

## ABSTRACT

We followed the movements, and documented the distribution of 39 adult greater white-fronted geese radio-marked on the Yukon-Kuskokwim (Y-K) Delta and in the Bristol Bay Lowlands (BBL) of Alaska during July 1988. The BBL population was represented by 15 geese captured near Hook Lagoon on the Alaska Peninsula, and 7 geese marked with radios on the Nushagak Peninsula. Seventeen radios were placed on geese near the Kashunuk and Manokinak Rivers as a sample of geese from the central Y-K Delta population. All geese were captured during wing molt; geese radio-marked on the Y-K Delta were from brood flocks, whereas geese captured in the BBL were thought to be non-breeding birds. Geese from the BBL were significantly larger than geese trapped on the Y-K Delta, with respect to culmen and body weight (males) and tarsus length (females). Radio tracking in Alaska revealed that some white-fronted geese from the Y-K Delta stopped along the Alaska Peninsula on their southward migration. A total of 30 of the 39 radio-marked geese were relocated outside of Alaska, 23 in the Klamath Basin, the most important fall and spring staging area of white-fronted geese in the Pacific Flyway. BBL white-fronted geese arrived in Oregon and California earlier (mean arrival 18 September) than geese marked on the Y-K Delta (mean arrival 12 October). Geese from the BBL departed the Klamath Basin earlier than geese from the Y-K Delta (3 Oct vs. 8 Nov), and were more likely to use the Sacramento-San Joaquin Delta than geese from the Y-K Delta. Two geese marked in the BBL were relocated in the central interior highlands of northern Mexico; one goose was observed in association with 4 white-fronted geese which were neck-collared in the Klamath Basin during September 1981. Our data suggest that white-fronted geese from the BBL are part of a subpopulation which migrates into Oregon and California in early September, many of which continue into Mexico by mid-October. Mortality rates may be significantly different for geese spending part of the winter in Mexico. Additional research will enable us to determine if components of the Pacific Flyway greater white-fronted goose population are subpopulations which require separate management.

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## INTRODUCTION

A drastic decline in populations of the Pacific race of the greater white-fronted goose (Anser albifrons frontalis) in the last 20 years (O'Neill 1979, Timm and Dau 1979, Raveling 1984) has hastened the need for better information on migration patterns and population distribution, and a better understanding of migration patterns. Our present knowledge of distribution and migration is based largely on geese banded in summer on the central Y-K Delta, and during October and November in the Klamath Basin (Lensink 1969, Bellrose 1976, Timm and Dau 1979). Geese breeding elsewhere in western Alaska, or migrating through the Klamath Basin before October are likely to be overlooked.

At least two subspecies of greater white-fronted geese exist in the Pacific Flyway; the Pacific white-fronted goose (A. a. frontalis) and the Tule white-fronted goose (A. a. gambelli). However, evidence suggests that the frontalis segment may be composed of two or more subpopulations. Analysis of band returns indicates a link between breeding area and winter distribution (Lensink 1969, 1986), while results of a distributional study of neck-collared white-fronted geese suggest that a significant proportion of the Pacific Flyway population may migrate through California before mid-October and winter in Mexico (Ely and Raveling

1982). The breeding distribution of these geese is unknown.

Geographic and temporal differences in migration patterns and winter distribution would subject geese to different environmental conditions which could influence both survival and reproductive potential. The recovery of several populations of Canada geese (Branta canadensis subsp.) has been due in part to research which established the existence, distribution, and timing of movements of subpopulations enabling harvest to be regulated as appropriate to each subpopulation (Crissey 1968; Raveling 1969, 1978; Kennedy and Arthur 1974; Woolington et al. 1979).

Here, we report the results of the first field season of a radio-telemetry project designed to determine whether the Pacific Flyway white-fronted goose population is composed of discrete subpopulations. The project is a unique effort to follow individual geese throughout their annual cycle, from Alaska to Mexico. These results are preliminary, based on our first field season of data collection which is still in progress.

#### METHODS AND STUDY AREAS

Flightless geese were caught in Alaska near Hook Lagoon on the Alaska Peninsula (south side of Bristol Bay), on the Nushagak Peninsula (north side of Bristol Bay), and near the Kashunuk and Monokinak Rivers on the central Y-K Delta (Fig. 1). Geese were caught on the Alaska Peninsula by running

down individual molting geese with the assistance of a helicopter. Geese on the Nushagak Peninsula and on the Y-K Delta were captured by herding molting geese into a drive trap with a fixed wing aircraft. Geese were aged, sexed, weighed, measured, and fitted with 50 g radio transmitters using a backpack configuration. Geese also were marked with yellow plastic neck collars and metal USFWS leg bands.

Radio-marked geese were monitored from fixed-wing aircraft near banding sites in Alaska during July, August, and September, along the coast of Oregon and Washington from September to December, in the Klamath Basin on the California-Oregon border and the Central Valley of California from September through April, and along the coast of Mexico in January. Ground surveys were conducted in most areas south of Alaska, including the central interior highlands of northern Mexico during January and February. Marked geese were also located by observers reading neck collar codes in the Klamath Basin and in the Central Valley of California.

## RESULTS

### Capture and Banding

Geese were captured at 3 sites in western Alaska, representing some of the most important breeding areas in western Alaska (Table 1). Geese from the BBL were captured by personnel from the Alaska Peninsula NWR near Hook Lagoon, and by personnel from Togiak NWR and the Alaska Fish and Wildlife Research Center (AFWRC) on the Nushagak Peninsula.

Representatives from the AFWRC, Northern Prairie Wildlife Research Center (NPWRC), the Yukon Delta NWR, and Migratory Bird Management (MBM) of Region 7 participated in the capture of geese on the Y-K Delta. Only adult geese were fitted with radio transmitters. Our goal was to put transmitters on adult females unless a quota of 15 geese in each area could not be reached, when males would be included in the samples. The absence of immature geese (locals) at sites in the BBL indicated that geese captured were either non-breeders, or failed breeders. Geese caught on the Y-K Delta belonged to family groups and were probably successful breeders.

#### Body Measurements

Geese marked on the Nushagak Peninsula were not significantly different in size ( $P > 0.10$  for culmen length, tarsus length, body weight) than geese captured on the Alaska Peninsula, so samples were pooled. Geese marked in the BBL were significantly larger than geese marked on the Y-K Delta (Table 2). Adult males from the BBL were significantly heavier ( $P < 0.02$ ) and had larger culmens ( $P < 0.008$ ) than adult males trapped on the Y-K Delta. Adult females from the BBL were also larger, but only significantly so with respect to tarsus length ( $P < 0.002$ ).

#### Locations of Radio-marked Geese in Alaska

Geese marked on the Alaska Peninsula were relocated near Port Heiden, south of King Salmon, and adjacent to the

banding site. White-fronted geese radio-marked on the Nushagak Peninsula were not relocated in Alaska. Several Y-K Delta geese were relocated before they left Alaska, one of which was reported on the Alaska Peninsula in late September.

## Autumn Migration

### Survival of Geese and Transmitters

Thirty of the 39 radio-marked geese (77%) were relocated outside Alaska (Table 3). Three geese were killed by hunters in Oregon and California, and one was found dead in southern Oregon. Fourteen of the 30 geese (47%) had lost their radio packages by the time they were encountered south of Alaska.

A figure-8 around-the-wing harness was used for this project to counteract abrasion problems. This harness was developed after wear was observed on white-fronted geese fitted with a standard harness during winter in California, 1987. Although the figure-8 harness prevented abrasion and the geese flew normally for several weeks, under extended flexing the harness deteriorated, resulting in breakage of the cabling.

### Time of Arrival in Oregon and California

The first geese to arrive in the lower 48 from Alaska were from the BBL (Fig. 2). Three geese from the BBL were located along the coast of Washington and Oregon. There were no significant differences ( $P > 0.05$ ) in the time of arrival of geese marked on the Alaska Peninsula versus those captured

on the Nushagak Peninsula, so these arrival times were pooled for analysis. The mean arrival date of geese from the BBL was 16 September (SE  $\pm$  6 days), which was significantly earlier than geese from the Y-K Delta (12 October  $\pm$  7 days).

#### Movement Through California

BBL geese left the Klamath Basin significantly earlier ( $P < 0.0001$ ) than geese marked on the Y-K Delta (mean departure 3 Oct  $\pm$  5 days vs. 8 Nov.  $\pm$  7 days). Three of the BBL geese which departed the Klamath Basin by the first week of October were not relocated anywhere in California until they appeared on the Sacramento-San Joaquin Delta in February and March.

#### Wintering Areas

##### California and Oregon

Only 12 geese were relocated in wintering areas after 1 November (Table 4). All 5 BBL geese observed in California after 1 November spent at least some time on the Sacramento-San Joaquin Delta or in the San Joaquin Valley; the same was true for only 1 Y-K Delta goose.

##### Mexico

Two white-fronted geese from the Alaska Peninsula were relocated in the province of Chihuahua in the central highlands of northern Mexico (Fig 3, 4). One was observed in Laguna Babicora (Fig 4) in association with another recently collared white-fronted goose the first week of December by R. Drewien, USFWS and R. Bromley, CWS (a bright new collar was



seen but the code was not near enough to read). The geese were in the proximity of 4 other collared geese which had been captured in the Klamath Basin in September 1981. Surveys of Babicora suggest several thousand white-fronted geese winter in the area (Table 5). The area is also heavily hunted (J. Taylor, BDANWR, pers. comm.).

A second white-fronted goose from the Alaska Peninsula was in the central highlands in late January. J. Taylor and B. Turner (CWS) located that radio-marked goose with a portable telemetry system. A Mexican hunter called to report he shot the goose on 4 February in the same area.

Hunter band recoveries of geese marked during September in Klamath Basin, 1979-81 included 4 geese which were recovered on the west coast of Mexico, 3 in Sonora and 1 in Sinaloa (Fig 4, Table 5). Two geese captured in Klamath Basin during September 1987 and 1988 were radio tracked near Culiacan, Sinaloa during midwinter surveys in January 1988 and 1989 (B. Conant, J. Voelzer, MBM).

## DISCUSSION

### Capture and Banding

The fact that we were unable to capture breeding geese in the BBL region confounds interpretation of these data. Geese captured in this area could have attempted to breed elsewhere and may not represent locally-nesting birds. We feel such a scenario is unlikely, since previous banding of breeders and non-breeders on the central Y-K Delta show

similar recovery patterns (Lensink 1969; C. Ely unpubl. data). The BBL are known to support "several thousand" nesting geese (Connelly, et al. 1987).

Female geese are known to be highly faithful to nesting locality (Owen 1980). The assumption that geese molting in the BBL are local breeders will be substantiated if we are able to relocate radio-marked geese in these areas during May and June, 1989.

### Morphology

Geese from the Bristol Bay area were intermediate in size between the larger Tule goose and the Pacific white-fronted goose (Krogman 1979). However, there may be considerable geographic variation in body size of white-fronted geese on the Y-K Delta (D. Timm and C. Lensink, unpubl. data). Differences in structural size between the BBL and Y-K Delta geese, although significant, does not necessarily indicate taxonomic distance, as clinal variation in body size has been demonstrated for several subspecies of vertebrates (Endler 1977).

### Autumn Migration

The earlier arrival and departure of BBL geese into and out of the Klamath Basin, supports the hypothesis that greater white-fronted geese nesting at lower latitudes are more likely to be early autumn migrants (Ely and Raveling 1989). The discovery of at least 2 BBL geese in Mexico

substantiates the contention that southern nesters have a propensity to winter farther south (Lensink 1986, Ely and Raveling 1989). The observation in Mexico of the BBL geese with other geese collared during September in the Klamath Basin is additional evidence that early September migrants are likely to come from southern nesting areas.

### Wintering Areas

Although relatively few geese were relocated on the wintering grounds after 1 November, it appears that geese from the Y-K Delta were more likely to remain in the Klamath Basin or Sacramento Valley of California than BBL geese, which had an affinity for the Sacramento-San Joaquin Delta.

Ely and Raveling (1982, 1989) also reported the disappearance of geese using the Klamath Basin in September and their subsequent appearance on the Sacramento-San Joaquin Delta in January and February; however, the location of these geese between October and December was not known at the time. It seems likely that these missing geese were in Mexico. Peak counts of white-fronted geese as determined from the Fall Goose Survey are generally much higher than can be accounted for in the mid-winter survey (Table 6). The discrepancy in counts is largely due to differences in survey conditions (the geese are much more dispersed during the later inventory), although it is not unreasonable to assume that a substantial number of geese may be unaccounted for

because they are in Mexico (the mid-winter inventory is usually conducted during the first two weeks of January, often before substantial numbers of geese arrive to the Sacramento-San Joaquin Delta).

#### FUTURE RESEARCH

For the 1989 field season, we propose putting radios on 30 white-fronted geese in the vicinity of Bristol Bay (15 on the Alaska Peninsula and 15 on the Nushagak Peninsula), and 30 radios on geese on the Y-K Delta (15 on geese from the central Y-K Delta, and 15 on geese from the southern Delta; see Fig. 1). As in the past, our work will rely heavily on the cooperation of the refuges in Alaska, as well as personnel from Region 7, Regions 1, the Alaska Fish & Wildlife Research Center (AFWRC), and Northern Prairie Wildlife Research Center (NPWRC). Additional efforts will be put into trying to catch local breeders in the BBL. If local breeders can not be captured in the BBL, we may radio a sample of non-breeders on the Y-K Delta, so geese of equal breeding status will be marked from each area.

We are currently improving our method of affixing radio packages on geese. We have yet to design a harness which does not encumber the goose, but we are developing a small solar neck collar radio package which may be least obtrusive.

As part of our work on nesting areas, we are investigating the possibility of determining the genetic distance of different groups of white-fronted geese nesting

in Alaska by sequencing mitochondrial DNA (the work would be in collaboration with G. Shields, University of Alaska, Fairbanks). Blood samples would be collected from white-fronted geese captured in this study in addition to white-fronted geese captured by refuge personnel in interior Alaska, and possibly from northern Canada. Mitochondrial DNA sequencing should allow us to look more closely at similarities and differences among geese from different nesting areas, and estimate when these groups may have diverged.

In addition to radio-marking geese in western Alaska, we are currently considering putting radios on additional white-fronted geese in September in the Klamath Basin, and more neck collars on geese during July in Alaska, and September in Klamath Basin. Increasing our marking efforts would allow us to use marked/unmarked ratios (radios and/or collars) to better estimate the size of the population originating in the BBL, and migrating through the Klamath Basin in September. Estimates could also be obtained in the Central Interior Highlands and along the west coast of Mexico, and in California after the geese return from Mexico in February or March.

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Derksen, D. Gilmer, R. Pospahala, and J. Baker. R. Hood, R. Wilk, K. Wilk, and S. Savage (USFWS) captured, or assisted with capturing geese on the Alaska Peninsula. L. Hotchkiss, D. Fisher and C. Lensink (AFWRC), along with a crew of volunteers, captured geese on the Nushagak Peninsula. R. King, B. Butler, B. McCaffery, M. Hinkes, J. Sarvis, J. Morgart, G. Walters, M. Wege (USFWS), W. Clark (Iowa State University), J. Fleskes (NPWRC) and assistants from the Yukon Delta NWR helped catch or track geese on the Y-K Delta. R. Lowe, M. Hills, and E. Nelson (USFWS) tracked along the Washington, Oregon, and California coasts. G. Kramer, W. Henry, B. Conant, and J. Voelzer looked for radio-marked geese along the west coast of Mexico. California trackers included D. Orthmeyer, K. Gonzalez, P. Cavanagh, J. Sayre, C. Frazer, M. Parker, R. Jerofke, and M. Casazza. R. Drewien (USFWS, University of Idaho), R. Bromley (Northwest Territories), B. Turner (Canadian Wildlife Service), J. Taylor (USFWS), and E. Klaas (Iowa State) assisted in the Interior Highlands of Mexico. The assistance of the staffs from the Klamath Basin NWR (R. Johnson, Mgr) and Sacramento NWR (G. Kramer, Mgr) is appreciated. Finally, thanks to all other individuals who helped us in this research effort.

LITERATURE CITED

- Bellrose, F. C. 1976. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, PA. 544pp.
- Connelly, D., T. Rothe, D. Timm, et al. 1987. Management plan for the Pacific Flyway population of the white-fronted geese. Pacific Flyway Council, U. S. Fish and Wildlife Service, and Canadian Wildlife Service.
- Crissey, W. F. 1968. Informational needs for Canada Goose management programs. Pages 140-147 in R. L. Hine and C. Schoenfield, eds. Canada goose management. Dembar Educ. Res. Serv., Madison, WI.
- Ely, C. R., and D. G. Raveling. 1982. Winter ecology of white-fronted geese. Prog. Rept. to Calif. Dept. Fish and Game. Univ. CA, Davis, 15pp.
- Ely, C. R., and D. G. Raveling. 1989. Body composition and weight dynamics of wintering white-fronted geese. J. Wildl. Manage. 53:in press.
- Endler, J. A. 1977. Geographic variation, speciation, and clines. Princeton Univ. Press, Princeton.
- Kennedy, D. F., and G. C. Arthur. 1974. Subflocks in Canada geese of the Mississippi Valley Population. Wild. Soc. Bull. 2:8-12.
- Krogman, B. D. 1979. A systematic study of Anser albifrons in California. Pages 22-43 in L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oregon State Univ. Bookstores, Inc., Corvallis, OR.

- Lensink, C. J. 1969. The distribution of recoveries from white-fronted geese (Anser albifrons frontalis) banded in North America. Unpubl. report. Bur. Sport Fisheries and Wildl., Bethel, Alaska. 63pp.
- . 1985. The Pacific white-fronted goose. Pages 448-452 in A. S. Eno and R. L. Silvestro, eds. Audubon Wildlife Report 1985. The National Audubon Society, New York.
- . 1986. Recoveries of Alaska white-fronted geese in Mexico. USFWS Research Info. Bull. 86-2:2pp.
- . 1987. Estimated number of white-fronted geese (Anser albifrons frontalis) using major nesting areas. Unpubl. report, U.S. Fish & Wildlife Service, Anchorage, AK. 14pp.
- O'Neill, E. J. 1979. Fourteen years of goose populations and trends at Klamath Basin refuges. Pages 316-321 in R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oregon State Univ. Bookstore, Inc., Corvallis, OR.
- Owen, M. 1980. Wild geese of the world. B. T. Batsford, London, U.K. 236pp.
- Raveling, K. G. 1969. Roost sites and flight patterns of Canada geese in winter. J. Wildl. Manage. 33:319-330.
- . 1978. Dynamics of distribution of Canada geese in winter. Trans. N. Amer. Wild. and Nat. Resour. Conf. 43:206-225.



- . 1984. Geese and hunters of Alaska's Yukon Delta: Management problems and political dilemmas. Trans. N. Amer. Nat. Resour. Couf. 49:555-575.
- Timm, D. E., and C. P. Dau. 1979. Productivity, mortality, distribution, and population status of Pacific Flyway white-fronted geese. Pages 280-298 in R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. OSU Bookstores, Inc., Corvallis, OR.
- Woolington, D. W., P. F. Springer, and D. R. Yparraguirre. 1979. Migration and wintering distribution of Aleutian Canada geese. Pages 299-309 in R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. OSU Book Stores, Inc., Corvallis, OR.

Table 1. Summary marking of greater white-fronted geese marked with radio transmitters on the Yukon-Kuskokwim (Y-K) Delta, and near Bristol Bay, Alaska in 1988.

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<u>Date</u>	<u>Location</u>	<u>No. of Adult Geese Marked</u>		
		<u>Male</u>	<u>Female</u>	<u>Total</u>
	<u>Bristol Bay Lowlands</u>			
4 July	Alaska Peninsula	3	12	15
14-20 July	Nushagak Peninsula	2	5	7
	<u>Yukon-Kuskokwim Delta</u>			
27-29 July	Kashunuk/Manokinak R.	1	16	17
<b>TOTAL</b>		<b>6</b>	<b>33</b>	<b>39</b>

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Table 2. Measurement of adult greater white-fronted geese marked on the Yukon-Kuskokwim (Y-K) Delta and near Bristol Bay, Alaska in 1988.

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<u>Sex/Marking Location</u>	<u>N</u>	<u>Weight(g)</u>		<u>Culmen(mm)</u>		<u>Tarsus(mm)</u>	
		<u>X</u>	<u>SE</u>	<u>X</u>	<u>SE</u>	<u>X</u>	<u>SE</u>
<u>Males</u>							
Central Y-K Delta	17	2202	39	51.5	0.7	87.9	2.1
Bristol Bay Lowlands	5	2410	78	55.6	0.8	92.1	0.8
<u>Females</u>							
Central Y-K Delta	16	1985	29	48.8	0.6	80.4	1.8
Bristol Bay Lowlands	19	2045	43	50.4	0.7	86.8	0.9

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Table 3. Fate of greater white-fronted geese fitted with radio transmitters in July 1988.

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<u>Parameter</u>	<u>Location of Marking</u>	
	<u>Bristol Bay</u>	<u>Yukon-Kuskokwim Delta</u>
Radio-marked	22	17
Never relocated	5	2
Located only in Alaska	1	1
Located outside Alaska	16 (73%)	14 (82%)

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Table 4. Autumn and winter observations of greater white-fronted geese fitted with radio transmitters in Alaska during 1988, and marked on the Yukon-Kuskokwim (Y-K) Delta or in the Bristol Bay Lowlands (BBL).

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Parameter	Location of Marking	
	Bristol Bay Lowlands	Y-K Delta
Located outside Alaska	16	14
Mortalities	2	2
Available for observation	14	12
Unaccounted for after 31 October	7	7
Located after 1 November	7	5
Located after 1 February	3	0
Located in Mexico	2	0

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Table 5. Midwinter waterfowl survey estimates of white-fronted geese in Mexico. The area number noted before each area name is associated with a square (west or east coast) or circle (interior highlands) in Fig 4.

		<u>WHITE-FRONTED GEESE COUNTED MEXICO WEST AND EAST COAST</u>																								
<u>REGION</u>		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1988	MEAN	
<u>WEST COAST</u>																										
1	Agiobampo	0	0	100	0	0	0	40	0	0	0	0	45	0	30	220	140	270	0	782	250	1020	10	0	126	
2	Topolobampo	1150	900	0	485	900	50	475	0	0	540	0	--	116	320	50	300	270	510	490	0	350	550	0	339	
3	B St Maria	650	0	0	0	0	25	0	1710	20	0	0	300	849	28	1132	40	800	0	190	0	300	0	35	264	
4	Pabellon	5200	2000	2125	430	--	--	50	25	0	475	1695	962	102	350	480	450	2930	860	0	2170	160	742	0	964	
5	Dordo-Dimas	0	0	0	0	--	75	550	435	0	2000	0	0	--	40	160	2610	60	6130	5000	--	--	1500	0	977	
6	Marismas	755	147	65	--	--	--	780	35	0	--	--	--	--	0	35	50	20	100	0	--	--	0	0	82	
7	Obregon, Tobari	685	345	0	10	100	75	575	50	110	200	0	507	--	300	60	200	120	0	10	0	0	0	0	275	
	Other	415	0	0	0	0	0	16	0	80	0	0	0	1022	0	0	0	0	0	0	0	0	9	0	70	
	<b>TOTAL</b>	<b>8855</b>	<b>3392</b>	<b>2290</b>	<b>925</b>	<b>1000</b>	<b>225</b>	<b>2486</b>	<b>2255</b>	<b>210</b>	<b>3215</b>	<b>1695</b>	<b>1930</b>	<b>1068</b>	<b>213</b>	<b>3790</b>	<b>4470</b>	<b>7600</b>	<b>6472</b>	<b>2420</b>	<b>1830</b>	<b>2802</b>	<b>310</b>	<b>2671</b>		
<u>EAST COAST</u>																										
1	Rio Grande Delta	36538	17101	1030	2751	11875	28455	7150	7800	30480	7920	2485	1040	6855	1200	11620										
2	L Madre, Tamulip	1725	207	150	1128	555	125	235	550	1500	7940	23240	2150	9265	4035	3771										
3	Tamesi, Panuco R	1287	2706	1038	590	1364	240	480	300	355	7990	0	110	350	290	1216										
4	Tamiah-Veracruz	502	256	--	265	40	480	555	900	820	1025	390	490	1920	495	626										
5	Atvarado Lagoon	50	165	--	50	20	0	0	0	0	0	0	0	0	0	23										
6	Tabasco Lagoons	740	50	--	120	0	0	0	0	10	0	20	0	--	0	78										
	<b>TOTAL</b>	<b>40832</b>	<b>20485</b>	<b>2218</b>	<b>4904</b>	<b>13854</b>	<b>29300</b>	<b>8420</b>	<b>9550</b>	<b>33165</b>	<b>24875</b>	<b>26135</b>	<b>3790</b>	<b>18390</b>	<b>6020</b>	<b>17281</b>										

## WHITE-FRONTED GEESE COUNTED IN THE MEXICO INTERIOR HIGHLANDS

	1964	1965	1967	1970	1975	1977	1978	1979	1980	1981	1982	1985	1988	MEAN
<b>Northern</b>														
1 Babicora	--	2150	--	200	3225	2000	1375	2600	500	1150	3275	2630	1385	1863
2 Tintero	--	--	--	--	145	125	125	150	30	75	40	0	0	77
3 Cuervo	--	--	--	--	0	--	--	0	0	160	--	80	0	40
4 Bustillo	475	45	275	250	0	10	850	60	1460	40	415	10	255	318
5 Minaco	--	--	--	100	0	0	300	100	0	110	0	0	0	61
6 Pedernales	--	--	--	--	--	--	--	--	--	0	0	0	670	168
7 Mexicanos	--	152	--	425	385	125	350	615	1075	45	690	565	1255	516
8 Delicias	--	--	--	0	0	100	250	425	400	310	0	2200	5125	881
9 Toronto	121	285	80	120	250	690	150	0	45	210	200	110	600	220
10 E La Cruz	--	95	--	0	135	--	--	600	0	--	--	275	185	184
11 Palomas	0	0	0	0	0	0	0	35	0	275	680	0	0	82
12 Rio d Ora	--	--	--	75	--	135	125	385	1005	--	--	125	1525	482
13 E Torre	--	--	--	--	250	--	--	0	0	1320	--	0	0	262
14 Santiago	1295	2565	1560	1260	3700	2440	3355	2610	7125	--	8935	3390	6100	1967
15 Durango	--	0	--	--	300	0	480	940	1900	85	6710	595	1090	1210
16 Victoria	--	--	--	--	--	1350	0	0	6125	3710	0	0	0	934
17 Vil Union	--	--	--	--	2600	3000	5800	3500	380	0	420	0	125	1758
18 S. Monica	--	--	--	325	2800	0	3650	6500	2000	0	13300	95	425	2910
19 Vil de Cos	--	700	--	800	1400	1730	2900	1810	4700	50	10450	0	5245	2708
20 Soldadito	--	935	--	0	100	715	550	910	420	15	0	890	0	412
21 Salinas	--	45	--	0	0	--	0	80	2300	--	--	650	0	384
Other	151	130	0	52	1810	0	20	10	0	0	0	0	0	167
<b>Total</b>	<b>1891</b>	<b>7123</b>	<b>2045</b>	<b>3555</b>	<b>15342</b>	<b>4230</b>	<b>20260</b>	<b>21340</b>	<b>29475</b>	<b>7555</b>	<b>45115</b>	<b>11615</b>	<b>23985</b>	<b>16425</b>
<b>Central</b>														
22 Languillo	--	5	--	0	800	220	3160	2250	710	0	0	75	65	662
23 Atotaniilco	--	124	--	0	0	100	350	0	30	0	0	250	10	79
24 Sayula	--	255	--	50	5	105	25	0	0	--	--	0	0	49
25 Tepatitla	--	200	--	150	0	--	0	240	0	0	10	25	0	63
26 Moreno	--	163	--	0	25	100	150	0	0	70	0	35	350	81
27 Cavadas	--	360	--	100	415	50	755	0	350	0	0	135	0	197
28 Irapuato	--	510	--	370	40	50	425	205	250	60	150	100	65	208
29 M Yuriria	--	0	--	500	--	0	0	0	400	0	0	0	0	90
30 Zacapo	--	300	--	200	--	25	90	40	70	125	80	100	60	109
31 Cuitzeo	--	620	--	0	--	25	0	0	140	250	0	0	0	103
Other	--	30	--	25	155	35	6235	2465	210	170	40	20	0	853
<b>Total</b>	<b>--</b>	<b>2567</b>	<b>--</b>	<b>1395</b>	<b>1440</b>	<b>710</b>	<b>11190</b>	<b>5205</b>	<b>2160</b>	<b>675</b>	<b>280</b>	<b>740</b>	<b>550</b>	<b>2447</b>
<b>TOTAL</b>	<b>1891</b>	<b>9690</b>	<b>2045</b>	<b>4950</b>	<b>16782</b>	<b>14940</b>	<b>31450</b>	<b>26545</b>	<b>31635</b>	<b>8230</b>	<b>45395</b>	<b>12355</b>	<b>24535</b>	<b>17726</b>

Table 6. Fall coordinated goose surveys and midwinter waterfowl survey estimates for greater white-fronted geese. Fall surveys are conducted during late October and early November while the midwinter survey is generally conducted in the first half of January.

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<u>Year</u>	<u>Fall Goose Survey</u>	<u>Midwinter Survey</u>	<u>% Difference</u>
1979-80	73,100	87,100	119
1980-81	93,500	68,100	73
1981-82	116,500	95,100	82
1982-83	91,700	30,100	33
1983-84	112,900	64,200	57
1984-85	100,200	---	--
1985-86	93,800	53,700	57
1986-87	107,100	70,400	66
1987-88	130,600	---	--
1988-89	161,500	102,100	63

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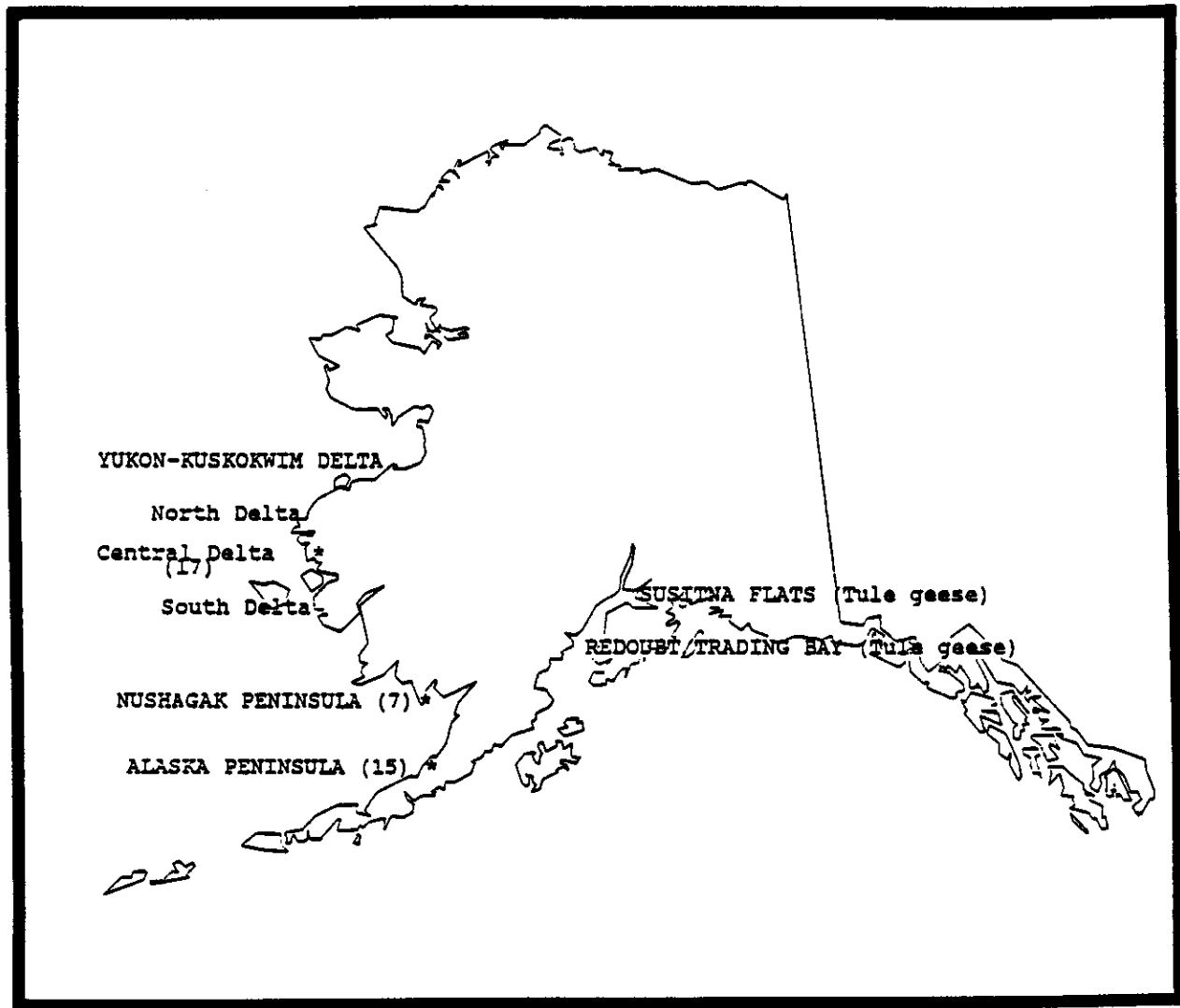


Fig. 1. Breeding areas, and location of marking (\*) of greater white-fronted geese in western Alaska in 1988.

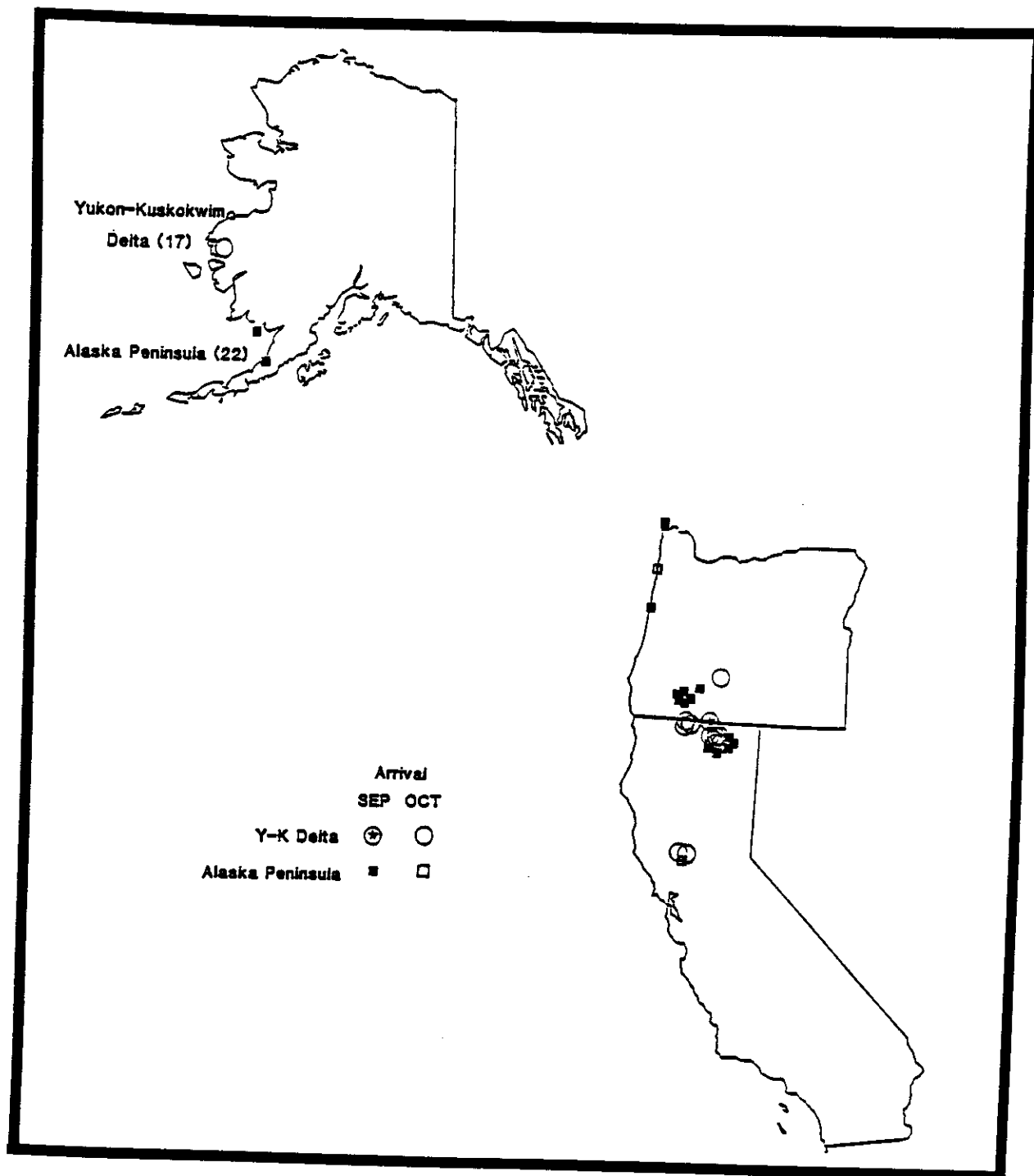


Fig. 2. Timing of arrival of greater white-fronted geese to Oregon and California from two banding locations in western Alaska in 1988.



Fig. 3. Locations of radio-marked greater white-fronted geese in Mexico, 1987-88 and 1988-89. (★) indicate geese marked near Bristol Bay, Alaska 1988. (■) indicate geese marked in Klamath Basin, California in September 1987 and 1988.

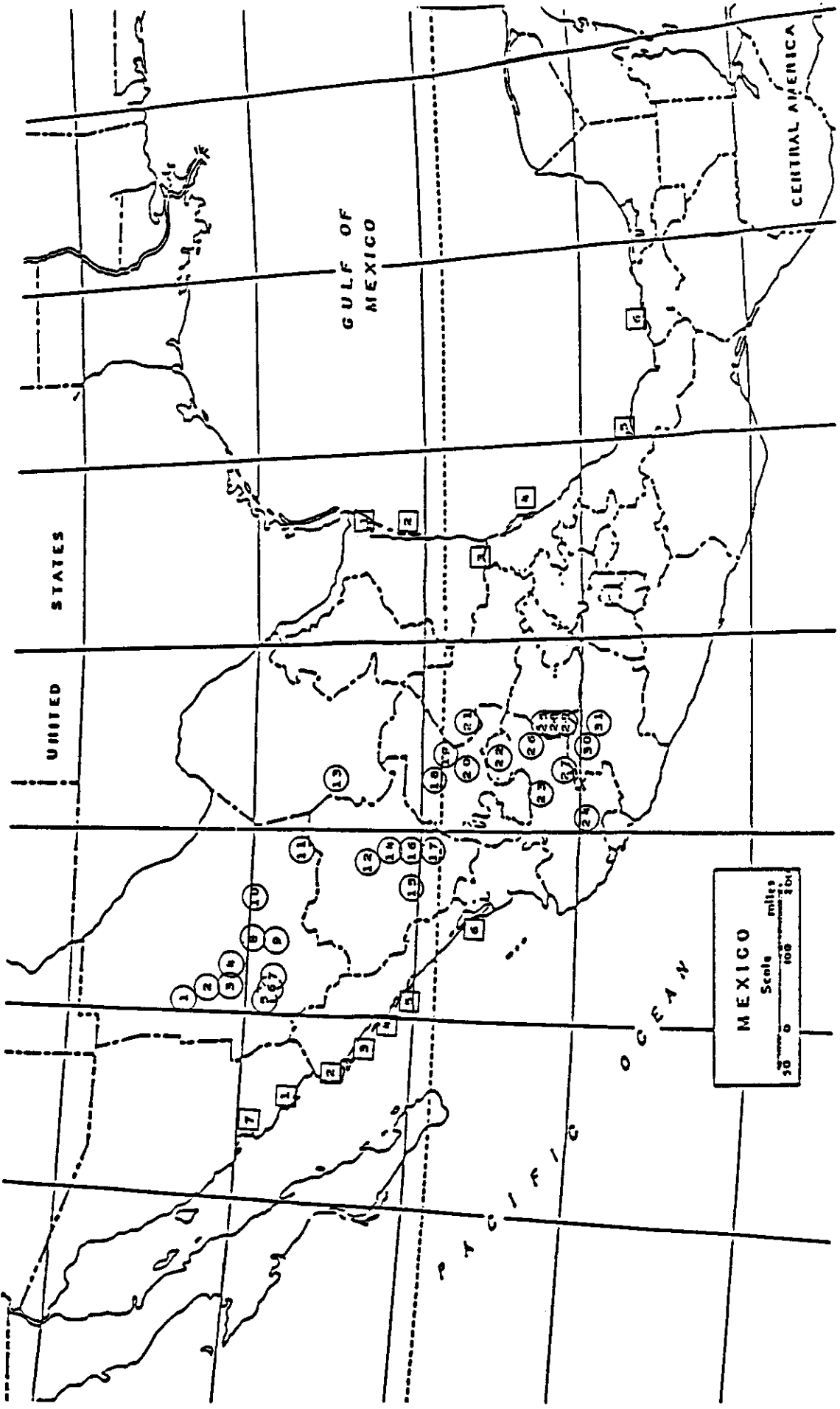


Fig. 4. Survey areas where white-fronted geese are observed on a regular basis during midwinter surveys. Squares (West and East Coast) and circles (Interior Highlands) indicate areas in Table 5.