	317.8	4.8
Auklet	3.9	58.5	0.3
Tufted Puffin	9.9	0.1	0.5
Total	281.0	424.6	79.8

Table 2. Densities (#/km²) of marine mammals by cruise, Unimak Pass area, Alaska, 1986-87.

SPECIES	Fall	Winter	Spring
Sea Otter	0.029	0.007	0.009
Steller Sea Lion	0.003	0.002	0.000
Northern Fur Seal	0.039	0.000	0.000
Harbor Seal	0.004	0.000	0.000
Killer Whale	0.005	0.000	0.009
Dall's Porpoise	0.139	0.074	0.051
Gray Whale	0.000	0.000	0.003
Minke Whale	0.004	0.003	0.001
Fin Whale	0.000	0.000	0.003
Total	0.22	0.10	0.08

birds/km²)—Whiskered Auklet, Northern Fulmar, and Tufted Puffin. These five species accounted for 94% of the birds seen.

Several species, including most of the common ones—Northern Fulmar, Short-tailed Shearwater, Black-legged Kittiwake, and Tufted Puffin—had a concentration area in the northwest portion of Unimak Pass, off Akun Island (Fig. 2).

As expected, many Whiskered Auklets were encountered within the passes of the Krenitzin Islands, especially Akutan Pass. However, this species was also numerous in the Gulf of Alaska south of the islands with peak numbers occurring off passes.

Most marine mammals also were found at their peak abundances during fall (Table 2). Dall's porpoise, sea otter, and northern fur seal were most striking in this regard.

In general there were too few observations of marine mammals to make any broad generalizations regarding distribution. Northern fur seals were not as common as expected, and were essentially confined to the Bering Sea west of Unimak Pass. Most Dall's porpoises were in the Bering Sea, peaking in abundance north of Unimak Pass, but also occurred in the deeper waters of the Gulf of Alaska. Humpback whales were observed in the area of seabird concentration north of Akun Island.

Winter

The highest overall density of marine birds was recorded on the winter cruise. Three species accounted for 97% of the total. At least three-quarters of all birds were Crested Auklets. Murres, predominantly Common Murres, were the second most numerous group, but they were an order of magnitude less numerous than the auklets. The only other common species was Whiskered Auklet.

The centers of bird abundance occurred in two areas—north of Unimak Island and within the passes and straits of the Krenitzin Islands (Fig. 2). Murres were numerous in both areas, being most common in western Unimak Pass, Avatanak Strait, and off Cape Sarichef. Crested Auklets were concentrated north of Unimak Island between capes Sarichef and Mordvinof and within Akutan Pass (including Baby Pass). Whiskered Auklets were restricted to the Krenitzins, sharing the Akutan Pass area with the Crested Auklets and also concentrated in Derbin Strait.

Marine mammals were encountered very infrequently during the winter cruise. The most numerous species recorded at sea was Dall's porpoise, which was largely restricted to the deepest portions of the study area in the

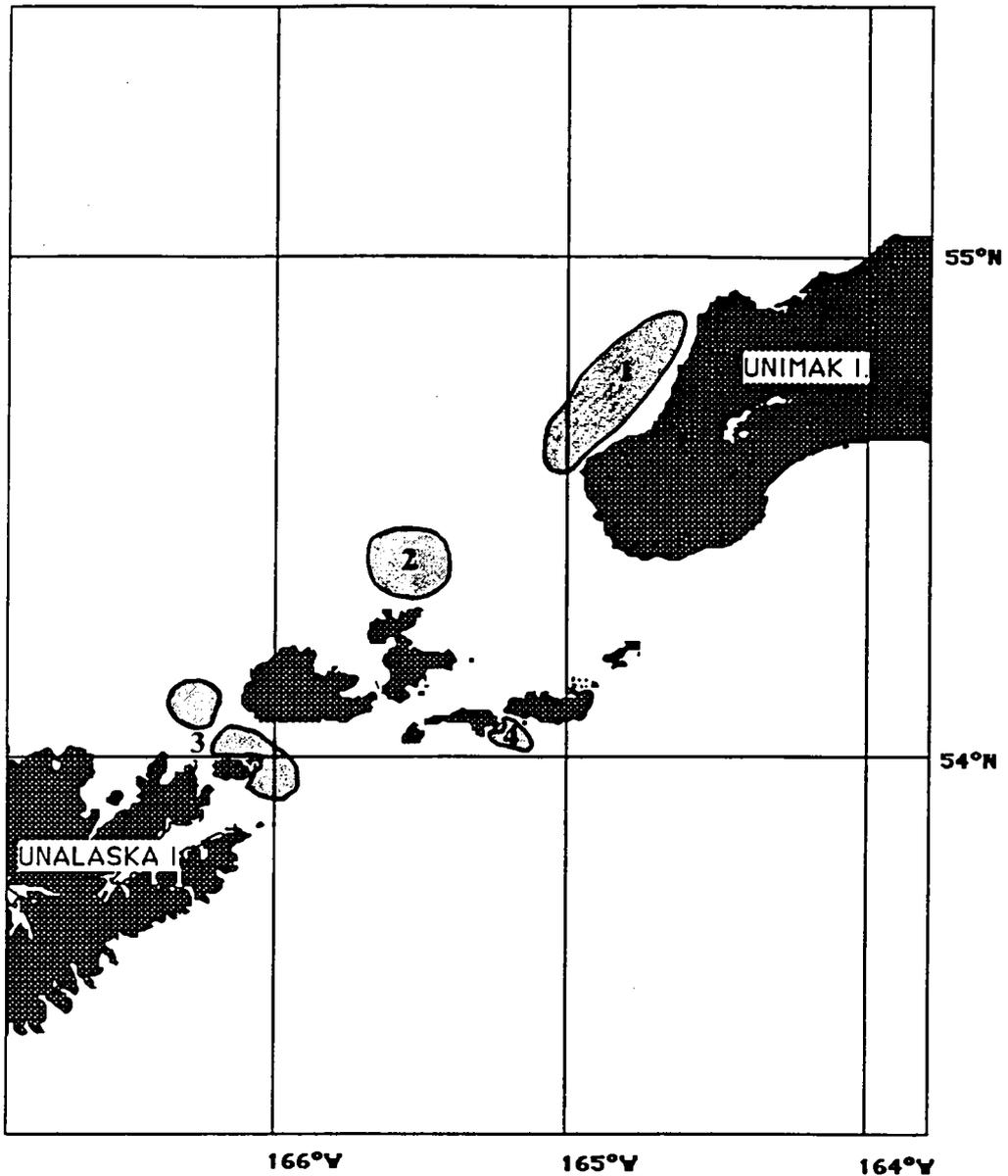


Figure 2. Areas with the highest densities of birds, Unimak Pass area, Alaska. (1=high densities of Crested Auklets and Common Murres during winter; 2=high densities of all species, especially Short-tailed Shearwaters, during fall; 3=high densities of Short-tailed Shearwaters during fall, Crested Auklets during winter, and Whiskered Auklets during all seasons.)

North Pacific. The only species of baleen whale recorded during winter was minke whale, which occurred within the passes and straits of the Krenitzins.

Spring

Overall bird densities in spring were only one-fifth of those recorded during the winter cruise, which ended not much more than a month prior to the start of the spring cruise. This illustrates the dynamic nature of bird populations during times of migration. During the spring cruise most winter birds had left for breeding areas and few of the summer birds were yet present. The most numerous species during the spring cruise—Short-tailed Shearwater—was abundant only near the end of the cruise. The only other common species observed during this cruise was Whiskered Auklet. The above two species comprised 68% of all sightings. It should be noted that Whiskered Auklet was the only species that was considered common during all cruises. Shearwaters in spring were most numerous in the eastern part of Unimak Pass, close to Unimak Island. Whiskered Auklets were more frequent north of the Krenitzins (opposite passes) than during the other cruises.

Marine mammals were at their lowest abundance during this cruise but several interesting sightings were made. Gray whales were recorded close to Unimak Island as expected. Fin whales were observed on transects within Unimak Pass. A group of Baird's beaked whales was seen repeatedly in the deep water of the Bering Sea north of Dutch Harbor, although not during a census.

Oceanographic Features

Distributional analyses of water quality variables were based on shipboard CTD casts and nitrate/nitrite samples taken on transects through the area, and on inspection of remote-sensing analyses of sea surface temperatures. Findings with important implications for the vertebrate food webs in the area include the following:

- (1) Low-salinity Alaska Coastal Current water was confined to the eastern parts of Unimak Pass in all seasons . Its farthest westward extension occurred in spring.
- (2) Water quality distributional characteristics indicated that upwelling of deep Gulf of Alaska water south of Unimak Pass, and its subsequent transport through the pass, was probably an uncommon occurrence. Rather, it seemed that upwelling probably occurred a few to several hundred km farther west in the Aleutian chain, and that the upwelled water moved eastward along the north side of the chain, eventually reaching the Unimak Pass area. This

is consistent with recent theory by other workers (e.g., Takenouti and Ohtani 1974, Kinder and Schumacher 1981).

- (3) Four different water masses probably occurred in the study area as a whole, based on surface salinities and mixing regimes. These were Alaska Coastal Current water (ACW) (adjacent to Unimak Island), Shelf Break Water (SBW) (north and west of the pass), Tidally-Mixed Water (TMW) (in shallow areas), and what we called Gulf of Alaska Water (GAW) (widely distributed in deeper, western parts of the study area). The spatial extent of the water masses, especially that of SBW and ACW, varied considerably among seasons (Fig. 3).

We subdivided two of the water masses, the GAW and the ACW, into northern (Bering) and southern (Pacific) masses. In the case of the GAW, these two regions were frequently discontinuous and so were analyzed separately. As discussed earlier the ACW retained its integrity as it passed through Unimak Pass; however, based on prior studies and on the nitrate content of the water, we anticipated that indications of upwelling would be manifest on the Bering Sea component of this water mass but not the Pacific side.

Prey Resources

Fish

The spatial and temporal distributions of forage fishes in the Unimak Pass area were assessed as a basis for explaining the distributions of marine birds and mammals of the region. These analyses were based on mid-water trawl samples taken in association with marine bird and mammal surveys.

In most portions of the study area and during most cruises, forage fishes were relatively uncommon and probably did not attract marine birds and mammals to the area. The food habits analyses of common birds (Short-tailed Shearwaters, Common Murres, Whiskered and Crested Auklets) confirmed that fish were a minor component of their diets.

During fall, however, young-of-the-year pollock were extremely abundant within the Tidally Mixed Waters around the Krenitzin Islands. Tufted Puffins were commonly seen carrying small pollock back to their nesting colonies. Lanternfish (myctophids) were present in intermediate abundance during all cruises in the deep (> 1000 m) portions of the GAWs. It is uncertain if large numbers of lanternfish were ever within the foraging range of most seabirds, but they are known to be a frequent prey of Dall's

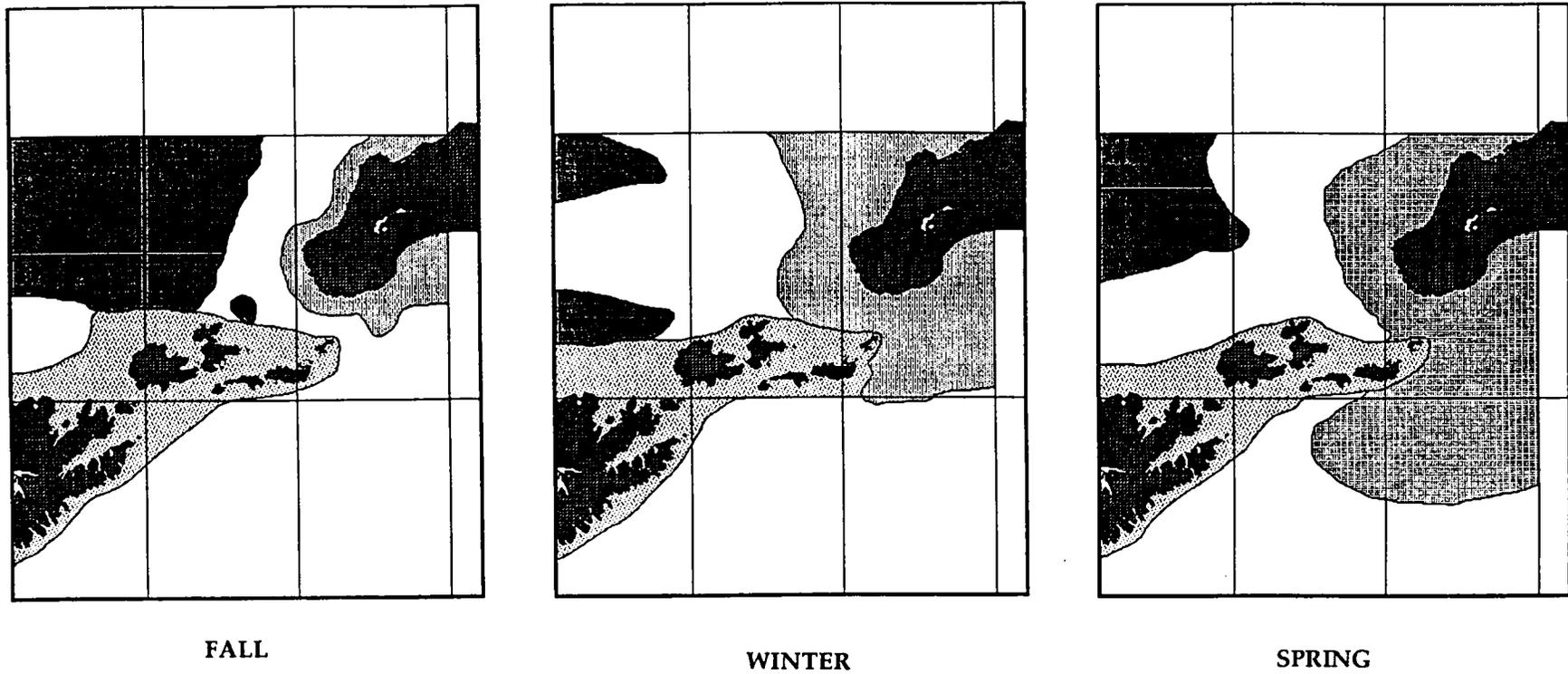


Figure 3. Distribution of major water masses during the fall, winter, and spring cruises, Unimak Pass, Alaska.

porpoises and were abundant in the same water masses during the winter and spring cruises as were the porpoises.

Invertebrates

Euphausiids and copepods, the zooplankton groups expected to dominate pelagic environments and vertebrate diets, were sampled in the water column and at the surface. Invertebrate wet-weight biomass and composition by major taxa (e.g., copepods, euphausiids) were estimated. Major findings and their implications include the following:

- (1) Proportions of the total invertebrate biomass that the major zooplankton groups contributed varied seasonally. Gelatinous zooplankton (jellyfish) dominated spring catches northeast of Unimak Pass in the vicinity of the well-known "slime bank" on the North Aleutian Shelf, but were inconsequential in other seasons and places. Euphausiids formed the overwhelming majority of non-gelatinous zooplankton biomass in fall and winter, and a slight majority in spring. Copepods were scarce in fall and winter but nearly equalled the abundance of euphausiids in spring.
- (2) During fall, euphausiids were virtually absent from the ACW but were present in all other water types; they peaked in abundance in the Bering Sea, especially in the SBW and GAWn (Fig. 4). During winter, euphausiid distribution changed markedly—large concentrations were found in the ACWn. By spring, abundance had dropped in most areas and the highest densities were found in the ACW and TMW.
- (3) Euphausiids were the predominant zooplankton found in the samples and in the diets of marine birds.
- (4) Food habits studies indicated that euphausiids found in bird stomachs from the study area were largely oceanic species; shelf species were uncommon. This finding supports other evidence that water upwelled from off the shelf dominates the Unimak Pass area.

Euphausiids

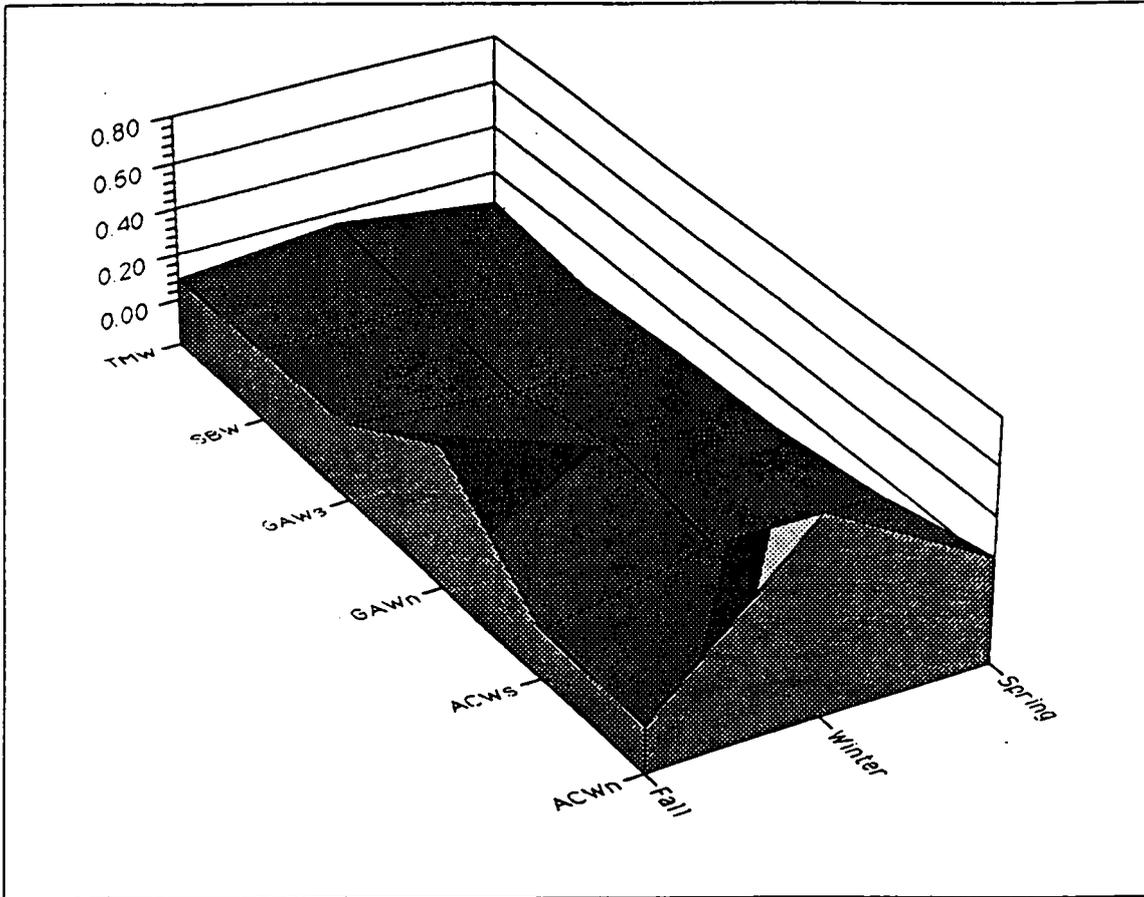


Figure 4. Density (#/km²) of euphausiids by water mass and cruise, Unimak Pass area, Alaska, 1986-87.

DISCUSSION

Water Mass Associations

Birds and mammals often exhibited striking differences in abundances among the various water masses. These distributional patterns frequently varied seasonally.

Fall

In fall, the highest densities occurred in the Shelf Break Water (SBW) because of the extreme abundance there of Short-tailed Shearwaters and Black-legged Kittiwakes. The spatial extent of this water mass was more than was observed during other seasons, occupying much of the northwest corner of the study area. Shearwaters were also abundant in the adjacent GAWn; however, Black-legged Kittiwakes were abundant only in the SBW. The abundance of these birds in the SBW and GAWn was paralleled by the highest densities of euphausiids, their principal prey, in these areas.

Birds were never abundant in the Alaska Coastal Water (ACW) in fall. Horned Puffins reached their peak abundance in the south portion of this water mass; however, they were still quite rare. These areas were also lacking in abundant prey sources for seabirds. Oceanic areas in the Gulf of Alaska likewise had very low bird and prey densities though one species, the Black-footed Albatross, was restricted to this area.

Although absolute bird densities in the TMW in fall were substantially lower than in the more structured water masses to the north, several species were largely restricted to this water mass. Most striking in this regard were Whiskered Auklet and Tufted Puffin. Cormorants, murrelets, and Common Murres also occurred most frequently in the TMW. Some species, especially Tufted Puffins, were preying heavily on the large numbers of young pollock abundant in this area. The presence of many of these birds in the TMW is probably due to its proximity to breeding areas, because the same species nest abundantly in colonies in the Krenitzin Islands, surrounded by TMW.

In general, the ACW was little used by birds in fall. Outside of this water mass, bird use of the Bering Sea side of the chain was high relative to that of the Gulf of Alaska side. Intermediate bird densities, of a distinctive species composition, occurred in the Tidally Mixed Water.

Among the mammals, the northern fur seal (present only in fall) was most common in SBW. Dall's porpoise and minke whale were most commonly associated with GAW. Harbor seal and sea otter were found primarily in ACW and TMW, respectively.

Winter Cruise

Use of the various water masses by birds during winter differed markedly from that observed during the fall cruise. The highest densities by a large margin occurred in the ACW. Very striking was the contrast between the southern and northern components of ACW; almost all the birds were found in the latter. Crested Auklets made up the greatest proportion of birds encountered in the ACWn; however, many other species also reached their peak abundances here. Other common species in the ACWn were Northern Fulmar and Common Murre. Several species of seabirds and gulls also reached peak abundance in this area. Euphausiid prey was also markedly more abundant in the ACWn than elsewhere during the winter.

The TMW also seemed important to birds in winter. As in fall, Whiskered Auklets were still largely confined to this water mass, but even higher densities of Crested Auklets were seen using these areas. Common Murres were also numerous in this water mass, although densities were not as high as in the ACW. Although not common in the areas surveyed by the ship, most of the encounters with Emperor Geese and cormorants were in TMW.

Gulf of Alaska water had few birds in winter. The northern portion had more birds than the south; however, neither area had many. Both Tufted and Horned puffins peaked in abundance in the GAWn, but puffins were rare everywhere during the winter. Marine mammals, in particular Dall's porpoise, were most numerous in the GAWs, having a distribution similar to myctophids, a probable prey item.

The areal extent of SBW was much smaller in winter than in fall. This water mass was identified in two areas, one north of Unalaska Island and the other at the northern extreme of the study area. A more complete picture might reveal this area to be connected west of our study area. Moderate densities of birds, including many auklets (thought to be mainly Crested Auklets), were found in this water mass.

Thus the winter results showed that the Gulf of Alaska side of Unimak Pass continued to have only a few birds as in fall, and that bird use of the western segment of the Bering Sea side was greatly reduced from that of fall. Alaska Coastal Current waters north of Unimak Pass were heavily used by marine birds. Tidally Mixed Waters were of greater importance to birds during winter than during fall.

Few mammals were abundant anywhere in winter, and fur and harbor seals and several whales seen during other seasons were absent. Minke whale and Steller sea lion were most common in TMW; Dall's porpoise was most abundant in GAW. Sea otters were observed only in ACW.

Spring

Bird abundance was more equitable among water masses in spring than in fall or winter, although overall densities were relatively low. The highest bird densities occurred in the Alaska Coastal Current water (ACW). Among all the water masses, ACW continued to have the greatest abundance of euphausiids, although lower than it had in winter. The northern portion was again the most important, but the portion south of Unimak Island had more birds than were observed during any other cruise. In both ACWn and ACWs, Short-tailed Shearwaters predominated.

Gulf of Alaska Water had similar overall bird densities in northern as in southern sectors, but the species composition was different. In the south, where bird densities were highest of all cruises, Common Murres were the most frequently encountered birds. In the north, Whiskered Auklets predominated, although this species was more numerous in the Tidally Mixed Water.

As mentioned above, the TMW continued to be the major habitat for Whiskered Auklets. Although several species peaked in abundance here—i.e., murrelets, Pigeon Guillemot, and cormorants—only Whiskered Auklets occurred in appreciable abundance.

In marked contrast to the results of the fall cruise, the SBW was the least used by birds of any of the area habitats during this cruise. No species peaked in abundance in this habitat.

Several mammals reached their peak abundance in the Unimak Pass area in spring. Among these, fin whales were restricted to GAW, killer whales to TMW, and gray whales to ACW; sea otters were most abundant by far in ACW. Dall's porpoise, less abundant than in fall, was most common in GAW. Harbor seals, Steller sea lions and minke whale were absent in spring.

Geographic Areas of Importance

Birds and marine mammals are frequently opportunistic feeders. Many search for prey directly while some rely on watching for other feeding birds (e.g., Sealy 1973). Aggregations can quickly develop, but also quickly dissipate. The occurrence of these ephemeral concentrations requires that caution be made in characterizing an area as important based on aggregations of birds or mammals seen during brief visits such as our surveys. Nonetheless, we believe that some areas of concentration identified during these investigations are probably of regular importance to marine birds, either because of past evidence of concentrations in the same area (e.g., auklet concentrations observed during the North Aleutian Shelf Studies) or the

apparent close associations between water masses, prey abundance, and bird/mammal presence.

The most significant bird and mammal concentration areas are as follows (see also Fig. 2):

- **Northwest of Unimak Island** within the Alaska Coastal Water. This nearshore area supported many (perhaps hundreds of thousands) Crested Auklets and Common Murres in winter.
- **Western Unimak Pass, northeast of Akun Island.** Huge concentrations of several seabirds, especially Short-tailed Shearwaters, occurred in this area during fall. Humpback whales were also observed here, but the regularity of their presence is unknown. Based on local measurements of high-salinity water in this vicinity, it appears that this is an area of upwelling.
- **Akutan Pass.** Concentrations of some marine birds occurred in Akutan Pass during all visits. During fall, Short-tailed Shearwaters were present in very large numbers in the northern portion of the pass. Whiskered Auklets were present during all cruises, augmented by large numbers of Crested Auklets during winter.
- **Derbin Strait.** Whiskered Auklets were associated with passes between the islands, although in many cases they were present offshore but opposite the passes. The major concentration areas within passes were in Akutan (including Baby) Pass and, during winter, Derbin Strait.

Vulnerability to Oil Spills

Birds

Oil spills, including the recent spill from the Exxon Valdez in Prince William Sound, have frequently resulted in high incidences of seabird deaths. Mortality is not random; the behavior of individual species, especially their mode of foraging and the degree to which they move between terrestrial and marine environments, influences their susceptibility to oiling. In general, diving birds such as loons, grebes, seaducks, and alcids are the most likely to be coated by spilled oil (Clark 1969, Vermeer 1976). Species that obtain most of their food on the wing or by wading in shallow water (i.e., tubenoses, gulls, terns, and shorebirds) are infrequently affected by oil spills (Clark 1969, Smail et al. 1972, Vermeer 1976).

Susceptibility to oiling varies among the species using Unimak Pass. Most of the major bird aggregations documented by this study, e.g., alcids and shearwaters, were of species that have a history of being susceptible to oiling. Seaducks (Oldsquaws, eiders, scoters) are also regular victims of oiling, but no major aggregations of these were identified in our study area. Storm-Petrels nest in very large numbers in the Unimak Pass area, yet they made very little use of the study area for foraging and thus would be at little risk from an oil spill should one occur in the Krenitzin Islands. The following paragraphs detail the vulnerabilities of the groups considered most at risk—the alcids and shearwaters.

The alcid species of concern with respect to oil spills in the Unimak Pass area are Common Murre, Whiskered Auklet, Crested Auklet, and Tufted Puffin. These species all occur in large numbers and frequently in large aggregations. Whiskered Auklets are of special concern because of their restricted worldwide distribution.

Murres, usually Common Murres, have topped the mortality lists of many northern oil spills (e.g., Baillie and Mead 1982, Stowe 1982, Stowe and Underwood 1984). This reflects both their widespread distribution and abundance and their susceptibility to oil. In the Unimak Pass area they are present primarily as winter visitors; there are no large breeding colonies in the area. Concentrations are most regular in the eastern part of Unimak Pass itself, especially off Cape Sarichef, and very large numbers of birds were encountered in Avatanak Strait during our winter cruise. Many swimming and foraging murres have been encountered at the south end of Akutan Pass.

Any extensive spill near land would almost certainly come in contact with murres, but the population-level consequences of heavy mortality on murres in this area are not obvious. The origins of these birds are unknown, but the major nearby colonies are Cape Peirce/Newenham to the north and the Semedi Islands to the east. If murres are essentially in mixed flocks while at sea, then oiling in a local area would presumably not be a major blow to any particular population. A major die-off of an estimated 100,000 Common Murres occurred in this area in 1970 (Unimak Island and Alaska Peninsula) (Bailey and Davenport 1972). This phenomena was believed to be weather related. No population decreases at any colonies have been linked to this event, although few studies were in existence that could have documented declines in any case.

Auklets have not figured prominently in any major oil spill, probably by virtue of their restricted distribution. Most auklets are found in the Bering Sea where no oil spills have occurred. They are probably susceptible to oiling, as most alcids have proved to be; although Vermeer and Vermeer (1975) suggest that these smaller alcids are less vulnerable to oil pollution because of their more aerial habits. In the Unimak Pass area, both Whiskered and

Crested auklets are frequently found in dense aggregations; thus if contact were made with an oil spill large numbers of birds would be involved.

Whiskered Auklets are confined primarily to the Aleutian Island chain, but relatively little is known about their breeding areas and population size. Attempts to census breeding birds on cliffs of the Krenitzin Islands (largely by call-counts) by us and others (Nysewander et al. 1982) have failed to locate large numbers. Considerable numbers of Whiskered Auklets were found during shipboard counts during all of our cruises; whether many of these leave during the summer or whether they are breeding birds is unknown. The most recent population estimate of Whiskered Auklets is "at least" 25,000 birds (Byrd and Gibson 1980). Our absolute counts in the Krenitzin Islands approached this value (e.g., 15,000 on transects during the fall cruise); hence the Unimak study area may support a substantial portion of the known Whiskered Auklets. The major concentration areas for Whiskered Auklets in our area of interest are Akutan Pass and Derbin Strait but aggregations can be found off or in almost any pass in the area. Given that an unknown but certainly high proportion of the world's Whiskered Auklets occur in the Unimak Pass area, that they are probably quite susceptible to oil, and that they occur in areas of high currents where movements of oil would be uncontrollable, this species is one of the most important with respect to potential impacts from oil.

Crested Auklets occur in the study area in much larger numbers than Whiskered Auklets. No breeding areas are known near the study area and the auklets appear to be present only during the nonbreeding season. The eastern Bering Sea (encompassing most of the worldwide distribution of this species) supports some 2 million Crested Auklets (Sowls et al. 1978). The numbers in the Unimak Pass study area in winter appear to be on the order of 200,000 to 400,000, or 10-20% of the Bering Sea population. These auklets presumably come from the major Bering Sea colonies; i.e., St. Lawrence, St. Matthew, or the Pribilof Islands. In the Unimak Pass area these birds are very concentrated; aggregations are found in Akutan Pass (especially near the Baby Islands) and north of Unimak Island. Like Whiskered Auklets, this species appears to be one of greatest concern with respect to the potential damage that an oil spill in this area could inflict. Crested Auklets occur in very large numbers in the area, a large proportion of the world's population occurs in the area, they appear to be susceptible to contact with oil, and they occur in areas of considerable currents.

Tufted Puffins differ from other alcids in the area in that they would be most susceptible to oil spills during the breeding season, which extends into October or later. The Krenitzin Islands have some of Alaska's largest colonies of Tufted Puffins, which use nearby waters intensively. After nesting, these puffins move from land into the offshore areas of the North Pacific, and are

probably not concentrated such that an individual spill would be a particular threat to them.

Shearwaters occur in very large numbers in the study area during fall. They also occur in spring, although this was not documented during the present study because their migration occurred after our cruise. Large numbers fly through the Unimak Pass area in immense flocks; however, birds in flight are not necessarily at risk from oil spills. In the Unimak Pass area (including Akutan Pass) the fall aggregations of shearwaters involve birds foraging and resting on the water. These concentrations represent marine staging prior to fall migration, and are probably vulnerable to an oil spill.

Mammals

The mammals that are most sensitive to contact with oil are the most vulnerable to impact. Species that are insulated largely with fur (fur seal, sea otter) respond more adversely to oil spills than do the other species, as illustrated by the large numbers of sea otters killed by the Exxon Valdez oil spill in Prince William Sound, Alaska, in 1989. The vulnerabilities of mammals in Unimak Pass depend also on the proportions of regional populations that use the Unimak Pass area and the tendency for the animals to congregate in areas where OCS activities might occur.

The northern fur seal is judged to be highly vulnerable. Large percentages of the total population of fur seals reportedly congregate in the Unimak Pass area in spring and fall during migration passage (Kenyon and Wilke 1953, Braham et. al. 1982) (though we saw none in spring), and an oil spill in the pass at peak migration could oil a relatively large number. Further, the seals spend much of their time at the sea surface where they would come into direct contact with an oil slick.

The sea otter is obviously sensitive to being oiled as indicated by the Exxon Valdez experience. However, the proportion of the Aleutian Islands-Alaska Peninsula population that occupies the Unimak Pass area is small, indicating a regional population that is relatively invulnerable should an oil spill be restricted to the study area.

The Steller sea lion population is also relatively vulnerable because a moderately large proportion of the population hauls out and pups in the Unimak Pass area. Further, the sea lion population is currently declining for unknown reasons; possibly the individuals are responding to some environmental stress. They might thus be more sensitive than usual to additional stress imposed by OCS activities.

The majority of the 17,000 eastern Pacific gray whales move through Unimak Pass in spring and fall; the population is thus relatively exposed to

OCS activities occurring in Unimak Pass during these times. However, most information suggests that they would be far less sensitive to oil than the above three species.

The remainder of the mammals using the Unimak Pass area would probably be relatively secure as populations from appreciable impact caused by OCS development. Most appear to be not particularly sensitive to oil, and at any rate most are sufficiently dispersed that localized OCS activities would affect only small proportions of the populations.

Geographic Regions

A detailed assessment of the relative vulnerabilities among geographic areas awaits the analysis of potential spill sites and the results of oil spill trajectory models. Some preliminary comments, with respect to the concentration areas identified in this report, can be made. All of the concentration areas occurred near land but well outside of the intertidal zone. Several of the concentrations were within or near the Krenitzin Islands, often within passes. These areas probably would not be subject to tanker traffic, and any oil introduced would probably not be resident long due to the extensive flushing in these areas. However, containment attempts to protect concentration areas would probably be impossible due to the strong currents.

The ACW appears to retain its integrity as it follows the coastline of the Alaska Peninsula and Unimak Island. This suggests that a spill in this water mass may not affect birds to the west, but that a spill on the south side could be a threat to murres and auklets north of Unimak Island. We have no direct information on currents but the nutrient data from our studies suggest that north of the Krenitzin Islands there may be an eastward flow parallel to the Aleutian Chain and the Alaska Peninsula. If this is indeed the case, a spill on the Bering Sea side west of Unimak Pass could affect concentration areas east of the spill location on the north side of Unimak Pass. Current action would probably result in some effects in all the passes and straits of the Krenitzins as well.

If oil tanker traffic through Unimak Pass constituted the main threat of an oil spill, the prevailing northeastward transport in the Bering Sea and the transport characteristics of the Alaska Coastal Current suggest that the marine bird concentration area most at risk would be the area north of Unimak Island. The marine birds predominating in this area are Crested Auklets and Common Murres. Relative to other parts of our study area it is also important for seaducks, although the numbers of ducks here are small relative to those in areas farther east (e.g., Izembek Lagoon). This area is also of importance to marine mammals—gray whale migration is confined to the ACW in this area and Steller sea lions haul out on Unimak Island near Cape Mordvinof.

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