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MARINE BIRD INFORMATION SYNTHESIS

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MARINE BIRD INFORMATION

SYNTHESIS

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1. MARINE BIRD INFORMATION SYNTHESIS

The northeast Pacific is an area inhabited by large numbers of marine birds. Competition may exist between birds and man for the fish resources in this area. Thus marine birds are a necessary component in ecosystem models which quantify changes in fish resources.

To assess the amount of bird predation on fish the PROBUB model requires as input the estimates of monthly bird distributions in numbers, and the mean weight, metabolic rate, and food composition of each bird group. Since the OCSEAP program funded many bird studies in the area most of the estimates were taken from this source. Other fragmentary data were taken from an extensive review of the sparse information available in the literature. The collected data are used in the PROBUB subregions as shown in Figure 1.

Table 1 shows the weights and lengths of marine birds which inhabit and utilize the marine environment for their existence. Descriptive information on the birds' migratory habits is synthesized in Table 2 because migration is a factor in determining the numbers of birds in model regions for different months. If the estimate of bird abundance can be identified as a maximum (e.g. summer) or minimum (e.g. winter) and the seasonal migration patterns are defined, then some seasonal estimates of bird numbers in different subregions can be deduced. Tables 3a-b show the maximum or minimum numbers of marine birds in the model subregions with some indication of when the minimum or maximum numbers occur. Feeding behavior and available food composition data are summarized in Tables 4 and 5.

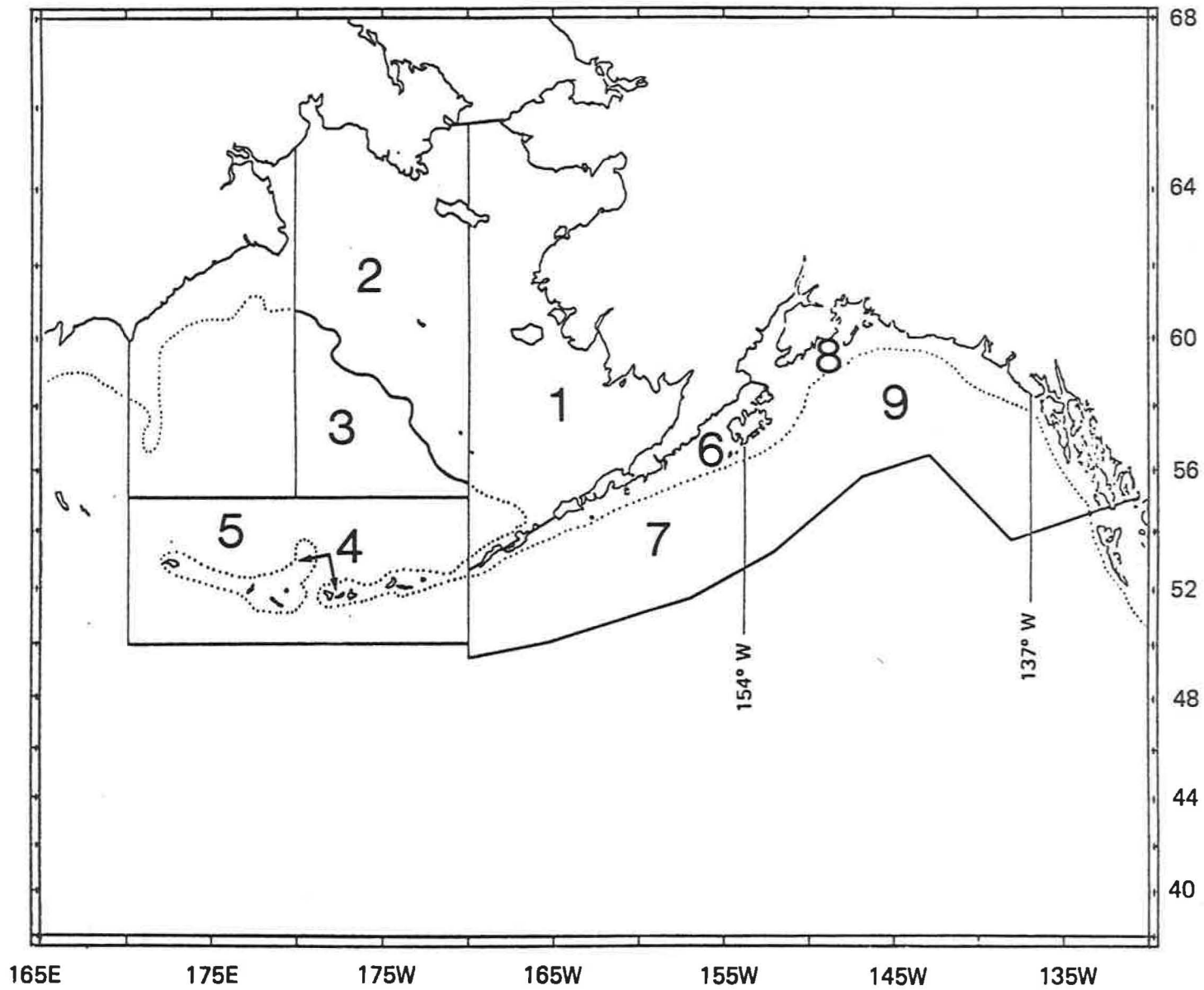


Figure 1.--PROBUB model subregions.

Table 1. Weights and lengths of marine birds of the Alaskan region.

<u>Common name</u>	<u>Scientific name</u>	<u>Mean Weight (kg)</u>	<u>Mean Length(in.)</u>
Glaucous gull	<i>Larus hyperboreus</i>		30.0
Glaucous-winged gull	<i>Larus glaucescens</i>	1.175	
Fork-tailed storm petrel	<i>Oceanodroma furcata</i>	0.055	8.-9.2
Leach's storm petrel	<i>Oceanodroma leucorhoa</i>	0.048	8.
Ancient murrelet	<i>Synthliboramphus antiquus</i>	0.205	10.
Cassin's auklet	<i>Ptychoramphus aleuticus</i>		8.-9.
Rhinoceros auklet	<i>Cerorhinca monocerata</i>	0.22-0.54	15.
Tufted puffin	<i>Lunda cirrhata</i>	0.8	15.
Common and thick-billed murre	<i>Uria</i> spp.	0.9	
Northern fulmar	<i>Fulmarus glacialis</i>	0.634	
Black-legged kittiwake	<i>Rissa tridactyla</i>	0.444	
Red-legged kittiwake	<i>Rissa brevirostris</i>	0.380	
Double-crested, pelagic, and red faced cormorants	<i>Phalacrocorax</i> spp.	2.459	
Horned puffin	<i>Fratercula corniculata</i>	0.518-0.599	14.
Parakeet auklet	<i>Cyclorhynchus psittacula</i>	0.23-0.26	10.
Crested auklet	<i>Aethia cristatella</i>	0.26-0.29	10.5
Least auklet	<i>Aethia pusilla</i>	0.09	6.5
Whiskered auklet	<i>Aethia pygmaea</i>		7.5
Pigeon guillemot	<i>Cepphus columba</i>		13.5
Sooty shearwater	<i>Puffinus griseus</i>	0.7	
Short-tailed shearwater	<i>Puffinus tenuirostris</i>	0.7	
Arctic and aleutian terns	<i>Sterna</i> spp.		15.5

Table 2. Migrations and movements of Alaskan marine birds.

<u>Name</u>	<u>Local(L) or Migrating(M)</u>	<u>Month of arrival</u>	<u>Month of departure</u>	<u>Months inshore(I), Offshore(O), at Slope(S) and comments</u>
Glaucous gull				
Glaucous-winged gull				Winter(O), Fall(O)
Fork-tailed storm petrel				Summer(S), 1000 fathoms all months
Leach's storm petrel	M	May		
Ancient murrelet				Winter(O)
Cassins's auklet				
Rhinoceros auklet	M	May	Sept-Oct	Winter south in WA-CA
Tufted puffin	M	May	Oct	Winters south of Aleutians in waters > 1000 fathoms
Common and thick-billed murre		April	Sept	Winters (O) in Aleutians and SE Alaska
Northern fulmar	M	late winter in Bering Sea	late fall in Bering Sea	Most months at shelf break and > 1000 fathoms
Black-legged kittiwake	M	spring in Bering Sea		Winter (S)
Red-legged kittiwake				Winters around Pribilofs
Double-crested, pelagic and red faced cormorants				Winters in Aleutians
Horned puffin	M	May-June	Sept	Moves south with ice
Parakeet auklet	M	April	Aug	Winters south of Alaska
Crested auklet	M	April	Sept	Winters in Pribilofs, Aleutians, Kodiak
Least auklet	M	May	Aug	Winters in S. Bering Sea, Aleutians
Whiskered auklet	M	May		Winters in Aleutians
Pigeon guillemot		April	Oct	Moves south with ice
Sooty shearwater	M	May	Oct	Patchy distribution, mostly in SE Alaska
Short-tailed shearwater	M	Spring	Aug	Patchy distribution, mostly in Aleutians and Bering Sea
Arctic and Aleutian terns	M	June	Aug	Winters in S. Hemisphere

Table 3a. Estimated numbers of marine birds in PROBUB subregions (in thousands). * 1/

Name	Subregions 1		2		3		4		5		6		8	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Glaucous gull	1.8		1.8											
Glaucous-winged gull	30.5 Jan	Jun					27. Jan	Jun			81.7 W		90. W	
Fork-tailed storm petrel							541.5				257. May-Sep		349.7 May-Sep	
Leach's storm petrel							820.2				80. S		809. S	
Ancient murrelet							7.5				22.9		82.9	
Cassin's auklet							0.4				125.5		193.2	
Rhinoceros auklet							0.03				2.2		110.4	
Tufted puffin	93.2		4.0		7.0		782.				567.2 Sp,F	W	655. Sp,F	W
Common and thick-billed murre	2056.7		701.4		1849.3		552.5				707.2 May,Nov	July	715.2 May,Nov	July
Northern fulmar			450.		70.7		456.7				237.3		237.3 S	W
Black-legged kittiwake	523. May-Sep	Jan	29.4 May-Sep	Jan	108. May-Sep	Jan	82.3 May-Sep	Jan			471.2 S		473.3 Apr-Oct	
Red-legged kittiwake					222.2		4.6							
Double-crested, pelagic & red-faced cormorants	28.		3.1		7.7		107.5				32.7 W		34. W	
Horned puffin	31.5		27.3		32.4		64.3				296.7 Sp,F	Aug	297.6 Sp,F	Aug
Parakeet auklet	45.		43.6		184.		67.				44.3		44.3	
Crested auklet	400.		400.		34.		468.1				21.2		21.2	
Least auklet	1146.5		1146.5		273.		906.1							
Whiskered auklet							6.4							
Pigeon guillemot	3.9		2.3				7.4				13.		14. Apr-Oct	
Sooty shearwater	600. S		600. S		600. S		600. S		600. S		500. Jul-Sep		500. Jul-Sep	
Short-tailed shearwater	1400. S		1400. S		1400. S		1400. S		1400. S		500. May-Jun		500. May-Jun	
Arctic & Aleutian terns	2.9		0.3				1.2				5.1 May-Aug		6.8 May-Aug	

* Main source: Fish and Wildlife Service Bird Colony Catalog

1/ No data available for subregions 7 and 9

Sp - spring

W - winter

F - fall

S - summer

Table 3b.--Estimated standing stocks of pelagic birds in the Bering Sea (adapted from Shuntov 1972).*

Species	December - March		April - May		June - August		September - November	
	No/100 km ²	Million of birds	No/100 km ²	Millions of birds	No/100 km ²	Millions of birds	No/100 km ²	Millions of birds
SHELF AND SLOPE AREAS (1.3 million km ²) a/								
Slender-billed Shearwater	--	--	720	9.36	702	9.13	240	3.12
Fulmar	20	0.06	180	2.34	216	2.81	108	1.40
Fork-tailed Storm Petrel	--	--	--	--	270	3.51	180	2.34
Murres (mainly T.-b.)	680	2.04	460	5.98	270	3.51	204	2.65
Other Alcids	40	0.12	180	2.34	180	2.34	132	1.72
Glaucous-winged Gull	170	0.51	80	1.04	18	0.23	120	1.56
Black-legged Kittiwake	20	0.06	120	1.56	54	0.70	120	1.56
Cormorant	10	0.03	20	0.26	--	--	--	--
Ducks	30	0.09	100	1.30	--	--	24	0.31
Red Phalarope	--	--	80	1.04	18	0.23	--	--
Other	30	0.09	60	0.78	72	0.94	72	0.94
TOTAL	1,000	3.00	2,000	26.0	1,800	23.40	1,200	15.6
OCEANIC AREA (1.0 million km ²) a/								
Slender-billed Shearwater	--	--	40	0.40	54.0	0.54	56.0	0.56
Fulmar	38.4	0.39	128	1.28	45.9	0.46	107.0	1.07
Fork-tailed Storm Petrel	--	--	--	--	136.0	1.36	22.4	0.22
Murres (mainly T.-b.)	8.0	0.08	20	0.20	5.4	0.05	2.8	0.03
Other Alcids	5.6	0.06	136	1.36	5.4	0.05	11.2	0.11
Glaucous-winged Gull	15.2	0.15	12	0.12	5.4	0.05	5.6	0.06
Black-legged Kittiwake	2.4	0.02	32	0.32	8.1	0.08	30.8	0.31
Cormorant	--	--	+	+	--	--	--	--
Ducks	+	+	4	0.04	--	--	8.4	0.08
Red Phalarope	--	--	--	--	+	+	8.4	0.08
Other	10.4	0.10	28	0.28	10.8	0.11	36.4	0.36
TOTAL	80.0	0.80	400	4.00	270.0	2.70	280.0	2.80

* From Sanger (1972)

a/ Area sizes from Hood and Kelley (1974)

Table 4.--Feeding behavior of marine birds.

Name	Description of feeding behavior
Glaucous gull	dipping, surface seizing, plunging
Glaucous-winged gull	omnivorous, opportunistic, intertidal feeder, surface seizing, scavenger
Fork-tailed storm petrel	surface feeders, offshore-oceanic
Leach's storm petrel	surface feeders, offshore-oceanic
Ancient murrelet	pursuit diving, some bottom feeding, feeds >2-3 km from shore
Cassin's auklet	dives or picks food from surface
Rhinoceros auklet	dives
Tufted puffin	dives
Common and thick-billed murre	dives, most food taken from mid-depths to bottom ($\geq 40-60$ m)
Northern fulmar	surface feeder
Black-legged kittiwake	surface feeder, dipping, pattering, opportunistic
Red-legged kittiwake	surface feeder
Double-crested, pelagic & red-faced cormorants	inshore divers
Horned puffin	
Parakeet auklet	forage at depth, pursuit diving down to 50 m
Crested auklet	pursuit diving down to 50 m
Least auklet	feeds in nearshore waters, pursuit diving down to 50 m
Whiskered auklet	
Pigeon guillemot	diving in nearshore waters outside surf near bottom
Sooty shearwater	shallow divers no deeper than 5 m
Short-tailed shearwater	pursuit diving no deeper than 5 m
Arctic and aleutian terns	surface divers

Table 5.--Major food items and percent food composition by weight.

Name	Food items	Percent food composition
Glaucous gull	bird eggs, young birds, euphausiids	<u>Beaufort Sea</u> 49% fish 9% euphausiids 42% other
Glaucous-winged gull	crab, limpets, urchins, fish, bird eggs, young birds	
Fork-tailed storm petrel	small crustaceans, plankton, copepods, cephalopods, small fish	
Leach's storm petrel	zooplankton, copepods, cephalopods	<u>Oregon</u> 44% hydrozoa 38% euphausiids 9% other crustacea 1% squid 8% other fish
Ancient murrelet	small crustaceans, fish, Euphausia, Thysanoessa, sandlance, seaperch, cephalopods, osmerids, stichaeids, scorpaenids	
Cassin's auklet	planktonic crustaceans, copepods, amphipods, euphausiids, squid	
Rhinoceros auklet	small fish, crustaceans, sandlance	
Tufted puffin	small fish, cephalopods, crustacean, sandlance	62% fish (gadids, capelin) 9% amphipods
Common and thick-billed murre	gadids, bottomfish, squid, small fish, crustaceans, shrimp	72% fish 15% euphausiids 8% squid 5% other
Northern fulmar	Squid, crustaceans, small fish, copepods, polychaetes, jellyfish	
Black-legged kittiwake	small fish, crustaceans, other invertebrates, sandlance, Boreogadus	<u>Beaufort Sea</u> 91% fish 7% amphipods

Table 5. (cont'd)

Name	Food items	Percent food composition
Red-legged kittiwake	small fish (up to 75%), squid, amphipods	Pribilofs: mostly pollock and myctophids
Double-crested, pelagic & red-faced cormorants	fish	<u>Bering Sea</u> 65-100% fish 13-37% shrimp, crabs <u>Oregon</u> Summer Winter 30% small pel fish 6% 4% smelts 28% 20% scorpæinidae 28% 20% cottids 38% 26% other fish
Horned puffin	small fish, cephalopods, crustaceans, squid	73% fish (capelin 27% amphipods
Parakeet auklet	small crustaceans, amphipods, euphausiids, echinoderms, small fish	40-88% fish 12-60% amphipods, euphausiids
Crested auklet	Small planktonic crustaceans, cephalopods, copepods, amphipods, euphausiids, mysids, polychaetes	74% amphipods 26-100% euphausiids
Least auklet	plankton, amphipods, decapods, gastropods	
Pigeon guillemot	fish, molluscs, crustaceans, marine worms	
Sooty shearwater	copepods, cephalopods, euphausiids, fish	<u>Oregon</u> 80% small pel. fish 12% other fish 8% squid
Short-tailed shearwater	copepods, cephalopods, euphausiids, sandlance	up to 100% euphausiids
Arctic and aleutian terns	small fish, invertebrates	<u>Beaufort Sea</u> 18% mysids 21% amphipods 18% euphausiids 39% fish

From this information synthesis the mean weight, monthly numbers, and food composition of marine birds were derived for input to PROBUB. The data used as input are shown in Tables 6-14. The birds were lumped into 7 groups to economize on computer program size and computation time. At this time a consumption rate of 15% body weight daily for all birds is used.

Table 6.--Marine bird groups and mean weights used in PROBUB.

<u>Group</u>	<u>Group members</u>	<u>Mean weight (kg)</u>
Gulls	Glaucous gull, glaucous winged gull, black-legged kittiwake, red-legged kittiwake, arctic and aleutian terns.	0.5
Petrels	Fork-tailed and Leach's storm petrels.	0.05
Other alcids	Ancient murrelet, Cassin's auklet, rhinoceros auklet, tufted puffin, horned puffin, parakeet auklet, crested auklet, least auklet, whiskered auklet, pigeon guillemot.	0.4
Murres	Common and thick-billed murres.	0.9
Northern fulmar	--	0.634
Cormorants	Double-crested, pelagic, red-faced cormorants.	2.459
Shearwaters	Sooty and short-tailed shearwaters.	0.7

Table 7.--Number of gulls (in thousands) in PROBUB region.

Month	<u>Subregions</u>								
	1	2	3	4	5	6	7	8	9
Jan.	400	10	50	150	100	300	250	300	250
Feb.	400	10	50	150	100	300	250	300	250
Mar.	458	10	50	150	100	300	250	300	250
Apr.	458	20	150	120	80	450	150	450	150
May	458	25	300	115	80	450	150	450	150
Jun.	558	31	330	115	80	558	50	570	50
Jul.	558	31	330	115	80	558	50	570	50
Aug.	558	31	330	115	80	558	50	570	50
Sep.	458	25	300	120	80	450	150	450	150
Oct.	400	10	150	150	100	300	250	300	250
Nov.	400	10	50	150	100	300	250	300	250
Dec.	400	10	50	150	100	300	250	300	250

Table 9.--Number of other alcids (in thousands) in PROBUB regions.

Month	Subregions								
	1	2	3	4	5	6	7	8	9
Jan.	50	50	50	2,000	10	1,000	400	800	500
Feb.	100	100	50	2,000	10	1,000	400	800	500
Mar.	500	500	50	2,000	10	1,000	400	800	500
Apr.	1,000	1,000	200	1,900	50	1,000	400	1,000	500
May	1,200	1,200	400	1,800	100	600	200	1,200	300
Jun.	1,720	1,624	537	1,800	300	600	50	1,400	100
Jul.	1,720	1,624	537	1,800	300	600	10	1,400	50
Aug.	1,720	1,624	537	1,800	300	600	10	1,400	50
Sep.	1,200	1,200	400	1,900	100	600	10	1,200	50
Oct.	1,000	1,000	200	2,000	50	600	50	1,000	100
Nov.	500	500	50	2,000	10	1,000	200	800	300
Dec.	100	100	50	2,000	10	1,000	400	800	500

Table 10.--Number of murre (in thousands) in PROBUB regions.

Month	Subregions								
	1	2	3	4	5	6	7	8	9
Jan.	200	100	150	550	100	600	100	615	100
Feb.	200	100	150	550	100	600	100	615	100
Mar.	200	100	150	550	100	600	100	615	100
Apr.	500	300	250	400	50	550	10	500	10
May	1,000	500	800	200	25	400	10	350	10
Jun.	2,050	700	1,850	200	25	400	10	350	10
Jul.	2,050	700	1,850	200	25	400	10	350	10
Aug.	2,050	700	1,850	200	25	400	10	350	10
Sep.	2,050	700	1,850	200	25	400	10	350	10
Oct.	2,050	700	1,850	200	25	400	10	350	10
Nov.	2,000	700	1,850	550	100	350	50	300	50
Dec.	200	100	150	550	100	600	100	615	100

Table 11.--Number of fulmars (in thousands) in PROBUB regions.

Month	Subregions								
	1	2	3	4	5	6	7	8	9
Jan.	1					5	5	5	5
Feb.	1					10	10	10	10
Mar.	5	50	20	50	5	20	20	20	20
Apr.	6	100	40	100	6	40	40	40	40
May	8	300	60	300	8	80	70	80	70
Jun.	10	450	71	457	10	137	100	137	100
Jul.	10	450	71	457	10	137	100	137	100
Aug.	10	450	71	457	10	137	100	137	100
Sep.	8	300	60	300	8	80	70	80	70
Oct.	6	100	40	100	6	40	40	40	40
Nov.	5	50	20	50	5	20	20	20	20
Dec.	1					10	10	10	10

Table 12.--Number of cormorants (in thousands) in PROBUB regions.

Month	Subregions								
	1	2	3	4	5	6	7	8	9
Jan.	1	0.1	0.7	87.5		32.7		34	
Feb.	1	0.1	0.7	87.5		32.7		34	
Mar.	8	1.1	3.7	87.5		22.7		24	
Apr.	18	2.1	6.7	97.5		12.7		14	
May	28	3.1	7.7	107.5		12.7		14	
Jun.	28	3.1	7.7	107.5		12.7		14	
Jul.	28	3.1	7.7	107.5		12.7		14	
Aug.	28	3.1	7.7	107.5		12.7		14	
Sep.	18	2.1	6.7	97.5		22.7		24	
Oct.	8	1.1	3.7	87.5		32.7		34	
Nov.	1	0.1	0.7	87.5		32.7		34	
Dec.	1	0.1	0.7	87.5		32.7		34	

Table 14.--Food composition in percent biomass of food item of marine birds in PROBUB.

Group	Food item	Percent
Gulls	Pollock	25
	Herring	15
	Capelin	20
	Salmon	4
	Squid	8
	Crab	5
	Cod	3
	Euphausiids	10
	Epifauna	10
Petrels	Copepods	25
	Squid	15
	Herring	2
	Euphausiids	40
	Epifauna	12
Other alcids	Squid	10
	Capelin	35
	Copepods	12
	Euphausiids	15
	Rockfish	5
	Cottids	10
	Epifauna	13
Murre	Euphausiids	15
	Squid	8
	Pollock	35
	Cod	12
	Flatfish	25
	Shrimp	5
Fulmars	Squid	25
	Copepods	30
	Herring	15
	Capelin	30
Cormorants	Cottids	20
	Rockfish	20
	Herring	10
	Capelin	25
	Shrimp	10
	Crabs	15
Shearwaters	Squid	8
	Copepods	10
	Euphausiids	12
	Herring	10
	Capelin	60

2. SUMMARY OF CONSUMPTION BY MARINE BIRDS IN PROBUB

Table 15 summarizes the annual consumption by marine birds in the eastern Bering Sea (PROBUB areas 1-3) and the Aleutian region (PROBUB areas 4, 5) as computed by PROBUB. The total food consumed in a year by all marine birds in these areas is approximately 0.4 million tons. Sanger (1972) estimated annual consumption by marine birds in the total Subarctic Pacific region to be 0.6-1.2 million tons. Thus the PROBUB estimate appears reasonable though a little high when compared with Sanger's older data.

Table 15 also shows the amount consumed by each bird group. Consumption by shearwaters, murre, and other alcids accounted for 87.8% of all the food eaten by birds. Gulls, petrels, fulmars, and cormorants were minor consumers, accounting for the remaining 12.2%.

Table 15.--Annual consumption in tons by birds in the eastern Bering Sea and Aleutian Region as computed by PROBUB.

Species/groups of species consumed	24		25		26		27		28		29		30		Total Bering Sea	Total Aleutian Region
	Gull family Bering Sea	Aleutian Region	Petrels Bering Sea	Aleutian Region	Other alcids Bering Sea	Aleutian Region	Murres Bering Sea	Aleutian Region	Northern fulmar Bering Sea	Aleutian Region	Cormorants Bering Sea	Aleutian Region	Shearwaters Bering Sea	Aleutian Region		
Flatfishes	-	-	-	-	-	-	33,209	5,113	-	-	-	-	-	-	33,209	5,113
Cod and sablefish	532	181	-	-	-	-	15,892	2,454	-	-	-	-	-	-	16,424	2,635
Pollock	4,433	1,508	-	-	-	-	46,352	7,158	-	-	-	-	-	-	50,785	8,666
Pacific ocean perch	-	-	-	-	2,183	2,183	-	-	-	-	-	-	-	-	2,183	2,183
Herring	2,660	905	8	36	-	-	-	-	1,187	1,000	267	1,273	7,888	5,259	12,010	8,473
Salmon	709	241	-	-	-	-	-	-	-	-	-	-	-	-	709	241
Total commercial species	8,334	2,835	8	36	2,183	2,183	95,453	14,725	1,187	1,000	267	1,273	7,888	5,259	115,320	27,311
Other fish	3,546	1,206	24	109	19,659	19,647	-	-	2,375	2,000	1,203	5,726	47,288	31,525	74,095	60,213
Total finfish	11,880	3,041	32	145	21,842	21,830	95,453	14,725	3,562	3,000	1,470	6,999	55,176	36,784	189,415	86,524
Squids	1,418	482	61	272	4,367	4,048	10,757	1,636	1,978	1,666	-	-	6,305	4,203	24,886	12,307
Crabs and shrimps	887	302	-	-	-	-	6,622	1,023	-	-	626	3,064	-	-	8,135	4,389
Benthos	1,763	604	49	217	5,677	5,675	-	-	-	-	-	-	-	-	7,489	6,496
Zooplankton	1,773	603	263	1,177	11,791	11,786	19,865	3,070	2,373	1,999	-	-	17,339	11,559	53,404	30,194
Total food eaten per bird group	22,753		2,216		87,016		153,151		14,578		12,159		131,366		423,239	Grand total
% consumed of grand total	5.4		0.5		20.6		36.2		3.4		2.9		31.0			

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