Exxon Valdez Oil Spill
Restoration Project Annual Report

Common Murre Population Monitoring at the Chiswell Islands, Alaska, 1998

Restoration Project 98144
Annual Report

This annual report was prepared for peer review as part of the *Exxon Valdez* Oil Spill Trustee Council restoration program to assess project progress. Peer review comments have been addressed in this version of the report.

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Study History: *Exxon Valdez* Oil Spill Trustee Council-sponsored common murre damage assessment studies were initiated at the Chiswell Islands in 1989 as part of Department of Interior - Fish and Wildlife Service (DOI-FWS) Bird Study No. 3 (Population surveys of seabird nesting colonies in Prince William Sound, the outside coast of the Kenai Peninsula, Barren Islands, and other nearby colonies, with emphasis on changes in numbers and reproduction of murres). Three progress reports were produced during the damage assessment work (Nysewander and Dipple 1990, 1991; Dipple and Nysewander 1992), and a final report of 1989-1991 results was completed in 1993 (see Nysewander *et al.* 1993, Effects of the *T/V Exxon Valdez* oil spill on murres: A perspective from observations at breeding colonies). In 1992, murre monitoring studies continued at the Chiswell Islands as part of Restoration Project No. 11 (see Dragoo *et al.* 1995, Effects of the *T/V Exxon Valdez* oil spill on murres: A perspective from observations at breeding colonies four years after the spill). In 1998, Project 98144 was authorized to recensus the Chiswell Islands murre colonies and help evaluate the recovery status of common murres in the spill area (see FY 98 DOI-FWS Detailed Project Description).

Abstract: We recensused the Chiswell Islands murre colonies six years after the last population counts were made using the same methods employed by the 1993-1994 and 1996-1997 Barren Islands murre population monitoring projects. Counts were pooled with estimates derived from the 1989-1992 U.S. Fish and Wildlife Service and 1991 Dames & Moore studies, and analyzed for trends and differences between year-groups. Although a negative trend was found at the six-island nesting complex over the 10-year postspill interval, numbers were highly variable and much lower at one of the colonies, compared to previous years. When data from this island were excluded from the analysis, the negative trend disappeared. These results, coupled with other information on murre attendance at the Chiswell and Barren islands, suggested that our 1998 population estimate was artificially low and did not accurately reflect the number of birds actually breeding at the Chiswell Islands nesting complex.

Key Words: Chiswell Islands, common murres, *Exxon Valdez*, Gulf of Alaska, oil spill, population monitoring, Prince William Sound, restoration monitoring, thick-billed murres, *Uria aalge, Uria lomvia.*

Project Data: (To be addressed in the final report).

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EXECUTIVE SUMMARY

Introduction

Several breeding concentrations of common murres *(Uria aalge)* were located in the northwestern Gulf of Alaska downstream of the T/V *Exxon Valdez* oil spill. When winds and currents swept oil through the region during April-May 1989, many of these seabirds were killed: they comprised 74% of 30,000 bird carcasses recovered by 1 August. Based on this information and a computer modeling study, estimates of total bird mortality suggested that 74,000-315,000 murres died after contacting floating oil. Because the impact of the spill on common murres appeared to be severe, the U.S. Fish and Wildlife Service (FWS) censused murres at the Chiswell Islands in 1989-1992. Dames & Moore (D&M) biologists also counted birds at this six-island nesting complex in 1991 during an Exxon-sponsored project. We censused murres at the Chiswell Islands in 1998, six years after the last population counts were made, and found a negative trend over the 10-year postspill interval. However, numbers of birds were highly variable and much lower at one of the colonies, compared to previous years, and when data from this island were excluded from the analysis, the negative trend disappeared. These results, coupled with other information on murre attendance at the Chiswell and Barren islands, suggested that our 1998 population estimate was artificially low and did not accurately reflect the number of birds actually breeding at the Chiswell Islands nesting complex.

Objectives

The objective was to test the null hypothesis that murre populations have not increased at the Chiswell Islands nesting colonies since 1989, the year of the spill.

Methods

Data were collected and analyzed by the same methods used during the 1993-1994 and 1996-1997 Barren Islands murre population monitoring studies, and were compatible with those employed by the 1989-1992 Chiswell Islands projects. Results were pooled with estimates derived from the 1989-1992 FWS and 1991 D&M studies, and tested for trends (linear regression). Differences between 1998 scores and averages of all previous postspill counts were checked with one-sample *t*-tests.

Results

When the six-island colony count of 1,884 birds was pooled with the respective 1989-1992 estimates of 2,613, 2,348, 2,628, and 2,481 individuals and tested for trends, a decrease in numbers was detected over the 10-year postspill interval (linear regression, $P = 0.04$). The six-island estimate was also significantly lower than the average of all previous counts at this island group (1989-1992 mean = 2,518 individuals; one-sample *t*-test, $P < 0.01$). However, when the 1989-1992 and 1998 counts from one of the six islands (Beehive B) were excluded from the analysis, the negative trend disappeared and the five-island score of 1,810 birds and the average of the 1989-1992 estimates (1,992 individuals) were similar ($P > 0.1$).

Discussion

No evidence was found that indicated the Chiswell Islands murre population had increased since 1989, the year of the spill. Instead, results from our six-island analysis suggested that numbers declined after 1992. However, results from our five-island analysis demonstrated that most of the difference between the 1989-1992 and 1998 population estimates that generated the negative trend was associated with lower, more variable numbers of birds at one island, Beehive B. These results, coupled with other information on murre attendance at the Chiswell and Barren islands,

suggested the 1998 population estimate was artificially low and did not accurately reflect the number of birds actually breeding at the Chiswell Islands nesting complex.

Conclusions

No evidence was found to indicate that the Chiswell Islands murre population had increased since 1989, the year of the spill. However, results suggested that the 1998 population estimate was artificially low and did not reflect the number of birds actually breeding at the Chiswell Islands nesting complex.

Recommendations

The Chiswell Islands murre colonies should be recensused in either 2000 or 2001, after any lingering affects of the 1997-1998 El Niño and La Niña events have dissipated. Recounting the nesting complex during one of these years will provide a better measurement of the islands' postspill population and help determine the recovery status of these birds in the spill area.

INTRODUCTION

Several breeding concentrations of common murres *(Uria aalge)* were located in the northwestern Gulf of Alaska downstream of the T/V *Exxon Valdez* oil spill (e.g., Sowls *et al.* 1978, Piatt *et al.* 1990, FWS 1994). When winds and currents swept oil through the region during April-May 1989, many of these seabirds were killed: they comprised 74% of 30,000 bird carcasses recovered by 1 August (see Piatt *et al.* 1990).[1] Based on this information and a computer modeling study, estimates of total bird mortality suggested that 74,000-315,000 murres died after contacting floating oil (see Piatt *et al.* 1990, ECI 1991).

Because the impact of the spill on common murres appeared to be severe, the U.S. Fish and Wildlife Service (FWS) censused murres at the Chiswell Islands in 1989-1992 (e.g., Nysewander and Dipple 1990, 1991; Dipple and Nysewander 1992; Nysewander *et al.* 1993; Dragoo *et al.* 1995). Dames & Moore (D&M) biologists also counted birds at this six-island nesting complex in 1991 during an Exxon-sponsored study (see Erikson 1995).

We censused the Chiswell Islands murre colonies in 1998, six years after the last population counts were made, to see if numbers of breeding birds had increased since the spill. No evidence of an increase was found; instead a negative trend was detected over the 9-year postspill interval. However, numbers of murres were highly variable and much lower at one of the colonies in 1998, compared to previous years, and when these data were excluded from the analysis, the negative trend disappeared. These results, coupled with other information on murre attendance at the Chiswell and Barren islands, suggested that our 1998 population estimate was artificially low and did not accurately reflect the number of birds actually breeding at the Chiswell Islands nesting complex.

OBJECTIVES

The project was designed to test the null hypothesis that murre populations have not increased at the Chiswell Islands nesting colonies since 1989, the year of the spill. The specific objective was to count birds at Natoa, Matushka, Chiswell, Chiswell B, Beehive, and Beehive B islands, and compare these scores with counts made during the 1989-1992 FWS and 1991 D&M postspill studies.

METHODS

The Chiswell Islands are located at about 59° 37' N, 149° 31' W, along the southeastern coast of the Kenai Peninsula near the entrances to Aialik and Resurrection bays (Fig. 1). Study sites consisted of Natoa, Matushka, Chiswell, Chiswell B, Beehive, and Beehive B islands (Fig. 2).

We used the M/V *Surfbird*, a 21-m-long FWS research vessel, as a base of operations to support 11-17 July field studies. Data were collected and analyzed by the same methods used during the 1993-1994 and 1996-1997 Barren Islands common murre population monitoring projects (see Roseneau *et al.* 1995, 1996, 1997a, 1998a), and were compatible with those used during the 1989-1992 Chiswell Islands studies.

Censuses were made by three experienced observers from an outboard-powered inflatable raft with the aid of 7 x 42 binoculars and hand-held tally meters (see Roseneau *et al.* 1995, 1996, 1997a, 1998a). During counts, the raft was allowed to drift slowly past nesting cliffs at distances of 30-

[1] Seventy percent of the murre carcasses were common murres (Piatt *et al.* 1990; J.F. Piatt, pers. comm.).

50 m. Although distances between birds and observers varied depending on the height and configuration of cliffs and other factors (e.g., presence of offshore rocks), this potential variable was kept as consistent as possible among censuses.

Census dates and times of day for making counts (13-17 July and 1100-2000 hrs Alaska Daylight Time, respectively) were based on attendance and nesting chronology data from recent Barren Islands studies (see Roseneau *et al.* 1997b, 1998b). During counts, observers arbitrarily divided nesting cliffs into small, manageable sections and counted birds on them by 1's simultaneously.[1] One person recorded the scores without revealing his or her own count to other team members. The recorder compared the scores to see if they were within 10% of each other (i.e., within 5% of their average). If they were not, cliff sections were recounted until scores fell within this range.

We censused murres on the six study islands on five separate days (13, 14, 15, 16, and 17 July), and during data analysis, we calculated one-day totals for the six-island nesting complex and then averaged these scores to obtain a six-island estimate. Because numbers of birds were noticeably lower and more variable on one of the islands (Beehive B, see Fig. 2) than during earlier postspill counts, we also calculated an average five-island score (i.e., for Natoa, Matushka, Chiswell, Chiswell B, and Beehive). Results were pooled with 1989-1992 FWS and 1991 D&M scores (see Nysewander and Dipple 1990, 1991; Dipple and Nysewander 1992; Nysewander *et al.* 1993, Dragoo *et al.* 1995; Erikson 1995), and analyzed for trends and differences among years by running linear regressions and one-sample *t*-tests (the single 1991 D&M estimate was treated as an additional count and averaged with the 1991 FWS scores). The 0.1 significance level was used to increase the power of the tests and reduce Type II error (the 0.9 confidence interval was adequate for our purposes; see Roseneau *et al.* 1997a, 1998a).

RESULTS

We completely censused the Chiswell Islands murre colonies on five separate days (Appendices 1-6). When we compared our six-island estimate of 1,884 birds with the respective 1989-1992 scores of 2,613, 2,348, 2,628, and 2,481 individuals, a negative trend was detected over the 9-year postspill interval (slope of linear regression, $P = 0.04$; see Table 1 and Fig. 3a). The six-island estimate was also significantly lower than the average of all previous counts at this island group (1989-1992 mean = 2,518 individuals; one-sample *t*-test, $P < 0.01$, see Table 1). However, we noticed that numbers of murres were highly variable and much lower at Beehive B Island than during previous years (see Appendix 6). When we subtracted the 1989-1992 and 1998 Beehive B counts from the respective six-island estimates and analyzed the resulting five-island data set, the negative trend disappeared and our five-island score of 1,810 birds and the average of the 1989-1992 estimates (1,992 individuals) were similar ($P > 0.1$, see Table 1 and Fig. 3b).

DISCUSSION

We did not find any evidence that indicated the Chiswell Islands murre population had increased since 1989, the year of the spill. Instead, results from our six-island analysis suggested that numbers declined after 1992 (see Fig. 3a). However, results from our five-island analysis demonstrated that most of the difference between the 1989-1992 and 1998 population estimates that generated the negative trend was associated with lower, more variable numbers of birds at one island, Beehive B (see Fig. 2). During 1989-1992, counts at this island showed little variation and

[1] We also counted murres on the water within 150 m of the colonies by 1's and 10's because of historical precedent (e.g., similar counts were made during the 1989-1992 FWS studies for comparison with corresponding prespill estimates).

averaged over 500 individuals, but in 1998 they varied from 5 to 266 birds and averaged only 74 individuals (see Table 1 and Appendix 6).

During censuses at Beehive B on 13-16 July, we noticed that few murres were regularly attending ledges at the island's primary area of high quality nesting habitat (four day mean = 26 birds, range = 5-42). Also, large rafts of about 200-400 birds were loafing on the water opposite the nesting area on three of these dates (13, 15, and 16 July; see Appendices 1-5). On 17 July, 10-12 murres were standing on ledges in the nesting area and several hundred more were congregated on the water below it when we passed by at about 1250 hrs to start our census on the opposite side of the island. When we returned to count murres at this nesting area 10 minutes later, the situation had changed dramatically: 200 birds were on the ledges and 88 were on the water beneath it (the presence of the birds on the nesting ledges helped produce the highest count for this island—see Appendix 6). We rechecked the area at 1415 hrs and found that attendance had changed again: about 20 murres were on the nesting ledges and 200-250 were on the water below it. These changes in attendance indicated murres were still in the process of settling down and selecting nest sites before laying eggs on this section of the island.

Other observations from the northwestern Gulf of Alaska also indicated that murre attendance was probably unstable when the Chiswell Islands colonies were censused on 13-17 July. Many birds were still flying on and off Barren Islands nesting cliffs during the second week of July, and when our primary population monitoring plot set BMP 1-8 was first counted on 15 July, only 149, 31, and 9 individuals were present at BMP 1, 7, and 8, respectively (Roseneau *et al.*, unpubl. data). However, when these plots were recounted on 29 July, respective numbers totaled 656, 930, and 439 birds—numbers similar to later counts and counts made during 1996-1997 (see Roseneau *et al.* 1997a, 1998a). Late settling of murres on some of the Barren and Chiswell islands nesting cliffs may have been related to the 1997-1998 El Niño and La Niña events.

The Barren Islands information, coupled with observations of rafting birds near the Chiswell Islands colonies during 13-17 July, the abrupt changes in attendance that were still occurring at Beehive B on 17 July, and the results of the five- and six-island analyses suggested that our 1998 population estimate was artificially low and did not accurately reflect the number of birds actually breeding at the Chiswell Islands nesting complex.

CONCLUSIONS

No evidence was found to indicate that the Chiswell Islands murre population had increased since 1989, the year of the spill. However, results suggested the 1998 population estimate was artificially low and did not accurately reflect the number of birds actually breeding at the Chiswell Islands nesting complex.

RECOMMENDATIONS

The Chiswell Islands murre colonies should be recensused in either 2000 or 2001, after any lingering affects of the 1997-1998 El Niño and La Niña events have dissipated. Recounting the nesting complex during one of these years will provide a better measurement of the islands' postspill population and help determine the recovery status of these birds in the spill area.

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Captain Joe McClung, Raptor Management Office, Juneau. Phil arranged for our use of the M/V *Surfbird*, and Joe gave us constant, cheerful assistance while sailing under his command. Joe's maritime expertise and willingness to help contributed significantly to the overall safety and success of the field work. Trina Fellows and Kris Thorsrud, AMNWR headquarters, monitored our daily radio calls and were always prepared to help us with logistical needs. The study was funded by the *Exxon Valdez* Oil Spill Trustee Council, as part of their ongoing restoration monitoring effort; additional support was provided by AMNWR.

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Table 1. Average counts of murres at the Chiswell Islands, Alaska, 1989-1998.

Year	Natoa Island	Matushka Island	Chiswell Island	Chiswell B	Beehive Island	Subtotal (5 Islands)	SD (n)[a]	Beehive B	Total (6 Islands)	SD (n)
1989[b]	267	1,076	375	274	93	2,085	— (1)	528	2,613	— (1)
1990[b]	424	507	251	329	212	1,723	95 (3)	624	2,348	168 (3)
1991[c]	480	951	350	326	83	2,189	390 (5)	440	2,628	534 (5)
1992[d]	378	954	330	227	81	1,970	142 (2)	512	2,481	149 (2)
1998[e]	198	685	612	225	89	1,810	276 (5)	74	1,884	232 (5)

Regression Analysis: Count vs. Year (Significance Level = 0.1)

Chiswell Colonies (5 Islands) (Natoa, Matushka, Chiswell, Chiswell B, & Beehive)	Chiswell Colonies (6 Islands) (Natoa, Matushka, Chiswell, Chiswell B, Beehive, & Beehive B)
No significant correlation (n = 5)	$r^2 = 0.80$, H_0: Slope = 0, $P = 0.04$ (n = 5)

One-sample *t*-test: Average of all Previous Postspill Counts vs. 1997 Count (Significance Level = 0.1)

Chiswell Colonies (5 Islands) (Natoa, Matushka, Chiswell, Chiswell B, & Beehive)	Chiswell Colonies (6 Islands) (Natoa, Matushka, Chiswell, Chiswell B, Beehive, & Beehive B)
Not significant (n = 5)	$P = 0.002$ (n = 5)

[a] SD = standard deviation; (n) = number of counts.

[b] Data are from Nysewander and Dipple (1990, 1991), Dipple and Nysewander (1992), Nysewander *et al.* (1993), and unpubl. Fish and Wildlife Service field notes and summary sheets.

[c] Data are from Nysewander and Dipple (1990, 1991), Dipple and Nysewander (1992), Nysewander *et al.* (1993), Erikson (1995), and unpubl. Fish and Wildlife Service field notes and summary sheets.

[d] Data are from Dragoo *et al.* (1995) and unpubl. Fish and Wildlife Service field notes and summary sheets.

[e] Data are from this study.

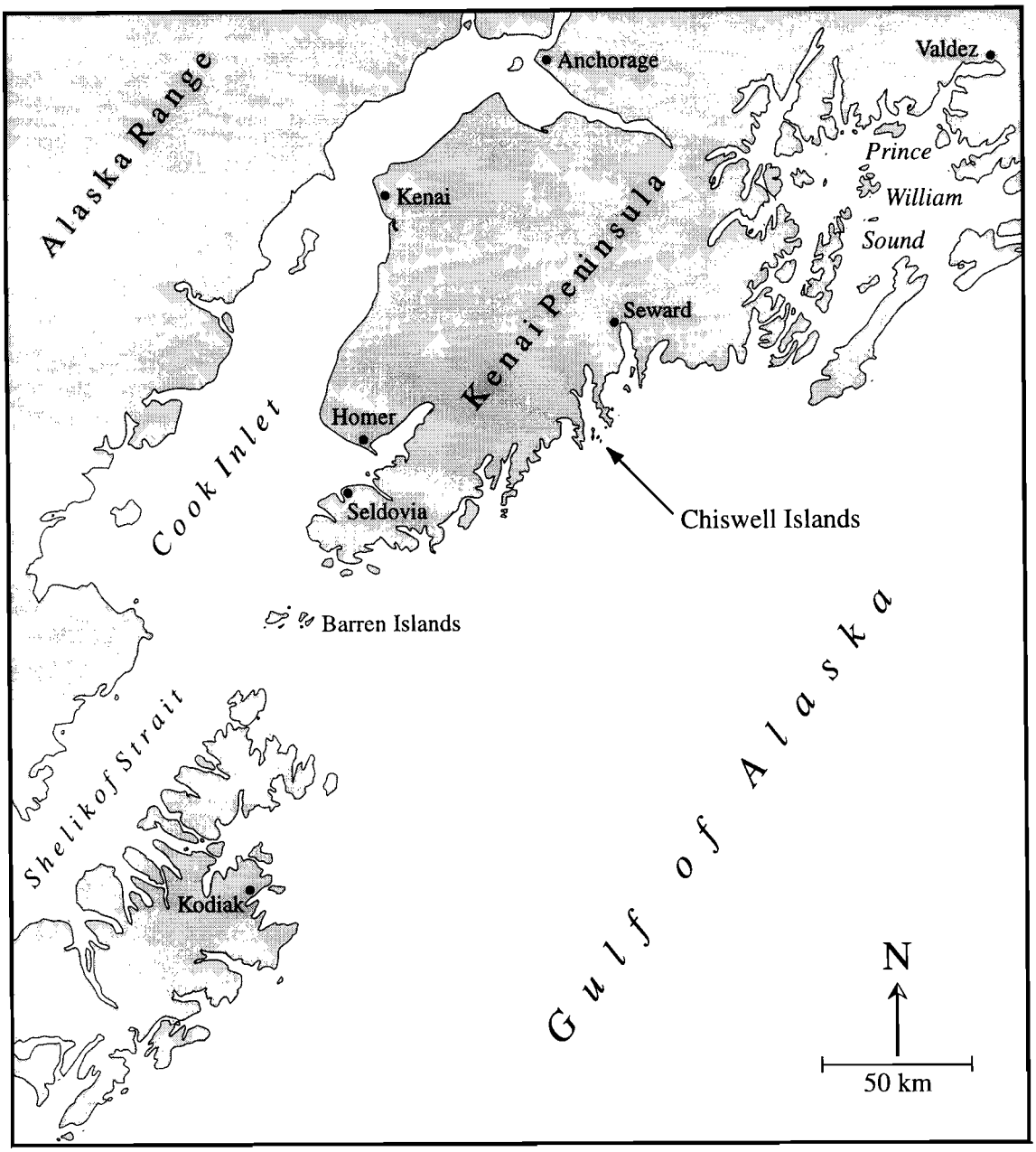

Figure 1. Location of the Chiswell Islands, Alaska.

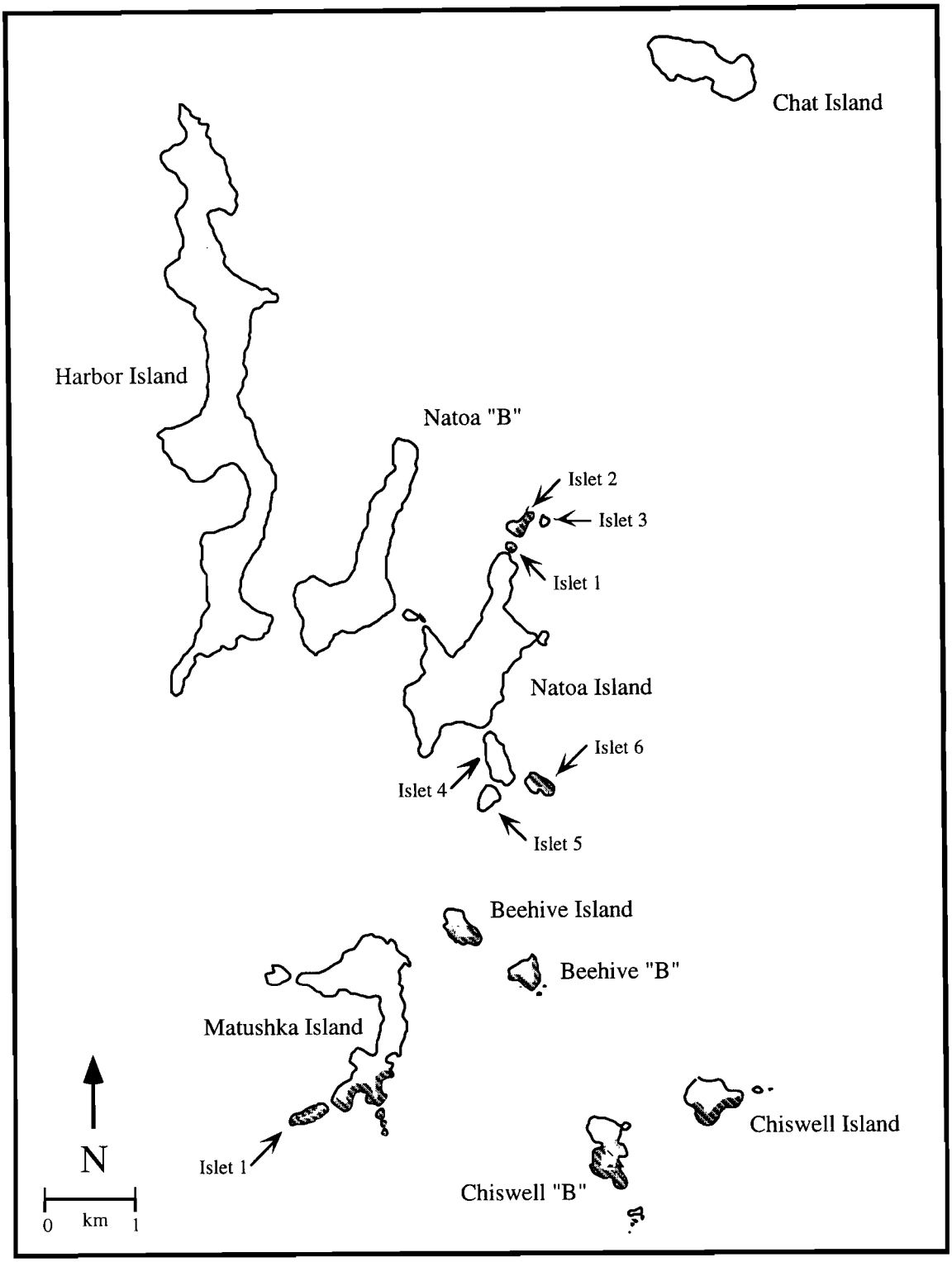

Figure 2. The Chiswell Islands study area (shaded areas show locations of murre nesting habitat).

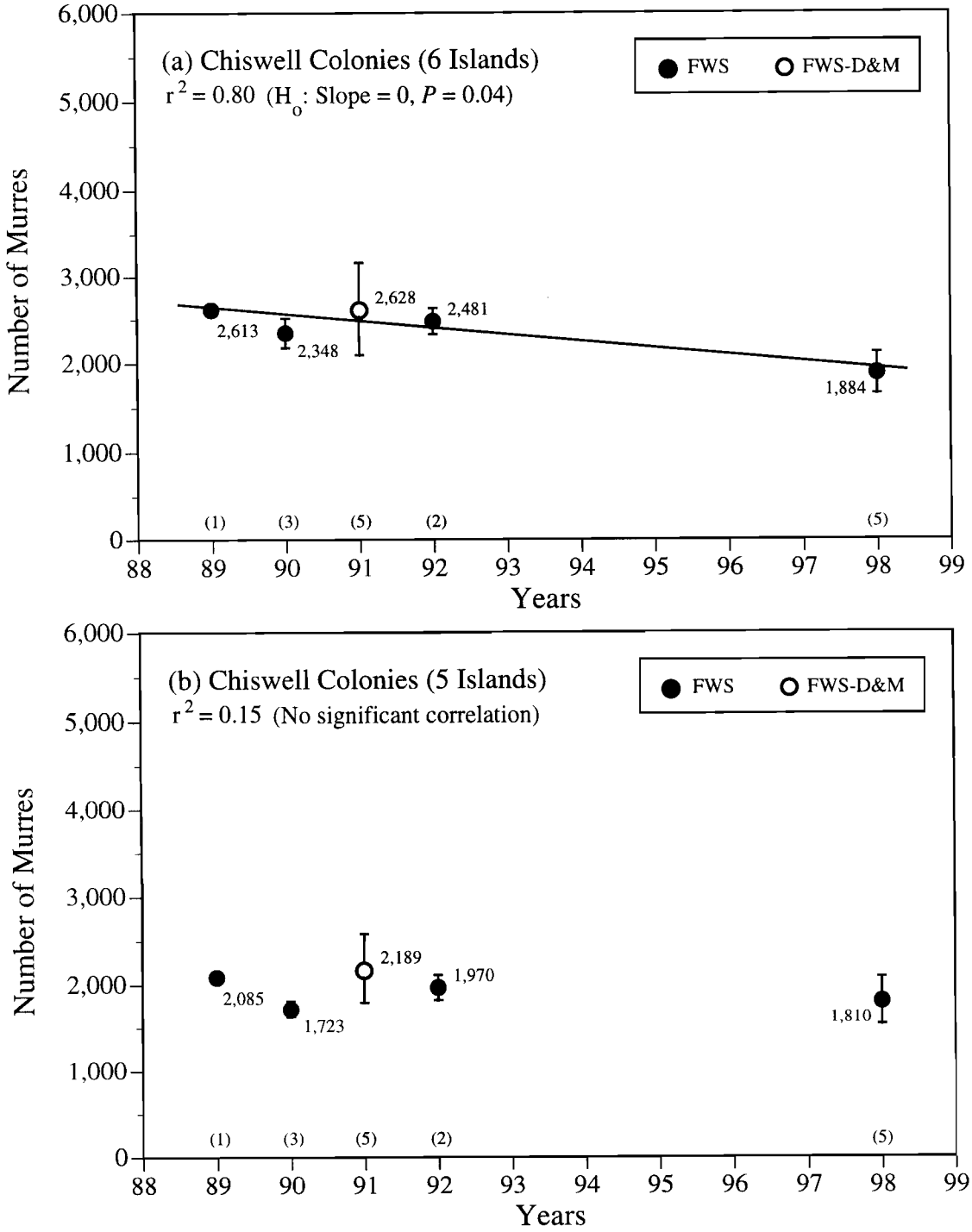

Figure 3. Average counts of murres at the Chiswell Islands, Alaska, 1989-1998: (a) Natoa, Matushka, Chiswell, Chiswell B, Beehive, and Beehive B islands; and (b) Natoa, Matushka, Chiswell, Chiswell B, and Beehive islands. Counts were made by the U.S. Fish and Wildlife Service (FWS) and Dames & Moore (D&M; see Erikson 1995). Number of counts shown in parentheses; error bars = standard deviation.

Appendix 1. Counts of murres at the Chiswell Islands, Alaska, 13 July 1998.

Note: All counts were made by 1's from small boats during 1240-1800 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1520	0		0	0		0	0		0	0
Islet 1	1745	0		0	0		0	0		0	0
Islet 2	1750	0		0	0		0	0		0	0
Islet 3	1800	0		0	0		0	0		0	0
Islet 4		0		0	0		0	0		0	0
Islet 5		0		0	0		0	0		0	0
Islet 6	1510	130		130	134		134	134		134	133
Subtotal:		130		130	134		134	134		134	133
Matushka											
Main island	1615	452		452	459		459	458		458	456
Islet 1	1715	180		180	171		171	174		174	175
Subtotal:		632		632	630		630	632		632	631
Chiswell											
Main island	1240	451		451	456		456	454		454	454
Subtotal:		451		451	456		456	454		454	454

Appendix 1 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1343	244	244	244	237	237	237	236	236	236	239
Subtotal:		244	244	244	237	237	237	236	236	236	239
Beehive											
Main island	1445	94	94	94	93	93	93	93	93	93	93
Subtotal:		94	94	94	93	93	93	93	93	93	93
Beehive B											
Main island	1430	5	5	5	5	5	5	5	5	5	5
Subtotal:		5	5	5	5	5	5	5	5	5	5
TOTAL (All Islands)		1,556	1,556	1,556	1,555	1,555	1,555	1,554	1,554	1,554	1,555

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 2; Matushka = 224; Chiswell = 181; Chiswell B = 84; Beehive = 136; Beehive B = 238. Two birds counted on the water were thick-billed murres (1 at Chiswell and 1 at Beehive B).

Appendix 2. Counts of murres at the Chiswell Islands, Alaska, 14 July 1998.

Note: All counts were made by 1's from small boats during 1408-1855 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1840	0	0	0	0	0	0	0	0	0	0
Islet 1	1850	0	0	0	0	0	0	0	0	0	0
Islet 2	1852	0	0	0	0	0	0	0	0	0	0
Islet 3	1855	0	0	0	0	0	0	0	0	0	0
Islet 4		0	0	0	0	0	0	0	0	0	0
Islet 5		0	0	0	0	0	0	0	0	0	0
Islet 6	1832	271	271	271	269	269	269	267	267	267	269
	Subtotal:	271	271	271	269	269	269	267	267	267	269
Matushka											
Main island	1709	572	572	572	550	550	550	554	554	554	559
Islet 1	1740	217	217	217	213	213	213	223	223	223	218
	Subtotal:	789	789	789	763	763	763	777	777	777	777
Chiswell											
Main island	1408	729	729	729	708	708	708	732	732	732	723
	Subtotal:	729	729	729	708	708	708	732	732	732	723

Appendix 2 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1523	187	187	187	187	187	187	190	190	188	
Subtotal:		187	187	187	187	187	187	190	190	188	
Beehive											
Main island	1622	130	130	130	129	129	129	127	127	129	
Subtotal:		130	130	130	129	129	129	127	127	129	
Beehive B											
Main island	1608	39	39	39	38	38	38	37	37	38	
Subtotal:		39	39	39	38	38	38	37	37	38	
TOTAL (All Islands)		2,145	2,145	2,145	2,094	2,094	2,094	2,130	2,130	2,124	

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 2; Matushka = 24; Chiswell = 32; Chiswell B = 50; Beehive = 0; Beehive B = 2.

Appendix 3. Counts of murres at the Chiswell Islands, Alaska, 15 July 1998.

Note: All counts were made by 1's from small boats during 1350-1925 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1900	0	0	0	0	0	0	0	0	0	0
Islet 1	1920	0	0	0	0	0	0	0	0	0	0
Islet 2	1922	9	9	9	9	9	9	9	9	9	9
Islet 3	1925	0	0	0	0	0	0	0	0	0	0
Islet 4		0	0	0	0	0	0	0	0	0	0
Islet 5		0	0	0	0	0	0	0	0	0	0
Islet 6	1820	182	182	184	184	184	184	184	184	183	
Subtotal:		191	191	193	193	193	193	193	193	192	
Matushka											
Main island	1350	595	595	598	598	592	592	595			
Islet 1		221	221	230	230	223	223	225			
Subtotal:		816	816	828	828	815	815	820			
Chiswell											
Main island	1523	652	652	658	658	662	662	657			
Subtotal:		652	652	658	658	662	662	657			

Appendix 3 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1503	235	235	235	237	237	237	237	237	237	236
Subtotal:		235	235	235	237	237	237	237	237	237	236
Beehive											
Main island	1740	96	96	96	96	96	96	96	96	96	96
Subtotal:		96	96	96	96	96	96	96	96	96	96
Beehive B											
Main island	1715	42	42	42	43	43	43	42	42	42	42
Subtotal:		42	42	42	43	43	43	42	42	42	42
TOTAL (All Islands)		2,032	2,032	2,032	2,055	2,055	2,055	2,045	2,045	2,045	2,043

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 1; Matushka = 72; Chiswell = 34; Chiswell B = 0; Beehive = 5; Beehive B = 469. Six birds counted on the nesting cliffs at Matushka Island were thick-billed murres.

Appendix 4. Counts of murres at the Chiswell Islands, Alaska, 16 July 1998.

Note: All counts were made by 1's from small boats during 1240-1741 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1700	0		0	0		0	0		0	0
Islet 1	1730	0		0	0		0	0		0	0
Islet 2	1735	32		32	30		30	39		39	34
Islet 3	1741	0		0	0		0	0		0	0
Islet 4		0		0	0		0	0		0	0
Islet 5		0		0	0		0	0		0	0
Islet 6	1632	176		176	169		169	172		172	172
Subtotal:		208		208	199		199	211		211	206
Matushka											
Main island	1432	439		439	437		437	432		432	436
Islet 1		200		200	194		194	211		211	202
Subtotal:		639		639	631		631	643		643	638
Chiswell											
Main island	1240	683		683	690		690	696		696	690
Subtotal:		683		683	690		690	696		696	690

Appendix 4 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1347	330	330		328	328		321	321		326
Subtotal:		330	330		328	328		321	321		326
Beehive											
Main island	1604	76	76		69	69		69	69		71
Subtotal:		76	76		69	69		69	69		71
Beehive B											
Main island	1553	21	21		18	18		18	18		19
Subtotal:		21	21		18	18		18	18		19
TOTAL (All Islands)		1,957	1,957		1,935	1,935		1,958	1,958		1,950

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 17; Matushka = 418; Chiswell = 5; Chiswell B = 69; Beehive = 0; Beehive B = 250. Four birds counted on the nesting cliffs at Matushka Island were thick-billed murres.

Appendix 5. Counts of murres at the Chiswell Islands, Alaska, 17 July 1998.

Note: All counts were made by 1's from small boats during 1100-1606 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1130	0		0	0		0	0		0	0
Islet 1	1100	0		0	0		0	0		0	0
Islet 2	1100	28		28	28		28	28		28	28
Islet 3	1100	0		0	0		0	0		0	0
Islet 4		0		0	0		0	0		0	0
Islet 5		0		0	0		0	0		0	0
Islet 6	1557	169		169	159		159	165		165	164
Subtotal:		197		197	187		187	193		193	192
Matushka											
Main island	1500	374		374	366		366	367		367	369
Islet 1		198		198	186		186	187		187	190
Subtotal:		572		572	552		552	554		554	559
Chiswell											
Main island	1310	531		531	537		537	547		547	538
Subtotal:		531		531	537		537	547		547	538

Table 1. Average counts of murres at the Chiswell Islands, Alaska, 1989-1998.

Year	Natoa Island	Matushka Island	Chiswell Island	Chiswell B	Beehive Island	Subtotal (5 Islands)	SD (n)[a]	Beehive B	Total (6 Islands)	SD (n)
1989[b]	267	1,076	375	274	93	2,085	— (1)	528	2,613	— (1)
1990[b]	424	507	251	329	212	1,723	95 (3)	624	2,348	168 (3)
1991[c]	480	951	350	326	83	2,189	390 (5)	440	2,628	534 (5)
1992[d]	378	954	330	227	81	1,970	142 (2)	512	2,481	149 (2)
1998[e]	198	685	612	225	89	1,810	276 (5)	74	1,884	232 (5)

Regression Analysis: Count vs. Year (Significance Level = 0.1)

Chiswell Colonies (5 Islands) (Natoa, Matushka, Chiswell, Chiswell B, & Beehive)	Chiswell Colonies (6 Islands) (Natoa, Matushka, Chiswell, Chiswell B, Beehive, & Beehive B)
No significant correlation (n = 5)	$r^2 = 0.80$, H_0: Slope = 0, $P = 0.04$ (n = 5)

One-sample *t*-test: Average of all Previous Postspill Counts vs. 1997 Count (Significance Level = 0.1)

Chiswell Colonies (5 Islands) (Natoa, Matushka, Chiswell, Chiswell B, & Beehive)	Chiswell Colonies (6 Islands) (Natoa, Matushka, Chiswell, Chiswell B, Beehive, & Beehive B)
Not significant (n = 5)	$P = 0.002$ (n = 5)

[a] SD = standard deviation; (n) = number of counts.

[b] Data are from Nysewander and Dipple (1990, 1991), Dipple and Nysewander (1992), Nysewander *et al.* (1993), and unpubl. Fish and Wildlife Service field notes and summary sheets.

[c] Data are from Nysewander and Dipple (1990, 1991), Dipple and Nysewander (1992), Nysewander *et al.* (1993), Erikson (1995), and unpubl. Fish and Wildlife Service field notes and summary sheets.

[d] Data are from Dragoo *et al.* (1995) and unpubl. Fish and Wildlife Service field notes and summary sheets.

[e] Data are from this study.

Appendix 1. Counts of murres at the Chiswell Islands, Alaska, 13 July 1998.

Note: All counts were made by 1's from small boats during 1240-1800 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1520	0		0	0		0	0		0	0
Islet 1	1745	0		0	0		0	0		0	0
Islet 2	1750	0		0	0		0	0		0	0
Islet 3	1800	0		0	0		0	0		0	0
Islet 4		0		0	0		0	0		0	0
Islet 5		0		0	0		0	0		0	0
Islet 6	1510	130		130	134		134	134		134	133
Subtotal:		130		130	134		134	134		134	133
Matushka											
Main island	1615	452		452	459		459	458		458	456
Islet 1	1715	180		180	171		171	174		174	175
Subtotal:		632		632	630		630	632		632	631
Chiswell											
Main island	1240	451		451	456		456	454		454	454
Subtotal:		451		451	456		456	454		454	454

Appendix 1 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1343	244	244	244	237	237	237	236	236	236	239
Subtotal:		244	244	244	237	237	237	236	236	236	239
Beehive											
Main island	1445	94	94	94	93	93	93	93	93	93	93
Subtotal:		94	94	94	93	93	93	93	93	93	93
Beehive B											
Main island	1430	5	5	5	5	5	5	5	5	5	5
Subtotal:		5	5	5	5	5	5	5	5	5	5
TOTAL (All Islands)		1,556	1,556	1,556	1,555	1,555	1,555	1,554	1,554	1,554	1,555

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 2; Matushka = 224; Chiswell = 181; Chiswell B = 84; Beehive = 136; Beehive B = 238. Two birds counted on the water were thick-billed murres (1 at Chiswell and 1 at Beehive B).

Appendix 2. Counts of murres at the Chiswell Islands, Alaska, 14 July 1998.

Note: All counts were made by 1's from small boats during 1408-1855 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1840	0	0	0	0	0	0	0	0	0	0
Islet 1	1850	0	0	0	0	0	0	0	0	0	0
Islet 2	1852	0	0	0	0	0	0	0	0	0	0
Islet 3	1855	0	0	0	0	0	0	0	0	0	0
Islet 4		0	0	0	0	0	0	0	0	0	0
Islet 5		0	0	0	0	0	0	0	0	0	0
Islet 6	1832	271	271	271	269	269	269	267	267	267	269
	Subtotal:	271	271	271	269	269	269	267	267	267	269
Matushka											
Main island	1709	572	572	572	550	550	550	554	554	554	559
Islet 1	1740	217	217	217	213	213	213	223	223	223	218
	Subtotal:	789	789	789	763	763	763	777	777	777	777
Chiswell											
Main island	1408	729	729	729	708	708	708	732	732	732	723
	Subtotal:	729	729	729	708	708	708	732	732	732	723

Appendix 2 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1523	187	187	187	187	187	187	190	190	188	
Subtotal:		187	187	187	187	187	187	190	190	188	
Beehive											
Main island	1622	130	130	130	129	129	129	127	127	129	
Subtotal:		130	130	130	129	129	129	127	127	129	
Beehive B											
Main island	1608	39	39	39	38	38	38	37	37	38	
Subtotal:		39	39	39	38	38	38	37	37	38	
TOTAL (All Islands)		2,145	2,145	2,145	2,094	2,094	2,094	2,130	2,130	2,124	

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 2; Matushka = 24; Chiswell = 32; Chiswell B = 50; Beehive = 0; Beehive B = 2.

Appendix 3. Counts of murres at the Chiswell Islands, Alaska, 15 July 1998.

Note: All counts were made by 1's from small boats during 1350-1925 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1900	0	0	0	0	0	0	0	0	0	0
Islet 1	1920	0	0	0	0	0	0	0	0	0	0
Islet 2	1922	9	9	9	9	9	9	9	9	9	9
Islet 3	1925	0	0	0	0	0	0	0	0	0	0
Islet 4		0	0	0	0	0	0	0	0	0	0
Islet 5		0	0	0	0	0	0	0	0	0	0
Islet 6	1820	182	182	184	184	184	184	184	184	183	
Subtotal:		191	191	193	193	193	193	193	193	192	
Matushka											
Main island	1350	595	595	598	598	592	592	595			
Islet 1		221	221	230	230	223	223	225			
Subtotal:		816	816	828	828	815	815	820			
Chiswell											
Main island	1523	652	652	658	658	662	662	657			
Subtotal:		652	652	658	658	662	662	657			

Appendix 3 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1503	235	235	235	237	237	237	237	237	237	236
Subtotal:		235	235	235	237	237	237	237	237	237	236
Beehive											
Main island	1740	96	96	96	96	96	96	96	96	96	96
Subtotal:		96	96	96	96	96	96	96	96	96	96
Beehive B											
Main island	1715	42	42	42	43	43	43	42	42	42	42
Subtotal:		42	42	42	43	43	43	42	42	42	42
TOTAL (All Islands)		2,032	2,032	2,032	2,055	2,055	2,055	2,045	2,045	2,045	2,043

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 1; Matushka = 72; Chiswell = 34; Chiswell B = 0; Beehive = 5; Beehive B = 469. Six birds counted on the nesting cliffs at Matushka Island were thick-billed murres.

Appendix 4. Counts of murres at the Chiswell Islands, Alaska, 16 July 1998.

Note: All counts were made by 1's from small boats during 1240-1741 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1700	0		0	0		0	0		0	0
Islet 1	1730	0		0	0		0	0		0	0
Islet 2	1735	32		32	30		30	39		39	34
Islet 3	1741	0		0	0		0	0		0	0
Islet 4		0		0	0		0	0		0	0
Islet 5		0		0	0		0	0		0	0
Islet 6	1632	176		176	169		169	172		172	172
Subtotal:		208		208	199		199	211		211	206
Matushka											
Main island	1432	439		439	437		437	432		432	436
Islet 1		200		200	194		194	211		211	202
Subtotal:		639		639	631		631	643		643	638
Chiswell											
Main island	1240	683		683	690		690	696		696	690
Subtotal:		683		683	690		690	696		696	690

Appendix 5 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1425	133	133		138	138		136	136		136
Subtotal:		133	133		138	138		136	136		136
Beehive											
Main island	1220	55	55		55	55		55	55		55
Subtotal:		55	55		55	55		55	55		55
Beehive B											
Main island	1252	267	267		258	258		274	274		266
Subtotal:		267	267		258	258		274	274		266
TOTAL (All Islands)		1,755	1,755		1,727	1,727		1,759	1,759		1,746

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 5; Matushka = 55; Chiswell = 4; Chiswell B = 95; Beehive = 78; Beehive B = 88. Six birds counted on the nesting cliffs at Matushka Island were thick-billed murres.

Appendix 6. Counts of murres at the Chiswell Islands, Alaska, 1989-1998.[a]

Date	Natoa I.	Matushka I.	Chiswell I.	Chiswell B	Beehive I.	Beehive B	Total	(SD)[b]	On Water[c]	Grand Total
1989[d]										
3 Jul	267	1,076	375	274	93	528	2,613		ND[e]	2,613
Mean	267	1,076	375	274	93	528	2,613		ND	2,613
1990[d]										
27 Jun	372	706	260	158	135	552	2,183		ND	2,183
28 Jun	444	380	380	305	210	623	2,342		ND	2,342
29 Jun	456	435	114	525	290	698	2,518		1,935	4,453
Mean	424	507	251	329	212	624	2,348	(168)	1,935	4,283
1991[f]										
26 Jun	515	918	191	454	71	592	2,741		ND	2,741
28 Jun	328	985	196	349	73	435	2,366		ND	2,366
30 Jun	657	1,008	602	271	144	582	3,264		ND	3,264
2 Jul	583	1,145	358	284	93	439	2,902		224	3,126
20-26 Jul	315	700	401	270	32	150	1,868		ND	1,868
Mean	480	951	350	326	83	440	2,628	(534)	224	2,852
1992[g]										
11 Jul	416	862	295	197	99	507	2,376		522	2,898
12 Jul	340	1,046	365	257	62	516	2,586		474	3,060
Mean	378	954	330	227	81	512	2,481	(149)	498	2,979

Appendix 6 (Continued).

Date	Natoa I.	Matushka I.	Chiswell I.	Chiswell B	Beehive I.	Beehive B	Total	(SD)[b]	On Water[c]	Total
1998[h]										
13 Jul	133	631	454	239	93	5	1,555		865	2,420
14 Jul	269	777	723	188	129	38	2,124		110	2,234
15 Jul	192	820	657	236	96	42	2,043		581	2,624
16 Jul	206	638	690	326	71	19	1,950		759	2,709
17 Jul	192	559	538	136	55	266	1,746		672	2,418
Mean	198	685	612	225	89	74	1,884	(232)	597	2,481

[a] In 1998, birds were counted on the nesting cliffs by 1's. Most 1989-1992 counts were also probably made by 1's; however, birds on some cliff sections may have been estimated by 10's.

[b] SD = standard deviation.

[c] In 1998, birds were counted on the water by 1's and 10's within 150 meters of the nesting cliffs (about 89 % were within 100 meters). The 1990-1992 counts were also probably made by 1's and 10's within 150 meters or less of the nesting cliffs; however, the 1990-1991 count dates were unclear—we assigned these estimates to the last Fish and Wildlife Service counts made during those years.

[d] Data are from Nysewander and Dipple (1990, 1991); Dipple and Nyswander (1992); Nyswander *et al.* (1993); and upubl. field notes and summary sheets.

[e] ND = no data.

[f] 26 June - 2 July data are from Nysewander and Dipple (1990, 1991); Dipple and Nyswander (1992); Nyswander *et al.* (1993); and upubl. field notes and summary sheets. 20-26 July data are from Erikson (1995)—the count was made on one day during this period.

[g] Data are from Dragoo *et al.* (1995) and unpubl field notes and summary sheets. One additional count made on 14 July 1992 was dropped from the data base because it was incomplete and partially based on results from the 11-12 July counts.

[h] Data are from this study.

Appendix 5 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1425	133	133		138	138		136	136		136
Subtotal:		133	133		138	138		136	136		136
Beehive											
Main island	1220	55	55		55	55		55	55		55
Subtotal:		55	55		55	55		55	55		55
Beehive B											
Main island	1252	267	267		258	258		274	274		266
Subtotal:		267	267		258	258		274	274		266
TOTAL (All Islands)		1,755	1,755		1,727	1,727		1,759	1,759		1,746

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 5; Matushka = 55; Chiswell = 4; Chiswell B = 95; Beehive = 78; Beehive B = 88. Six birds counted on the nesting cliffs at Matushka Island were thick-billed murres.

Appendix 6. Counts of murres at the Chiswell Islands, Alaska, 1989-1998.[a]

Date	Natoa I.	Matushka I.	Chiswell I.	Chiswell B	Beehive I.	Beehive B	Total	(SD)[b]	On Water[c]	Grand Total
1989[d]										
3 Jul	267	1,076	375	274	93	528	2,613		ND[e]	2,613
Mean	267	1,076	375	274	93	528	2,613		ND	2,613
1990[d]										
27 Jun	372	706	260	158	135	552	2,183		ND	2,183
28 Jun	444	380	380	305	210	623	2,342		ND	2,342
29 Jun	456	435	114	525	290	698	2,518		1,935	4,453
Mean	424	507	251	329	212	624	2,348	(168)	1,935	4,283
1991[f]										
26 Jun	515	918	191	454	71	592	2,741		ND	2,741
28 Jun	328	985	196	349	73	435	2,366		ND	2,366
30 Jun	657	1,008	602	271	144	582	3,264		ND	3,264
2 Jul	583	1,145	358	284	93	439	2,902		224	3,126
20-26 Jul	315	700	401	270	32	150	1,868		ND	1,868
Mean	480	951	350	326	83	440	2,628	(534)	224	2,852
1992[g]										
11 Jul	416	862	295	197	99	507	2,376		522	2,898
12 Jul	340	1,046	365	257	62	516	2,586		474	3,060
Mean	378	954	330	227	81	512	2,481	(149)	498	2,979

Appendix 6 (Continued).

Date	Natoa I.	Matushka I.	Chiswell I.	Chiswell B	Beehive I.	Beehive B	Total	(SD)[b]	On Water[c]	Total
1998[h]										
13 Jul	133	631	454	239	93	5	1,555		865	2,420
14 Jul	269	777	723	188	129	38	2,124		110	2,234
15 Jul	192	820	657	236	96	42	2,043		581	2,624
16 Jul	206	638	690	326	71	19	1,950		759	2,709
17 Jul	192	559	538	136	55	266	1,746		672	2,418
Mean	198	685	612	225	89	74	1,884	(232)	597	2,481

[a] In 1998, birds were counted on the nesting cliffs by 1's. Most 1989-1992 counts were also probably made by 1's; however, birds on some cliff sections may have been estimated by 10's.

[b] SD = standard deviation.

[c] In 1998, birds were counted on the water by 1's and 10's within 150 meters of the nesting cliffs (about 89 % were within 100 meters). The 1990-1992 counts were also probably made by 1's and 10's within 150 meters or less of the nesting cliffs; however, the 1990-1991 count dates were unclear—we assigned these estimates to the last Fish and Wildlife Service counts made during those years.

[d] Data are from Nysewander and Dipple (1990, 1991); Dipple and Nyswander (1992); Nyswander *et al.* (1993); and upubl. field notes and summary sheets.

[e] ND = no data.

[f] 26 June - 2 July data are from Nysewander and Dipple (1990, 1991); Dipple and Nyswander (1992); Nyswander *et al.* (1993); and upubl. field notes and summary sheets. 20-26 July data are from Erikson (1995)—the count was made on one day during this period.

[g] Data are from Dragoo *et al.* (1995) and unpubl field notes and summary sheets. One additional count made on 14 July 1992 was dropped from the data base because it was incomplete and partially based on results from the 11-12 July counts.

[h] Data are from this study.

Appendix 4. Counts of murres at the Chiswell Islands, Alaska, 16 July 1998.

Note: All counts were made by 1's from small boats during 1240-1741 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1700	0	0	0	0	0	0	0	0	0	0
Islet 1	1730	0	0	0	0	0	0	0	0	0	0
Islet 2	1735	32	32	30	30	39	39	39	39	34	
Islet 3	1741	0	0	0	0	0	0	0	0	0	
Islet 4		0	0	0	0	0	0	0	0	0	
Islet 5		0	0	0	0	0	0	0	0	0	
Islet 6	1632	176	176	169	169	172	172	172			
Subtotal:		208	208	199	199	211	211	206			
Matushka											
Main island	1432	439	439	437	437	432	432	436			
Islet 1		200	200	194	194	211	211	202			
Subtotal:		639	639	631	631	643	643	638			
Chiswell											
Main island	1240	683	683	690	690	696	696	690			
Subtotal:		683	683	690	690	696	696	690			

Appendix 4 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1347	330	330		328	328		321	321		326
Subtotal:		330	330		328	328		321	321		326
Beehive											
Main island	1604	76	76		69	69		69	69		71
Subtotal:		76	76		69	69		69	69		71
Beehive B											
Main island	1553	21	21		18	18		18	18		19
Subtotal:		21	21		18	18		18	18		19
TOTAL (All Islands)		1,957	1,957		1,935	1,935		1,958	1,958		1,950

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 17; Matushka = 418; Chiswell = 5; Chiswell B = 69; Beehive = 0; Beehive B = 250. Four birds counted on the nesting cliffs at Matushka Island were thick-billed murres.

Appendix 5. Counts of murres at the Chiswell Islands, Alaska, 17 July 1998.

Note: All counts were made by 1's from small boats during 1100-1606 hrs Alaska Daylight Time; DGR = David G. Roseneau, BLS = Barbara L. Slater, BE = Brenda Eliason.

Island	Time	Observer 1 (DGR)			Observer 2 (BLS)			Observer 2 (BE)			Observer 1-3
		Count 1	Count 2	Average	Count 1	Count 2	Average	Count 1	Count 2	Average	Average
Natoa											
Main island	1130	0	0	0	0	0	0	0	0	0	0
Islet 1	1100	0	0	0	0	0	0	0	0	0	0
Islet 2	1100	28	28	28	28	28	28	28	28	28	28
Islet 3	1100	0	0	0	0	0	0	0	0	0	0
Islet 4		0	0	0	0	0	0	0	0	0	0
Islet 5		0	0	0	0	0	0	0	0	0	0
Islet 6	1557	169	169	169	159	159	159	165	165	165	164
Subtotal:		197	197	197	187	187	187	193	193	193	192
Matushka											
Main island	1500	374	374	374	366	366	366	367	367	367	369
Islet 1		198	198	198	186	186	186	187	187	187	190
Subtotal:		572	572	572	552	552	552	554	554	554	559
Chiswell											
Main island	1310	531	531	531	537	537	537	547	547	547	538
Subtotal:		531	531	531	537	537	537	547	547	547	538

Appendix 5 (Continued).

Island	Time	Observer 1 (DGR) Count 1	Observer 1 (DGR) Count 2	Observer 1 (DGR) Average	Observer 2 (BLS) Count 1	Observer 2 (BLS) Count 2	Observer 2 (BLS) Average	Observer 2 (BE) Count 1	Observer 2 (BE) Count 2	Observer 2 (BE) Average	Observer 1-3 Average
Chiswell B											
Main island	1425	133	133		138	138		136	136		136
Subtotal:		133	133		138	138		136	136		136
Beehive											
Main island	1220	55	55		55	55		55	55		55
Subtotal:		55	55		55	55		55	55		55
Beehive B											
Main island	1252	267	267		258	258		274	274		266
Subtotal:		267	267		258	258		274	274		266
TOTAL (All Islands)		1,755	1,755		1,727	1,727		1,759	1,759		1,746

Note: Birds were also counted on the water within about 200 meters of the nesting cliffs. Totals were: Natoa = 5; Matushka = 55; Chiswell = 4; Chiswell B = 95; Beehive = 78; Beehive B = 88. Six birds counted on the nesting cliffs at Matushka Island were thick-billed murres.

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[a] In 1998, birds were counted on the nesting cliffs by 1's. Most 1989-1992 counts were also probably made by 1's; however, birds on some cliff sections may have been estimated by 10's.

[b] SD = standard deviation.

[c] In 1998, birds were counted on the water by 1's and 10's within 150 meters of the nesting cliffs (about 89 % were within 100 meters). The 1990-1992 counts were also probably made by 1's and 10's within 150 meters or less of the nesting cliffs; however, the 1990-1991 count dates were unclear—we assigned these estimates to the last Fish and Wildlife Service counts made during those years.

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