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MIGRATION, STAGING AND NESTING OF MIGRATORY WATERFOWL, SOUTHWEST ALASKA

-- A Status Report of the 1990 Waterfowl Monitoring Efforts on the Togiak National Wildlife Refuge

BY

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ABSTRACT

Waterfowl related projects continued to gain importance on Togiak Refuge in 1990. Aerial surveys in May found 60-70,000 brant staging in Nanvak and Chagvan Bays. Fall surveys were limited due to high winds. Staging observations at Nanvak Bay were continued in 1990, with more effort being applied during the spring migration than in past years. Peak use during spring migration occurred in early May while the timing of fall use varied between species. Telemetry equipment was used to monitor for radio-collared geese during both on-ground and aerial waterfowl staging surveys. Only two frequencies were heard throughout the season. The refuge goose banding program is now part of an international project. Geese captured and collared on the Nushagak Peninsula are being studied in Mexico during the winter. Four hundred and twenty-six geese were banded in 1990. Of those, 50 were fitted with radio collars and an additional 61 were released with standard neck collars. Waterfowl production surveys were conducted in accordance with the draft protocols established by the Region. Dabblers broods were once again the most prominent, with green-winged teal being the most common.

INTRODUCTION

Located on the coast in southwestern Alaska (Fig. 1), Togiak National Wildlife Refuge is host to a wide variety of migrant and resident waterfowl. Lakes, ponds, streams, rivers and marshes combine to offer nourishment and resting areas for staging, breeding and molting waterfowl. Togiak Refuge includes approximately 350 miles of coastline. Major waterfowl concentrations or areas of activity occur at: Nushagak Peninsula, Kulukak Bay, Osviak Slough, Nanvak Bay, Chagvan Bay, Carter Bay and Jacksmith Bay (Fig. 2).

Special emphasis of the Togiak Refuge waterfowl program is placed on four species of arctic-nesting geese, (Pacific brant, *Branta bernicla*; emperor geese, *Chen canagica*; Canada geese, *B. canadensis*; and greater white-fronted geese, *Anser albifrons*) which use the refuge as a primary spring and fall migration/staging area. Currently there are no known breeding grounds for these species on the refuge. However, large concentrations of greater white-fronted and Canada geese utilize the Nushagak Peninsula as a molting area. These groups are composed of failed and nonbreeding birds, indicating nesting grounds may be close by.

Aerial surveys have been conducted for spring and fall waterfowl migrations since the refuge began in 1981. On-ground migration watches were started in the fall of 1986 at Nanvak Bay. These watches increased in importance and now include monitoring radio-collared birds. Duck brood surveys were initiated in 1984 and were intensified in 1987. In 1990, a statewide survey procedure was

developed and implemented.

During aerial surveys in 1983, a large concentration of molting geese was observed on the Nushagak Peninsula (Togiak Annual Narrative 1983). A banding program was established in 1988 to capture and band white-fronted and lesser Canada geese. This project has developed into a cooperative effort with Alaska Fish and Wildlife Research Center - Anchorage (AFWRCA) and the Northern Prairie Wildlife Research Center (NPWRC) in Dixon, California.

OBJECTIVES

1) Determine timing and magnitude of spring and fall migration/staging of migratory waterfowl on the refuge.

2) Determine seasonal use and migration of white-fronted geese on the Nushagak Peninsula in cooperation with AFWRCA and NPWRC.

3) Determine waterfowl production on the refuge and adjacent habitat.

METHODS

Spring and Fall Aerial Surveys

Aerial surveys were used to determine abundance and concentrations of waterfowl during spring and fall migrations. Surveys were attempted weekly along the refuge coastline and systematically over Nanvak and Chagvan Bays. Species were identified and estimates were made for concentrations of waterfowl along the refuge coastline, in uplands, sloughs and bays.

A pocket tape recorder was used to log data which was later transcribed onto survey forms back at the office.

Flights were conducted along the refuge coastline between 400-600 feet depending upon visibility and weather conditions and at a speed of 90k. Surveys were flown with the refuge Cessna 185 when available. When the refuge aircraft was not available, a Cessna 185 was chartered from a local airtaxi operator.

Waterfowl Staging - Nanvak Bay

Daily migration/staging observations were recorded for the southern half of Nanvak Bay from an observation tower located on a dune along the southern shore of the bay, approximately 1/2 mile north-northeast of the cabin (Fig. 3). Observations were also made while hiking in the surrounding uplands, kayaking the bay, and from the cabin window. These observations included: species and number of

birds present in the lower bay, movements within and around the bay, and areas utilized by each species. Because the difference between emperor juveniles and adults is easily distinguished, family groups were noted whenever possible.

Watches were conducted once a day (weather permitting) in the afternoon to early evening. Duration of observations varied depending upon weather conditions but range from one to five hours. When conducting a watch, counts were made on the hour, with the highest count being used for the daily total. Locations of large concentrations were noted and recorded by the areas : Brant Bay, Brant Bay Slough, Cabin Pond/Slough, North Spit, Mud Bay and the Upper Bay (Fig. 3). Brant Bay, Brant Bay Slough and the Cabin Pond/Slough were the most easily monitored. Estimates of birds using North Spit and Mud Bay were obtained on days with greater than 1.5 miles visibility. Estimates of the Upper Bay were few and far between, occurring only when personnel had time available to hike or kayak in that area.

A spotting scope and binoculars were used to identify species and estimate numbers of birds using the lower bay and surrounding uplands. Any geese venturing close enough to the tower were observed for neck collars and color tarsal bands.

Weather conditions were recorded daily for ceiling, wind direction and velocity, temperature, precipitation and visibility.

Waterfowl Production Surveys

Togiak Refuge is part of the Bristol Bay Stratum (Stratum #8) of the statewide waterfowl production survey. The Bristol Bay Stratum also includes Alaska Peninsula Refuge and Izembek Refuge, both in southern Bristol Bay. Sample units were selected both on and off refuge lands. Togiak Refuge was responsible for refuge lands and the area bordered on the east by Lake Iliamna, on the south by Kvichak River/Bay and on the north by the Nuyakuk River (Fig. 4).

For the purpose of this paper, the stratum will be broken into two areas, Northern Bristol Bay will consist of Togiak Refuge and the surrounding area and Southern Bristol Bay will consist of the Alaska Peninsula Refuge, Izembek Refuge and their surrounding areas.

Maps were created by Migratory Bird Management (MBM) in Juneau, for each refuge. The maps delineated the area each refuge was responsible for surveying, the potential waterfowl habitat within each area and the core or high potential habitat. Sample units were to be selected from the high potential or core areas.

Sample units could be one of two types, plots or clusters. A plot is defined as a sample unit which is an exact square of a

determined size. A cluster is roughly a square of determined size, however the boundaries are adjusted to include or exclude waterbodies lying on the borders. To determine if a waterbody should be included, a line was drawn along the lake/pond axis (may be curvilinear). If the center point was within the square, the waterbody was included and if it fell outside the square, the waterbody was excluded (USFWS Draft Waterfowl Production Plan 1990).

Clusters approximately one mile square were selected for the Northern Bristol Bay area by using the computer program developed by MBM - Juneau. The program generates latitude and longitude coordinates and randomly selects center points for the sample units.

Due to the large amount of area designated as "core" habitat in Northern Bristol Bay, three divisions were made to ensure a distributed sample (Togiak Drainage, Nushagak Peninsula, and the area east of Dillingham). The number of clusters selected per division was based upon the percent of the total core area involved. Center points were randomly selected until a total of ten clusters were established (two clusters in the Togiak Drainage, three on the Nushagak Peninsula, and five for the area east and northeast of Dillingham (Fig. 4).

The locations of these clusters were relayed to Donna Dewhurst, Biologist, Becharof National Wildlife Refuge, who was designated as the primary observer for all plots in the Bristol Bay region. All plots were surveyed using a Bell 206 helicopter following the standard operating procedures drafted by MBM. Each cluster was located and all waterbodies inside were surveyed. Data were recorded on 1:63,630 maps, then transferred to the data form (Appendix B).

A copy of the data was forwarded to the refuge office. The data were logged into the computer and summarized using the Lotus program developed by MBM-Juneau.

Radio Telemetry

White-fronts, emperors and brant have been radio collared by Yukon Delta Refuge and AFWRC-A. In support of these projects, radio-equipped birds were monitored during aerial surveys and staging observations. Frequencies were scanned at a rate of approximately one per second during aerial surveys.

Two yaggi antennas and 20' antenna poles were supplied by U.S. Fish and Wildlife Research, to monitor for radioed geese. One antenna was erected at the observation tower and the other at the cabin. Tests were conducted with a radio collar to determine range and

clarity of signal for each antenna. The collar was first placed at the base of the observation tower. The signal was received clearly at the cabin. The collar was then moved to Nanvak Hill, located approximately 1.5 to 2 miles from the tower (Fig. 3). The signal was received clearly at the tower but was not heard at the cabin.

Telemetry units were to be monitored at least two hours per day, one hour from the cabin and one hour from the tower. The units were programmed with frequencies for brant, white-fronted geese and emperor geese (Table 1). Aerial surveys were conducted in the spring in an attempt to locate geese radio collared in 1989 and again in the fall to determine movement and status of geese collared in 1990.

White-fronted Goose Banding

Greater white-fronted geese were captured on the Nushagak Peninsula using a drive trap technique. When the birds became flightless during the molt, they were herded from the water into a funnel trap set on shore. Two float equipped Cessnas (185 and a 206) were used to push the geese into the trap. A total of seven personnel were required for the drive and banding.

In a cooperative effort with the Northern Prairie Wildlife Research Center, Dixon, CA, and Alaska Fish and Wildlife Research Center, Anchorage, radio collars and standard yellow neck collars were deployed on white-fronts. One of the objectives of deploying radio collars is to locate the nesting ground of these birds the following spring. As a result of this objective, radios were primarily affixed to females which were measured and weighed before release. To obtain a comparable sample, measurements were also obtained from an equal number of males fitted with standard collars. Measurements obtained included: approximate age (if possible), sex, culmen length, bill width, bill height, bill length, total tarsus, diagonal tarsus and weight. The remaining geese were banded and released.

RESULTS

Spring and Fall Aerial Surveys

Four aerial surveys were flown during the spring migration (April 19, April 23, May 4 and May 9). Peak estimates for emperor geese occurred on May 4 (1,300-1,500) and peak estimates for brant were recorded on May 9 (60,000-70,000) (Table 1).

Other species of waterfowl observed in order of abundance included: northern pintail (Anus acuta), common eider (Somateria mollissima), Steller's eider (Polysticta stelleri), mallard (A. platyrhynchos), red-breasted merganser (Mergus serrator), northern shoveler (A. clypeata) and tundra swan (Cygnus columbianus).

Three aerial surveys were conducted during the fall migration, August 30, September 10 and October 16. Surveys were attempted on September 4 and September 21 but were aborted due to high winds. Peak estimates for brant occurred on August 30 (13,160) and peak estimates for emperor and Canada geese were recorded on September 10 with 310 and 1,630 respectively (Table 1).

Other species of waterfowl observed in order of abundance include: northern pintail, white-winged scoter (Melanitta fusca), scaup (Aythya sp), common eider, Steller's eider, American green-winged teal (Anas crecca) and black scoter (M. nigra),

Waterfowl Staging - Nanvak Bay

Spring Observations:

Prevaling winds during the spring migration period were from the east to northeast (occuring on 14 of 23 days) and varied in intensity from light to 35+ knots. Winds were generally calmer during early morning and late evening hours. Precipitation occured on 14 of 23 days. Amount of precipitation was not accurately recorded due to high winds blowing the rain out of the gauge before it could fall into the graduated cylinder. A functional max/min thermometer was not obtained until June. As a result, the low temperature was recorded at approximately 7:30 am each morning and the high was checked intermittently throughout the afternoon with the highest temperature seen being recorded. Temperatures varied from below freezing, (1 inch thick ice formed on nearby ponds) to a high of 55 degrees on May 14. No data has been collected on time of break-up at Nanvak Bay in past years. This year, the upper bay appeared to be ice-free by April 29. Strong winds and moderate temperatures contributed to the break-up.

During the spring waterfowl migration, 28 hours were logged in the observation tower between April 27 and May 28. Observations of staging activity were made on a regular basis from April 26 until May 18, then sporadically until May 28, when tower observations were discontinued. Time was spent identifying species, estimating numbers and observing for collared or color-banded birds in the lower bay. No collared or marked birds were seen. Estimates of flocks feeding or staging in the lower bay were dependent on weather conditions as both the birds and observers were trying to stay out of the wind.

Pacific brant were the most prominent species observed and were first noted on April 26. The peak activity in 1990 appears to have occurred during the first two weeks of May (Fig. 5). The peak estimate was obtained from the tower on May 4 when weather conditions were optimal: 12,000 brant were observed in the lower to mid-bay.

On May 10, several flocks of brant were observed migrating northward near Shaiak Island (Fig. 3). The majority of the flocks followed a coastal or overwater route, remaining approximately a quarter to a half mile offshore and following the coast to Cape Peirce Point. At the point, some flocks were observed turning and flying into Nanvak Bay while others continued toward Cape Newenham. A few scattered flocks turned overland near Shaiak Island and into Nanvak Bay.

Emperor geese appeared to have a shorter activity window with the peaks occuring the first week in May (Fig. 6). Initial observation of emperors was made on May 1. Peak numbers were observed on May 4 when 800 emperors were seen in the lower to mid bay. Groups of emperors were observed interchanging within the bay, but no flocks were observed flying north.

Canada geese were not seen in large numbers during the spring migration. A flock of approximately 30 birds was observed in lower Nanvak Bay on May 4. Additional sightings occured on May 8, 9, 10 and 12, when a pair was observed feeding in the slough area.

Greater white-fronted geese were not observed during the spring staging surveys.

Other species observed include: northern pintail, American green-winged teal, northern shoveler, mallard, American wigeon (Anas americana), Scaup (sp), bufflehead (Bucephala albeola) and tundra swan.

The slough area in front of the cabin becomes flooded each spring during the initial melt. Several species of waterfowl use this area for staging and feeding. Numbers of pintails, green-winged teal and shovelers using the slough area were monitored from the cabin. Although the numbers are not high, a use pattern was established. Pintail were already present when personnel arrived to establish the camp on April 25. Green-winged teal were the next migrants to arrive and were noted on May 1. The northern shovelers had the shortest attendance period, with their peak activity occuring between May 4 and May 12 (Fig. 7).

Mallards were noted on three occasions, the first on April 30 when a flock of 11 was seen flying over the bay. The second and third sightings (May 1 and 3) were of a pair feeding in the slough area.

The tundra swan, scaup, bufflehead and American wigeon were only observed once.

Fall Observations:

High winds and poor visibility plagued the ground observation effort during the fall migration. Observations began on August 14, when the first flock of Canada geee was observed near Nanvak Bay. Between August 14 and September 22, 46.1 hours were spent observing birds. The telemetry receiver was monitored 45.5 hours on the ground.

Pacific brant was again the most prevalent species, with numbers ranging from 26 to 3,000. The peak estimate of 3,000 birds was observed twice - on September 5 in the lower bay and again on September 13 in the upper bay. Brant activity was first noted on August 15 with 26 birds observed. Numbers fluctuated throughout the entire observation period (Fig. 8), with the higher numbers occurring between August 26 (2,237 birds) and September 13 (3,000 birds). Little data were collected in 1989; however data from 1988 suggests a slightly later window of activity (Fig. 8).

Brant congregated along the shore of North Spit near the mouth of Mud Bay, Brant Bay, and in the eelgrass beds between Brant Bay and Mud Bay (Fig. 3). The upper bay appears to be used extensively by brant and other species of waterfowl. On intermittent trips up the bay by kayak, larger concentrations of brant and northern pintail were noted at the north end.

Very little active migration was observed in 1990 due to high winds and poor visibility. When birds were seen leaving the bay, they tended to depart out the mouth of the bay to Cape Peirce Point, then turned southward. This pattern was also observed in 1988 (Bourassa, 1988 unpublished).

Emperor geese appeared to be active in the area from August 23 until the camp was closed on September 22 (Fig. 9). The first group observed was composed of seven adult birds (August 23). The first flock containing juveniles was observed on August 24 (8 adults and 6 juveniles). Peak estimates were obtained on September 6 when approximately 400 emperors were noted feeding in the uplands with the Canada geese.

Seven neck collared emperor geese were seen on September 9 feeding in the slough area near the cabin. Six of the collars belonged to a family group (2 adults and 4 juveniles) and the remaining collar belonged to a lone adult. The numbers included: #400 adult; #362 adult; #255 juvenile; #318 juvenile; #203 juvenile; #314 juvenile; and #147 as the lone adult. No other collared or color marked birds were observed.

Canada geese were the second most frequently observed species during the fall survey. The first flock (36 birds) was observed on August 14. Peak estimates were made on September 6 (1,500) when several large flocks were noted feeding in the uplands. Higher numbers were observed during the 1990 migration (Fig. 10) than in past years. The window of activity appeared to occur between August 18 and September 21.

Although few flocks were observed actively migrating, two routes were noted. One route was from the slough area and uplands, directly south overland, staying above the ridges. The other route was from the bay, slough and upland area overland toward Shaiak Island then following the coast southeast (Fig. 3).

White-fronted geese were observed on August 20 when a flock of approximately 30 birds was seen flying over lower Nanvak Bay.

Waterfowl Production

Bristol Bay Stratum

Twenty sample units were surveyed in the Bristol Bay Stratum during 1990, ten clusters in Northern Bristol Bay and ten in Southern Bristol Bay. A total of 376 waterbodies was surveyed resulting in 79 broods observed. Species observed with broods include: American green-winged teal, mallard, northern pintail, scaup sp., black scoter, American wigeon, oldsquaw (*Clangula hyemalis*) and common goldeneye (*Bucephala clangula*). Additional species observed include: white-winged scoter, northern shoveler, Canada goose, white-fronted goose, common loon (*Gavia immer*), red throated loon (*G. stellata*), red-breasted mergansers (*Mergus serrator*) and sandhill crane (*Grus canadensis*).

Average brood sizes varied slightly between the two portions of the stratum (Table 2). Mallard and pintail were the only species with close sample sizes between Northern and Southern Bristol Bay. Northern Bristol Bay accounted for eight mallard broods averaging 5.31 ducklings per brood (dpb) and seven pintail broods averaging 3.71 dpb. Observations in Southern Bristol Bay included nine mallard broods producing an average of 4.65 dpb and six pintail broods averaging 4.95 dpb. Although 24 green-winged teal broods were observed in Northern Bristol Bay and only 4 in Southern Bristol Bay, average brood size was close with 5.72 and 5.93 dpb respectively.

Northern Bristol Bay (Togiak Refuge and surrounding area), was surveyed from July 14-17. One hundred and thirty-three waterbodies were surveyed resulting in 46 broods observed (0.35 broods per waterbody). Of the 46 broods, 41 were dabblers. Green-winged teal accounted for 56.5% of the observed broods. Other species include: mallard (17.4%), pintail (15.2%), scaup (8.7%) and common goldeneye

(2.2%).

Ages varied with 31.7% of the dabbler broods in age class I; 48.8% in age class II; and 19.5% in age class III. Of the four diver broods observed, three were age class and I and the remaining brood was age class II. The lone sea duck brood observed in Northern Bristol Bay was age class I (Table 3).

Southern Bristol Bay was surveyed between July 15 and 24. Two hundred and forty-three waterbodies were surveyed resulting in 33 broods observed (0.14 broods per waterbody). Of the 33 broods, 21 were dabblers, 6 were diverS and 6 were sea ducks. Mallard accounted for 27.3% of all broods observed in Southern Bristol Bay. Other species include: pintail (18.2%); scaup (18.2%); black scoter (15.2%); green-winged teal (12.1%); American wigeon (6.0%) and oldsquaw (3.0%).

Break down by age class for dabblers is: 14.3% class I; 47.6% class II; and 38.1% class III. All diver and sea duck broods observed were in age class I (Table 3).

Radio Telemetry

Radio transmitter frequencies were monitored from the ground (83 hours) and during all aerial staging/migration surveys (9 hours).

Signals were heard on two occasions, the first during a spring aerial survey and the second during a fall aerial survey. Two radio frequencies (164.429 and 164.572) were received on the Nushagak Peninsula during the April 23 flight. Both frequencies belong to brant, however one frequency (164.572) is extremely close to the frequency of a caribou collar in the vicinity. Therefore, it is unknown if it was the brant or the caribou that was located. No other frequencies were received during the spring.

One brant frequency was heard during the August 30 survey. Frequency 164.161 was located in upper Nanvak Bay. No other signals were received during the fall.

Between the spring and fall effort, 83 hours were spent monitoring radio frequencies during the staging surveys at Nanvak Bay. No signals were heard.

White-fronted Goose Banding

The 1990 banding effort consisted of two drives (June 27 and 28), resulting in 426 white-fronts being captured. This year's effort produced eleven recaptures from the 1989 drives: seven standard leg bands, three visual collars and one non-functional radio collar. The nonfunctional radio collar was replaced with a

standard neck collar (yellow with black numbers) before the bird was released.

Fifty white-fronts (47 females and 3 males) were fitted with radio collars and an additional 61 birds received standard yellow neck collars. Measurements were taken on all radio-collared birds and on all males fitted with standard neck collars (Appendix C).

The totals for the 1990 banding effort on Togiak Refuge are 214 white-fronts banded under the refuge master permit (#22209) and 201 white-fronts banded by Orthmeyer using bands from NPWRC. One capture mortality occurred this season and three of the radio collars (166.765; 167.765; and 167.272) were heard in mortality mode on July 25. No visual observations were made and the causes of death are unknown. Due to time limitations, the collars were not retrieved.

DISCUSSION

Timing and Magnitude of Migration:

The field camp at Cape Peirce (Nanvak Bay) was staffed on April 25 this spring. Some birds were already present when personnel arrived. The majority of bird movement, appeared to occur during early May when peak estimates were reached for brant (May 9), emperors (May 4) and Canada geese (May 4) during both ground and aerial surveys.

An estimate of 60-70,000 brant was recorded between Nanvak and Chagvan Bays during an aerial survey on May 9. In 1989, the brant population was estimated at 128,200 (USFWS, 1989). Therefore, between 47%-55% of the brant population utilized Nanvak and Chagvan Bays as a spring staging area in 1990.

Importance of the Area to Migratory Waterfowl

Nanvak Bay is used by a variety of waterfowl and shorebirds as a staging area during spring and fall. Extensive tidal mudflats, eelgrass beds, and the berries and sedges of surrounding uplands offer nourishment and protection to migratory birds. Flocks of sandpipers estimated in the thousands have been seen covering exposed mudflats during the fall.

In the spring, large concentrations of brant stage in Nanvak Bay feeding on eelgrass beds and waiting for the nesting grounds farther north to break up. The bay also appears to play an important role in the fall migration of emperor and Canada geese. Flocks of up to 1,200 birds have been seen feeding in the upland

berry patches. Better coverage of the uplands during the fall of 1991 will offer a clearer picture of use by these two species.

Waterfowl Production

The 1987 and 1988 surveys indicated that green-winged teal was the primary species of dabbler, scaup were the only divers, and black scoters were the primary sea duck observed breeding on the refuge (Campbell, 1987; Bourassa and Umbright, 1988). Although the 1990 survey consisted of only ten sample units (five on refuge land and five outside refuge boundaries) data supported that teal are the primary dabbler of the area. Only four diver and one sea duck broods were observed during the single survey in 1990. It is felt this was due to the timing and not the habitat surveyed.

Expanded estimates from the 1990 surveys (Hodges and Conant, 1990) illustrate the importance of production habitat in Bristol Bay. Bristol Bay accounted for 23.8% of the tundra habitat and 15.3% of all habitat involved in the survey. Estimates also show Bristol Bay with 33.3% of the estimated broods in tundra habitat and 22.1% of total estimated broods for the state. Expanded estimates for number of young show Bristol Bay accounting for 39.0% of the young found in tundra habitat and 24.5% of the young in the state.

White-fronted Goose Telemetry

Telemetry data show the "Bristol Bay" white-fronts' (geese collared on Togiak and Alaska Peninsula refuges) movements are different than white-fronts nesting on the Yukon Delta. In 1989, Bristol Bay birds arrived in Klamath Basin on September 8, while the Yukon Delta geese did not arrive until October 12. Also, Bristol Bay geese departed Klamath Basin for Mexico on September 19 while the Delta birds departed on October 21 (Orthmeyer, pers. comm.). It is suspected that the geese molting on the Togiak and Alaska Peninsula refuges may belong to a distinct subpopulation.

Contact with personnel at NPWRC in August and September, 1990, revealed the white-fronts had moved approximately two weeks earlier than usual. Most of the Bristol Bay geese reached Klamath Basin in late August and departed by September 6. NPWRC personnel captured and collared an additional 15 white-fronts associated with the Bristol Bay birds.

A fax received from Dennis Orthmeyer, NPWRC on December 19, 1990 stated that 40 of the 50 radio collars deployed on Togiak Refuge had been heard in Mexico or California as of December 15. Seventeen of 19 active radios from the Alaska Peninsula were also received. The total for the Bristol Bay white-fronts is 57/69 radios or approximately 83% relocated. Orthmeyer anticipates roughly 40-45 collared birds returning to Bristol Bay in the

spring. Chances will be improved for locating the nesting area of these geese.

RECOMMENDATIONS

Inventory Design and Methods

Spring and Fall Aerial Surveys

An inventory procedure was written in 1983 for spring and fall aerial staging surveys. The objectives in this procedure are: to gain insight into the relative abundance of various species passing through and staging on the area and compiling data on the timing of the migration during the spring and fall. In essence, these objectives still apply. Aerial surveys give a good indication of when large groups of birds are moving through the area. The problem lies in determining relative abundance. Estimates vary between observers sometimes by several thousand birds. Who is right? Do we average everyone's estimates? This would require keeping two sets of data which is next to impossible on the rapid pace of an aerial survey, especially when one of the observers is the pilot. Estimates are made and recorded, with no way to calibrate the numbers.

It may be beneficial to begin obtaining aerial photos of flocks and attempting photo counts. The counts would allow observers to calibrate their estimates. Implementation of this action would involve an increased cost for film, developing and staff time devoted to doing the photo counts.

Waterfowl Staging Surveys - Nanvak Bay

A detailed inventory plan needs to be developed for the Nanvak Bay migration observations. Outlining a systematic survey for the bay would improve results and give seasonal employees more direction for data collection. Weather permitting, watches should be conducted for a minimum of two hours each day from the dune observation tower. In 1991, watches will be conducted in the upper bay, lower bay and uplands. This action should help in establishing use patterns between the three areas and will allow more efficient scheduling of watch times in the future.

The upper bay will be surveyed at least once every three days (weather permitting). With the distance involved and the usually harsh weather, an additional tower or blind should be constructed near the north end of the bay.

During fall migration, the majority of emperors and Canada geese are seen in the uplands feeding on berries and sedges. If

personnel are available, transects should be set up and walked to determine the number of birds and areas of use in the uplands. Doing this in conjunction with the bay watches could require an additional person.

Spring staging observations should begin the last week in April and continue until June 1. Past data show the largest concentrations of birds moving through Nanvak Bay in early May. Fall migration appears to span a wider timeframe. Therefore, watches should be conducted from early August until late September.

Waterfowl Production Surveys

A better representation of species could be obtained by conducting two surveys approximately a week to ten days apart. The first survey would cover dabbler broods while the second survey would cover diver and sea duck broods.

Waterfowl production surveys should be continued as mandated by the Region. The results of the 1990 survey show the Bristol Bay Stratum is the third largest and the second highest production area in the state. Based on these findings, additional sample units should be selected in the Bristol Bay area.

Conducting the survey by helicopter seems to be quite efficient. It would be recommended to continue this practice for surveys in the future. The cost of availability and flight time for the helicopter would be comparable to the cost involved in stationing two individuals in the field and providing the logistical support to move them from plot to plot for three months. Also, use of the helicopter would alleviate the bias involved in selecting units on the basis of accessibility.

Production along river corridors may be significant and is not represented by the state-wide survey. The riverine habitat on Togiak Refuge has yet to be surveyed for waterfowl production. It is recommended that at least one river survey be cnducted to determine the need or feasibility of continuing the practice. This survey should be given a higher station priority than resurveying previously established plots. Survey of the riverine habitat would complete initial coverage of potential production habitat types on the refuge.

Radio Telemetry

Radio telemetery work should be continued in support of ongoing research determining migration corridors. It is strongly recommended that the antenna ranges be tested more thoroughly. For example, take a transmitter out in the kayak or boat to determine if there are areas of the bay in which the signal cannot be

received. The tests conducted in 1990 consisted of setting the transmitter in a place where it would not be washed away by the tide. Since it was placed high above the waterline, the signal was line of sight with the antenna.

Continuation of the telemetry support is one of the most important aspects of the banding program. This effort should be continued and possibly expanded in 1991.

The major emphasis on the "Bristol Bay White-fronts" at present is to locate their nesting grounds. Telemetry flights should begin early in the spring (mid-April) and include interior flights as well as coastal flights. Surveys should be coordinated with Alaska Peninsula Refuge and Yukon Delta Refuge. It is also important to begin flying telemetry surveys a week to ten days following the banding effort to determine mortality and movement of newly collared geese.

White-fronted Goose Banding

The banding program appears to work well for the refuge. During the 1990 drive, most of the birds had moved off of the molt lake when the trap was set the day before the drive. It was recommended that on future drives the trap be constructed on the day of the drive.

No Canada geese were banded during 1990. The program was reassessed and the general consensus was that the data were not needed for Canada geese. The recommendation is to discontinue banding Canada geese, except on an incidental trap basis, until a need is outlined for the data.

ACKNOWLEDGMENTS

Many people were involved in the collection of waterfowl data in 1990. For the Nanvak Bay migration observations, big thanks go to Lauri Jemison, biological technician, marine mammals and Lisa Haggblom, biological technician, seabirds for conducting tower counts and monitoring telemetry equipment in their "spare time." Volunteers John Klicka, Kevin Winker and Jeff Jemison also added to the observation data during hikes and boat trips to the upper end of the bay.

The waterfowl production surveys were conducted completely by Donna Dewhurst, Wildlife Biologist from Becharof Refuge and Tom Ratledge, Pilot for Yukon Helicopters.

The goose banding program involved many individuals: Randy Arment, ARM/Pilot Becharof Refuge; Larry VanDaele, Area Biologist ADF&G; Mary Farmer, volunteer; and Togiak staff: John Bolling, Biological Technician; Mike Hinkes, Wildlife Biologist/Pilot; Aaron Archibique, ARM; and Diane Campbell, Biological Technician Wildlife. Much appreciation goes to Dennis Orthmeyer, Biologist with NPWRC in Dixon California. For the second year running, Dennis traveled to Togiak Refuge to assist in the drive and deploy radios and yellow neck collars on the white-fronts. Also, the assistance of the Becharof staff and the use of their aircraft were important to the success of the project. The cooperation between agencies was outstanding.

Support was given to the telemetry work by AFWRC-A by up-dating frequency lists as birds moved through the area and by loaning us two Yaggi antennas with 20 'poles for use at Nanvak Bay. Also, Sue Hills, Biologist Trainee with AFRWRC-F assisted by monitoring for radio frequencies while flying coastal surveys for marine mammals.

Finally, appreciation goes to Mike Hinkes, Wildlife Biologist/Pilot for Togiak Refuge for his continued support and confidence.

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PERSONAL COMMUNICATIONS

Dennis Orthmeyer, Biologist, NPWRC, 6924 Tremont Rd, Dixon California, 95620.

Table 1. Estimates of arctic geese during 1990 spring and fall aerial surveys on Togiak National Wildlife Refuge, Southwest Alaska.

SPRING

DATE	AREA SURVEYED	BRANT	EMPEROR	CANADA	WHITE-FRONT
4/19/90	Nushagak Pen.	-0-	-0-	3	-0-
	Cape Peirce	-0-	-0-	-0-	2
	Osviak Slough	-0-	-0-	-0-	-0-
	TOTALS	**0**	**0**	**3**	**2**
4/23/90	Nushagak Pen.	-0-	-0-	235	-0-
5/4/90	Nanvak Bay	20-25,000	1-1,200	-0-	-0-
	Chagvan Bay	30-40,000	250	-0-	-0-
	To Carter Spit	1,200	35	35	-0-
	TOTALS	**51-66,200**	**1-1,535**	**35**	**0**
5/9/90	Nanvak Bay	30-35,000	20	-0-	-0-
	Chagvan Bay	30-35,000	35	-0-	-0-
	TOTALS	**60-70,000**	**55**	**0**	**0**

FALL

DATE	AREA SURVEYED	BRANT	EMPEROR	CANADA	WHITE-FRONT
8/30/90	Osviak Slough	-0-	25	10	-0-
	Nanvak Bay	11,975	-0-	140	-0-
	Chagvan Bay	1,185	52	125	-0-
	TOTALS	**13,160**	**77**	**275**	**0**
9/4/90	Aborted due to high winds				
9/10/90	Nanvak Bay	1,100	2	800	-0-
	Chagvan Bay	1,650	120	310	-0-
	to Jacksmith	200	187	518	-0-
	TOTALS	**2,950**	**309**	**1,628**	**0**
9/21/90	Aborted due to high winds				
10/16/90	Togiak Bay-				
	Cape Peirce	-0-	-0-	-0-	-0-
	Nanvak Bay	-0-	2	300	-0-
	Chagvan Bay	-0-	-0-	187	-0-
	TOTALS	**0**	**2**	**487**	**0**

Table 2. Number and size of broods observed in Bristol Bay Stratum during 1990 Waterfowl Production Survey.

Northern Bristol Bay

SPECIES	NUMBER OF BROODS	* NUMBER OF DUCKLINGS	AVERAGE BROOD SIZE
Green-winged teal	26	142.95	5.72
Mallard	8	42.46	5.31
Northern Pintail	7	26.0	3.71
Greater Scaup	4	21.7	5.43
Common Goldeneye	1	1	1.0
TOTALS	46	234.11	

Southern Bristol Bay

SPECIES	NUMBER OF BROODS	* NUMBER OF DUCKLINGS	AVERAGE BROOD SIZE
Green-winged Teal	4	23.7	5.93
Mallard	9	41.86	4.65
Northern Pintail	6	29.69	4.95
Greater Scaup	6	36.0	6.0
Black Scoter	5	25.0	5.0
American Wigeon	2	13.0	6.5
Oldsquaw	1	6.0	6.0
TOTALS	33	175.25	

Entire Bristol Bay Stratum

SPECIES	NUMBER OF BROODS	* NUMBER OF DUCKLINGS	AVERAGE BROOD SIZE
Green-winged Teal	30	166.65	5.76
Mallard	17	84.32	4.96
Northern Pintail	13	55.69	4.28
Greater Scaup	10	57.7	5.8
Black Scoter	5	25.0	5.0
American Wigeon	2	13.0	6.5
Common Goldeneye	1	1.0	1.0
Oldsquaw	1	6.0	6.0
TOTALS	79	409.36	

* Average brood sizes (obtained using Lotus program developed by Migratory Bird Management) were used for partial broods observed.

Table 3. Ages of broods observed in the Bristol Bay Stratum during the 1990 Waterfowl Production Survey. Surveys for Northern Bristol Bay were conducted from July 14-17. Surveys for Southern Bristol Bay were conducted between July 15-24.

SPECIES	Northern Bristol Bay			Southern Bristol Bay			Bristol Bay Stratum		
	I	II	III	I	II	III	I	II	III
Green-winged Teal	10	13	3	0	4	0	10	17	3
Mallard	2	4	2	2	2	5	4	6	7
Northern Pintail	1	3	3	0	3	3	1	6	6
American Wigeon	0	0	0	1	1	0	1	1	0
Common Goldeneye	1	0	0	0	0	0	1	0	0
Scaup sp.	3	1	0	6	0	0	9	1	0
Black Scoter	0	0	0	5	0	0	5	0	0
Oldsquaw	0	0	0	1	0	0	1	0	0
TOTALS	17	21	8	15	10	8	32	31	16

Figure 1: Location of Togiak National Wildlife Refuge, Southwest Alaska

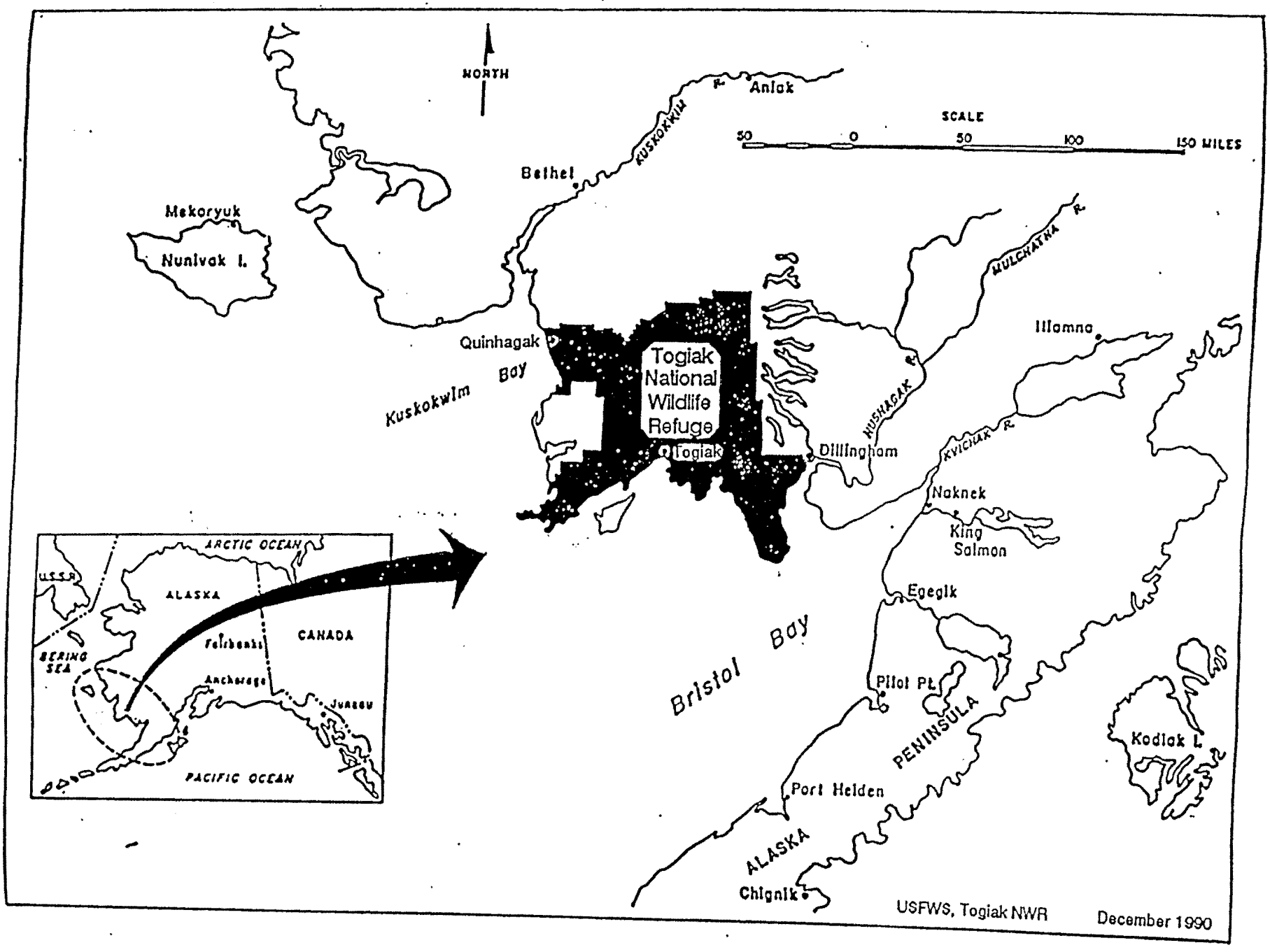


Figure 2: Waterfowl staging areas and aerial survey route, Togiak National Wildlife Refuge, Southwest Alaska

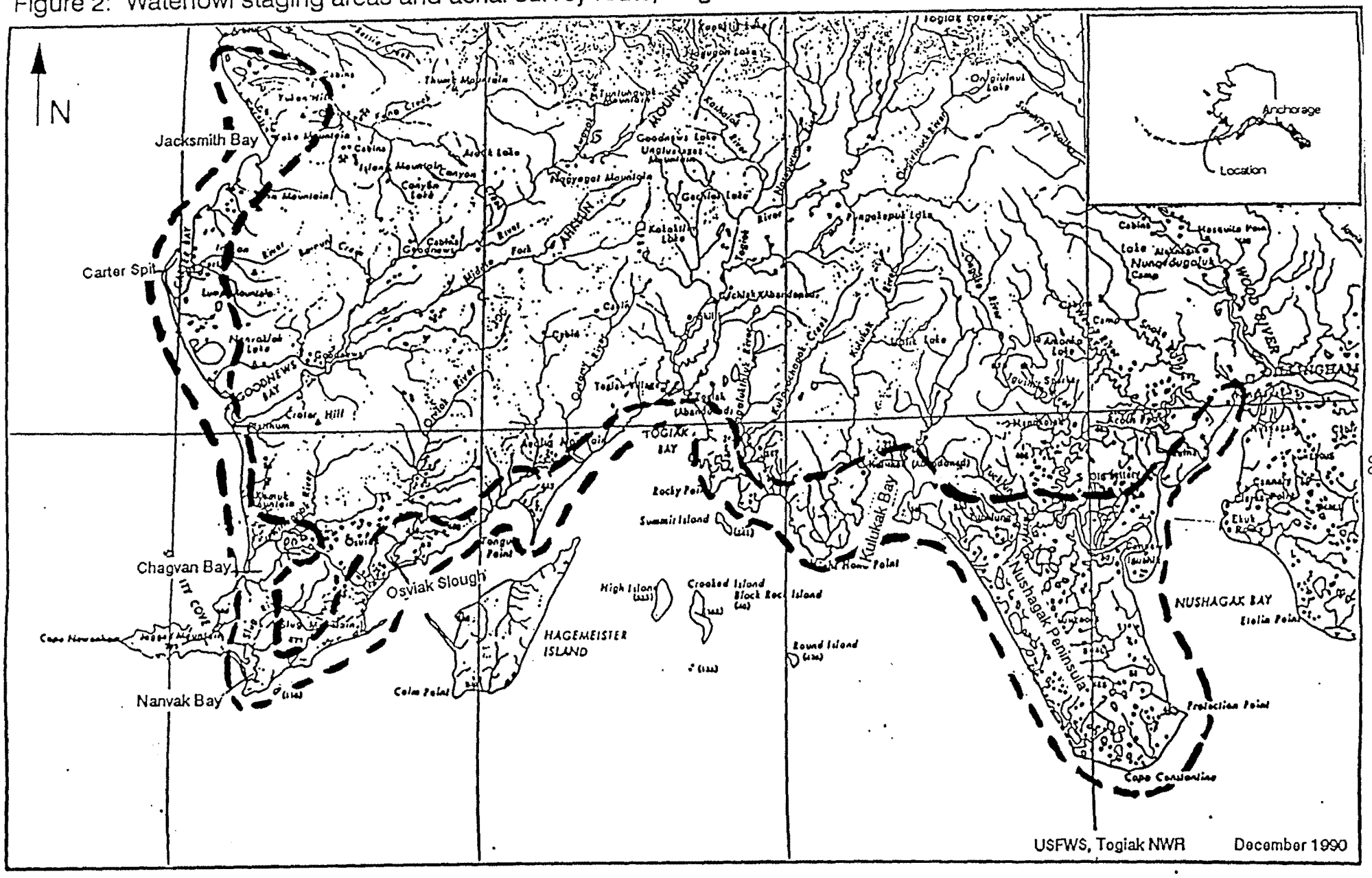


Figure 3: Spring and Fall Waterfowl Staging Activity at Nanvak Bay, Togiak National Wildlife Refuge, Southwest Alaska.

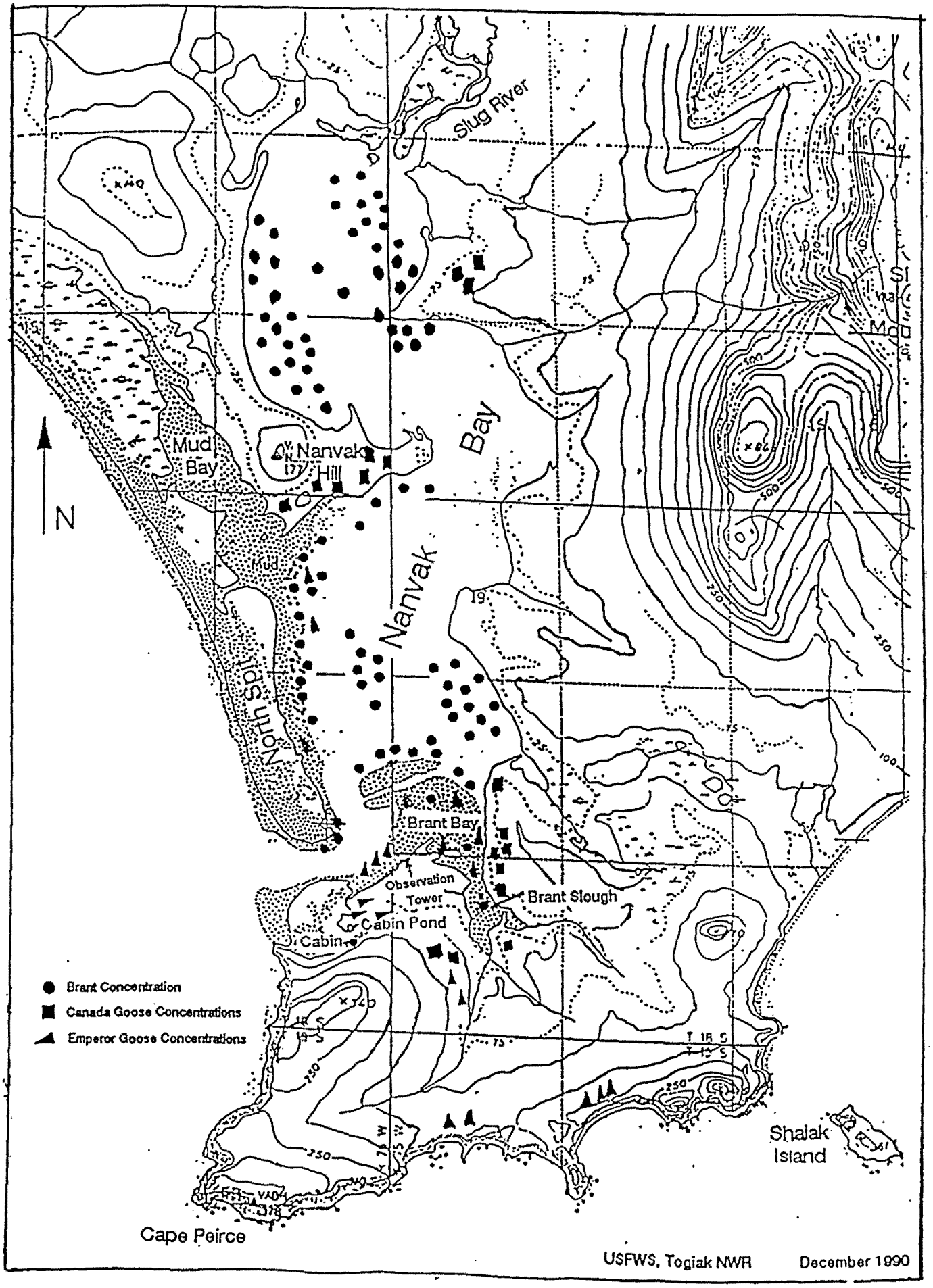
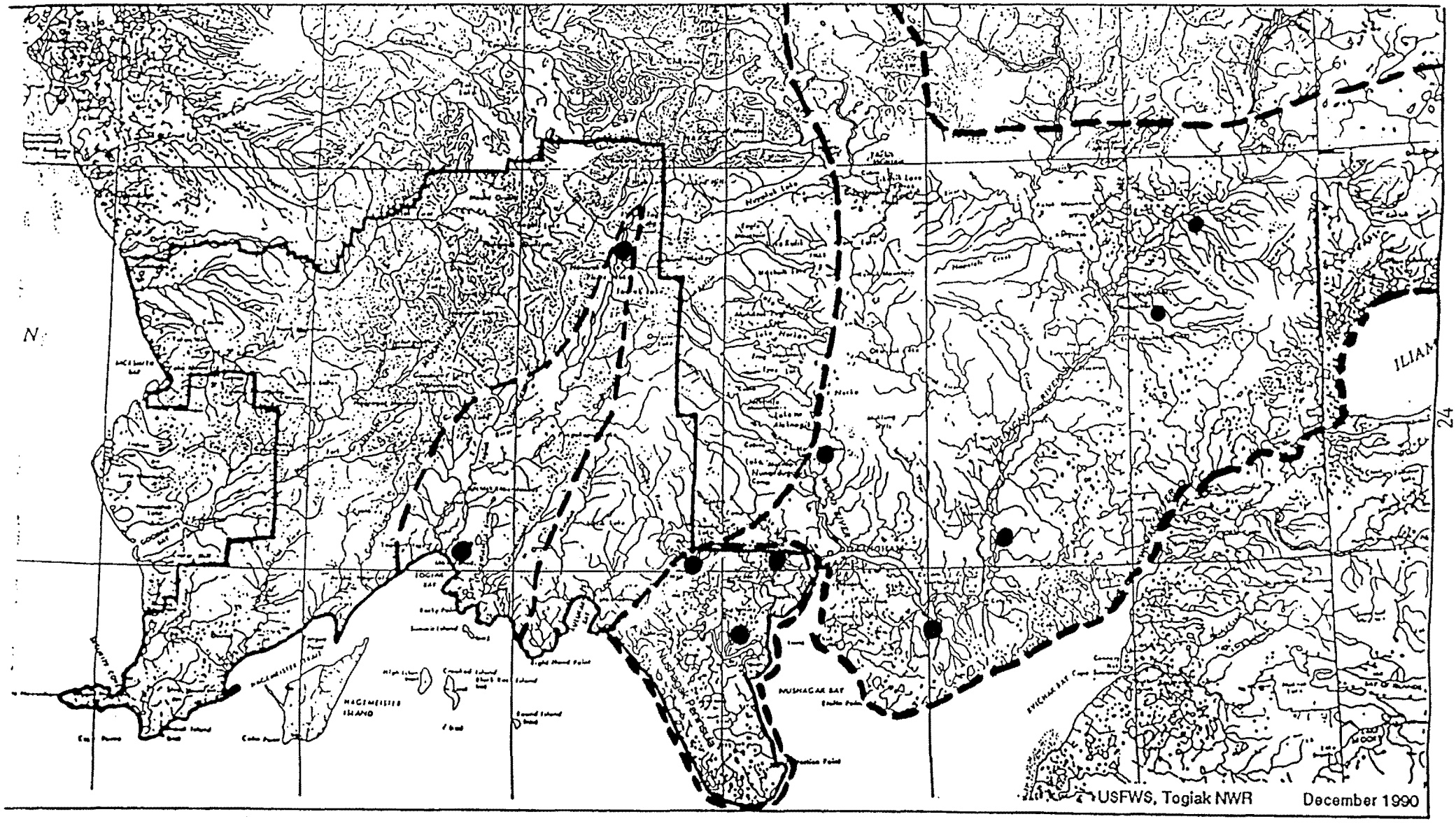
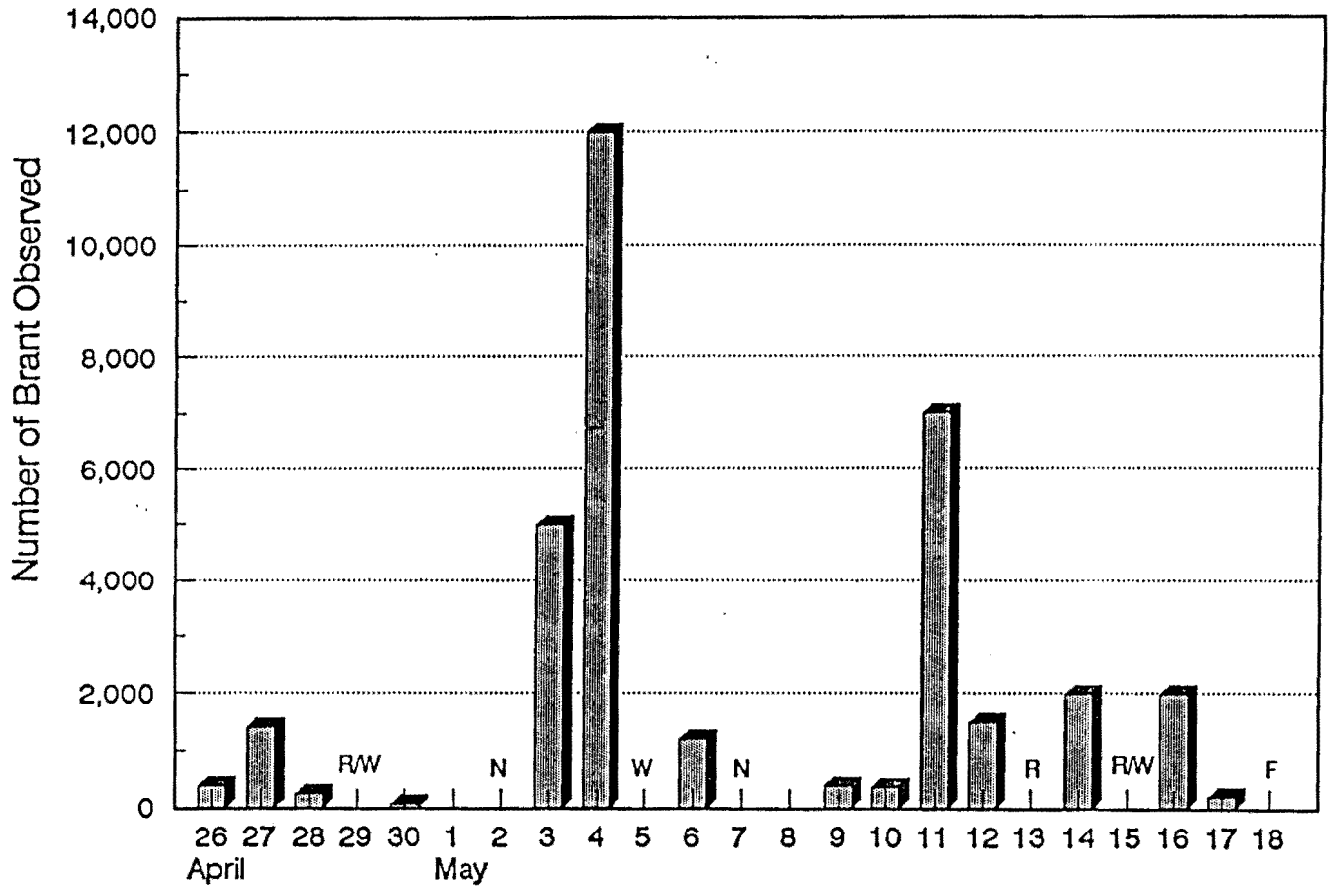


Figure 4: Waterfowl production core areas and cluster locations. Togiak National Wildlife Refuge, Southwest Alaska.



Refuge Boundary — Core Area Boundary — Sample Units

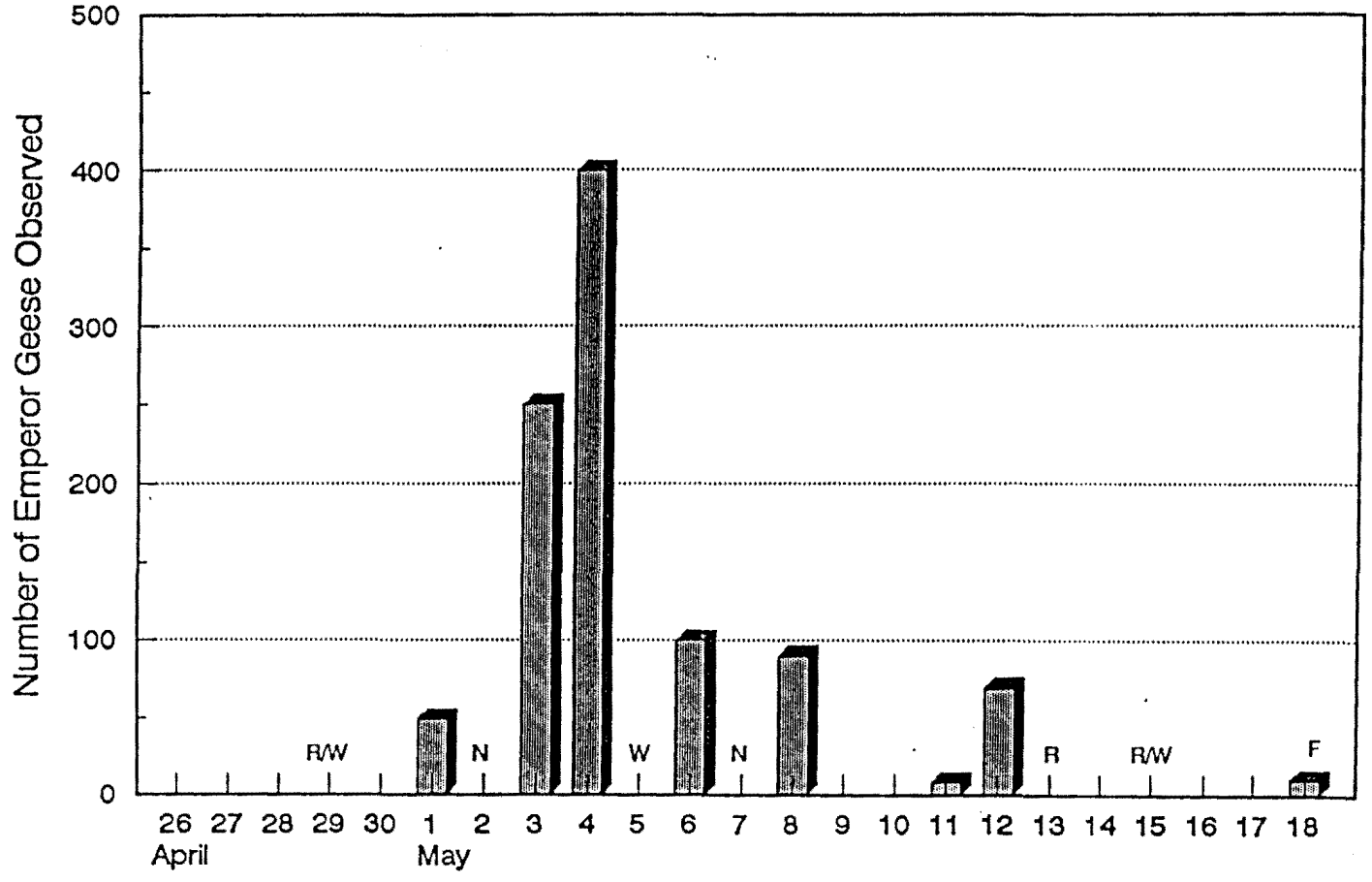
Figure 5. Observations of Pacific Brant during spring migration/staging at Nanvak Bay, Southwest Alaska, April-May 1990.



Observations were attempted daily. If no code is present no birds were observed.

W= High Winds N= No Watch Attempted F= Fog R= Heavy Rain

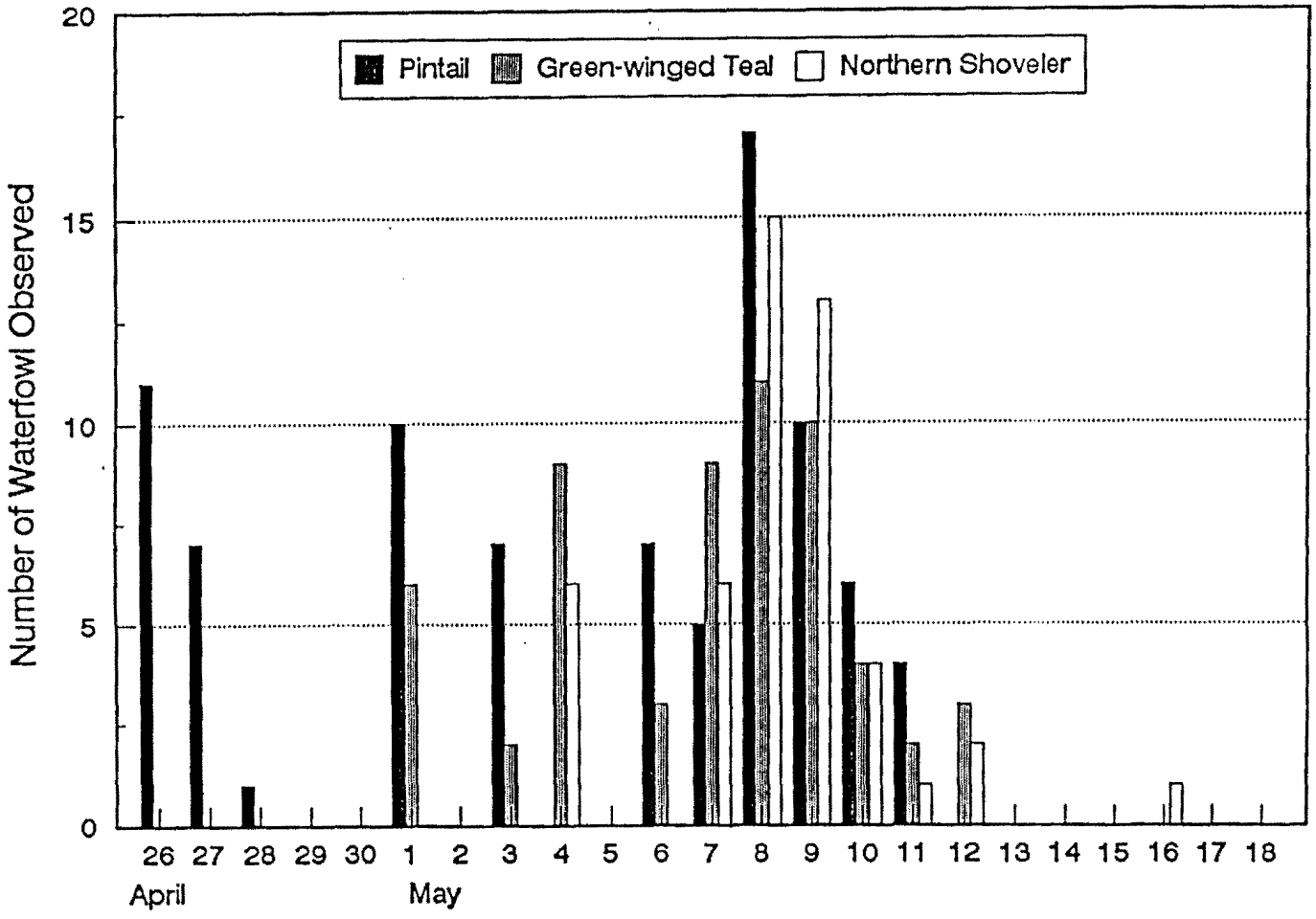
Figure 6. Observations of Emperor Geese during spring migration/staging at Nanvak Bay, Southwest Alaska, April-May 1990.



Observations were attempted daily. If no codes are present, no birds were observed

W= High Winds; N= No Watch Attempted; F= Fog; R= Heavy Rain

Figure 7. Observations of Northern Pintail, Northern Shoveler and Green-winged Teal during spring migration/staging at Nanvak Bay, Southwest Alaska, April-May, 1990.



Species were observed in the slough area near the cabin.

Figure 8. Observations of Pacific Brant during fall migration/staging at Nanvak Bay, Southwest Alaska, 1987-1990.

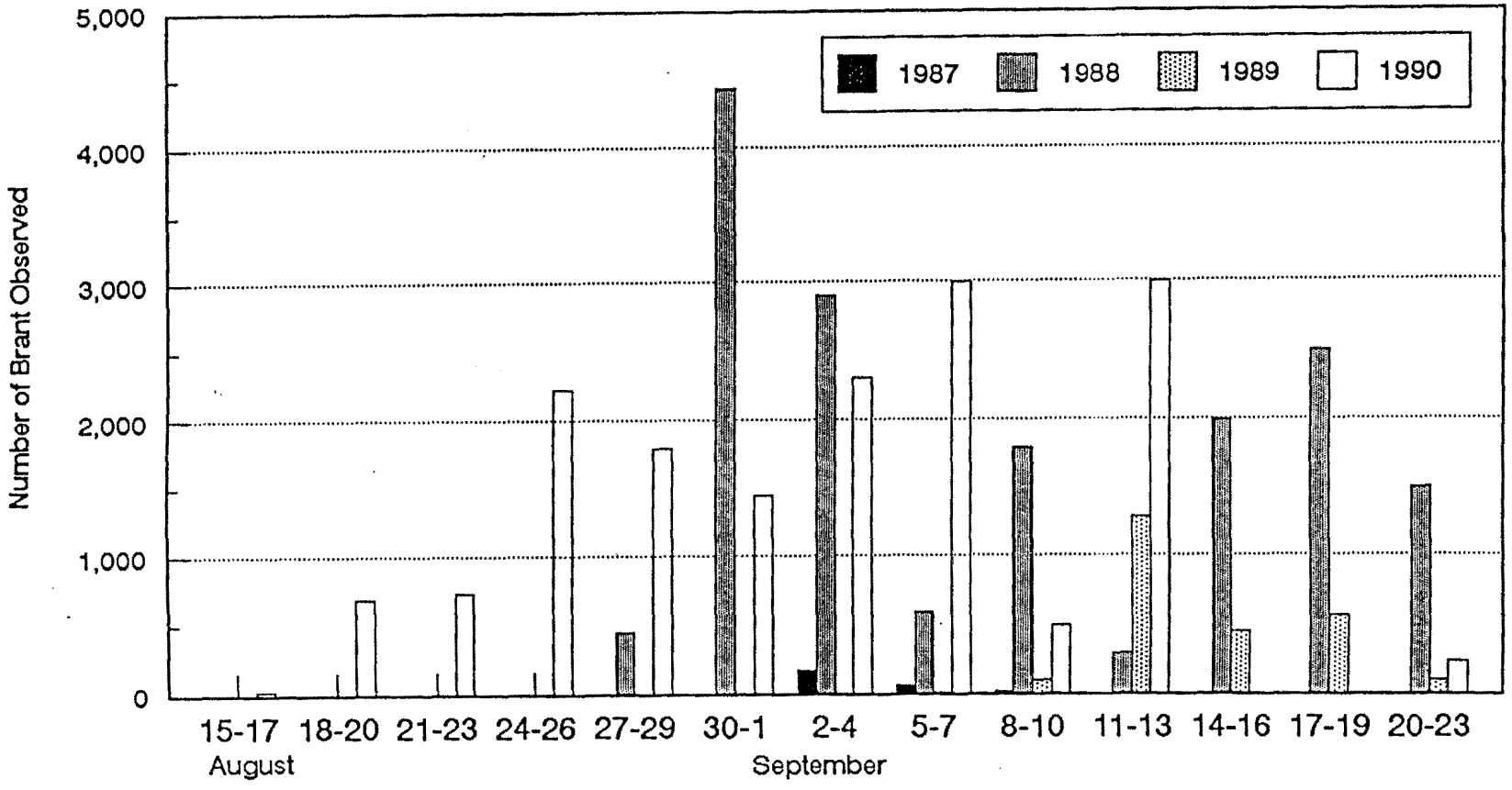


Figure 9. Observations of Emperor Geese during fall migration/staging at Nanvak Bay, Southwest Alaska, 1987-1990.

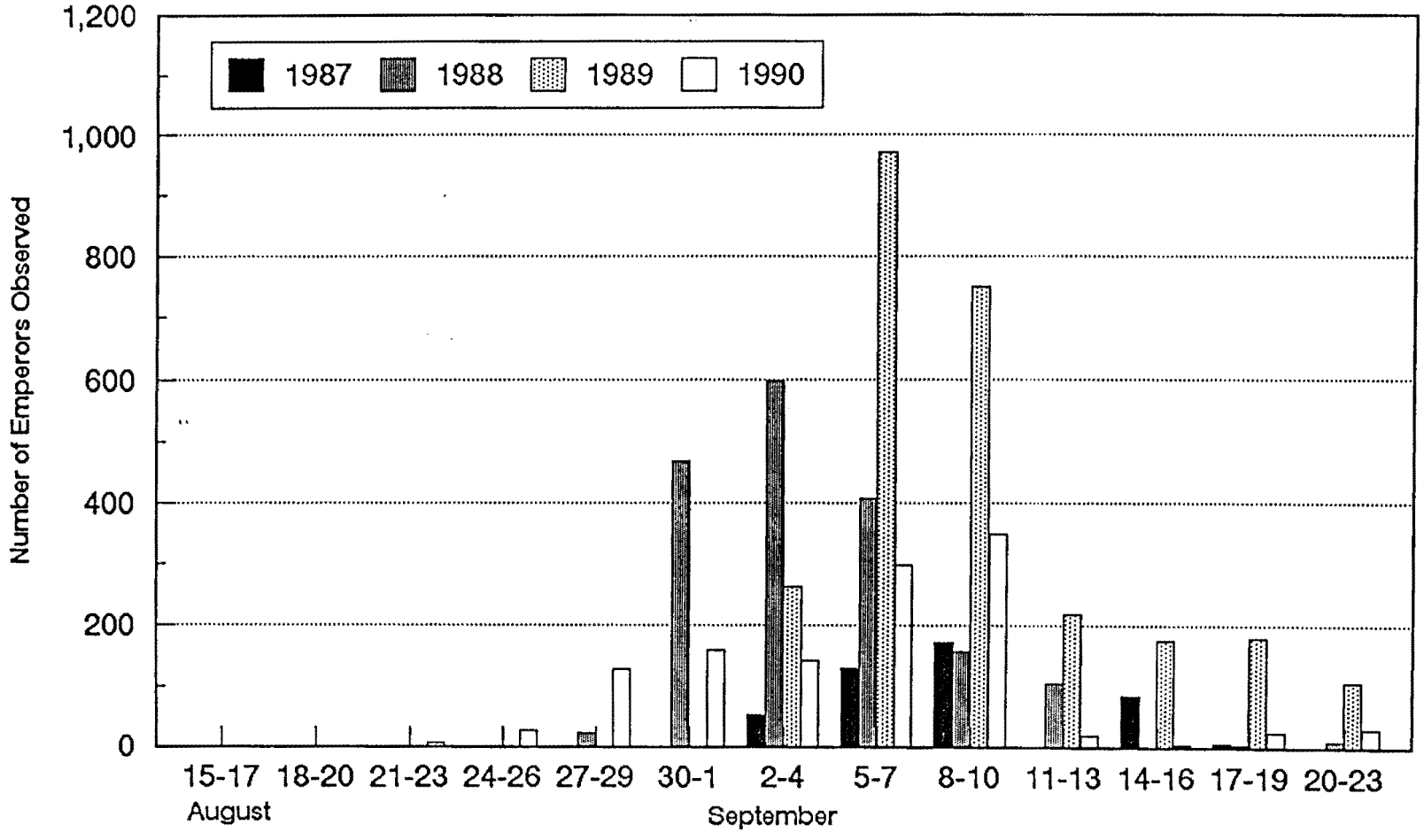
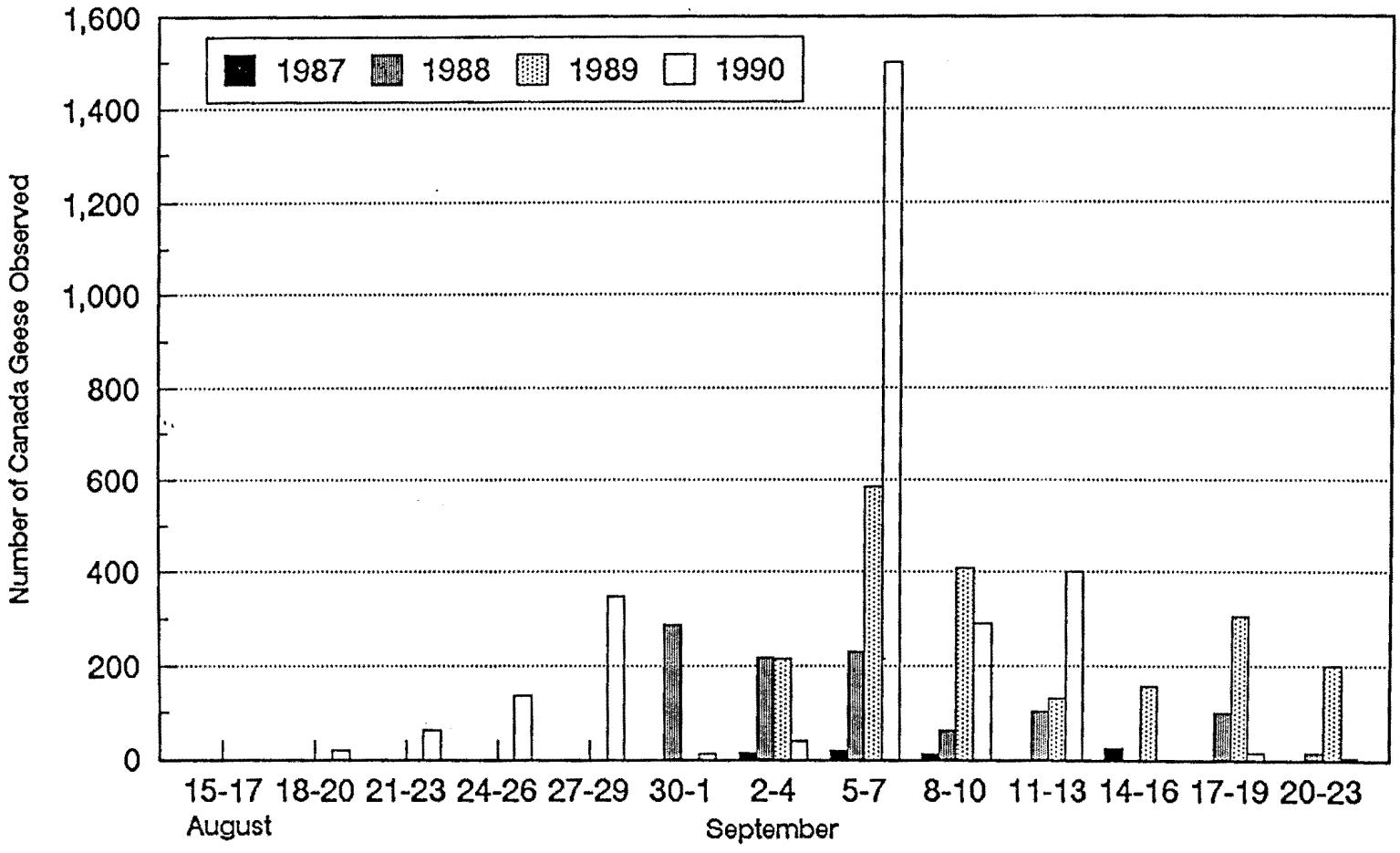


Figure 10. Observations of Canada Geese during fall migration/staging at Nanvak Bay, Southwest Alaska, 1987-1990.



Appendix A: Radio frequencies monitored during the 1990 spring and fall migration at Nanvak Bay, Togiak National Wildlife Refuge, Southwest Alaska.

SPRING				FALL			
BRANT	*GWFG	**EMGO	CURLEWS	BRANT	*GWFG	*GWFG	**EMGO
164.010	166.055	167.500	167.032	164.014	166.001	166.143	167.661
164.027	166.076	167.518	167.060	164.070	166.010	166.171	167.757
164.047	166.115	167.500	167.112	164.105	166.030	166.220	167.999
164.057	166.125	167.518	167.180	164.161	166.047	166.348	
164.064	166.142	167.545	167.287	164.175	166.065	166.365	
164.077	166.170	167.561	167.295	164.612	166.096	166.385	
164.086	166.190	167.573	167.359	164.633	166.105	166.447	
164.100	166.274	167.583	167.544	164.654	166.133	166.508	
164.166	166.462	167.591		164.739	166.206	166.720	
164.186	166.520	167.598		164.765	166.266	166.840	
164.200	166.530	167.603		164.123	166.281	166.909	
164.210	166.540	167.613		164.141	166.306	167.130	
164.238	166.549	167.624		164.153	166.314	167.172	
164.254	166.598	167.633		164.233	166.322	167.419	
164.282	166.620	167.643		164.265	166.339	167.485	
164.296	166.632	167.662		164.305	166.375	167.555	
164.303	166.680	167.682		164.314	166.404	167.590	
164.313	166.700	167.696		164.342	166.430	167.716	
164.338	166.708	167.701		164.359	166.454	167.785	
164.349	166.732	167.722		164.371	166.471	167.803	
164.364	166.740	167.735		164.183	166.490	167.859	
164.375	166.770	167.772		164.027	166.514	167.905	
164.398	166.790	167.797		164.332	166.580	167.915	
164.406	166.798	167.809		164.388	166.595	167.974	
164.415	166.832	167.817		164.412	166.626		
164.429	166.849	167.833		164.022	166.641		
164.443	166.890	167.844		164.029	166.649		
164.451	166.918	167.951		164.043	166.772		
164.483	166.930	167.967		164.051	167.005		
164.572	166.940	167.972		164.082	167.012		
164.634	166.950	167.990		164.059	167.027		
164.644	166.968	167.993		164.399	167.057		
164.704	166.980	167.997		164.420	167.097		
164.720	166.990	167.998		164.429	167.177		
164.802	166.997			164.443	167.213		
164.872	167.019			164.462	167.221		
164.886	167.048			164.468	167.310		
164.890	167.088			164.480	167.369		
164.899	167.107			164.499	167.445		
164.917	167.228			164.507	167.525		
164.942					167.538		
164.955					167.743		
164.961					167.867		
					167.925		
					167.955		

* GWFG = greater white-fronted goose
** EMGO = emperor goose

Appendix B:

ALASKA WATERFOWL PRODUCTION SURVEY FORM

Production Area _____ **Observers** _____

Stratum (A, B or C) _____ _____

Plot Number _____ _____

Date MM/DD/YY	HOUR	WIND SP	WATER HT	METHOD	WATER BODY NO	SPECIES	ADULTS	TYPE	YOUNG	CLASS	SUB CLASS	SITING	NUMBER	COMMENTS

Appendix C: Measurements obtained from white-fronted geese captured and collared in 1990 on Nushagak Peninsula, Togiak National Wildlife Refuge, Southwest Alaska

Prefix	Band #	Age	Sex	Bill Height	Bill Width	Culmen	Head Length	Total Tarsus	Diagonal Tarsus	Weight	Frequency	Collar #
887	34501	ASY	F	24.7	24.1	52.8	105.4	82.1	70.9	2312	167.867	3N
887	34502	ASY	F	23.9	22.5	49.2	105.4	86.8	74.3	2200	166.626	BO
887	34503	ASY	F	22.7	21.5	46.5	103.2	79.8	69.1		167.221	7N
887	34504	ASY	F	23.9	24.0	50.4	105.7	82.9	70.8	2267	167.538	6N
887	34505	ASY	F	25.1	24.5	47.6	103.9	86.3	75.8	2275	167.272	1Z
887	34506	AHY	M	27.0	23.2	56.1	108.9	86.2	72.8	2400	167.057	WZ
887	34507	ASY	F	23.8	22.3	48.7	104.5	83.8	75.3	2450	166.490	1B
887	34508	ASY	M	27.4	25.3	50.3	109.0	88.5	76.8	2750		6Z2
887	34509	ASY	M	23.3	22.7	51.1	103.6	82.2	73.4	2450		
887	34510	ASY	F	24.5	23.6	50.4	106.8	78.6	70.1	2225	166.454	7W
887	34511	ASY	F	25.9	23.6	48.8	103.4	88.4	78.9	2400	166.514	BN
887	34512	ASY	F	24.1	24.2	47.1	100.3	79.1	69.4	2350	167.012	2W
887	34513	ASY	M	27.2	24.2	50.9	108.7	91.2	80.1	2600		0Z0
887	34514	ASY	F	24.2	25.1	52.0	106.0	77.9	75.4	2450	166.649	WB
887	34515	ASY	M	24.4	23.5	54.0	108.2	88.8	77.6	2425		0Z1
887	34516	ASY	M	25.1	25.1	53.5	108.4	75.9	73.6	2350		0Z2
887	34517	ASY	F	25.4	23.3	56.5	108.7	81.9	74.1	2212	166.580	W2
887	34518	ASY	M	24.8	23.7	53.6	109.0	90.1	79.9	2450		6Z1
887	34519	ASY	F	23.8	23.9	47.3	103.4	81.7	70.7	2250	166.001	ZG
887	34520	ASY	F	23.0	23.1	47.1	100.1	82.7	71.4	2212	166.595	5Z
887	34521	ASY	F	25.7	24.6	54.7	107.9	86.8	73.4	2375	167.097	B8
887	34522	ASY	F	23.7	24.3	48.1	104.3	86.5	76.1	2325	166.010	OB
887	34523	ASY	M	25.5	23.5	57.0	112.1	86.9	78.1	2687	166.314	NH
887	34524	ASY	F	25.2	22.1	50.4	102.1	84.4	72.4	2050	166.105	NZ
887	34525	ASY	F	24.8	24.3	50.4	103.8	87.5	73.9	2400	166.065	1W
887	34526	ASY	F	25.7	23.5	48.4	99.4	82.5	73.0	2212	166.404	6G
887	34527	ASY	M	26.1	24.7	49.9	106.8	89.2	76.7	2800		0Z3
887	34528	ASY	F	22.4	22.2	47.8	101.6	81.6	69.2	2300	166.030	6Z
887	34529	ASY	F	24.0	23.2	26.0	99.0	82.7	69.1	2087	166.375	2N
887	34530	ASY	F	23.6	22.9	48.1	101.4	89.1	77.1	2150	167.027	GH
887	34531	ASY	F	25.4	24.3	46.2	100.7	82.7	71.3	2400	166.306	8N
887	34532	ASY	F	21.8	24.7	50.0	101.5	86.8	71.7	2300	166.772	BZ
887	34533	ASY	M									0Z4
887	34534	ASY	M	23.8	29.9	49.5	99.5	81.4	69.4	1987		0Z5
887	34535	ASY	M	23.3	23.9	55.4	113.8	88.2	76.3	2775		0Z6
887	34536	ASY	F	24.9	23.9	50.4	104.8	86.4	73.5	2250	166.281	6W
887	34537	ASY	F	22.4	22.1	47.1	105.2	83.8	70.1	2100	166.266	B5
887	34538	ASY	F	23.4	24.1	50.4	100.9	86.0	74.5	1900	166.765	6B
887	34539	ASY	M	27.1	26.2	59.2	114.5	98.1	82.6	2812		0Z7
887	34540	ASY	M	24.7	26.9	51.1	108.8	85.4	71.6	2325		0Z8
887	34541	ASY	F	23.1	20.4	49.1	101.3	84.1	71.5	2300	166.887	2Z
887	34542	ASY	F	23.8	23.9	52.4	104.1	87.5	73.7	2700	166.206	WO
887	34543	ASY	F	23.8	23.7	26.5	98.0	81.4	68.2	2225	166.133	OG

Appendix C. Continued

Prefix	Band #	Age	Sex	Bill Height	Bill Width	Culmen	Head Length	Total Tarsus	Diagonal Tarsus	Weight	Frequency	Collar #
887	34544	ASY	F	21.8	22.3	48.9	102.6	86.1	74.1	2375	167.525	GW
887	34545	ASY	M	24.6	23.7	52.4	108.9	90.3	76.5	2550		1Z0
887	34546	ASY	F	22.6	23.8	47.9	102.9	80.1	69.0	2287	167.955	W8
887	34547	ASY	F	25.2	24.1	52.0	103.1	83.7	71.8	2250	167.310	OW
887	34548	ASY	F	22.5	24.7	51.2	104.2	84.3	71.0	2365	166.047	BG
887	34549	ASY	F	25.1	23.5	51.1	104.4	82.3	72.6	2300	167.005	2G
887	34550	ASY	F	23.4	23.4	51.7	107.0	81.9	72.2	2300	166.322	B9
887	34551	ASY	F	22.1	24.6	43.6	97.5	82.5	73.0	1900	167.925	WH
887	34552	ASY	M	24.7	24.6	51.5	108.3	90.3	78.9	2625		1Z1
887	34553	ASY	M	26.4	25.0	55.5	108.1	87.3	76.2	2362		1Z2
887	34554	ASY	F	23.9	22.6	49.8	104.8	80.7	70.2	2087	167.369	9G
887	34555	ASY	M	24.8	25.1	55.1	114.7	90.4	78.3	2800		1Z3
887	34556	ASY	F	22.9	23.3	47.0	101.0	82.2	72.0	2150	167.445	W3
887	34557	ASY	M	25.1	27.7	52.0	107.8	90.7	76.3	2612	167.743	3B
887	34558	ASY	F	25.7	24.0	52.1	108.4	85.6	74.6	2367	167.177	8B
887	34559	ASY	F	27.1	23.7	48.8	106.9	88.9	75.3	2500	167.213	GZ
887	34560	ASY	M	22.4	22.0	47.4	106.0	86.3	73.0	2200		1Z4
887	34561	ASY	F	24.2	23.2	49.9	103.7	82.4	73.5	2200	167.245	7B
887	34562	ASY	F	22.6	23.2	44.4	100.4	82.7	72.7	2125	166.096	7G
887	34563	ASY	F	25.2	24.9	50.3	102.9	85.6	71.9	2300	167.765	3W
887	34564	ASY	M									1Z5
887	34565	ASY	M	26.4	24.7	54.0	107.7	91.1	78.4	2750		1Z6
887	34566	ASY	F	23.9	22.7	48.3	99.4	92.7	79.2	2250	166.339	9Z
887	34567	ASY	M	25.1	23.9	52.7	112.3	88.2	74.5	2525		1Z7
887	34568	ASY	M									1Z8
887	34569	ASY	F									1Z9
887	34570	ASY	M	24.5	23.3	50.5	104.9	85.9	75.6	2475		2Z0
887	34571	ASY	M									2Z1
887	34572	ASY	F									2Z2
887	34573	ASY	F									2Z3
887	34574	ASY	F									2Z4
887	34575	ASY	M	24.6	23.2	53.5	108.7	93.3	79.7	2475		2Z5
887	34576	ASY	F									2Z6
887	34577	ASY	F									2Z7
887	34578	ASY	M	24.3	24.9	52.8	110.4	86.9	76.3	2350		2Z8
887	34579	ASY	F									2Z9
887	34580	ASY	M	24.1	23.7	54.7	111.2	83.1	75.1	2425		3Z0
887	34581	ASY	M	25.0	25.3	51.0	103.4	87.2	75.6	2587		3Z1
887	34582	ASY	M									3Z3
887	34583	ASY	M	26.5	24.1	50.6	114.3	85.9	77.2	2200		3Z4
887	34584	ASY	F									3Z5
887	34585	ASY	M	27.8	24.9	55.9	113.6	91.0	78.0	2700		3Z6
887	34586	ASY	M	25.9	24.1	52.5	106.0	90.1	77.0	2412		3Z7
887	34587	ASY	F									3Z8
887	34588	ASY	F									3Z9
887	34589	ASY	M	25.4	25.1	54.7	113.4	91.3	78.7	2900		4Z0

Appendix C. Continued

Prefix	Band #	Age	Sex	Bill Height	Bill Width	Culmen	Head Length	Total Tarsus	Diagonal Tarsus	Weight	Frequency	Collar #
887	34590	ASY	F									4Z1
887	34591	ASY	M	26.4	24.9	54.6	110.9	94.2	82.4	2725		4Z2
887	34592	ASY	M	24.2	24.9	51.1	106.4	94.1	78.2	2462		4Z3
887	34593	ASY	F	24.3	23.1	48.0	103.0	89.1	77.2	2387	166.430	4N
887	34594	ASY	M	27.6	26.2	54.6	106.9	86.1	77.2	2650		4Z4
887	34595	ASY	M	24.3	24.1	51.2	107.5	85.5	75.0	2625		4Z5
887	34596	ASY	F									4Z6
887	34597	ASY	F									4Z7
887	34598	ASY	F									4Z8
887	34599	ASY	M	26.5	24.2	56.8	113.3	89.0	79.2	2700		4Z9
5037	4801	ASY	M	23.7	23.6	53.4	109.0	84.0	75.9	2100		5Z0
5037	4802	ASY	M	25.4	24.0	51.8	104.0	87.1	73.9	2387		5Z1
5037	4803	ASY	M	24.1	23.5	54.1	112.3	92.5	80.7	2450		5Z2
5037	4804	ASY	M	26.2	25.1	54.8	104.8	87.7	76.9	2525		5Z3
5037	4805	ASY	M	24.1	23.2	49.6	103.1	86.0	76.5	2400		5Z4
5037	4806	ASY	M	27.5	26.4	53.2	115.8	91.4	80.7	2800		5Z5
5037	4809	ASY	M	26.5	25.2	53.7	108.3	91.2	80.4			5Z6
5037	4811	ASY	M	24.7	24.6	56.1	114.4	92.8	79.3	2625		5Z7
5037	4812	ASY	M	25.5	25.3	56.7	110.7	94.5	82.7	2525		5Z8
5037	4813	ASY	M	26.1	24.6	54.8	112.0	90.3	80.7	2525		5Z9
5037	4815	ASY	M	24.9	25.2	49.0	115.6	87.8	74.3	2300		6Z0
5037	1764			22.1	24.5	52.1	104.1	83.4	70.2	2250		3Z2
5037	1714			24.9	22.8	49.2	103.4	84.9	74.0	2012		K87
1137	8606		F	23.4	24.8	46.5	112.4	82.8	72.5			W65
1137	9962			25.2	22.4	53.7	102.3	81.7	71.8	2162	166.641	BW
1137	9962			24.1	23.1	50.3	105.2	84.2	73.4	2225	166.471	MZH