I. SUMMARY OF OBJECTIVES, CONCLUSIONS, AND IMPLICATIONS WITH RESPECT TO OCS OIL AND GAS DEVELOPMENT

The main purpose of this study is to determine the actual size of seabird populations nesting on the Pribilof Islands.

St. George, the most important of these islands for birds, has about 48.1 km of cliffs all of which are used for nesting by 11 species. Seabird numbers on this island were considerably down in 1975 from the "millions" reported there in the past. The main least auklet colony held over 200,000 birds, the main murre cliffs appeared to hold over 400,000, and 10.6 km of the lower cliffs had about 40,000 breeding pairs of 11 species.

St. George now represents the principal nesting ground of the red-legged kittiwake in North America, much smaller numbers being found on nearby St. Paul Island. (Unknown numbers have been reported on the Komandorskie Islands.)

The principal threats to seabird populations on St. George posed by petroleum exploration will be (a) disturbance of the ledge-nesting species by people or aircraft if the island is used as a local or regional base of operations and (b) potential spillage at or near the birds' main feeding area (56°37'30"N, 169°11'W) a shallow area (about 2-5 fathoms) 13.7 km to the northeast.

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II. INTRODUCTION

A. General Nature and Scope of Study

No systematic census or population estimate of the seabirds of the Pribilofs has ever been attempted, although for almost a century ornithologists have reported their numbers as in the "millions." The project proposed here is to provide enumerational data on what supposedly is the largest aggregate of colonial birds anywhere in North America, as a baseline on which to estimate any subsequent effects and environmental impact of petroleum exploration and development on the birdlife of this part of the Bering Sea.

The information required to meet this objective will consist of (a) actual counts of cliff-nesting species in the main colonies on St. George and St. Paul islands and (b) estimates (with confidence limits) of the numbers of puffins and auklets that nest in burrows on St. George and St. Paul.

The population estimates of the burrowing species should be available by 30 September 1976, although the confidence limits on these cannot be predicted at this time. The enumeration of ledge-nesting species will depend on (a) our success in getting photos of the cliffs during the birds' nesting season and (b) the time required to analyze these photographs after they are developed. With presently available techniques, it will take some months to analyze these pictures. The project is actively exploring a new method to expedite this analysis.

B. Specific Objectives

The primary task of this study is to define a major biological population which is subject to potential impact by petroleum exploration and development in the Bering Sea. The particular objectives of the project are twofold:

(a) to obtain precise estimates, for as many species as is practical within the time framework of this study, of the breeding seabirds on the Pribilof Islands, and

(b) to explore the possibilities of obtaining refined estimates of those additional nesting populations that do not readily lend themselves to conventional census techniques.

C. Relevance to problems of petroleum development

Seabirds, because of their large numbers and high visibility, are valuable indicators of the health of a marine ecosystem. Because of their importance in the ecosystem, and their high vulnerability to oil, their numbers are a natural index to the effect of oil on the biology of the area. Birds will be among the first species to be affected by oil pollution, and the techniques to monitor their numbers are now being developed. A repeatable census technique or techniques for colony seabirds is essential to understanding the effects of oil and gas development on the outer continental shelf.

III. CURRENT STATE OF KNOWLEDGE

Ornithological investigations of the Pribilofs began in 1872 when Henry Elliot (1881) described "the vast numbers of water-fowl," their disappearance in winter, and the considerable taking of eggs by the Aleut people. As evidence of the latter, six men on 5 July 1872 at Walrus Island loaded a 4-ton-capacity boat "down to the water's edge"with murre eggs collected in less than three working hours. Elliott regarded least auklets as present by the "millions," but he also encountered thick-billed murres in "immense multitudes," the males circling St. George as "a dark girdle of birds more than a quarter of a mile broad and thirty miles long." Gabrielson reported that in his opinion "St. George Island, considered as a whole, contains the greatest aggregation of breeding birds" he has ever seen and that "the least auklets are the most numerous in the swarming millions of birds" (Gabrielson and Lincoln, 1959; 506).

IV. STUDY AREA

The study area comprises the islands of St. George, St. Paul, Otter, and Walrus. Colonies are found on all cliff areas around the islands, among talus slopes at the bases of cliffs, and among beach boulders. In the past, murres nested on the flat plateau on Walrus Id. In 1975, we concentrated our field work on the main avian concentrations, which are on St. George. Here about 48 km of cliffs offer immense opportunities for seabird nesting (Table 1). The major shallow area in the nearby sea has a depth of about 2-5 fathoms (3.7-9.2 m) extending over about 1 km by 0.5 km.

The weather on the Pribilofs during the breeding season is primarily fog and wind with almost constant rain early in the season.

V. SOURCES, METHODS, AND RATIONALE OF DATA COLLECTION

The seabirds nesting on the Pribilofs consist of six species that nest on cliff ledges

- Thick-billed murre, *Uria lomvia*
- Common murre, *U. aalge*
- Black-legged kittiwake, *Rissa tridactyla*
- Red-legged kittiwake, *R. brevirostris*
- Fulmar, *Fulmarus glacialis*
- Red-faced cormorant, *Phalacrocorax urile*

and five species that nest underground

- Parakeet auklet, *Cyclorrhynchus psittacula*
- Crested auklet, *Aethia cristatella*
- Least auklet, *A. pusilla*
- Horned puffin, *Fratercula corniculata*
- Tufted puffin, *Lunda cirrhata*

Table 1. Types of Cliffs on St. George Is.

Stratum		Cliff No.	Name of cliff	Exposure	Height (m)	Length (km)	
A	(40-100 ft)	[12.2-30.5 m]					
		1.	Village W	N	12.2	3.5	
		2.	Village E	N	12.2	1.5	
		3.	Zapadni Beach N	SW	12.2-24.4	0.55	
		4.	Tolstoi W (East Cliffs)	E	12.2-24.4	1.0	
		5.	Zapadni Bay So.	W	24.4	1.6	
		6.	Zapadni Bay to Maynard Pt.	SW	24.4	2.4	
			Total length				10.6
B	(100-200 ft)	[30.5-61 m]					
		7.	Maynard Pt. - Zap. Bay	SW	48.8	3.5	
		8.	Rush Pt.	SW	36.6	0.5	
		9.	N. Tolstoi to Pinacle Pt.	N	24.4-61	0.468	
		10.	Sealion Pt. (S. Tolstoi - Garden Cove)	SE	30.5-61	3.0	
			Total length				7.468
C	(200-300 ft)	[61-91.4 m]					
		11.	Pinnacle Pt. to 3 Boulders Pt.	NE	61	0.460	
		12.	Tolstoi Pt. (3 Boulders-So. Tolstoi)	E	61	1.8	
		13.	Red Bluffs — Zapadni Bay	SW	61-91.4	3.2	
			Total length				5.5
D	(300-400 ft)	[91.4-122 m]					
		14.	Garden Cove SW (Black Cliffs)	SE	61-122	2.5	
		15.	Cascade Pt. NE	SE	91.4	3.6	
		16.	Umanangula Bluffs	S	91.4	2.9	
		17.	Dalnoi Pt.--Samlalogh Ridge	N	97.5-140.2	5.3	
			Total length				14.3
E	(400-600 ft)	[122-182.9 m]					
		18.	Fox Castle W to Dalnoi	W	140.2-182.9	1.7	
		19.	Rush Pt. to Fox Castle	SW	182.9	2.0	
		20.	First Bluff	N	146.3	1.7	
			Total length				5.4
F	(600-1000 ft)	[182.9-308.5 m]					
		21.	High Bluffs	N	122-308.5	4.8	
			Total length				4.8
	Total length km						48.1

Ledge-nesting species.--The conventional method of counting cliff-nesting birds on island situations has been to photograph the birds from aircraft (Nettleship 1975). There has been some conjecture as to how to interpret these data, since under various conditions a pair may be represented by more than two birds. In censusing murres, the Canadian Wildlife Service tries to photograph murres before the nonbreeders arrive (late-June or early July in eastern Canada) and at the same date and hour each year (Nettleship, pers. comm.). In this approach, the Canadians assume each bird equals one pair. The bias in this assumption may be cancelled out in year-to-year comparisons, but the potential bias remains real in single-year data.

To understand this potential bias and to be able to correct for it, we explored ledge attendance by counting birds on a given series of ledges on different days and at different times of the day.

Photographs of the cliffs on St. George were carried out for us by the U. S. Fish and Wildlife Service in 1975, and 306 aerial photos were turned over to us by Dr. James C. Bartonek in December.

Burrow-nesting species.--The sampling scheme for censusing occupied burrows has been worked out by Bédard (1969) whose technique was to lay out quadrats 14.2 by 14.2 m, the observer stationing himself 40 or more meters away between 5 and 8 A.M. during the few days preceding laying (and coinciding with minimum daily attendance of immature birds in the colony and maximum activity of breeding birds on the surface of the slope). This involves making tallies every 30 minutes during the 3-hr. period on three successive days. This procedure further involves (1) ignoring the highest count in each series in order to correct for abnormal values resulting from disturbance and (2) averaging the 2nd-, 3rd-, and 4th-highest census figures for each quadrat.

Reference areas.--In order to provide future indices of population change on these islands, we selected

(1) small but well-described sections of the cliffs that could be recensused in the future; and
(2) observation points where major flights could be counted.

The location of 15 reference cliffs is shown in Figures 1-2, and their coordinates are given in Table 2.

Observation points are located in the same figures and their coordinates set forth in Table 3.

General.--The scientific party for this study consisted of the following from the University of Wisconsin: Joseph J. Hickey (Professor of Wildlife Ecology), F. Lance Craighead (research assistant), and Ronald C. Squibb (undergraduate field assistant). The party arrived on St. Paul on 14 June, was held up by fog, and reached St. George on 21 June. Hickey left on 14 July, Craighead on 8 August, and Squibb on 13 August.

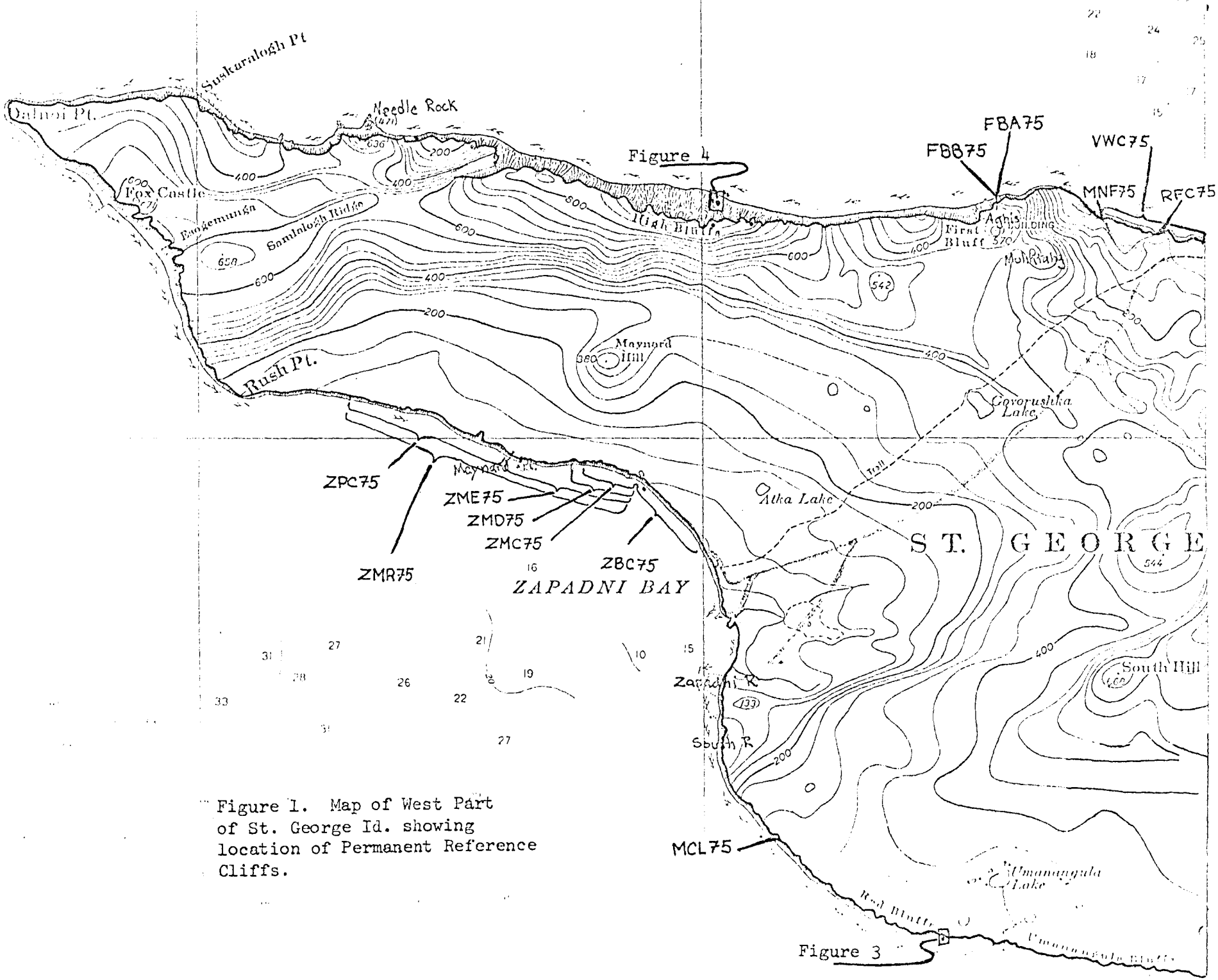

Figure 1. Map of West Part of St. George Id. showing location of Permanent Reference Cliffs.

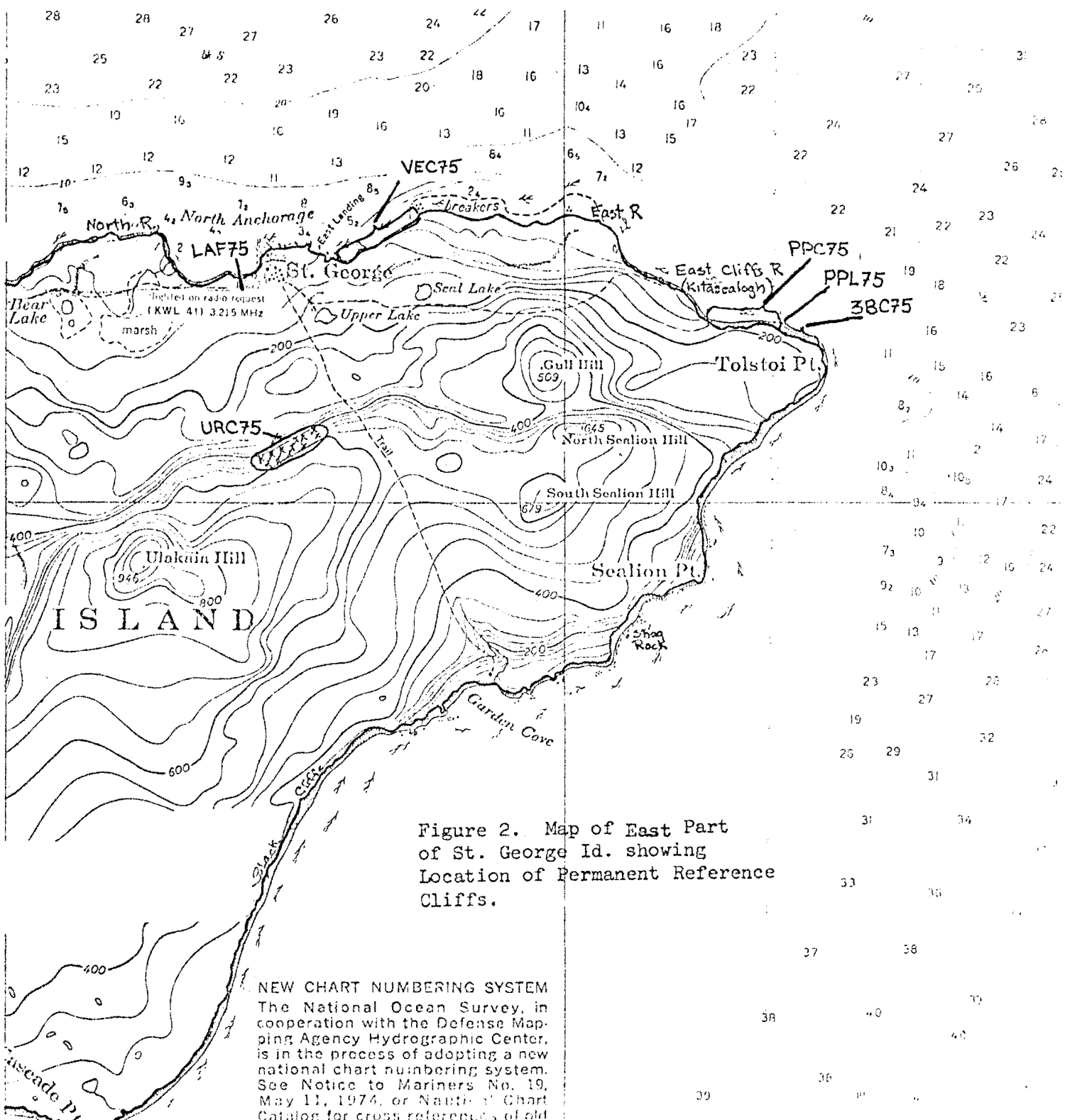

Figure 2. Map of East Part of St. George Id. showing Location of Permanent Reference Cliffs.

NEW CHART NUMBERING SYSTEM

The National Ocean Survey, in cooperation with the Defense Mapping Agency Hydrographic Center, is in the process of adopting a new national chart numbering system. See Notice to Mariners No. 19, May 11, 1974, or Nautical Chart Catalog for cross references of old

Table 2. Coordinates of Fifteen Reference Cliffs

Station No.	Island Stratum	Project No. Local Name	Coordinates
Entire Cliffs			
VWC75	A	No. 1 Village West	563612N to 563606N 1693601W 1693500W
VEC75	A	No. 2 Village East	563625N to 563610N 1693115W 1693155W
ZBC75	A	No. 3 Zapadni Beach N.	563420N to 563448N 1693958W 1694042W
	A	No. 6 Zapadni towards Rush Pt.	
ZMC75		(First 524 meters)	563448N to 563452N 1694042W 1694112W
ZMD75		(First 545 meters)	563448N to 563452N 1694042W 1694118W
ZME75		(First 1,346 meters)	563448N to 563454N 1694042W 1694200W
ZPC75		(Next 1,573 meters)	563454N to 563514N 1694200W 1694332W
ZMR75		(Total 2,919 meters)	563448N to 563514N 1694042W 1694332W
PPC75	B and C	No. 9 Kitasealogh to Pinnacle Point	563554N to 563552N 1692842W 1692802W
3BC75	C	No. 11 Pinnacle Point to 3 Boulders Point	563552N to 563548N 1692802W 1692742W
Partial Cliffs			
MCL75	A	No. 13 Murie Cove Ledges	563250N 1693913W
PPL75	C	No. 9 Pinnacle Point Ledges	563552N 1692802W
	E	No. 20 First Bluff Ledges	
FBA75		(area A)	563614N 1693710W
FBB75		(area B)	563614N 1693711W
		No. 1	
RFC75	A	Rosy Finch Cove Ledges	563609N

Table 3. Coordinates of Least Auklet colony and Flight-count observation points.

Station no.	local name	coordinates
Least Auklet Colony		
URC75	Ulakaia Ridge	563518N 1693230W
Flight Observations		
LAF75	Airstrip, Least Auklet Flights to Colony	563606N 1693300W
MNF75	Staraya Artel Observation Point, Murre Flights, East to West	563612N 1693554W

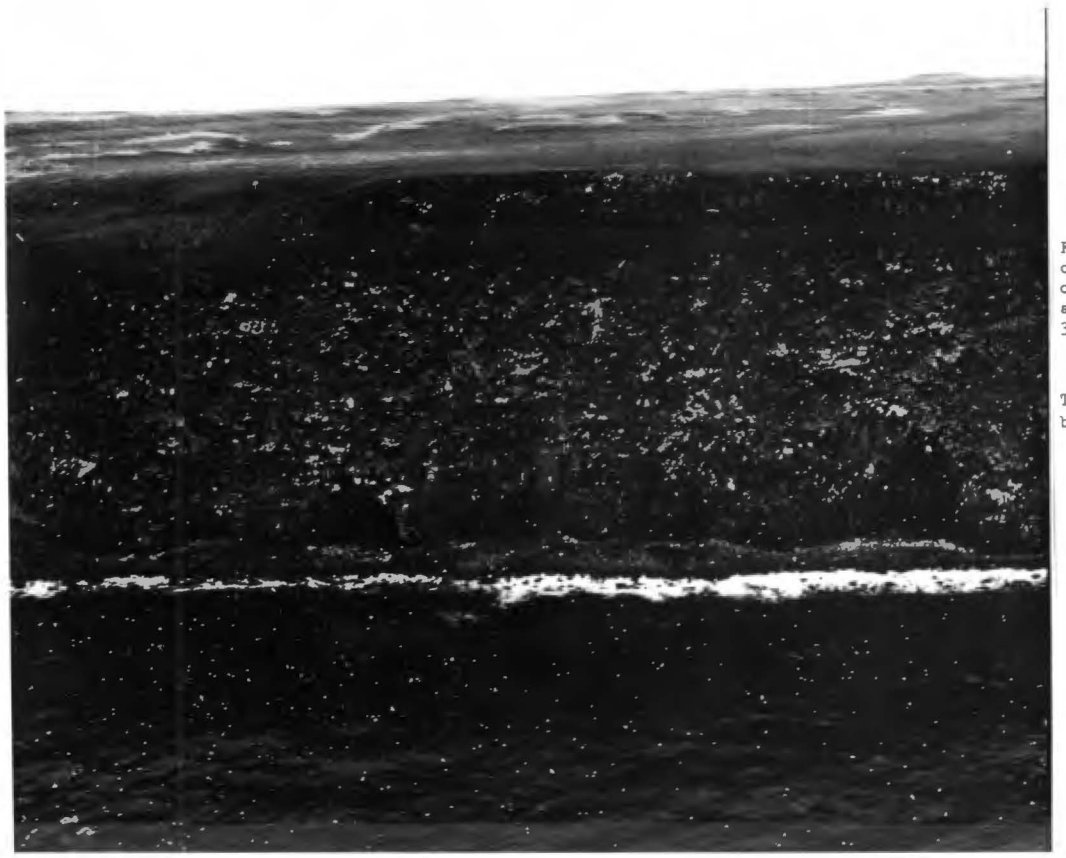

Figure 3. Cliff Section of Red Bluffs, SE coast of St. George Is. (shown also on figure 1) height 300 ft. (91.4 m).

This coastline is used by nesting:
- thick-billed murre
- common murre
- red legged kittiwake
- black legged kittiwake
- red faced cormorant
- fulmar
- tufted puffin
- horned puffin
- parakeet auklet
- least auklet
- crested auklet

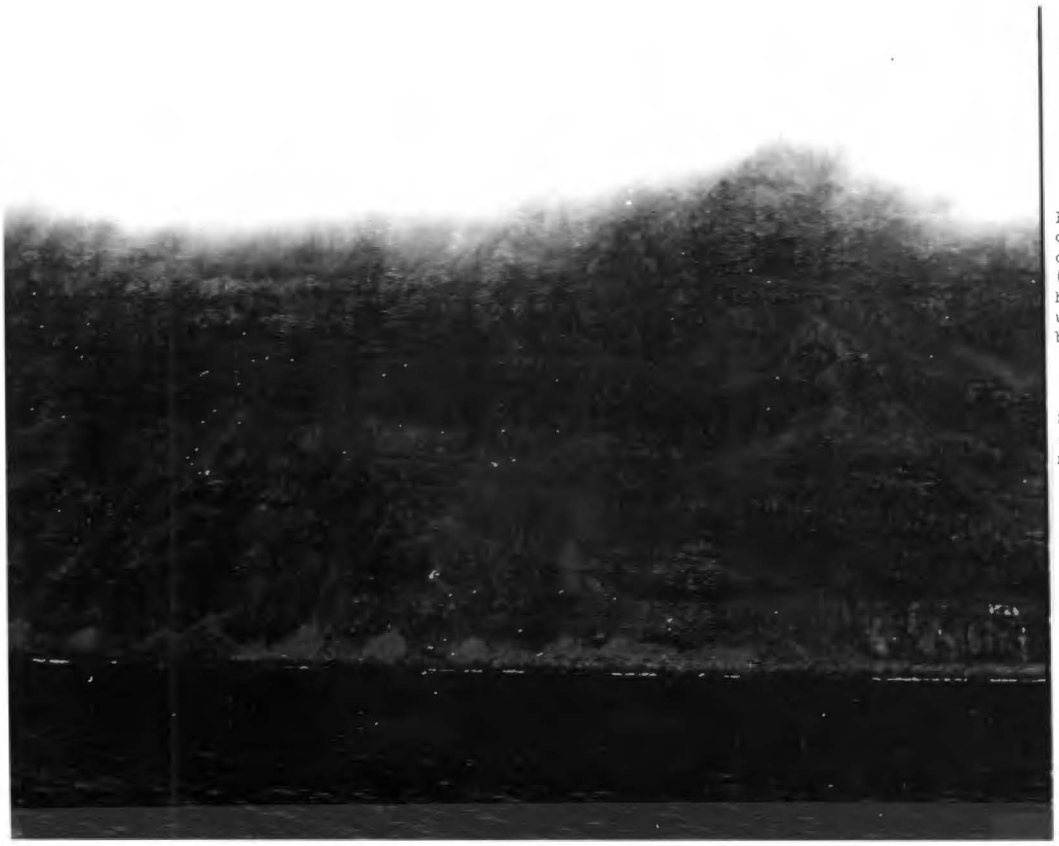

Figure 4. Cliff Section of High Bluffs, N. coast of St. George Island (shown also on Figure 1) height 900 ft. (274.3 m) upper 300 ft. obscured by fog.

Seen from land, this coastline is used by nesting:
- thick-billed murre
- red legged kittiwake
- black legged kittiwake
- red faced cormorant
- fulmar
- tufted puffin
- horned puffin
- parakeet auklet

VI. RESULTS

Aerial Photographs.--A photographic survey of the cliff-nesting birds on St. George was run by the U. S. Fish and Wildlife Service on 1 August 1975, a relatively clear day on the island. The resulting 306 positive prints were turned over to us in December by Dr. James G. Bartonek of USFWS. Two examples of these prints are illustrated in Figures 3 and 4.

Quadrat Counts.--No progress was made in laying these out. A number of the talus slopes, including part of the great Ulakaia Ridge (famed for its nesting colony of least auklets) were covered with snow throughout June and July. Field work on St. George did not begin until 22 June when nonbreeding birds appeared to be everywhere present on least auklet nesting sites.

Reference Cliffs and Reference Ledges.--Fifteen cliff study areas were laid out (Table 2) and subjected to repeated censuses. In reporting on these reference cliffs, we have used a series of symbols (Table 4) in order to tighten up the tables of data that follow. The actual observations on entire cliff sections are set forth in Tables 5-9; those on partial cliffs are given in Tables 10-13.

Flight Observations.--A virtually complete count of the flight of least auklets from the sea in to the famed colony on Ulakaia Ridge was obtained on 1 July (Table 14), and additional data on evening flights were secured on 22 June and 17 July (Table 15). For roughly comparable evening periods, the successive totals were

22 June	38,357
1 July	50,940
17 July	33,130

Counts of the murre flights along the north shore of St. George were carried out for brief periods on 25 June, 30 June, and 1 July (Table 16) by two men and then by a single observer on 3-6 July (Table 17).

Table 4. Symbols Used in This Report

BK	Black-legged kittiwake	PA	Parakeet auklet
CA	Crested auklet	pr N	Pair observed on nest
CM	Common murre	RC	Red-faced cormorant
F	Fulmar	RK	Red-legged kittiwake
H	Height of cliff (in m)	s N	Single bird on nest
hole	crevice- or hole-nesting bird observed in front of crevice or hole	sec	Section measured
HP	Horned puffin	sit	Sitting bird
K	Kittiwake (species not distinguished)	std	Standing
L	Length of section (m)	TM	Thick-billed murre
LA	Least auklet	tot	Total
M	Murre (species not distinguished)	TP	Tufted puffin
N	Nest	W	Width of beach

Throughout the tables, a dash indicates that no counts were attempted. Numerical observations are handled as follows:

479 no. of birds observed

(53) no. of nests observed

[47] no. of birds presumed brooding or incubating

When three such numbers are used, as for kittiwakes, the first number is always the total and includes the other two.

Station VWC75

Table 5. Census Data--Stratum A
Cliff No. 1
Village West--Cumulative Data
From Staraya Artil Pond to North Rookery
Length--1.2 km, by tape

Date	Time	TM	CM	RK	BK	F	HP	TP	PA	CA	LA	RC
27 July	0930-1000	300	4	55 (16) [14]	15 (9) [6]	0	2	0	34	0	35	(7)
	-1030	415	36	96 (54) [39]	24 (10) [4]	0	0	0	12	0	10	(14)
	-1100	176	0	40 (7) [4]	69 (42) [26]	(11)	1	0	16	0	24	0
	-1130	196	65	32 (13) [4]	63 (30) [27]	(33)	3	0	19	1	21	0
	-1200	136	4	67 (9) [9]	187 (112) [78]	(42)	3	0	22	1	59	(1)
Total[a/]	0930-1200	1223	109	290 (99)[b/] [70]	358 (203) [141]	(86)	9	0	103	2	149	(22)
8 August	1300-1330	308	19	191 (13) [13]	44 (7) [6]	0	7	1	80	1	9	(7)
	-1400	450	19	68 (40) [36]	34 (21) [8]	0	7	0	73	0	2	(14)
	-1430	140	0	86 (4) [4]	81 (42) [32]	(22)	1	0	8	0	3	0
	-1500	272	209	113 (13) [5]	138 (76) [52]	(41)	2	0	70	1	0	0
	-1530	177	7	208 (5) [5]	172 (80) [45]	(42)	7	4	34	0	1	(1)
Total[a/]	1300-1530	1347	254	666 (75) [63]	469 (226) [143]	(105)	24	5	265	2	15	(22)

a/ Total birds of all species: 27 July--2,351; 8 August--3,174. When only nests are counted for kittiwakes, the totals are 2,005 and 2,340 respectively.

b/ This included the start of nests; on 8 August such started nests were not counted.

Station VEC75

Table 6. Census Data--Stratum A

Cliff No. 2

Village East Cliffs--Cumulative Data

Length--1,073 km, by tape

Date	Time	L	H	W	TM	CM	BK	RK	P	RC	PA	CA	LA	TP	HP
5 July	Sec. A. (W. end to "Pahoehoe Pt") - counted from cliff top														
	1410-50	-	-	-	500	64	22(1)	22(4)	(4)	-	-	-	-	-	-
11 July [a]	Sec. B. ("Pahoehoe Pt" to E. end) - counted from beach														
	1723-1824	-	-	-	1,559	96	164(110)	65(32)	(59)	13(3)	-	-	-	7	23
20 July	entire cliff counted from beach with exception of E. extreme														
sea 0-1;	1400-30	273 m	-	-	454	23	110(53)[38]	34(6)[5]	(13)	6(3)	96	11	63	8	13
light fog;	-1500	180 m	-	-	686	14	87(46)[31]	35(14)[12]	(49)	1	72	4	19	5	7
counted from	-1530	190 m	23 m	17 m	57	0	3(1)[1]	2 0		2	15	2	1	0	2
W. end to	-1600	290 m	10 m	22 m	294	25	22(11)[8]	33(12)[7]	(12)	0	0	0	0	0	0
E. end.	-1630	140 m	-	-	47	0	22(2)[2]	81 (8) [4]	(8)	0	0	0	0	0	0
Total [a]	1400-1630	1,073 m			1,538	62	244(113)[80]	185(40)[28]	(82)	9(3)	183	17	83	13	22

[a] Total birds of all species were 2,156 on 11 July and 2,438 on 20 July. When only nests are used for kittiwakes and cormorants, these totals become 1,889 and 2,156 respectively.

Station No. ZBC75 Table 7. Census Data--Stratum A

Cliff No. 3

Zapadni Beach North--Cumulative Data [a]

Includes cliffs above beach from beginning of cliffs north to headland where beach ends and boulders begin. Length--0.55 km, by tape.

Date	Time	TM	CM	BK	RK	F	HP	TP	PA	CA	LA	RC	
25 June	958-1045	M:	931	K: 83		11	22	4	—	—	—	—	1,051
27 June	1110-1130	M:	283	K: 62		7	12	2	110	4	540	1	1,021
	1135-1155	M:	224	K: 68		6	10	1	115	0	370	0	794
8 July	1235-1355	569	13	43(37)	35(14)	5(5)	0	0	115	14	855	3	1,652
16 July	1535-1620	760	13	77(35) [18]	139(19) [16]	17(9)	0	2	23	0	23	5	1,036
6 August	1030-1105	542 [9]	17	73(24) [13]	96(16) [16]	15(10)	14	5	25	1	12	6	806
10 August	0930-1007	836 [58]	7	—	—	8(6)	21	4	112	0	6	17	1,124
	1014-34	—	—	48(24) [15]	65(3) [1]	—	—	—	—	—	—	—	
Mean of 2nd-, 3rd-, and 4th- highest counts of birds		624	11	55	65	9	16	3	112	2	311	5	1,613
Same for nests				28	11	7							46

[a] This cliff had extensive snow drifts covering many of its talus slopes right into August. The auklets were quite often seen on these snow banks, and most of them undoubtedly were nonbreeding birds.

Station ZMR75

Table 8. Census Data--Stratum A

Cliff No. 6

Zapadni Bay to Maynard Point and beyond

Total distance 2.919 km, by tape

Date	Time	L	N	W	TM	CH	BK	BK-W	RK	RKH	F(N)	RC	PA	CA	LA	PP	EP
Partial Count (524 m)			Station No. ZMC75														
6 July	0940-1005	55	30 m		43	0	27	(17)	5	(2)	(1)	0	8	0	110	0	5
	-1030	45	29		68	0	16	(7)	0	0	0	1	6	0	40	0	3
	-1047	40	25		29	0	15	(11)	0	0	0	0	15	0	45	0	
	-1130	110	20		144	0	22	(15)	11	(4)	(1)	1	13	0	75	1	7
	-1150	48	23		89	0	22	(16)	2	(2)	(5)	0	7	0	10	0	1
	-1200	60	19		142	2	4	(2)	2	(0)	(2)	0	15	0	70	0	3
	-1300	127	23		262	8	33	(22)	2	(1)	(5)	0	28	0	280	0	6
	-1327	39	19		126	17	7	(2)	0	0	0	0	12	0	60	0	4
Total	0940-1327	524	23.5		903	27	146	(92)	22	(9)	(14)	2	104	0	690	1	29
Partial Count (545 m)			Station No. ZMD75														
21 July	0845-0950	545			1035	52	124	(86)	3	(2)	(61)	2	39	0	140	1	17
Complete Count Part A (first 1,346 m)[a/]			Station No. ZME75														
21 July	0645-0930				827	15	109	(76)	3	(2)	(61)	2	22	0	100	1	13
	-1000	1,110			354	37	62	(39)	0	0	(13)	1	35	0	110	0	25
	-1030				384	0	33	(20)	0	0	(17)	0	41	1	260	0	15
	1045-1120	236	21 m	23 m	725	54	65	(36)	62	(37)	(140)	0	113	15	210	7	32
Subtotal	0845-1120	1,346m			2,290	106	269	(171)	65	(39)	(231)	3	211	16	680	8	85

Table continued on next page

Table 8 continued

Part b (next 1.573 m)

Date	Time	L	H	W	TM	CM	BK	BK-N	RK	RKN	F(N)	RC	PA	CA	LA	TP	HP
25 July	1045-1100	166	15.5 m	22 m	522	0	5	(4)[1]	7	(4)[2]	(23)	2	49	0	15	1	10
	-1130	148	17	22	770	32	86	(56([38]	99	(50)[32]	(32)	0	40	4	40	0	22
	-1200	162	17	21	528	108	64	(48)[28]	19	(7)[5]	0	0	29	0	170	0	14
	1230-1300	148	18	19	756	41	27	(17)[12]	6	(1)[0]	0	0	37	1	160	0	12
	-1330	229	20	18	886	72	7	(5)[4]	0	0 0	(41)	0	65	3	270	5	34
	-1400	140	21	18.5	716	12	96	(40)[34]	43	(18)[24]	(66)	1	42	0	105	0	25
	-1430	113	18.5	17	670	0	53	(24)[17]	1	(0)[0]	(34)	0	40	0	50	1	13
	-1500	170	22	12	391	148	74	(40)[32]	0	0 0	(25)	1	54	2	50	0	32
	-1530	157	21	12	1,111	17	110	(72)[48]	21	(6)[4]	(57)	7(5)	22	0	30	0	13
	-1600	140	24	9	1,388	8	12	(6)[6]	92	(39)[34]	(91)	1	18	0	20	0	17
Subtotal 1045-1600 Station No. ZPC75		1,573	-	-	7,738	438	534(312)[220]		288(125)[101]		(369)	12(5)	396	10	910	7	192
Total b/ - For 21 and 25 July Station No. ZMR75		2,919	-	-	10,028	544	803(483)[110]		353(164)[101]		(600)	15(5)	607	26	1,590	15	277

a/ Includes 545-m area above.

b/ The total birds for all species was 14,858; when only nests are included for kittiwakes and cormorants, this drops to 14,349.

Station Numbers PPC75
3BC75

Table 9. Census Data--Strata B and C

Cliffs No. 9 and 11

Total length 0.468 and 0.460 km, by tape

Date	Time	L	H	M	BK BK-N	RK RK-N	F(N)	RC	PA	CA	LA	TP	EP
28 June Wind 7 knots SW	Cliff No. 9: from "trail down" (Kitasealogh to Pinnacle Pt.												
	1255-1420	468 m	59 m	783	K: 572	KN:(342)	-	111(82)	-	-	-	-	2
	Cliff No. 11 from "Pinnacle Pt." to "3 Boulders Pt."												
	1520-1750	460 m	61 m	4,382	K: 869	KN:(459)	-	35(20)	-	-	-	-	-
24 July light fog	Cliff No. 9: from "trail down" (Kitasealogh) to Pinnacle Pt.												
	1040-1205			1,093	556(310)	163(117)	14	(90)	49	11	250	-	9

Station No. MCL75 Table 10

Ledge Attendance Counts: Thick-billed Murres
Place: Murle Cove (Cliff divided into two groups of ledges: Upper and Lower).
Birds classified as sitting or standing. No common murres observed.

Date	Upper				Lower				Total (both)
	Time	Sit	Stnd.	Tot.	Time	Sit	Stnd.	Tot	
10 July	1000-15	approx.		125	1000-15	approx.		75	200
14 July	1050-1100	46	99	145	1103-10	20	74	94	239
	1130-40	55	83	138	1130-40	13	80	93	231
	1205-10	51	91	142	1205-10	24	70	94	236
16 July	930-35	64	136	200 a/	925-28	18	128	146	346
	949-1000	43	148	191 a/	945-47	20	104	124	315
	1005-10	55	152	207	1000-04	20	105	125	332
	1019-24	48	149	197	1015-18	14	114	128	325
	1032-36	61	134	195	1030-32	17	114	131	326
	1047-51	65	132	197	1045-46	21	107	128	325
	1103-08	63	126	189	1100-02	16	114	130	319
	1117-22	66	121	187	1115-17	15	104	119	306
	1134-38	64	132	196	1131-33	20	100	120	316
	1148-54	76	128	204	1145-47	24	86	110	314
18 July	1403-09	65	126	191	1400-02	21	99	120	311
	17-22	63	123	186	15-17	23	105	128	314
cloudy,	33-38	69	115	184	30-33	31	102	133	317
vis. fair	48-53	67	123	190	45-47	38	101	139	329
	1504-09	93	107	200	1500-02	27	102	129	329
	18-23	71	127	198	15-17	28	107	135	333
	33-38	76	120	196	30-32	33	106	139	335
	47-52	78	123	201	45-47	30	111	141	342
	1604-08	65	141	206	1600-03	37	106	143	349
	17-22	73	143	216	15-17	29	111	140	356
	34-38	72	145	217	30-33	16	129	145	362
	48-53	67	148	215	45-47	24	120	144	359
	1703-08	64	149	213	1700-03	26	97	123	336
	18-22	68	143	211	15-17	29	98	127	338
	35-40	62	117	179	30-35	19	116	135	314
	48-53	62	121	183	45-48	18	118	136	319
20 July b/	455-50	32	74	106	500-05	6	83	89	195
	515-20	54	81	135	20-24	10	91	101	236
cloudy,	33-37	57	76	133	30-33	11	91	102	235
fog,	48-53	64	69	133	45-47	16	85	101	234
drizzle	603-05	76	55	131	600-03	20	84	104	235
entire period	19-23	66	63	129	15-18	19	87	106	235
	33-38	58	79	137	30-32	13	95	108	245

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Date	Upper				Lower				Total (both)
	time	sit	stn	tot	time	sit	stn	tot	
26 July	645-53	65	60	125	45-48	22	87	109	234
	703-07	65	63	128	700-03	16	82	98	226
	18-21	66	64	130	15-18	11	81	92	222
	33-37	65	61	126	30-33	19	76	95	221
	48-51	69	65	134	45-48	18	74	92	226
	803-06	66	65	131	800-03	16	75	91	222
	18-22	72	57	129	15-18	14	84	98	227
	33-36	63	64	127	30-33	19	78	97	224
	48-51	70	58	128	45-48	22	77	99	227
	903-06	63	69	132	900-03	23	72	95	227
	18-22	67	54	121	15-18	16	79	95	216
	33-36	73	50	123	30-33	23	68	91	214
	48-51	63	63	126	45-48	20	70	90	216
	1003-07	61	61	122	1000-03	21	65	86	208
	18-23	68	59	127	15-18	22	60	82	209
	1034-38	64	68	132	1030-33	17	59	76	208
	48-54	64	68	132	45-48	18	65	83	215
	1103-08	68	64	132	1100-03	19	64	83	215
23 July	1740-45	36	172	208	1745-50	10	142	152	360
	1750-55	36	148	184	1755-1800	8	140	148	332
27 July	1815-20	40	140	180	1820-21	4	113	117	297
	30-34	43	133	176	35-37	5	110	115	291
sea 2	45-48	33	147	180	49-50	10	109	119	299
high ceiling	1900-04	46	131	177	1904-05	16	99	115	292
vis:good	15-20	45	120	165	20-21	12	101	113	278
	30-35	53	110	163	35-36	9	98	107	270
	45-48	43	104	147	49-50	9	92	101	248
	2000-05	43	98	141	2005-06	6	94	100	241
	15-18	44	97	141	18-19	10	89	99	240
	30-34	50	64	114	34-35	10	74	84	198
	45-48	40	55	95	48-49	10	57	67	162
31 July	1534-39	50	158	208	1530-34	19	125	144	352
	48-52	64	147	211	45-47	30	119	149	360
sea 0-1	1605-08	69	145	214	1600-03	34	120	154	368
vis:v. good	19-23	67	154	221	15-18	23	131	154	375
	35-37	67	149	216	30-32	34	120	154	370
	48-52	56	158	214	45-47	35	118	153	367
	1705-08	71	145	216	1700-04	35	114	149	365
	18-21	63	156	219	15-18	33	120	153	372
	34-38	59	159	218	30-33	25	133	158	376
	49-53	61	153	214	45-48	20	139	159	373
	1804-08	72	139	211	1800-03	23	131	154	365
	18-22	55	134c/189		15-17	31	119	150	339
	34-37	52	131	183	30-33	25	111	136	319
	48-52	55	132	187	45-48	27	109	136	323
	1904-06	53	113	166	1900-04	21	119	140	306

continued on next page

Table 10 (cont.)

Date	Upper				Lower				Total (both)
	time	sit	stn	tot	time	sit	stn	tot	
31 July	19-22	50	113	163	15-18	22	105	127	290
	34-38	52	105	157	30-32	22	102	124	281
	49-53	43	107	150	45-48	23	88	111	261
	2004-08	47	99	146	2000-03	22	87	109	255
	18-22	46	91	137	15-18	25	79	104	241
	33-39	50	74	124	30-32	16	74	90	214
	48-51	45	55	100	45-47	13	57	70	170
	2103-08	54	27	81	2100-03	16	37	53	134
9 Aug.	1049-55	31	137	168	1045-48	23	101	124	292
	1103-06	35	130	165	1100-02	23	94	117	282
wind lt. from N. good vis.	17-21	35	120	155	15-17	22	92	114	269

a/ Shrouding fog.

b/ Cloudy, fog, drizzle entire period.

c/ Fox intrusion (compensated by adding flushed TM to "stn." col.)

Station No. PPL75

Table 11.

Ledge Attendance Counts: Kittiwakes, Murres and Cormorants with Supplementary Observations on Parakeet and Least Auklets.

Pinnacle Pt. Study Area (Part of Cliff No. 2)

Width: 50 m(68-18 m E. of Pinn. Pt.); ht: 15-16 m

		RK					BK					K	TM			RC		PA	LA
Date	Time	pr N	sN	Loose	Tot. N	Tot. indiv.	prN	sN	Loose	Tot. N	Tot. indiv.		Sit.	Stand	Tot.	at N	loose	No.	No.
9 July	1380-1410	11	70	22	(81)	114	1	38	10	(39)	50	3	85	70	155	12	7	10	11
"	1516-1550	10	66	21	(76)	107	5	33	16	(38)	59	3(3)	70	97	167 b/	12	6	8	4
11 July	1000-1023	9	54	22	(63)	94	5	34	9	(39)	53	(7) a/	76	28	104	12	4	3	-
14 July	1630-1710	-	-	-	(64)	101	-	-	-	(30)	48	9(8)	60	75	135	-	-	6	-
"	1705- 35	7	55	24	(62)	93	3	26	16	(29)	48	6(6)	67	66	133	12	20	5	-
"	1805- 20	8	71	16	(79)	103	7	25	11	(32)	50	8(7)	83	68	151	12	22	1	-
15 July	1000- 30	18	59	33	(77)	128	2	30	18	(38)	64	-	81	71	152 b/	14	16	1	-
"	1100- 30	14	61	30	(75)	119	4	33	21	(37)	62	-	67	59	126	-	-	-	-
"	1130- 50	11	65	22	(76)	109	6	37	15	(43)	64	-	78	65	143	12	15	2	3
"	1230-1300	13	64	34	(77)	124	7	28	18	(35)	60	-	63	73	136	12	13	6	3
"	1305-1320	11	68	36	(79)	126	6	33	12	(39)	57	3	72	61	133	12	13	2	3
22 July	0500- 30	-	41	0	(80) a/	41	-	24	1	(43) a/	25	-	36	113	149	-	-	-	-
"	0530- 50	-	42	-	(73) a/	42	-	23	-	(36)	23	-	91	78	169	-	8	-	-
"	0600- 17	-	39	-	(80) a/	39	-	26	-	(43)	26	-	69	82	151 c/	-	8	-	-
"	0630- 45	-	53	-	(72)	53	1	27	1	(39)	30	-	72	35	107 b/	-	6	-	-
"	0700- 15	-	60	5	(81)	-	-	-	-	-	-	-	69	35	104 b/	-	7	-	-

Table continued on next page

Table 11 continued.

Date	Time	RK pr N	RK sN	RK loose	RK Tot. N	RK Tot. indiv.	BK pr N	BK sN	BK loose	BK Tot. N	BK Tot. indiv.	A	TM Sit.	TM Stand	TM Tot.	RC at N	RC loose	PA No.	LA No.
24 July	0935-1004	9	66	31	(76)a/	115	1	33	18	(35)	53	-	57	82	139b/	-	?	-	-
"	1030- 38	4	42	61	(46)d/	111	4	24	22	(29)d/	54	-	69	25	94	-	13	-	-
29 July	0930- 52	-	37	55	-	92	-	27	21	-	48	-	57	87	144	11	11	-	-
"	1000- 25	2	42	68	-	114	1	23	25	-	50	-	66	92	158	-	13	-	-
"	1030-1100	3	37	62	-	105	-	23	31	-	54	-	64	100	164	-	12	-	-
"	1100- 25	3	40	67	-	113	1	24	32	-	58	-	71	92	163	-	9	-	-
10 August	1930-2015	brood/sit[35] chicks seen: 2 1	37	65e/	(38)d/	104	brood/sit[18] chicks seen: 8 1	22	40f/	(23)d/	64	-	54	82	136 [11]	1	14 (10) g/	-	-

a/ Nest unoccupied

b/ Plus 1 common murre

c/ Plus 2 common murres

d/ Only completed nests counted; all others in the first 17 lines above defined as any nest site under construction

e/ Includes 56 adults at 45 incomplete nests

f/ Includes 24 adults on 17 incomplete nests

g/ the 10 nests had 21 chicks

Station No. FBA75

Table 12

Ledge Attendance Counts: Kittiwakes and Murres

Place: First Bluff--Center Study Area

Subsection A (face nearer observation pt.)

		RK					BK					K			TM		
date	time	pr N	sN	loose	tot. n	tot. indiv	pr N	sN	loose	tot. n	tot. indiv.	pr N	sN	tot. indiv	sit.	stn	tot. TM
10 July	1514-20	4	43	11	(47)	62	1	15	0	16	17	1	7	9	29	92	121
10 July	1600-16	9	27	10	(36)	55	1	12	0	13	14	3	9	17	43	107	150
12 July	1642-1703	5	24	14	(29)	48	2	15	2	17	21	1	13	15	28	97	125
"	1904-23	10	23	14	(33)	57	0	11	5	11	16	0	15	17	42	89	131
23 July	1115-31	6	49	17	(55)	78	-	13	-	13	13	-	-	-	28	56	84
"	1202-07	7	49	19	(56)	82	-	13	-	13	13	-	-	-	37	38	75
"	1230-40	5	43	20	(50)a/	73	-	12	3	12	15	-	-	-	52	38	90
"	1300-00	6	39	19	(47)a/	70	-	8	5	8	13	-	-	-	48	41	89
"	1330-37		time	spent		mapping	K	nests	-	—	-	-	-	-	40	50	90
"	1400-06	-	-	-	-	-	-	-	-	-	-	-	-	-	52	48	100
"	1430-35	-	-	-	-	-	-	-	-	-	-	-	-	-	61	51	112
"	1500-10	5	43	18	(48)	71	3	11	3	14	20	-	-	-	58	60	118
"	1530-42	4	44	19	(48)	71	1	13	3	14	18	-	-	-	69	58	127
27 July	1755-1812	5	38[31]	20	(43)	68	1	11[8]	3	12	16	-	-	-	51	61	112
"	1845-53	5	41	21	(46)a/	72	1	11	5	12	18	-	-	-	51	60	111
"	1915-26	4	40	16	(44)	64	1	11	4	12	17	-	-	-	58	49	107
"	1944-52	3	42	18	(45)	66	1	12	2	13	16	-	-	-	52	50	102
"	2005-10	1	42	14	(43)	58	1	12	4	13	18	-	-	-	57	42	99
"	2022-29	1	46	13	(47)	61	1	12	3	13	17	-	-	-	49	48	97
29 July	1500-20		44[46]	7	(48)a/	51		12[12]	3	13b/	15	-	-	-	47c/	25	72
very strong wind	1540-47		42	8	(47)b/	50		12	5	13b/	17	-	-	-	56c/	22	78
"	1612-20		43[41]	8	(47)	51		13[12]	4	13	17	-	-	-	65c/	17	82
"	1642-47		42[40]	9	(46)a/	55		13[12]	4	13	17	-	-	-	66c/	28	94
"	1710-17		44[41]	8	(47)b/	52	1	12[12]	2	13	16	-	-	-	51c/	37	88
"	1730-37		41[39]	11	(47)b/	52	1	12[12]	2	13	16	-	-	-	60	39	99

Table 12 (Cont.)

Subsection A (face nearer observation pt.)

date	time	RK pN	RK sN	RK loose	RK tot. N	RK tot. indiv.	RK sitting	RK Nw/ chicks	BK pN	BK sN	BK loose	BK tot. N	BK tot. indiv.	BK sitting	BK Nw/ chicks	TM sit.	TM stn	TM tot.	TM brooding chick se
30 July	0930	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	61	90	-
"	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	54	95	-
"	1000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	54	93	-
"	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	54	97	-
"	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	48	91	-
"	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	64	104	-
"	1100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	68	105	-
"	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	69	104	-
	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	54	100	
6 August	1400-13	3	44	13	(48)d/	63	-	-	-	13	4	(13)	17	-	-	32	50	82	-
"	15-25	2	44	18	(48)d/	66	-	-	-	12	3	(13)d/	15	-	-	30	58	88	-
"	30-36	2	43	20	(48)d/	67	-	-	-	13	2	(13)	15	-	-	42	52	94	-
"	50-55	4	41	12	(48)d/	61	-	-	-	13	4	(13)	17	-	1	29	63	92	-
"	1500-06	3	42	16	(47)d/	64	-	-	-	13	5	(13)	18	-	-	40	53	93	-
"	15-21	2	45	14	(48)d/	63	-	-	-	13	5	(13)	18	-	-	39	56	95	4
"	30-38	3	42	-	(47)d/	48	-	-	1	12	5	(13)	19	-	-	41	56	97	-
"	45-50	3	42	18	(47)d/	66	-	-	-	-	-	-	-	-	-	55	53	108	-
8 August	0615-25	-	38	5	(47)d/	43	[25]	-	-	11	1	(12)	12	[9]	3	31	67	98	-
"	0630-40	-	38	5	(47)	43	-	-	-	11	1	(12)	12	-	-	35	61	96	3
"	0645-50	-	39	5	(47)	44	[24]	-	-	11	1	(12)	12	[7]	-	35	56	91	-
"	700-06	-	39	3	(47)	42	[20]	-	-	10	-	(12)	10	[8]	-	28	63	91	-
"	0715-24	1	38	6	(47)	46	[26]	-	1	10	-	(12)	12	[6]	-	36	60	96	-
"	0730-40	1	37	8	(46)e/	47	[24]	-	-	12	-	(13)e/	12	[6]	-	38	58	96	3
"	0745-52	2	39	10	(46)e/	53	[27]	-	-	12	4	(13)e/	16	[8]	-	38	54	92	-
"	0800-07	2	39	15	(47)	58	[29]	-	-	11	4	(12)	15	[5]	-	37	55	92	4
"	0815-24	4	39	15	(47)	62	[27]	-	1	10	2	(12)	14	[5]	-	36	57	93	6
"	0830-36	4	38	16	(47)	62	[29]	-	1	10	4	(12)	16	[10]	-	38	53	91	7
August	1125-44	3	25	49f/	(28)e/	80	[23]	4	2	8	7g/	(10)e/	19	[8]	5	24	64	88	10
"	1200-03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	74	96	-

Table continued on next page

Table 12 (Cont.) Station No. FBB75

Subsection B (farther from observation pt.)

date	Time	RK pr N	RK sN	RK loose	RK tot N	RK tot. indiv.	BK pr N	BK sN	BK loose	BK tot. N	BK tot. indiv.	K pr N	K sN	K tot. indiv.	TM sit.	TM stn	TM tot.	HP hole	PA hole	F N
10 July	1530-45	3	20	20	(23)	46	-	-	-	0	0	1	9	11	76	243	319	2/1	5/0	1/(1)
"	1746-1800	3	24	15	(27)	45	-	-	-	0	0	1	7	10	80	269	349	5/1	13/0	1/(1)
12 July	1704-1730	7	11	13	(18)	38	-	2	-	2	2	-	7	8	74	249	323	8/2	14/1	2/(2)
23 July	1133-40	tot. k: 47, too foggy for further classification													41	121	162	6/	1/	-
27 July	1815-38	3	21 [17]	22	(24)	49	-	-	-	-	-	-	-	-	78	207	285	4/2	17/	2/(2)
"	1900-12	4	23	18	(27)	49	-	-	1	-	1	-	-	-	87	194	281	1/1	20/	2/(2)
"	1933-40	1	22	13	(23)	37	-	-	-	-	-	-	-	-	63	166	229	-	18/	2/(2)
"	1954-2000	1	24	10	(25)	36	-	-	-	-	-	-	-	-	57	172	229	3/	15/	1/(2)
"	2013-20	-	22	7	(22)	29	-	-	-	-	-	-	-	-	63	146	209	2/	22/	0/(2)
29 July	1525-38	2	27 [28]	10	(29)	41	-	-	2	-	2	-	-	-	43	202	245	1/	3/	1/(1)
"	1548-1600		28 [26]	4	(28)	32	-	-	-	-	-	-	-	-	52	179	231	1/1	1/	1/(1)
"	1622-34		26 [24]	8	(26)	34	-	-	2	-	2	-	-	-	54	199	253	1/1	1/	-
"	1658-1700	1	23	13	(24)	38	-	-	-	-	-	-	-	-	72	160	232	2/2	9/	1/(1)
"	1719-28	1	24 [20]	17	(25)	43	-	-	-	-	-	-	-	-	72	178	250	-	12/	1/(1)
6 August	1507-12 (foggy weather)					-	-	-	-	-	-	-	-	-	45	177	222	-	-	-
"	22-28	3	23	28	(26)	77	-	-	-	-	-	-	-	-	63	189	252	2/1	12/1	2/(2)
"	38-44	2	24	26	(26)	54	-	-	-	-	-	-	-	-	62	177	239	1/1	4/	2/(2)
11 August	1145-1200	2	22	23h/	(24)e/	49i/ [22]	-	-	-	-	-	-	-	-	40 brood: [7]	161	201	-	-	2/(2)

Table is continued on next page

Table 12. (concluded)

a/ plus 2 unoccupied nests

b/ plus 1 unoccupied nest

c/ strong winds

d/ some nests unoccupied

e/ complete nests with side walls

f/ also includes 22 adults at 18 incomplete nests

g/ also includes 4 adults at 3 incomplete nests

h/ also includes 2 adults at 2 incomplete nests

i/ 8 chicks seen

Station No. RFC75

Table 13.

Ledge Attendance Counts: Thick-billed and Common Murres, Red-legged and Black-legged Kittiwakes, and Fulmars. Place: Rosy Finch Cove

		TM			CM					
Date	Time	stn	sit	total	stn	sit	total	RK	BK	F
18 July	Normal observation point									
	1415	–	–	86	–	–	47	(1)	(5)	(1)
	1430	–	–	85	–	–	46	2 (1)	–	–
	1445	–	–	86	30	21	51	4 (1)	–	–
	1500	–	–	96	24	22	46	2 (1)	–	–
	1515	–	–	107	20	24	44	3 (1)	–	–
	1530	–	–	97	31	17	48		–	–
	1545	–	–	100	20	24	44	2 (1)	–	–
	1600	–	–	112	28	21	49	–	–	–
18 July	On east of ledge--birds hidden in above count									
	1525	–	–	17	17	9	26			
	1605	–	–	13	19	9	28	–	–	–
19 July	Viewing from beach below									
	1025	–	–	–	–	–	112[a]	–	–	–
19 July	Normal observation point									
	1045	28	45	73	30	17	47[b]	4 (1)	7 (6)	–
	1105	16	39	55	25	43	68	4 (1)	7 (6)	–
	1120	29	40	69	28	25	53	3 (1)	7 (6)	–
	1130	32	40	72	24	29	53	–	–	–
	1157	33	45	78	27	25	52		–	–
	1207	34	46	80	27	27	54	2 (1)	–	–
20 July	Normal observation point									
	0815	9	42	51	28	18	46	(1)	(6)	–
	0830	13	45	58	16	18	34	2 (1)	–	–
	0845	9	44	53	17	21	38	–	–	–
	0900	12	40	52	13	25	38			
	0915	6	47	53	20	24	44	4 (1)	6 (6)	–
	0930	12	45	57	20	21	41	–	–	–
20 July	On east of ledge--birds hidden in above count									
	0940	–	–	9	–	–	18	–	–	16 (10)
20 July	Normal observation point									
	0945	14	41	55	20	22	42	2 (1)	–	–
	1000	14	40	54	24	18	42	3 (1)		–
	1015	12	46	58	18	25	43	3 (1)	7 (6)	1
	1030	10	47	57	11	31	42	2 (1)	9 (6)	–
20 July	On east of ledge									
	1040	–	–	10	–	–	18	–	–	–

Table continued on next page

Table 13 continued.

Date	Time	TM stn	TM sit	TM total	CM stn	CM sit	CM total	RK	BK	F
23 July	Normal observation point									
	1215	24	45	69	26	16	42	3 (1)	—	8
	1230	21	49	70	21	26	47	3 (1)	—	—
	1245	20	42	62	28	27	55	—	—	—
	1300	17	47	64	20	27	47	—	—	—
	1315	21	42	63	28	23	51	—	—	—
	1330	27	40	67	30	28	58	—	—	—
	1345	37	36	73	29	28	57	—	—	—
	1400	37	37	74	28	21	49	—	—	—
	1415	26	50	76	15	33	48	—	—	—
	1430	32	44	76	23	27	50	—	—	—
	1445	34	48	82	20	27	47	—	—	—
	1500	41	39	80	29	29	58	—	—	—
	1515	64	32	96	34	24	58	—	—	—
	1530	54	35	89	27	26	53	—	—	—
23 July	On east of ledge									
	1545	—	—	14	—	—	30	—	—	—
27 July	Normal observation point									
	1116	19	31	50	44	21	65	—	—	—
28 July	Normal observation point									
	1215	18	44	62	22	18	40	5 (1)	2 (7) [4]	—
28 July	On east of ledge									
	1230	3	3	6	12	6	18	—	—	—
28 July	Normal observation point									
	1245	15	42	57	16	22	38	7 (1)	9 (7)	—
	1300	18	42	60	22	16	38	6 (1)	8 (7)	—
	1315	26	46	72	17	17	34	5 (1)	8 (7)	—
	1330	29	44	73	23	20	43	9 (1)	9 (7)	—
28 July	On east of ledge									
	1335	0	4	4	16	9	25	—	—	—
28 July	Normal observation point									
	1345	29	40	69	16	21	37	11 (1)	10 (7)	—
	1400	30	44	74	16	25	41	8 (1)	12 (7)	—
	1415	29	46	75	20	20	40	10 (1)	10 (7)	—
	1430	26	41	67	27	17	44	11 (1)	11 (7)	—
28 July	On east of ledge									
	1433	1	4	5	18	12	30	—	—	—
28 July	Normal observation point									
	1445	21	45	66	22	19	41	10 (1)	10 (7)	—
	1500	20	45	65	22	22	44	6	9	—
	1515	20	41	61	19	20	39	7	10	—
	1530	16	44	60	19	22	41	6	10	—

Table continued on next page

Table 13 continued.

Date	Time	TM stn	TM sit	TM total	CM stn	CM sit	CM total	RK	BK	F
28 July	On east of ledge									
	1532	1	4	5	23	9	32	–	–	–
28 July	Normal observation point									
	1545	16	39	55	24	19	43	5	9	–
	1600	16	43	59	21	19	40	4	10	–
	1615	13	20	33	22	20	42	5	11	–
29 July	Normal observation point									
	1630	19	38	57	18	15	33	–	–	–
30 July	Normal observation point									
	1100	31	41	72	24	26	50			
				+15 flushed			+39 flushed	3	8 (4) [3]	–
	1115	39	38	77	18	31	49	4	8	–
	1130	50	36	86	51	25	76	5	10	–
	1145	42	42	84	154	23	177	3 (1) [1]	(4) [3]	–
	1154	–	–	–	–	–	107 flew off		–	–
31 July	Normal observation point									
	1430	41	43	84	47	29	76	4 (0)	5 (4)	
	1445	44	43	87	39	34	73	3 (0)	8 (4) [3]	–
	1500	38	49	87	52	27	79	1	5 (4)	–
	1515	47	48	95	50	26	76	5	5	–
	1530	45	45	90	51	34	85	5	3	–
	1545	49	38	87	55	34	89	3	4	–
	1600	51	38	89	46	37	83	3	4	–
31 July	On east ledge									
	1610	7	6	13	27	7	34	–	–	–
4 August	Normal observation point									
	1015	32	28	60	38	22	60	6	4	8
	1030	20	40	60	27	27	54	4	5	8
	1045	25	39	64	28	27	55	6	5	7
	1100	22	40	62	31	26	57	3	4	7
	1115	32	36	68	29	30	59	3	5	6
4 August	On east of ledge									
	1125	1	6	7	26	12	38	–	–	–
5 August	Normal observation point									
	1015	31	39	70 [6]	39	26	65 [7]	4	4	
	1030	33	35	68 [11]	37	22	59 [9]	3	4	7
	1045	33	39	72 [12]	34	24	58 [7]	3	4	5
	1100	31	42	73 [16]	38	25	63 [12]	5	5	–
	1115	36	39	75 [13]	31	28	59 [11]	–	–	–
5 August	On east of ledge									
	1125	4	4	8 [2]	49	5	54 [2]	–	–	–

Table continued on next page

Table 13 continued.

Date	Time	TM stn	TM sit	TM total	CM stn	CM sit	CM total	RK	BK	F
7 August										
	Viewing from beach below									
	1430	176	96	272 [11][c/]	177	32	509	–	–	–
8 August	Normal observation point									
	0530	41	35	76 [5]	29	24	53 [3]	–	4	5
	0545	43	35	78 [4]	38	25	63 [1]	–	–	–
	0600	44	33	77 [4]	57	28	85 [1]	–	–	–
	0615	48	27	75 [5]	97	25	122 [2]	–	–	–
	0630	46	36	82 [4]	97	23	120 [2]	–	–	–
	0645	45	35	80 [4]	90	22	112 [2]	–	–	–
	0700	54	33	87 [5]	97	17	114 [2]	–	–	–
	0715	49	30	79 [4]	98	20	118 [4]	–	–	–
	0730	51	39	90 [7]	104	16	120 [4]	–	–	3
	0745	53	39	92 [9]	83	21	104 [3]	–	–	4
	0800	52	36	88 [3]	76	28	104 [3]	–	–	–
	0815	46	38	84 [3]	94	18	112 [0]	1	5	–
	0830	47	39	86 [3]	76	20	96	1	3	3
8 August	On east of ledge									
	0840	6	2	8 [0]	31	7	38 [0]	–	–	–

a/ 58 loitering on lower edge

b/ loiterers leave

c/ large numbers of loiterers present on lower edge

Station No. LAF75

Table 14. Flight Count--Least Auklets Flying Over Airstrip To Colony on Ulakaia Ridge July 1

Time	Flight Count		Percent
Start-0519	9		
0519-0556	379		
0556-0612	650		
0612-0700	2,628		
0700-0733	3,890		
0733-0800	4,750		
0800-0830	7,700		
0830-0905	10,200		
0905-0930	6,950		
0930-1003	7,200		
1003-1030	7,300		
1030-1100	5,100[a/]		
1100-1130	11,900		
1130-1200	8,100		
1200-1230	6,495		
1230-1300	12,285		
1300-1330	10,500		
1330-1400	9,140		
1400-1430	8,330		
1430-1500	5,830		
1500-1530	3,460		
1530-1600	2,125		
1600-1630	1,025		
1630-1700	586		
1700-1730	91		
1730-1800	8	136,631	63.2
1800-1830	66		
1830-1900	230		
1900-1930	770		
1930-2000	1,550		
2000-2030	8,550		
2030-2100	16,460		
2100-2130	24,180		
2130-2200	18,530		
2200-2230	8,820		
2230-2300	475		
2300-2330	--		
2330-2400	--	79,631	36.8
		216,262	100.0

a/ Involves a slight estimate for some minutes in which the observer was absent.

Station No. LAF75

Table 15

Flight Counts: Comparison of Evening Flights of Least Auklets over airstrip on 22 June and 17 July from 2040 to 2200 hours.

	Totals	
Time	22 June	17 July
2040-2050	15,410	8,110
2050-2100		
2100-2110		5,930
2110-2120	5,740	7,470
2120-2130	6,150	6,260
2130-2140	4,260	3,560
2140-2150	4,430	1,350
2150-2200	2,367	450
TOTALS	38,357	33,130

Table 16.

Station No. MNF75 — Flight Counts: Murre Flights on North Side of St. George, as observed from Staraya Artil

Two observers with spotting scopes, counting in 10's unless otherwise noted.

Date	E to W time	above horizon	below horizon	sum	count/min	W to E time	above horizon	below horizon	sum	count/min
25 June	1655-1705	8,440	3,440	11,880	1,188	1710-20	220	1,980	2,200	220
	1730-40	6,700	8,900	15,600	1,560	1747-57	510	1,650	2,160	216
	1820-30	3,480	5,920	9,400	940	1820-30	data collected		682	68
	1840-50	6,950	5,320	12,270	1,227	40-50	by only 1 obser-		481	48
	1900-10	2,950	5,790	8,740	874	1900-10	ver		616	62
Total and mean				57,890	1,158					
30 June wind 3-4 kt from SSW vis. good T 11°C	1510-15	630	5,060	5,690	1,138	1520-21	2	430	432	432
	1522-27	580	4,750	5,330	1,066	1530-31	1	490	491	491
						1542-43	10	350	360	360
	1545-50	1,360	4,050	5,410	1,082	1550-51	20	440	460	460
	1553-58	720	4,410	5,130	1,026	1602-03	3	470	473	473
	1605-10	160	4,610	4,770	954	1612-14	14	560	574	287
	1620-25	520	4,580	5,100	1,020	1622-23	6	300	306	306
	1630-35	610	4,140	4,750	950					
	1645-50	120	3,920	4,040	808					
Total and mean				40,220	1,005					
1 July fog vis. 300 m. effective flying low	536-41	630	550	1,180	236	519-22	3,570	4400	7,970	2,657
						522-	by 10's	------	5,780	1,156
						27	by 25's	------	8,340	1,668
						546-47			3,000	3,000
						652-	by 100's		15,600	3,900 a/
						56			13,600	3,400 a/

Table continued on next page

Table 16 (cont.)

Date	E to W		
	time	sum	count/ min
July 7	1015-25	9,900	990
	25-35	9,300	930
	35-45	8,800	880
	45-55	10,700	1,070
	1055-1105	7,700	770
	1105-15	8,200	820
	15-25	7,700	770
	25-35	6,600	660
Total and Mean		68,900	861

a/ considered to be best estimate by observers.

Station No. MNF75

Table 17

Flight Counts: Diurnal East-to-West Flight of Murres on North Side of St. George Island in Early July

(Birds counted with 10-power, Zeiss binoculars in units (flocks) of 80 every other 10 minutes.)

Hours	Date	No. of Flocks counted in 3 x 10-minutes	Flocks x 80	x 2 = Total Each Hour
5-6	4 July	8	640	1,280
6-7	"	76	6,080	12,160
7-8	"	83	6,640	13,280
8-9	"	255	20,400	40,800
9-10	3 July	372	29,760	59,520
10-11	"	380	30,400	60,800
11-12	"	680	54,400	108,800
12-13	"	301	24,080	48,160
13-14	"	223	17,840	35,680
14-15	"	79	6,320	12,640
15-16	6 July	99	7,920	15,840
16-17	"	58	4,640	9,280
17-18	"	17	1,360	2,720
18-19	"	44	3,520	7,040
19-20	"	--a/	4,520	9,040
20-21	"	--a/	3,860	7,720
21-22	"	12	960	1,920
Totals			223,340	446,680

a/ From 1950 hr. to 2050, birds were counted by another observer using a different method.

VII. DISCUSSION

Aerial Surveys of Ledge-nesting Species.--St. George during the summer period is more or less regularly serviced by Peninsula Airways by means of flights chartered by the National Marine Fisheries Service 2-3 times per month. The plane, a twin-engined Navaho, flies out of King Salmon almost exactly 500 miles (800 km) due East. In our brief experience, the plane was often late by at least a day (once, 4 days), and its arrival on St. George once was effected under conditions that could only be termed by we laymen as "hairy." The weather factor here is fog, and on St. George it can facetiously be said that the weather seemed to change every 2 hours on the hour. Fogs proved to be local. One part of the island at this time of the year would be fog-bound, the others clear; or the others fog-bound, and this one clear. We repeatedly set out on long hikes only to be frustrated by a developing fogbank that came in just before or just after we arrived. During the course of our 54 days on St. George, there appeared to be 6 days in which the island was seemingly free of fog; but on some of these 6 days we did not actually check the entire island for this condition.

Of course, there are no U.S. weather stations to the east of St. George, and there was no way that one could predict when a survey plane might find the cliffs reasonably free of fog--after the plane had flown something like 800 km from a place like King Salmon. We therefore came to conclude that aerial photographic surveys of ledge-nesting species on St. George will be extremely difficult to carry out, and it was no surprise to us that the U.S. Fish and Wildlife Service flight on 1 August encountered fog on the higher cliffs.

Bartonek (pers. comm.) has expressed to us his deep disappointment in the photos that FWS secured on this date. On two of our Reference Ledges (Station Numbers FBA75 and FBB75 at First Bluff), we can discern in the FWS photos on 1 August (under a 23-power binocular microscope) 34 and 9 birds respectively. On 6 August we counted the following on these areas:

	FBA75	FBB75
Time . .	1538-1544	1530-1538
Red-legged kittiwakes	54	66
Black-legged "	-	17
Thick-billed murres	239	82
Other species (3)	7	-
Total . . .	300	165

This difference occurs on one of the better FWS photographs.

Boat Photography.--On 14-16 January 1976 we reviewed the FWS photos with Dr. David N. Nettleship (Canadian Wildlife Service at Ottawa), discussed our photographic problems with him, went over CWS methods of analyzing aerial photos (see also below), and decided to have our own boat available for quick use of good weather in photographing ledge-nesting birds. (No national Marine Fisheries Service boats with motors were available to us in 1975, and the Aleuts' private boats were only occasionally available. We had actually contracted to use one such boat on a fine-weather day but lost out because

the whole village decided to go fishing!) In early March 1976 we therefore shipped on the Pribilof, the Aleut vessel servicing the islands, a 13-foot Avon rubber raft equipped with a 25-HP Evinrude motor. This will permit us to have much flexibility in photographing at least the lower cliffs, but we may not be able to do a good job of photographing all the higher ledges on the highest cliffs.

Analysis of Photographs.--The errors inherent in census counts based on photographs of gulls have been reviewed by Kadlec and Drury (1968) and by Drury (1973) and for alcids by Nettleship (1975). Our conference in Ottawa yielded the following information:

> CWS has found Hasselblad photos to be "not good" and has settled on Pentax 6 by 7 cm in photographing murre cliffs at 600-900 ft. with a 100-mm lens and trying to fill the cliff in each frame. Higher cliffs have to be photographed at a greater distance.
>
> The CWS blows its photograph prints to 28 by 36 cm [about 10 1/2 by 15 inches] on glossy paper (for resolution and storage) and counts each carefully with the aid of gridded plastic overlays. The time involved varied from about 1,500 to 3,000 birds or nests per day in examples that we studied. Specific counting statistics provided us by Nettleship and his photo interpreter, Mike Channing, follow:
>
> | | | |
> |---|---|---|
> | Great Island | 23,229 nests | about 3 weeks to count |
> | Degges Sound | 89,647 murres | about 1 1/2 months |
>
> It is worth adding that the photo interpreter involved here is an experienced technician with a great deal of patience.
>
> The Service assumes that 1 bird = 1 pair. It attempts to photograph murres before the nonbreeders come in. This ordinarily is late June but was early July on Funk Island. What it tries to do is standardize date and time of day--preferably in the second half of the incubation period.
>
> It is obvious that the censusing of ledge-nesters on St. George by means of photographs can only be done, under CWS methodology, on a stratified sampling basis: it will be impractical to try and count say 400,000 murres on say 50 km of cliffs.
>
> It is at least possible that the birds photographed on these cliffs could be counted mechanically by a particle-counter which is used in hematological labs. Dr. Don H. Anderson, director of the Industrial Laboratory of Eastman Kodak Company, Rochester, has found (pers. comm.) that a Quantimat counter is easily able to enumerate blackbirds (on the order of 3-5 thousand in a single picture) photographed against the sky as they approached a night-time roost. We are currently exploring the practicality of such a technique for the analysis of our St. George photos. The machine presumably will not distinguish between a bird on a ledge and one in the air; and it may not be able to distinguish between birds and rocks that have been whitened by fecal droppings. Nettleship (pers. comm.) feels that the variance in Alcid ledge numbers in Eastern Arctic colonies requires him to count 65 percent

of the total number of ledges. This figure is clearly impossible to attain on St. George; its need would presumably be reduced by stratification. Mechanical counting impresses us as a practical necessity. Even with the limitations already envisioned (and there must be others), it would appear to have considerable utility as an order-of-magnitude estimate of the present population and as a year-to-year population index.

Flight Observations.--In personally discussing their St. George fieldwork with us last December, I. R. Gabrielson and M. C. Thompson (pers. comm.) maintained that the least auklet was the most abundant species on the island at the time of their visits (3 July 1940 and 3 other days on a later visit--IRG; 1964-68--MCT). This was not our impression in 1975, when murres were more numerous; we did not see Gabrielson's "swarming millions" (Gabrielson and Lincoln 1959:506). In the flight of least auklets over the village on 3 July, Gabrielson saw "many cresteds." In our all-day count on 1 July 35 years later we saw not more than 200. Thompson's impressions of the least auklet flight back up Gabrielson's, and we feel it probable that a significant decrease in this species took place on St. George sometime in the last 10 years. Aleut people who have for many years witnessed the auklet spectacle on this island all seem to agree that some diminution in numbers has taken place, but they place it earlier after the road was put through near the edge of the Ulakaia Ridge. This would be about 1950; but the Aleuts are not talking about a great reduction which we feel has taken place. There is at least some possibility that a pronounced change in auklet breeders could have taken place in 1975 as a result of the usually late snowfields to persist on Ulakaia Ridge. This will of course be watched for in 1976.

The least auklet flight into Ulakaia Ridge on 1 July dropped to a scant 8 birds between 1730 hr and 1800 (Table 14). We initially hypothesized that the 79,631 that then came in were females preparing to take over their nests for the night. If one is willing to accept an even sex ratio in the breeding population, it then follows that the morning flight consisted of 79,631 males and the remaining 57,000 birds (27 percent of those counted on 1 July) were nonbreeders. This 27 percent may be compared to the 30-35% that Bédard (1969) estimated as nonbreeders in the least auklet population on St. Lawrence Island. We did not attempt to test this hypothesis on St. George until 30 July when we collected 10 least auklets flying in from the sea between 2030 and 2130 hr. The sex ratio (Table 18) on this occasion was 5:5. We lack a good flight count for this late date in the season, and at present we regard the hypothesis as not yet adequately tested. George and Molly Hunt report (personal communication) that, in collecting least auklets on St. Paul this summer for their food-habits study, they found no evidence of a difference in sexual behavior such as we initially hypothesized. If the 79,600 evening fliers on 1 July were all and the only birds that would be incubating that night, it might still follow that 27 percent of the birds seen on 1 July were nonbreeders.

Flight counts do vary somewhat as the season progresses. For the period 2100-2200 hr, we counted 29,380 least auklets flying into Ulakaia Ridge on 22 June; on 1 July this number was 42,710.

Table 18

Least Auklets Collected

30 July 1975; 2030-2130 hr.; on St. George Island

#1 ♂	Left testis 0.4 cm x 0.2 cm right testis not found food sample taken - skin saved
#2 ♀	largest ova 1.5 mm burst follicle found food sample taken - skin saved
#3 ♂	left testis 0.5 cm x 0.3 cm right testis 0.5 cm x 0.2 cm food sample taken - skin saved
#4 ♀	largest ova 0.1 cm has collapsed follicle food sample taken - skin saved
#5 ♂	left testis 0.8 cm x 0.3 cm food sample collected; rt. testis not found skin discarded since badly damaged
#6 ♂ 92 g	left & right testes both 0.4 x 0.2 cm food sample collected, skin saved
#7 ♀ 87 g	ova to 0.05 cm food sample collected, skin saved
#8 ♀ 94 g	ova to 0.05 cm skin saved, food sample collected
#9 ♀ 87 g	ova to 0.05 cm skin saved, food sample collected
#10 ♂ 90 g	left testis 0.5 x 0.2 cm, right testis 0.4 x 0.2 cm. skin saved, food sample collected.

The east-to-west flight of murres of the north shore of St. George was an impressive ornithological sight in 1976. Using spotting scopes, for 5 to 10-minute counts scattered over about 4 late afternoon hours on 25 and 30 June, we estimated this flight to involve about 1,000 birds per minute. This ran to about 900 per minute in a morning count on 7 July (Table 16). When a single observer "counted" these flocks with a 10-power binocular on 3-6 July (Table 17), there was good agreement between the morning counts (1000 vs. 900 per minute) but not at all for the afternoon counts (200 vs. 1000 per minute). We hope to make more direct comparisons of these two techniques in 1976.

We did carry out comparative side-by-side counts or estimates of least auklets on our full-day count of the flight going into Ulakaia Ridge on 1 July. These were independent estimates by J. J. Hickey and R. C. Squibb. Their estimates were invariably less than 10 percent apart, and no bias on the part of one man was evident. Auklet counting at this site is quite comparable to counting starlings as they fly into a roost.

Reference Areas.--In the field we delineated our reference cliffs and reference ledges by taking Polaroid pictures in color or black and white. These were immediately pasted into field note books against the need to replicate counts in subsequent days. It would have been preferable to have taken a duplicate set of these pictures for use in the present report. Conventional 2 x 2 pictures taken of the reference areas have not been entirely satisfactory, and efforts will be made this summer to remedy this situation.

Ledge Attendance.--It is now well-known that a diurnal rhythm in the ledge attendance of murres does take place (Tuck, 1960:120; Swartz, 1966:659), although no such rhythm was evident to Uspenski (1956) at Novaya Zemlya nor to Pennycuick (1956) at Spitzbergen.

Our ledge counts (Tables 10-13) were made for trial time periods of varying length whenever our work schedule and the weather permitted. Because of the patchy nature of these observations, confidence intervals can not be calculated and the counts can only be considered as a rough estimate. Preliminary analysis of these counts reveals a general trend during incubation: the lowest numbers of birds are present on the cliffs in the evening just before dark (presumably equals over night) and in the morning before it is light enough to make an accurate count; and the highest numbers are present in the afternoon, around 1630 hours. This is best seen in our most numerous set of counts--for Murie Cove, where we made 94 counts spread over 8-days from 10 to 31 July (Table 10). The behavior is illustrated in Figure 5. It appears that only those birds with very high motivation for breeding (i.e., those properly classified as breeding birds) are spending the night on land. Evening ledge counts may be valuable in correlating ledge counts with numbers of breeding pairs. This phenomenon is further discussed under Direct Counts (below).

Figure 5. Ledge attendance of thick-billed murres at Murie Cove Study Area (Station No. MCL75) 14 July-31 July. Each dot indicates one datum point. (First thick-billed murre chick seen August 2.)

We are considering doing systematic counts in the coming season at 1/2-hour intervals for one full day at regular intervals at each of the study ledges we will set up. This of course will be modified somewhat by weather conditions.

Direct Counts.--In 1975, we succeeded in counting from the beach a total of 6.67 km of the lower cliffs, most of them in Stratum A (Table 19). With more than half of this stratum thus censused, it would appear that the 10.6 km of this lowest stratum carried about 40,000 birds . . . and that the numbers present on the higher cliffs will in turn be much higher. These higher strata

Table 19. Effect of Cliff Height on the Numbers of Birds Present

Approx. Cliff Height (m)	Station No. (Table 2)	Length Cliff Counted (km)	No. of Counts[a]	Mean No. of Birds	Mean No. of Pairs[b]	Birds per 100 m	Table Ref.
Stratum A							
12.2	VWC75	1.2	2	2,763	2,173	230.3	5
12.2	VEC75	1.07	2	2,297	2,023	214.7	6
ca 18	ZBC75	0.55	3	1,613	1,530	293.3	7
24.4	ZMR75	2.92	1	14,858	14,349	508.8	8
Totals		5.74	8	21,531	20,075		
Stratum mean						375.1[c]	
Stratum B							
24.4-61	PPC75	0.47	2	1,852	1,576	394.0	9
Stratum C							
61	3BC75	0.46	1	5,286	4,861	1,149.1	9

[a] Where 2 counts were available, the numbers were averaged. Where 3 or more counts were available, the 2nd-, 3rd-, and 4-th highest counts for each species were averaged, the mean total of these was used to arrive at the mean numbers shown in the table.

[b] For "Pairs" here we substituted the actual number of nests or started nests for the numbers counted for kittwakes and cormorants.

[c] Weighted according to the length of cliff censused.

must be sampled by boat and aerial photography; they have little in the way of beaches at their bases, and the cliff-nesting birds there cannot be fully counted from the cliff tops.

The variables affecting this estimate appear to result, at least importantly, from differences in the number of nonbreeding birds present (1) throughout the day, as one might suspect from Figure 5, and (2) throughout the season, as one can infer from the work of Swartz (1964) at Cape Thompson on murres. Our census work on Stratum A was equally divided between morning and afternoon hours (Table 20). Morning counts on the whole were 24 percent lower than afternoon counts. Of this 24 percent, half was due to a difference in thick-billed murre counts, one-quarter was due to least auklet counts, and the remaining one-quarter was spread over the other nine species. The afternoon least auklet counts invariably included flocks of obvious nonbreeders on the beach or talus slopes. We believe that the difference of 25.8 birds between A.M. and P.M. birds of this species was produced by this segment of the population. If 44.6 least auklets in Table 20 are a reasonable index of the incubating half of the breeding population, the total population is represented by 44.6 + 44.6 + 25.8 = 115. This would mean that the nonbreeders were 22 percent of the population. This compares to an inferred 27 percent in the flight at Ulakaia Ridge and Bédard's (1969) estimate of 30-35 percent on St. Lawrence Island.

The major difference between A.M. and P.M. counts for a single species appears in the common murre. We interpret at least part of this to be due to an inadvertent increase in flat ledges in the higher cliffs of Zapadni Bay that we could reach only in the latter part of our field trips. Counting these higher cliffs in the afternoon (Station No. ZPC75) has probably biased our afternoon totals somewhat also. There were more birds per meter here than anywhere else in this stratum.

At Cape Hay, Tuck (1960:119) found the murre population to be increased about 10 percent by nonbreeders that appeared after 1 August. On the basis of extensive collecting during the incubation and early nestling period. Swartz (1966) did not consider nonbreeding murres to represent any significant fraction of the population at Cape Thompson. His diurnal cycle, obtained 30 August to 1 September involved a maximum of 250 birds on his study ledges. Our curve (Figure 5) compiled from data obtained on 14-31 July closely follows that of Swartz. This is a bit surprising since (1) Tuck (1960:120) found different rhythms for different parts of the nesting cycle, (2) Swartz's rhythm data in 1959 were obtained late in the nestling period, and (3) our curve holds only for the latter half of incubation. Swartz corrected all his ledge counts and census data to 100 percent of his afternoon maximum.

We have extrapolated the Table 20 data to 10.6 km for Stratum A in Table 21. The use of all our afternoon data instead of a correction factor based on the peak at 1630 hr gives a somewhat somewhat more conservative estimate than Swartz's approach, being 12.8 percent lower.

Table 20. Effect of Time of Day on Census Totals for Lowest Cliffs (Stratum A)[a]

Species	Mean no. birds (and nests) counted per 100 m		AM as Percent of PM
Time counted	0845--1200	1200--1630	
Total hours counted	8 hr 44 min	8 hr 43 min	
Thick-billed murre	185.6	234.8	79
Common murre	9.8	17.3	57
Red-legged kittiwake	12.7 (4.7)	19.1 (4.6)	66
Black-legged kittiwake	24.3 (15.3)	26.7 (15.2)	91
Fulmar	8.6	9.8	88
Horned puffin	4.7	4.8	98
Tufted puffin	0.3	0.4	75
Parakeet auklet	15.7	20.8	75
Crested auklet	0.4	0.6	67
Least auklet	44.6	70.4	63
Red-faced cormorant	0.8 (0.3)	0.9 (0.5)	89
Total birds per 100 m	307.5	405.6	76

[a] Counts of zero birds are included in the means shown.

Table 21. Estimated Breeding Population (Pairs) in Stratum A Cliffs[a]

Ledge nesters	
Thick-billed murre	25,000
Black-legged kittiwake	2,800
Red-legged kittiwake	2,000
Common murre	1,800
Fulmar	1,000
Red-faced cormorant	100
Hole nesters	
Least auklet	4,700
Parakeet auklet	2,200
Horned puffin	500
Crested auklet	60
Tufted puffin	40
Total	40,000 (40,200)

[a] Extrapolations to 10.6 km from AM figure for least auklet and from PM statistics for all other species in Table 20.

VIII. CONCLUSIONS

1. In 1975, the seabird numbers on St. George were considerably down from the "millions" reported in the past.

2. The cause of this change is not yet clear; some disturbance of the main least auklet colony may have taken place. Some instability induced by persisting snowbanks in 1975 also seems to have occurred.

3. The main least auklet colony held over 200,000 birds, of which as many as 27 percent may have been nonbreeders.

4. The lower cliffs on the island, extending for 10.6 km, held approximately 40,000 breeding pairs of 11 species. Higher densities undoubtedly occur on the 37.5 km of high cliffs, the highest of which held at least 400,000 murres on the north side of the island.

5. On the lower cliffs, the commonest species were thick-billed murres, least auklets, black-legged kittiwakes, parakeet auklets, red-legged kittiwakes, common murres, and fulmars in that order. Horned puffins, red-faced cormorants, crested auklets, and tufted puffins were also present in much reduced numbers.

6. Pelagic cormorants, formerly found on this island, were completely absent in the summer of 1975.

7. St. George now appears to be the main stronghold of red-legged kittiwakes in North America. (Their only other known nesting grounds, outside the Pribilofs, are in the Komandorskie Islands). If any species of seabird can be seriously threatened by petroleum exploration in the Bering Sea, it will be this one.

8. Conventional census-photography by aircraft on St. George is extremely difficult to carry out due to fog; boat photography of ledge-nesting birds will have to be substituted.

9. If conventional photograph-analysis is used, it would take an experienced technician 26-52 weeks to count 400,000 murres. This time can be reduced by stratified sampling. It will in turn be increased by the need to count other species. The search for a mechanical counting technique should be pushed.

10. The major threats to these seabird populations posed by petroleum exploration will be (a) disturbance of the ledge-nesting species by people or aircraft if St. George is ever used as a local or regional base of operations for petroleum drilling and (b) potential spillage at or near the birds' main (but not their only) feeding areas 13.7 km (less than 8 nautical miles) NE of the island at 56°37'30" N and 160°11' W. ~~This is about 2-5 fathoms deep and involves about 1 km by 500 m.~~

IX. NEEDS FOR FURTHER STUDY

Most of our needs for 1976 have already been alluded to:

(1) We will need to take advantage of good weather, whenever we get it, to photograph ledge-nesting species. We expect to use a boat to do this.

(2) We need to jack up our ledge-attendance statistics for other species besides murres and for different parts of the birds' nesting cycles in which we will be photographing the cliffs.

(3) We will need to lay out the quadrat system on Ulakaia Ridge in order to get some confidence limits in estimating the main nesting population of least auklets. We will explore the possibility of revising our budget so as to put one man full time on this subprotect.

(4) We will have to run down the possible use of a mechanical counter for cliff photographs.

(5) We are considering the use of a miniature radio telemetry system to monitor the flight of least auklets and determine how often breeding birds approach and leave the colony.

(6) We need some new understanding from NOAA about how long it takes to write up a final report. If our field work runs well into August, we are appalled at an "absolutely firm" deadline for a final report on 1 October.

(7) A cooperative effort with Dr. George Hunt and his team on St. Paul is being worked out whereby (1) we will monitor kittiwake nests at two study areas on St. George and collect growth and reproductive data. (Molly Hunt will spend a month on St. George from mid-August until fledging in mid-September) and (2) they will photograph and census the cliffs of St. Paul and other Islands in the course of their work there. Plane schedules permitting, we will try to join them on some of this.

X. SUMMARY OF 4TH-QUARTER ACTIVITIES

(1) Field Trip Schedule

11-12-75 to 12-12-75
Pacific Seabird Group Meeting in Asilomar, California. Conference with NOAA personnel on research problems and data management.

14-01-76 to 16-01-76
Meeting with Dr. David N. Nettleship and Canadian Wildlife Service staff in Ottawa, Canada, to discuss and examine CWS techniques for censusing seabirds by means of aerial photography.

(2) Scientific Party
Dr. Joseph J. Hickey, Professor of Wildlife Ecology, University of W Wisconsin, P. I.
F. Lance Craighead, Research Assistant, University of Wisconsin

(3) Methods
We received 306 aerial photographs of the cliffs of St. George Island from Dr. James C. Bartonek of the U. S. Fish and Wildlife Service. These were taken on 1 August 1975, from an FWS P2V. We examined these photographs and then conferred with Dr. David N. Nettleship who agreed that many of them were impossible to analyze for census information. It was concluded that much better-quality photographs could be taken by boat with a 6 X 7 cm Pentax as used by the Canadian Wildlife Service. This we have now secured.

We also conferred (by phone) with Dr. Don H. Anderson, director of the Industrial Laboratory of Eastman Kodak Company, Rochester, N. Y., relative to a mechanical counter for the birds we photograph on ledges. We are currently trying to find a Quantimat counter here in southern Wisconsin so that we can explore this further.

(4) Sample localities, etc.
None. A rubber boat and motor were shipped to St. George on the Pribilof early in March.

(5) Data analysis
Upon receipt of Data Management Formats 034 and 035, work was begun keypunching last summer's data for storage on magnetic tape. This should be completed by 1 April.