ALASKA DEPARTMENT OF FISH AND GAME
JUNEAU, ALASKA

STATE OF ALASKA
Jay S. Hammond, Governor

DEPARTMENT OF FISH AND GAME
Ronald O. Skoog, Commissioner

DIVISION OF GAME
Ronald J. Somerville, Director
Donald McKnight, Research Chief

ANNUAL REPORT OF SURVEY AND INVENTORY ACTIVITIES

WATERFOWL

BY

Dan Timm

Volume XI
Project Progress Report
Federal Aid in Wildlife Restoration
Project W-19-1, Job No. 10.0

(Printed November 1980)

1979-1980 ALASKA WATERFOWL REGULATIONS SUMMARY SEASONS AND LIMITS

Area	NORTHERN	GULF COAST	SOUTHEAST	ALEUTIANS	KODIAK
State Game Management Units	11-13 & 17-26	5-7, 9, 14-16 & Unimak Island	1-4	10 (except Unimak Is.)	8
Open Seasons	Sept. 1- Dec. 16	Sept. 1 - Dec. 16	Sept. 1 - Dec. 16	Oct. 8 - Jan. 22	Sept. 10- Oct. 9 &Nov. 5- Jan. 20

	LIMIT BAG	POSS.	LIMIT BAG	POSS.	LIMIT BAG	POSS.	LIMIT BAG	POSS.	LIMIT BAG	POSS.
Ducks	10	30	8	24	7	21	7	21	7	21
Sea Ducks* & Mergansers	15	30	15	30	15	30	15	30	15	30
Geese**	6	12	6	12	6	12***	6	12****	6	12
Emperor Geese	6	12	6	12	6	12	6	12	6	12
Brant	4	8	4	8	4	8	4	8	4	8
Snipe	8	16	8	16	8	16	8	16	8	16
Crane	2	4	2	4	2	4	2	4	2	4

* Sea Ducks: Eiders, Scoters, Old Squaw, Harlequin.
** No more than 4 daily, 8 in possession may be Canada and/or white-fronted geese.
*** Provided that Unit 1C is closed to the taking of snow geese.
**** The taking of Canada geese in the Aleutian Islands, except on Unimak, is illegal. (To protect the Aleutian Canada goose).

(a) WEAPONS: Waterfowl may be taken with a shotgun (not larger than 10 gauge) or bow and arrow, but not rifle or pistol.

(b) PLUGS: Shotguns must be plugged to a 3-shell capacity or less for waterfowl hunting.

(c) CONVEYANCES: Hunting is not permitted from an aircraft, motor driven vehicle, air boat, jet boat, or propellor driven boat which the motor of such has not been completely shut off and its progress therefrom has ceased.

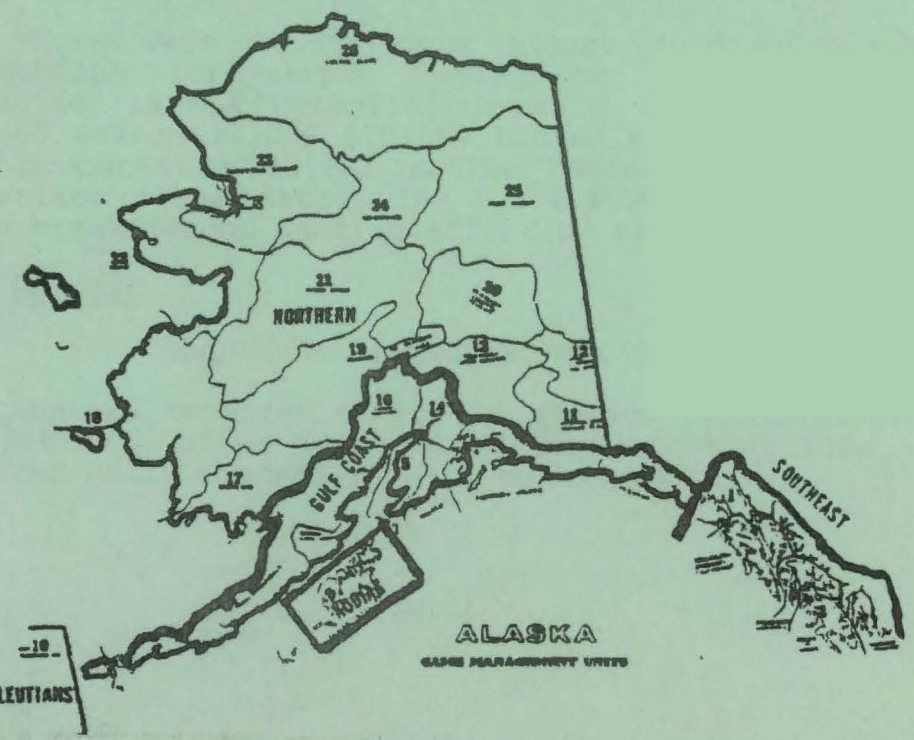
(d) POSSESSION: No person may receive or possess any migratory game bird belonging to another unless such birds have a tag attached with the signature of the hunter, his address, the date and total number and kinds of birds taken.

(e) TRANSPORTATION: Waterfowl may be plucked in the field but one fully feathered wing or the head must remain attached while being transported.

(f) SHOOTING HOURS: One half hour before sunrise to sunset.

(g) STAMPS: No person 16 or more years of age may take waterfowl unless he carries a current validated Federal migratory bird hunting stamp (Duck Stamp) on his person.

For additional and more complete information refer to Federal regulatory announcement available on request from Fish and Wildlife Service, 1011 E. Tudor, Anchorage, 99507.



CONTENTS

WATERFOWL HARVEST AND HUNTER ACTIVITY

This was the third year that the Department has utilized the U.S.F.W.S. mail questionnaire and parts collection surveys to estimate harvest and hunter activity. Timm (1978) described the progression of events which led to discontinuing the State survey of waterfowl hunters.

The U.S.F.W.S. categorizes data from their parts collection survey according to codes listed in Table 1. Data are coded to either specific locations within 11 harvest areas (Fig. 1), or, if birds were not taken at the specific locations listed in Table 1, then the general harvest area code is assigned. For example, a duck shot at Palmer Hay Flats would be coded 1123; a duck shot on the Kasilof Flats would be coded 1103. Timm (1978) provided a more detailed description of the coding system.

Results

Hunter Activity

There were 18,946 duck stamps sold in Alaska. After corrections for people buying two stamps, there were a projected 18,564 potential hunters in Alaska. During the 1979-80 season 13,065 (70.3%) hunted waterfowl 1 or more days. This compares to 13,811 active hunters a year ago. Table 2 summarizes these data. The U.S.F.W.S. survey does not allow for a breakdown of hunting effort by area.

Duck Harvest

Magnitude of the Harvest (Table 2)

Hunters reported taking an average of 8.8 ducks each (8.9 in 1978-79), after corrections for reporting bias were made. Reported daily success was 1.3 ducks per day.

Table 1. Summary of FWS codes used to assign harvest locations in Alaska.

Old Code	New Code	ADFG Region (R) and Place Names	Original FWS "County" Name	Harvest Zone
0001	0000	Unknown	Unknown	Unknown
0011	0101	North Slope (R)	Arctic Slope	NW
0031	0301	Seward Peninsula (R)	Seward Peninsula	"
0051	0502	Yukon Valley (R)	Upper Yukon-Kuskokwim	Central
0051	0512	Yukon Flats	"	"
0071	0702	Central (R)	Fairbanks-Minto	"
0071	0712	Minto Flats	"	"
0071	0722	Eielson AFB	"	"
0071	0732	Salchaket Slough	"	"
0071	0742	Healy Lake	"	"
0071	0752	Delta Area	"	"
0071	0762	Tok-Northway	"	"
0091	0901	Yukon Delta (R)	Yukon-Kuskokwim Delta	NW
0111	1103	Cook Inlet (R)	Anchorage-Kenai	SE
0111	1113	Susitna Flats	"	"
0111	1123	Palmer-Hay Flats	"	"
0111	1133	Goose Bay	"	"
0111	1143	Potter Marsh	"	"
0111	1153	Chickaloon Flats	"	"
0111	1163	Portage	"	"
0111	1173	Trading Bay	"	"
0111	1183	Redoubt Bay	"	"
0111	1193	Kachemak Bay	"	"
0131	1303	Gulf Coast (R)	Cordova-Copper River	"
0131	1313	Copper River Delta	"	"
0131	1323	Yakutat Area	"	"
0131	1333	Prince William Sound	"	"
0151	1503	Southeast Coast (R)	Juneau-Sitka	"
0151	1513	Chilkat River	"	"
0151	1523	Blind Slough	"	"
0151	1533	Rocky Pass	"	"
0151	1543	Duncan Canal	"	"
0151	1553	St. James Bay	"	"
0151	1563	Mendenhall Wetlands	"	"
0151	1573	Farragut Bay	"	"
0151	1583	Stikine River Delta	"	"
0171	1704	Kodiak (R)	Kodiak Island	SW
0171	1714	Kalsin Bay	"	"
0191	1904	AK Peninsula (R)	Cold Bay-AK Peninsula	"
0191	1914	Cold Bay	"	"
0191	1924	Pilot Point	"	"
0191	1934	Port Moller	"	"
0191	1944	Port Heiden	"	"
0211	2104	Aleutian Chain (R)	Aleutians-Pribilofs	"

Figure 1. Harvest areas used in data analysis.

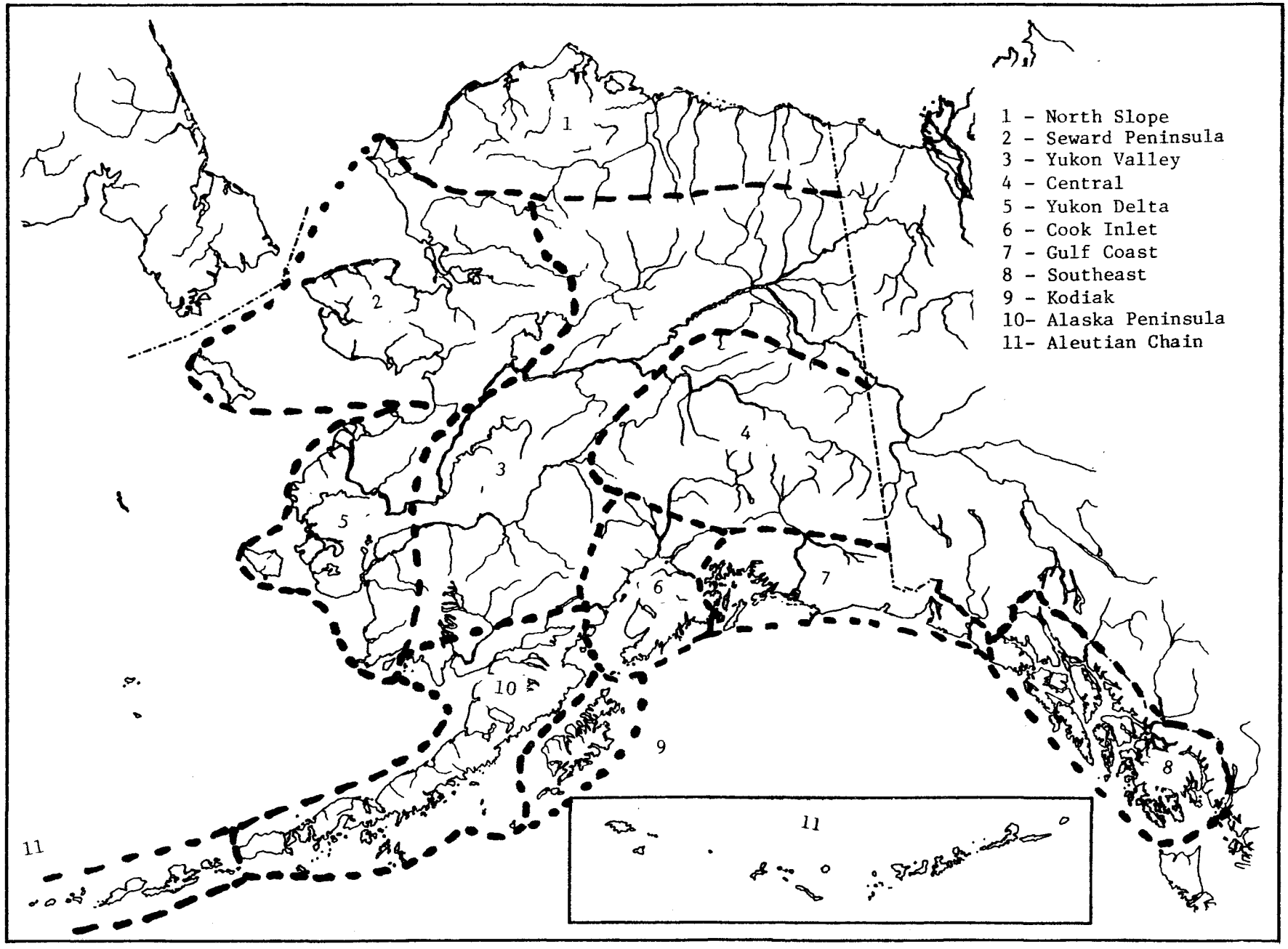


Table 2. Summary of waterfowl hunter success and activity, 1979-80 season (after Carney et al. 1980).

Number of duck stamps sold	18,946 (18,584 potential hunters)
Number of mail questionnaires	1,323
Number of duck wings received	1,321
Number of goose tails	103
Number of active hunters	13,065 (70.3%)

Calculated statewide harvests:

Ducks: 109,808; Sea ducks and mergansers 4,826; Total 114,634

Geese: Canada 11,742; Emperor 2,055; White-fronted 586; Brant 733; Snow TR; Total 15,116

Ducks per active adult hunter 8.8

Percent successful hunters 55.7

Cranes: 675 (Sorensen 1978)

Calculated total hunter days 96,824*

Days per active adult hunter 6.8

* Includes about 7,750 juvenile hunter days.

The projected total statewide harvest was 114,634 ducks, of which 4,826 (4.2%) were sea ducks and mergansers.

Location of Harvest (Table 3)

According to the U.S.F.W.S. survey, about 50 percent of the kill occurred in the Cook Inlet area, while no birds were shot on the North Slope, Aleutian Chain, Seward Peninsula or in the Yukon Valley. These abberant data are the result of small or no samples from these areas. For comparative purposes the 1974-76, 3-year average distribution of harvest data, as obtained from State mail surveys, are also presented in Table 3. These data are believed to more accurately portray harvest by location than does the Federal survey.

Species Composition of Harvest (Table 4)

As in previous years, mallards, pintails, green-winged teal and wigeons comprised the bulk of the harvest (82.4%). Dabblers made up 87.5 percent of the total kill, divers 8.2 percent and sea ducks and mergansers 4.2 percent. Mallards comprised a large portion of the harvest in the Gulf Coast, Southeast, Kodiak and Alaska Peninsula harvest areas. Relatively uncommon ducks (blue-winged teal, ring-necked ducks and redheads) occurred in scattered locations.

Goose Harvest

A breakdown by species and area of the 1979-80 statewide goose harvest of 15,116 birds is provided in Table 5. This represented an 8 percent increase in harvest over last year. Canada, emperor, white-fronted geese and brant comprised 77.9 percent, 13.5 percent, 3.8 percent, 4.8 percent, respectively, of the statewide kill. According to the Federal survey, over 35 percent of the harvest occurred in Cook Inlet and 32 percent on the Alaska Peninsula, while no geese were killed on the North Slope, Seward Peninsula, in the Yukon Valley, on the Aleutian Chain, Kodiak Island or along the Gulf Coast (Table 6). These abberrant data resulted from the same biases which were described for the duck harvest and were magnified in 1979-80 because only 104 goose tails were sent in compared to 163 last year. We believe that a more accurate picture of the location of goose harvests is portrayed by 3-year average data obtained from past State mail surveys (Table 6).

Crane Harvest

A retrieved take of 675 cranes by 335 successful hunters was calculated by Sorensen (1980) for the 1979-80 season in Alaska. Information on the location of crane harvest was not obtained from the U.S.F.W.S. survey, but averages are available from past State surveys.

Table 3. A comparison between reported duck harvest from the 1977-78, 1978-79 and 1979-80 U.S.F.W.S. parts collection survey and the A.D.F.&G. mail survey, 1974-76 3 year average.

Harvest area	Percent of Statewide Harvest ADFG	USFWS			
	1974-76	1977	1978	1979	1977-79 avg.
North Slope	0.2	0.0	0	0	0
Seward Peninsula	1.4	0.0	0	0	0
Yukon Valley	2.5	0.3	0	0	0.1
Central	18.0	14.1	14.6	25.0	17.9
Yukon Delta	1.4	1.3	1.5	1.2	1.3
Cook Inlet	39.2	55.6	50.1	49.4	51.7
Gulf Coast	8.4	4.9	6.6	2.9	4.8
Southeast	20.6	15.9	14.6	11.5	14.0
Kodiak	2.7	2.2	3.6	7.3	4.4
Alaska Peninsula	5.1	5.7	9.0	2.7	5.8
Aleutian Chain	0.5	0.0	0	0	0
	100.0	100.0	100.0	100.0	100.0

Specific Location	Percent of Statewide Harvest ADFG	USFWS			
	1974-76	1977	1978	1979	1977-79 avg.
Susitna Flats	10.6	13.3	13.3	11.5	12.7
Minto Flats	7.3	4.4	4.2	3.6	4.1
Palmer-Hay Flats	7.3	2.7[1/]	10.9	1.1[1/]	4.9
Copper River Delta	5.6	4.6	2.8	2.3	3.2
Mendenhall	4.1	8.6	4.2	5.5	6.1
Stikine River Delta	3.6	4.4	8.0	3.6	5.3
Kachemak Bay	2.6	9.3	0.4	2.9	4.2
Redoubt Bay	2.5	4.7	1.0	2.2	2.6
Trading Bay	2.1	0.9	2.5	3.1	2.2
Portage Flats	2.1	1.7	0.9	2.7	1.8
Pilot Point	1.8	1.9	1.0	2.0	1.6
Chickaloon Flats	1.3	0.0	0.1	0.2	0.1
Potter Marsh	1.2	0.0	0.5	0	0.2
Duncan Canal	1.1	0.0	0.0	0	0
Eagle River Flats (Cook Inlet)	1.1	not coded		--	--
Kalsin Bay	1.1	0.0	0.0	0	0
Yakutat Area	1.0	0.3	1.3	0.2	0.6
Rocky Pass	0.9	0.0	0.0	0	0
Blind Slough	0.9	0.0	0.5[2/]	0	0.2
Cold Bay Area	0.8	3.6	4.6	TR	2.7
Eilson AFB	0.8	0.0	2.6	TR	0.9
Salchaket Slough	0.6	0.0	0.0	0	0
Healy Lake	0.5	0.0	0.0	2.7	0.9
Goose Bay	0.4	0.3	1.5	0.4	0.7
Farragut Bay	0.4	0.0	0.0	0	0
St. James Bay	0.4	0.0	0.0	0	0
Chilkat River	0.2	0.6	0.0	0.4	0.3
Delta Area	TR	0.5	1.6	1.0	1.0[3/]
Tok-Northway Area	TR	1.9	4.3	13.2[3/]	6.5[3/]
Prince William Sound	0	0.0	2.4	0.4	0.9
	62.3	62.7	68.6	59.0	63.7

1/ The FWS apparently assigned many ducks shot at Palmer to the general Cook Inlet code.
2/ Blind Slough has been closed to hunting since 1978-79.
3/ This figure is unreasonably large and incorrect.

Table 4. Species composition of the duck harvest, 1979-80 waterfowl season.

Species	Central	Y-K Delta	Cook Inlet	Gulf Coast	Southeast	Kodiak	Alaska Peninsula	Percent of Total Statewide[1/]
Mallard	38.4	--	25.0	52.8	51.4	50.0	57.6	36.6
G-W Teal	7.7	40.0	17.0	25.0	21.8	18.9	9.1	15.9
Am. Wigeon	21.1	--	17.6	11.1	2.8	3.3	6.1	15.8
Pintail	11.0	53.3	20.4	5.6	6.3	5.6	21.2	14.1
Shoveler	3.2	--	6.2	--	2.1	1.1	--	3.8
Gadwall	--	--	1.5	2.8	--	4.4	--	0.8
B-W Teal	--	--	--	--	--	--	--	0.5
Total Dabbler	87.4	93.3	87.5	97.2	84.5	83.3	93.9	87.5
Lesser Scaup	3.9	--	2.8	--	--	--	--	1.9
Common Goldeneye	1.6	--	2.1	--	--	2.2	--	1.5
Greater Scaup	0.3	6.7	2.4	2.8	--	2.2	--	1.4
Barrow's Goldeneye	--	--	1.8	--	3.5	--	3.0	1.3
Bufflehead	1.3	--	0.5	--	1.4	6.7	--	1.1
Redhead	--	--	1.3	--	--	--	--	0.5
Canvasback	--	--	0.7	--	--	--	--	0.2
Ringneck	0.3	--	0.2	--	--	--	--	0.2
Total Diver	7.4	6.7	11.7	2.8	4.9	11.1	3.0	8.2
W-W Scoter	3.2	--	0.3	--	1.4	--	--	1.5
Surf Scoter	0.3	--	0.3	--	7.7	--	--	1.5
Mergansers	1.6	--	--	--	--	1.1	--	0.5
Harlequin	--	--	0.2	--	0.7	3.3	--	0.4
Steller's Eider	--	--	--	--	--	--	3.0	0.1
Common Scoter	--	--	--	--	--	1.1	--	0.1
Old Squaw	--	--	--	--	0.7	--	--	0.1
Total Sea Ducks/ Mergansers	5.1	0	0.8	0	10.5	5.5	3.0	4.2
Sample Size	310	15	614	36	142	90	33	1,321

[1/] Includes birds harvested in unknown locations.

Table 5. Species composition of the goose harvest, 1978-79 waterfowl season.

Species	Percent of Total Harvest by Area							
	North Slope	Central	Y-K Delta	Cook Inlet	Gulf Coast	South-east	Alaska Peninsula	Percent of Total Statewide
Canada	-	62.5	50.0	97.3	-	100.0	45.5	77.9
Emperor	-	-	50.0	-	-	-	39.4	13.5
Brant	-	-	-	-	-	-	15.1	4.8
White-fronted	-	37.5	-	2.7	-	-	-	3.8
Snow	-	-	-	-	-	-	-	0
Sample Size	0	8	2	37	0	24	33	104

Table 6. A comparison between reported retrieved goose harvest from the 1978-79 and 1979-80 U.S.F.W.S. parts collection survey and the A.D.F.&G. mail survey, 1974-76 3 year average.

Harvest area	Percent of Statewide Harvest			Specific Location	Percent of Statewide Harvest		
	ADFG	USFWS			ADFG	USFWS	
	1974-76	1978	1979		1974-76	1978	1979
North Slope	0.4	1.2	0.0	Izembek Lagoon	21.3	45.4	10.6
Seward Peninsula	4.4	0.0	0.0	Pilot Point	11.5	6.7	8.7
Yukon Valley	4.4	0.0	0.0	Copper River Delta	9.4	3.1	0.0
Central	8.1	6.7	7.7	Minto Flats	4.9	1.8	0.1
Y-K Delta	7.3	1.8	1.9	Chickaloon Flats	2.1	3.7	13.5
Cook Inlet	10.1	16.0	35.6	Susitna Flats	1.8	5.5	2.9
Gulf Coast	13.6	4.9	0.0	Delta Area	1.8	3.1	1.9
Southeast	13.1	16.6	23.1	Stikine River Delta	1.5	6.7	9.6
Kodiak	0.2	0.0	0.0	Redoubt Bay	1.5	0.0	0.0
Alaska Peninsula	38.2	52.8	31.7	Mendenhall Wetlands	1.1	6.7	7.7
Aleutian Chain	0.1	0.0	0.0	Duncan Canal	1.1	0.0	0.0
	99.9	100.0	100.0	P. Moeller & Nelson Lagoon	1.0	0.0	0.0
				Trading Bay	0.8	5.5	0.0
				Palmer-Hay Flats	0.8	0.0	0.0
				Kachemak Bay	0.8	0.0	0.0
				St. James Bay	0.8	0.0	0.0
				Portage Area	0.4	0.0	0.0
				Port Heiden	0.4	0.0	0.0
					63.0	88.2	55.0

Discussion

The U.S.F.W.S. samples more hunters in their mail questionnaire survey than were sampled by State mail surveys. Compared to other states in the Pacific Flyway, sample size is proportionately much greater in Alaska. However, a major weakness lies in the parts collection survey which does not accurately reflect species composition of the harvest nor harvest by area. For example, perhaps 10 people from the Gulf Coast reported taking 25 geese in the mail questionnaire survey. However, if nobody from the Gulf Coast sent in goose tails (which happened this year) a calculated 0 geese were taken in 1979-80, which is erroneous.

As discussed by Timm (1978), the Department believed that the major compromise made when the State survey was dropped, was the loss of annual estimates of harvest and hunter days by specific location. However, it was believed that 3-year average estimates of these data, based on State surveys made during 1974-76, would be adequate until a need for more precise data arose. Requests for current and specific data continue to increase and a State survey is planned for the 1981-82 season, to update specific location of harvest and hunter activity information.

DUSKY CANADA GOOSE STUDIES

Production and Fall Flight

Timm (1978) described the growing difficulties of determining the size of the breeding population, due to increasing numbers of lesser Canadas (*Branta canadensis parvipes* and *B. c. taverneri*) in traditional dusky Canada goose (*B. c. occidentalis*) wintering areas. Simpson and Jarvis (1979) described some aspects of this change in subspecies composition in western Oregon.

Production in 1979 was far below average (16.0%). Although the spring was early and production prospects looked excellent, predation by brown bears was very high. Both on and off study areas, nest success averaged 7 percent (R. G. Bromley, pers. comm.). The only place where large numbers of goslings were seen during July was on islands in the Copper River. Bear use of the Delta during summer has been increasing gradually and may be a result of brush invasion. Vole (*microtus* sp.) numbers were high in 1979 and that may have contributed to the increased bear abundance.

On July 27, 1979 the authors counted 12,700 geese from the air and subsequently calculated 16 percent young in the population. Table 7 summarizes population data since 1971. The 1980 spring population is well above the population objective of >20,000 geese.

Table 7. Summary of population data for dusky Canada geese, 1971-80.

Year	Mid-winter	Breeding population[2]	% Yg.	% non-prod. ad.[3]	No. Yg. produced	Fall flight	Harvest[4]
1971	20,850	20,065	16.2	79.7	3,880	23,945	5,995
1972	17,950	17,275	10.6	71.7	2,050	19,325	3,450
1973	15,875[1]	15,280	36.0	64.6	8,595	23,875	4,875
1974	19,000[1]	18,290	51.4	35.7	19,345	37,635	12,070
1975	26,550[1]	25,565	17.9	84.5	5,575	31,140	9,010
1976	22,725[1]	21,870	24.2	54.2	6,890	28,850	6,350
1977	22,500[5]	21,650[5]	44.3	56.9	17,225	38,875	15,100[5]
1978	23,775[5]	23,000[5]	24.8	71.8	7,600	30,600	5,100[5]
1979	25,500[5]	24,500[5]	16.0	87.0	3,700	28,200	6,200
1980	22,000[5]	21,300[5]					

[1] Calculated from spring breeding grounds survey.
[2] Mid-winter less 0.037 mortality (Chapman et al. 1969).
[3] Percent of total adults in flocks with no young.
[4] Fall flight less mid-winter inventory.
[5] Preliminary estimates pending further analyses.

1980 Breeding Population Estimate

Increasing numbers of Canada geese other than duskys wintering in the Willamette Valley have made population estimates there more difficult, and has increased the need for reliable estimates from the Copper River Delta. However, the lack of an air-ground visibility correction factor for geese has hampered counts on the breeding area.

In 1978, some air-to-ground comparisons were made (R. G. Bromley, pers. comm.) and the conclusion was: as the number of geese present increased, the proportion of geese counted decreased (Timm 1978). Two back-to-back surveys were made in 1979; geese were first counted on both sides 110 yards from the aircraft and then the flight lines were reflown and geese were counted to 220 yards. The results from these two counts (Timm and Sellers 1979) further defined, but complicated, the visibility problems encountered in trying to estimate the dusky goose population on the nesting grounds.

On May 19, 1980 Sellers and two volunteer observers flew a survey using the standard procedures counting out to 220 yards (Timm 1978). After finishing the standard survey, flight lines 1-20 were reflown at 700 ft and approximately 400 aerial photos were taken using a Hasselblad camera with 80 mm lens, mounted in the belly of a Beaver aircraft. We used Ectachrome (ASA 200) 70 mm film and this combination resulted in a film scale of 1:2,664.

Preliminary examination of the film convinced us that, unlike the easily identifiable gulls and terns, geese were difficult to see on the negatives, even using 10 X magnification, because of poor contrast with vegetation. This was especially true in brushy areas. Twenty-seven randomly selected photos of the high density nesting area were examined using a binocular microscope. From these photos which covered 232 acres, we calculated a density of 121 geese/sq. mi. This estimate was higher than obtained from visual counts on the standard survey (81.6 geese/sq mile), but was still much lower than the actual density determined from field searching of study plots (about 400 geese/per sq. mi.).

Based on the experience gained from this first attempt at an aerail photo survey, we plan to implement changes in procedure to improve results:

1. Use a higher resolution film.

2. Fly at 700 ft using a 150 mm lens to reduce the film scale to 1:1,421).

Although we made a literature search and contacted people knowledgeable about aerial photography before the survey, no one could tell us exactly how to photograph geese on the Delta.

Band Recoveries

For the first time in 10 years, large numbers of dusky geese were not banded (only 9 females were nest-trapped). The revised flyway management plan for dusky geese calls for banding every 3-4 years, to determine distribution and timing of the harvest. Banding is planned for 1982.

The recovery distribution of bands reported from birds shot or found dead during hunting seasons, by area, since 1974 is as follows (through 7/14/80 IBM run):

Year	Oregon	Alaska	Br. Columbia	Washington
1974	67.8	11.5	14.4	6.3
1975	67.3	14.0	13.5	5.2
1976	65.5	10.0	13.3	11.2
1977	71.4	17.0	4.1	7.5
1978	63.3	19.3	14.2	3.2
1979	64.2	18.5	2.5	14.8

During the 1978-79 season there were 6 "abnormal" recoveries - 5 in California and 1 in Utah (Timm and Sellers 1979). There were no abnormal recoveries south of Alaska during 1979-80. R. L. Jarvis (pers. comm.) felt the abnormal winter in the Willamette Valley (cold temperatures which froze open water and reduced available food) contributed to the wandering. Timm and Sellers (1979) speculated that the influx of lesser Canada geese (*B. c. taverneri* and *parvipes*) may have resulted in overcrowding. A gradual shift to small grain crops from grass may be a major reason for the large influx of lesser Canadas in the Valley since the mid-1970's.

LESSER CANADA GOOSE STUDIES

Cold Bay

No banding of Canada geese (*B. c. taverneri*) was attempted in 1979. Since Timm and Sellers (1979) reported the derivation of 21 recoveries from banding in 1977 and 1978, there have been 7 additional bands reported: 2 from the northern Yukon-Kuskokwim Delta, shot in May and July; 1 each from the mouth of the Columbia River, in the Willamette Valley, on Sauvie Island, in the Klamath Falls area, and at Cold Bay during fall 1979. These recoveries further confirmed the short stopping of Cold Bay geese in Oregon's Willamette Valley and along the Columbia River.

The nesting area for Cold Bay geese was further indicated to be the Y-K Delta by band recoveries from geese banded on the Delta and Nunivak Island in 1979. One recovery occurred at Cold Bay and four were from Oregon. Birds were banded on the Y-K Delta and on Nunivak by the USFWS and Dr. Bob Jarvis, Oregon State University.

Cook Inlet

The U.S. Army requested that Canada geese be transplanted to Otter Lake on Fort Richardson. The Army made extensive waterfowl habitat improvements of Otter Lake in early 1980, which included small islands and other suitable goose nesting areas.

On July 31, 1979 a crew of Army and ADF&G personnel captured 108 Canada geese on the Palmer Hay Flats, using an Army Huey helicopter. Sixty goslings and 13 adults were transplanted to Otter Lake; 19 adults and 16 goslings were banded and released at the capture site. Otter Lake is 19 miles southeast of the capture area.

During the 1979-80 hunting season, 6 of 108 banded birds were reported shot: 3 transplanted goslings (5.0%); 1 transplanted adult (7.7%); and 1 adult and 1 gosling of the birds not transplanted (5.3% and 6.2%, respectively). Two transplanted birds were shot in Oregon, one in southern British Columbia and one on Palmer Hay Flats in early October.

Although the Otter Lake project was less than 1 year old and we expected no use of the area by nesting Canada geese until the transplanted goslings were 3 years old (1982), a brood of five goslings was reared on the area in 1980. One of the adult pair had a leg band.

TULE GOOSE

The nesting grounds of the tule white-fronted goose (*Anser albifrons gambeli*) were discovered in 1979 and verified in 1980 (manuscript in preparation). The following is a report describing the background of the discovery.

During spring and summer 1980, visual observations of tules were made from the ground and air, eight nests were located in Redoubt Bay, and geese were banded and measured. The geographically isolated nesting area was confirmed by observations of tules marked in California, morphological criteria and assessment of population size compared to population estimates in California.

An Alaskan Summering Area for Tule White-fronted Geese

Daniel E. Timm
Alaska Department of Fish and Game, Anchorage

July 1979

On July 28, 1979 I collected, at random, four flightless adult white-fronted geese in Redoubt Bay, Cook Inlet, Alaska. I estimated that 1,125 adults were present (incomplete count), and 75 percent were flying. The following morphological

characters were recorded (after Krogman 1979). Measurements are in millimeters.

Specimen 79RB1; age - over 1 year; sex - male; culmen - 56.6; diagonal tarsus - 78.6; posterior nares to bill tip - 38.8; maximum mandible width - 27.6; bill depth - 31.7; weight - 3,080 grams; moderate orange stain on face patch; sparse breast mottling.

Specimen 79RB2; age - over 1 year; sex - male; culmen - 59.0; diagonal tarsus - 80.4; posterior nares - 42.7; mandible width - 26.8; bill depth - 31.8; weight - 3,280 grams; moderate orange stain on face patch; sparse breast mottling.

Specimen 79RB3; age - over 1 year; sex - female; culmen -58.9; diagonal tarsus - 72.2; posterior nares - 40.9; mandible width - 24.3; bill depth - 28.8; weight - 2,460 grams; moderate orange stain on face patch; sparse breast mottling.

Specimen 79RB4; age - over 1 year; sex - female; culmen - 57.4; diagonal tarsus - 75.4; posterior nares - 38.6; mandible width - 26.8; bill depth - 32.2; weight - 2,580 grams; slight orange stain on face patch; sparse breast mottling.

All of the birds had dark brown necks and backs. Comparisons of these morphological characteristics with those presented by Bauer (1979) Krogman (1979) and Delacour and Ripley (1975), gross comparisons with mounted specimens of *Anser albifrons frontalis*, and the population characteristics of white-fronts in Redoubt Bay, indicate that the breeding area for tule geese has been found. The nearest nesting white-fronts from Cook Inlet are about 150 miles southwest, across the Alaska Range.

History of Cook Inlet Summering Flock

To my knowledge Rae Baxter, fisheries biologist for ADF&G, was the first to report summering white-fronts in Redoubt Bay. In about 1962 he saw "several hundred." State and federal biologists have been aware of the birds since then.

Havens (1971) observed three broods of white-fronted geese on Susitna Flats on June 25, 1970. This observation was about 75 miles NNE of Redoubt Bay, across Cook Inlet from Anchorage. Despite numerous air and ground counts of Canada geese on Susitna Flats since 1971, I have seen no flightless white-fronted geese on that area. In 1975, one yearling female *frontalis* was captured with a molting flock of Canada geese on Palmer Hay Flats, about 40 miles NE of Susitna Flats.

Bob Elgas, Warren Hancock and Ed Collins inspected the white-fronts in Redoubt Bay from a helicopter in July 1974.

Although they did not handle the geese, they did not believe the birds were "tule type" (W. J. Hancock 1975, unpublished report, Tule Goose Search - Alaska 1974, 2p). Seven tules had radios attached in California that year, but no signals were heard during aerial searches of Alaska by these individuals and Dick Bauer. Ed Collins (pers. comm.) said that they saw two or three broods of white-fronts in Redoubt Bay.

On July 30, 1974 I made an inventory of geese in Cook Inlet (Timm 1975). Incomplete counts of birds showed 693 adult white-fronts in Redoubt Bay, 110 adults in Trading Bay and 60 adults on Susitna Flats. The 60 birds on Susitna Flats were capable of flight. From 1974 to 1978 I saw white-fronts in Redoubt Bay several times during the summer, and in 1978 I estimated 1,000 to be present (unpubl. data). Jim King (unpubl. data) saw 300 white-fronts in Redoubt Bay during a trumpeter swan survey on August 7, 1975. These birds were probably capable of flight. A complete count of white-fronts in Cook Inlet has never been made.

In 1978, Dan Connelly, CDF&G, flew over the area at high altitude, trying to locate 16 tule geese equipped with radio collars in California the previous winter; he located none. One radio-equipped goose, however, was found dead on Queen Charlotte Island (Bauer 1979).

During August 2-4, 1978 Richard Sellers and I observed about 500 white-fronts on Susitna Flats near Lewis River Slough. All geese were flight capable and some were seen arriving from the south. During the day the geese utilized intertidal flats characterized by *Carex* and *Triglochin*. The birds roosted at night in wet "pucker brush" (sweet gale and dwarf birch).

On September 1, 1978 I shot a large, dark adult male white-fronted goose on Susitna Flats. The culmen measured 57.5 mm and the diagonal tarsus 79.0 mm. The bird had light mottling on its breast and a moderate amount of orange stain on the face patch.

On April 21 and 22, 1979 I observed about 75 white-fronts on the Kenai River Flats, across Cook Inlet from Redoubt Bay. Although I had never seen a tule goose, these birds appeared large and dark. All of the above observations led me to believe that a closer examination of the geese in Redoubt Bay was warranted.

On July 3, 1979, Warren Hancock and Bob Elgas observed over 100 goslings with adults in three flocks, near the mouth of Big River in Redoubt Bay. They observed the birds from a fixed-wing aircraft. There was one light colored whitefront in a flock of about 30 larger and dark adults, but Elgas said he recognized the birds as tules, even though he was unaware of the light bird and before the pictures were developed (pers. comm.). To my knowledge this is the first verified observation of goslings in Redoubt Bay.

On July 22, 1979, Elgas, Hancock and I used a helicopter to capture seven male and three female goslings. We tried unsuccessfully to capture adults. The young ranged from about 4½ weeks to 6 weeks of age. Elgas and Hancock had a permit for up to 15 birds, so they have the 10 in captivity. The geese were developing a dark head, neck and back. We captured the young geese from a flock of about 20-25 adults and 50-60 young.

The flock with young was located near salt water at the mouth of the Big River. Since I have never seen young near the flocks of molting adults (about 5 miles inland), I assume that brood rearing occurs near tidal waters in a *Carex-Triglochin* plant community.

I looked closely at 500 to 600 adults from a helicopter on July 22 and all were uniformly dark colored and of a similar size. Between July 22 and July 28 most of the adults had moved about 1.5 miles after the Big River had risen several feet from heavy rains.

Land Status and Potential Habitat Threats

Redoubt Bay is State-owned land. In 1977 and 1978 the Alaska Legislature did not act on proposals to classify the area as State Refuge. Both Trading Bay and Susitna Flats are, however, State Refuges. The Kenai River Delta is owned by the State and Borough.

A potential threat of oil spills exists from some 14 platforms in Cook Inlet, offshore of Redoubt Bay and Trading Bay. Although numerous small spills of oil and jet fuel have occurred from the platforms, tankers and shore facilities, none are known to have adversely affected either area in the past.

The Kenai River Delta has been identified by ADF&G as a "sensitive" area under Coastal Zone Management Planning, due to use by snow geese *(Chen hyperborea)* in the spring. The area is subject to increasing pressures for land development as it is located near Kenai.

Uplands of Trading Bay, Susitna Flats and Redoubt Bay have many long-term oil and gas leases in effect; exploration has been most active on Susitna Flats. All activities are closely monitored by ADF&G, and pre-exploration plans are approved or modified by the Department.

Management and Research Needs

Studies in Alaska are necessary before a rational classification of the birds can be made. A "threatened" or "endangered" designation at this time would be premature and perhaps unnecessary.

Minimum needs include a complete census during mid-July and a banding and color marking program with observations throughout the flyway. A color marking program would not only verify tule classification by observations on behavior in California, but it would also provide management information. It is also necessary to make a thorough analysis of potential threats throughout the birds' range. The identification of nesting habitat is also of high priority.

The Department of Fish and Game will be contacting the USFWS and at that time we will advise the Service of our plans for study of this goose.

LEAD POISONING STUDIES

The effects of ingested lead shot have been studied in Alaska since 1974. Uncertainties and some controversy have persisted regarding mandatory conversion to nontoxic (steel) shot.

In 1978 the Department decided to resolve the issue with an intensive study, partially funded by the USFWS, that had mutually agreed upon standards for identification of a lead poisoning problem in Cook Inlet.

The following report was sent to the USFWS and they concurred with the findings: mandatory use of steel shot in Alaska was unwarranted. Periodic monitoring for lead poisoning is planned, and may be done by collecting ducks in the spring, as suggested by R. I. Smith, USFWS (pers. comm.).

Effects of Ingested Lead Shot - 1978 Studies In Cook Inlet, Alaska

By: Richard Sellers and Daniel Timm, Alaska Department of Fish and Game, Anchorage

Submitted: January 1980

INTRODUCTION

The controversy over identification of areas with lead poisoning problems and imposition of steel shot requirements for these areas continues despite a common goal of minimizing waterfowl losses from plumbism. Cook Inlet has been identified as the only region of Alaska with a possible lead poisoning problem based on high rates of shot ingestion by mallards and pintails. To evaluate the extent of lead poisoning occurring within Cook Inlet, the Alaska Department of Fish and Game undertook a study during 1978-79 in cooperation with the U.S. Fish and Wildlife Service. The study objectives, as mutually agreed upon by both agencies were:

(1) To ascertain lead levels in livers and wing bones from immature mallards and pintails collected during summer and fall; the desired sample was 250 of each species. Lead levels of 30 ppm in each species, would be considered significant. In that case, additional studies, such as a dosing experiment, may be warranted or the use of steel shot may be required.

(2) To determine the relationships between body weight, the amount of lead in bone and tissue, and shot ingestion.

(3) To determine food habits of mallards and pintails in Upper Cook Inlet during late summer and fall.

ADF&G conducted the field work and analyzed data while USFWS provided funds for tissue analysis. Timm and Sellers (1979) reported the results of the food habits study and a preliminary analysis of lead ingestion rates.

METHODS

Gizzards from mallards and pintails collected in 1978 from Cook Inlet were examined for ingested lead shot by flushing contents into tall beakers and then flooding the beakers with running water to wash out lighter material. The residual material was examined for lead shot. Each pellet was classified as "ingested" or "shot in" based on physical characteristics of the pellet and evidence of wounds in the gizzard.

Fresh body weight (measured with a spring scale), a wing, and liver tissue from randomly selected birds were collected only from immature mallards and pintails. Frozen wings and livers were sent to Raltech Scientific Services, Inc. for analysis of lead content.

RESULTS AND DISCUSSION

Incidence of Ingested Shot in Gizzards

Analyses of 3,070 waterfowl gizzards collected in Alaska since 1974 have shown that Cook Inlet is the only region of the state where ducks ingest significant amounts of lead shot (Table 8).

Table 8. Incidence of ingested lead shot in duck gizzards by region, 1974-1979.

Region	Number of Gizzards	% with ingested shot
Southeast	1,117	1.9
Gulf Coast	229	3.5
Cook Inlet	1,064	15.1
Kodiak	79	1.3
Alaska Peninsula	225	0
Interior	356	4.2

Within Cook Inlet, ingestion rates for mallards and pintails varied considerably between local marshes and by time period (Table 9). Ducks on Palmer Hay Flats and Susitna Flats had the highest ingestion rates (31.7% and 17.3%, respectively) while ingestion rates on other marshes averaged about 10 percent. Palmer Hay Flats and Susitna Flats are the two most intensively hunted areas of the state (Timm 1977), and the high ingestion rates undoubtedly reflect the availability of lead to waterfowl using these marshes. Besides having the highest ingestion rates, ducks from Palmer Hay Flats and Susitna Flats had higher average numbers of shot per gizzard (Table 10) than other Cook Inlet marshes.

Of those ducks with ingested shot, 44 percent and 28 percent from Palmer Hay Flats and Susitna Flats, respectively, contained five or more shot. Only 15 percent of ducks with ingested shot collected from 12 hunting areas in the Lower 48 states had five or more ingested shot (White and Stendell 1977).

Of 99 mallards and pintails collected during summer in Cook Inlet and 86 collected opening morning, September 1, (when the chance of ingesting newly spent lead shot was minimal), 22.2 percent contained ingested shot. These data suggest that lead shot deposited during previous seasons remained readily available for at least a year. The average number of ingested shot per positive gizzard was lower for the summer sample (2.7 pellets) than for positive gizzards collected after opening day (5.1 pellets).

Mallards and pintails collected during October in Cook Inlet had the lowest ingestion rate (8.7%) of any time period, which probably reflects the relatively short time late migrants spend in Cook Inlet.

Table 10. Frequency distribution and average number of ingested lead shot for duck gizzards from Cook Inlet, Alaska, 1974-78.

Number of Shot	Palmer Hay Flats No. of gizzrds	(%)	Susitna Flats No. of gizzards	(%)	Other Cook Inlet No. of gizzards	(%)
1	22	26	24	47	10	71
2	8	10	8	16	0	-
3	5	6	3	6	2	14
4	12	14	2	4	1	7
5-10	11	13	7	14	1	7
> 10	26	31	7	14	0	-
Totals	84	100.0	51	100.0	14	99.0
Ave. No. of shot/ gizzard	11.5		4.8		1.9	

Table 9. Incidence of ingested lead shot in mallards and pintails by time period for Upper Cook Inlet, 1974-1979.

Area	Summer		Sept. 1-15		Sept. 16-30		Oct. on		Total	
	% With Shot	Sample Size	% With Shot	Sample Size	% With Shot	Sample Size	% With Shot	Sample Size	% With Shot	Sample Size
Palmer Hay Flats	34.5	29	45.4	141	7.7	13	10.0	79	31.7	262
Susitna Flats	19.0	58	27.3	66	20.0	50	7.0	86	17.3	260
Chickaloon Flats	-	-	8.3	24	0	1	18.2	11	11.1	36
Goose Bay	33.3	3	8.3	24	-	-	-	-	11.1	27
Potter Marsh	-	-	10.8	37	0	2	0	8	8.5	47
Trading Bay	11.1	9	-	-	-	-	-	-	11.1	9
TOTAL	17.2	99	23.0	391	16.7	66	8.7	184	21.8	641

Lead in Livers

Although the relatively high ingestion rates for several Cook Inlet marshes were acknowledged, Timm (1976) questioned whether ingested shot were actually poisoning waterfowl on these marshes in light of the lack of clinical symptoms of lead poisoning among virtually all waterfowl examined. To determine how much lead was absorbed by waterfowl on Cook Inlet marshes, Timm (1976) analyzed 35 livers from ducks with known numbers of ingested shot. Lead residues varied from 0.03 to 48.1 ppm. Longcore et al. (1974) found that acute exposure to lead resulted in lead residues in liver of 6 to 20 ppm. Only four ducks in the 1975 sample had over 6 ppm of lead in the liver, and these four birds had a total of 165 ingested lead shot (Timm 1976).

In the 1978 sample, lead residues in livers of 117 randomly selected immature mallards and pintails from Cook Inlet ranged from trace levels to 15.6 ppm (Table 11). Only two (1.7%) of these livers contained over 6 ppm lead, and these two ducks had ingested 10 and 13 lead shot.

Table 11. Lead residues in livers of immature mallards and pintails from Cook Inlet, Alaska, 1978.

Area	No. Analyzed	ppm Lead		Percent of Livers with	
		Mean	Range	<0.1 ppm	>6 ppm
Palmer Hay Flats	44	0.57	<0.1- 4.8	48.0	0.0
Susitna Flats	57	0.87	<0.1-15.6	47.0	3.5
Other	16	0.29	<0.1- 3.02	62.0	0.0
TOTAL	117	0.68	<0.1-15.6	50	1.7

Lead in Wingbones

Lead residues in bone tissue can reflect acute and/or chronic exposure because lead is generally deposited rapidly, but lost slowly (Stendell et al. 1979). Unlike areas to the south, lead residues in wings of immature ducks collected in Cook Inlet, Alaska can be assumed to originate almost soley from locally ingested lead shot or lead present in the Alaskan environment from other sources. For example, a recent study documented the assimilation of lead by aquatic plants in areas with high accumulations of lead shot in the soil (Selser 1977).

Lead residues in wingbones from immature mallards and pintails collected in Cook Inlet in 1978 ranged from <0.5 to 826 ppm. Table 12 compares residues of lead in wings of immature mallards and pintails from Cook Inlet with residues from several other areas of the Pacific Flyway as reported by Stendell et al. (1979). Other than for eastern Washington, ducks from Cook Inlet had lower lead burdens than found in other states of the Pacific Flyway.

Table 12. Residues of lead (ppm) in wing bones of immature mallards and pintails from Cook Inlet, 1978 and of immature mallards from different zones of Pacific Flyway States, 1973 (from Stendell et al. 1979).

Area	Sample Size	Statistic (ppm)			Percent of Wings With	
		Mean	Median	Interquartile Range	>20.0 ppm	<0.5 ppm
Cook Inlet, Alaska	227	13.7	0.8	6.1	15.0	36.1
Washington, East	56	8.4	0.9	2.5	14.3	16.1
Washington, West	62	23.6	2.5	20.8	25.8	32.3
Oregon, Columbia River	37	44.7	10.1	46.6	43.2	32.4
Oregon, Remainder	60	15.3	1.3	12.7	20.0	23.3
California, Merced	62	15.0	4.1	22.2	25.8	1.6
California, Sacramento	63	28.4	1.8	17.6	23.8	22.2
California, Remainder	64	24.6	7.4	20.4	26.6	6.3

Stendell et al. (1979) also used cumulative frequency distribution curves of lead residues from <0.5 to >20 ppm to analyze lead levels in wings. Fig. 1 shows Cook Inlet samples plotted on their graph for immature mallards from the four flyways. The value on the ordinate of this graph represents the sum of all residues up to and including the level indicated. Immature mallards and pintails from Cook Inlet showed lower lead burdens in wing bones than immature mallards in the Atlantic, Mississippi and Pacific Flyways. A greater percentage of Cook Inlet ducks (36%) were "clean" (<0.5 ppm in wing bones) than were mallards from the Central Flyway (32.9%), but 15.0 percent of the Cook Inlet wings had over 20 ppm compared to only 4.9 percent for the Central Flyway. In Cook Inlet, 12.7 percent of the 227 wings contained over 30 ppm of lead, a standard used by the U.S.F.W.S. for identification of problem areas.

Correlation of Lead in Liver, Wing Bones, and Gizzards

Lead residues in liver have been used as an indication of recent exposure because circulating lead is readily deposited in soft tissues. Several studies of experimentally dosed ducks have shown that lead is also rapidly deposited in bone tissue after exposure (Stendell et al. 1979). Assuming that Cook Inlet is the primary source of lead for immature mallards and pintails collected there, a correlation between the number of lead shot in the gizzards and lead residues in both livers and wing bones could be expected. However, there was no predictable relationship between the number of lead shot in the gizzard of an individual duck and the lead level in either liver ($r = .50$, $N = 117$) or wing bone ($r = .10$, $N = 227$). White and Stendell (1977), likewise, found no correlation between ingested shot and lead levels in wing bones.

Of those ducks from Cook Inlet with one or more lead shot in their gizzards, 24 percent had "clean" livers (<0.1 ppm) and 16 percent had "clean" wing bones (<0.5 ppm). Of those Cook Inlet birds with heavy lead residues (>20 ppm) in their wing bones, 47 percent had no shot in their gizzards. The two birds with heavy lead levels in their livers--12.5 ppm and 15.6 ppm--also had heavy residues in their wing bones (35.8 ppm and 341 ppm, respectively) and large numbers of ingested shot (10 and 13 shot, respectively).

There was a positive correlation ($r = .84$) between lead levels in corresponding livers and wing bones for all immature mallards and pintails from Cook Inlet analyzed in 1975 and 1978 ($N = 119$).

Duck Weights

Waterfowl suffering toxic effects from ingested lead show rapid weight loss (Longcore et al. 1974; Anderson 1975; U.S.D.I. 1976). However, correlations of lead residues in

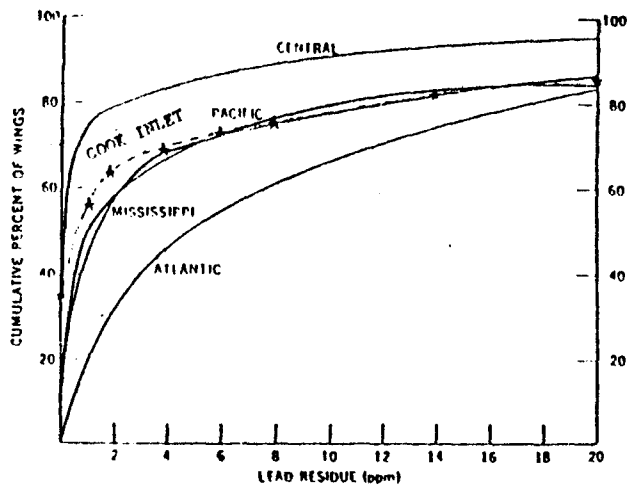


Fig. 2. Cumulative frequency distributions showing differences in lead residues for immature mallards from different flyways and immature mallards and pintails from Cook Inlet*, Alaska.

wing bones to body weights for immature mallards and pintails in Cook Inlet showed no predictable relationships ($r < .50$). However, some sample sizes were too small to analyze correlations due to variation in body weight by species, sex and date of collection.

Ratios of average body weights for ducks with less 20 ppm of lead in wing bones versus those with more than 20 ppm ranged from .89 to 1.16 (Table 13). The average of these ratios was very close to unity (.996), indicating that lead residues in wing bones did not have a significant influence on body weight.

Clinical Symptoms

Since lead poisoning studies began in Cook Inlet in 1974, only 3 of 641 mallards and pintails (0.47%) exhibited symptoms of lead poisoning. These birds had 15, 43 and 98 ingested shot in their gizzards. The latter two had 48.1 ppm and 15.1 ppm lead in their livers.

Food Habits

The influence of diet on toxic effects from ingested lead has been recognized by many investigators (summarized by Irwin 1977). While some diets, most notably hard grains, seem to exacerbate plumbism, certain elements of more complete diets tend to reduce the toxicity of lead.

The diet of Cook Inlet mallards and pintails consists primarily of seeds, vegetation and tubers of aquatic plants (*Carex, Scirpus, Hippuris, Potomogeton, Triglochin,* and *Zannichellia)* and animal matter (insects, clams, snails) (Timm and Sellers 1979). The extent to which this diet of natural food inhibits lead absorption and subsequent pathogenesis is unknown. It is likely, however, that this diet, which is high in protein and calcium and is void of commerical grain, is at least partly responsible for the absence of lead-induced die-offs in Cook Inlet and for tissue lead levels which are not commensurate with ingestion rates.

CONCLUSIONS

Mallards and pintails using Cook Inlet marshes, especially Palmer Hay Flats and Susitna Flats, have high rates of ingested lead shot, both prior to and during the hunting season. However, data on indicators of acute lead toxicity (liver residues, body weights and clinical symptoms) do not suggest significant lead poisoning occurs within Cook Inlet. Only 1.7 percent of mallards and pintails had >6.0 ppm lead in their livers. Overall wing bone residues were not higher than for the entire Pacific Flyway.

Stendell et al. (1979) concluded that, "The occurrence of lead pellets in gizzards indicates current ingestion rates, but

Table 13. Average weights of immature mallards and pintails with less than versus more than 20 ppm of lead in wingbone, Cook Inlet, Alaska 1978.

	Average weight (g)				Ratio of weights for <20 ppm/>20 ppm
	<20 ppm	(No.)	Ducks with >20 ppm	(No.)	
Mallards					
Male					
August	1110	(2)	980	(1)	1.13
Early Sept.	1145	(10)	1140	(3)	1.00
Late Sept.	1188	(9)	1183	(4)	1.00
October	1232	(11)	-	(0)	-
Female					
August	957	(3)	993	(3)	.96
Early Sept.	1027	(4)	1088	(3)	.94
Late Sept.	1007	(3)	983	(2)	1.02
October	1101	(19)	1225	(1)	.90
Pintails					
Male					
August	788	(13)	888	(4)	.89
Early Sept.	901	(24)	936	(3)	.96
Late Sept.	975	(3)	-	(0)	-
October	931	(11)	970	(1)	.96
Female					
August	719	(14)	712	(2)	1.01
Early Sept.	837	(15)	883	(3)	.95
Late Sept.	830	(4)	775	(1)	1.07
October	879	(12)	760	(1)	1.16

because of the complexity of factors influencing lead toxicity, it does not necessarily indicate mortality or the extent of sublethal effects." Analysis of lead residues in liver and bone may not supply conclusive evidence of the physiological threats of sublethal doses because the effects of factors such as migration, weather and various natural diets have not been adequately evaluated.

Biochemical lesions, particularly inhibition of delta-aminolevulinic acid dehydratase (an enzyme involved in the synthesis of heme), may persist long after the initial exposure to lead, even when no clinical symptoms, weight loss or mortality occur (Dieter and Finley 1979, Finley and Dieter 1976). However, Hanzlik (1923), concluded "tissue injury, or poisoning, by lead is not increased in proportion to the mere quantity of deposited lead, but is dependent on the concentration of soluble lead in the tissues..." The low residues of lead in livers of Cook Inlet ducks suggest that most lead absorbed is quickly stored in bone and consequently is not circulating in soluble form.

Even if lead shot ingested in Cook Inlet is voided before ducks reach wintering areas where lead shot is again more available and where diets may be exasperating, it is likely that lead residues remain in bone tissue and that delta-aminolevulinic acid dehydratase continues to be inhibited. The extent that sublethal burdens of lead acquired in Cook Inlet contribute to mortality during migration or upon subsequent exposure to lead on wintering areas continues to be obscure.

MANAGEMENT RECOMMENDATIONS

1. We recommend retaining the use of lead shot for waterfowl hunting in Cook Inlet. However, the Department must remain ready to reevaluate the use of lead shot in Cook Inlet upon evidence of either of the following occurrences:

   (a) waterfowl die-offs within Cook Inlet attributable to lead poisoning

   (b) reduced survival rates for ducks with sublethal residues of the magnitude acquired in Cook Inlet

2. The Department should continue to monitor the ingestion of lead pellets in ducks using Cook Inlet as long as lead shot remains in common use. Monitoring can be accomplished most efficiently by sampling immature mallards and pintails taken on or near opening day on Palmer Hay Flats.

   Sampling Procedure:

   (a) Sampling should be done every 3 to 4 years beginning in 1981 or 1982.

(b) A minimum sample of 100 immature mallards and pintails should be collected between 9/1 and 9/3.

(c) Samples should include the following:

(1) whole body weight

(2) examination of ducks for clinical signs of lead poisoning.

(3) gizzard analysis for ingested lead and gizzard weight (empty)

(4) Collection and analysis of body tissues for lead residues are desirable, but would be dependent upon availability of funds.

3. This report should be circulated publicly, and news releases should be made. Hunters should be presented with unbiased summaries of all sides of the issue. Since ingested lead shot are not believed to cause increased mortality of a significant degree to ducks in Alaska, hunters should have the option of discretionary use of steel shot.

PACIFIC AND CENTRAL FLYWAY MANAGEMENT PLANS

The authors participated in writing management plans for geese, swans and cranes common to Alaska, the Central Flyway and the Pacific Flyway. One-half of Timm's salary has been paid directly by the FWS the past year. In return, ADF&G has been deeply involved with writing the plans (3 in the Central Flyway and 12 Pacific). The documents are mostly written and are in various stages of inter and intra-agency review. The reimbursable services contract with the FWS ends September 30, 1980.

The plans have already been beneficial by prompting change in goose surveys in Oregon and California, reducing the frequency of dusky goose banding, and by providing population objectives which States and the FWS used to justify recent goose harvest reductions in the lower Pacific Flyway.

STUDIES AT PILOT POINT AND CINDER RIVER: AIRCRAFT DISTURBANCE OF GEESE

Pilot Point and Cinder River Critical Habitat areas support some of the largest fall concentrations of cackling Canada geese *(B. c. minima)* and snow geese in Alaska. In addition, both areas receive heavy use by migrating emperor geese. During peak use, these two coastal marshes support tens of thousands of geese (Table 14), and despite its relative remoteness, Pilot Point is the second most important goose hunting area in the state (Table 6).

Concern has been expressed by some local residents, hunters and biologists (Jim Faro pers. comm.) that geese have been changing their pattern of use during fall migrations. Some of the suspected changes include: (1) fewer geese present at peak migrations; (2) a shorter period of peak use; (3) later arrival, particularly for snow geese; and (4) heavier use of tundra habitat by snow geese. Since there is no indication of a significant alteration of habitat at either Pilot Point or Cinder River, the most obvious factors that could be affecting goose use are weather, human disturbance of geese once they arrive, and population size.

The influence that weather plays on fall migration is not fully understood. In talking with several long-time residents of Pilot Point, the concensus was that the geese arrive shortly after they are frozen out of the Y-K Delta area and stay in Pilot Point until a cold snap pushes them out. Unfortunately, long-term records on the arrival and departure dates of geese on the Alaska Peninsula are not available to confirm this sequence of events. To document the roll that weather has on fall use of these Critical Habitats, annual records will be kept and compiled for the following: (1) peak hatching dates for cacklers and Wrangel Island snow geese; (2) fall temperatures for breeding grounds and staging areas north of the

Table 14. Estimates of fall goose contentrations at Pilot Point and Cinder River, Alaska.

	10/23/68		10/06/69		09/24/79		10/08/70		10/04/71		10/17/75		10/14/76	
	Pilot Point	Cinder River	Pilot Point	Cinder River	Pilot Point	Cinder River	Pilot Point	Cinder River	Pilot Point	Cinder River	Pilot Point	Cinder River	Pilot Point	Cinder River
Canada geese	0	0	64,000	0	5,150	135	33,600	3,350	9,095	6,891	12,135	5,347	11,774	10,744
Snow geese	0	0	190	0	12	0	36,950	6,700	7,674	14,020	0	391	422	3,601
Emperor geese	250	25,000	0	75,000	50	17,180	0	10,050	60	4,984	270	0	545	2,250

Alaska Peninsula; (3) departure dates (if available) for geese leaving the breeding grounds and northern staging areas; (4) weather records for Alaska Peninsula; (5) dates of major arrivals and departures for cacklers and snows at Pilot Point; and (6) possibly some measure of physiological condition of birds as they progress down the flyway.

In view of evidence that low flying aircraft disturb waterfowl, especially geese, in Cook Inlet (Sellers 1979), evidence that snow geese are especially susceptible to aircraft disturbance (Salter and Davis 1974) and the increase in aircraft traffic over Pilot Point, a study was initiated in 1979 to evaluate the possibility that aircraft disturbance affects goose use of these two critical habitat areas.

1979 Goose Migration

Geese which nest on the Yukon-Kuskokwim Delta experienced an early spring in 1979 and a generally good breeding season. The same was true for Wrangel Island snow geese. Possibly because of the advanced reproductive season, there was an early departure of Canadas (subspecies not identified) from the Clarence Rhode National Wildlife Refuge (Chris Dau pers. comm.). Weather during early September, when these geese departed, was seasonable.

Several Pilot Point residents reported thousands of emperor and Canada geese on Cinder River in early September. Alec Griechen (pers. comm.) referred to the Canadas as "lessers" but it remains uncertain whether these were *parvipes* or *minima*. This large concentration apparently dissipated by mid-September.

In most years peak cackler and snow goose migration through Pilot Point occurs about October 10-12. Aerial counts and ground observations between October 3-15, 1979 indicated a relatively stable, but small maximum number of geese:

	Cacklers	Snow Geese	Emperors
Pilot Point	<1000	1	400
Cinder River	22	4	3000

Bob Gill (USFWS) flew surveys along the coast from the Y-K Delta to Izembek Lagoon, in 1979. He reported large numbers of cacklers still on the Y-K Delta and only about 400 Canadas at Chagvan Bay on October 1; about 200 Canadas at Pilot Point and 1,300 Canadas and 3,500 emperors at Cinder River on October 2.

Warm weather on the Y-K Delta evidently kept geese in that region until a cold snap occurred about October 18, which moved both cacklers and snow geese towards the Alaska Peninsula.

Reports from several people at Pilot Point and Ugashik indicated that both cacklers and snow geese were seen overflying there between October 19-22. Bob Curtis (pers. comm.) arrived at Ugashik on October 20. Despite flying over part of the area, he encountered few cacklers and virtually no snow geese until October 22 when he found 10,000-15,000 cacklers near King Salmon Slough. A hard overnight freeze on October 22 drove all geese from the Pilot Point area.

Aircraft Traffic was monitored at Pilot Point and Cinder River to provide baseline data on the frequency of low altitude overflights and landings.

Pilot Point - Random observation periods from 3-7 October and 11-15 October totaled 29.5 hours. Between 7:00 a.m. and 7:00 p.m. there was an hourly average of 3.6 aircraft flights below 500 feet and another 0.6 overflights above 500 feet altitude. The frequency of flights was greatest in late afternoon when an average of 4.8 low overflights occurred per hour. Although it was difficult to keep track of the entire wetland area at Pilot Point, I tried to estimate how many landings and take-offs occurred on the coastal marsh. During the first half of October, a daily average of about five planes landed and later took-off.

Cinder River - Aircraft traffic over Cinder River was considerably lighter and every incident was recorded during 28 hours of daylight observation from 9:30 a.m. on 8 October to 2:00 p.m. on 10 October. Low altitude flights (<500 feet) averaged 0.4 per hour and higher overflights averaged 0.3 per hour. During the 3 days of observation, only two planes landed at Cinder River.

Aircraft Disturbance of Geese

Emperor geese at Cinder River were flushed by low flying aircraft nine times during 28 hours of observation. The number of emperors disturbed per incident averaged 900 (range 40 to 3000) and depended primarily on the number of geese in close proximity to the airplane. On two occasions when a plane flew the center of the bay at an altitude of 200 to 300 feet, all geese present, including those over a mile away from the plane, flushed. Once disturbed, the reaction varied considerably. Three disturbances resulted in only a brief arousal with most or all geese returning to their original location after a few seconds of flying. However, the other six incidents caused most of the disturbed emperors to move to a new area, either within Cinder River Bay or to Hook Lagoon, several miles away.

A flock of about 450 cacklers at Pilot Point reacted in a similar manner when disturbed by planes. The flock was flushed twice by planes about ½ mile away. On these occasions the geese milled for less than 30 seconds before landing in the original spot. More severe disturbance (closer aircraft) caused the flock to move approximately 2 miles to another favored area. The geese alternated between these two areas when disturbed either by planes or boats. Depending on wind direction and velocity, flight time varied from 3 to 7 minutes.

Investigations will continue in 1980 to gather additional data on goose migration and use of Pilot Point and Cinder River, including information on habitat preference, food habits and the impact of aircraft disturbance. A general lack of geese present during the 1979 study period precluded extensive or intensive information gathering.

ALEUTIAN CANADA GOOSE RECOVERY TEAM

Since 1975 Timm has served on the Aleutian Canada Goose Recovery Team. One team meeting is attended each year; costs are paid by the FWS.

In February 1979 a paper on Canada goose taxonomy was presented at a goose management symposium in Portland (Johnson et al. 1979). By discriminate function analysis of measurements from 1,345 geese, formulas were derived to objectively classify Canada geese in the Pacific Flyway by subspecies. We found that *leucopareia* could be differentiated from *taverneri* and *minima* (the two subspecies most easily confused with *leucopareia*) with about 97 percent accuracy.

LITERATURE CITED

Anderson, W. L. 1975. Lead poisoning in waterfowl at Rice Lake, Illinois. J. Wildl. Manage. 39(2):264-270.

Bauer, R. D. 1979. Historical and status report of the tule white-fronted goose. Pages 44-55 In R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oreg. State Univ. Book Stores, Inc. Corvallis.

Dieter, M. P., and M. T. Finley. 1979. Delta-aminolevulinic acid dehydratase enzyme activity in blood, brain and liver of lead-dosed ducks. Environmental Research, No. 19, pp 127-135.

Finley, M. T., and M. P. Dieter. 1976. Sublethal effects of chronic lead ingestion in mallard ducks. J. Toxicology and Environmental Health 1:929-937.

Hanzlik, P. J. 1923. Experimental plumbism in pigeons from the administration of metallic lead. Arch. Exp. Pathol. Pharmakol. 97:183-101.

Havens, P. D. 1971. Report of survey and inventory activities - - - waterfowl and small game. Alaska Dept. Fish and Game, Proj. Prog. Rep., Fed. Aid Wildl. Rest. Proj. W-17-3, Job 10 and 11. 52p.

Irwin, J. C. 1977. The influence of diet on the pathogenesis of lead poisoning in waterfowl. PhD. Thesis. University of Guelph.

Johnson, D. L., D. E. Timm, and P. F. Springer. 1979. Morphological characteristics of Canada geese in the Pacific Flyway. Pages 56-80 In R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oreg. State Univ. Book Stores, Inc., Corvallis.

Krogman, B. D. 1979. A systematic study of *Anser albifrons* in California. Pages 22-43 In R. L. Jarvis and J.C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oregon State Univ. Book Stores, Inc. Corvallis.

Longcore, J. R., L. N. Locke, G. E. Bagley, and R. Andrews. 1974. Significance of lead residues in mallard tissues. Spec. Scientific Rep. Wildlife No. 182. Washington, D.C. 24 pp.

Salter, R., and R. H. Davis. 1974. Snow geese disturbance by aircraft on the North Slope, September 1972. Arctic Gas B.R.S. Vol. 14, Ch. VII.

Sellers, R. A. 1979. Waterfowl use and management considerations for Cook Inlet state game refuges. Unpublished report ADF&G.

Selser, W. I. 1977. Assimilation and accumulation of lead through the aquatic food chain of migratory waterfowl. M.S. Thesis, Univ. of Montana.

Simpson, S. G., and R. L. Jarvis. 1979. Comparative ecology of several subspecies of Canada geese during winter in western Oregon. Pages 223-241 In R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oreg. State Univ. Book Stores, Inc., Corvallis.

Sorensen, M. F. 1980. Sandhill crane harvest and hunter activity in the Central Flyway during the 1979-80 hunting season. U.S. Fish and Wildl. Serv. Admin. Rept., July 1, 1980. 7 pp.

Stendell, R. D., R. I. Smith, K. P. Burnham, and R. E. Christensen. 1979. Exposure of waterfowl to lead: a nationwide survey of residues in wing bones of seven species, 1972-73. Spec. Scientific Rep. Wildlife No. 223, Washington, D.C. 12 pp.

Timm, D. E. 1975. Report of survey and inventory activities-waterfowl. Alaska Dept. Fish and Game, Proj. Prog. Fed., Aid Wildl. Rest. Proj. W-17-7, Job 11.4 and 11.5. 53p.

_____. 1976. Report of survey and inventory activities-waterfowl. Fed. Aid in Wildl. Rest. Proj. W-17-8, Alaska. 61 pp.

_____. 1977. Report of survey and inventory activities-waterfowl. Fed. Aid in Wildl. Rest. Proj. W-17-9, Alaska. 37 pp.

_____. 1978. Report of survey and inventory activities-waterfowl. Fed. Aid in Wildl. Rest. Proj. W-17-10, Job No. 10.0. Alaska. 27 pp.

_____, and D. Sellers. 1979. Report of survey and inventory activities-waterfowl. Fed. Aid in Wildl. Rest. Proj. W-17-11, Job No. 10.0. Alaska. 29 pp.

White, D. H., and R. C. Stendell. 1977. Waterfowl Exposure to lead and steel shot on selected hunting areas. J. Wildl. Manage. 41(3):469-475.

U.S. Department of Interior. 1976. Final environmental impact statement--proposed use of steel shot for hunting waterfowl in the United States. U.S. Fish and Wildl. Serv. 276 pp.