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US FISH & WILDLIFE SERVICE--ALASKA
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ANNUAL NARRATIVE REPORT
Calender Year 1987

IZEMBEK NATIONAL WILDLIFE REFUGE

Including Izembek, Unimak and Pavlof Units

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1987

IZEMBEK NATIONAL WILDLIFE REFUGE
P.O. BOX 127
COLD BAY, ALASKA 99571

Including:
Izembek, Pavlof and Unimak Units

ANNUAL NARRATIVE REPORT
CALENDAR YEAR 1987

NATIONAL WILDLIFE REFUGE SYSTEM
Fish and Wildlife Service
U.S. DEPARTMENT OF THE INTERIOR

PERSONNEL

1.	John Sarvis, Refuge Manager, PFT, GS-485-12	6/23/74-Present
2.	Michael D. Blenden, Assistant Refuge Manager, PFT, GS-485-11	8/26/84-Present
3.	Christian P. Dau, Wildlife Biologist, PFT, GS-485-11	1/30/81-Present
4.	Frank Dunn, Maintenance Worker, PFT, WG-4749-8	11/21/86-Present
5.	Annette E. Alexander, Refuge Secretary	1/21/86-Present
6.	Jim Ehret, YCC Enrollee	5/26/87-8/15/87
7.	Jason Accuardi, YCC Enrollee	5/26/87-8/15/87

REVIEW AND APPROVALS

John Sarvis 4/21/88

Submitted By Date

Alaska Regional Office (R-7) Date

US FISH & WILDLIFE SERVICE--ALASKA
3 4982 00021125 9

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John Sarvis, Refuge Manager

Michael Blenden
Assistant Refuge Manager

Christian P. Dau/Wildlife Biologist

Frank Dunn
Maintenance Worker

Annette E. Alexander, Refuge Secretary (on left)

Jim Ehret, YCC Enrollee

Jason Accuardi
YCC Enrollee

INTRODUCTION

The Izembek National Wildlife Range was established in 1960 (Public Land Order 2216) with a boundary encompassing 415,300 acres dominated by wet and upland tundra. Within this area are approximately 95,000 acres of tide lands and lagoons owned by the State of Alaska. These areas have been identified as critical habitat by the state and are largely the basis for the identification and establishment of the refuge. Some of the largest eelgrass beds in the world are in these shallow lagoons and this resource, in addition to those in adjacent fresh water and terrestrial habitats, supports the large numbers of migratory waterfowl which characterize the area in fall through spring. Brown bear and barren ground caribou, both impressive resident game species, occur commonly in the area as well.

The Izembek National Wildlife Range became the Izembek National Wildlife Refuge on December 2, 1980, with signing of the Alaska National Interest Lands Conservation Act (ANILCA - P.L. 96-487) by President Carter (Figure 1). Under ANILCA, 16 refuges were either established, redesignated (such as our name change), or enlarged, adding 53,720,000 acres to the National Wildlife Refuge system for a total of 76.1 million acres of refuges in Alaska. The purposes for which each of these 16 refuges are to be managed were also changed and/or defined. In addition, 13 refuge Wilderness areas were established, totalling 18,560,000 acres. A Wilderness area of 300,000 acres was designated from Izembek's total of 320,893.

The Izembek NWR lies near the western terminous of the Alaska Peninsula, approximately 650 miles southwest of Anchorage. The refuge headquarters is in Cold Bay, Alaska, a largely federal and state government town of approximately 200 people. The Cold Bay office also has responsibility for the administration of part of the Aleutian Islands Unit of the Alaska Maritime NWR (989,000 acres on Unimak Island) and the 1.5 million acre Pavlof Unit of the Alaska Peninsula NWR. These areas support some of the largest seabird colonies in Alaska with a wide variety of species present. In addition, Unimak Island and the Pavlof Unit support important populations of brown bear, caribou, furbearers and a resident population of tundra swans. Adjacent coastal areas support rich and diversified populations of migratory waterfowl, marine birds and mammals, and fin and shellfish. Several fishery stocks exist in commercial quantities and activities associated with these resources increase on a seasonal basis. This report on Izembek NWR integrates information from the Pavlof Unit and Unimak Island Unit.

The Aleutian Islands National Wildlife Refuge was created from public lands in 1913 by Executive Order 1733. The refuge is administratively divided at Unimak Pass. Unimak Island (989,000 acres) is managed out of the Cold Bay office for logistical and biological reasons. The split conforms to natural boundaries,

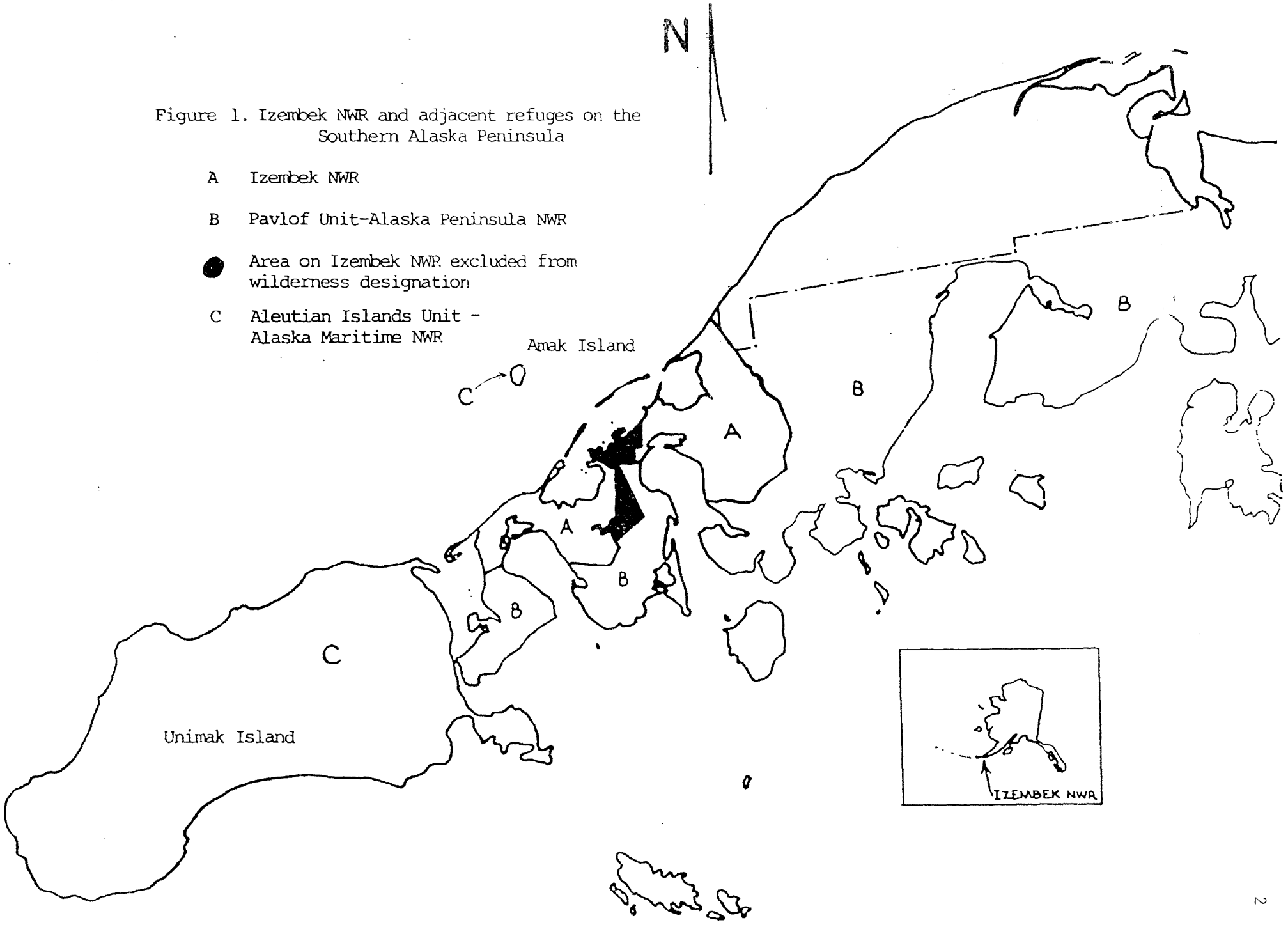
Figure 1. Izembek NWR and adjacent refuges on the Southern Alaska Peninsula

A Izembek NWR

B Pavlof Unit-Alaska Peninsula NWR

● Area on Izembek NWR excluded from wilderness designation

C Aleutian Islands Unit - Alaska Maritime NWR



Unimak Pass forming a distinct and extremely important 'biological' divide before the unique Aleutian flora and fauna of the central and western islands. With the passing of ANILCA, came the establishment of the Alaska Maritime NWR with an Aleutian Islands Unit, which included the islands that formerly comprised the Aleutian Islands NWR.

Unimak Island's habitat closely resembles that of the Alaska Peninsula, although it is somewhat impoverished. Cover, such as alder and willow shrubs, are quite restricted in distribution, and there are fairly extensive, bare or nearly bare, ash and lava flows of varying ages. Especially in the western portion, salmon runs are small or non-existent, due partly to steep terrain and bluffs which make upstream negotiation impossible.

Since 1982, management responsibilities for the Pavlof Unit of the APNWR have been assigned to the staff of Izembek NWR. The Cold Bay office is more centrally located and hence, logistically able to adequately perform the required management functions.

The unit encompasses approximately 1.5 million acres of which well over half is native-selected or conveyed. This patchwork of land ownership may cause problems with management of the refuge, in particular, since the native corporations have selected the coastal areas which are also the most important lands to wildlife.

The Aleutian Range runs the length of the unit and provides some of the most spectacular scenery in Alaska. Pavlof Volcano, the highest peak at 8,261 feet, is an active volcano that has erupted several times in recent years. The northern portion of the unit is characterized by lowland meadows interspersed with numerous ponds and lakes and areas of upland tundra. The southern portion is mountainous with steep-sided valleys drained by alder-lined streams supporting large salmon runs.

Maintenance of refuge habitats in their present pristine condition is the goal of the refuge staff. In view of land status changes resulting from ANILCA and the leasing and subsequent development of offshore petroleum rich basins in the Bering Sea, this chore will be no small one. Research such as the effects of disturbances on black brant and other waterfowl and movements and population dynamics of brown bear and caribou will provide support of our ongoing goal of protecting wildlife and its habitats.

A. HIGHLIGHTS

1. The three year Research/Management Study of brown bear distribution and ecology was completed.

2. The third year of a cooperative research project to assess the effects of disturbance on spring and fall staging black brant and other waterfowl was completed.

3. A total of 102 tundra swans was captured during neck collaring on the Izembek NWR. Resightings of 15 Pavlof birds and 20 Izembek birds were reported in British Columbia, Alberta, Washington, Oregon and California.

4. A cooperative fall productivity survey of the southern Alaska Peninsula caribou herd was performed with the Alaska Department of Fish and Game. Aerial census and radio marking programs were conducted. Emergency regulations were put into effect to close the hunting season and then later re-open it.

5. The seventh annual spring emperor goose survey performed by Migratory Bird Management North and Izembek NWR resulted in a count of 51,655. The population increased 22.3% from 1986; all hunting of the species has been prohibited since 1986.

6. Brant and emperor goose productivity counts were conducted for the 25th and 21st consecutive years, respectively. Juveniles made up 31.2 and 33.8 percent of the respective populations.

7. Biologist/Pilot position advertized and filled.

8. Izembek Fisheries Management Plan goes to final draft for Regional Office review.

9. Water well drilled at refuge headquarters.

B. CLIMATIC CONDITIONS

Floral and faunal phenology were near normal during the summer and fall of 1987, in dramatic contrast to 1986. Ericaecous berry producing plants characteristic of upland tundra failed to produce fruit in 1986 versus good production in 1987. Average monthly temperatures were near average in 1987 however annual precipitation was 3 inches above normal (Table 1). A comparison of fall conditions in 1987 showed that with the exception of nearly a 12 percent increase in precipitation, dominant parameters such as temperature and wind speed were average (Table 2).

Primary waterfowl species utilizing Izembek Lagoon, including black brant, emperor geese, Taverner's Canada geese and Steller's

Table 1. Summary of Weather Data, Cold Bay, Alaska, 1987[1]

Month	Av. Temp. (F)	Departure from Av.	Precip.	Departure from Av.	Wind Speed (Av. mph)	Peak[2] (mph)
January	30.5	2.2	3.17	0.47	18.9	60
February	31.2	3.7	3.15	0.88	16.9	53
March	33.6	5.0	3.18	0.87	16.6	52
April	34.2	1.2	1.94	-0.01	19.1	60
May	38.8	-0.7	1.52	-0.95	15.9	38
June	44.5	-0.9	4.00	1.84	16.3	49
July	50.9	0.6	1.80	-0.70	17.2	46
August	52.8	1.6	2.56	-1.14	15.8	48
September	46.9	-0.6	4.25	0.48	17.9	52
October	41.0	1.5	5.60	1.31	17.1	46
November	30.0	-4.3	3.16	-0.88	15.0	49
December	28.3	-1.2	3.69	0.84	18.5	56
1987 Average	38.6	0.7	38.0 (1987 Total)	3.01	17.1	51

[1] Data reported by the National Weather Service, Cold Bay, Alaska

[2] This figure is the fastest mile (i.e. it is the peak sustained wind for a one-minute period). Actual peak gusts (less than one minute duration) are much higher.

Table 2. Fall and Winter Weather Conditions, Cold Bay, Alaska 1987

Month	Ave. Temp.(F)		Precipitation (in		Av. Wind Speed (mph)	
	1987	Normal	1987	Normal	1987	Normal
September	46.9	46.3	4.25	3.77	17.9	16.3
October	41.0	39.5	5.60	4.29	17.1	16.9
November	30.0	34.3	3.16	4.04	15.0	17.6
December	28.3	29.5	3.69	2.85	18.5	17.2
Overall Average	36.6	37.4	16.70	14.95	17.1	17.0
Change from Normal	-2.1		+11.7		+0.6	

eiders, arrived at normal times this fall. Influxes of any of these species can be altered by varying climatic conditions. The fall migration phenomenon was a week to ten days delayed in 1986. Temperatures from January through April of 1987 were 3 degrees (F) above normal. This factor resulted in an accelerated progression of spring migration for several species including emperor geese and Steller's eiders. The spring influx of black brant exhibited the same pattern with a first arrival from wintering areas on 3 April, a peak in late April and a departure to the north in the first week of May.

C. LAND ACQUISITION

Native conveyed lands (22g-ANSCA) within the Izembek NWR and conveyed and selected lands adjacent to the Pavlof Unit of the Alaska Peninsula NWR vary in resource value. The village corporations of King Cove, False Pass and Pauloff Harbor have suggested they are interested in land exchanges and the Realty Division prepared Land Exchange Ascertainment Reports for lands belonging to each of these three Native Corporations. These reports were distributed in December of 1986 allowing further negotiations to proceed.

Preliminary responses by the Native Corporations to appraised land values presented in the Realty Division ascertainment reports were not encouraging. Their trade lands, largely marsh and coastline adjacent to shallow estuaries, were evaluated at a quite low dollar/acre figure. Proposed USFWS trade lands adjacent to the Cold Bay road system were, on the other hand, valued quite high due to their economic development potential. It will be necessary to negotiate a reasonable compromise if any land exchanges are to be consumated. Progress toward an exchange in 1987 was essentially nil as the Native corporations were digesting the USFWS proposal and formulating responses of their own.

The Alaska Peninsula NWR Comprehensive Conservation Plan and the Bristol Bay Cooperative Management Plan suggest the potential for land exchanges involving the Fish and Wildlife Service. Our potential trade lands are those areas of the Pavlof Unit of the APNWR adjacent to the town of Cold Bay.

The possible land exchange in the southern Alaska Peninsula area would add valuable wildlife habitat to the refuge while at the same time provide the private sector with commercially valuable land.

D. PLANNING

1. Master Plan and 2. Management Plan

The Izembek NWR Comprehensive Conservation Plan mandated by passage of ANILCA in 1980, was finalized in 1985. We are currently operating under that plan.

In general, the ICCP restated the Fish and Wildlife Service's desire to continue management of Izembek NWR as has been done since it was established in 1960. The Service selected a management alternative that will continue to manage 300,000 acres (95%) as wilderness. The remaining 15,000 acres (5%) consist of refuge land adjoining the city of Cold Bay and the associated road system. This land was not designated as Wilderness in 1980, due to the extensive system of roads and disturbance from military habitation during WW II. Under the Service's preferred management alternative, this land will not be recommended for Wilderness designation, but is designated as a Minimal Management Area in which development and vehicular access would be kept at current levels.

The Final Alaska Peninsula NWR Comprehensive Conservation Plan was released by the Regional Office in 1985. The Izembek NWR staff manages the Pavlof Unit of the APNWR which is to become the Pavlof Unit of the Izembek NWR. A similar shift of managerial responsibility is called for in the CCP process for the Alaska Maritime NWR. Under this plan which was distributed as a draft on 1 February 1988, Unimak Island will become the Unimak Unit of the Izembek NWR. The Izembek NWR staff has long held management responsibility for Unimak Island.

3. Public Participation

A fundamental part of the CCP process was collection and assessment of public input. Public hearings on the Izembek CCP, Alaska Peninsula CCP and Alaska Maritime CCP were held in Anchorage and local villages to obtain public comments.

All public meetings attended by Izembek NWR staff were beneficial for us and for village members present as well. Discussions ranged from specific comments on one or both refuge plans to comments on specific refuge management practices and Service policy. In spite of a few critical comments, some of which were well deserved, the general concensus expressed contentment with the status quo and skepticism toward significant development.

Written and oral comments received from the public and other agencies were summarized and considered in the CCP process. Selection of the preferred management alternatives was based, in part, on these comments.

Public participation in planning for an Izembek Fisheries Management Plan took the form of coordination with local and regional personnel of the Alaska Department of Fish and Game in 1987. Biologists and managers with ADF&G divisions of commercial

fish, sport fish and fisheries rehabilitation and enhancement (hatcheries) were contacted for their input.

RM Sarvis attended Public Participation and Cultural Awareness Workshops sponsored by the Alaska Department of Fish and Game in January, 1987. A wide variety of interesting and valuable approaches was presented for obtaining and utilizing public input in relation to agency management programs. Of specific interest to Alaska managers was the participation of Alaska Native leaders in the workshop. Dealing with such topics as subsistance use of fish and game and land management, in a bilingual approach, is a continual growing and learning process with a high level of inherent frustrations. Such workshops will aid long and short term Alaska managers in their resource management decision making.

4. Compliance with Environmental Mandates

In accordance with the Alaska Coastal Zone Management Act, the Aleutians East Coastal Resource Service Area (CRSA) was formed. The majority of Izembek NWR, Alaska Peninsula NWR and Unimak Island fall within the boundaries of the Aleutians East CRSA. In addition to this administrative designation, the Aleutians East Area voted in 1987 to become a borough of the State of Alaska. This step calls for establishment of a local, borough government and elected school board for the area as a whole rather than the village by village approach previously maintained. Implications of a borough government on individual residents of the area are poorly understood. We hope the basic goals for which the borough was established can be manifested in long-term stratagies and that holding to these goals will preclude "governmental proliferation".

5. Research and Investigation

Refuge Personnel

Seasonal Movements and Distribution of Brown Bear on Izembek NWR

This telemetry project, begun in 1977, involved analysis of the movements of 33 radio-collared bears using aerial and ground location techniques. The project was completed in 1987 and data analysis and reporting will be accomplished in 1988. See Section G. 8, Game Mammals, Brown Bear.

Seasonal Movements, Distribution and Productivity of Caribou on Izembek NWR

Census efforts, begun in 1979, were continued along with continued ground productivity appraisals. Use of radio telemetry equipment was begun in 1986 and expanded in 1987 in coordinaion with the Alaska Department of Fish and Game. See Section G. 8., Game Mammals, Caribou.

Caribou Winter Range Survey

Vegetative composition of three general habitat types within the wintering area of the southern Alaska Peninsula caribou herd are being evaluated to provide baseline data on species composition, distribution and abundance. These data will be compared to patterns of caribou distribution and forage consumption. See Section G. 8., Game mammals, Caribou.

Caribou Age and Condition Index

A large sample of hunter harvested animals were involved in this aspect of caribou research being performed by the refuge staff. Aging of individual animals will be assessed by both degree of tooth wear and by sectioning of incisors. In addition femurs, female reproductive tracts and stomach samples were obtained from a lessor number of individuals to address general fitness, reproductive rate and food preferences. See Section G.8., Game Mammals, Caribou.

Population Size and Productivity of Black Brant

This continuing program receives a high degree of emphasis during the fall staging period to ensure accurate assessments for management of the species throughout the Pacific Flyway, per the Pacific Flyway Black Brant Management Plan. This work in 1987 is summarized in Section G.3., Waterfowl, Black Brant.

Population Size and Productivity of Emperor Geese

Emperor geese winter in the Aleutian Islands and the Alaska Peninsula and use the Izembek NWR extensively during the spring and fall migration. Fall productivity surveys and periodic inventories aid in implementing the Pacific Flyway Emperor Goose Management Plan. The 1987 project results are summarized in Section G 3., Waterfowl, Emperor Goose.

Species Composition and Distribution of Aquatic Vegetation on Izembek NWR

Fertile freshwater lakes with tributaries to the sea are important habitats for fish, aquatic mammals and water birds. Aquatic vegetation is an important component in the biological make-up of these water bodies. This project involves the collection of baseline data on species composition and distribution of aquatic plants and water chemistry. Characteristics such as size and depth of each water body evaluated will also be determined.

Seasonal Movements and Population Dynamics of the Resident Tundra Swan Population

This project continued in 1987. Eighty-four new birds and 18 previously banded birds were captured. Thirty-five different

individuals were observed in British Columbia, and Alberta, Canada and in the states of Washington, Oregon and California. See Section G. 3., Waterfowl, Tundra Swan.

Seasonal Movements and Morphological Characteristics of the Gray-Crowned Rosy Finch, Snow Bunting and McKay's Bunting

This project is a low intensity effort performed primarily at the Cold Bay headquarters of Izembek NWR. Birds are baited to a permanent trap site near the office, captured, banded and released. The age, sex and weight of all birds are noted along with other observations made on physical and plummage characteristics. Banding efforts performed at Cold Bay in 1987 are summarized in Table 3.

Other Personnel

Movement Patterns and Population Status of Western Alaska Peninsula Sea Otters

This project, funded by the Minerals Management Service through the USFWS, involved the capture and radio implanting of 16 otters. The study was performed by Charles Monnett of the University of Minnesota. Izembek NWR provided logistic support and some of the necessary radio tracking flights throughout 1987.

Behavior and Energetics of Pacific Black Brant and other Geese in Response to Aircraft Overflights at Izembek Lagoon.

Research Division personnel from the Alaska Fish and Wildlife Research Center continued their analysis of disturbance factors affecting spring and fall staging geese of the Izembek NWR. See Section G. 3., Waterfowl, Black Brant.

E. ADMINISTRATION

1. Personnel

The Wildlife Biologist position at the Izembek NWR was reclassified to include dual function pilot duties. The position was greensheeted however no fully qualified applicants applied. The position was readvertized on 16 March as a WB/Pilot trainee position and the incumbent, WB Dau, was selected from among four qualified applicants. WB/Pilot Dau was in California throughout June undergoing his training for Instrument and Commercial ratings, successfully completing check-rides for each on 29 and 30 June, respectively. At this point only an OAS check-ride, and waiver to authorize flying with less than 500 total hours of flight time were necessary to begin work. Seven months later, after continous pressuring, the waiver was granted and check-ride obtained. WB/Pilot Dau was given his flight authority on 25 January 1988.

Table 3. Passerine Banding, Izembek NWR, 1987

Species	Number Banded						Number Recaptured		
	AHY		LOCAL			Total	AHY		Total
	M	F	M	F	U		M	F	
Snow Bunting	21	3				24	3		3
Gray-crowned Rosyfinch	8					8			0

No other changes of permanent personnel were made in 1987. (Table 4).

Jim Ehret and Jason Accuardi, both of Cold Bay were enrolled in our YCC program this year. They worked from 26 May to 15 August on a wide variety of refuge projects.

2. Funding

Shown in Table 5.

3. Safety

RM Sarvis and WB/P Dau attended the OAS pilots' ground school in December. Numerous safety related topics were discussed and specific training in disorientation/water emersion was given.

In cooperation with the Alaska Department of Fish and Game, caribou were captured using the immobilization drug Carfentanil. This project was completed without mishap. Safety discussions relating to helicopter operations, drug handling and handling of immobilized animals were conducted.

Numerous safety meetings were held on many topics throughout the year.

The refuge staff participated in a clean-up program of the Cold Bay area on 7 and 8 August. Tons of loose debris, which created hazards during high wind conditions, were removed.

Personal floation equipment was purchased for use by staff and cooperators during float plane operations. Orientation and follow-up field training associated with safety in aircraft operations were conducted throughout the year.

4. Technical Assistance

Alaska Department of Fish and Game regional Biologist Dick Sellers assisted refuge staff in the capture and radio collaring of 30 caribou from the southern Alaska Peninsula caribou herd. These collared animals will enable us to more easily locate this herd during survey periods.

The Izembek staff assisted Research personnel (AFWRC) with aerial reconnaisance and ground logistics during their evaluation of disturbance factors affecting migratory waterfowl.

5. Other Items

Special Use Permits

Table 4. Staffing pattern, Izembek NWR

	Full Time	Part Time	Temporary	YCC
FY 1977	3	1	1	-
FY 1978	4	1	1	-
FY 1979	4	1	1	-
FY 1980[1]	3	3	1	-
FY 1981[2]	3	2	-	-
FY 1982	5	-	-	-
FY 1983	5.0 FTE Permanent	-	-	2
FY 1984	5.0 " "	-	-	2
FY 1985	5.0 " "	-	-	2
FY 1986	5.0 " "	-	-	2
FY 1987	5.0 " "	-	-	2
FY 1988	5.0 " "	-	-	2

[1] Includes 1 PFT and 1 PPT ceiling and funding for Cape Sarichef field station, Eastern Aleutian NWR.

[2] One PFT ceiling and 1 PPT ceiling vacated due to closing of Cape Sarichef field station. One PFT ceiling filled at Izembek.

Table 5. Funding for Izembek NWR (in thousands of dollars)

	1210	1220	1240	1260	1360	1500	Total
FY 1977	93[1]	17				5	115
FY 1978	122[2]	25[3]	20[4]				167
FY 1979	128	35	15				178[5]
FY 1980	169	40	16				225
FY 1981	160	75	13				248
FY 1982	207	96	10				313
FY 1983	208[6]	100[7]	10				318
FY 1984				500	10		510[8]
FY 1985				401	15		416
FY 1986				385			385
FY 1987	3			432			435
FY 1988							442

[1] Includes $3,000 for rehabilitation of Grant Point building.

[2] Includes $9,000 cyclic maintenance.

[3] Includes $10,000 ANCSA.

[4] Includes $15,000 cyclic maintenance.

[5] Includes funding for 3 months' operation and salaries at Cape Sarichef, Unimak Island, Eastern Aleutian NWR.

[6] Includes $15,000 for management of Pavlof Unit of APNWR.

[7] Includes $5,000 for managment of Pavlof Unit of APNWR.

[8] Includes $135,000 for ARMM projects, of which $120,000 was for construction of aircraft hangar.

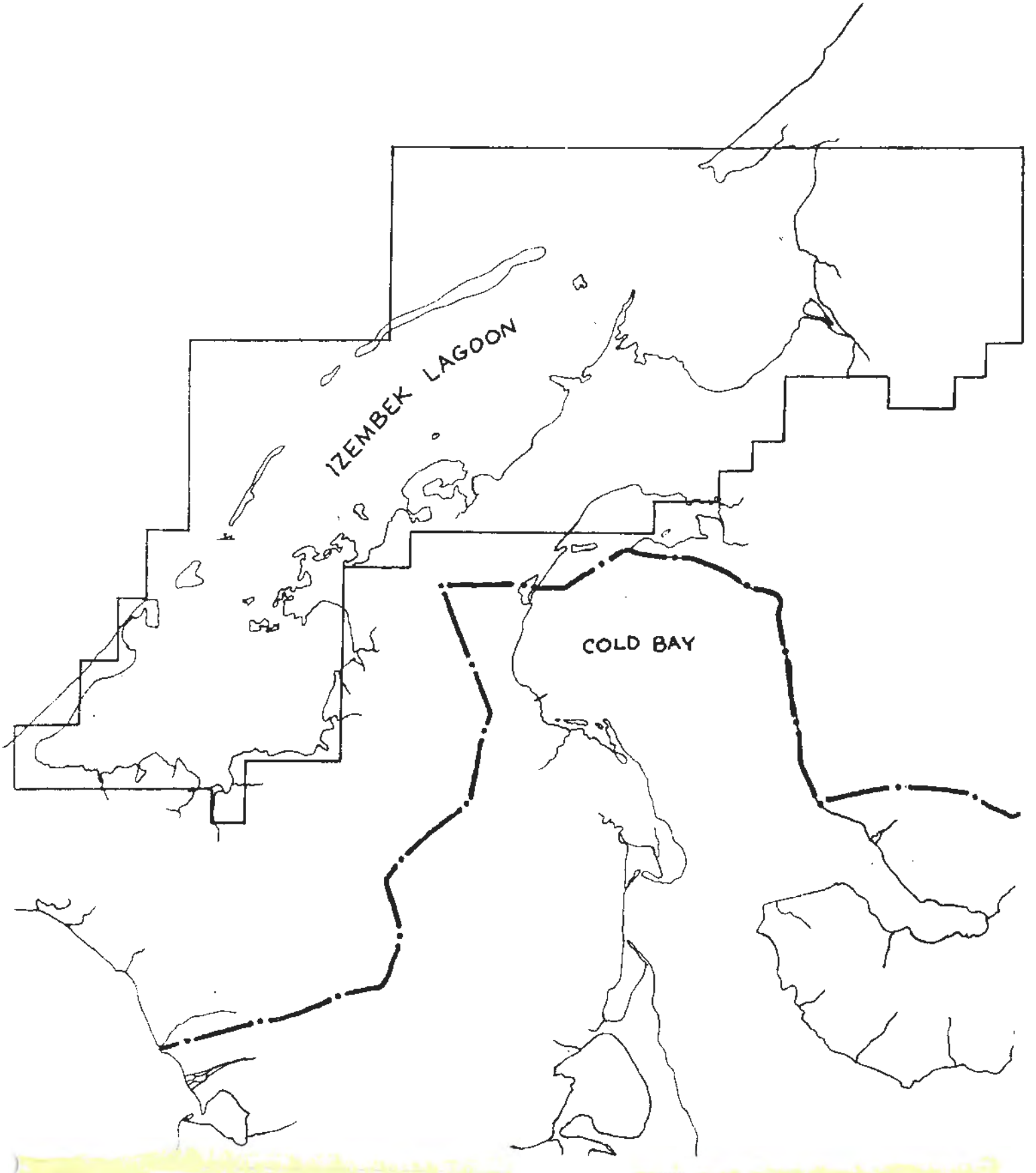


Figure 2. Boundary of Izembek State Game Refuge (———) in relation to Izembek NWR (-·—·—).

Thirty-five special use permits were issued for Izembek NWR, Pavlof Unit of Alaska Peninsula NWR and Unimak Island, Alaska Maritime NWR. Of the total, 18 were for trapping; 8 were to commercial hunting guides; 3 were for gravel removal; two for groundwater testing and one each to conduct volcanic research, seismic research, surfical geology, operation of a set net site, conduct a gravity survey, sample for hazardous wastes, conduct an outfitting operation, maintain an existing cabin, and install a buried power line.

F. HABITAT MANAGEMENT

1. General

Since its establishment in 1960, Izembek National Wildlife Refuge has been managed as a defacto wilderness. Maintenance of the wilderness qualities of the refuge has been and continues to be the primary objective. With the passage of ANILCA, 300,000 of Izembek's total 320,893 acres were designated as Wilderness. Refuge lands on Unimak Island, long administered from the Cold Bay office, were also designated as Wilderness with the passage of ANILCA. It sounds good, but ANILCA also abolished long established special regulations which were prime movers in keeping the refuge pristine until Congress could act. And now seven years later with mounting pressure from such special interest groups as the petroleum industry, mining, regional and village Native corporations and commercial big game guides, we find ourselves less able to maintain habitat integrity than before ANILCA. In 1982 we initiated the process to re-establish refuge special regulations in force prior to ANILCA. Through 1985 the process was suppressed by the WDC office until the feasibility and need could be evaluated at one refuge, Kenai. Late in 1986 we received the go ahead to try again to return our special regulations to Izembek and Unimak Island since the Kenai "test project" was complete. Our homework was completed and the necessary paperwork submitted for RO review in 1987. We are hopeful of success this time, but as of this writing are waiting for word from the Washington office and Alaska Congressional delegation.

The Izembek NWR boundary encompasses approximately 100,000 acres of lagoon systems which provide habitats essential to the wildlife of the area. These areas are tidelands owned by the State of Alaska. One, Izembek Lagoon, has been afforded protection by the state as a State Wildlife Refuge (114 SLA 1960, Chapter 20, Article 1) (Figure 2). Izembek NWR and the Izembek State Game Refuge received special recognition in 1986 as "Wetlands of International Importance". This designation was in accordance with the 1971 RAMSAR convention of the International Union for the Conservation of Nature. Izembek was one of the first four U.S. sites to be so identified.

The thoughtful planning process leading to the establishment of the Izembek NWR resulted in a refuge characterized by diverse

Moist lowlands of the Izembek Refuge transition from glacial moraine, with ericaceous vegetation dominating, to sedge/grass covered coastal floodplains and river mouths. Terrestrial vegetative communities adjoin the aquatic and estarine eelgrass beds of Izembek Lagoon. Blenden

habitats all within the boundary of a single watershed - Izembek Lagoon. Headwaters of the major tributaries on the refuge originate in mountainous areas in the center of the Alaska Peninsula. Drainage from glaciers around 4,800 foot Mt. Dutton and the Aghileen Pinnacles give rise to the Joshua Green River, the largest drainage on the Izembek Unit. Frosty Creek and several smaller streams originate from snowpack and glaciers on 6,000-foot Frosty Peak, west of Cold Bay.

The majority of the refuge is below 1,000 feet in elevation. This undulating coastal plain is derived from glacial outwash and deposition, which supports a mixture of low shrub/ericaceous and graminoid tundra. Characteristic species are arctic willow and other Salix spp., crowberry (Empetrum nigrum), mountain cranberry (Vaccinium vitis-idaea), bluejoint grass (Calamagrostis canadensis), white cotton grass (Eriphorum Scheuchzeri), and reindeer moss (Cladonia spp.). Along many watercourses and at intermediate elevations on mountain slopes, dense bands of Sitka alders (Alnus crispa) are found.

The conveyance of 17,800 acres of Izembek NWR lands to adjacent village corporations has posed potential management problems as the regulations relating to these 22g (Alaska Native Claims Settlement Act) lands may be more liberal than those presently in force. When ANILCA was first passed, we assumed that refuge rules and regulations would remain in effect, as this was the direction that Native corporations were given in ANSCA, in an effort to discourage them from selecting lands from existing refuges. However, in 1983, it was the solicitor's opinion that those regulations do not apply and that new regulations would have to be promulgated. This was certainly a bad decision and will probably result in further degradation of lands that are supposed to be protected, as well as greatly decrease the potential trade value of these lands. A regional task force has been assigned to develop new regulations, but for three years now nothing has resulted from this effort.

The specific land development plans of the village and regional corporations are unknown at present, but center on economic return for the shareholders. Roads, hunting lodges, small boat harbors, gravel mining and thermal and hydroelectric development have been mentioned as potentials. The area promises to be a hub for activities associated with offshore petroleum exploration in the Bering Sea, as well as for an expanding fishing industry. These activities and changing land use patterns will be closely monitored in an attempt to maintain the integrity of the refuge and its wildlife resources. The present status of land conveyances under ANILCA is summarized in Table 6.

2. Wetlands

Approximately 87% of Izembek NWR is characterized as true wetlands. Nearly 200,000 acres of upland tundra (61%), 22,400 acres of wet sedge/grass marsh (7%) and 60,000 acres of pond, lake

A complex of species is common to moist, ericaceous uplands of the Izembek Refuge (Pyrola, Fragaria, Empetrum) 8/87 Blenden

Lousewort (Pedicularis) is common in several lowland plant communities on the refuge. 7/87 Blenden

TABLE 6 Native Selection of Land Within the Izembek NWR per the Alaska Native Claims Settlement Act

Village	Refuge Lands Conveyed (acres)	Refuge Lands Remaining for Conveyance (acres)	Total (acres)	Remarks
King Cove	9,695	5,760	15,455	22g land
False Pass	8,105	1,264	9,369	22g land
Pauloff Harbor	-	-	approx. 320	22g land
Aleut Corp.	-	-	96,030	14 (h) (8)[1]
Aleut. Corp.	-	-	152	14 (h) (1)

[1] In January, 1983, a verbal decision by the Regional Office was made that all 14(h) (8) selections on Izembek are invalid.

Summits within the Izembek Refuge are characterized by volcanic activity of current (Pavlof Volcano) and past ages (Frosty Peak). Lower elevations exhibit the effects of the resulting geologic turmoil. Blenden; Blenden; Sarvis (458)28

and riverine areas (19%) make up this total. Most of these areas are covered under Wilderness designation and all are important to the continued stability of fish and wildlife populations on the refuge.

The nearly 100,000 acres of state-owned lagoon within Izembek NWR are essential wetland habitat for up to 250,000 migratory waterfowl in the fall. Eelgrass is the most important food item for migratory waterfowl using the lagoon complex and is essential year-round habitat for numerous fish and invertebrate species. Izembek Lagoon covers an area of approximately 84,220 acres (132 sq. mi.). Of this area, 78% (65,692 acres) is tide flat and of that area, 44,671 acres are covered by eelgrass beds (i.e. 53% of the total lagoon area).

6. Other Habitats

Continuing pressure from the Izembek NWR staff, with support from the Regional Office, concerning the removal of the USAF abandoned Grant Point radar site finally paid off in 1987. A crew arrived in mid-March to evaluate the site for aesbestos or other potentially harmful substances. All such materials found were disposed of, a step necessary prior to arrival of the building demolition crew.

Preparation for demolition was completed by mid-summer and equipment and a crew of approximately twenty people from Elmendorf AFB arrived in mid-September to begin work on removal of the building. At the same time, the refuge was advised that a representive of the Governors Office and the Corps of Engineers would be coming to Cold Bay to make a "final" appraisal of the radar site for other purposes. Demolition was put on hold pending the outcome of the 24 September trip and meeting. Dr. Brian Allee, of the Alaska Department of Fish and Game, was the Governor's Office representive and Mora Dennison represented the Corps of Engineers. RM Sarvis, ARM Blenden and the foreman of the demolition crew participated. The site was deemed unsuited to needs of the State of Alaska. After two years delay, demolition of the facility was finally begun on 25 September. The final structure fell on 23 February 1988 leaving only revegetation of the site to be done in the summer of 1988.

9. Fire Management

The lower Alaska Peninsula has very little history of range fires. Wet tundra and continually moist air are effective natural fire suppressants. For this reason, we petitioned for and were granted, an exemption from preparation of a Refuge Fire Management Plan.

12. Wilderness and Special Areas

These photographs show the sequence of demolition activities at the Grant Point radar site.

Carla Corin with the Regional Office (Fish and Wildlife Enhancement) assisted the Izembek staff in contaminant sampling at the abandoned military installation at Cape Sarichef.

Pavlof Volcano slowed in activity only slightly in 1987 versus last years level. Close inspection by passing aircraft suggested that a vent on the north side of the 8,260 foot peak emitted lava and rock throughout the year. Spectacular bursts of lava, to several hundred feet above the peak, were visable by eye from 35 miles away in the Cold Bay area on 19 and 25 October. The rare combination of volcanic activity and clear weather allowed us to enjoy these sights from a distance.

On December 2, 1980, 300,000 acres of Izembek were officially designated Wilderness by ANILCA. Preservation of the striking geographic features and conservation of the internationally important fish and wildlife values of the area have always been the primary goals of the refuge so this designation did not greatly alter our program direction.

Volcanos form the backbone of the Wilderness Area of Unimak Island, from Roundtop in the East to Faris-Westdahl in the West. Perpetual snow fields and glaciers surround the five most prominent peaks; Roundtop, Isanotski, Shishaldin, Pogromni and Faris-Westdahl. At 9,372 feet, Shishaldin is the highest peak on the island, and also the most spectacular, being a near-perfect volcanic cone. This mountain is a National Historic Landmark because it has served as a navigational aid for seamen at least since the days of Russian exploration and was undoubtedly used by the Aleuts well before that. Active volcanos include Shishaldin, Pogromni and Faris-Westdahl. Steam and/or smoke rising from the vent of Shishaldin occurs continually. A huge lake, Fisher Caldera, lies in west-central Unimak in the crater of a volcano.

Extensive lava flows of varying ages are found below Shishaldin, Isanotski, Roundtop, Faris-Westdahl and Pogromni. Some of those on the north side of Shishaldin have revegetated, although so sparsely that the nature of the substrate is obvious from the air. Several rivers, among them North Creek, Coal Oil Creek and others unnamed, flow partly through wide ash flats. To the southeast of Roundtop, Isanotski and Shishaldin, are areas several thousand acres in size overlaid with virtually bare lava and ash. These are also drained by sizeable streams.

Cliffs ranging from steep bluffs to spectacular wave-cut promonotories and sea stacks occur along the coast, except at Unimak Bight and along the north side of the island from St. Catherine's Cove to Urilia Bay, where more gentle beaches and dunes are found. The more inaccessible bluffs and cliffs support some seabird nests, but are most important for bald eagles. Because of its large size and unique features, Unimak was proposed as a separate unit for Wilderness in 1972. Designation was held up pending resolution of the D-2 lands issue by Congress resulting from passage of the ANSCA. Finally, a Wilderness area of 910,000 acres was established on December 2, 1980, with passage of ANILCA. Management of Unimak will still be the same since it also has been historically managed as a wilderness.

The spectacular peaks of Unimak Island, awesome in their beauty, have guided mariners for centuries. Left to right: Round Top Mtn., Isanotski Peaks and Shishaldin Volcano. 9/23/87 Blenden

G. WILDLIFE

1. Wildlife Diversity

Approximately 142 species of birds and 23 species of mammals have been reported as residents and/or migrants on Izembek NWR. Four species of Pacific Salmon (chum, pink, red and silver), two varieties of trout (dolly varden and arctic char) and stickelbacks are the primary fish species in fresh-water habitats on the refuge. King salmon may occur in very low numbers in the Moffett Bay area. A minimum of 23 species of saltwater fish have been reported in Izembek Lagoon.

2. Endangered Species

The endangered Aleutian Canada goose (*Branta canadensis leucopareia*) may occur on Izembek NWR during fall migration from their western Aleutian nesting areas, however, this use has not been documented by actual sightings. A single Canada goose with a yellow tarsus band, possibly an Aleutian Canada, was observed by Dave Ward (AFWRC) on 17 October near the Outer Marker. In addition, the Arctic and American races of the peregrine falcon (*Falco peregrinus tundrius* and *F.p. anatum*, respectively) may occur in the area during migration, however, use by these species has not been documented either. The nonendangered or unthreatened Peale's race of the peregine falcon (*F.p. pealei*) is a fairly common resident of the area.

A study was initiated in 1987 by the Regional Office Endangered Species Division to determine numbers and taxonomic status of the Amak Song Sparrow (*Melospiza melodia amaka*) and Amak Tundra Vole (*Microtus oeconomus amakensis*) both of which occur only on Amak Island, northwest of Cold Bay (see Figure 1). The cooperator on this project, Dr. Gerald Shields of the Institute of Arctic Biology-University of Alaska, was granted permission to live trap several specimens of each species. Researchers were on Amak 24 and 25 July and reported a total population of approximately 25 song sparrows. One specimen was live trapped and one was collected both of which will be used for genetic research. A total of four voles were captured during 18 trap-nights and were judged, on the basis of sign, to be present throughout lowland habitat of the island.

Further work with both the Amak song sparrow and vole may be proposed for 1988 to obtain a larger sample of live specimens.

3. Waterfowl

Tundra Swan

Tundra swans, the key nesting waterfowl species at Izembek, utilize the entire refuge and remain on refuge lands all year. Therefore, a knowledge of their habitat needs and population parameters is essential to managing and protecting refuge ecological units. In order to fulfill one of our mandates of protecting the essentially pristine wilderness nature of the refuge, knowledge is necessary of species such as the tundra swan which require wilderness conditions in order to reproduce. Swans are a key indicator species that show the health of refuge habitats and conditions.

Winter weather at the beginning of 1987 was unseasonably mild with many days of above freezing temperatures. Consequently open water areas were present throughout the refuge and the swans did not have to concentrate at the springs at Peterson Lagoon on the Unimak Unit. Without reliable ice, winter access to much of the refuge is impossible. We are unable to read large numbers of swan collars if the swans do not concentrate at Peterson Lagoon. Also an accurate winter survey is very difficult with such conditions. The swans are scattered in small groups and are "camouflaged" when standing on patches of snow and ice creating very difficult survey conditions. Therefore no winter survey or neck collar readings were done in 1986/87. Unfortunately similar conditions occurred again during the winter of 1987/88 and again no survey was done.

Table 7 shows a summary of winter survey information prior to the recent 2 mild winters. The peak winter population has

TABLE 7. Winter Tundra Swan Surveys of Unimak Island and Izembek NWR

Date	Immature	Adult	Total Classified	Total Observed	Marked[1] Swans	Swan[2] Location	Area[2] Covered
01/06/78				294	na	I,P,C,S	I,U
02/08/78				309	na	P,C	U
11/13/78				400	1	I,S,P,C	I,U,
11/15/78	40(17.6%)	187	227	235	14	P	P
11/29/78				286	?	P	P
12/05/78	7(4.7%)	143	150	196	4	L,P,C	L,P,C
12/29/78	29(8.0%)	332	361	361	9	P	P
01/05/79				136	1	P	P
01/12/79				264	1	I,S,L,C	I,U
01/24/79				300+	5+	P	P
02/24/79				229	?	I,S,P,C	I,U
03/05/79				241	8	I,S	I,S
03/07/79				236	7	I,S,O,P,C,Z	I,U,Z
11/06/79				266	9	I,S,P,C	I,U
12/12/79				390	?	P	P
12/21/79				493	6+	L,P,C	U
01/02/80				458	?	L,P,C	U
01/07/80				494	5	P,C,	L,P,C
01/09/80	48(11.9%)	354	402	533	17	P,C	L,P,C
02/06/80				573	11	L,P,C	U
10/24/80	3(4.3%)	70	73	92	0	I,P	I,P
10/28/80				247	9	I,S,O,L,P	I,U
11/02/80				148	?	L,P	L,P
01/20/81	26(7.5%)	321	347	540	16+	S,O.L,P,C	U
01/27/81	43(7.6%)	521	564	564	27	L,P,C	U
11/16/81				285	?	L,P	U
12/24/81				598	?	S,O,L,P	U
01/09/82	86(14.7%)	499	585	673	44	L,P	S,O,L,P
02/10/82				270	?	P	P
02/20/82				150	?	S	S
02/24/82	80(13.5%)	512	592	592	30	P,Z	I,U,Z
12/08/82				654	?	P,L	P,L
12/23/82				90	?	I	I
01/17/83	72(12.0%)	527	599	672	44+	I,L,P,C	I,U
02/05/83				517	?	P,L,C	U
03/18/83				162	17	I	I
11/15/83				120	17	I	I
01/20/84				580	44	S,P,O,C	I,U
01/23/84				575	?	P,O	I,U
02/22/84	70(15.8%)	374	444	444	44	P,L	I,U
01/07/85				114	?	I	I(N. ½ only)
01/21/85				168	?	I	I(S. ½ only)
01/22/85				264	3+	I,S,O,L,P,C	I,U
12/30/85				104	?	I	I(N. ½ only)
01/24/86	21(5.2%)	380	401	635	59	P,L	I,U
02/01/86				272	?	L	U
02/02/86				241	5	P	P
7-year av.	10.8%[3]			585[3]			

[1]Includes birds who have lost neck collars, but legband(s) were observed.

[2]I-Izembek NWR, U-Unimak, S-Swanson Lagoon, O-Otter Point, L-Cape Lapin R., P-Peterson Lagoon, C-Christianson Lagoon, Z-Lazaref R.

[3]From peak count each winter (excluding '78 and '85 which were open winters and swans did not congregate enough for reliable total count).

[4]No winter surveys done due to weather. Winters of '86/'87 and '87/'88 were not cold enough to cause swans to concentrate on Peterson Lagoon.

been quite consistant showing a remarkably stable population. The combination of high nest predation, high cygnet mortality, and some adult mortality appears to negate any increase in the population.

It was unfortunate we were unable to read neck collars here during the winter of 1986/87, because at the same time a large increase in Lower 48 swan resightings occurred (Table 8). Twenty-three different swans were observed 40 times in Washington, Oregon, and California. This was quite an increase since only 19 swans total had been observed in the Lower 48 in 8 winters prior to the 1986/87 winter.

In 1985 we began neck collaring swans on the Pavlof Unit (about 70 miles NE) to determine whether or not these birds were part of the non-migratory population. We knew only 600 to 700 swans wintered here each year, but several thousand swans are present each year throughout the Alaska Peninsula. The first winter after banding on the Pavlof Unit, results were somewhat inconclusive. No Pavlof Unit birds were observed here in the winter while 4 were observed in the Lower 48 (Table 8), suggesting the Pavlof Unit birds migrate. This was confirmed in the winter of 1986/87 when 22 out of 23 swans sighted in the Lower 48 were birds banded on the Pavlof Unit.

It all seemed so straightforward. Izembek Unit birds were non-migratory and Pavlof Unit birds migrated. Then came the winter of 1987/88! Thirty-five different swans were observed 127 times in Alberta, British Columbia, Washington, Oregon, and California (Table 8). The surprise was 20 out of the 35 were banded in the Izembek Unit! For 9 previous winters a total of only 16 birds (8 in one family group) from the Izembek Unit were observed in the Lower 48, compared to 20 more in just one winter! We are at a loss to explain why this occurred. Our winter weather did not seem to be the reason, since it was mild. Many of the birds that migrated were captured from flocks of non-breeders molting in areas of Izembek we usually do not reach. The use of a floatplane in 1987 allowed us to reach some new areas. Also possibly some of the Pavlof Unit non-breeders shifted to Izembek before molting.

As with most biological occurrences, nothing is absolute. In addition to the change in migration pattern noted above, four birds have now wintered both in Alaska and the Lower 48. Swan 11 (female) spent the winters of 1978/79 and 1979/80 at Izembek and 1980/81 in Oregon. Swan A1 (female) spent 1982/83 and 1985/86 at Izembek and 1984/85 in Oregon. Swan 8T (male) spent 1983/84 at Izembek and 1987/88 in California. And swan AK (female) spent 1985/86 at Izembek and 1987/88 in Oregon.

An unusually high number of neck collared tundra swan were seen during the winter of 1987/88 from British Columbia to California. Izembek swans are normally seen in mixed flocks with trumpeter swans. 1/23/87 Sarvis (453)7

Table 8. Summary of Tundra Swans resighted in the Lower 48 states.

Winter	Collar Code	State	No. of Sightings	Year Banded	Location	Age-Sex @ Banding
80/81	11 [1]	OR	1	1978	IZM	SY-F
(3 birds)	55	CA	3	1980	"	ASY-M
	70	WA	1	1980	"	SY-F
81/82	55	CA	1	1980	"	ASY-M
(3 birds)	T4	WA	1	1981	"	L-F
	T5	BC	1	1981	"	SY-M
82/83		0 BIRDS SEEN				
83/84	9U [2]	WA	21	1983	IZM	ASY-M
(9 birds)	1F [2]	"	"	"	"	L-M
	2F [2]	"	"	"	"	ASY-F
	4F [2]	"	"	"	"	L-F
	6F [2]	"	" +	"	"	L-F
	8F [2]	"	"	"	"	L-F
	0F [2]	"	"	"	"	L-F
	2J [2]	"	"	"	"	L-F
	7J	"	1	"	"	ASY-M
84/85	A1 [1]	OR	1	1982	IZM	ASY-F
(2 birds)	6F	WA-11; ID-3		1983	"	L-F
85/86	CF	WA-2; OR-1		1985	Pavlof	ASY-F
(4 birds)	CP	WA	9	"	"	ASY-M
	CT	OR	2	"	"	ASY-M
	JY	OR	2	"	"	ASY-F
86/87	CF	WA-1; OR-	1	1985	Pavlof	ASY-F
(23 birds)	CY	OR	1	"	"	ASY-F
	JK	WA	2	"	"	ASY-M
	JY	WA-1; OR-	1	"	"	ASY-F
	KF	WA-1; OR-	1	"	"	SY-F
	MJ	WA	2	"	"	ASY-F
	YP	WA	5	"	"	ASY-F
	9R	WA-1; OR-	2	"	"	ASY-M
	B3	OR	1	1986	IZM	ASY-M
	H8	CA	1	"	Pavlof	SY-F
	N1	CA	1	"	"	SY-M
	N3	WA	2	"	"	ASY-M
	N5 [3]	"	1	"	"	ASY-M
	N7 [3]	"	1	"	"	L-M
	N0 [3]	"	1	"	"	ASY-F
	R4 [3]	"	1	"	"	L-F
	R6	"	4	"	"	SY-F
	S2	WA-1; OR-	2	"	"	ASY-F
	S6	WA	1	"	"	ASY-F
	S7	OR	1	"	"	ASY-M
	S8	WA	1	"	"	ASY-M
	S9	"	1	"	"	ASY-M
	4R	OR	1	"	"	SY-F

Winter	Collar Code	Paired With	State/ Province	No. Of Sightings	Year Banded	Banding Location	Age-Sex @ banding
87/88	29(8T)[1]		CA	1	1983	IZM	ASY-M
(35 birds)	AK[1]		OR	3	1985	"	SY-F
(12% obs.)	CF	2	WA	8	"	Pavlof	ASY-F
	CP		WA	12	"	"	ASY-M
	CU	5	WA	2	"	"	ASY-M
	JK		WA	2	"	"	ASY-M
	KF		WA	3	"	"	SY-F
	PU		WA	1	"	IZM	SY-M
	UC		WA	2	"	"	L-M
	UT		OR	2	"	"	L-M
	YC	5	WA	3	"	"	ASY-F
	YP		WA	3	"	"	ASY-F
	9R		OR	2	"	Pavlof	ASY-M
	H4		CA	1	1986	IZM	L-F
	N2		ALB	2	"	Pavlof	ASY-F
	N6		ALB-1; CA-1		"	"	ASY-F
	NO		WA	4	"	"	ASY-F
	R5		WA	4	"	"	ASY-M
	S2	2	WA	8	"	"	ASY-M
	S7		OR-1; WA-1		"	"	ASY-M
	S8	3	WA	4	"	"	ASY-M
	S9	3	WA	3	"	"	ASY-M
	V9		WA	2	"	"	ASY-M
	05	1	WA	3	1987	IZM	ASY-M
	26	1	WA	3	"	"	ASY-F
	42	4	WA	5	"	"	ASY-F
	AO		OR	2	"	"	SY-F
	X4		BC	2	"	"	ASY-F
	X6		WA	7	"	"	ASY-F
	X9		OR	16	"	"	SY-M
	Z4		WA	1	"	"	SY-F
	3B		OR	1	"	"	L-M
	7H		WA	2	"	"	ASY-M
	7S	4	WA	6	"	"	ASY-M
	ZZ		CA	3	"	"	SY-F

SUMMARY: 64 individuals resighted 375 times (WA-309; OR-45; CA-12; ID-3; BC-3; ALB-3).

13 individuals seen two winters in L-48 states (55, NO, S2, S7, S8, S9, 6F, 9R, CP, JK, JY, KF, YP).

1 individual seen three winters in L-48 states (CF).

[1] Four swans have wintered both at Izembek and in the L-48 states. Swan 11 spent the winters of 78/79 and 79/80 at Izembek and 80/81 in Oregon. Swan A1 spent 82/83 and 85/86 at Izembek and 84/85 in Oregon. Swan 8T(29) spent 83/84 at Izembek and 87/88 in California. Swan AK spent 85/86 at Izembek and 87/88 in Oregon.

[2] Brood of 2 adults and 6 cygnets.

[3] Brood of 2 adults and 4 cygnets (only 2 observed in L-48).

Thirteen swans have been observed for 2 winters in the Lower 48. One swan (CF) has been seen in Washington all 3 winters since banding it in 1985.

With 35 swans observed south of Alaska in the winter of 1987/88 and 23 in 1986/87, a pattern is beginning to emerge regarding wintering location. The majority are wintering along the Columbia River on and near Ridgefield National Wildlife Refuge with 22 of the 35 swans in 1987/88 observed in this area. The rest of the observations are scattered with some in the Skagit River area (Wash.), a few in the Willamette Valley, and coastal areas of Oregon, a few in northern California, and occasionally one in British Columbia. The migration route is unclear at this point, but we have had 3 birds observed in Idaho/southern Alberta during migration time periods, so some may migrate in Canada east of the Rockies. Where they divert from the route taken by swans destined for northern Alaska is a mystery so far.

A spring nesting/population survey was again done on the Pavlof Unit following the tundra swan survey protocol developed by the Migratory Bird Management office. The five 1:63,000 USGS quadrangle maps surveyed last year were again done and one more map was added (Table 9). All section lines on these maps were flown using Loran equipment for navigation. A total of 520 swans were found in 707.6 square miles for a density of .73 swans/square mile. In 1986 quite a few more nests were found than in previous years. The swan population and number of nests occurring in 1987 were nearly identical to 1986 indicating another good year for nesting (Table 10).

The annual Izembek area nesting and population survey was accomplished May 19 with 214 swans (30 neck collared) observed on Izembek, Pavlof Unit (SW of Black Hills only) and adjacent areas (Table 11). The number of nesting pairs (38) was only one less than the most ever recorded in the ten years swan surveys have been done. The total counted (214) was close to the nine year average of 225, again indicating an essentially stable population.

A total of 40 nests were found in 1987 (Table 12), one nest above the eight-year average. We are beginning to build an accurate long-term record of swan production on Izembek which should prove valuable in monitoring/predicting future changes. At any rate, 1987 proved to be an average year for number of nests, clutch size, and hatching success, but the best ever for cygnet survival (Table 12).

The first nest hatched on May 27 and the last nest to hatch was June 15 (Figure 3). In contrast to more northern nesting areas, we have a wide range of hatching dates. Probably because we have a much longer "growing" season before freeze-up and because the ice disappears several weeks before

Table 9. May 1987 Tundra Swan Survey of the Pavlof Unit.

Date	PML Map	Single	Single w/nest	Pair w/nest	Pair w/brood	Pair w/o nest	Birds in Flocks	Total Swans	Area Covered (sq. mi.)	Density (sq. mi.)
5/27	D-3	0	0	2	0	2	0	8	29.0	.28
5/27	D-4	11	1	16	0	21	128	214	175.8	1.22
5/27-28	D-5	17	9	13	0	35	42	164	177.1	.93
5/28	D-6	6	1	1	0	13	6	41	104.5	.39
5/27-28	C-5	9	2	6	0	15	6	59	110.7	.53
5/28	C-6	5	1	2	0	5	14	34	110.5	.31
1987 Total		48	14	40	0	91	196	520	707.6	.73

Table 10. Summary of Tundra Swan nesting surveys on the Pavlof Unit.

Date	PML Maps	Search Method[1]	Single	Single w/nest	Pair w/nest	Pair w/brood	Pair w/o nest	Birds in Flocks	Total Swans	Area Covered (sq. mi.)	Density (sq. mi.)	Avg. Clutch	Avg. Brood
6/12/84	D-5 & 6	RS	11	5	16	10	39	25	171	281.6	.61	3.7(11/3)	3.4(34/10)
6/6-10/85	D-5,6 & C-5,6	SL	35	5	16	0	124	166	486	502.8	.97	4.4(61/14)	N/A
5/16-21/86	D-4,5,6 & C-5,6	SL	46	18	38	0	92	182	506	678.6	.75	not done	N/A
5/27-28/87	D-3,4,5,6 C-5,6	SL	48	14	40	0	91	196	520	707.6	.73	not done	N/A

[1] RS-Random Search of all swan habitat; SL-flew each section line using Loran C radio.

Table 11. Spring Nesting Surveys of Tundra Swans (Area of Coverage: Izembek NWR, Cathedral Lakes, lakes south of Cold Bay to Thin Point and west side of Morzhovoi Bay)

	No. of Swans Observed (% of Total)							
	Singles	Swans (nesting pairs)	Swans (other pairs)	In Groups	Total	Area Cov. (sq. mi.)	Density (sq. mi.)	No. of Collared Swans Seen
5/8/78[1]	6 (8%)	18 (23%)	26 (33%)	28 (36%)	78	315.5	.25	NA
4/25,28/79[2]	10 (5%)	24 (12%)	96 (47%)	75 (36%)	205	413.9	.50	12
5/14-15/80	9 (4%)	60 (26%)	84 (36%)	80 (34%)	233	413.9	.56	1
5/13,15/81	16 (8%)	58 (29%)	94 (48%)	29 (15%)	197	413.9	.48	21
6/2,6/82[3]	11 (5%)	68 (30%)	92 (41%)	55 (24%)	226	413.9	.55	23
5/31-6/1/83[3]	8 (4%)	48 (21%)	94 (41%)	77 (34%)	227	413.9	.55	37
6/7-8/84[3]	5 (2%)	78 (35%)	54 (25%)	85 (38%)	222	413.9	.54	42
5/28,30,6/1/85	20 (7%)	54 (20%)	52 (20%)	140 (53%)	266	413.9	.64	32
5/20/86	11 (5%)	70 (29%)	66 (28%)	90 (38%)	237	413.9	.57	24
5/19/87	7 (3%)	76 (36%)	50 (23%)	81 (38%)	214	413.9	.52	30
Avg. last 9 yrs.	11 (5%)	59 (26%)	76 (34%)	79 (35%)	225	413.9	.55	25

1 Cathedral lakes, lakes south of Mortensen's Lagoon and west side of Morzhovoi Bay areas not covered. Other areas not covered thoroughly.

2 Survey done too early to include peak of nesting.

3 Survey late for peak of nesting.

Table 12. Tundra Swan production on Izembek NWR (includes Izembek Unit, W. portions of Pavlof Unit, and vicinity).

Parameter	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	8 Yr. Avg.
Nests with known clutch				17	23	22	14	30	26	32	37	-
Number eggs				82	118	105	75	142	114	154	180	-
Mean clutch				4.82	5.13	4.77	5.36	4.73	4.38	4.81	4.86	4.86
Total nests	?	14+[1]	17+[1]	34	47	44	28	42	35	40	40	39
No. hatched (nest hatch success)	10+	9+	7+	17(50%)	17(36%)	22(50%)	19(68%)	32(76%)	16(46%)	21(53%)	21(53%)	21
First obs.-# broods (cygnets)				15(51)	17(64)	22(74+)[2]	19(87+)[2]	30(118+)[2]	15(57+)[2]	19(72+)[2]	21(79+)[2]	20(75)
Average brood size at hatch				3.4	3.8	3.4	4.6	3.9+	3.8+	3.8+	3.8+	3.8
Last Obs.-before 9/1 No. broods(cygnets)	10(34)	9(28)	7(17)	10(22)	13(32)	9(23)	17(49)	22(75)	10(27)	16(50)	18(62)	14(38)
Average brood size at flight	3.4	3.1	2.4	2.2	2.5	2.6	2.9	3.4[3]	2.7	3.1	3.4	2.9
Dates of last observation	7/22	7/21,8/8	7/18	Various	Various	8/22,9/2	Various	Various	8/21-26	Various	Various	NA
Egg hatching success[4] (successful nests only)				78%	65%	85%	90%	86%	89%	69%	77%	80%
Success-eggs to[4] flight stage				32%	33%	28%	46%	51%	42%	44%	60%	42%
Success-hatched[4] to flight stage				41%	50%	33%	51%	59%	47%	68%	78%	53%

1 Total nests estimated in 1978 and 1979 from a combination of nest surveys done too early and later brood surveys.

2 In 1982, 1983, 1984, 1985, 1986 and 1987: 1 brood, 1 brood, 6 broods, 2 broods, 2 broods, and 3 broods, respectively were not observed close enough to their hatching dates to be sure of the original number of cygnets. Number of cygnets at hatch is therefore an estimated minimum number. In addition, two nests hatched in 1984 and one in 1985, but the brood was never observed.

3 Probably high since many broods were last observed in July. Other duties prevented brood checks normally done in August.

4 Excluded from these calculations in 1984 (nest no.s 6,9,12,30,31,36,42), in 1985 (28,32,33,35), in 1986 (20,25,39), and in 1987 (39).

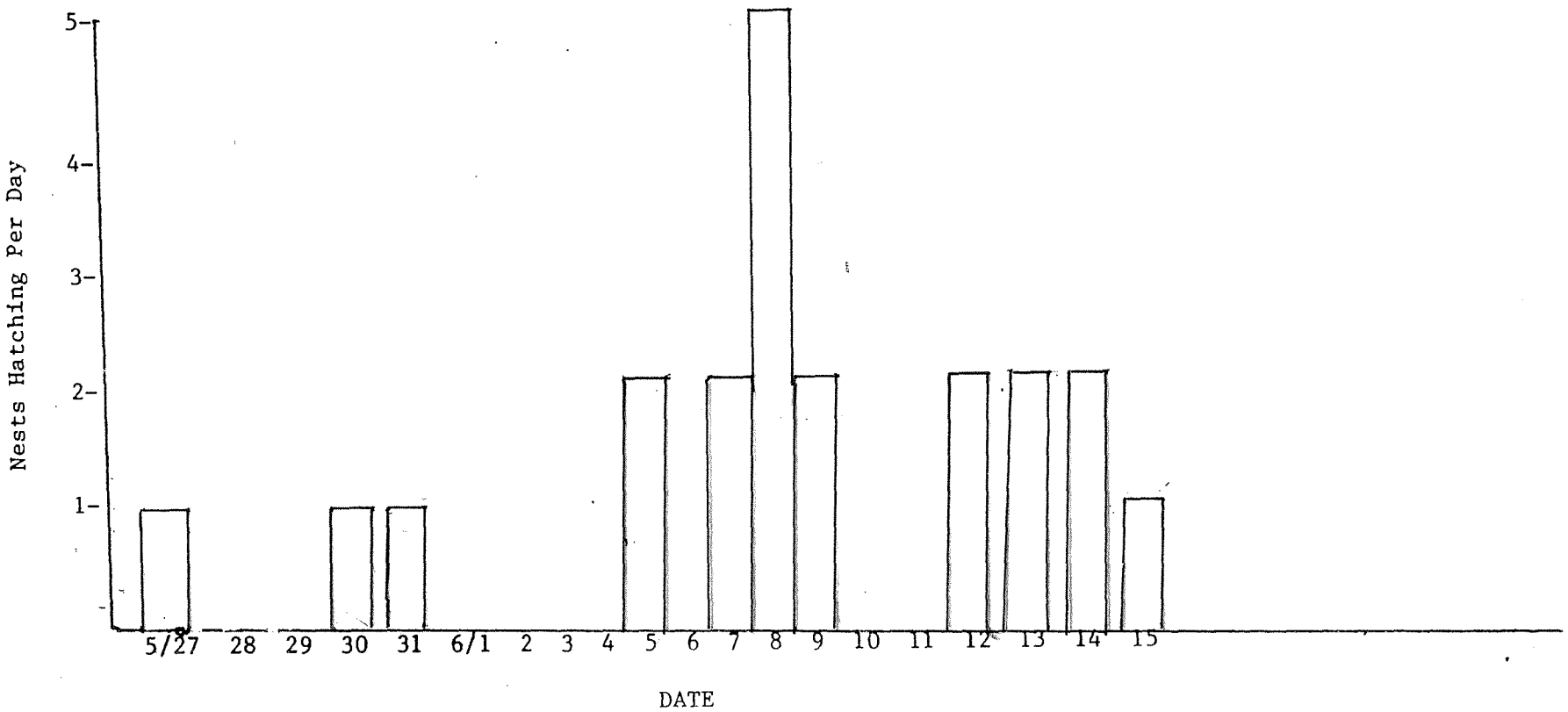


Fig. 3. Hatching dates for 21 successful tundra swan nests in 1987.

egg laying. The timing of nest initiation and hatch is not as critical to cygnet survival at Izembek as in more northern areas. The peak of hatch occurred from June 5-9 with 11 of the 21 successful nests hatching then (Figure 3). This pattern of nearly a month between first and last hatching dates with the peak in early June is typical of a normal year with average weather conditions.

Over the last several years, brown bear numbers in the Cold Bay road system have been reduced considerably due primarily to hunting. This situation has provided an opportunity to further test the theory that bears are the primary tundra swan nest predator. Nesting success in the road system area containing low bear numbers has been nearly twice as high as the rest of the refuge. In 1987, 86% of the nests within the road system area hatched, while 45% hatched on the remainder of the refuge (Table 13). Normally, if there was any difference, it would seem nest success in the more disturbed portions of the refuge would be less than the Wilderness portions, since tundra swans prefer undisturbed nesting territories. But in this case, the benefit of low bear predation more than makes up for any additional disturbance that may be occurring in the central area.

The 21 nests that hatched this year had an initial cygnet total of at least 79 (Table 14). There were probably a few more than this initially, since two broods (#39 and #40) were not observed until 14 and 23 days old, respectively.

Of the 21 original broods, 18 broods (86%) containing 62 cygnets reached flight stage, even better than 1986, (which was 78%). This 86% survival rate was by far the best recorded so far and considerably above the eight year average of 53%. As in past years, cygnets perished at a higher rate within the first 10 days of hatching (77% of the cygnet loss) than later. (Figure 4). During the last seven years, an average of 52% of the cygnets that died did so when less than 10 days old (Table 15). Though a similar number of cygnets died this year during the first 10 days compared to other years, the similarity ended after that. Only 4 more cygnets died after they were 10 days old, a phenomenal surival rate! Weather was mild with no major storms or high wind chill conditions. This may have been the reason for the excellent cygnet survival.

We first documented high cygnet loss here during the early years of this study and initially speculated it might be due to diseases or parasites. We had been finding many of the dead cygnets, so decided that predation was not a major factor. We sent some cygnets to the National Wildlife Health Lab for necropsy and received results that indicated no disease or parasite problems. We also had over 100 blood samples analyzed for parasites and none were found. With information only obtainable through a longterm study such as

Table 13. Comparison of Tundra Swan nest success between the Cold Bay road system and the rest of the refuge.

Year	Nests in Road System Area[1]			Non-Road System Nests		
	Hatched	Unsuccessful	Total	Hatched	Unsuccessful	Total
1981	9 (64%)	5	14	8 (24%)	25	33
1982	8 (80%)	2	10	14 (41%)	20	34
1983	10 (100%)	0	10	9 (50%)	9[2]	18
1984	7 (100%)	0	7	25 (71%)	10[2]	35
1985	3 (75%)	1	4	13 (42%)	18	31
1986	4 (67%)	2	6	17 (50%)	17	34
1987	6 (86%)	1	7	15 (45%)	18	33
Total	47 (81%)	11	58	101 (46%)	117	218

[1] The Cold Bay Road System Area is described in the ADF&G brown bear regulations and includes central Izembek NWR and lands south of Cold Bay.

[2] Undoubtedly low since numerous destroyed nests were not located in 1983 and 1984 due to late surveys.

Table 14. Summary of 1987 successful Tundra Swan nests.

Nest No.	Collar Status[1]	Clutch[2]	Hatching Date	No. Cygnets in Brood (age in days) First Obs.	Intermed. Obs.	Last Obs.[3]
5		2	6/15	2(2)	2(3-4),(7)	1(38)
6		5	5/30	4(1)		4(58)
8		6	5/31	6(2)		6(61)
9		6	6/7	6(2)	6(10-50),5(107)	5(142)
10		5	6/13	4(1)		0(6)
11		5	6/8	5(1)		5(53)
12		5	5/27	5(1)		5(61)
14	SCP	4	6/8	3(1)		3(45)
16	SCP	6	6/8	6(1)	5(2)	5(49)
19	DCP	4	6/14	2(3)		2(100)
20	DCP	5	6/7	4(2)	3(10)	3(53)
21	DCP	6	6/9	2+(1)	1(8)	1(130)
22	DCP	7	6/5	5(1)		5(110)
23		4	6/12	3(5)	3(6-23),2(24)	2(48)
24		3	6/8	3(1)		3(52)
25		6	6/9	3(1)		0(8)
26		5	6/14	3(3)		2(39)
28		6	6/5	4(1)	2(4)	2(63)
34	SCP	4	6/13	1(4)	1(6-55)	0(55)
39		(2+)	6/12	2+(14)		2(27)
40		(6+)	6/8	6+(23)		6(45)
Totals						
21		102+		79+		62
	Av.	4.86 clutch	77% of eggs[4] hatched	60% of eggs resulted[4] in cygnets reaching flight stage.		78% survived[4] from hatch to flight.

[1] SCP-Single Collared bird in Pair; DCP-both birds collared.

[2] Eggs in ( ) were derived from first brood observation and eggs remaining in nest.

[3] Cygnets first fly at 65-75 days of age.

[4] Excluding nest no. 39. Percentage shown is the minimum egg hatching success since more eggs may have hatched, but the cygnets died before the first brood observation.

Table 15. Chronology of Cygnet Deaths by Age Period, 1981-1987.

	Age of Cygnet in Days								
Year	0-5	6-10	11-20	21-30	31-40	41-50	51-60	61+	Total Cygnets Lost
1981	6	14	2	5	1		1	3	32
1982	12	17	13	3	2	3		1	51
1983	9	6	9	7	3		3	1	38
1984	9	8	11	12	2	1			43
1985	6	9	6	3	1	1	3	1	30
1986	11	4	1	3	4	1	1		25
1987	11	2	1	1			1	1	17
Total	64	60	43	34	13	6	9	7	236
%	27%	25%	18%	14%	6%	3%	4%	3%	

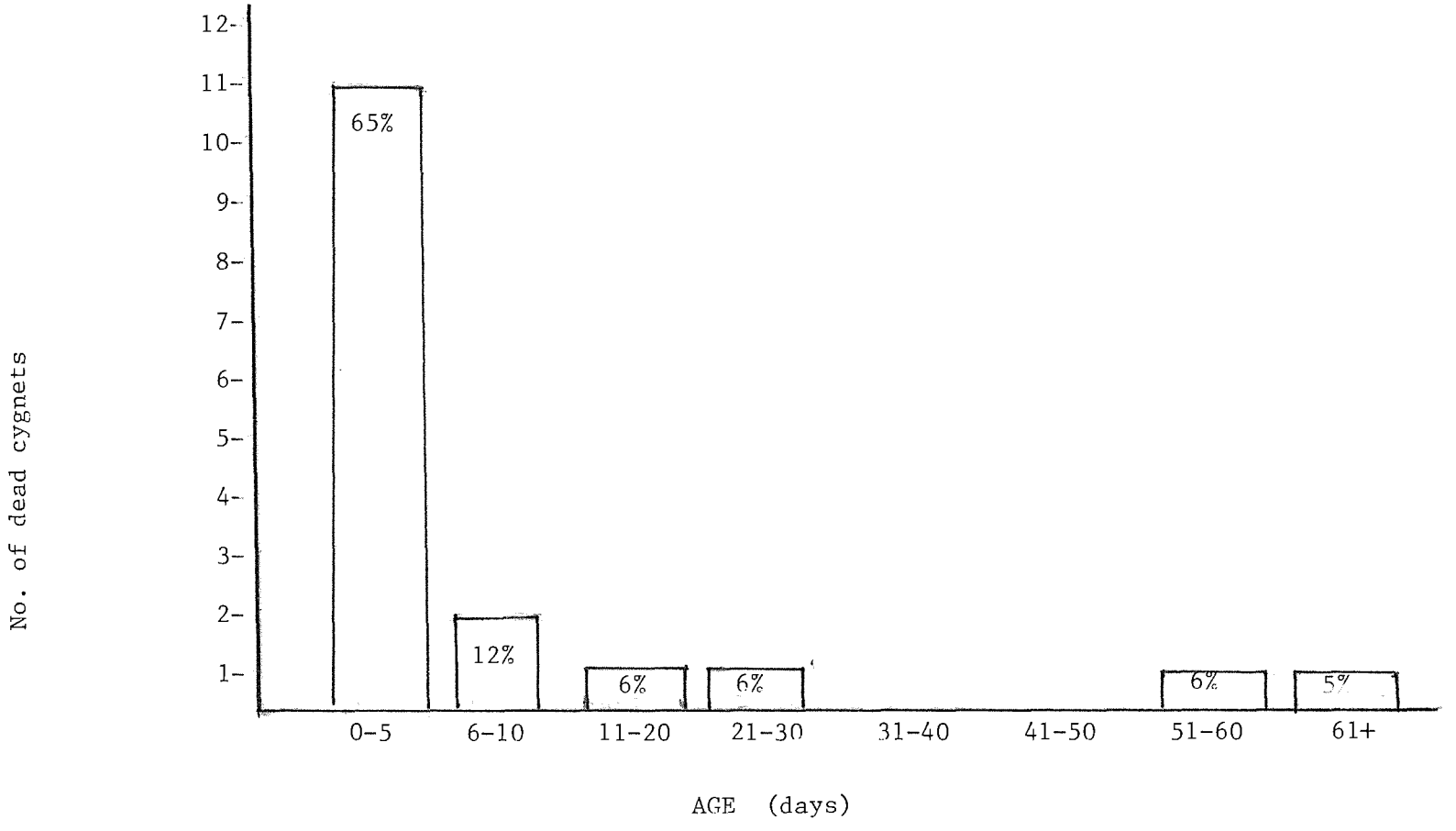


Fig. 4. Chronology of cygnet loss in 1987 (data from Table 15).

Molting tundra swans are pursued and captured by dip-netting from outboard powered, inflatable boats. After 8 to 10 are captured, they are deposited on shore for processing. 7/31/87 Blenden

The data collection phase of tundra swan banding occurs after the capture operations. Birds and banders both find time to dry off during the process. Blenden

this one it now appears that weather may be the most important factor influencing cygnet survival. During unusual years when the weather has been mild during June and early July, cygnet survival has been better (e.g. 1985). June and early July in 1987 were dry and slightly warmer than normal and cygnet survival was well above average. In 1985, the temperature was several degrees colder than normal. Compared to 1987, 1985 was colder, wetter and had high average wind speeds. 1987 was the best year for cygnet survival while 1985 was one of the worst.

With several years' data on production by neck-collared swans, we have shown that neck collars have no adverse behavioral impacts on nesting. This year nine marked pairs nested (Table 16). For two pairs, both swans had neck collars, five pairs the female only had a neck collar and for two pairs only the male had a neck collar. As usual the hatching success rate (78%) for marked swan pairs was higher than all swan pairs combined (53%). Seven of the nine marked pairs had successful nests this year. Their average clutch size (5.0) was slightly larger than for all nests combined (4.9) (Tables 16 and 12).

For the nine marked-pair swan nests in 1987, the male was observed incubating 23 times (34%) and the female 45 times (Table 16). Over the last 7 years, observations have been made on the nesting behavior of 55 marked swan pairs. The male has been observed incubating the nest 30% of the time and 70% of the time the female has been on (Table 17). Although occasionally with individual pairs the male is on the nest more than the female, normally the female does the majority of the incubating. It is interesting to note in contrast, that trumpeter swan males apparently never incubate.

The history of pairs using two of the principal and most readily observed swan territories on the refuge is chronicled in Table 18. Bluebill Lake is the most productive swan territory on the refuge and has had a nest there for at least 15 years in a row. Before marking individual birds, one might have assumed the same pair was nesting there each year. But in fact, there appears to be considerable turnover. One male used the territory three years and another 4 years. A female (74) has used it five years with three different mates. One male (61) has used both territories and had four different mates in six years of nesting!

Further information showing the importance of the Bluebill Lake swan territory is shown in Table 18a. Rarely do we find a nest with more than six eggs. In five of the last 8 years the Bluebill Lake nest has contained a clutch more than 6. Less than 10 nests in the last 10 years have had more than six eggs, yet 5 of these have been at Bluebill Lake. The

Table 16. Summary of nine nests made by neck-collared swan pairs in 1987.

Nest	Collar number	Bird Incubating Nest		Clutch	Outcome[1]	Number of Cygnets	
	(male/female)	Male	Female		(date)	At Hatch	Flight
14	89/Uncoll.	3(37%)	5(63%)	4	H(6/8)	3	3
16	Uncoll/TO	1(17%)	5(83%)	6	H(6/8)	6	5
18	5Y?/Uncoll.	0	2(100%)	?	DM(5/28)	-	-
19	(5M)[2]/8M	5(45%)	6(55%)	4	H(6/14)	2	2
20	(8T)[2]/B2	3(30%)	7(70%)	5	H(6/7)	4	3
21	3F/4J	5(42%)	7(58%)	6	H(6/9)	2+	1
22	61/74	4(36%)	7(64%)	7	H(6/5)	5	5
29	Uncoll/2U		1(100%)	4	DA(5/30)	-	-
34	Uncoll/A7	2(29%)	5(71%)	4	H(6/13)	1	0
		23(34%)	45(66%)	40 (avg.5.0)		23+	19

1 H-Hatched; DM-Destroyed, probably mammalian predation; DA-Destroyed, probably avian predation.

2 Swans marked 5M and 8T had lost their collars before nesting; identity later confirmed when they were recaptured.

Table 17. Summary of nests made by neck-collared tundra swan pairs-all years.

Year	No. marked Pairs that nested	Bird Incubating Nest Female	Male	No that Hatched	Number Cygnets At Hatch	Flight Stage
1981	6	30(67%)	15(33%)	3(50%)	12	6
1982	5	35(59%)	24(41%)	5(100%)	16+	6
1983	7	25(83%)	5(17%)	5(71%)	12	12
1984	12	25(74%)	9(26%)	11(92%)	41+	22+
1985	9	23(77%)	7(23%)	4(44%)	17+	7
1986	7	40(78%)	11(22%)	5(71%)	19	15
1987	9	45(66%)	23(34%)	7(78%)	23+	19
7 Year Summary	55	223(70%)	94(30%)	40(73%)	140	87(62% survival)

Table 18. History of two principal swan territories near Cold Bay.

Year	Y Territory (nest location)	Bluebill Lake Territory (nest location)
1977	23/28 (?)	?
1978	23/28 (?)	26/27 (?)
1979	23/28 (?)	? (Peninsula?)
1980	61/62 (Lake #27)	73/74 (Island)
1981	61/16 (Lake #45)	C9/U8 (Peninsula)
1982	Unc. pair, maybe 9U/2F (Trout Cr. marsh)	C9/74 (Island)
1983	9U/2F (nr. Lake #93)	C9/74 (Island)
1984	9U/2F (nr. Lake #93)	61/46 (Island)
1985	None	61/46 (Island)
1986	None	61/74 (Island)
1987	None	61/74 (Island)

Table 18a. Eight year history of Bluebill Lake Swan Territory.

Year	Nest No.	Adults (M/F)	Clutch Size	Number Hatched	Number to flight stage	Cygnet Neck Collar Codes
1980	#19	73/74	8	7	5	69,71,76, 78,80
1981	#26	C9/U8	7	2	2	C5,C7
1982	#23	C9/74	5	5	0	0-predation
1983	#14	C9/74	7	7	3	3U,5U,7U,OU
1984	#30	61/46	2+	2+	2	5K,2M
1985	#16	61/46	5	5	4	PM,TM,UJ,UK
1986	#24	61/74	8	5	5	B7,B9,H2, H4,H6
1987	#22	61/74	7	5	5	5R,7R,OR, 14,20
Total			49+	38+	26	
Average			6.7[1]	5.1[1]	3.7[2]	

[1]Excluding 1984.

[2]Excluding 1982.

average clutch size for Bluebill Lake is a phenomenal 6.7 compared to the refuge-wide, 8 year average clutch of 4.9. The average number of cygnets hatched on Bluebill Lake is 5.1, again well above the refuge-wide average of 3.8. Only two broods of 7 have ever been observed at Izembek and they both occurred at Bluebill Lake (and by swan 74 with 2 different mates). The number of cygnets at Bluebill Lake reaching flight stage has averaged 3.7 compared to the refuge-wide average of 2.9. And finally, the only marked cygnet to survive 5 years is swan C7, a cygnet hatched at Bluebill Lake (Table 19).

So far, we have still not had any swans nest that were banded as cygnets. The mortality rate of cygnets is high even after they survive their first year. We have banded 156 cygnets so far, but the vast majority have not survived to breeding age (Table 19). Only nine birds banded as cygnets have been observed at 3 years old or older (Table 20). These few that have reached breeding age have not bred yet. More cygnets are probably recruited into the breeding population than collaring information shows (since some collars are being lost), but it nevertheless still appears difficult for a cygnet to survive to breeding age and successfully establish a territory. We have a saturated, stable swan population. Apparently a swan must be several years older than its biological breeding age to establish a territory and successfully nest.

In addition to cygnets, we have also neck collared 134 additional known age birds. These were collared as one year old. Of the 134, we have obtained breeding age from only six (Table 21), again showing the difficulty associated with a younger bird obtaining a territory. Swans 49 and 50 were collared in 1980 as 1-year-old birds and had an unsuccessful nest in 1981 as 2-year-olds. They nested in a marginal area normally used by few swans. The area had not had a nest before, possibly explaining this pair's ability to have a nest at an early age. Swan 49 nested unsuccessfully again in 1982.

The third known-age individual that has nested is swan 46, who was banded in 1979 as a yearling. In 1981 when she was recaptured, her cloaca was classafied as stretched. This possibly indicated a nesting attempt, but it seems unlikely since the area she frequented was near Cold Bay and thoroughly searched. This bird was observed every summer since 1979, but had its first known nest in 1984 as a 6-year-old bird. She nested successfully at Bluebill Lake (a prime nesting territory) with an experienced male (61) who had broods in earlier years with two different females. In 1985, she again had a successful nest with #61 at Bluebill Lake, hatching five young and raising four to flight stage.

Table 19. Resightings of swans banded as cygnets.

Yr. Banded	Age[1] 0	1+	2+	3+	4+	5+	6+	Total Banded
1978	4	3			1			8
1979								0
1980	5	1	1	1				8
1981	14		2			1		17
1982	6	4	1	2			N/A	13
1983	28	5	5	1		N/A	N/A	39
1984	4	1		3	N/A	N/A	N/A	8
1985	13	1	4	N/A	N/A	N/A	N/A	18
1986	13	8	N/A	N/A	N/A	N/A	N/A	21
1987	24	N/A	N/A	N/A	N/A	N/A	N/A	24
Summary	111	23	13	7	1	1	0	156
	71%	15%	8%	4%	1%	1%		

[1] 0(0 to 1 year old; figured from banding date to about 3/31 of following year); 1+(1-2 years old, from 4/1 to 3/31 of following year); etc.

Table 19. Resightings of swans banded as cygnets.

Yr. Banded	Age[1] 0	1+	2+	3+	4+	5+	6+	Total Banded
1978	4	3			1			8
1979								0
1980	5	1	1	1				8
1981	14		2			1		17
1982	6	4	1	2			N/A	13
1983	28	5	5	1		N/A	N/A	39
1984	4	1		3	N/A	N/A	N/A	8
1985	13	1	4	N/A	N/A	N/A	N/A	18
1986	13	8	N/A	N/A	N/A	N/A	N/A	21
1987	24	N/A	N/A	N/A	N/A	N/A	N/A	24
Summary	111	23	13	7	1	1	0	156
	71%	15%	8%	4%	1%	1%		

[1] 0(0 to 1 year old; figured from banding date to about 3/31 of following year); 1+(1-2 years old, from 4/1 to 3/31 of following year); etc.

Table 20. Summary of resightings of swans banded as cygnets.

AGE	POTENTIAL (NO. SWANS)	NO. SWANS ACTUALLY RESIGHTED
5+	46	1 (2%)
4+	85	2 (2%)
3+	93	9 (10%)
2+	111	22 (20%)
1+	132	45 (34%)

Table 21. Ages of breeding and nesting outcome of six known age Tundra Swans.

Age (yrs.)	Collar Number					
	Males		Females			
	49[1]	U3[1]	46	50[1]	P8	72[1]
2	D[2]			D		
3	HF		?S		?S	
4		D				
5		D				D
6		D	HF			D
7			HF			D

[1]49/50 were paired one year; U3/72 paired all three years.

[2]HF-hatched and raised brood to flight; D-nest destroyed; ?S-cloaca stretched indicating egg laying occurred, nest not found.

Female swan 72 was banded as a yearling in 1980 and male swan U3 was banded as a yearling in 1981. In 1986 and 1985 they nested in the southwest part of Izembek, but their nests were destroyed. In 1984 a double collared pair had a nest in the same location, but we were unable to read the collars before their nest was destroyed and they dispersed. From this information, it appears highly probable that U3/72 nested for the first time in 1984 at the ages of four and five years, respectively.

The sixth possibly known age nester was female P8. She was captured and collared in 1981 as a yearling. Two years later, she was again captured and at that time, her cloaca was classified as stretched indicating egg laying might have occurred. No nest or brood were ever found associated with this bird.

To summarize, there has been quite a wide variation in age at first nesting, possibly due to the stable nature of the population and "saturated" nesting territories. First nesting has occurred for the six known age swans at two (two swans), three, four, five and six years old (Table 21).

Swan T0 and swan 61 have both nested a minimum of 6 times (Table 22). Swan 61 has nested with 4 different mates in two different territories. He appears to be one of the most dominant birds in the population having taken over and held the most productive territory (Bluebill Lake) for the last 4 years. The record for most consecutive years (5 in a row) is held by 3 swans...T0, 3F, and 4J. In addition swan 74 has nested 5 years, but not consecutively. Three swans have nested a minimum of 4 years now.

As in previous years, brood movements were monitored to identify the extent of brood rearing habitat with special emphasis on the location of preferred areas. Lakes with outlets large enough to support even a small run of salmon were fertile and had good stands of aquatic vegetation (primarily Potamogeton perfoliatus, P. filiformis and Sparganium hyperboreum). Ponds with similar vegetation stands are present in wet marshes and these, in addition to the somewhat deeper lakes with salmon runs, were used preferentially by swans during the nesting, molting and brood rearing periods. We are collecting data on lake type and use on a seasonal basis and feel this is essential to providing the protection necessary to maintain the tundra swan population and to protect refuge wilderness habitats. Additional limnological information was gathered on these lakes in 1985 and 1986 by the FWS Fisheries Resources crew.

In 1985 we had a floatplane for the first time and banding operations were considerably easier and more successful than past years. Then in 1986 we had to revert to past methods

Table 22 . Nesting longevity of marked tundra swans, Izembek NWR.

Swan	Mate (Year)	Years Nesting 6	5	4	3
61	62(81); 16(82); 46(84,85); 74(86,87)	81, 82, 84, 85, 86, 87			
T0	?	81, 82, 83, 84, 85, 87			
74	73(80); C9(82,83) 61(86,87)		80, 82, 83, 86, 87		
3F	4J		83, 84, 85, 86, 87		
4J	3F		83, 84, 85, 86, 87		
K4	M5			82, 83, 84, 85	
M5	K4			82, 83, 84, 85	
A7	Y7(82,83,84); 7X(87)			82, 83, 84, 87	
23	28				77, 78, 79
28	23				77, 78, 79
45	48				81, 82, 83
48	45				81, 82, 83
72	U3				84, 85, 86
U3	72				84, 85, 86
A6	?				84, 85, 86
Y7	A7				81, 82, 83
C9	U8(81); 74 (82, 83)				81, 82, 83
K9	Y4				81, 82, 83
Y4	K9				81, 82, 83
8C	3P				83, 84, 85
3P	8C				83, 84, 85
1P	OT(83); ?(84); B2(86)				83, 84, 86
89	?				85, 86, 87

because a floatplane was not available. In 1987 we again had the pleasure of banding using a Super Cub on floats. We had planned to again band on the Pavlof Unit. Supplies were bought and ready, but the weather never cooperated enough to allow us to get there.

The drives we were able to conduct, all on the Izembek Unit, went very well. Unfortunately we were weatherbound with fog, winds, and rain many days during the 20 days swans were molting. We were only able to band 8 of the 20 days, less than usual. But the 102 swans captured was only second in number to 1985 the only other year we used a floatplane. Eighty-four of the birds were new captures and 18 were recaptures from previous years (Table 23).

The most successful drive was on August 5 in the Bug Lake area. Fifty swans were molting there, the largest group yet encountered. Nine people, two inflatable boats, and the floatplane were involved in the drive. Shuttling all this to and from the banding lake in one day using a one passenger airplane made for a lengthy and interesting operation. Everything went according to plan, the lake and swans were surrounded at the appropriate time, and 29 swans were captured. We intentionally let 9 others escape that had been collared on an earlier drive and the rest outwitted us.

As usual besides placing two-digit blue neck collars on the captured swans, we also put on a matching plastic legband and a FWS metal legband. In addition to placing the markers, we recorded age, sex, plummage characteristics, eye color, size of bill, size of yellow spot on lores, wing and leg measurements. Weight and presence or absence of external parasites were also recorded. Before releasing the swans, photos of facial patterns were taken. Figure 4a shows an example of the data form used.

In 1987, 19(18%) of 103 swans had leeches (Theromyzon rude) in their eyes (Table 24). Over the ten years that we have checked swans for leeches, 135(20%) out of 672 have had them in their eyes. There were 120 which had leeches (up to four) in one eye and 15 had them in both eyes. They do not appear to be causing significant mortality, but one wonders how much a swan's forward vision is affected by the large bulge a leech causes under the nictitating membrane.

After ten years of neck collaring tundra swans, our resightings card file is bulging. As of 4/3/88 we have compiled 7,903 observations (Table 25). Each different date that a swan is observed is counted as one observation. Our need for some extensive computer time is obvious. Of the 552 swans collared so far, 361(65%) have been resighted at least once since collaring (Table 25a). This is an excellent resighting rate considering the remoteness of this area and

Figure 4a. SWAN DATA FORM - Izembek NWR

_____	Neck collar number (1/8" thick)	_____	Size of yellow lores (left) (length x width)
_____	Date captured	_____	Size of yellow lores (right) (length x width)
_____	Location (specific)	_____	
_____	Age (L/HY/SY/ASY)	_____	
_____	Sex	_____	
_____	Cloaca (tight/stretched/n.a.)	_____	Longest primary length
_____	FWS metal band no. (left-known age)	_____	Primary measured (first/second)
_____	Colored leg band no. (1/16" thick)	_____	Dew claw (left)
	Plumage (juv./sub-adult/adult)	_____	Dew claw (right)
	Flightless (yes/no)	_____	Length of middle toe (w/o nail)
	Parents flightless (yes/no/n.a.)	_____	Length of middle toenail
	Rust on head (absent/slight/conspicuous)	_____	Diagonal tarsus length
	Rust on neck (absent/slight/conspicuous)	_____	Overall tarsus length
	Iris color (normal/pale)	_____	Weight
	Pink on upper bill (present/absent)	_____	Parasites (kind & location)
	Pink on lower bill (present/absent)	_____	Photo both sides of face (yes/no)
	Color of yellow lores (normal/pale/n.a.)	_____	Final capture method
_____	Data Recorder Initials _____ Measurer Init.	_____	Total swans seen/total captured

Band numbers this batch:

Banding crew:

Remarks (behavior, abnormal marks, condition of old collars & bands, etc.):

Table 23. Summary of Tundra Swans banded and neck-collared in 1987, Izembek NWR and vicinity.

Date	Location	ASY M	ASY F	SY M	SY F	L-M	L-F	Neck Collar Codes
7/23	Thin Point L.	1	1	1				V6, X9, Z1, (6B)[1]
7/25	New Record L.	2	3	2	5			V8, V0, X2, X4, X6, X8, Z3, Z4, Z5, Z7, Z8, Z9
7/27	Mouth-Joshua Green R.	1	1			6		Z0, 1B, 3B, 5B, 7B 9B, 1R, 3R
7/30	Hatchery L.	1	1				3	NS, JS, 2B, 4B, 8R
"	Bluebill L.					2	3	5R, 7R, 0R, 14, 20
"	VOR L.					1	2	03, 22, 24, (29)
"	Baldy L.	1	1			1	1	05, 15, 26, 28
7/31	Surprise L. area(L.#71)	1	1	6	2			K3, ZZ, 21, 25, 32 34, 35, 37, 41, 57, (T1)
8/5	Bug L. area (L. #187)	8	7	7	4			40, 42, 44, MJ, ZV, A0, T5, 7C, 6F, 2H, 3H, 4H, 5H, 7H, 7J, 2N, 3N, 5N, 7N, 8P, 3S, 7S, 1V, 3V, 5V, 7V
8/6	Crab Arm L.					1		VS
"	L. #190 (W. Moffett)						2	4N, 2S
8/7	Steephill L. area (L.#66)	1	1			1	1	4S, 2V, 9V, 3X
"	near Middle Lagoon	1						7X
Total - 1987		17	16	16	11	12	12	84 (+18 recaptures)[2]
Cumulative Total (1978-1987)		138	149	47	60	74	82	550

[1] Swan collars in ( ) are new collar codes placed on birds captured in previous years (B6 now 6B, 8T now 29, 1Y now T1).

[2] In addition 61, 74, A7, B2, B7, B8, B9, H2, H4, H6, Z6, 3F, 4J, 7K, and 5M were recaptured in 1987.

Table 24. Occurrence of Leeches in Tundra Swan Eyes, 1978-1987.

Year	ASY-M	ASY-F	SY-M	SY-F	L-M	L-F	Total Swans W/Leeches	Swans W/O Leeches	Total
1978	1	2			1	2	6(22%)	21	27
1979		1					1(6%)	17	18
1980	3	3					6(14%)	38	44
1981	7	6		4	3	2	22(29%)	54	76
1982	4	3			1		8(12%)	58	66
1983	6	4	3		4	6	23(26%)	67	90
1984	4				1	2	7(37%)	12	19
1985	9	4	2	1	2	4	22(15%)	124	146
1986	6	3		2	2	8	21(25%)	62	83
1987	5	3	3	4	4		19(18%)	84	103
Totals	45	29	8	11	18	24	135(20%)[1]	537	672

[1] 120 swans had leeches in one eye and 15 had leeches in both eyes.

Table 25. Summary of Neck Collared Tundra Swan Observations.

Time Period	Year Collared										Total
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	
Prior to Collaring[1]	30	68	261	1013	293	854	45	238	195	465	3462
1978-Band thru Fall	120										120
1979-Winter	12										12
1979-Spring to Molt	51										51
1979-Band thru Fall	15	23									38
1980 - Winter	10	15									25
1980-Spring to Molt	18										18
1980-Band thru Fall	22	1	174								197
1981-Winter	10	5	43								58
1981-Spring to Molt	217	17	338								572
1981-Band thru Fall	29	1	26	253							309
1982-Winter	5	2	31	37							75
1982-Spring to Molt	5	3	111	53							172
1982-Band thru Fall	8	2	34	22	183						249
1983-Winter	3	1	8	11	20						43
1983-Spring to Molt	6		83	63	147						299
1983-Band thru Fall	6		19	5	12	328					370
1984-Winter	2		9	8	8	221					248
1984-Spring to Molt			23	9	22	104					158
1984-Band thru Fall	2		2	3	4	15	18				44
1985-Winter					1	13					14
1985-Spring to Molt	2		43	13	36	62					156
1985-Band thru Fall	4		6	1	1	4	4	132			152
1986-Winter	2		4	4	8	9	4	32			63
1986-Spring to Molt			57	3	10	96	1	25			192
1986-Band thru Fall			10	1		14	1	14	109		149
1987-Winter			2			2	1	19	29		53
1987-Spring to Molt			54	16	14	69	3	73	56		285
1987-Band thru Fall			8		1	15	2	3	11	152	192
1988-Winter						1		43	32	51	51
Total Observations	579	138	1346	1515	760	1807	79	579	432	668	7903

[1] Consists mainly of observations of individually recognizable broods and parents prior to initial neck collaring.

Table 25a. Tundra Swan Collaring and Resighting, 1978-1987.

	Year										Total
	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	
Number Collared	27	16	37	66	52	76	13	113	68	84	552
No. Resighted at Least Once	25	9	36	54	38	66	8	56	37	32	361
Resighting Rate	93%	56%	97%	82%	73%	87%	62%	50%	54%	38%	65%
No. Resightings After Banding	552	54	1048	436	415	877	21	228	167	119	3889

the fact that most of our swans do not migrate to more populous areas in the winter.

The most observed individual so far is swan 61 (an adult male collared in 1980). He has been seen 217 times. This bird has been an interesting one. He has occupied two territories close to town and the road system. Also we have captured him several times and put new neck collars on. Therefore we have been able to keep track of him for 7 years in a row. He nested and successfully raised broods in 1980 and 1981, did not nest in 1982 or 1983, and again nested and successfully raised broods in 1984, 1985, 1986, and 1987.

In 4 of the 6 nesting years he was with a different female. In 1980, he nested and raised three cygnets (63, 64, 66) with swan 62 in the Y lakes area. Swan 62 was last seen 10/24/80. On 3/9/81, he was observed with swan 16, and they raised one cygnet (U0) in 1981, again, in the Y lakes area. That year he did most of the incubating. Swan 16 was last observed on 2/5/82. During the summer of 1982, 61 was not observed, but we are 99% sure he did not nest, since all nests were located in 1982. He was next observed 1/17/83 wintering at Unimak again, and then seen 5/31/83 paired with swan 46. They did not nest in 1983. Then in 1984, 61 and 46 nested in a new territory (Bluebill Lake) and raised two cygnets (5K, 2H). Again in 1985 61 and 46 nested at Bluebill Lake and raised four cygnets (PM, TM, UJ, and UK). He again nested at Bluebill Lake in 1986 with a bird that was uncollared. When we captured them in late July we were surprised to discover his mate was 74, not 46 as expected! This was his fourth mate in 5 years. The discovery of 74 was also interesting since we thought she was dead. She had nested at Bluebill Lake with 2 other mates in 3 of the 4 years before 61 took over the territory in 1984. 61 and 74 raised 5 cygnets (B7, B9, H2, H4, and H6) in 1986. They again nested at Bluebill Lake in 1987 raising 5 more cygnets (5R, 7R, OR, 14 and 20).

Swan 61 and his mates have raised 20 cygnets to flight stage. The average annual number of cygnets produced to flight stage on the refuge is 38 (Table 12). This bird's contribution of 20 is more than total refuge production in some years and attests to the importance of both this bird, swan 74, and the territory they occupy (see discussion of Bluebill Lake territory earlier in this section).

Table 26. Eleven Most Observed Tundra Swans.

Collar Number	Sex	Age Last Observation	Last Observation	Number of Observations
61	M	11	9/23/87	217
74	F	11	9/23/87	161
C9	M	8	1/24/86	120
3F	M	8	10/17/87	119
4J	F	8	10/17/87	119
60	F	5	2/24/82	101
59	M	5	1/09/82	100
12	F	7	2/24/82	100
48	F	7	1/20/84	95
45	M	7	1/20/84	94
13	M	7	10/17/81	94

Pairing for these birds is: 61/74, C9/74, 3F/4J, 59/60, 12/13, 45/48.

Black Brant

The Pacific Flyway (PF) population of black brant breeds primarily on the Yukon-Kuskokwim Delta and along the arctic coast and islands of the Chukotka Peninsula (USSR), Alaska and the Northwest and Yukon Territories of Canada. Currently this population numbers about 150,000 birds and essentially all of these make the Izembek NWR area home for up to three weeks in the spring and six to eight weeks in the fall. Surveys and research on brant and their primary attractant, the eelgrass beds of Izembek Lagoon, are conducted annually by refuge personnel and cooperators. Continuing and primary commitments are toward collection of production and family group size data during fall and providing of facility, logistic and manpower assistance to the Division of Research during their spring and fall analysis of waterfowl disturbances.

The Izembek NWR staff continued to provide assistance to Migratory Birds-Waterfowl Investigations personnel in Juneau by monitoring the numbers of black brant overwintering in Izembek and adjacent lagoons. These data are important in assessing the distribution and abundance of brant, flyway wide, as determined from the annual mid-winter surveys conducted in January. Approximately 3100 and 8400 brant were found overwintering at Izembek in 1987 (February) and 1988 (January), respectively.

Brant productivity and family group counts conducted at Izembek in 1987 marked the 25th consecutive year such appraisals have been made. Brant were first seen arriving on the lagoon on 4 August in 1987 (x=18 August, n=16 years). Production counts were obtained from 29 August to 14 October with a total of 25,293 individual brant classified to age. Juveniles comprised 7,882 (31.2%) of this total in comparison to the long-term average of 23.4% (Table 27). Productivity of the PF brant population, based on observations from Izembek, has been below average in five of the past seven years, however, overall population size , determined from mid-winter surveys, is relatively stable. Production above 30 percent, as documented this year, has not occured since 1977, and only three times since then has above average production occurred.

Family group size data were collected concurrently with productivity counts. A total of 948 individual families were observed giving an average of 2.7 juveniles/family (Table 28). Productivity was good in 1987, however based on our family group counts, survival of young was average (i.e. up 0.01 juveniles/family in comparison to the 22-year average). Productivity appraisals of brant conducted this fall were a joint effort of the Research Division and the Izembek NWR staffs. The substantial contributions of Research personnel the past three years are very much appreciated.

Black brant respond to tidal rhythms within Izembek Lagoon by initiating movements from feeding to roosting and sanding areas twice daily. Amak Island is in the distance, 10 miles offshore. After several poor production years, brant production in 1987 was well above average. Blenden

Table 27. Annual black brant production counts, Izembek NWR, 1970-1987.

Year	Adults	Juveniles	Total	% Juveniles
1970	12,104	6,256	18,360	34.1
1971	4,820	1,953	6,773	28.8
1972	6,599	3,698	10,297	35.9
1973	12,025	4,999	17,024	29.4
1974	13,118	632	13,750	4.6
1975	9,396	5,452	14,848	36.7
1976	7,962	4,340	12,302	35.3
1977	8,856	4,092	12,948	31.6
1978	10,696	1,842	12,538	14.7
1979	13,674	2,349	16,023	14.7
1980	9,618	3,341	12,959	25.8
1981	4,109	936	5,045	18.6
1982	11,509	1,213	12,722	9.5
1983	6,149	1,947	8,096	24.1
1984	9,451	1,499	10,950	13.7
1985	12,032	1,915	13,947	13.7
1986	15,621	2,823	18,444	15.3
1987	17,411	7,882	25,293	31.2
25 Yr. $\bar{X}$	11,069	3.398	14,467	23.5

Table 28. Black brant family group counts at Izembek NWR, 1977-1987

No. of Juveniles	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	22 Yr $\bar{X}$
1	49	13	22	26	34	18	25	19	125	23	168	42
2	77	31	64	47	38	22	40	49	223	46	263	75
3	71	29	37	57	36	25	55	70	173	43	267	71
4	29	24	17	39	27	20	26	39	73	19	171	41
5	13	10	5	7	10	4	21	10	24	4	66	14
6	1	3	0	0	8	0	6	4	6	2	13	3
7	0	0	1	1	1	0	0	1	0	0	0	<1
8	0	0	0	0	0	0	0	0	0	0	0	<1
Total Families	240	110	146	177	154	89	173	192	624	137	948	247
Total Juveniles	603	326	361	489	431	237	515	564	1,538	352	2,587	664
Mean Family Size	2.51	2.96	2.47	2.76	2.80	2.66	2.98	2.94	2.46	2.57	2.73	2.69

Nesting success for brant on the Yukon-Kuskokwim Delta was excellent at 90 percent versus the 52 percent recorded in 1986. Likewise the mean clutch size during incubation was 4.09 eggs/nest this summer, up from 3.59 in 1986. Researchers with the Division of Research and the University of Alaska working with brant on the Yukon-Kuskokwim Delta report brood sizes post-hatch and pre-fledging of 3.6 and 3.1 young/brood, respectively. Compared with the average 2.7 juveniles/family seen at Izembek these data suggest 25 and 13 percent redutions, respectively in brood size.

The fall population of brant at Izembek Lagoon includes birds from Alaska, the western Canadian arctic and Wrangel Island (USSR). It was hypothesized that these birds mix throughout the lagoon and hence our counts are representative of the whole PF population. Radio marking of brant from various breeding areas in 1987 to address this mixing in Izembek Lagoon among other questions proved very interesting. A total of 33 backpack radio transmitters were placed on 16 Alaskan birds from the Tutakoke colony on the Yukon-Kuskokwim Delta (YKD) and 17 Canadian birds from 4 breeding colonies: Mackenzie River Delta (4), Mellville Island (8), Prince Patrick Island (2), and Victoria Island (3).

The radio-tracking effort at Izembek Lagoon involved several techniques: 1) aerial tracking, 2) directional antenna systems at fixed locations, 3) an automatic, nondirectional chart recorder, and 4) handheld "H" antennas used at mobile locations on the ground.

Aerial tracking of radio-equipped brant was used initially to determine dates and locations of arriving brant. After a majority of the radio-equipped brant had arrived, aerial tracking was concentrated on those birds that were absent or infrequently detected by ground tracking systems. Many times aerial tracking coincided with and was secondary to population surveys.

Radio-tracking from the ground occurred from 1 September to 2 November at 8 study blind locations along the shoreline of Izembek Lagoon (Figure 5). Six of the blinds, Applegate Cove (AC), Norma Bay (NB), Banding Island (BI), Grant Point-east (GE), Halfway Point (HP), and Round Island (RI) were in the same or near locations as in 1985 and 1986. The site at the east end of Round Island was moved from the 1986 location to a new location at Outer Marker (OM). On 7 October the blind at Round Island (RI) was moved to Cape Glaznap (CG).

On 10 October an additional tracking station was erected on top of Baldy Mountain (BM) and maintained daily from 17 October to 17 November (Figure 5). This station was unique due to it's 1000 ' elevation, proximity (2 miles) to Izembek Lagoon and subsequent long range (approx. 10 miles) of signal detection. BM received good, consistent signals from radio transmitters in all parts of Izembek Lagoon, except Moffet Bay and Kinzarof Lagoon and on occasion was able to detect radio-equipped brant in Big or Middle Lagoons.

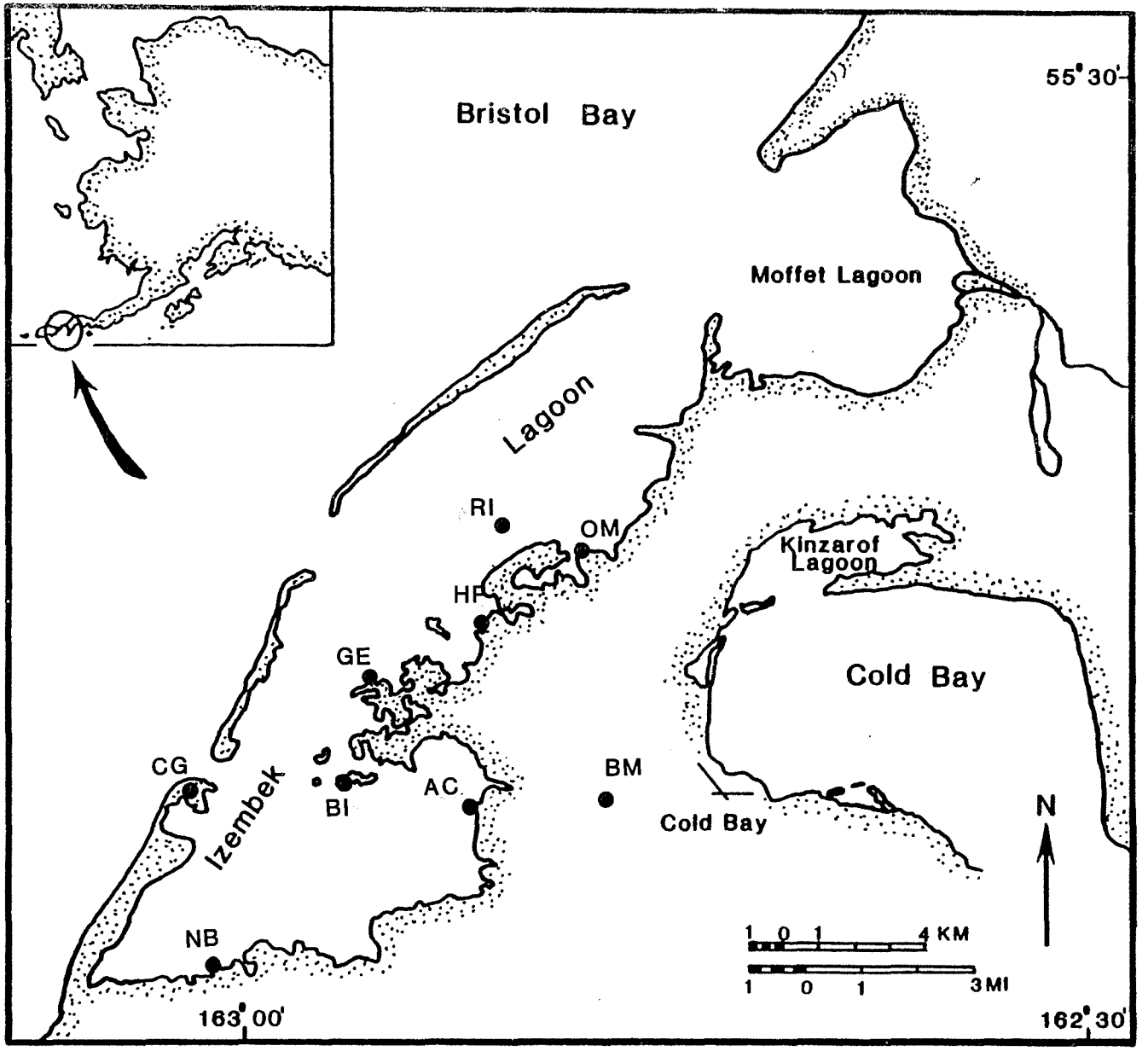
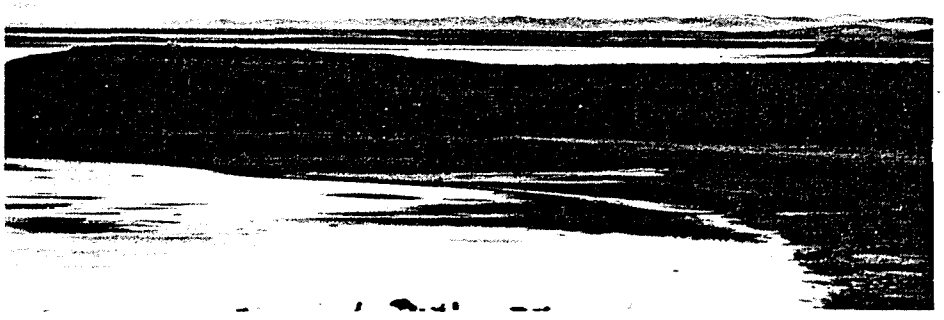


Figure 5. Black brant research observation points on or adjacent to Izembek Lagoon.



Research Division personnel Bob Stehn and Mike North installing one of the observation blinds used during the study of waterfowl disturbances. Aircraft such as this Bell 205 were used to perform experimental overflights to quantify numerous variables. D. Ward

Each radio-tracking station was equipped with either four-element (AC, NB, BM, and GE) or five-element (BI, CG, RI, OM, and HP), stacked, dual Yagi antenna arrays with a null detection system. The quality of reception of a radio signal at a particular station depended on the individual transmitter, distance between the source and receiver, obstructions between source and receiver, elevation, and weather conditions (i.e. rain reduced reception of signal). Attempts to locate radio-equipped birds from the 8 blinds occurred intermittantly, from 1 to 5 days per week for up to 12 hours per day. Time and occupancy varied for each blind site depending on weather, use of the area by geese, and timing of experimental overflights. During a tracking session the start time, end time, and frequencies searched during each scan were recorded as well as the time, azimuth, null width, and signal strength for each frequency located.

An additional automated receiving station was established at BM to augment detection of emigrating brant. This station was equipped with a programable receiver interfaced with a strip chart recorder and a pair of four-element Yagi antennas. The battery operated system continuously cycled through 15 programmed frequencies every 7 minutes and recorded the presence or absence of each frequency. Signal detection with the automated system was influenced by environmental factors (i.e. rain) and limited to Izembek Lagoon excluding Moffet Bay. Frequencies selected for monitoring were determined by their prior use within Izembek Lagoon, strength of signal, and the capacity of the automated system.

Handheld "H" antennas were used for radio-tracking during mobile situations from boats or in areas not covered by permanent stations. This device had a very limited range of approximately 3 mile, line of sight.

Generally, the radio telemetry data suggested that, at least in 1987, brant from Canadian arctic nesting areas arrived later than birds marked on the Yukon-Kuskokwim Delta (Table 29). In addition, Canadian arctic birds preferred the Moffet Bay area throughout most of the fall staging period (Figure 6).

Canadian arctic nesting brant show wide color variation from "typical" light-bellied (Atlantic Type) to dark phases approaching that characteristic of breeds on the Yukon-Kuskokwim Delta. In nearly 30 years of bag checking during the hunting season refuge personnel have not documented the presence of light-bellied forms at Izembek. Radio telemetry data, collected in 1987, showed that most of the light-bellied and intermediate phase brant marked in the Canadian arctic stayed in the Moffet Bay area. This provided us with insight into why they have not appeared in hunters' bags. Moffet Bay is a remote, virtually unhunted area at the north end of Izembek Lagoon. With this new distribution data in hand we assisted Research personnel with more intensive aerial and ground radio tracking and further attempted to view and obtain productivity data from brant in Moffet Bay. In this way it may be

Canadian Wildlife Service biologists Austin Reed and Jim Hawkings aided Research and Refuge personnel in the tracking of radio marked black brant during September and October. They also assisted in the aircraft disturbance study. Here they survey one of the observation blind locations to determine precise elevation. D. Ward

Table 29. Arrival and departure times at Izembek Lagoon of Black Brant originating from different nesting areas.

Breeding location:	Y-K Delta	Mackenzie Delta	Victoria Island	Melville/ Pr. Pat. I.
number of transmitters	16	4	3	10
number detected at Izembek	14(88%)	2(50%)	2(67%)	8(80%)
first/last dates of arrival	4/9-3/10	22/9-1/10	1/10-5/10	27/9-8/10
mean (+/sd) date of arrival	18(+/7)Sep	26(+6)Sep	3(+/3)Oct	3(+4)Oct
number (% of arrivals) departing Izembek	9(64%)	1(50%)	1(50%)	6(75%)
first/last dates of departure	23/10-17/11	17/11	10/11	6/11-27/11
mean (+/sd) date of departure	8(+/9)Nov	17/11	10/11	19(+/7)Nov

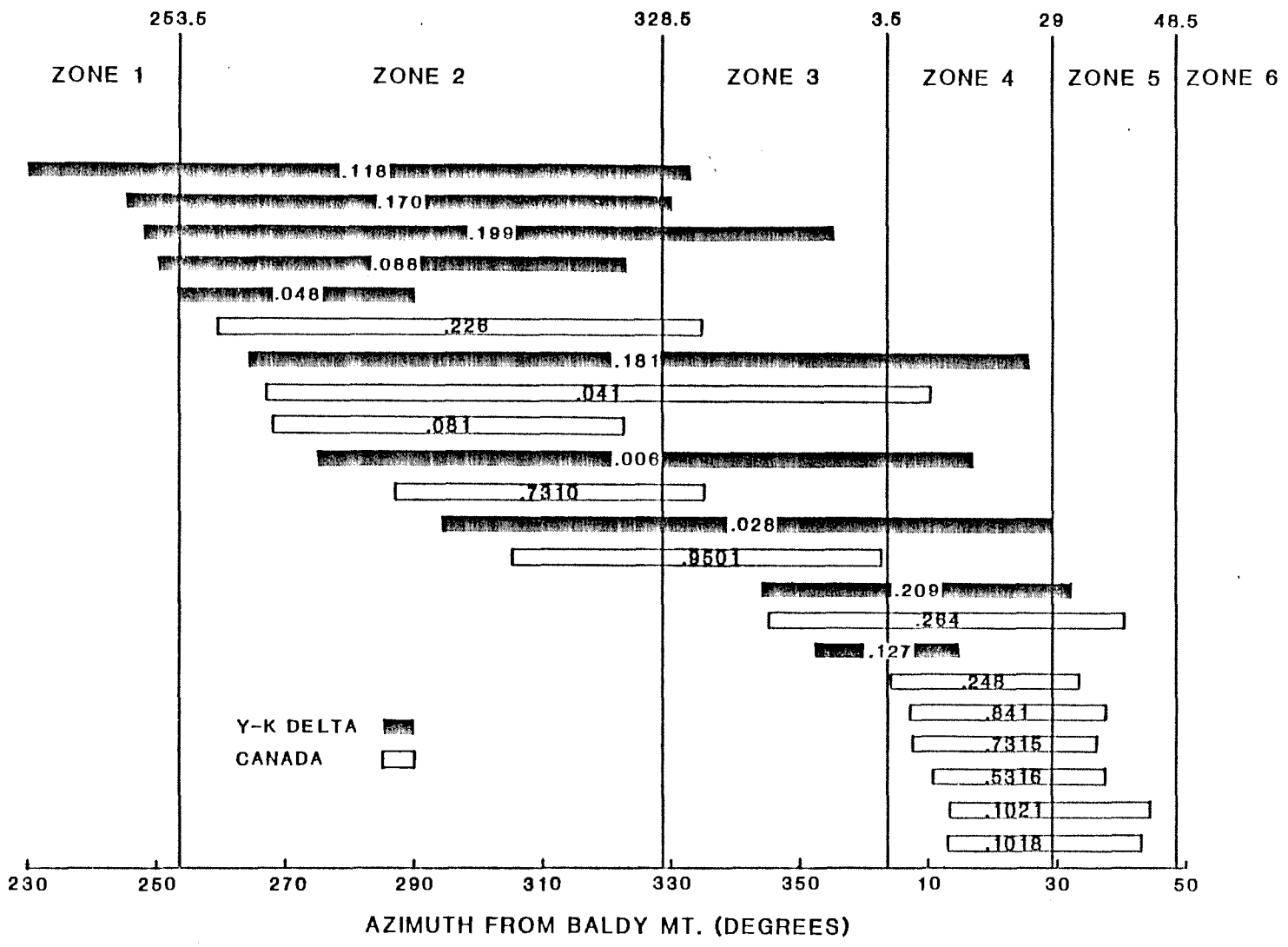


Figure 6a. Range of azimuths representing principal use areas, taken from Baldy Mt. for 22 radio equipped brant at Izembek Lagoon, Alaska, between 17 October - 17 November, 1987

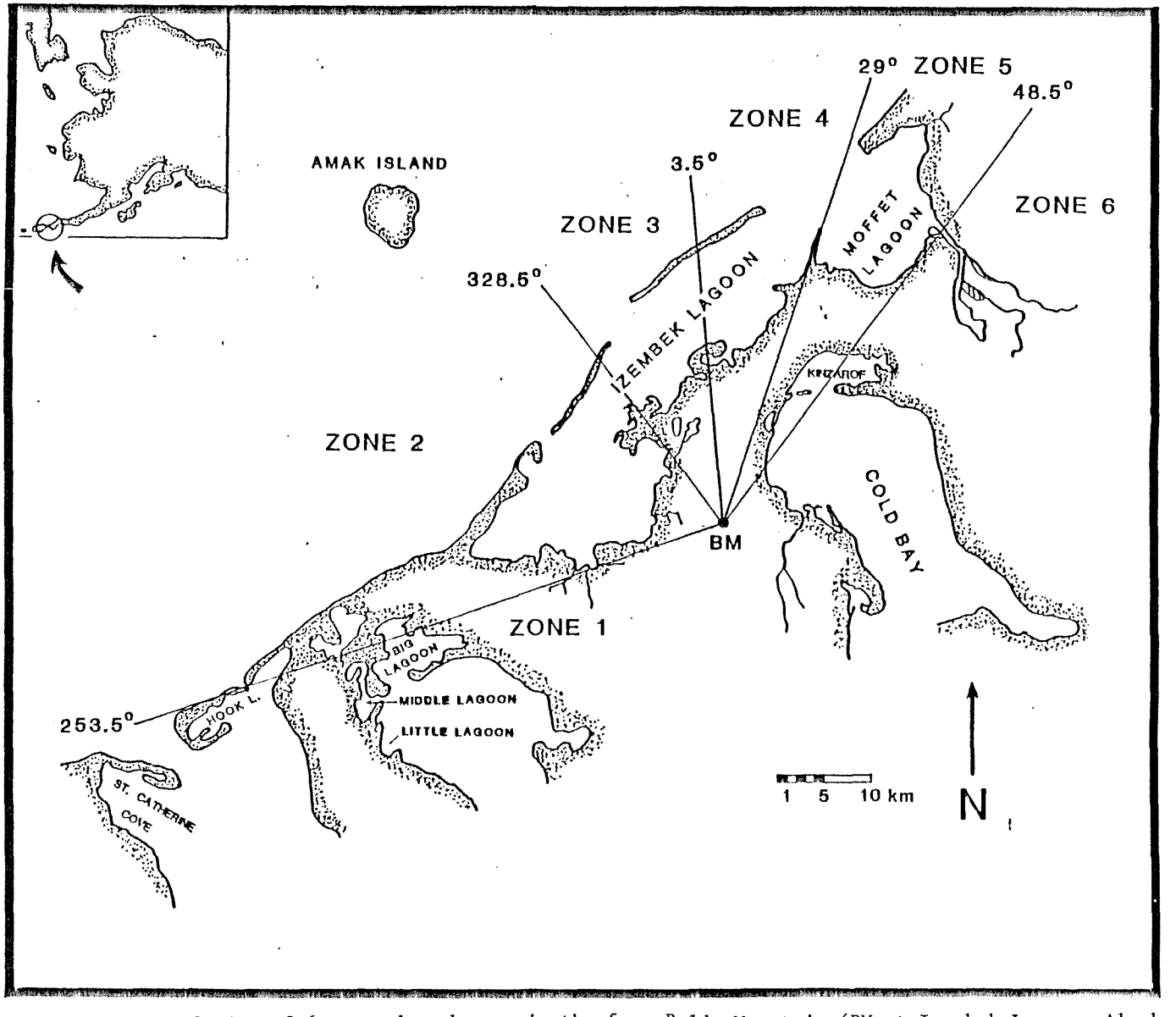


Figure 6. Boundaries of 6 zones based on azimuths from Baldy Mountain (BM at Izembek Lagoon, Alaska fall, 1987.

Baldy Mountain, 3 miles west of Cold Bay, at 1000' proved to be an excellent location to monitor radio marked brant. An abandoned WWII outpost served as a temporary shelter from which azimuths were recorded for each radio signal. 10/87 Blenden

possible in the future to access numbers and reproductive success of the Canadian arctic component of the population.

This increasing emphasis of biological investigations on PF brant in Alaska during 1987 came primarily from the Alaska Office of Fish and Wildlife Research which intensified its appraisal of disturbance and behavior of brant at Izembek this fall. A seven-person team including Dirk Derksen, Cal Lensink, Bob Stehn, David Ward, Peggy Blenden, Mike North and Mark Wotawa spent the bulk of September and October on this important project.

The research effort took various approaches to quantify the types and effects of disturbances of fall staging geese, primarily black brant. Efforts to refine the methodology used by field workers to insure the compatability of data collected and reduce observer bias as much as possible were intensified. Data sheets and recording procedures have, of necessity, undergone several revisions. Also intensified were efforts to moniter both natural and human induced disturbance factors. This monitoring took the form of a more thorough and precise estimate of weather conditions, bird behavior, and distance of the disturbance factor from the geese during various phases of their reaction. These types of data are essential to a more complete understanding of the overall impact of various disturbances. When the disturbance is a fast moving aircraft, disturbance/birds distances and behavioral responses change rapidly necessitating the use of tape recorders by observers to describe the event. Data so collected was later converted to numerical data and/or directly transfered to various data sheets.

Several parameters relating to various disturbance factors are important to the quantification of their effects on birds. Parameters such as altitude, speed, and distances of the disturbance from the subjects were estimated as precisely as possible for all uncontrolled events. To qualify observations of numerous important uncontrolled disturbances, experimental controlled disturbances were performed. Controlled disturbances were primarily overflights with a wide variety of fixed-winged and rotary-winged aircraft. This is an essential aspect of the research program as statistically acceptable results require valid sample sizes.

In 1987 we attempted to increase sample sizes for all types of disturbances. An important data void was present in our attempt to assess the effects of large helicopter overflights. A contract with Alaska Helicopters Inc. allowed us to perform experimental overflights with a Bell 205. Effects of this aircraft on birds may be comparable with the slightly larger helicopters used by oil companies and the U.S. Coast Gaurd offshore operation.

All forms of waterfowl disturbance encountered by observers were analyzed including boat and foot traffic, various types of auditory stimulus and predator activities (primarily bald eagles). It is apparent that brant can undergo some level of disturbance

without having adverse affects on their physical capabilities to assimilate nutrient reserves necessary to migrate or breed. Natural forms of disturbance such as activities of predators like bald eagles or gyrfalcons are largely uncontrollable, but must be viewed as a cumulative factor in the overall analysis of disturbance. Identification of an "acceptable level" of disturbance, and development of means to avoid exceeding that level, are critical to managing waterfowl and public use at Izembek.

Behavioral interactions and responses of disturbed and undisturbed brant, engaged in various activities, must be quantified in relation to a number of climatic and phenological factors. To obtain these types of data, Research crews viewed birds for several days from key areas of Izembek Lagoon through out the fall. Time budget analyses were performed throughout diurnal periods to provide these baseline data. Such observations also will help to identify increases in migratory restlessness within the population.

Work continued in 1987 on a report: The Fall Trans-Oceanic Migration of Pacific Flyway Black Brant and its Relation to the Passage of Low Pressure Weather Systems. This paper will summarize 28 years of data collected by the Izembek NWR staff and cooperators on the brant fall migration phenomenon.

The spring arrival of brant at Izembek occurred from 3 April to 3 May. The normal arrival usually occurs over about a 10 to 15 day period. Flocks of a few hundred up to a thousand are observed during daylight hours over Cold Bay. As these birds move north over Cold Bay, they gain altitude (to approximately 1500 feet AGL), cross the Alaska Peninsula and descend into Izembek Lagoon. Peak arrival was noted on 29 April in 1987. Some of the spring influx occurrs during nocturnal hours and may not be detected at Cold Bay. A total of 34,900 brant were counted in the Izembek/Kinzarof Lagoon areas on 3 May. From 30 April to 4 May the refuge cooperated in a coastal waterfowl survey of southwestern Alaska with brant numbers totaling 42,499. Spring migration of brant is characterized by short, daily movements over roughly a two-month period. Nevertheless, brant do not normally arrive at Izembek over a month-long period as occurred in 1987 and 1986 as well.

Numbers and distribution of brant within Izembek and adjacent lagoons are determined each fall by aerial survey. The refuge staff performed and assisted Wildlife Assistance personnel on two other censuses in 1987 (Table 30). Additionally, Wildlife Assistance personnel surveyed the area as part of a more comprehensive coverage of southwestern Alaska. The average count from the peak staging period, resulting from these various efforts to enumerate the population was, 142,461 brant. This figure was used to estimate the composition of the population with reference to age and breeding status (Table 31).

Table 30. Aerial surveys of goose populations on Izembek and adjacent lagoons during Fall/Winter months 1987/88.

Date	Number of Birds			Observers
	Black Brant	Canada Goose	Emperor Goose	
22 September	112,106	11,548	1,651	Sarvis/ Blenden
25 September	149,290	24,090	6,999	Butler/ Dau
5 October	128,000	37,393	3,716	King / Eldridge
9 October	150,415	37,163	7,260	Butler/ Dau
28 October	142,138	44,261	6,628	Sarvis/ Dau
4 November	55,615	13,835	1,055	Sarvis/ Dau
27 November	9,355	0	no count	Sarvis/ Dau
11 December	3,975	0	1,633	Sarvis/ Dau
15 January 1988	8,385	0	2,521	Sarvis/ Dau

Table 31. Fall composition of the black brant population, Izembek Lagoon

	Number of Birds				
	1983	1984	1985	1986	1987
Peak Count	147,933	123,602	135,680	131,594	142,461(n=4)
Est. number of juvenile birds (Percent young X total)	35,652	16,933	18,588	20,134	44,448
Est. number of families (number of HY ÷ Avg. family group size)	11,964	5,838	7,435	7,744	16,462
Est. maximum number of breeding adults with young (number of families X 2)	23,927	11,676	14,870	15,488	32,924
Est. total number of sub-adults and non and/or failed breeding adults (total count minus juveniles and breeding adults)	88,354 (59.7%)	94,993 (76.9%)	102,222 (75.3%)	95,972 (72.9%)	65,089 (43.3%)

A total of 138,578 black brant were reported during the mid-winter inventory with 116,696 of these in Mexico (Table 32). The peak fall count for southwestern Alaska was 150,415 brant. The Izembek NWR coordinated with personnel performing the mid-winter survey by performing an aerial count of brant in the Izembek area. A total of 8,385 brant were counted during this survey. Considering that a minimum of 8,385 overwintered in Alaska, and the bulk of hunting mortality had occurred by mid January , the fall and mid-winter censuses were in quite close agreement.

Table 32. Black brant mid-winter survey data

Year[1]	Washington	Oregon	California	Mexico (West Coast)	Total	3 Year Running Avg.
1974/5	6,163	1,507	480	115,340	123,490	126,382
1975/6	7,540	1,769	680	112,056	122,045	125,395
1976/7	14,111	2,100	0	130,756	146,967	130,834
1977/8	18,100	1,110	560	143,117	162,887	143,966
1978/9	8,078	1,255	10	120,070	129,413	146,422
1979/80	7,665	1,015	135	137,550	146,365	146,222
1980/1	10,107	1,790	540	181,760	194,197	156,658
1981/2	6,451	706	485	113,402	121,044	153,869
1982/3	3,113	718	565	104,918	109,314	141,518
1983/4	7,097	930	700	124,703	133,430	121,262
1984/5	11,675	641	801	131,568	144,685	129,143
1985/6	12,026	1,113	706	114,725	128,570	135,562
1986/7	14,371	1,133	736	86,913	103,153	125,469
1987/8	19,831	1,104	947	116,696	138,578	133,317

[1] Calendar year prior to January mid-winter survey (i.e. 1987 data represents survey done in January 1988).

Canada Goose

Taverner's Canada geese are an important component in the fall waterfowl concentration on the Izembek NWR. The first fall arrivals were a flock of eight observed on 21 August. The influx of birds continued slowly through September. Greatest numbers are present in October each year and aerial survey efforts in the fall of 1987 placed the peak population at 44,261 birds (Table 30 in brant section). Numbers of Canada geese were approximately 5,000 birds below the average determined from surveys since 1980.

The Canada goose is the primary species in the hunter's bag at Izembek. Canada geese are of increasing importance due to the harvest restrictions or closures on other species. Canada geese made up 88.3% of the goose harvest and 61.1% of the total waterfowl take at Izembek in 1987 (Table 65 in public use section). Adults predominated slightly over juvenile Canada geese in the fall harvest based on our bag check data (Table 33).

In 1987 we received only one indirect recovery of a Canada goose banded at Izembek. To date, 54(12.9%) of the 418 birds banded have been harvested with 17 of these taken on the refuge. Of the remaining recoveries 18 (34.0%) are from southeast Oregon/northeast California. These recoveries have also been analyzed by year after banding (Table 34) which reveals that over 60% (n=32) were harvested within two years of banding while less than 10% (n=5) were harvested five or more years after banding. Adult recoveries total 14.9% of the adults banded versus 11.1% for juveniles. Both ages appear in the direct harvest (i.e. same year as banding) in nearly equal proportions, however adults appeared in a greater rate in the indirect harvest (Table 35).

The fall departure of Canada geese from the Izembek area began on 21 October and peaked from 23 to 24 October and on 3 November. Canada geese initiate their migration with weather conditions similar to those used by brant, but Canadas leave during daylight hours. All Canada geese have usually departed the area by late November. The last sighting in 1987 was seven birds at Grant Point on 19 November.

Emperor Goose

The emperor goose population responded with good production in 1986 and 1987. The 1986 spring population size of 42,228 was 28.2 percent below the 1985 level and 69.6 percent below the "historic" peak of 139,000 geese. Production of young was good in 1986 at 29.6 percent. This boosted the fall 1986 population to 68,051 geese. By spring 1987, the population was estimated to number 51,655 (22.3% above the 1986 level) based on a survey conducted 30 April to 4 May (Table 36;Figure 7). The Izembek NWR staff (WB Dau) and Migratory Bird Management-North (Rod King) cooperated to perform this aerial survey of coastal areas from the

Table 33. Age ratio of Canada geese in hunters' bags, Izembek NWR

Year	Canada Geese Harvested		Total	Adult Immature Ratio in Harvest
	Adults (%)	Immatures (%)		
1976	78 (38.6)	124 (61.4)	202	1.00:1.6
1977	32 (43.2)	42 (56.8)	74	1.00:1.3
1978	29 (37.7)	48 (62.3)	77	1.00:1.7
1979	98 (53.3)	86 (46.7)	184	1.10:1.0
1980	30 (43.5)	39 (56.5)	69	1.00:1.3
1981	113 (57.1)	85 (42.9)	198	1.30:1.0
1982	74 (50.7)	72 (49.3)	146	1.03:1.0
1983	51 (49.1)	53 (50.9)	104	1.00:1.04
1984	37 (41.6)	52 (58.4)	89	1.00:1.4
1985	23 (67.6)	11 (32.4)	34	2.09:1.0
1986	11 (50.0)	11 (50.0)	22	1.00:1.0
1987	17 (51.5)	16 (48.5)	33	1.06:1.0
Total	593 (48.1)	639 (51.9)	1,232	1.00:1.08

Table 34. Recoveries of Taverner's Canada geese banded on Izembek NWR, 1977 - 1983

Year	Age/Sex[1]	Number Banded	Recoveries by Year After Banding						
			1[2]	2	3	4	5	6	7
1977	AHY/M	17	2		1				
	AHY/F	22	2	2		1			
	HY/M	38	2		1		1		
	HY/F	31	3		1	1			
	U/F	1				1			
1978	AHY/M	25	1	2		1	1		1
	AHY/F	22		1	1	1		1	
	HY/M	43	2	1		1			
	HY/F	53	2	2	1	2			
1980	AHY/M	15		2		2			
	AHY/F	18	2						
	HY/M	15		2					
	HY/F	18		1					
1981	AHY/M	14	1						
	AHY/F	16						1	
	HY/M	7							
	HY/F	8							
1983	AHY/M	10							
	AHY/F	15							
	HY/M	24	1	1	1				
	HY/F	6				1			
Totals		418	18	14	6	11	2	2	1

[1]AHY = After hatching year; HY=hatching year; U=Unknown; M=Male; F=Female

[2]Recoveries duirng the first hunting season after banding (i.e. direct recoveries

Table 35. Harvest rates of Izembek-banded Taverner's Canada geese by age and sex

Age/Sex	Number[1] Banded	Direct Recoveries(%)	Indirect Recoveries(%)	Total Recoveries(%)
AHY/M	81	4(4.9)	10(12.4)	14(17.3)
AHY/F	93	4(4.3)	8(8.6)	12(12.9)
TOTAL ADULTS	174	8(4.6)	18(10.3)	26(14.9)
HY/M	127	5(3.9)	8(6.3)	13(10.2)
HY/F	116	5(4.3)	9(7.8)	14(12.1)
TOTAL JUVENILES	243	10(4.1)	17(7.0)	7(11.1)

[1]One bird captured was not aged.

Table 36. Summary of emperor goose sightings by survey area, 30 April- 4 May,1987.

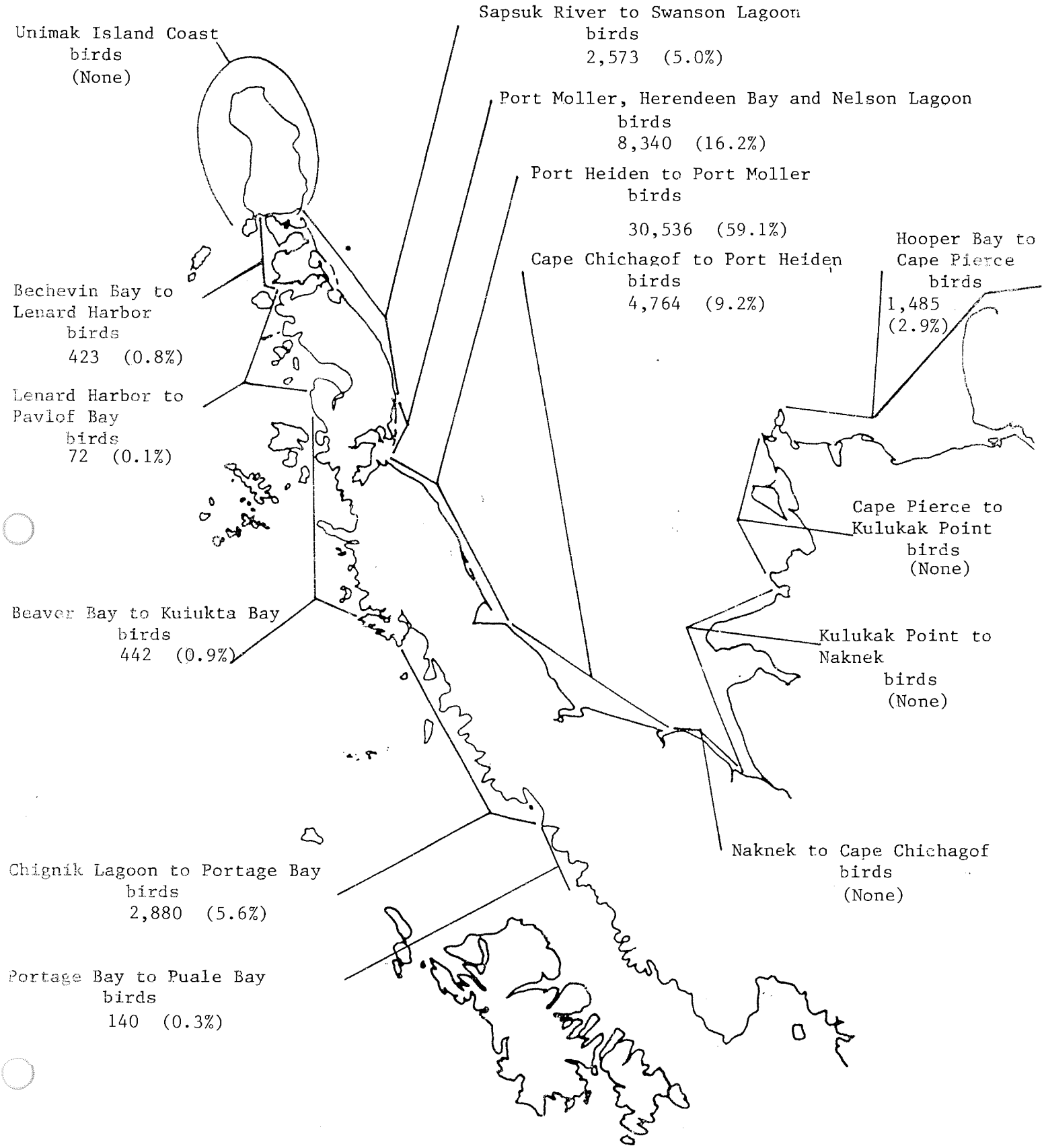
Date	Location	No. of Emperor Geese Observed
30 April	Hooper Bay to mouth of Kuskokwim River	296
1 May	Mouth of Kuskokwim River to Quinhagak	33
"	Quinhagak to Jacksmith Bay	4
"	Jacksmith Bay to Carter Bay	234
"	Carter Spit to Platinum	73
"	Platinum to Security Cove (incl. Chagvan Bay)	480
"	Security Cove to Cape Pierce(incl. Nanvak Bay)	365
"	Cape Pierce to Tongue Point	0
"	Tongue Point to Kulukak Point	0
"	Kulukak Point to Dillingham	0
"	Dillingham to Nakeen	0
"	Nakeen to Naknek	0
2 May	Naknek to Cape Chichagof	0
"	Cape Chichagof to Goose Point(incl. Egegik Bay)	659
"	Goose Point to Cape Menshikof(incl. Ugashik Bay)	1,298
"	Cape Menshikof to Port Heiden (incl. Cinder River estuary and Hook Lagoon)	2,807
"	Port Heiden to base of Strogonof Point (incl. Port Heiden)	24,997
"	Base of Stogonof Point to Ilnik (incl.Seal Islands lagoon)	5,539
"	Ilnik to Port Moller	0
"	Port Moller to Point Divide	93
"	Point Divide to Sapsuk River mouth (incl. Herendeen Bay, Nelson Lagoon, Mud Bay, and Kudobin, Deer and unnamed sand islands)	8,247
"	Sapsuk River mouth to Moffet Point	0
"	Moffet Point to Strawberry Point (incl. Moffet Bay)	1,856
3 May	Strawberry Point to Cape Krenitzin (incl. Izembek Lagoon and Applegate Cove)	687
"	Cape Krenitzin to Chunak Point (incl. Swanson Lagoon, Hook Bay, St. Catherines Cove and Hot Springs Bay)	30
"	Urilia Bay	0
"	Uminak Island (incl. Cape Lutke to Ikatan Bay)	0
"	Boiler Point to Littlejohn Lagoon (incl. Little, Middle, Big and Littlejohn Lagoons)	15
"	Kenmore Head to Thinpoint	15
"	Thinpoint to Delta Point (incl. Old Man's Mortensen's and Nurse Lagoons)	0

Table 36. (continued)

Date	Location	Number of Emperor Geese Observed
4 May	Delta Point to Lenard Harbor (incl. Kinzarof Lagoon)	393
"	Belkofski Bay	0
"	Volcano Bay to Arch Point	7
"	Arch Point to Jackson Lagoon	65
"	Jackson Lagoon to Canoe Bay	0
"	Canoe Bay to Dorenoi Bay	1
"	Dorenoi Bay to Mitrofania	441
"	Mitrofania to Chignik Lagoon (mouth)	0
"	Chignik Lagoon to base of Cape Kumliun	220
"	Base of Cape Kumliun to Cape Kuyuyukak	651
"	Cape Kuyuyukak to Cape Kilokak	102
"	Cape Kilokak to Hartman Island	0
"	Hartman Island to Coal Point	1,907
"	Coal Point to Cape Kekurnoi	140
"		
	30 April- 4 May Total	51,655

Majestic emperor geese are referred to by the Aleuts as "beach geese" due to their attraction to intertidal areas for feeding and roosting. 10/87 Blenden

Figure 7. Percentage distribution of emperor geese by survey area, 30 April-4 May, 1987



Yukon-Kuskokwim Delta to Unimak Island including the north and south sides of the Alaska Peninsula.

The annual spring survey is initiated when essentially the entire population is believed to be staging in bays and lagoons within the survey area. Climatological charts prepared by the National Weather Service (NOAA) and aerial reconnaissance by refuge personnel from the Yukon Delta, Togiak and Alaska Peninsula/Becharof NWRs are essential indicators used to determine when to initiate the survey. We believe very few emperor geese were outside of the survey area from 30 April to 4 May. During the survey, no emperor geese were seen west of Swanson Lagoon, Unimak Island or along the coast of Unimak Island, which suggests to us that essentially all of the population had moved east out of the Aleutian Islands. Soviet biologists working in the Commander Islands and along the coast of the Kamchatka Peninsula consider emperor geese very uncommon during spring migration. This confirms that most of the U.S. and Soviet components of the population migrate through southwestern Alaska.

The concern that large numbers of Emperor geese may delay their migration from the Aleutian Islands and hence be missed during our spring surveys was addressed in 1987. A Department of the Interior turbo Grumman Goose (N780) surveyed the area from Kodiak Island to Attu Island from 2 to 6 May. This occurred while the normal aerial survey of southwestern Alaska was in progress. As anticipated, few emperor geese were observed with the total of 1,040 birds likely being sub-adults or non-breeders. These data confirm that the coordinated spring survey of emperor geese in southwestern Alaska provides the best available index of status of the population. In addition, these efforts are expanding our knowledge of the migratory behavior of this and other species in critically important coastal estuaries. These data are essential for the development of a recovery program for emperor geese.

Below average productivity in the emperor goose population in recent years is directly related to the alarming population decline observed through 1985 (Table 37). Management stratagies had little if any effect in slowing this decline even though all hunting was theoretically stopped, beginning in 1986. It was gratifying to see the population respond to good nesting conditions in 1986 and 1987.

Negotiations among residents of the Yukon-Kuskokwim Delta (i.e. Waterfowl Conservation Committee of the Association of Village Council Presidents), the states of Alaska and California, sportsmen's groups and the USFWS culminated in the 1985 Yukon Delta Goose Management Plan. According to this plan, if the spring emperor goose population falls below 60,000 birds based on a 3-year moving average all hunting must stop. With the 1987 survey total of 51,655 geese, this average fell to 50,906 (Figure 8). Restricted hunting of emperor geese may be allowed again when the spring population reaches 80,000 geese again based on a 3-year moving average.

Table 37. Spring Population size and productivity trends in Emperor geese.

Year	Spring Population Size (% change from prev.year)	Production[1] (% young in population)	Family Group Size
1980	No survey	24.8	2.3
1981	91,267	31.7	3.2
1982	100,643 (+10.3)	7.8	2.7
1983	79,155 (-21.4)	27.1	3.2
1984	71,217 (-10.0)	22.3	2.8
1985	58,833 (-17.3)	17.4[2]	2.8
1986	42,228 (-28.2)	26.1	2.6
1987	51,655 (+22.3)	33.6	3.1

[1] Data from Izembek NWR.

[2] Data from Izembek NWR and other Alaska Peninsula areas.

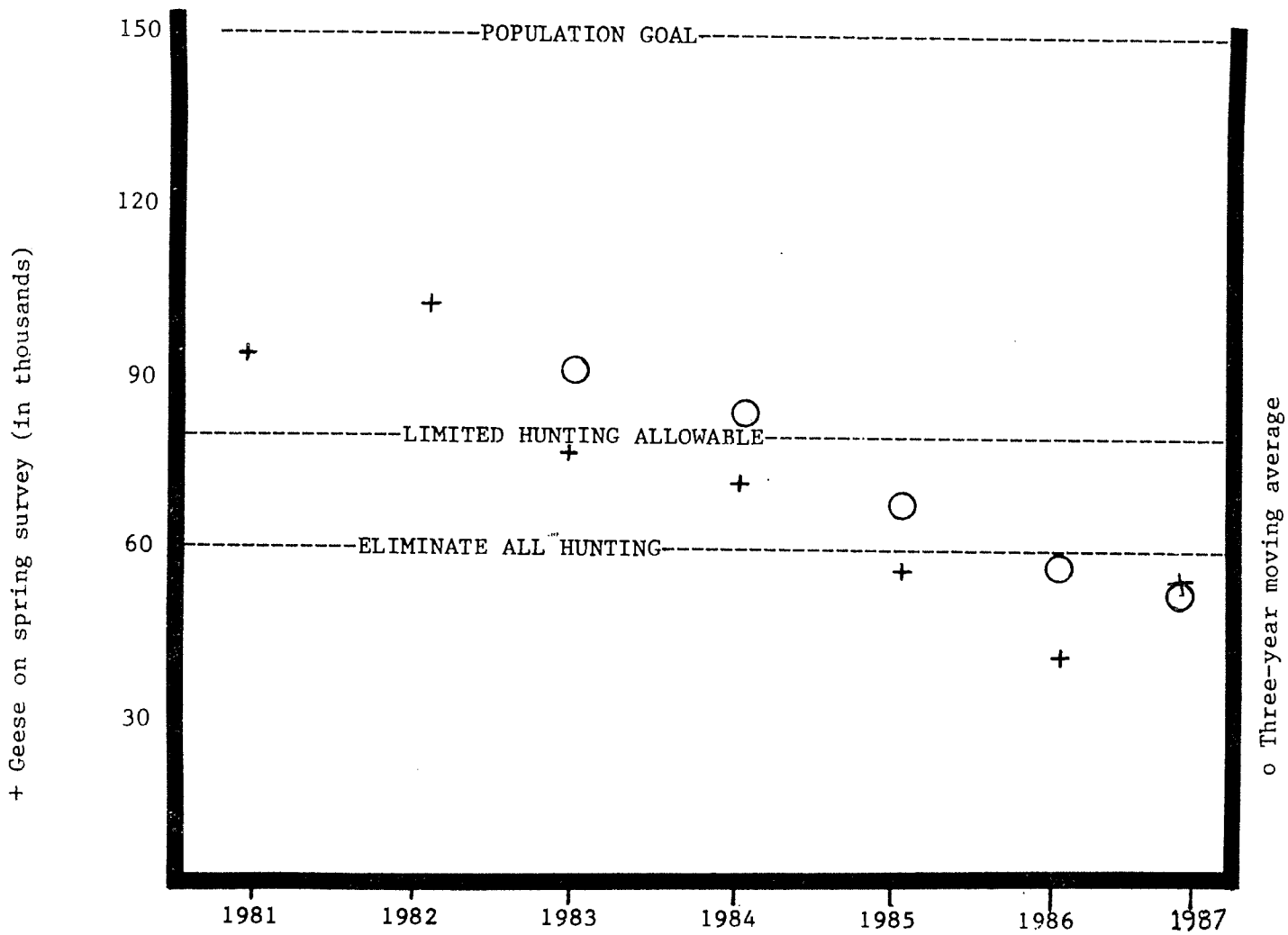


Figure 8. Emperor goose spring population size in relation to management thresholds

An action plan and a draft Pacific Flyway Management Plan for emperor geese identify a population goal of 150,000 birds. This goal is comparable to historic levels and should be maintained. It seems, to the Izembek NWR staff, that the difficulty in reaching and maintaining a population of 150,000 emperor geese is greatly increased by allowing hunting when only 80,000 individuals are present. We would suggest that hunting be prohibited if the population falls to 25% below the identified goal (i.e. when 110,000-115,000 geese are present).

Emperor geese began their fall influx into the Izembek NWR on 21 August when six birds were seen at Stapp Creek near Cold Bay. Peak numbers were present in October as determined from five aerial surveys (Table 30 in brant section). The aerial survey conducted by Rod King and Bill Eldridge (MBMN/WA-RO) was part of the annual fall survey of emperor geese in southwestern Alaska. The total of 65,663 geese counted from 2-5 October 1987 was used to estimate the composition of the fall population (Table 38).

Emperor goose productivity counts in 1987 were performed by the Izembek NWR staff and personnel from the Research and Migratory Bird Management Divisions in the Regional Office. Observations were made from 4 September to 17 October. Emperor goose productivity as determined from Izembek counts was based on 24 September and 6 October aerial photographic surveys and by conventional ground counts at other times using spotting scopes. Aerial surveys by the Izembek staff resulted in 38 photographic samples totaling 1,935 geese from the Nelson Lagoon to Moffet Bay area. This sampling effort gave a weighted average of 36.6 percent juveniles in the population. Combined aerial and ground productivity counts through October resulted in 4,512 emperor geese classified to age with 1,523 (33.8%) of these juveniles (Table 39).

Izembek information was combined with similar counts made at other bays and estuaries along the northside of the Alaska Peninsula from 16 September to 10 October (Table 40). The proportion of young in the population based on all sampling (10,178 geese) in 1987 was 23.7%.

The estimate of percent young from specific locations and times (Table 41) varied again this year. This corroborates 1986 data that indicated production estimates from aerial photographs taken from one area and time may not be representative. Comparison of the proportion of young present in each area during the first week of the survey (Table 42 suggest there may be a difference in the age composition of emperor geese using each lagoon. These results may indicate that discrete sub-populations use specific lagoons for extended periods during fall migration.

Family group sizes of emperor geese observed in the Izembek area averaged 3.1 young per family (n=186 families) over the period 4 September to 17 October. Average Class I and Class II sizes for

Table 38. Composition of the emperor goose population based on fall surveys in southwestern Alaska

	Number of Birds				
	1983	1984	1985	1986	1987
Fall Peak Count	72,551	82,842	59,792	68,051	65,663
Est. number of juvenile birds (percent young X total)	21,112	18,557	10,404	17,761	22,063
Est. number of families (number HY ÷ Avg. family group size)	6,598	6,628	3,716	8,881	7,117
Est. maximum number of breeding adults with young (number of families X 2)	13,196	13,256	7,432	17,762	14,234
Est. total number of sub-adults non and/or failed breeding adults (total count minus juveniles and breeding adults)	38,243 (52.7%)	51,029 (61.6%)	41,956 (70.2%)	32,528 (47.8%)	29,366 (44.7%)

Table 39. Emperor goose productivity counts, Izembek NWR, 1970-1987.

Year	Adults	Juveniles	Total	% Juveniles	No. of Families	Family Group Size
1970	9,722	4,933	14,655	33.7	383	2.9
1971	8,142	3,458	11,600	29.8	480	2.7
1972	4,680	2,270	6,950	32.7	210	3.1
1973	-	-	-	-	-	-
1974	2,025	377	2,402	15.7	50	2.6
1975	744	405	1,149	35.2	51	2.9
1976	1,023	324	2,247	14.4	207	2.7
1977	996	683	1,679	40.7	108	2.8
1978	1,395	495	1,890	26.2	62	3.0
1979	841	113	954	11.8	53	3.3
1980	1,777	586	2,363	24.8	40	2.3
1981	1,067	495	1,562	31.7	181	3.2
1982	1,653	140	1,793	7.8	32	2.7
1983	1,058	393	1,451	27.1	192	3.2
1984	2,753	795	3,548	22.4	79	2.8
1985	2,245	503	2,748	18.3	125	2.8
1986	3,283	1,381	4,664	29.6	266	2.6
1987	2,989	1,523	4,512	33.8	186	3.1
21 Yr. $\bar{X}$	2,860	1,153	4,028	27.0	148	2.9

Table 40 Percent young observed in photographic samples of emperor geese from five locations on the northside of the Alaska Peninsula in fall 1987.

Location				
Cinder River	Port Heiden	Seal Islands	Nelson Lagoon	Izembek Lagoon
25.0(2845)[1]	19.5(1721)	22.0(912)	26.1(3659)	23.0(904)

1. The number of emperor classified from photographs taken at each location are in parenthesis.

Table 41. Estimates of percent young of the year from aerial photographs on the Alaska Peninsula in fall of 1987.

	Location						
Date	Eggegik	Ugashik	Cinder River	Port Heiden	Seal Islands	Nelson Lagoon	Izembek Lagoon
9/16						33.5(892)	42.8(272)
9/24	0.0(28)[1]	0.0(27)	30.2(792)	16.9(462)	29.2(360)	14.0(650)	11.1 (72)
9/26			34.8 (69)	22.5(631)	5.2 (58)	10.9(175)	
10/6						35.0(972)	
10/7		6.1(82)	24.3(853)	17.8(225)	14.4(118)		9.5 (95)
10/8							11.9(344)
10/10			21.5(1131)	18.9(403)	20.2(376)	21.0(970)	20.7(121)

1. The number of emperors classified from photographs at each location are in parentheses.

Table 42. Percent young observed in photographic samples of emperor geese early and late in the survey period during fall 1987 at five locations on the Alaska Peninsula.

	Location				
Date	Cinder River	Port Heiden	Seal Islands	Nelson Lagoon	Izembek Lagoon
Early 9/16-9/26	30.5(861)[1]	20.1(1093)	25.8(418)	23.5(1717)	38.8(344)
Late 10/6-10/10	22.7(1984)	18.5 (628)	18.8(494)	28.6(1942)	15.5(560)

1. The number of emperors classified from photographs at each location are in parenthesis.

emperor geese at one study site on the Yukon-Kuskokwim Delta were 3.65 and 3.61, respectively (Craig Ely, Research, Anchorage). These data suggest an attrition rate of 15.1% for young emperor geese from hatch into the fall migration period. This rate of mortality, as evidenced by size of family groups, is 3% less than the average for the historical period, suggesting above average survival of young in 1987 (Table 43).

Neck collaring of emperor geese at research study sites on the Yukon-Kuskokwim Delta continued in 1987. A total of 232 birds were captured and 218 of these were fitted with yellow neck collars with black number/letter combinations. Three neck collared emperor geese were observed by AFWRC personnel at Izembek during the fall of 1987. An adult (6J9) was observed on 20, 21, and 27 September and two juvenile birds P07 and 21C were observed 12, 15 and 16 October, and 23 October, respectively.

4. Marsh and water birds Page 25

Common loons and red-necked grebes nest regularly in the area, but in low numbers. Both species appear to use remote areas of the refuge, however, a pair of common loons did successfully fledge two young at Blinn Lake in 1986. These birds move directly to Cold Bay and saltwater during winter.

5. Shorebirds, Gulls, Terns and Allied Species

Rock sandpipers and semipalmated plovers are two of the most common shorebird species nesting on the refuge.

Gull migration in 1987 appeared normal with flocks of glaucous-winged gulls moving north continuously beginning from 9 to 11 April. Mew gulls arrived on schedule and hatch dates in the first week of July suggest slight, if any, phenological delays.

Other noteworthy shorebird and gull observations follow:

Bar-tailed Godwit: A migrating flock struck lights and buildings at the USAF radar site on 19 October. Nine birds were recovered and processed for body composition analysis in coorperation with Bob Gill at the AFWRC (RO).

Black-bellied Plover: Three seen with a flock of 5 American Golden Plovers on 26 September.

American Golden Plover: Behavior suggestive of nesting was noted in an adult bird near Trader Mountain on 6 July.

Wandering Tattler: Two on Grant Point on 21 May.

Ruddy Turnstone: Approximately 1,500 birds in flocks of up to 100 were seen migrating south at 300-400 feet (AGL) near Moffet Bay on 6 August.

Table 43. Juvenile mortality of emperor geese during summer and fall, 1969-1980[1]

	$\bar{X}$ Clutch Size (n)	$\bar{X}$ Class I Brood Size (n)	$\bar{X}$ Class III/F Brood Size (n)	$\bar{X}$ Fall Family Group Size (n)
1969-1980	5.0±0.3 (806)	4.1±0.4 (517)	3.5±0.6 (497)	2.9±0.3 (1,805)
Estimated mortality from preceeding age classification		18%	15%	17%
Estimated mortality in relation to fall family group size	42%	29%	17%	

[1]Summer data from Yukon-Kuskokwim Delta study areas; fall data from Izembek NWR

The semi-palmated plover is quick to employ "distraction" behavior to lead potential predators from its exposed nest. 7/8/87 Blenden

Red-faced and pelagic cormorants share nesting ledges on Unimak and Amak Islands. 6/24/87 Sarvis(461)29

Sharp-tailed Sandpipers: Single birds or groups up to three were seen near Izembek Lagoon from 20 September to 2 November.

Dowitcher spp.: Pair with three chicks seen near Outer Marker (Izembek Lagoon) on 14 June.

Northern Phalarope: Pair seen on a small lake near Grant Point on 31 May.

Pomarine Jaeger: A flock of 5 was seen flying southwest over Norma Bay on 23 September.

Glaucous-winged Gull: An adult gull was seen flying on 5 November near Grant Point carrying a live, thrashing crested auklet. The gull attempted on three occassions to drown the bird which eventually escaped.

6. Raptors

Three kestrel sightings were obtained for the area near Cold Bay from mid-September to mid-October. The last records of this species were single birds seen in January of 1966, December of 1978 and October of 1986.

From 15 January to 11 February, three carcasses of bald eagles were recovered by the refuge staff. Electrocution appeared to be the cause of death in one of the birds while the other two were shot. The second nesting record of the bald eagle was documented for the Izembek NWR in 1987. These birds nested on top of a large boulder in a foothill area of Frosty Peak. The nest was investigated and the single eaglet banded on 24 July.

7. Other Migratory Birds

A chronology of routine and unusual sightings of 'other' migratory birds follows:

Tree Swallow: First sighting at Cold Bay was on 4 May.

Fox Sparrow: First sighting at Cold Bay on 13 May.

Song Sparrow: One on beach near the Cold Bay dock on 24 October.

Double-crested Cormorants: Approximately 10 breeding plumaged birds in the Old Man's and Thinpoint Lagoon areas on 19 May. Several flocks (12, 3, 22) moving southwest near Norma Bay on 21 October.

Lesser Snow Goose: Flock of 4 near Bluebill Lake on 25 October.

Bald eagles nest commonly on cliffs and offshore rocks along the Alaska Peninsula and Unimak Island. Few such sites exist on the Izembek Unit hence this nest, the second ever documented on the refuge, was a valuable observation. Dau

Eurasian Wigeon: Flocks of 1 to 25 seen on Izembek Lagoon from 25 September to 19 October.

Tufted Duck: A single adult male was seen with 5 greater scaup on Applegate Cove on 30 September.

Oldsquaw: A flock of approximately 1000 was seen in Cold Bay, from Lenard Harbor to Mortensen Lagoon, on 23 and 24 November.

The Izembek NWR staff banded 32 individuals of two passerine species in 1987. All birds were captured at a remote controlled bait station/trap located at the refuge office (Table 3).

The refuge staff conducted the 21st annual Christmas bird count in the Cold Bay/Izembek area on 2 January 1988. Viewing conditions were poor with rain, snow, and wind occurring that day. A total of 413 individuals of 25 species were observed (Table 44).

8. Game Mammals

Brown Bear

The Research and Management Study designed to evaluate the distribution, habitat use and population ecology of brown bears in the Right- and Left-Hand Valley area (Figure 9) of the Izembek NWR entered its third field season in 1987. This study is designed to provide the refuge with baseline data on an area and brown bear population which we believe is critical to the maintenance of historical distribution and abundance patterns of brown bears throughout the lower Alaska Peninsula. The primary management application of the study relates to identification and hopefully, protection of critical habitats. Data on immigration patterns of bears as related to hunting pressure and the effects of other forms of disturbance, including fixed-wing aircraft and helicopters on the activity patterns and distribution of bears is also an important goal.

Most brown bears captured and radio-collared as part of this study were immobilized in August of 1984. The maximum estimated life span for the battery operated collars is 3 years hence most of these and only a few additional animals captured in 1985 were available for monitoring late in 1987.

A single den checking flight (29 Dec. 1986) performed during 1986/87 period suggested that six bears still carried active neck collars. Two survey efforts were performed on 24 September and eight signals were recovered, four of which had been located during the previous den check. The 1987/88 den checking flight was performed on 2 March 1988 with six signals received. Four of these neck collars were placed on bears during 1985 capture operations and two are from the primary capture period in August of 1984 (Table 45). Only one bear (IZ24♀), of the ten with active radio collars in 1987, was lost to the study either due to radio

Table 44. Results of Christmas Bird Count, Cold Bay, Alaska 2 January 1988.

Species	1987	Average No. Seen (No. Years Seen)	% Change From Avg.
Red-necked Grebe	2	2.7(9)	-26
Horned Grebe	4	13.5(11)	-70
Pelagic Cormorant	6	13.2(20)	-55
Emperor Goose	25	1158.0(22)	-98
Mallard	7	36.4(14)	-81
Common Goldeneye	37	114.6(21)	-32
Oldsquaw	12	241.3(22)	-95
Harlequin Duck	27	29.4(21)	- 8
Steller's Eider	83	1114.1(22)	-93
White-winged Scoter	2	18.9(18)	-89
Black Scoter	51	162.2(19)	-69
Common Merganser	19	11.7(10)	62
Red-breasted Merganser	7	124.6(20)	-94
Bald Eagle	12	10.9(22)	10
Gyrfalcon	1	1.5(11)	-33
Glaucous-winged Gull	48	166.8(22)	-71
Common Murre	1	1 (5)	0
Pigeon Guillemot	1	6.5(13)	-85
Belted Kingfisher	2	1.3(4)	54
Black-billed Magpie	5	2.7(14)	85
Common Raven	32	91.6(22)	-65
Dipper	1	2.2(13)	-55
Northern Shrike	1	1.3(15)	-23
Gray-crowned Rosyfinch	2	58.5(22)	-97
Snow Bunting	25	40.9(22)	-39
Total number of Species	25		
Total number of individuals	413		

Number of observers: 2 (John and Jean Sarvis)
Observation time: 8 hours (0.5 on foot; 7.5 by car)
Distance covered: 77 miles (1 on foot; 76 by car)

[1] A total of 58 species have been observed in 22 years.

[2] Average 22 years of participation in the Christmas Bird Count.

[3] Extremely poor weather conditions occurred in 1987.

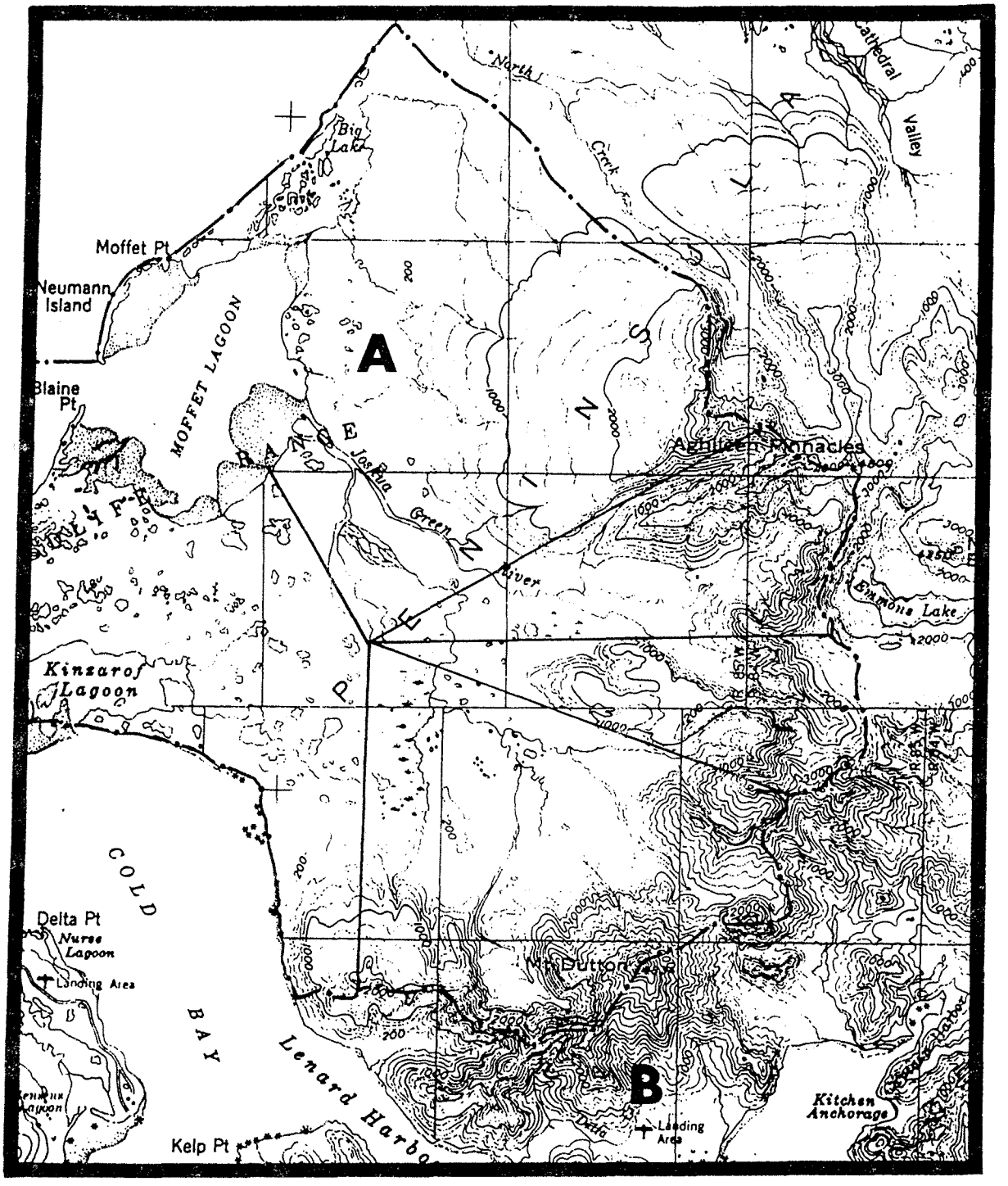


Figure 9 . Brown bear study area in the Right- and Left-Hand Valley areas with radio quadrants. A: Izembek NWR (-·-·- boundary), B: Pavlof Unit, Alaska Peninsula NWR

Table 45. Brown bears with active radio collars during 1987.

Bear ID/Frequency	Date Capture	Tracking Period		
		Denning 1986/87	Fall 1987	Denning 1987/88
IZ77♂ /425	8/85	X		X
IZ24♀ /445	8/84	X		
IZ28♀ /485	8/84		X	
IZ51♀ /500	8/84		X	
IZ27♀ /510	8/85		X	
IZ49♀ /525	8/84	X	X	X
IZ73♀ /550	8/85	X	X	X
IZ80♀ /575	8/85	X	X	X
IZ67♀ /595	8/84	X	X	X
IZ38♀ /625	8/84	X	X	

failure or death. Clear relatively calm weather is a necessary prerequisite for flights in mountainous denning areas as several physical characteristics of each site are estimated. Denning information obtained allowed us to characterize areas used by various components of the population (Table 46). Of four bears collared in 1984, whose den sites were found in the winter of 1986/87, all returned to the same general denning area (i.e. 0-1.6 km). Two of these 1984 captures were still carrying active radios during the 1987/88 denning period. Both were adult sows of unknown reproductive status with IZ49 and IZ67 selecting sites 2.6 and 0.2 kilometers, respectively from their 1986/87 sites and 3.5 and 0 kilometers, respectively, from their 1985/86 sites. Four bears captured in 1985 (i.e. IZ27,73,77,80) were located in dens during the winter of 1987/88 while only three (i.e. IZ73,77,80) were located the previous winter of 1986/87. All were adults with IZ77 the only male. IZ77 moved his den site 3.6 and 2.9 kilometers, respectively, during the two successive denning periods while the movements by the adult sows ranged from 0.2 to 2.6 kilometers (Table 47).

Den site characteristics of adult sows which were known to give birth to cubs were compared to those seen later without cubs and presumed to be non-productive. None of the den site parameters compared suggested any difference between reproductive and non-reproductive females (Table 48).

It is apparent from our study that analysis of denning fidelity or den site preferences of bears, when compared on the basis of sex, age or status, can be done only in a general way. Bears are highly individual as evidenced by the high degree of variability within groupings of 'similar' bears. Sows with cubs-of-the-year may den at lower elevations than do maternal females with older cubs, however, they appear to remain longer in areas of higher elevation. We hypothesize that this may be avoidance behavior toward other bears, primarily adult males, which descend to lower elevations soon after den emergence. Our data suggest that males den at lower average elevations than do females of various status and often in areas of low denning concentrations (Table 46). Both sexes and all categories of bears preferred denning areas with slopes greater than 45 (i.e. 78% overall). Fifty percent of all dens were northerly facing sites and 52% were in areas of high denning concentrations. We believe our data show that characteristics of ruggedness or inaccessibility are the primary selective factors used by bears. Hence, suitable habitat draws more animals and supports higher densities.

Denning concentration or density in our analysis is a subjective index based on the number of other radio-collared bears denning within a 1km radius of each den site during the winter of 1984/85 and 1986/87. We assume marked bear densites should provide a rough approximation of high, medium or low concentrations of unmarked bears as well. This aspect of the study has been extremely valuable in identifying several key, high density denning areas. This information will aid us in evaluation of

Table 46. Den characteristics of brown bears summarized by sex and status, Izembek NWR, 1984-1987.

Bear Type	No.	Den Elevation	General Aspect[1]							Slope[2]			Denning Concentrations[3]		
		$\overline{X}$ (range)meters	N	NE	SE	S	SW	W	NW	1	2	3	High	Med.	Low
Males	9	586(152-976)	2	2		1	2	1	1	3		6	3	1	5
Females															
Singles	15	795(488-1159)	3	1	0	3	2	2	4	1	3	11	8	2	5
W/COY	12	763(198-1159)	1		4	1	4		2	2		10	7	1	4
W/YRL	4	968(793-1037)	1		1			1	1		1	3	1	1	2
W/2½	3	966(884-1037)			1				2			3	2		1
Unknown Status	7	771(305-1068)	2		3				2	1		6	5	1	1
TOTALS[4] (%)	50	755±250(1 SD)	9 (18)	3 (6)	9 (18)	5 (10)	8 (16)	4 (8)	12 (24)	7 (14)	4 (8)	39 (78)	26 (52)	6 (12)	18 (36)

[1] Categories are 45° spans centered on listed compass headings

[2] Categories are 1= ≤30°, 2=30°≤45°, 3>45°

[3] Categories are High=≥3, Medium=>1≤2, Low=0, other marked bears denning within a 1 km radius of den site

[4] Percentage of sightings in parentheses

Table 47. Characteristics of brown bear dens, 1984/85 to 1987/88, Izembek NWR.

Bear No.	Sex	Age	Status	Den Characteristics[1]			Denning Concentration[3]			Distance From Previous Den (km)[6]
				Elevation (meters)	Aspect (°TN)	Slope[2]	High	Medium	Low	
Winter 1984/85										
IZ23[4]	F	16	W/3 COY	701	225	3			*	NA
IZ24	F	12	W/3 COY	915	225	3		*		NA
IZ26	F	13	W/2 YRL	1037	360	3			*	NA
IZ27	F	10	W/3 YRL	793	335	3	*			NA
IZ28	F	10	W/3-2½	884	315	3	*			NA
IZ29	F	15	W/1 COY	1067	135	3	*			NA
IZ33	F	13	W/1 YRL	1037	135	2			*	NA
IZ37	F	7	W/2 YRL	1006	270	3		*		NA
IZ38	F	19	W/2 COY	640	315	3	*			NA
IZ39	F	13	W/2 COY	335	135	3			*	NA
IZ40	M	11	-	152	045	1			*	NA
IZ41	M	21	-	976	360	3		*		NA
IZ46	F	6	Single[5]	976	270	3	*			NA
IZ47	F	19	Single	1006	180	3		*		NA
IZ48	F	13	Single	762	160	3	*			NA
IZ49	F	14	Single[5]	549	315	3			*	NA
IZ50	M	4	-	579	360	1			*	NA
IZ51	F	6	Single[5]	854	360	1			*	NA
IZ63	F	8	W/2-2½	976	135	3	*			NA
IZ66	F	18	Single	884	270	3	*			NA
IZ67	F	4	Single	732	225	3	*			NA
IZ68	M	4	-	793	270	3	*			NA
IZ69	M	5	-	549	045	3			*	NA
Winter 1985/86										
IZ23	F	17	Single[5]	610	225	3			*	0.48
IZ27	F	11	W/3-2½	1037	315	3	*			1.08
IZ28	F	11	Single	884	315	2	*			0.84
IZ38	F	20	Single[5]	854	360	3	*			0.78
IZ40	M	12	-	366	235	1			*	19.20
IZ49	F	15	Single	640	180	3			*	1.68
IZ67	F	5	Unknown	915	135	3		*		0.30
IZ71	F	4	Single	732	315	2	*			NA
IZ73	F	4	Single	763	180	3		*		NA
IZ77	M	18	-	458	315	3	*			NA
IZ78	F	6	W/1 COY	1037	225	3	*			NA
IZ80	F	16	Single[5]	519	045	2			*	NA
Winter 1986/87										
IZ24	F	15	W/2 COY	732	225	3	*			0.8
IZ38	F	21	W/2 COY	854	315	3	*			1.3
IZ49	F	17	Unknown	488	315	3	*			1.6
IZ67	F	7	Unknown	915	135	3	*			0.0
IZ73	F	5	Single[5]	1159	180	3	*			0.8
IZ77	M	19	-	427	225	3		*		3.6
IZ80	F	17	W/3 COY	198	135	1			*	3.6
Winter 1987/88										
IZ27	F	13	Unknown	915	335	3	*			1.1
IZ49	F	18	Unknown	793	360	3	*			2.6
IZ67	F	8	Unknown	1068	135	3	*			0.2
IZ73	F	6	W/1 COY	1159	135	3	*			0.5
IZ77	M	20	-	976	180	3	*			2.9
IZ80	F	18	Unknown	305	360	1			*	2.4

[1] Den characteristics are subjective estimates of the general location obtained during aerial tracking flights

[2] Slope evaluations 1=$\angle 30°$, 2=$\geq 30° \angle 45°$, 3=$\geq 45°$.

[3] Based on the number of marked bears denning within $\angle$ 1.6 km radius (High=$\geq$3, Medium=1-2, Low=0).

[4] Adopted 1 COY in fall 1984.

[5] Produced cubs-of-the-year.

[6] All distances if more than two dens are involved.

Table 48. Characteristics for adult female brown bears in relation to reproductive status, Izembek NWR, 1984-1988.

STATUS[1]	I.D./AGE	DEN ELEVATION (meters)	ASPECT (°TN)	SLOPE[2]	DENNING CONCENTRATION HIGH	MED	LOW
Reproductive	23 / 17	610	225	3			*
	38 / 20	854	360	3	*		
	46 / 6	976	270	3	*		
	49 / 14	549	315	3			*
	51 / 6	854	360	1			*
	73 / 5	1159	180	3	*		
	80 / 16	519	045	2			*
TOTAL/ $\bar{X}$	12.0±6.2(1SD) (5-20)	789±239(1SD) (519-1159)	250±113(1SD)	1 2 3(5)	3	0	4
Non-Reproductive	28 / 11	884	315	2	*		
	47 / 19	1006	180	3		*	
	48 / 13	762	160	3	*		
	49 / 15	640	180	3			*
	66 / 18	884	270	3	*		
	67 / 4	732	225	3	*		
	71 / 4	732	315	2	*		
	73 / 4	763	180	3		*	
TOTAL/ $\bar{X}$	11.0±6.3(1SD) (4-19)	800±116(1SD) (732-1006)	228±64(1SD)	2(2) 3(6)	5	2	1

[1]Sows that produce cubs (reproductive), Sows that don't produce cubs (non-reproductive).

[2]Catagories are 1=≤30°, 2=>30°≤45°, 3=>45°.

various forms of development and public use that are occurring or may be proposed in these areas.

Low aerial overflights were made of denned collared bears in an attempt to determine alertness in previous years when most radios were still active. Additional data on only two bears (IZ27 and IZ67) were added in 1987/88. Twenty-six bears found in dens the past three winters were fitted with collars with both active and inactive modes (i.e. different pulse rates) (Table 49). When the transmitter is stationary for one hour or more a slower (inactive) pulse rate is initiated. Very little movement on the part of the bear is necessary to switch the transmitter to the faster (active) pulse rate. Eleven bears varied between active and inactive mode on successive den checks and three encountered initially on inactive mode switched to active mode when approached by the aircraft. These data suggest that at least some bears may respond to aircraft disturbance while denned and that these and others appear to normally undergo periods of activity in the den. Of the five bears alerted by the aircraft, one was a large boar, and the remaining four were non-maternal sows.

We have not identified any adverse effects of intra-den alertness in response to aircraft overflights or if such responses are the result of aircraft disturbance or normal activity rhythms of individual bears.

After bears emerged from their dens in April and May of 1987, we attempted to determine the status of all radio-collared sows. This was done to determine if single sows had produced young during the winter and to determine survival of older cubs. Three sows were observed with cubs-of-the-year during the fall of 1986. Relocations of these sows during 1987 were obtained, however visual sightings were not possible due to dense vegetative cover. Similar situations existed with respect to the single sows observed with yearling and 2.5 year old cubs in the fall of 1986 (Table 50). Spring through fall survival of cubs could not be determined as no spring tracking flights were performed in 1987. Only three marked adult sows were available to give birth during the winter of 1986/87 and only one of these (IZ73 w/1 COY) was observed in the fall of 1987.

Locations of radioed bears were marked on mylar overlays of 1:120,000 scale black and white aerial photographs of the study area. When time or weather conditions precluded determining exact locations, general locations were estimated.

Only one radio marked male bear was available for monitoring in 1987. This bear (IZ77) was located only during the 1986/87 and 1987/88 denning periods (Figure 10). Exact radio locations are presented for sows of various status in Figure 11 a-b. Data allowing more specific analysis of distributional patterns as related to season, habitat type and food availability were collected and will be analyzed in a final report on the study. Categories used to classify habitat use by brown bears followed a

Table 49. Index of alertness during denning for bears with bi-modal radio collars

Bear No.	Sex	Age	Status	Number of Times Monitored in Den	Transmitter Mode		
					Active	Inactive	Audibly Switched Inactive to Active
IZ40	M	11	-	2			2
IZ41	M	21	-	2	2		
IZ68	M	4	-	2	2		
IZ69	M	5	-	3	2	1	
IZ23[1]	F	17	Single	2		2	
IZ28[1]	F	11	Single	2		1	1
IZ29	F	15	Single	2	1	1	
IZ38[3]	F	20	Single	2		2	
IZ48	F	13	Single	2	2		
IZ66	F	18	Single	3	2		1
IZ67[3]	F	4	Single	5	3	1	1
IZ71	F	4	Single	2	2		
IZ78	F	6	Single	2		1	1
IZ23[1]	F	16	W/COY	1		1	
IZ24[2]	F	12	W/COY	3	1	2	
IZ38[1]	F	19	W/COY	2	1	1	
IZ38[3]	F	21	W/COY	1	1		
IZ39	F	13	W/COY	3	1	2	
IZ26	F	13	W/YRL	1		1	
IZ27[5]	F	10	W/YRL	1		1	
IZ37	F	7	W/YRL	2	1	1	
IZ27[5]	F	11	W/2½	2	1	1	
IZ28[1]	F	10	W/2½	2	1	1	
IZ63	F	8	W/2½	2	1	1	
IZ27[5]	F	12	Unknown	1	1		
IZ67[4]	F	7	Unknown	1		1	

[1]Monitored 1984/85 and 1985/86

[2]Monitored 1984/85 and 1986.87

[3]Monitored 1984/85, 1985/86 and 1986/87

[4]Monitored 1984/85 through 1987/88

[5]Monitored 1984/85, 1985/86 and 1987/88

Table 50. Brown bear cub survival, fall 1986 through spring 1987, Izembek NWR.

Family	Age	Fall	Spring	
		No. of Cubs	No. of Cubs	% Cub Survival
COY				
IZ23	18	2	Unknown	-
IZ38	21	2	Unknown	-
IZ80	17	3	Unknown	-
YEARLING				
IZ78	7	1	Unknown	-
2½ YEAR OLD				
IZ39	15	2	2	100

THIS LEGEND APPLIES TO THE FOLLOWING TWO FIGURES:

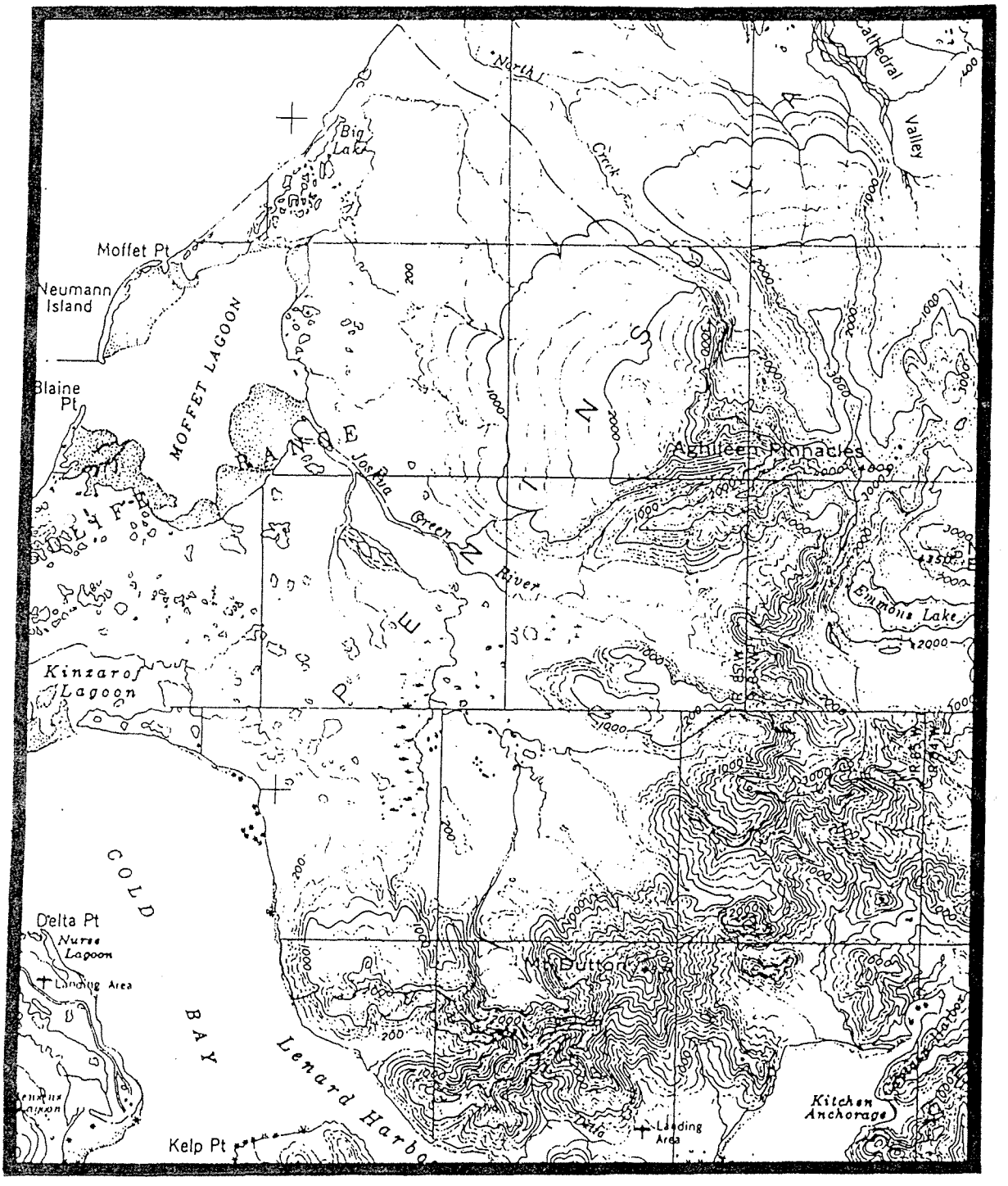
○ 1984/85 Den

□ 1985/86 Den

△ 1986/87 Den

+ 1987/88 Den

● September location


Moffet Pt
Neumann Island
Blaine Pt
MOFFET LAGOON
Big Lake
North Creek
Cathedral Valley
Joshua Green River
Achilleen Pinnacles
Emmons Lake
Kinzarof Lagoon
COLD BAY
D'Delta Pt
Nurse Lagoon
Landing Area
Mt Dutton
Lenard Harbor
Kelp Pt
Landing Area
Kitchen Anchorage

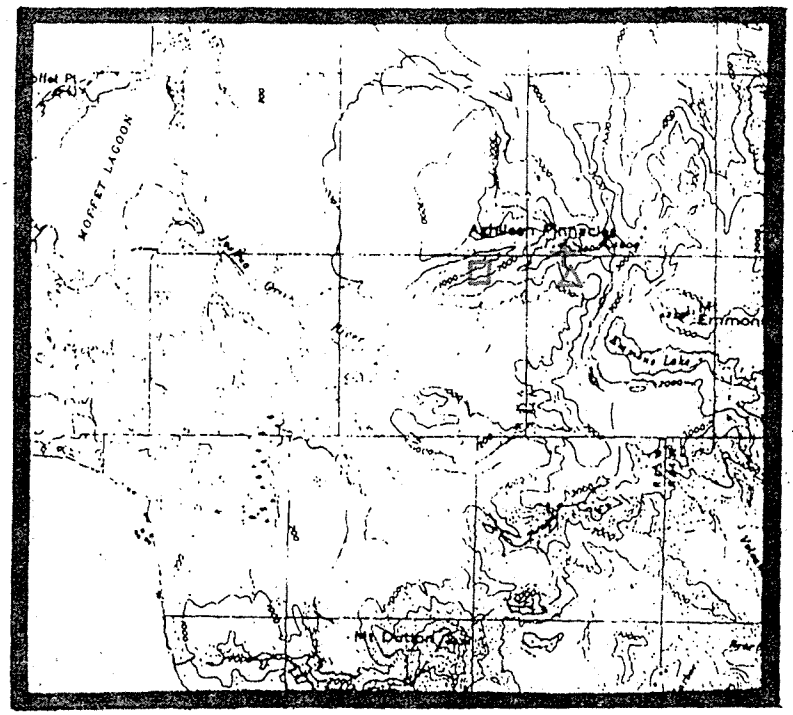
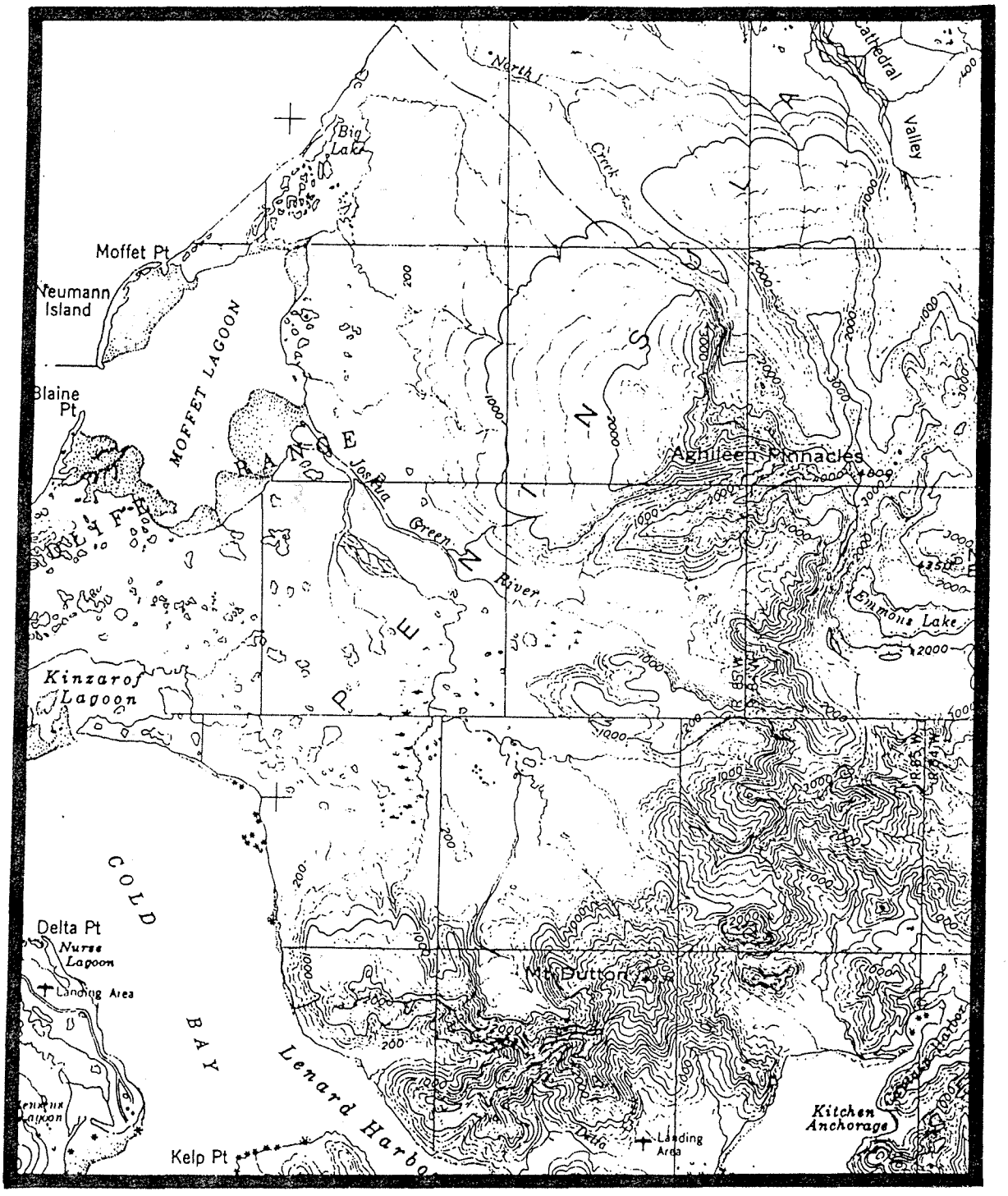


Figure 10. Radio location of Male brown bear (IZ77), 1987.


Moffet Pt
Neumann Island
Blaine Pt
MOFFET LAGOON
Big Lake
North Creek
Cathedral Valley
Aghileen Pinnacles
Joshua Green River
Emmons Lake
Kinzarof Lagoon
COLD BAY
Delta Pt
Nurse Lagoon
Landing Area
Mt Dutton
Lenard Harbor
Kelp Pt
Kitchen Anchorage
Landing Area

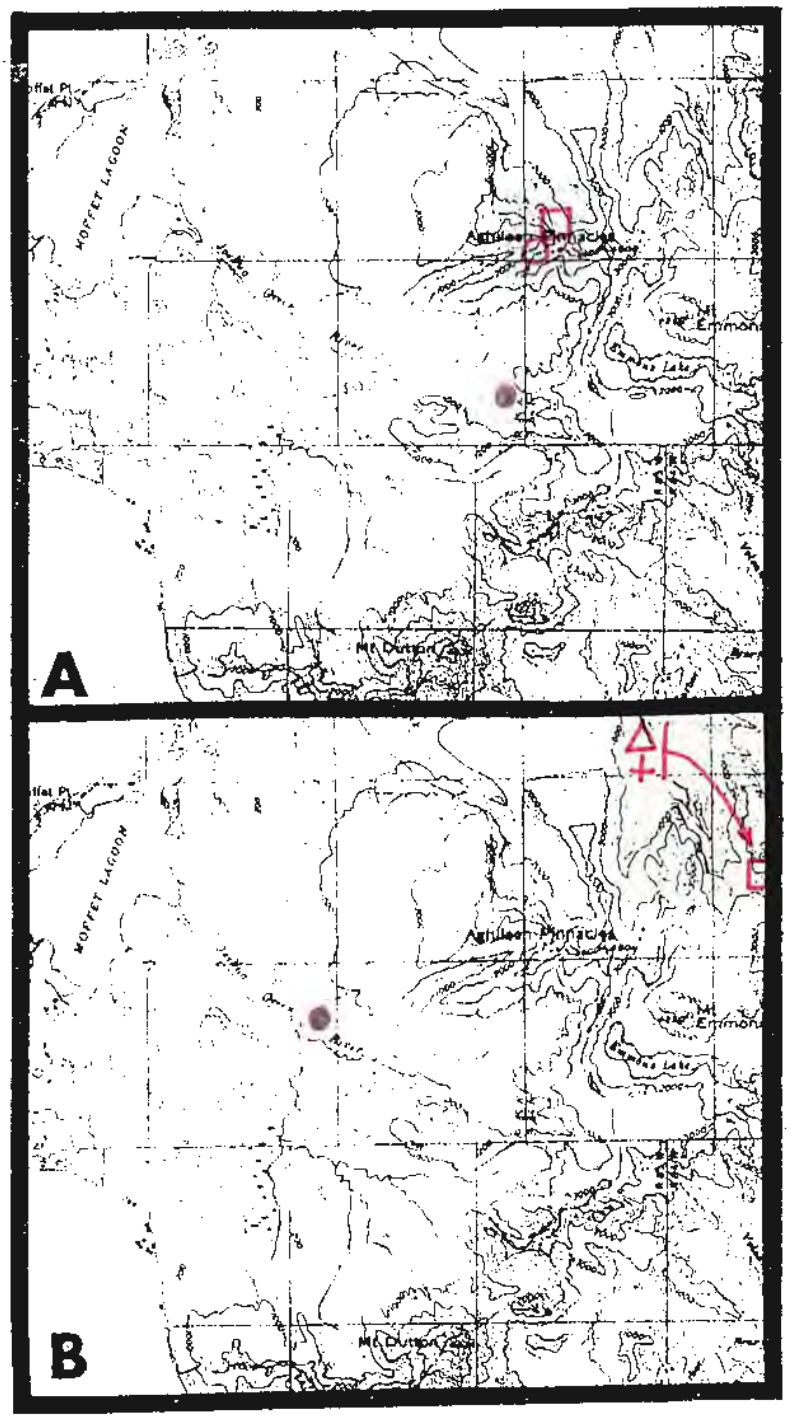
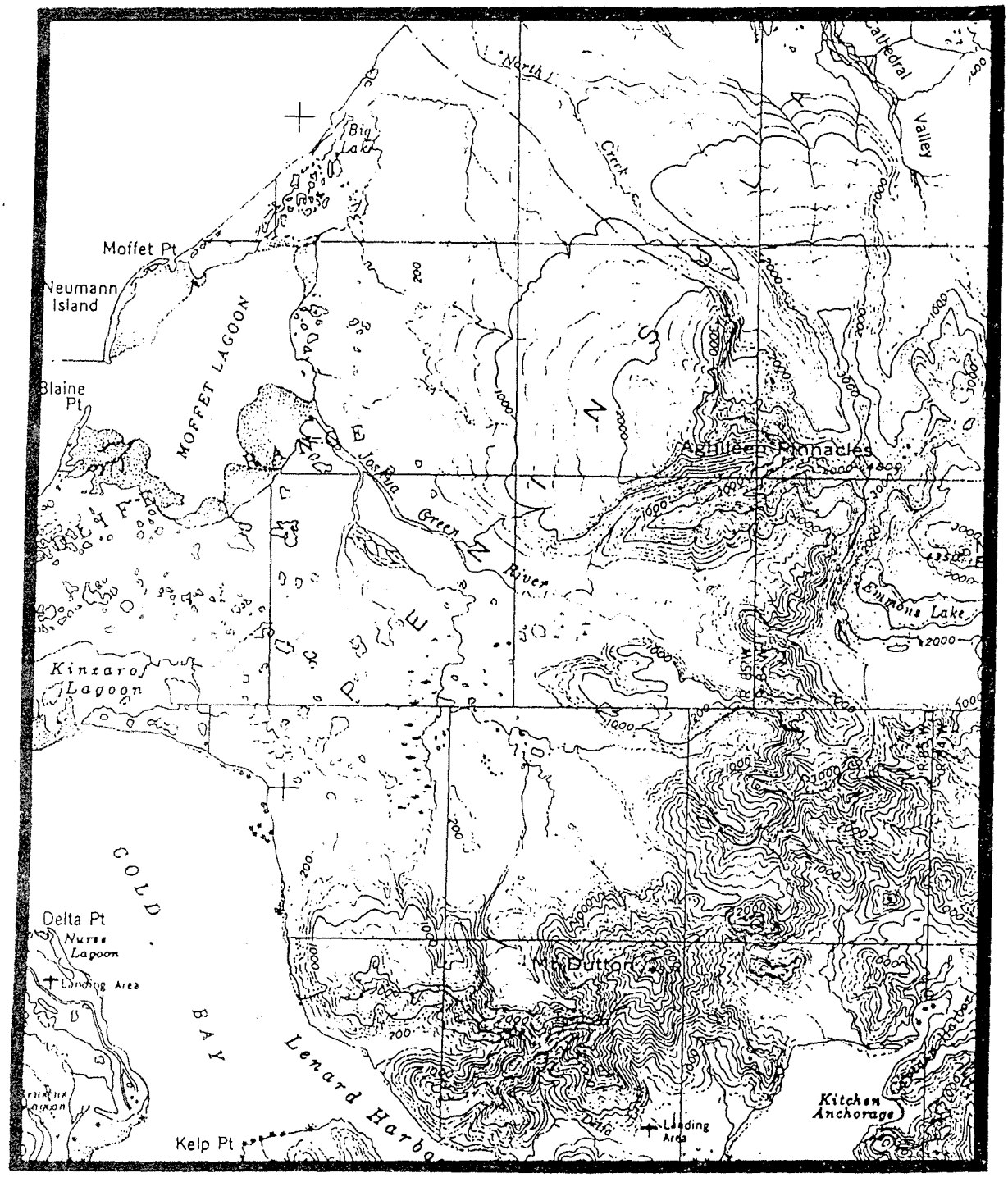


Figure 11a. Radio locations of female brown bears with cubs-of-the-year, 1987. A: IZ28; B: IZ73.


Big Lake
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Cathedral Valley
Moffet Pt
Neumann Island
MOFFET LAGOON
Blaine Pt
Green River
Aghileen Pinnacles
Emmons Lake
Kinzarof Lagoon
COLD BAY
Delta Pt
Nurse Lagoon
Landing Area
Mt Dutton
Lenard Harbor
Kelp Pt
Delta
Landing Area
Kitchen Anchorage

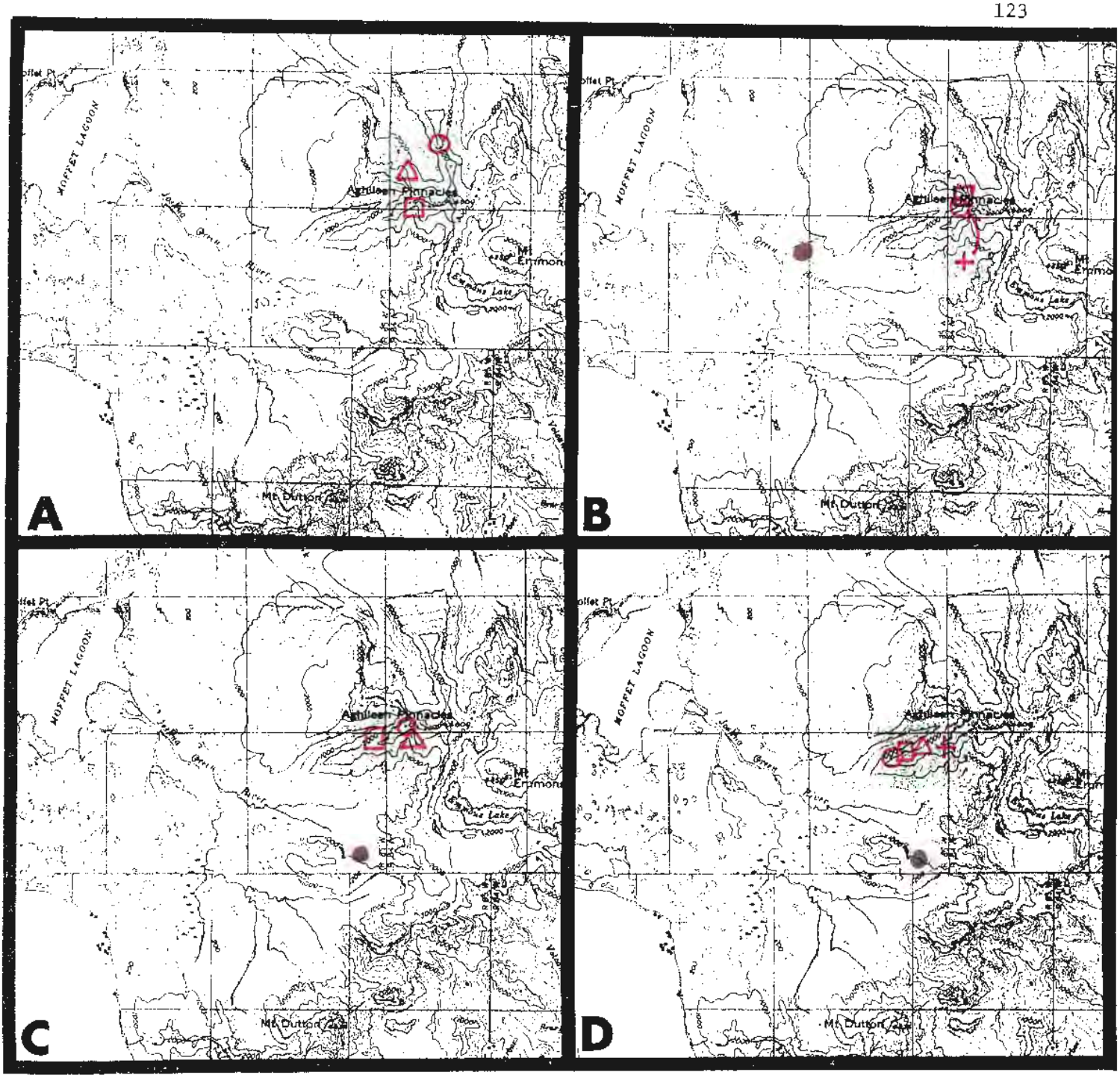
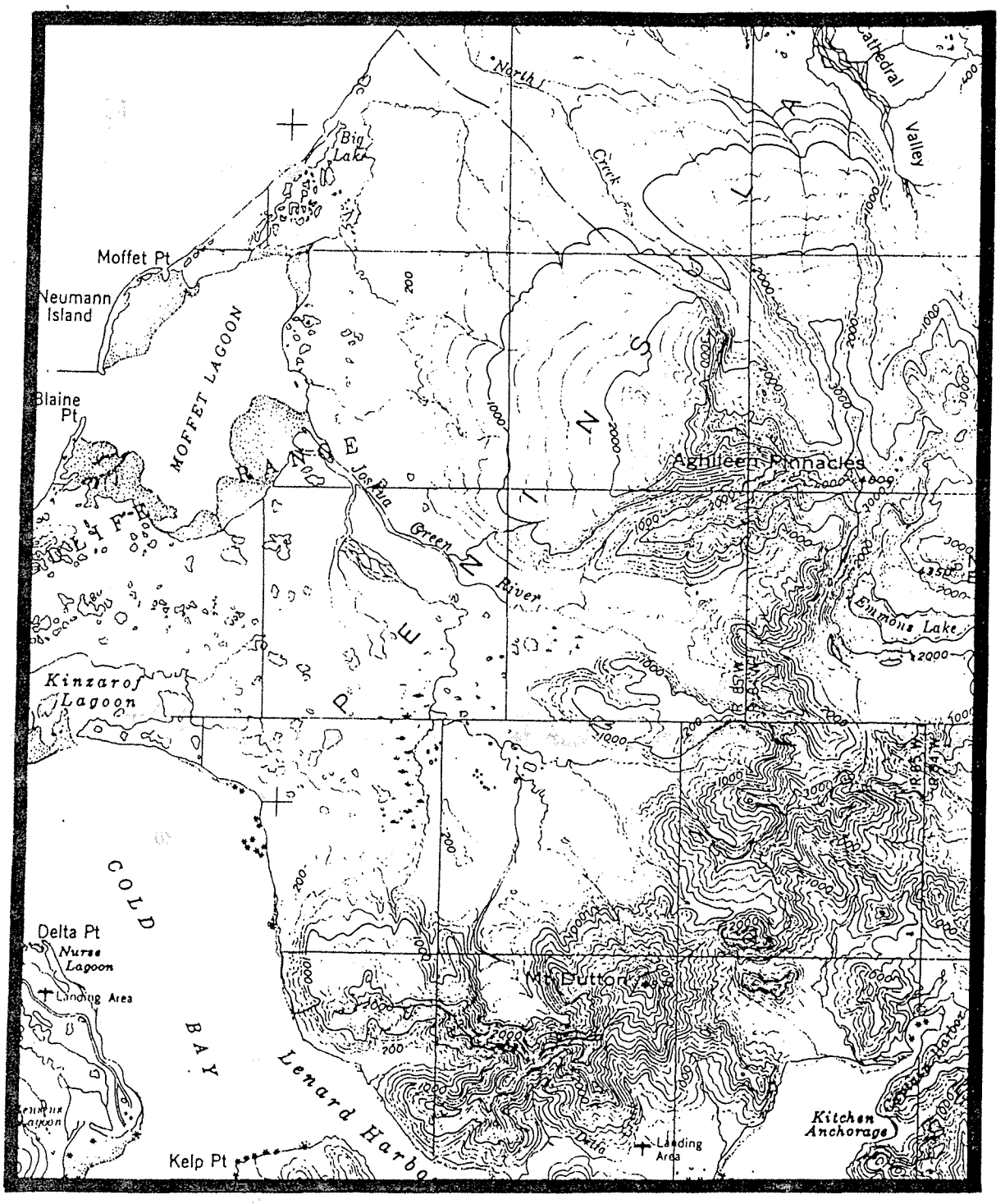


Figure 11b. Radio locations of adult female brown bears of unknown status, 1987. A: IZ24; B: IZ27; C: IZ38; D: IZ49.


Cathedral
Valley
North
Creek
Big
Lake
Moffet Pt
Neumann
Island
MOFFET LAGOON
Blaine
Pt
Joshua
Green
River
Aghileen Pinnacles
Emmons Lake
Kinzarof
Lagoon
COLD
BAY
Delta Pt
Nurse
Lagoon
Landing Area
Mt Dutton
Lenard Harbor
Kelp Pt
Delta
Landing
Area
Kitchen
Anchorage

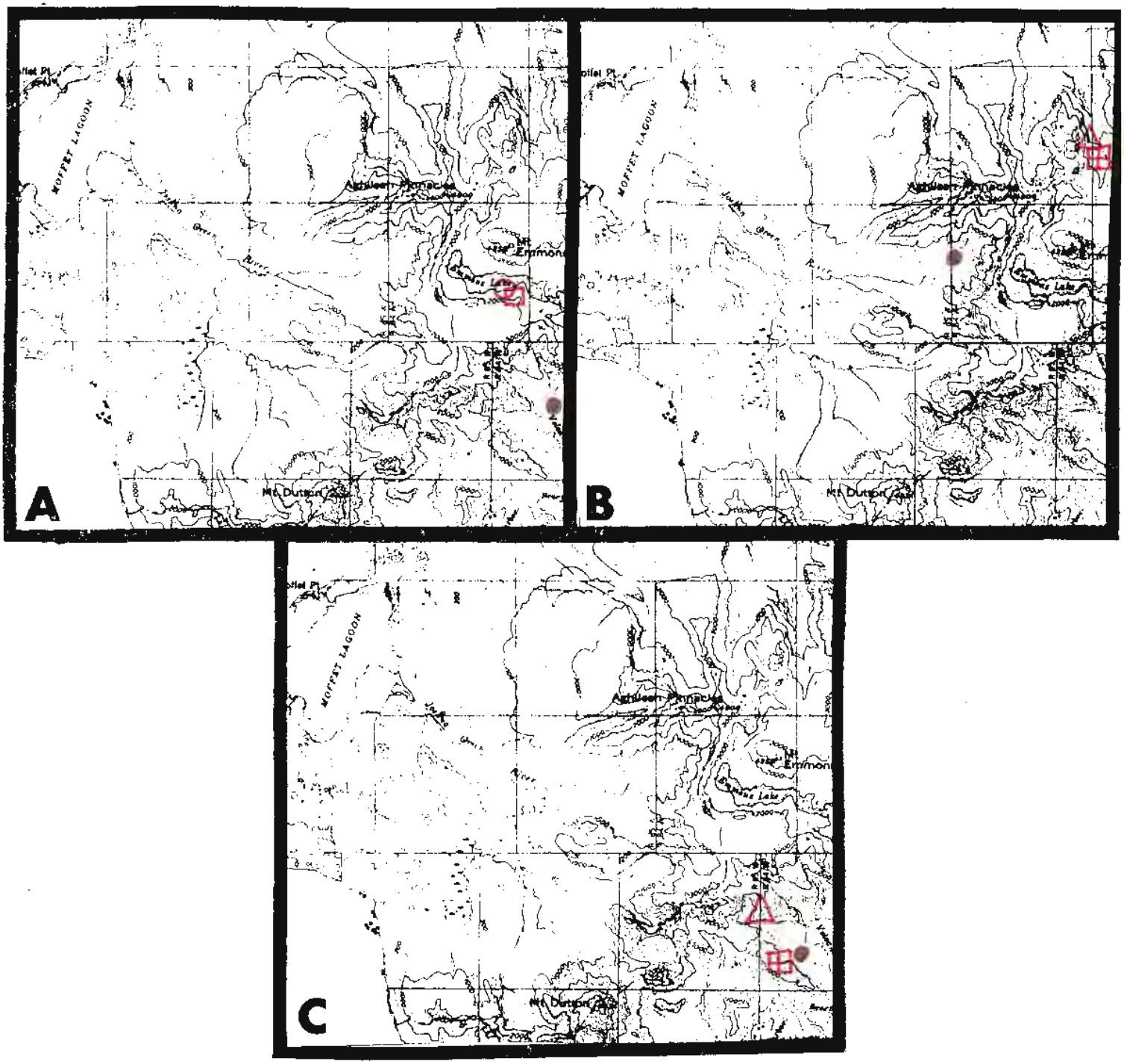


Figure 11b. (con'd). A: IZ51; B: IZ67; C: IZ80.

format used in similar studies on the Kodiak NWR. Habitats on the Izembek NWR are not as diverse as those encountered at Kodiak, hence only selected categories were applicable (Table 51). Each observation of a radio-collared bear was coded to habitat type to determine seasonal use patterns. These data were combined by population cohorts in Table 52 to show preliminary patterns. Considerable individual variation and small sample sizes within cohorts suggest that animals particularly, in this study, are best dealt with separately to most accurately portray variability in habitat use.

Most radio locations obtained during aerial tracking flights do not correspond to actual visual sightings of the bear. Obviously this was the case during the denning period, but it also occurred often when animals were occupying "day-beds" within the alder (Alnus crispa) zone. Activity patterns of most bears are primarily nocturnal and crepuscular. This fact presents an obvious problem in projects such as ours which rely on data collected primarily from diurnal aerial surveys. Fortunately, the determination of seasonal patterns of habitat use, which is a primary goal of our study, can be determined from such surveys. Daily activity rhythms are nevertheless of considerable importance to us as an index of visibility which can help qualify our annual survey efforts.

Unimak Island - Brown Bear

Brown bear hunting on Unimak Island is allowed annually during spring and fall seasons. The Alaska Department of Fish and Game administers a drawing to allocate the fifteen available permits (i.e. 7 permits in spring and 8 permits in fall) (Table 53). The spring hunting season extends from 10 to 25 May and in 1987, five of the seven permittees participated in the hunt. Three bears were taken during the season (2 males and 1 female). Hunters were in the field for an average of 5.6 days and saw an average of 5 bears each.

The fall hunt on Unimak Island was from 1 to 21 October with six of the eight permittees participating. Five bears were taken (4 males and 1 female). Hunters were in the field for an average of 4.4 days and saw an average 4 bears each.

TABLE 51. Habitat categories used to classify habitat use by brown bear, Izembek NWR [1]

Code	Habitat Type
Lowland	(Sea level to base of foothills)
130	Tall Shrub (≥1.5 m), closed (≥50% crown cover)
140	Tall Shrub (≥1.5 m), open (25-75% crown cover)
150	Low Shrub (<1.5 m) - Herbaceous (≥25% shrub cover)
160	Ericaceous Shrub - Herbaceous (hummocks)
180	Wet Herbaceous Meadow (marsh, <25% shrub cover)
190	Herbaceous Aquatic Marine (Intertidal areas)
Midland	(Base of foothills to upper limit of alder (*Alnus crispa*) zone)
220	Barren (≤25% bedrock, scree, bare soil)
230	Tall Shrub (≥1.5 m), closed (≥75% corwn cover)
250	Low Shrub (<1.5 m) - Herbaceous (≥25% shrub cover)
260	Ericaceous Shrub - Herbaceous (hummocks)
280	Wet Herbaceous Meadow (marsh, <25% shrub cover)
Upland	(Above upper limit of alder zone)
320	Barren (≥25% bedrock, scree, bare soil)
360	Ericaceous Shrub - Herbaceous (hummocks)

[1]Habitat types and codes follow a portion of those used in brown bear studies on the Kodiak NWR

Table 52. Temporal distribution of brown bear sightings by habitat type, Izembek NWR, 1984-1987[1]

Bear Type (n)	Season of Year																										
	April-June						July-September											October-November						December-March[2]			
	[3]130	140	180	220	230	320	130	140	150	160	180	190	230	250	260	320	350	130	140	180	220	230	320	130	140	220	230	320
Males (6)	1	1		1	1		7	3	1		7		3	1				1			1			1	1	2 (1)		9 (7)
Females Single (20)		3	1			1	7	8	3	2	19		11	1		4		1	1		1							19 (15)
Females W/COY (11)						4	5	3	2	1	24	2	4		1	3				1							1 (1)	7 (7)
Females w/YRL (7)		1					1	2		7	12	7	6			3				1			1					6 (4)
Females 2-2½-yr.olds (7)					3	2	1	2	3	3	11	3	7	1								1						3 (3)
Females Unknown Status (9)						2	4	4			1		6				1						9 (9)					
All Bears n=294 observations	1	5	1	1	4	9	25	22	9	13	74	12	37	3	1	10	1	2	1	2	2	1	1	1	1	2	1	52

[1]Some females appeared in different categories due to loss or production of cubs and the changing ages of cubs (i.e. 1984 vs 1985). Total marked individuals was 36 during the period.

[2]Number of dens in Parentheses

[3]See Table 51 for explanation of Habitat Type Codes.

Table 53. Brown Bear Hunter Numbers and Success Unimak Island, 1975-1987.

	Permits Issued	Hunters Active	# Bears Known Taken
CY 1975	20	9	6
CY 1976	18	10[1]	4
CY 1977	15	10[1]	7
CY 1978	15	3[1]	1
CY 1979	15	8[1]	7
CY 1980	15	6	3
CY 1981	15	5	3
CY 1982	15	7[1]	4
CY 1983	15	10[1]	6
CY 1984	15	4	1
Spring 1985	7	3	2
Fall 1985[3]	6	6	5
Spring 1986[3]	2	2	2
Fall 1986	8	5	3
Spring 1987	7	5	3
Fall 1987	8	6	5

[1]One permittee failed to return questionnaire, unknown if active.

[2]Three permittees failed to return questionnaires, unknown if active. One additional hunter was lost at sea on his return flight to Anchorage, not known if he took a bear.

[3]Changed to a registration hunt with permits issued on a first-come-first-served basis at the refuge office.

Caribou

The lower Alaska Peninsula caribou herd ranges from Port Moller southwest to the tip of the Alaska Peninsula, occurring seasonally on Izembek NWR (Figure 12). Intermingling is unlikely between this herd and one northeast of Port Moller. The rugged terrain between Port Moller and the Pacific Ocean is thought to effectively impede interchange between the herds, enough so to warrant their separate management.

The primary calving ground for the lower Alaska Peninsula herd is on State owned land near the Black Hills area, 40 miles northeast of Cold Bay. Arrival on the calving ground occurs in mid-May. After calving in early June, a large portion of the herd moves toward wintering areas southwest of the Cathedral River during the latter part of July. They typically arrive in the Cold Bay area with the first snows of the year in mid to late October and use the area from two to four months before returning to lowlands adjoining the Black Hills area.

It is here, around Cold Bay that what is thought to be a large portion of the sport/subsistence harvest occurs. During the last several years the popularity of caribou hunting has increased substantially, especially among military and airline employees with travel benefits who can economically travel from Anchorage to Cold Bay for a caribou hunt. Good accessibility afforded by refuge roads and liberal bag limits for resident hunters appeal to many.

Population surveys of this caribou herd have been sporadically conducted since 1949. Refuge staff initiated systematic survey attempts in 1978. Management of the herd has been shared by the Alaska Department of Fish and Game and Izembek NWR. State hunting regulations have been set with consideration given to data and recommendations provided by Izembek NWR staff.

Since 1978, efforts have been directed toward obtaining herd composition and total population estimates. Post-calving surveys conducted in mid-June through early July primarily provide an estimate of the year's calf crop and in some years an idea of the total population size. Herds are spotted from the air, and after landing near accessible groups, observers hike to suitable observation points to count and classify the animals. Fall composition data have been obtained by ground observation of groups as they cross the Cold Bay road system. Winter population estimates have only been accomplished sporadically during past years because of the improbability of simultaneous snow cover and suitable flying conditions throughout all caribou habitat. During successful attempts a combination of caribou counted from 35mm photos and with the unaided eye has proven effective.

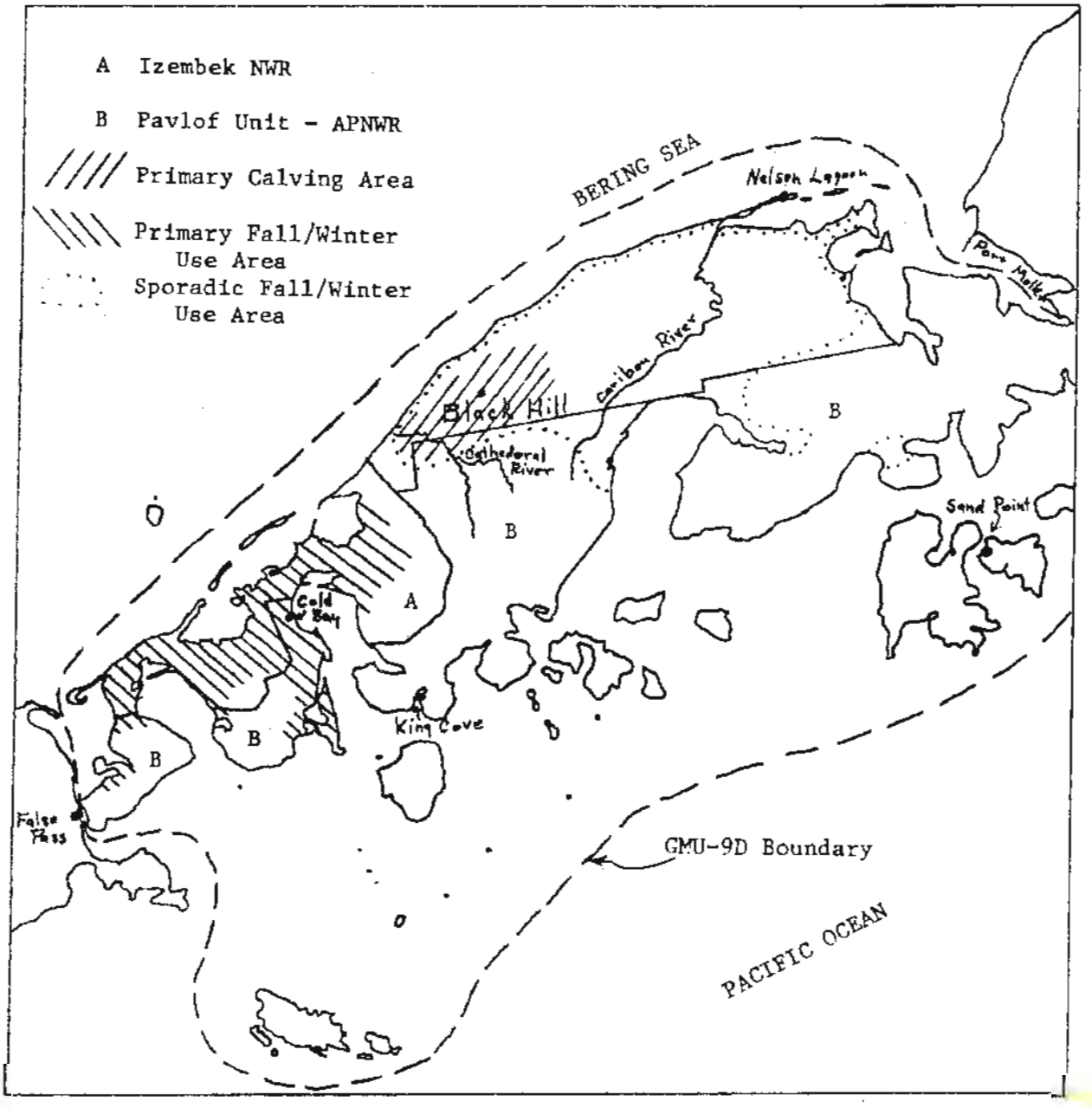


Figure 12. Seasonal distribution of the southern Alaska Peninsula caribou herd, Game Management Unit (GMU) 9D.

In an effort to expedite location of caribou concentrations and provide an index for population size estimates, 10 caribou were fitted with radio collars on April 3 and April 8, 1986. Due to serious problems with the telemetry system utilized in 1986, 30 more collars of a different manufacturer (Telonics) were fitted on adult cows during 1987. On April 3 and 4 RM/Pilot Sarvis, ARM Blenden and ARM/Pilot Payne (Alaska Peninsula NWR, King Salmon) worked with Dick Sellers (ADF&G area game biologist, King Salmon) in collaring adult cows. Later on October 15 Sellers returned to Cold Bay and worked with refuge staff in radio collaring 10 more adult cows.

The spring 1987 operation got off to a sour start on April 3. Although Carfentanil and the antagonist Narcan were used in the same concentration as were used during last year's successful procedures, five animals never regained mobility and subsequently died. On the advice of an ADF&G veterinarian, the dosage of the antagonist was increased significantly. The 14 animals captured on April 4 reacted and recovered normally, and seem unaffected from that point on. We recognize these are risks in handling animals but such high mortality rates are clearly unacceptable. We have since learned that several caribou marking operations throughout the State had similar experiences using Carfentanil. An expensive lesson was learned. The fall collaring effort went more smoothly, however one animal died from capture related stress.

Results of this year's survey efforts were revealing. They amply demonstrated the challenge of studying caribou population dynamics. Following Izembek's 1986 post-rut survey that showed a significant drop in caribou numbers from 1983 the concern of both Izembek NWR and ADF&G was heightened to the extent that the state issued an Emergency Regulation reducing caribou bag limits from four animals to one for the 1986 season.In the wake of the 1986 assessment, that the populations may be experiencing problems, survey efforts were intensified during 1987. On June 26 RM/Pilot Sarvis and ARM Blenden assisted ADF&G biologist Sellers in a census of post-calving concentrations in the Black Hills area. Radio transmitters fitted on cows in April enabled the quick location of groups as well as an index of the proportion of the cows present in the area. Sixteen (89%) of 18 radio collared cows were found in groups totaling 4,067 animals. This suggested the total number of cows, calves, and subadult bulls in the post-calving concentrations to be approximately 4,569. Assuming something less than 500 breeding bulls were not represented in this census all indications were that the total population was something comparable to last years. Not only was the population

A helicopter was used during fall caribou composition counts. Mature bulls, cows and calves are discernable. 10/16/87 Sarvis (102)20

Caribou captures were also performed using a helicopter. ARM Blenden and ADF&G biologist Dick Sellers release a processed cow recovering from immobilization. 4/4/87 Sarvis (456)34

still low but calf production was extremely low, based on this survey (11.9%).

On July 9 Sarvis and Blenden conducted a second production count. During this ground based count 1,689 animals were classified 202 (12.0%) were calves, adding credence to the June 26 production estimate (Table 54).

During the following weeks and after several discussions with ADF&G the decision was made to close the caribou season to "subsistence", "resident" and "non-resident" hunters. The decision was based on the low population estimate from the June post-calving survey and the low number of calves produced as estimated during the June and July surveys. Even with a conservative estimate of natural mortality, the population would barely maintain itself with no hunting mortality. At that time Izembek NWR agreed to conduct an intensive fall survey using the methods implemented during 1986. Hunting seasons would be reevaluated upon completion of the survey and analysis of the results.

On September 3, 1987 RM Sarvis and ARM Blenden conducted a public meeting at the Cold Bay Public School explaining results of surveys conducted since the last public meeting in November 1986 and why the decision was made to close the season. Reactions to the season's closure varied from strong support to utter dismay. In fact one big game guide threatened to sue the State. He claimed the closure was unwarranted, he should have been involved with the decision and he was going to lose a considerable amount of money in bookings that would now have to be cancelled.

A fall composition survey was conducted by WB Dau, ARM Blenden and ADF&G Sellers from helicopter on October 16 and 17. During this survey of 1,769 animals, 16.3% were calves, a surprisingly high number since the animals classified included rutting bulls not present during either of the earlier surveys (Table 55).

On October 19 the intensive fall survey was started but abandoned due to poor weather for the next several days. Efforts were resumed on the 25th and continued through the 26th and 27th. RM/Pilot Sarvis, WB Dau and ARM Blenden participated. Most of the area was surveyed by flying transect lines spaced at one-mile intervals. The refuge Piper SuperCub was used maintaining an altitude of 400-500' AGL. Transect lines were identified using the aircraft's Loran C navigation instrument, freeing the pilot from constant reference to maps. The pilot and observer counted all caribou seen within 0.5 mile horizontal distance from either side of the transect line. The pilot counted animals ahead and to the right

Table 54. June and July productivity surveys of the southern Alaska Peninsula caribou herd.

Year	Method	N	% Calves
1981	ground	2971	10.4
1983	aerial/ground	2125	17.9
1984	ground	2389	16.9
1985 *	aerial	2333	5.5
1986	ground	2594	17.2
1987	ground	1689	12.0
% Calves X (±SE)			14.88 ± 3.43

* Incomplete survey due to fog, results not used in ± or SE calculations.

Caribou seeking forage on winter range adjacent to Cold Bay with the Aghileen Pinnacles and Pavlof Volcano in the distance. 11/87 Blenden

Opportunistic caribou made extensive use of recently re-seeded areas where WWII structures once stood. Blenden

Table 55. Fall composition survey results of the southern Alaska Peninsula caribou herd.

Date	N	% Calves	%Subadults & Cows	% Cows*	% Bulls	% Large Bulls
1982	1527	13.1	72.2	-	-	14.7
1983	1596	15.2	80.3	-	-	4.5
1984	1567	15.3	80.9	-	-	3.8
1985	1460	9.4	78.7	-	-	11.9
1986	2307	13.0	-	65.8	21.1	2.8
1987	1769	16.3	-	62.0	22.0	4.5
X's		13.7	-	63.9	21.6	7.0
SE		± 2.5	-	± 2.7	± 0.64	±5.0

* Data unavailable prior to 1986 when helicopter first used.

side of the plane and the observer counted animals on the left side of the plane.

The Loran C line transect survey scheme was altered in specific areas including narrow mountain valleys and on Izembek NWR where geographic reference was easily maintained. On Izembek NWR flight lines were regularly spaced except around the rough terrain around the base of Mt. Dutton where large numbers of animals were seen. In this case, the area was flown several times at various altitudes and flight paths in order to ensure an accurate count.

The survey area was divided into three segments (Figure 13). It required approximately eight hours of flight time to complete each segment. Segment A, between Cold Bay and the Black Hills, was covered first on October 19. At this point the survey was interrupted due to weather until October 25 when segment B, between the Black Hills and mid-Caribou River was completed. Segment C, between mid-Caribou River and Port Moller was completed October 26. Since six days had elapsed since segment A had been surveyed, it was redone on October 27.

A total of 6,401 caribou were counted during the three consecutive days, October 25-27 (Figure 14). Results from October 19 were not considered in this analysis except to point out that 2,538 animals were counted on the 19th and 4,782 were counted on the 27th. The average group size was 18.8 animals during the survey period.

The distribution of caribou was considered typical for that time of year. Segment A contained 4,732 (74%); segment B contained 610 (10%); and segment C contained 1,059 (17%) caribou.

Within segment A, 4,574 caribou were counted in the area between Moffet Bay, Right-Hand Valley, Left-Hand Valley, and Kinzarof Lagoon. This reflects the typical migratory movement from the Black Hills calving ground to wintering areas near Cold Bay.

The results of this survey were quite surprising considering only 4,454 caribou were counted using very similar methods during the fall of 1986 and only 4,067 caribou were counted during the 1987 post-calving survey. This would represent a 42.3% increase in population size in one year but cannot be explained by recruitment since 16% was the highest estimate of this year's calf crop. Assuming this year's total of 6,401 is an accurate minimum population estimate, approximately 2,000 caribou imigrated into the area between the two census periods or were missed during the 1986 survey. The former hypothesis is highly unlikely.

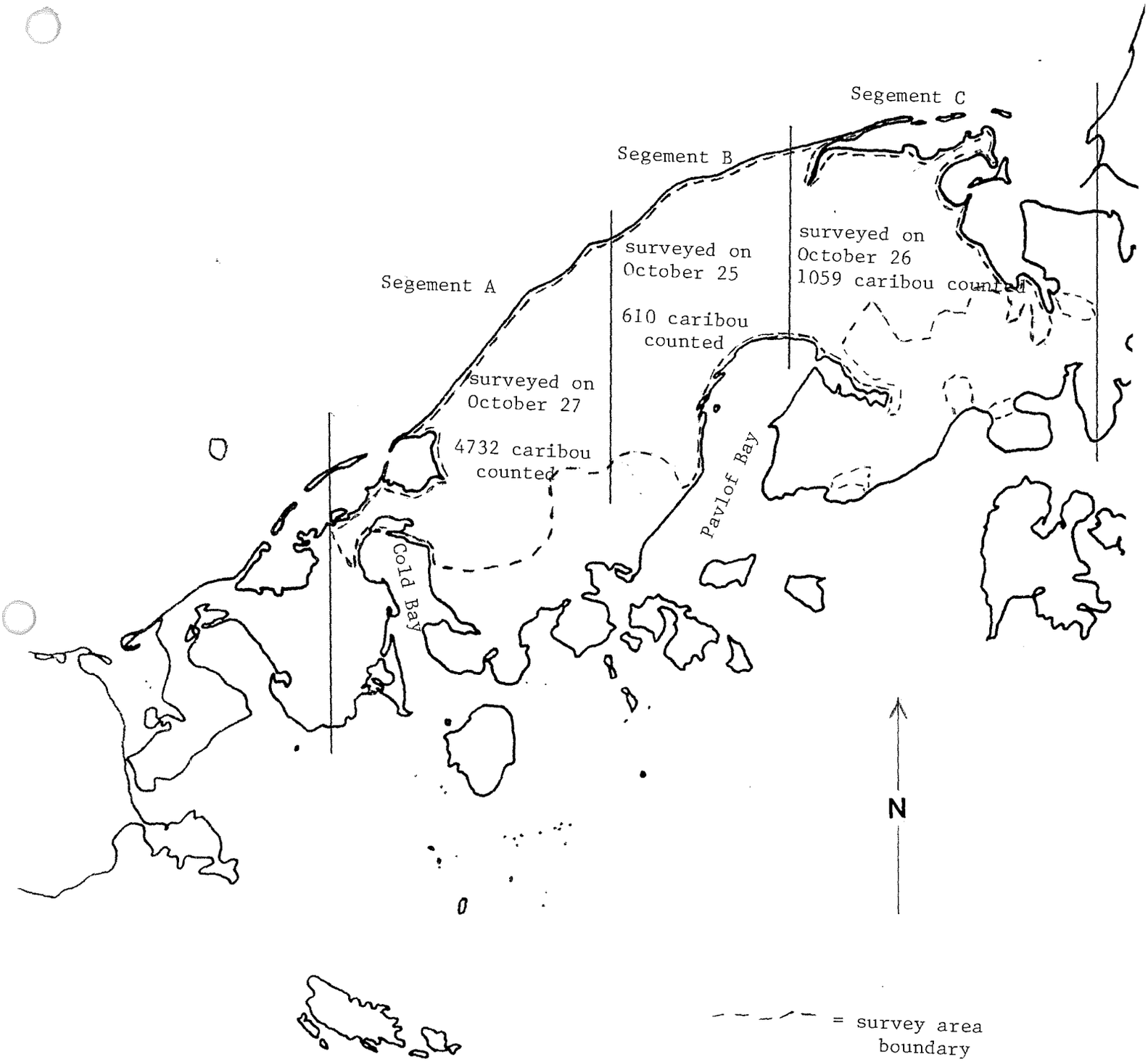


Figure 13 . Distribution of the Southern Alaska Peninsula Caribou Herd during an October 25, 26, and 27, 1987 aerial survey.

Red foxes, ravens and bald eagles are the primary scavengers on the refuge. A caribou gut pile was the target here. 11/18/88 Blenden

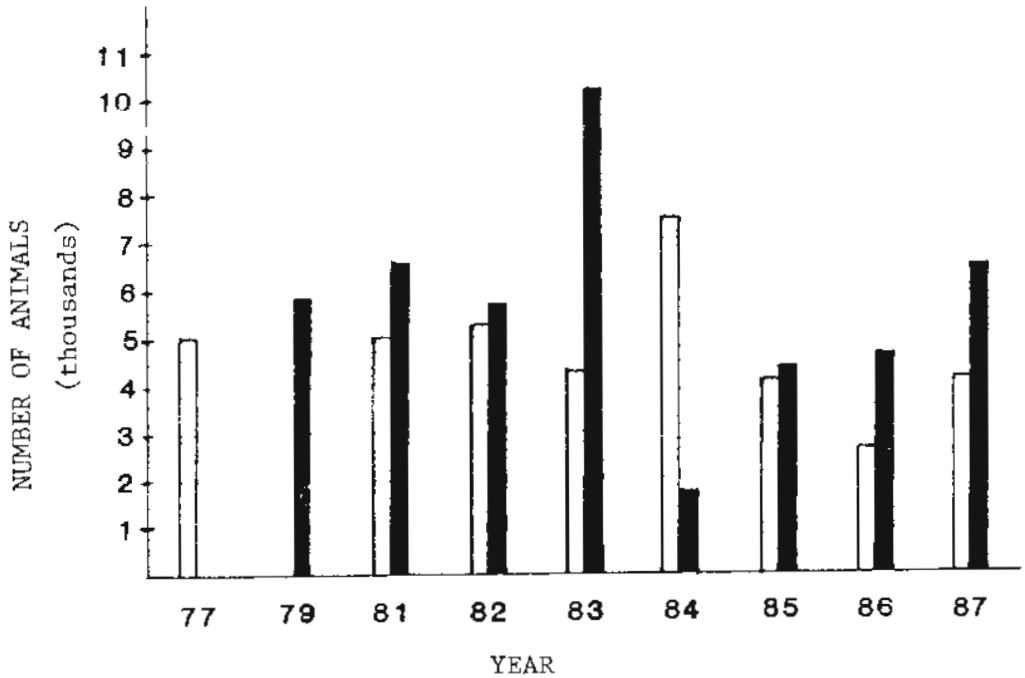


Figure 14 . Results of post-calving ▯ and post-rut ▮ surveys of the southern Alaska Peninsula caribou herd.

Several factors lead us to believe the 1986 survey undercounted actual population numbers. Telemetry efforts during the past year have not indicated any dramatic movements in radio-collared animals either above or below Port Moller; nor did relocation of all radio-collared caribou during and immediately after the post-calving survey reveal significant numbers of animals in excess of the 4,067 counted.

Persuasive evidence comes from the fact observers found several groups totaling up to 200 animals at 1,500' elevation on the 27th. Those animals were in extremely precipitous terrain, in snow and clouds and were very difficult to distinquish. This habitat type was assumed void of caribou during the 1986 survey and the first two days of the 1987 survey. This observation implies an unknown number of caribou still use alpine areas at this time of year despite dramatically more favorable conditions at lower elevations.

A radio receiver was monitored during all survey flights. Time did not allow all 26 radio collared caribou to be individually tracked and locations identified. As a minimum, the aircraft's position was noted when the strongest signal was received. This serves as a general indication of the marked caribou's location. We were able to identify groups containing 12 marked animals, while only four marked individuals were actually observed.

Signals from the following three transmitters were not detected during any flights. The caribou transmitting frequency 150.550 was captured in the Canoe Bay area on April 3, 1987. It was last located in the Chichagof Bay area Spetember 25, 1987. This area was covered October 25, 1987. The caribou transmitting frequency 150.745 was marked October 17, 1987, southwest of Little Lagoon. This frequency was not detected during any survey flights, but none extended southwest of Cold Bay. This radio was later heard on October 30, 1987, while monitoring all frequencies from the top of Baldy Mountain. It was heard along an azimuth heading towards the approximate capture area. The caribou transmitting frequency 150.749 was also marked October 17, 1987, approximately six miles north of Pavlof Bay, near the Caribou River. It has not been heard since it was marked.

The distribution of marked animals appears comparable to the pattern of the total population. Segment A contained 74% (4,782) of the population, while 73% (19) of the radio transmitters were detected while flying through the segment. Segment B contained 10% (610) of the population and 12% (3) of the transmitters. The proportions in segment C were the most disparate. It contained 17%

(1,059) of the population and only 4% (1) of the marked animals.

This year's fall survey suggest that higher elevations (at least 1500' AGL) must be included to increse reliability in censusing this population. The increased number of animals counted is best explained if animals were missed during last year's fall survey. The 1987 survey indicated a significant number of caribou were using alpine areas previously thought uninhabited. Snowfall occurring at these elevations during this year's survey may have moved animals into the survey area that would have otherwise been missed, explaining the increased number counted in Segment A on October 27 over that counted on October 19.

Although survey data still indicate the Southern Alaska Peninsula Caribou Herd may be considerably smaller in size than the 10,203 counted in 1983, the decline is probably not as drastic as thought earlier this year.

The ADF&G and refuge staff felt the herd could sustain a conservative harvest. On November 11, 1987 a second emergency order of the year was issued opening the subsistence caribou hunting season in game management unit 9(D) and on Unimak Island. The season opened on November 17, 1987 and continued through January 17, 1988. Residents of these units were allowed two caribou each.

By our estimates the season's harvest was indeed conservative. Based on field checks conducted by Izembek NWR staff approximately 116 caribou were harvested, very similar to last seasons estimated harvest of 108 (Table 56). Prior to the 1986-1987 season the average harvest was estimated to be 487 animals. Other than the obvious reduction in overall harvest during the last two seasons these data indicate approximately equal numbers of bulls and cows were taken. However twice as many bulls were taken during the less restrictive seasons prior to 1986. This may indicate fewer trophy hunters have participated in the last two hunts, possibly because of bag limit reduction or their inellegiblity due to residency.

Overall, 1987 turned out to be a good year for caribou. The population is above the State's minimum population objective of 5,000. However, our most recent population estimate of 6,400 is well below the 10,000+ counted in 1983. Considering the imprecision of our estimates it is unknown whether the most recent estimates are reflecting an actual population decline or survey error. Until better survey techniques are developed our recommendations to ADF&G will still be based on a conservative interpretation of survey results, realizing they are minimum population estimates.

Table 56. Caribou harvest reports for Game Management Unit 9D.

Season	No. Successful Hunters	Caribou Harvest				No. Caribou/ Hunter	Total* Harvest
		Male	Female	Unknown	Total		
3							
1981-82	187	298	130	4	432	2.3	575
1982-83	180	300	110	0	410	2.3	545
1983-84	100	168	81	5	254	2.1	338
1984-85	174	279	109	0	388	2.2	516
1985-86	151	180	162	3	345	2.3	459
1986-87	81	27	32	22	81	1.0	108
1987-88	55	39	37	11	87	1.6	116
X (±SE)	132.6 (±52.2)	184 (±1165)	94.4 (±47.7)		271.0 (±147.1)	2.0 (±0.5)	379.6 (±198.1)

* Corrected for 75% reporting rate.

Post calving surveys conducted in the Black Hills area (Figure 12) have characteristically shown a relative low number of calves (Table 54). The percentage of calves in the Northern Alaska Peninsula Caribou Herd is commonly twice that of the southern herd. Predation immediately after calving and inability of the cow to carry the calf to term are two popular hypothesis explaining this situation.

During 1987 refuge staff have initiated data collections looking into range quality on Izembek NWR, reproductive status of cows, and animal health as measured by growth rate and levels of bone marrow fat.

Vegetation data collected during the 1987 field season will provide an estimate of plant species abundance in terms of frequency of occurrence and aerial coverage. These data are currently awaiting analysis. The second objective of this exercise is to compare the availability of preferred forage species or groups with other caribou ranges in the State, for example the range of the Northern Alaska Peninsula Herd. Originally the forage value of plants occurring in the communities being sampled was to be gleaned from the literature. However published information on winter forage preferences is often vague and for all practical purposes non existant on the Alaska Peninsula. Therefore fecal samples were collected during November 1987 for food habits analysis. The samples will be analyzed by Washington State University's Wildlife Habitat Management Laboratory, once their plant reference collection is completed for this area. Once the collective diet is determined for caribou wintering on the refuge and index of availability of preferred forage will be obtained by comparison with vegetation data.

During the 1987-88 hunting season eighteen reproductive tracts were collected from cows killed by area hunters. These are currently being analyzed by ADF&G for reproductive history and current status. Due to the excessive effort required to collect these specimens and have them analyzed we are hoping to obtain an index of reproductive status next spring by performing an udder survey on the calving grounds, whereby the number of cows with calves will be compared to cows without calves but with distended udders. This will provide an estimate of reproductive success.

To determine animal health, bone marrow samples were obtained from femurs provided by area hunters. The percent fat in the marrow was determined using accepted "dry weight" procedures. Values ranged from 11.1% to 89.8% fat content. Mean fat percentage for bulls was 57.8 $\pm$ 21.6 (SE) and 74.1$\pm$ 26.4 (SE) for cows. The only calf sampled was from a fresh carcass. Its fat percentage was 32.0.

9. Marine Mammals

The Izembek NWR staff continued its enthusiastic support of an investigation of sea otter distribution along the lower Alaska Peninsula. This work is being conducted by Charles Monnett of the Department of Ecology and Behavioral Biology, University of Minnesota. The project is being funded through a Minerals Management Service contract with the U.S. Fish and Wildlife Service. The Izembek NWR supplied aerial support and accomodations in Cold Bay. Monnett and his assistants captured eighteen adult sea otters during August 1986 using nets and immobilizing drugs (Table 57; Figure 15). Sixteen animals were surgically implanted with radio transmitters. These animals were monitored during numerous aerial tracking flights throughout the falls of 1986 and 1987 and winters of 1986, 1987 and 1988 (Figures 16 and 17). This research was undertaken to test the hypothesis that sea otters along the lower Alaska Peninsula make a seasonal migration between the Bering Sea and the Pacific Ocean through Bechevin Bay and Isanotski Strait. Most of the marked otters remained in Bechevin Bay year round. It was found that a few individuals had larger home ranges that included portions both in the Bering Sea and Bechevin Bay, or the Pacific Ocean and Bechevin Bay. However, results obtained thus far do not support the contention that animals that reside in the Bering Sea during the summer undergo a mass seasonal migration to the Pacific Ocean and then overwinter there.

Numbers and distribution of various species of marine mammals in the Izembek NWR area have been determined opportunistically during spring waterfowl surveys since 1981. Data presented in Table 58 were collected on 3 May, 1987 during a coastal survey for emperor geese. This survey took place as peak numbers of gray whales were migrating to the Chuckchi and Beaufort Seas as indicated by the large numbers seen around the periphery of Unimak Island.

10. Other Resident Wildlife

Meadow voles (*Microtus* spp.) were near peak abundance in 1987 on the Izembek NWR. Historical observations in the refuge files suggest a previous "high population" in 1975 which may be indicative of a near 10 year cycle for the lower Alaska Peninsula. We expect the large microtine population to boost predator populations such as red foxes, wolves, wolverines, short-eared owls, etc. Trapping results for the Izembek NWR indicated a lower than average take for the primary species (Table 59), but this was primarily due to less trapper interest. One permittee was active on Unimak Island taking 72 red fox, three land otters, three mink and one wolf.

Arctic ground squirrels, the harbingers of spring break-up and fall freeze-up made their first appearance on 18 March. This is the Cold Bay version of "Ground Hog Day". An "early" spring , climate wise, was indicated and received in conjunction with this

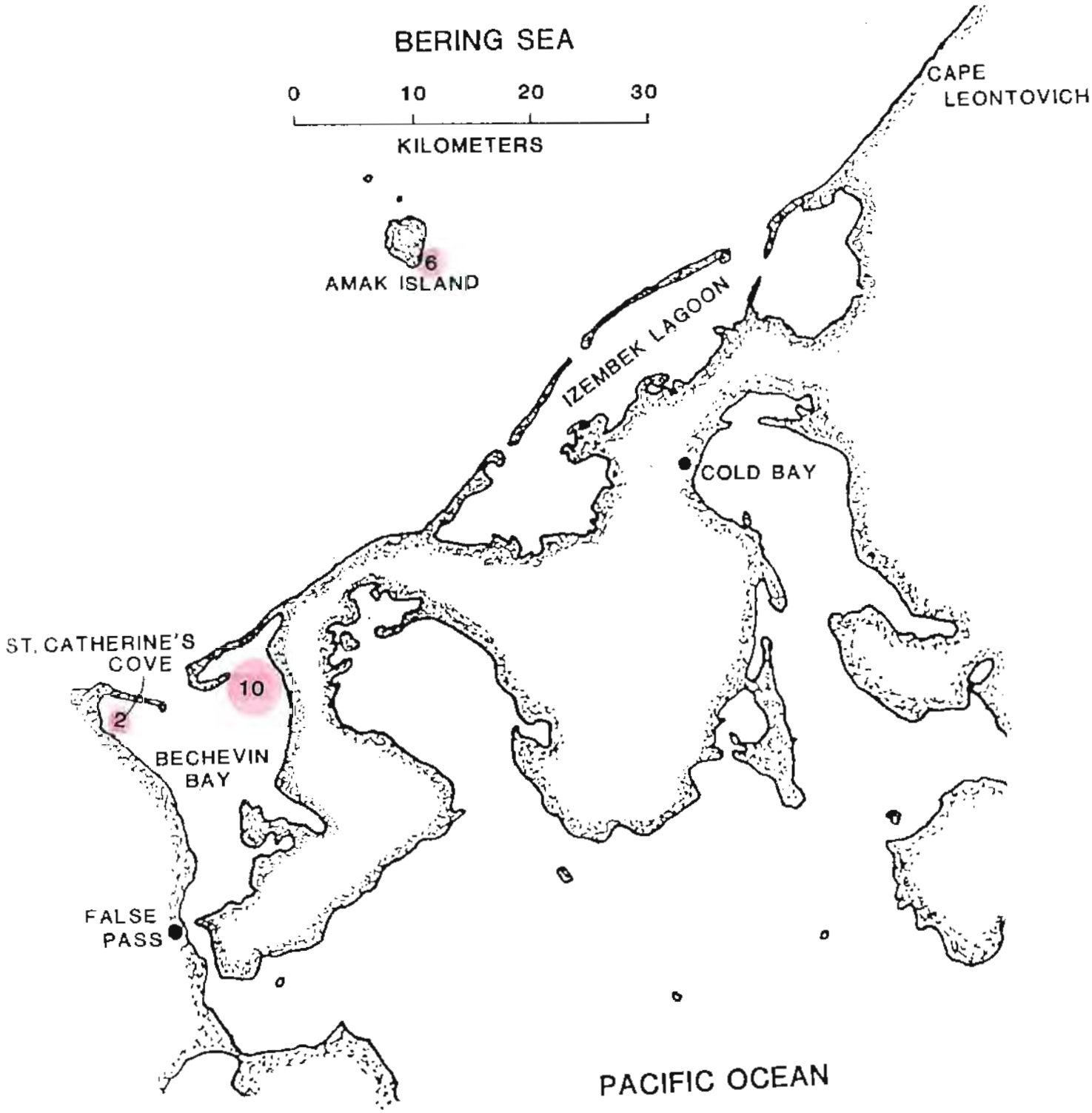
Sea otters captured in Bechevin Bay and near Amak Island in 1986 were monitored throughout 1987. The refuge provided housing and aircraft support to University of Minnesota scientist Chuck Monnett during the project. 8/86 T. Simon Jackson

Table 57. Data on adult sea otters captured in the vicinity of False Pass, Alaska, 1986.

ID #	CAPTURE DATE	RADIO FREQ.	SEX	CAPTIVE LOCATION	WT (LBS)	LGTH (IN)	TAGS[1]
86101	8/03	164.280	M	St. Catherine			None
86102	8/03	164.470	F	St. Catherine			None
86103	8/04	164.053	F	Bechevin Bay	36.0		None
86104	8/04	164.133	F	Bechevin Bay	51.0	53.0	red 122
86105	8/04	164.932	F	Bechevin Bay	37.0	46.0	red 123
86106	8/04	164.073	F	Bechevin Bay	51.0		red 124
86107	8/05	164.412	F	Bechevin Bay	52.0		red 125
86108	8/05	164.451	F	Bechevin Bay	51.0		red 126
86109	8/07	164.793	F	Bechevin Bay	41.0	45.5	red 127
86110	8/07	164.289	F	Bechevin Bay	57.5		red 128
86111	8/07	164.672	F	Bechevin Bay	50.0	50.5	red 129
86112	8/07	164.974	F	Bechevin Bay	68.0	50.0	red 130
86113	8/13	164.352	F	Amak Island	60.0		red 131
86114	8/14	164.872	M	Amak Island	83.5	54.0	red 132
86115	8/14	164.513	M	Amak Island	68.0	54.0	red 134
86116	8/14	164.611	M	Amak Island	83.0	54.5	red 135
86117	8/14	None	M	Amak Island	88.0	52.5	None
86118	8/14	None	M	Amak Island	76.0		None

[1] Flipper tags, right side.

Figure 15. Sea otter research project study area (capture locations and number of animals caught.



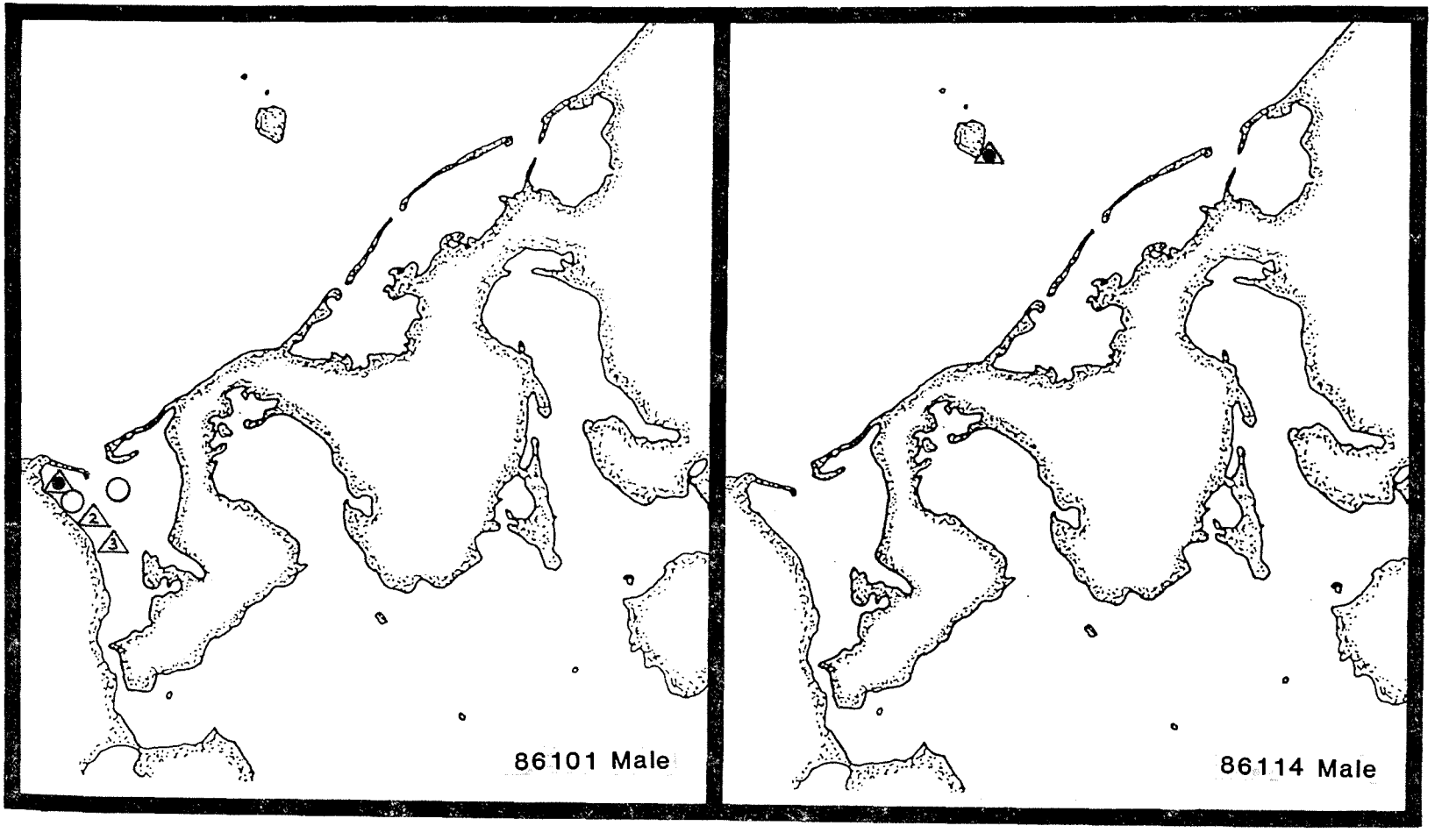


Figure 16. Distribution of radio implanted male sea otters, 1986-1988. (● capture location; ▽ June; △ August, September, October; ○ December, Janary, February, March; Number indicates frequency of observations).

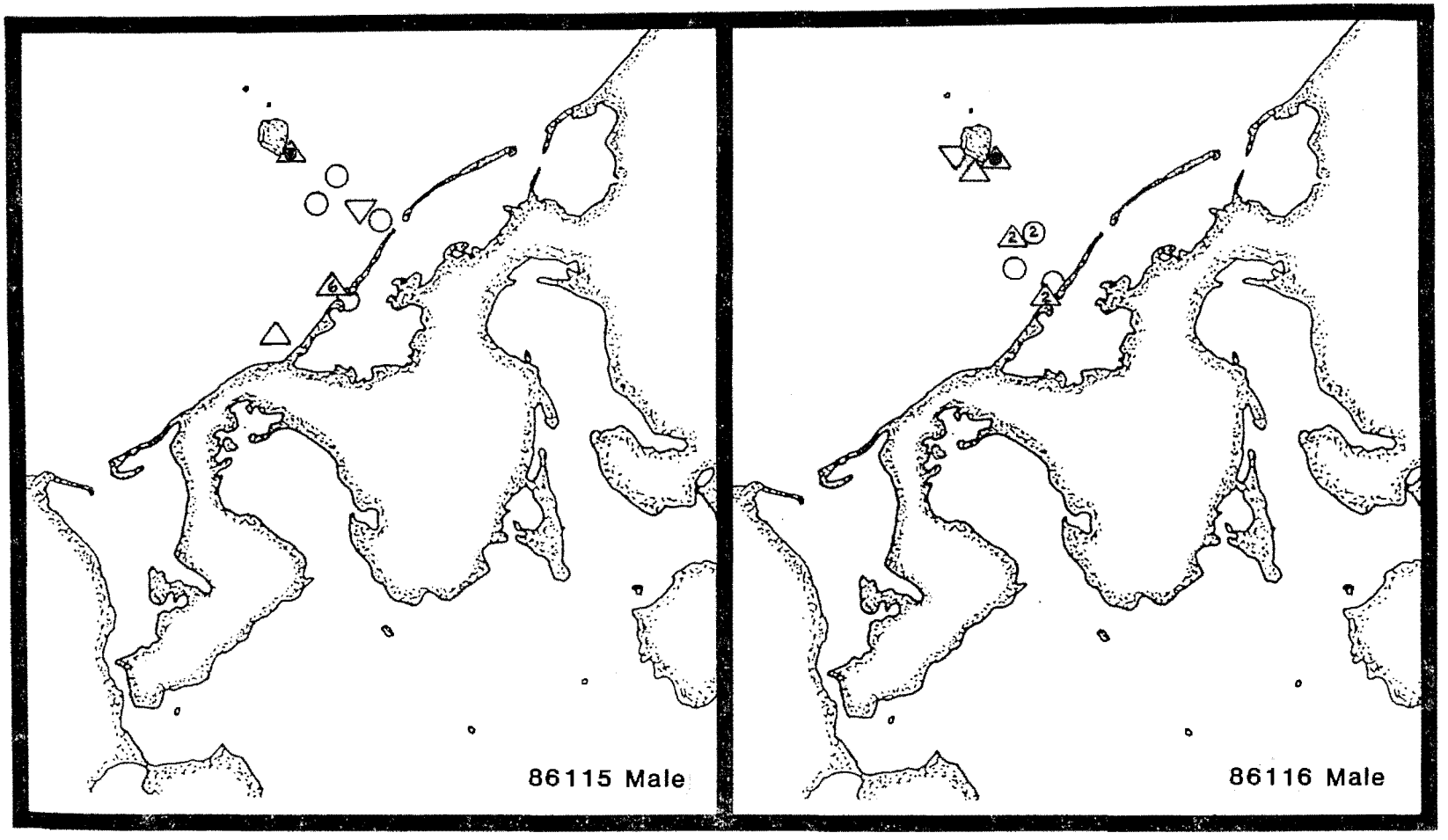


Figure 16a. (cont'd)

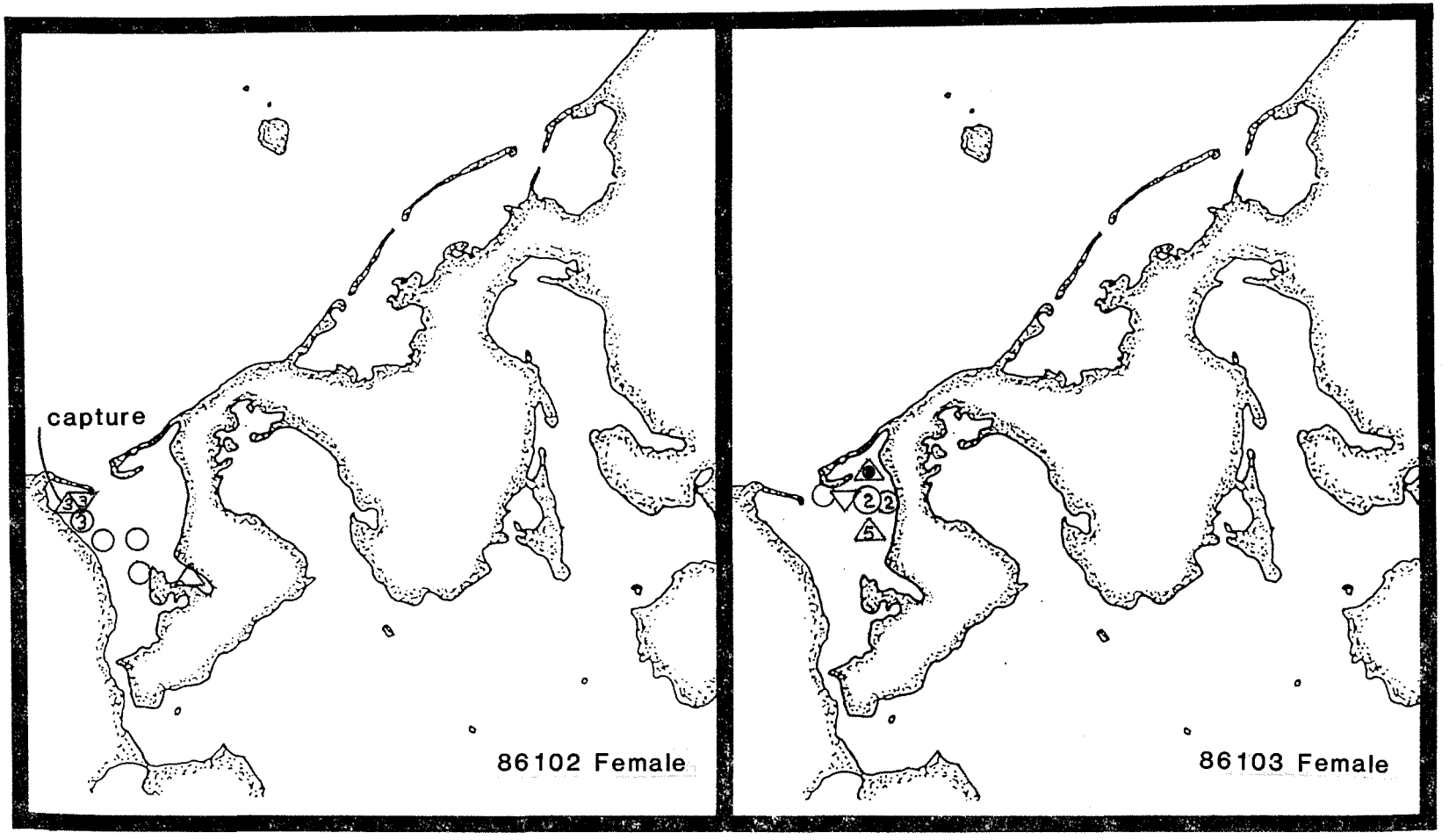


Figure 17. Distribution of radio implanted female sea otters, 1986-1988. (● capture location; ▽ June; △ August, September, October; ○ December, January, February, March; Number indicates frequency of observations).

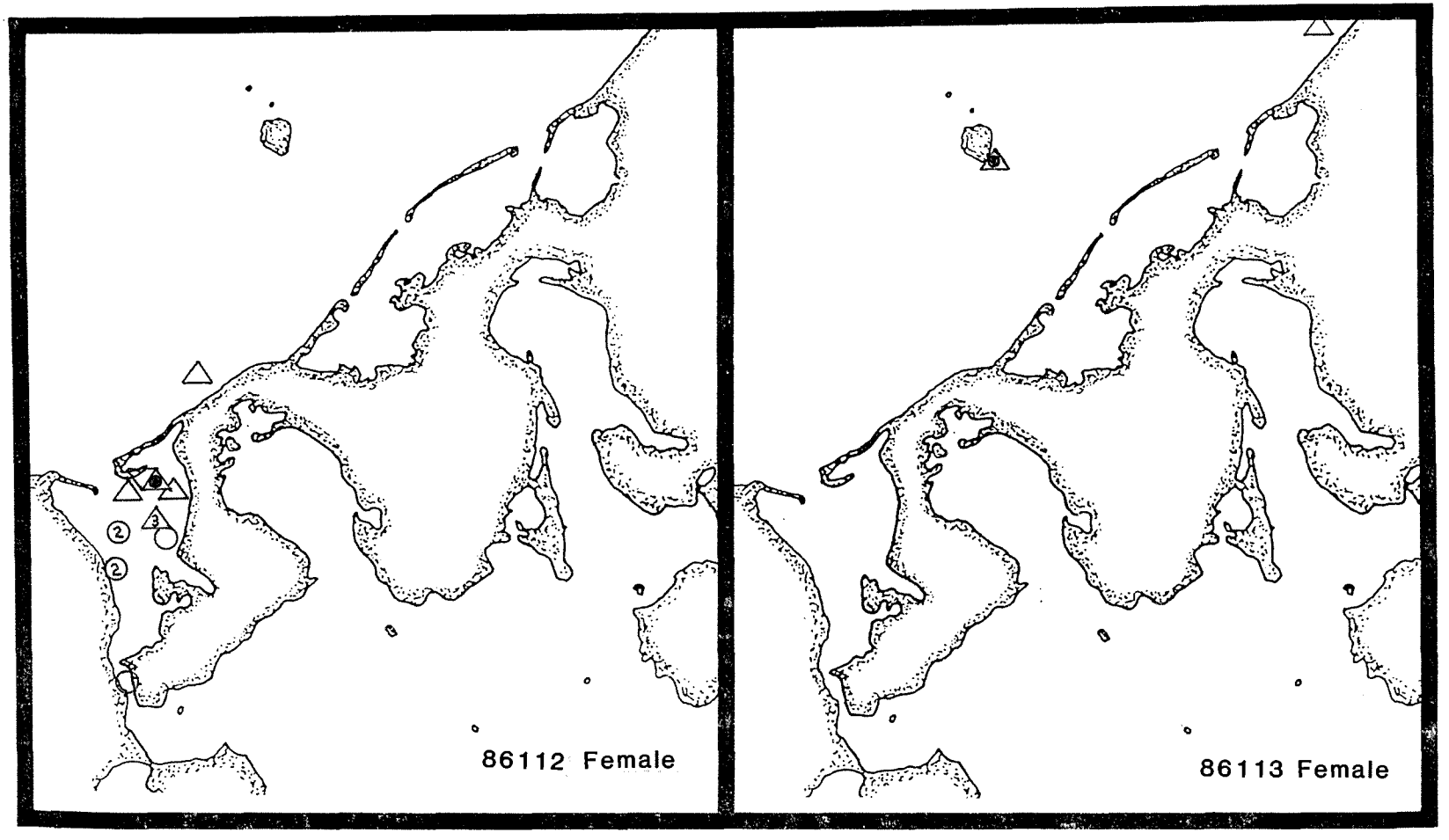


Figure 17. (cont'd)

Northern sea lions bask in harems near Cape Sarichef, Unimak Island. Note the female at left of herd marked on the right fore flipper with a red tag. Sarvis (468)3,4/11/87;(460)23,6/24/87

Table 58. Marine mammals observed along the southern Alaska Peninsula shoreline, 3 May 1987.

Area	Species			
	Gray Whale	Sea Lion	Harbor Seal	Sea Otter
Izembek Lagoon	-	-	250	252
Kinzarof Lagoon	-	-	75	-
Swanson Lagoon to Ikatan Bay (incl. periphery of Uminak Island.	131	72	-	2
Ikatan Bay to Cold Bay	-	-	-	78
Totals	131	72	325	332

A handsome resident of the Izembek Refuge willing to give you the shirt off its back. July 87 Blenden

Table 59. Results of permit trapping program, Izembek NWR.

	1982/83 (21)	1983/84 (17)	1984/85 (16)	1985/86 (11)	1986/87 (7)	1987/88 (11)
Red Fox	74	82	51	29	16	29
Land Otter	18	25	3	5	7	5
Mink	6	32	34	15	12	5
Wolverine	1	1	0	0	0	0
Wolf	0	0	0	3	1	1

Number of trappers in parentheses.

earliest recorded spring emergance of the arctic ground squirrel. Squirrels took to their burrows by the second week of November.

11. Fisheries Resources

The Izembek NWR provided support and logistics for a baseline fisheries inventory in 1985 and 1986. This work, undertaken by the King Salmon Fisheries Resources field office, was designed not only to fill information voids but also to impart local knowlege to Service fisheries biologists so that they could aid the Izembek NWR staff in the preparation of a refuge fishery management plan. No field work was performed in 1987 to allow time for data analysis and the drafting of our management plan. By year's end a draft plan outlining goals/objectives and issues/concerns was available for Regional Office review. Fishery management plan goals below are broad statements corresponding to those found in the Izembek NWR Comprehensive Conservation Plan:

Goal A: To conserve refuge fish populations and habitats in their natural diversity.

Sub-Goal A.1; Administer the refuge fishery program.

Sub-Goal A.2; Manage anadromous fish population.

Sub-Goal A.3; Manage resident fish population.

Goal B: To fulfill international treaty obligations..

Goal C: To provide for the opportunity of continued subsistence with respect to Goals A and B.

Sub-Goal C.1; Manage and maintain subsistence harvests.

Goal D: To ensure water quality and quantity to meet Goal A.

Sub-Goal D.1; Manage and maintain refuge water quality and quantity.

Salmon runs in various streams on Izembek NWR, and the Pavlof Unit of the Alaska Peninsula NWR are annually monitored by ADF&G biologists of the Commercial Fish Division. Commercial catch and escapement data for these areas are presented in Tables 60 and 61.
ADF&G, Fisheries Rehabilitation and Enhancement Division (FRED) constructed the $4 million Russell Creek Hatchery near Cold Bay in 1979. At full capacity, the facility should be able to rear up to 50 million salmon annually. The facility has yet to have reared stock return to the Russell Creek system (Table 62). FRED has been plaqued by recent legislative uncertainties with respect to funding which has left the future for personnel and facilities in doubt. With declining state revenues the Russell Creek facility became one of the four scheduled to close in 1987. This decision

Table 60. Commercial salmon catch and escapement, vicinity of Izembek NWR, 1969-1987
(Data supplied by Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak)

Pink (Humpy) salmon (in thousands)

	Cold Bay & Morzhovoi*		Izembek & Moffett	
Year	Catch	Escape	Catch	Escape
1969	0.2	20.3	0	2.3
1970	1.5	43.9	0	0
1971	3.6	4.5	0	0.1
1972	0	5.7	0	0
1973	0	4.6	0	0
1974	0	9.9	0	0
1975	0	8.3	0	0.1
1976	0.8	55.8	0.1	0
1977	0	21.7	0	0.2
1978	6.0	157.7	2.2	0
1979	0.03	19.2	0.01	0
1980	126.1	127.1	0	0
1981	8.5	17.5	0	0
1982 [1]	136.9	319.7	0	0.2
1983	13.8	31.2	0	0
1984	139.7	236.7	0.1	0
1985	5.3	15.6	0	0
1986	48.2	84.4	0	0
1987	0.1	17.4	0	0

Chum (Dog) salmon (in thousands)

	Cold Bay & Morzhovoi*		Izembek & Moffett	
Year	Catch	Escape	Catch	Escape
1969	0	24.6	4.5	94.4
1970	1.8	43.5	10.0	53.4
1971	0.5	54.3	36.3	54.8
1972	0	51.0	57.9	72.7
1973	0.7	30.4	96.6	70.3
1974	0	30.9	11.2	70.6
1975	0	17.7	3.4	77.6
1976	2.9	38.7	40.8	123.3
1977	0	139.1	20.3	368.3
1978	5.9	102.2	81.4	119.0
1979	4.6	27.4	17.8	178.0
1980	43.3	64.4	282.6	365.2
1981	27.0	48.5	296.4	235.0
1982 [1]	103.6	103.6	57.5	166.4
1983	58.9	62.5	154.8	173.3
1984	145.5	123.4	102.7	427.5
1985	87.4	94.4	126.6	194.7
1986	134.5	157.9	69.1	142.4
1987	2.9	163.8	148.6	286.0

* Much of the Cold Bay/Morzhovoi runs occur off refuge

1 Includes inner Cold Bay, Lenard Harbor, Sandy Cove-Mortensen's Lagoon, Morzhovoi Bay

Table 60. Commercial salmon catch and escapement, vicinity of Izembek NWR, 1969-1987 (Cont'd)
(Data supplied by Alaska Department of Fish and Game, Division of Commercial Fisheries, Kodiak)

Red (Sockeye) salmon (in thousands)

	Cold Bay & Morzhovoi*		Izembek & Moffett	
Year	Catch	Escape	Catch	Escape
1969	2.2	7.5	6.1	14.0
1970	1.0	3.3	3.1	7.5
1971	1.1	2.3	6.9	3.5
1972	0	2.5	0.8	4.8
1973	0.2	3.3	1.2	2.0
1974	0	27.3	4.7	3.7
1975	0.5	15.6	1.5	13.6
1976	1.4	27.3	20.4	15.3
1977	12.5	28.7	3.1	26.1
1978	1.0	24.7	15.5	23.0
1979	0	8.5	10.8	8.4
1980	15.7	6.1	34.2	11.2
1981	8.9	7.0	30.9	12.0
1982[1]	19.8	17.0	24.5	21.2
1983	13.8	18.2	15.2	18.5
1984	59.3	14.1	4.7	19.1
1985	30.8	7.1	6.2	17.2
1986	42.5	19.7	19.1	15.7
1987	1.5	23.5	6.5	13.6

King (Chinook) salmon (in thousands)

	Cold Bay & Morzhovoi*		Izembek & Moffett	
Year	Catch	Escape	Catch	Escape
1969	0	0	0	6.9
1970	0	0	0	2.1
1971	0	0	0	0.2
1972	0	0	0	0.2
1973	0	0	0	0.7
1974	0	0	0	0
1975	0	0	0	0
1976	0	0	0	0
1977	0	0	0	0
1978	0	0	0	0
1979	0.002	0	0	0
1980	0	0	0	0
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0.1	0

1 Includes inner Cold Bay, Lenard Harbor, Sandy Cove-Mortensen's Lagoon

Table 60. Commercial salmon catch and escapement, vicinity of Izembek NWR, 1969-1987 (cont'd)

Coho (Silver) salmon (in thousands)**

Year	Cold Bay & Morzhorvoi* Catch	Izembek & Moffet Catch
1969	0	0
1970	0	0
1971	0	0
1972	0	0
1973	0	0.2
1974	0	0
1975	0	0
1976	0	0
1977	0	0
1978	1.3	0
1979	7.0	0
1980	16.4	0
1981[1]	13.1	0
1982	1.4	0
1983	0.7	0
1984	0.6	0
1985	1.9	0
1986	2.5	0
1987	6.7	2.9

* Much of the Cold Bay-Morzhovoi runs occur off refuge

** Coho escapement data is incomplete. Some surveys are done, but they are rarely peak counts. Fishing effort is usually very light on Alaska Peninsula coho (per comm. Arnold R. Shaul, ADF&G, Comm. Fish Div., Kodiak).

[1]Includes inner Cold Bay, Lenard Harbor, Sandy Cove-Mortensen's Lagoon, Thin Point Cove from 1982 on.

Commercial fishing in Alaskan waters is a large, diversified and internationally important industry. Near-shore waters adjacent to the Izembek NWR and other areas of the Alaska Peninsula can draw crowds during peak summer fishing periods. 8/21/86 Blenden

Table 61. Catch and escapement data for salmon in the Hoodoo (Sapsuk) Lake/Caribou River Drainage.

(Data supplied by Arnold Shaul, Commercial Fisheries Division, Alaska Department of Fish and Game Kodiak, Alaska).

Year		Species					
		Red	Silver	Chum	King	Pink	Total
1983	Catch	192,900	64,000	14,000	12,100	0	283,000
	Escapement	128,800	13,000[1]	14,000	12,500	0	168,300
1984	Catch	118,800	113,300	78,400	7,800	100	318,400
	Escapement	251,000	41,000[1]	49,000	6,300	-	338,300
1985	Catch	706,300	88,200	6,600	10,900	0	812,000
	Escapement	318,500	18,100	13,000	3,200	0	352,800
1986	Catch	178,400	99,300	3,600	4,800	100	286,200
	Escapement	117,900	23,000	1,800	1,800	0	144,500
1987	Catch	128,500	83,700	6,700	5,800	0	224,700
	Escapement	155,700	27,500	5,200	4,100	0	192,500

[1] Sapsuk River Only

Table 62. Management Data, Russell Creek Hatchery, 1984-1987 (data supplied by Arnold Shaul, fisheries biologist, Commercial Fisheries Division, ADF&G, Kodiak, Alaska)

	SPECIES							
	Chum Salmon				Pink Salmon			
	1984	1985	1986	1987	1984	1985	1986	1987
No. adults taken for egging	9,700	-	-	-	-	-	-	-
Aerial assessment of stream pop. (i.e. escapement)	55,000	64,800	94,100	66,400	94,000	Trace	18,900	300
Estimated commercial harvest	25,655	42,600	26,500	900	20,144	4,000	4,900	-
No. fish fin clipped	-	-	-	-	-	-	-	-
Total run (approx.)	-	NA	121,000	-	-	NA	25,000	-

The effects of the tons of lost or abandoned nets or other fishing gear on non-target marine wildlife are well known. Sea birds and sea otters are especially susceptible. Sea lions are also often entangled and to a lesser extent terrestrial mammals such as this red fox can be affected. Sarvis (462)19,6/24/87; 470)34,1/88.

was later reversed and in fact increased funding was provided to expand the brood rearing capabilities of its facility. Hatchery personnel collected eggs from silver salmon spawning on refuge lands to experiment with the possibility of increasing the runs of this important sport fish. The Izembek NWR and the King Salmon Fisheries Assistance Office will trade this project to insure the continual stability of fish runs in refuge streams.

14. Scientific Collections

Three bald eagles found dead along the Cold Bay road system in portions of the Pavlof or Izembek units were examined by the refuge staff. Necropsy results showed that two were shot and the third electrocuted. We were not able to determine who shot these birds based on the available evidence. The required plumage was preserved for shipment to the Law Enforcement Division in the Anchorage Regional Office.

A total of fifteen (15) black brant were collected by Research personnel (AFWRC). These birds and others collected in previous years are processed at the University of Missouri for analysis of body composition. This analysis will further our understanding of brant energetics and migration.

Endangered Species personnel and cooperator Dr. Gerald Shields of the University of Alaska trapped one Amak Song Sparrow and collected another on Amak Island. In addition four (4) Amak voles were collected for analysis of taxonomic relationships.

16. Marking and Banding

Mammals

See Section G. WILDLIFE 8. Game Mammals, Caribou for a discussion of marking activities in 1987.

Birds

Passerine species banded under the Refuge Master Banding Permit #20826 are summarized in Table 3. Refer to the appropriate sections in G. WILDLIFE, 3. Waterfowl, Tundra Swans, Black Brant and Emperor Goose for specific discussion of marking involved in these projects.

H. PUBLIC USE

1. General

The majority of public use for the refuge comes from residents of Cold Bay and visiting waterfowl and caribou hunters. Although residents of King Cove (20 miles southeast) and False Pass (35

Kayaking can provide spectacular scenic and wildlife viewing opportunities to the back-country enthusiast. 6/20/88 Sarvis (458)10,8

Here kayakers are observing a bear leaving its daybed on a sandbar in the shallow lake.

miles west) villages do use the refuge, it is typically limited to a small amount of caribou and waterfowl hunting.

The population of Cold Bay, although largely transient, remains at the 1985 level of approximately 180. We expect the population stabilization seen in 1985 and 1986 to be temporary. The potential for development of petroleum basins north and south of the Alaska Peninsula could change overnight as a result of the world economy. On a local basis, this would mean people, aircraft and development in Cold Bay. A local population increase of 15% occurred during the 1984 testing of the St. George Basin northwest of Cold Bay.

The population status and structure of Cold Bay in 1987 and the near future may change drastically. Not only do we anticipate more and permanent offshore oil related support facilities, but the U.S. Coast Guard is also planning to build a 65 to 70 person search and rescue base adjacent to the airfield. This latter facility would be a helicopter base with daily training flights and C-130 support. It would be staffed by personnel unaccompanied by families. Hence, the next few years show great potential for increases in aircraft activities, specifically large helicopters which will accelerate our concern over disturbance of spring and fall staging waterfowl. In addition, a potentially more drastic problem could be the near doubling of the adult population which will affect the intensity of various forms of public use of the refuge. This change will greatly alter the lifestyle of the present residents of the area.

Caribou and waterfowl hunting seasons are the refuge's most intensive periods of public use. However, harvest limitations eliminated much of the non-local use. In alternate regulatory years, the Alaska Peninsula is open to brown bear hunting, so Izembek had a fall 1987 hunt only. A summary of commercial guiding activities and hunting by Alaska residents in the important Right and Left-hand Valley and Moffet Bay areas of the Izembek refuge was prepared to respond to guide conflicts and complaints (Table 63). Use ofthis area by brown bear hunters has increased dramatically in the 1980's. A spring and fall permit bear hunt occurred on Unimak Island. Bear hunting significantly increases the number of visitors to the area and typically these users engage in other forms of outdoor, consumptive activities as well.

The refuge has taken a low key approach to its interpretive program. Due to Cold Bay's small population, and the predictable patterns of refuge users, refuge staff are able to make personal contact with a very high percentage of users and visitors. In addition to the small visitor display at refuge headquarters, information is presented to the public in several locations around town.

Planning continued during the year towards the preparation of interpretive displays at both the airport terminal and the U.S.

Hiking, sometimes only a few hundred yards from the road, can quickly take the Izembek visitor into a pristine wilderness setting. Blenden

Table 63. Commercial, big game, guide use and harvest in the Lefthand Valley Righthand Valley/ Moffett Bay portion of Izembek NWR, 1983-1987.

	(Number of Guides/ Clients/ Bears Taken)				Total	Total	
Season	Black(Jones)	Guthrie	Carlson	Residents	Persons	Bears	Caribou
F,1983 [1]	2/ 4 /2	2/ 3 /2	2/ 3 /2	0/ 2 /1	18	7	6
S,1984	2/ 2 /2	2/ 2 /2	3/ 2 /2	0/ 1 /1 [2]	14	7+ [2]	closed
F,1985	1/ 3 [4] /2	2/ 4 [4] /1	3/ 2 /1 [2]	0/ 7 /4	22	8+ [2]	3
S,1986	3/ 2 /2	2/ 3 [4] /1	3/ 2 /3 [3]	0/ 2 /0	17	6	closed
F,1987	2/ 2 /0	2/ 1 /1	3/ 6 [5] /2	0	16	3	closed
Average					17.4	6.2	4.5

[1] In Fall, 1983 no client restrictions for guides; from Spring 1984 on guides were limited to 2 clients for bear.

[2] It was reported that one or more other bears were wounded, but lost.

[3] One bear was killed by guide Dick Carlson for himself.

[4] When more than 2 clients occurred, they were backpackers or caribou hunters.

[5] Four extra clients taken in violation of his SUP; SUP for Spring, 1988 bear season was denied.

The Izembek staff presented a two hour program to primary students from the Cold Bay School. The topic was life history of common bird and mammal species in the area. Hands-on instruction was provided and the film "Chain of Life" was shown. 3/88 Dau

Post Office. In addition, with input from the refuge staff, the Engineering Division (RO) prepared plans for a visitor shelter/ contact station to be located at Grant Point.

6. Interpretive Exhibits/Demonstrations

The visitor displays in the lobby of refuge headquarters exhibit mounted specimens of several species of migratory waterfowl found on the refuge. Also displayed is information aiding public use and the results of ongoing waterfowl surveys on the refuge. A blackboard installed in the lobby, displays current information on production and population surveys being conducted by refuge staff and other divisions on black brant, Canada geese, emperor geese and tundra swans.

In 1987 we expanded the office interpretive displays with exhibits of several additional mounts of representative waterfowl species including a depiction of a tundra swan feeding on aquatic vegetation.

A twelve foot long relief map of the area from Port Moller to Unimak Pass will be the center of our office/visitor center. By year's end the contractor had a rough mock-up prepared for scrutiny. Also reviewed by year's end were text and graphic drafts and mock-ups for interpertative displays at the airport terminal and Post Office. We hope to finalize these projects early in 1988 and have them installed by this summer. Both displays will feature maps of the local Cold Bay area (including the road system) and the lower Alaska Peninsula as well as interchangable information panels providing biological data on key species or habitats and their use by the public.

We hope our expanded visitor contact efforts will lead to greater public awareness of the refuge areas of the lower Alaska Peninsula for local residents as well as other visitors.

8. Hunting

Migratory waterfowl of numerous species occur at Izembek NWR each fall and winter. These alluring resources draw many consumptive as well as non-consumptive users to the refuge. Consumptive use of waterfowl in the Izembek area has in recent years been primarily by local residents. Declining populations of arctic nesting geese have resulted in harvest restrictions and in the case of one species, the emperor goose, a closed season. The hunting season for black brant throughout the Pacific flyway in 1987 was limited to 50 days which gave us an opening of from 12 September to 31 October with a limit of 2 per day (4 in possession). Such restrictions on harvest and rising air fares to Cold Bay have resulted in a large decrease in numbers of non-local hunters. The refuge staff maintains high visibility during the waterfowl hunting season for law enforcement and bag checking. Data collected from these activities are summarized in Tables 64 and 65.

Caribou attract viewers, photographers and hunters to the Cold Bay area and the Izembek Refuge each fall. 11/87 Blenden

Table 64. Law enforcement cases made on Izembek NWR during 1987.

Violation	Case[1] Made by	Date	State Court	Federal Court	Residency		Source	Disposition
					Local	Non-Local		
Unauthorized use of motor vehicle on NWR	IZ	2/5		x		x	vehicle patrol	$100.00 fine
"	IZ	11/17		x		x	vehicle patrol	$100.00 fine
"	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	IZ	10/10		x	x		FWP tip	$100.00 fine
"	IZ	10/10		x	x		FWP tip	$100.00 fine
"	IZ	10/10		x	x		FWP tip	$100.00 fine
"	IZ	10/11		x	x		aerial patrol	$100.00 fine
"	IZ	10/11		x	x		aerial patrol	$100.00 fine
"	IZ	10/11		x	x		aerial patrol	$100.00 fine

[1]Case made by: IZ-Izembek NWR; SA-Special Agent, James Sheridan; FWP-Alaska Fish and Wildlife Protection.

Table 64. (Con'd)

Violation	Case[1] Made by	Date	State Court	Federal Court	Residency		Source	Disposition
					Local	Non-Local		
Take of waterfowl after legal shooting hours.	SA	10/9		x	x		foot-patrol	$126.00 fine
"	SA	10/9		x	x		foot-patrol	$196.00 fine
"	SA	10/9		x	x		foot-patrol	$196.00 fine
"	SA	10/9		x	x		foot-patrol	$106.00 fine
"	SA	10/9		x	x		foot-patrol	$196.00 fine
"	SA	10/9		x	x		foot-patrol	$106.00 fine
"	SA	10/10		x		x	foot-patrol	$152.00 fine
"	SA	10/10		x		x	foot-patrol	$152.00 fine
Take of waterfowl with unplugged shotgun	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	SA	10/9		x	x		foot-patrol	$100.00 fine
"	SA	10/9		x	x		foot-patrol	$100.00 fine

Table 64. (Con'd)

Violation	Case[1] Made by	Date	State Court	Federal Court	Residency Local	Residency Non-Local	Source	Disposition
Take of waterfowl with unplugged shotgun	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	IZ	10/9		x	x		aerial patrol	$100.00 fine
"	SA	10/9		x	x		foot-patrol	$100.00 fine
"	IZ	10/10		x	x		FWP tip	$100.00 fine
Take of caribou in closed area 1 count	FWP	10/10	x		x		FWP aerial patrol	$2000.00 fine, $1000.00 suspended. 10 days jail suspended. 3 wheeler forfeited. 1 year probation
Take of caribou in closed area 2 counts	FWP	10/10	x		x		FWP aerial patrol	$4000.00 fine, $2000.00 suspended. 20 days jail,16 suspended. Forfeit 3 wheeler. 1 year probation.
Take of caribou in closed area 3 counts	FWP	10/10	x		x		FWP aerial patrol	$6000.00 fine, $3000.00 suspended. 30 days jail 24 days suspended. 3 wheeler forfeited. 1 year probation.

Table 64. (Con'd)

Violation	Case[1] Made by	Date	State Court	Federal Court	Residency Local	Residency Non-Local	Source	Disposition
Violation State reg/ hunting caribou same day airborne.	IZ	11/21		x	x		phone tip	$250.00
"	IZ	11/21		x	x		phone tip	$250.00
"	IZ	11/21		x	x		phone tip	$250.00
"	IZ	11/21		x	x		phone tip	$250.00
Violation State reg/ hunting without license.	IZ	10/9		x		x	aerial patrol	$125.00
"	IZ	10/9		x	x		aerial patrol	$125.00
Hunting waterfowl w/o federal conservation stamp.	IZ	10/9		x	x		FWP tip	$100.00
Take of Emperor Geese/closed season.	IZ	10/10		x	x		FWP tip	$250.00
"	IZ	10/9		x	x		FWP tip	$150.00
Over bag limit Canada geese.	IZ	10/10		x	x		FWP tip	$125.00
Take waterfowl after legal hours/aiding & abetting.	SA	10/9		x	x		foot-patrol	$196.00
Violation State reg/ Take caribou w/o harvest ticket.	IZ	12/12		x	x		vehicle patrol	pending

In late fall and throughout the winter, willow ptarmigan are commonly found in large flocks, often in the hundreds. 11/87 Blenden

Table 65. Summary of waterfowl bag check data, Izembek NWR, 1987

Species	(Harvest by age/sex) Adult M	Adult F	Adult U	Immature M	Immature F	Immature U	Unknown M	Unknown F	Unknown U	Lost	Total[1]	% of Harvest
Emperor Goose[2]												
Black Brant	5	2	2	5	2	1			6	0	23	11.7
Tav. Canada	5	8	4	6	6	5			139	10	173	88.3
Goose Total										10	196	
Pintail	4	3		14	6	3	10	16	8	8	64	51.2
Mallard	4			1	1		2			1	8	6.4
Gadwall	4	2			1					1	7	5.6
G-W Teal	4	2		3	2		2	1	7	2	14	11.2
Shoveler	1				2				6		9	7.2
G. Scaup	1			2	4				8	4	15	12.0
Bufflehead					1						1	0.8
C. Goldeneye	1			1				3			5	4.0
Steller's Eider				1							1	0.8
R-b Merganser								1			1	0.8
Duck Total										16	125	
Total Birds[3]	29	17	6	33	25	9	14	21	174	26	321	

No. Hunter Contacts (Hours afield/hunter)	No. Ducks (Av./Hunter)	No. Canada Geese (Av./Hunter)	No. Brant (Av./Hunter)
77 (6.2/hunter)	125 (1.6)	173 (2.3)	23 (0.3)

Species	Est. Bag[3]	Est. Cripples(%)[4]	Est. Ttl Harvest
Ducks	125/.1=1250	160 (12.8)	1410
Canada Goose	173/.1=1730	100 (5.8)	1830
Black Brant	23/.1= 230	0 (0)	230

[1]Excluding Cripples (lost)
[2]No open season on emperor geese in 1986 or 1987
[3]Estimate 10% of hunters contacted
[4]Percent crippling rate per goose species and ducks as a group

The Alaska Peninsula was open to brown bear hunting in the fall of 1987 (1-21 October) and closed during the spring season (10-25 May). Izembek NWR is in State Game Management Unit 9D which is open to brown bear hunting every other regulatory year, hence will be opened also during the spring of 1988. The refuge staff sealed 15 brown bears during the fall of 1987 season in cooperation with the Alaska Department of Fish and Game. We sealed all bears harvested on Izembek NWR and only a portion of those taken in adjoining areas. Approximately 200 brown bears are annually harvested on the Alaska Peninsula.

Unimak Island, in State Game Management Unit 10, is open to brown bear hunting annually by drawing permit. Fifteen (15) permits are issued per year for spring (N=7 permits) and fall (N=8 permits) seasons. Only five hunters participated in the spring hunt and three took bears (2 males and 1 female). Six hunters took five bears (4 males; 1 female) during the fall hunt (Table 53).

Caribou hunting in State Game Management Unit 9D was restricted in 1986. Season length for non-residents was restricted and bag limit of one animal was established for all hunters. The previous bag limit was four animals per hunter. These restrictions were due to a decline in the southern Alaska Peninsula herd documented by the refuge staff.

The Alaska Board of Game dealt with the GMU 9D caribou situation and established a harvest level of two animals per hunter again with a restricted season length for non-residents. Survey data obtained in the summer of 1987 jointly by refuge and Alaska Department of Fish and Game suggested more drastic measures were necessary and the season was closed by emergency order. This closure carried the proviso that if a fall census/productivity survey showed more than the expected number present that a special opening would be allowed. This situation occurred and a 60 day season (17 November to 17 January) was allowed during which the refuge documented a harvest of 86 animals. The caribou season is dealt with more fully in Section G. Wildlife, 8 Game Mammals, Caribou.

9. Fishing

Sport fishing is very popular during the summer and early fall. Primary species sought are silver, chum and pink salmon; and Dolly Varden trout. Saltwater fishing is also popular with Pacific cod, starry flounder and halibut making up the majority of the harvest.

10. Trapping

Trapping is permitted under state regulations and a trapping permit is also issued by the refuge. Izembek and Unimak Island (Alaska Maritime NWR) were refuge lands specifically mentioned in ANILCA for which trapping permits are required. Twelve trappers received permits in the 1987-88 season, eleven for Izembek and

three for Unimak Island. Several other local residents trapped in areas of the adjacent Pavlof Unit of the Alaska Peninsula NWR where trapping permits are not required. This year's harvest data (for '87/'88 season) and the reported catches for the last five seasons are shown in Table 59 in Section G. 10. Other Resident Wildlife.

11. Wildlife Observation

Most wildlife observation on the refuge is incidental to other activities. There are rare days when the weather is good and most of the town turns out to drive refuge roads and view wildlife.

17. Law Enforcement

The 1987 law enforcement effort consisted of vehicle and aerial patrols during peak hunting seasons, investigation of public complaints, hunter surveillance and bag checks. The refuge was fortunate this year to receive field assistance from Alaska Division of Public Safety, Fish and Wildlife Protection and Region 7 Law Enforcement staff. Fish and Wildlife Protection officers were present on and off during the summer commercial fishing season and during the October 1 to 21 brown bear hunting season. During this latter period they made 3 big game hunting cases on the refuge and alerted refuge staff to Migratory Bird Treaty Act violations and unauthorized use of motor vehicles on the refuge. During October 9 and 10 Assistant Special Agent in Charge, James Sheridan made 12 cases involving violations of the Migratory Bird Treaty Act. Refuge staff made 28 cases including unauthorized use of a motor vehicle on a National Wildlife Refuge, various taking violations of the Migratory Bird Treaty Act and several violations of state big game (caribou) hunting regulations on a National Wildlife Refuge (Table 64).

The total of 43 cases made this year is at least twice the annual total of past years for a number of reasons. Thirty six of these occured during a period when Fish and Wildlife Protection, Izembek NWR and the Division of Law Enforcement simultaneously had officers in the field. If it was not for the beautiful flying weather the 25 violations discovered from the air would have likely gone undetected. Hunter activity was probably at its peak during the period October 9-11 not only because of high waterfowl concentrations at that time but a Bering Sea commercial crab fishing season had just closed the day before. This is significant since about 31 of the 36 cases made during October 9-11 were for violations committed by commercial fishermen from King Cove and Sandpoint, villages bordering the refuge.

Although the refuge staff is pleased with results of the 1987 law enforcement effort, it points to a sizable void in public awareness and concern for hunting and refuge regulations. This problem is especially evident in some of the communities adjoining the refuge. The problem seems most critical in King Cove. Not only did King Cove residents receive the "lion's share" of these

Refuge officers and State Fish and Wildlife Protection personnel apprehended several individuals engaged in numerous waterfowl, big game and vehicular use violations during October near Big Lagoon. Confiscated game and equipment were loaded aboard the State enforcement vessel Wolstad. Sarvis(469)16,29,35

violation notices but the most serious cases of the year, taking of big game during closed season, were committed by the Superintendent of King Cove School, an administrator/teacher from King Cove and the school janitor.....role models for King Cove youth.

In addition Tom Early, Assistant Refuge Manager from Alaska Maritime NWR in Homer, reported to Izembek staff rumors he had heard concerning the shooting of several bald eagles near King Cove. Early had heard this while conducting public meetings for the Alaska Maritime Comprehensive Conservation Plan in March, 1987. Investigation by Izembek staff revealed five bald eagles had been shot around a bait station just outside of town. The King Cove Police Department originally investigated the incident but had no suspects. The case was turned over to Special Agent Steve Tuttle. Tuttle suggested posting reward notices in several communities, newspapers and radio stations. Unfortunately no new information came to light. Hopefully, alot more people are now aware that shooting bald eagles is illegal, incidents will be investigated and a substantial reward will be offered for related information.

Hopefully we (Izembek NWR, Region 7 Public Use and Information and Law Enforcement staff) can more aggressively confront these problems in the near future in a more positive fashion.

18. Youth Programs

This year Izembek NWR continued its YCC program in 1987 at the established level of two enrollees. Jim Ehret, Jr. and Jason Accuardi both of Cold Bay were on staff from 26 May to 15 August assisting on numberous maintenance and biological projects.

I. EQUIPMENT AND FACILITIES

1. New Construction

A contract was drafted early in 1987 for the drilling of a water well to supply the needs of the Izembek NWR headquarters. The refuge currently is supplied water via a contract with the Federal Aviation Administration. When our system is operational a considerable savings will occur.

The water well was drilled to 160 feet to obtain the necessary flow of 10 gallons per minute. A concrete pad was laid in late summer and a 8 X 12 foot well house was constructed to house three 220 gallon water and storage tanks and associated plumbing.

Work continued in 1987 on final preparations of our emergency generator building. This building will also house the meters and switching panel for the entire refuge headquarters compound. Commercial power was routed and a new transformer was installed adjacent to the generator building in 1987. Final preparation and operational testing will be accomplished in 1988.

In 1988 the Izembek refuge will go off commercial water (at the rate of $5,000+/year) thanks to the drilling of a well and construction of a well house at the headquarters. Sarvis(463)9; 9/87 Blenden

MW Dunn constructed new frames for refuge entrance signs at two locations near Cold Bay. New signs were prepared for installation in early 1988.

2. Rehabilitation

Two large picture windows were replaced in quarters No. 4. Buildings in Cold Bay must handle routine winds in the 40 to 50 mph range with occasional gusts to 100 mph. The Engineering Division over the years has often learned the hard way what works in the bush. They have learned, we hope, while the field has suffered the financial and physical burdens.

The arctic entrance and associated metal siding on the south entrance to the refuge office was repaired after being bumped by a vehicle driven by a refuge visitor. Damage was not extensive and parking barriers were extended.

Routine maintenance through rehabilitation was performed on six refuge passenger vehicles. Two refrigerators and one clothes dryer were replaced in refuge quarters.

J. OTHER ITEMS

1. Cooperative Programs

Alaska Department of Fish and Game

Caribou: Area biologist Dick Sellers (King Salmon) assisted the refuge in the capture and radio collaring of caribou from the southern Alaska Peninsula herd. Further assistance was obtained in the completion of a productivity survey. The Izembek NWR and ADF&G cooperated in emergency regulatory changes on caribou hunting in GMU's 9D and 10.

Research (AFWRC):
Housing, general and aerial support, etc., were supplied by Izembek NWR staff in this cooperative work to quantify disturbance factors, behavior and energetics of spring and fall staging geese, primarily black brant.

Migratory Bird Management-MBMN:
The Izembek NWR provided personnel and funding toward an ongoing effort to census emperor geese in southwestern Alaska during spring.

Wildlife Management-Marine Mammals:
Via an MMS contract through the USFWS, a researcher from the University of Minnesota worked on sea otters in the Izembek area in 1987. Temporary housing,

One advantage of our notorious weather, it beautifies many a sunset for local residents. Blenden;Sarvis(470)30

logistic support and aerial radio tracking and survey flights were cooperatively provided by Izembek NWR.

British Columbia Provincial Museum:
Dr. Ted Miller was provided housing support as part of his short term project on vocalization patterns of arctic shorebirds, specifically the rock sandpiper. This is the primary nesting shorebird species on the Izembek NWR.

National Audubon Society:
A Christmas bird count has been conducted by the refuge staff since 1963.

With a small staff in a rural area such as Izembek, it is essential to maintain a highly cooperative rapport with various types of agencies and groups. This is an important goal of the refuge staff which to date has resulted in comparatively high biological output in relation to manpower and funding.

4. Credits

John Sarvis wrote Section G.3., Tundra Swan and reviewed and edited the remainder of the report.

Mike Blenden wrote Sections G.8, Caribou, H. 17, Law Enforcement and K.

Chris Dau wrote the remainder of the report.

Shirley Simpson, Clerk/Typist handled word processing and editing.

K. FEEDBACK

The Izembek NWR staff continued to monitor the level of additional paperwork responsibilities placed upon us from within as well as outside the Fish and Wildlife Service (Table 66). We began this annual analysis in 1983 by maintaining a reporting deadlines list on which all incoming requirements are logged in and out. The reporting requirements summarized are additional to identified responsibilities in the AWP, and those in other routine areas such as payroll, energy, activities and outputs. Reporting requirements in 1987 decreased from the 1986 level [i.e. 1986 n=73, 1987 n=57 (-22%)]. The effects of this reduction are noticable and hopefully represent a trend. Our thanks goes out to those responsible.

Table 66. Non-Annual Work Plan reporting responsibilities assigned to Izembek NWR during 1987.[1]

Requesting Office	No. Received (%)	$\bar{X}$ Reporting Period (Days ± 1SD)	$\bar{X}$ Izembek NWR Turnover Time (Days ± 1SD)	$\bar{X}$ Days Ahead of Deadline	Type of Report	
					Resource (%)	Non-Resource (%)
Refuges (RO)	21 (37)	21.7 ± 12.0	15.6 ± 11.1	6.42	20 (35)	37 (65)
Regional Office (other)	33 (58)					
Central Office	1 (2)					
Other Agency	2 (4)					
Total	57					

[1] Reporting with a deadline; many written and verbal requests are also received by the refuge staff with an estimated 75% of these also being non-resource oriented.

THE END