ALASKA DEPARTMENT OF FISH AND GAME

JUNEAU, ALASKA

STATE OF ALASKA
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DEPARTMENT OF FISH AND GAME
James W. Brooks, Commissioner

DIVISION OF GAME
Robert A. Rausch, Director

REPORT OF SURVEY AND INVENTORY ACTIVITIES - WATERFOWL

By Dan Timm

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STATEWIDE WATERFOWL

SEASONS

1975-76

OPEN SEASONS	Species	LIMITS Daily Bag	Possession	Exceptions or Explanations
GAME DUCKS, OLD SQUAW, HARLEQUIN, SCOTERS, EIDERS, MERGANSERS, GEESE AND BRANT:	Game Ducks	6	18	
(a)* Pribilof and Aleutian Islands (except Unimak Island). Oct. 11 - Jan. 25	Old Squaw, Harlequin, Scoters, Eiders and Mergansers	15	30	Singly or in aggregate of all kinds.
(b) Kodiak Island (State Game Management Unit 8). Sept. 6 - Oct. 12 and Nov. 8 - Jan. 16	Geese (except Emperor)	4	8	For snow geese 6 per day 12 in possession.
(c) Remainder of Alaska and Unimak Island Sept. 1 - Dec. 16	Emperor Geese	6	12	
	Brant	4	8	
JACKSNIPE: All of Alaska Sept. 1 - Nov. 4	Jacksnipe	8	16	
CRANES: All of Alaska Sept. 1 - Oct. 15	Cranes	2	4	

*The taking of Canada geese in the Aleutian Islands, except on Unimak, is illegal. (To protect the Aleutian Canada goose).

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WATERFOWL HARVEST AND HUNTER ACTIVITY

INTRODUCTION

A post-season mail survey of waterfowl hunters in Alaska was conducted for the fifth year. This survey, in conjunction with field bag checks and data from the Fish and Wildlife Service parts collection survey, provides the most accurate estimate of hunter activity and waterfowl harvest by species in Alaska.

The number of hunters sampled in the U.S. Fish and Wildlife Service (FWS) parts collection survey has been significantly increased during the past three hunting seasons. Mr. Sam Carney (pers. comm., 1974, USFWS, Laurel, Md.) believes duck species composition harvest data for Alaska, as measured by the federal mail survey, are becoming more and more reliable.

Waterfowl hunter field bag check data have been summarized in this report by the harvest areas used for data breakdown of the mail questionnaire survey. More specific location data are available in the Anchorage office files.

The 1975 fall flight of waterfowl from Alaska was predicted to be average. There were average numbers of breeding ducks and normal weather prevailed over much of Alaska during the nesting season. However, weather conditions which facilitated good hunting prevailed over much of Alaska during the season. Reports from the field indicated that hunting was good and this survey confirms those field reports.

PROCEDURES

Mechanics of the Survey and Hunter Reports

A computerized list of all residents legally licensed to hunt in 1975 was used as a sampling base. On 3 February 1975, 6,500 survey

forms (10.0% sample) were mailed. As in the four previous mail surveys, a second mailing to non-respondents was planned this year. However, before the forms were sent from data processing they were inadvertently discarded. Therefore, a second mailing was not made this year.

Each form (Fig. 1) was self-contained inside a snap-open envelope. This container eliminated the folding of conventional survey forms and stuffing them into envelopes. A postage paid return address was printed on the form's reverse side.

Field Bag Checks

Random field checks of hunters were made in 4 of the 11 harvest areas. A total of 652 ducks were checked by Department of Fish and Game biologists. About 74 percent of the duck species composition data came from the Cook Inlet and Gulf Coast harvest areas.

The number of ducks checked this year was substantially less than in some years. The department was conducting an ingested lead shot study and biologists spent more time collecting gizzards from individual birds on restricted areas rather than examining large numbers of birds from many areas.

Analyses of Survey Results

The state was divided into 11 harvest areas to facilitate analysis of survey data (Fig. 2). Because the area of residence for each hunter was known, an accurate estimate of days hunted, birds bagged, etc., could be made for each harvest area.

Bias factors influencing reported days hunted and ducks bagged were considered to be: (1) a superstition bias resulting from a tendency not to report the number 13; (2) a memory bias resulting in a tendency to report numbers ending in zero, five and multiples of the daily bag and (3) a memory bias from the unreliability of those hunters reporting large numbers. Bias corrections for the average number of days hunted were made as suggested by Williams (1953). The reported mean season duck bag was reduced by 15 percent, as suggested by Mr. Sam Carney (pers. comm., 1973, USFWS, Laurel, Md.).

No bias corrections were made for goose harvest. It is believed that most hunters know exactly how many geese they shoot each season. Therefore, reporting rates may be higher for geese than ducks, as geese are usually considered more of a trophy.

Data from the 911 usable waterfowl questionnaires were expanded for total waterfowl hunters on a proportionate basis. Although about 16,100 duck stamps were sold in Alaska according to Fish and Wildlife Service data, only 15,131 people were considered to be potential hunters. The FWS annually measures the proportion of stamps purchased by collectors and about 1,000 were purchased in Alaska for this purpose.

Figure 1. Waterfowl hunter questionnaire used in the 1975-76 survey.

STATE OF ALASKA

DEPARTMENT OF FISH AND GAME

WATERFOWL HUNTER SURVEY
1975-1976

REMINDER

DEAR HUNTER:

Several weeks ago you were requested to fill out a hunter survey form. Perhaps you misplaced it or just neglected to complete this form. Would you at this time please complete the form below and mail it at your earliest convenience? No stamp is necessary. Thank you for your cooperation.

If you have completed and mailed the first questionnaire, please disregard this letter.

1.

PART I (ALL HUNTERS COMPLETE)

2. DID YOU BUY A DUCK STAMP IN 1975? _____ YES ☐ NO ☐

3. DID YOU HUNT FOR WATERFOWL DURING THE 1975-76 SEASON? YES ☐ NO ☐

PART II (COMPLETE ONLY IF YOU ANSWERED YES TO EITHER QUESTION ABOVE)

4. HOW MANY DAYS DID YOU HUNT WATERFOWL? ☐

AT WHAT PLACE DID YOU HUNT FOR MOST OF YOUR DUCKS?

5. _____
(I.E. PILOT POINT, MINTO FLATS, PYBUS BAY, ETC.)

AT WHAT PLACE DID YOU HUNT FOR MOST OF YOUR GEESE?

6. _____

PART II (CONT.) HOW MANY OF THE FOLLOWING BIRDS DID YOU SHOOT AND RETRIEVE?

GAME DUCKS	☐	7
NON-GAME DUCKS	☐	8
CANADA GEESE	☐	9
SNOW GEESE	☐	10
WHITE FRONTED (SPECKS) GEESE	☐	11
BRANT	☐	12
EMPEROR GEESE	☐	13
UNKNOWN KIND OF GEESE	☐	14
CRANE	☐	15
SNIPE	☐	16

HUNTER OPINION: Do you favor increased daily bag limits for game ducks?

YES ☐ NO ☐

COMMENTS _____

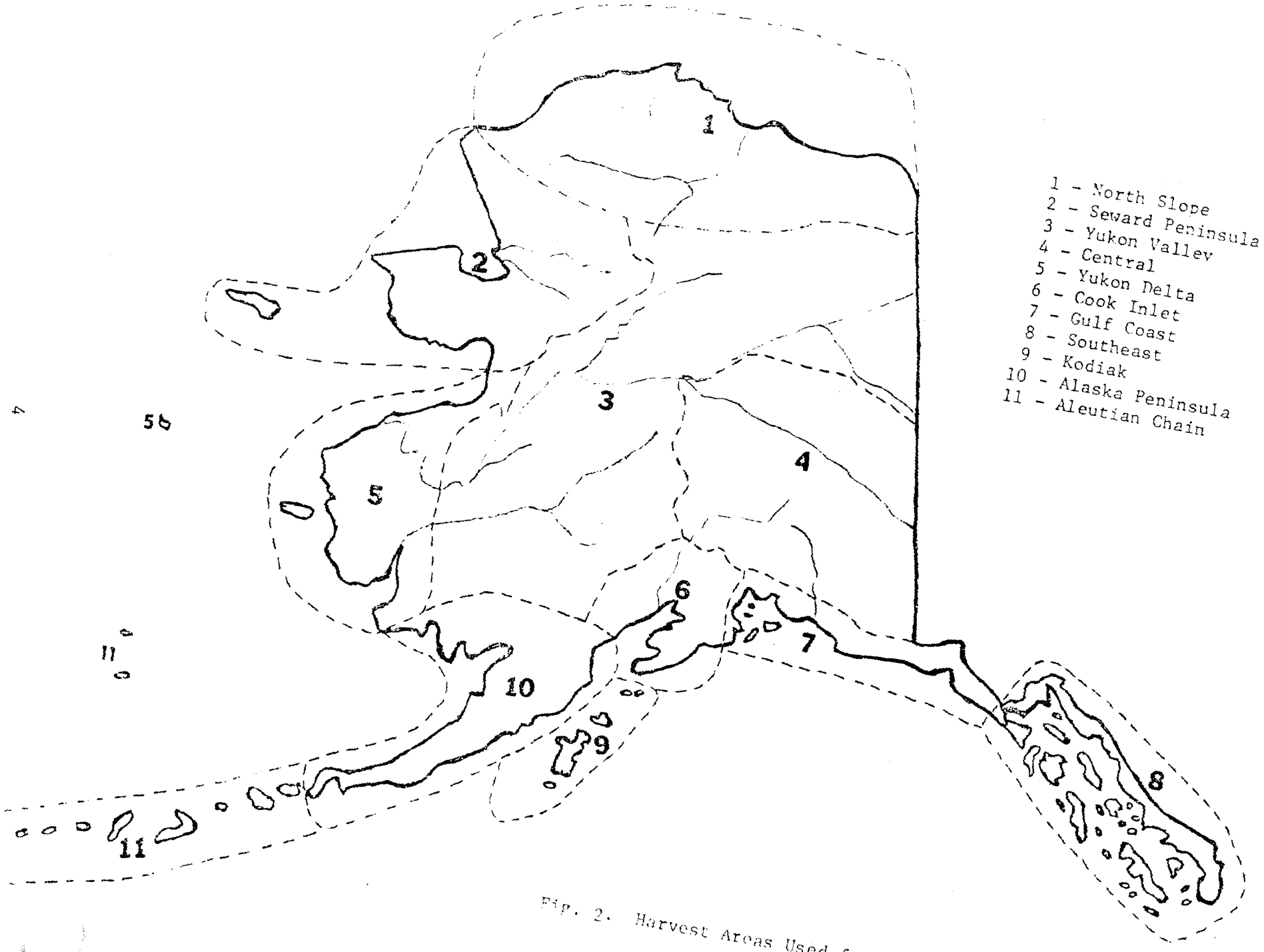


Fig. 2. Harvest Areas Used for Data Analysis.

The effects of not mailing a second notice were difficult to analyze. It seems that hunter days and harvests may be inflated using only returns from the first mailing, if successful hunters were "anxious" to report their take. Unsuccessful hunters or those people having little success perhaps thought their report wouldn't be important and thus wouldn't return the form until being contacted a second time. However, this may not be the case.

For the 1971 season (first year of a state mail survey) results of the mail survey were analyzed separately for the first and second mailings. The averages reported per hunter for days hunted and ducks harvested were: hunter days-1st mail 5.0, 2nd mail 6.4; ducks shot-1st mail 8.5, 2nd mail 9.9. These data indicate that for the 1971 season, by using only returns from the first mailing the projected hunter days and ducks harvested would have been underestimated. Consequently, no corrections in the 1975-76 survey were made and all estimates are based on results of the first mailing (6500 forms, 3324 respondents and 911 usable waterfowl forms).

RESULTS

Number of Hunters

Because of the number of people in Alaska hunting without duck stamps and the incidence of hunting outside the legal season limits, the assessment of waterfowl hunter activity and waterfowl harvest is complicated (Timm 1972). Although 16 people returned questionnaires which indicated they hunted waterfowl but purchased no duck stamp, these people were not included in the analyses. Data on number of hunters, harvest, etc. in this report are based solely on duck stamp sales and therefore should be considered the sport hunting harvest only.

Of those sampled, 631 people reported that they purchased stamps and hunted 1 day or more. The number of stamp purchasers who did not hunt was 280 (69 percent active hunters). A calculated 10,480 people hunted waterfowl one or more days during the 1975-76 season. Table 1 summarizes these data.

Hunting Activity

Hunters reported hunting an average of 5.9 days during the 1975-76 season. After corrections for bias, each active hunter was calculated to have hunted an average of 5.4 days during the season. This projects to a total of 57,011 waterfowl hunter days during the 1975-76 season.

Table 2 presents statewide hunter activity, success and birds bagged by harvest area. Table 3 provides projected hunter days and duck and goose harvests for specific hunting areas in the state on which the most activity and harvest occurred. Table 4 summarizes season statistics for the 4-year, 1971-75 period.

Table 1. Summary of Alaska waterfowl hunter mail questionnaire survey, 1975-76.

Number of licensed hunters: Resident-64,720 (includes 5,004 subsistence)

Number of license buyers sampled: 6500 (10 %)

Number and proportion of respondents from survey[1/]: 1st mailing 3,324 (51.5%)

2nd mailing None sent

TOTAL 3,324 (51.5%)

Number of returns usable for waterfowl calculations: 911

Projected number of hunters:

Duck stamps sold in Alaska: 16,100 (15,131 potential hunters)

Number of active hunters: 10,480 (69.26%)

Calculated statewide sport harvests:

Ducks: Game 82,377;other species 5,445; Total 87,822

Geese: Canada 11,547;emperor 2,891; brant 1,847; white-fronted 933; snow 1,436 Total 18,654

Cranes: 1,642

Snipe: 4,318

Hunter Days: 57,011

1/ Estimated rate of deliverable questionnaires only-excludes change of address, insufficient address, deceased, etc.

Table 2. Calculated duck, crane and snipe harvests and hunter activity by harvest area, 1975-76.

Harvest Area	Hunter Days		Game Ducks		Non-game Ducks		Crane		Snipe	
	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total	No.	% of Total
North Slope	228	0.4	412	0.5	0	0	0	0	0	0
Seward Pen.	1,368	2.4	1,565	1.9	125	2.3	199	12.1	0	0
Yukon Valley	1,539	2.7	1,812	2.2	82	1.5	0	0	0	0
Central	8,723	15.3	13,180	16.0	1,165	21.4	729	44.4	281	6.5
Yukon Delta	1,710	3.0	1,400	1.7	114	2.1	166	10.1	35	0.8
Cook Inlet	18,586	32.6	30,562	37.1	1,318	24.2	100	6.1	1,244	28.8
Gulf Coast	5,245	9.2	7,497	9.1	419	7.7	248	15.1	216	5.0
Southeast	12,429	21.8	18,535	22.5	1,280	23.5	100	6.1	1,196	27.7
Kodiak	1,938	3.4	2,554	3.1	169	3.1	0	0	1,346	31.2
Alaska Pen.	3,820	6.7	4,119	5.0	381	7.0	100	6.1	0	0
Aleutian Chain	1,425	2.5	741	0.9	392	7.2	0	0	0	0
Statewide	57,011	100.0	82,377	100.0	5,445	100.0	1,642	100.0	4,318	100.0

Table 3. Locations of most hunting activity and greatest waterfowl harvest, 1975-76.

	Calculated duck kill and hunter days						
	Ducks		Hunter Days				
Location	No.	% of State Total	No.	% of State Total	Location	No. Geese	% of State Total
Susitna Flats	9485	10.8	3763	6.4	Izembek Lagoon	4048	21.7
Palmer-Hay Flats	7114	8.1	4162	7.3	Copper R. Delta	2350	12.6
Copper R. Delta	6148	7.0	3649	6.4	Pilot Point	1996	10.7
Mendenhall Flats	3864	4.4	2851	5.0	Chickaloon Flats	765	4.1
Minto Flats	3689	4.2	1710	3.0	Minto Flats	504	2.7
Stikine R. Delta	3689	4.2	1425	2.5	Yakutat Area	448	2.4
Redoubt Bay	2898	3.3	912	1.6	Redoubt Bay	373	2.0
Portage Flats	1669	1.9	1710	3.0	Stikine R. Flats	317	1.7
Kachemak Bay	1581	1.8	912	1.6	Mendenhall Flats	280	1.5
Pilot Point	1493	1.7	1197	2.1	Susitna Flats	224	1.2
Chickaloon Flats	1405	1.6	1368	2.4	Palmer-Hay Flats	112	0.6
Rocky Pass	1405	1.6	627	1.1	Rocky Pass	112	0.6
Yakutat Area	1405	1.6	1140	2.0	Duncan Canal	112	0.6
Duncan Canal	1230	1.4	684	1.2	Blind Slough	93	0.5
Trading Bay	1054	1.2	342	0.6	Kachemak Bay	75	0.4
Eagle R. Flats (Cook Inlet)	1054	1.2	1026	1.8	Trading Bay	37	0.2
Blind Slough	966	1.1	912	1.6			
Eielson AFB	966	1.1	399				
Salchaket Slough	966	1.1	627	1.1			
Healy Lake	966	1.1	513	0.9			
Kalsin Bay	878	1.0	456	0.8			
Cold Bay	878	1.0	741	1.3			
Farragut Bay	703	0.8	228	0.4			
Potter Marsh	615	0.7	684	1.2			
Chilkat River	439	0.5	456	0.8			
Goose Bay	351	0.4	342	0.6			
Port Heiden	176	0.2	228	0.4			
St. James Bay	176	0.2	114	0.2			
Subtotal	57,263	65.2	33,178	58.2		11,846	63.5
Statewide	87,823	100.0	57,011	100.0		18,654	100.0

Table 4. Comparison of statewide resident waterfowl hunting statistics, 1971-75.

Category	Hunting Season 1971	1972	1973	1974	1975	5 year Average
Duck stamp sales	14,320	14,824	16,449	15,750	16,100	15,488
Percent active hunters	.7244	.7506	.6857	.6757	.6926	.7058
No. active hunters	9,843	10,930	11,150	10,499	10,480	10,580
No. days per hunter	4.3	5.4	5.2	5.1	5.4	5.1
Total hunter days	42,719	59,350	57,868	53,650	57,011	54,120
No. ducks per hunter	8.2	8.4	8.0	6.8	8.4	8.0
Total duck harvest	80,417	91,703	89,534	71,813	87,822	84,258
No. geese per hunter	1.08	0.99	1.65	1.27	1.78	1.35
Total goose harvest	10,630	10,822	18,397	13,334	18,654	14,367
Total crane harvest	502	765	602	640	1,642	830
Total snipe harvest	3,051	3,498	1,661	2,205	4,318	2,947

Duck Harvest

Magnitude of the Harvest

Hunters reported taking an average of 9.8 ducks this season, compared to 7.9 in 1974. Corrections for bias provide a mean calculated kill of 8.4 ducks per active hunter, compared to 6.8 in 1974. Reported daily success was 1.7 ducks per day, while calculated daily success was 1.5 birds per day. Calculated daily success in 1974 was 1.3 birds.

The projected statewide duck harvest was 87,822 birds, or a 22 percent increase from the 1974 harvest and a 4 percent increase from the 1971-75 5-year average (Table 4). Game ducks represented 93.8 percent (82,377) and nongame ducks 6.2 percent (5,445) of the total bag.

Species Composition of Harvest

From 1960 through the 1971-72 season, field bag checks were intermittently conducted in 6 of the 11 harvest areas. Timm (1972) summarized these data. During the 1975-76 season, field checks were conducted in four of the harvest areas (Table 5). Pintails, mallards, shovelers, green-winged teal and American widgeons comprised over 92 percent of the total ducks checked. Nongame ducks represented only 0.1 percent of the total ducks checked, compared to 6.2 percent nongame ducks reported in the mail questionnaire survey. However, species composition data were biased because of intensive gizzard collecting on a few areas.

As described previously, the FWS significantly increased their hunter sample in the parts collection survey during the 1972-75 seasons. Because of random hunter sampling of this survey throughout the season and adequate sample size, it is believed that duck species composition of the harvest estimated by the FWS is the best estimate available for 1975-76 statewide game duck projections. However, it is also believed that hunters somewhat bias this survey by tending not to send in wings of nongame ducks. The state's hunter questionnaire mail survey is believed to provide the best estimate of nongame duck kill.

Table 6 provides what is believed to be the most reliable estimate of duck harvest by species in Alaska, during the 1975-76 season. A combination of FWS and state mail survey data is used.

Goose Harvest

Hunters reported taking an average of 1.78 geese per active waterfowl hunter. This is substantially above hunter success for the 1971-75, 5-year average of 1.35 birds (Table 4). The 1975-76 statewide goose harvest was calculated to be 18,654 birds.

Field bag checks are not considered to be adequate for determining statewide or even regional species composition of the goose kill. Numbers of geese checked are few and bag checks are not conducted in enough locations to adequately sample harvests of all species.

Table 5. Duck species composition in the harvest as determined by random field bag checks-Cook Inlet, Gulf Coast, AK. Peninsula, Southeast harvest areas, 1975-76.

Species	Area and Percent Species Composition				
	Cook Inlet	Gulf Coast	Ak. Pen.	Southeast	All Areas
Pintail	37.7	19.8	57.5	4.2	32.7
Mallard	21.0	28.6	5.0	22.9	20.7
Widgeon	10.5	29.1	17.5	29.2	19.6
G-W Teal	10.9	7.0	14.2	22.9	11.2
Shoveler	11.3	8.8	2.5	4.5	8.1
Scaup	3.1	3.5	0.8	2.1	2.8
Gadwall	0.8	1.3	0.8	4.2	1.2
Goldeneye	1.9	0.4	-	-	0.9
Scoter	-	-	1.7	8.3	0.9
Canvasback	1.9	-	-	-	0.8
B-W Teal		1.3	-	-	0.5
Redhead	0.4	-	-	-	0.1
Bufflehead	0.4	-	-	-	0.1
Harlequin	-	-	-	2.1	0.1
	99.9	99.8	100.0	100.1	99.9
Sample Size	257	227	120	48	652

Table 6. Estimate of statewide duck harvest by species, 1975-76.

Species	Harvest[1/]	Percent of Total[2/]
Pintail	20,199	23.0
Mallard	19,672	22.4
Widgeon	15,018	17.1
G-W Teal	12,383	14.1
Scaup (both spp.)	5,006	5.7
Shoveler	5,006	5.7
Goldeneye (both spp.)	2,020	2.3
Bufflehead	1,756	2.0
Ringneck	439	0.5
Gadwall	439	0.5
Canvasback	263	0.3
B-W Teal	88	0.1
Redhead	88	0.1
Total game ducks	82,377	93.8
Total other ducks[3/]	5,445	6.2
Total ducks	87,822	100.0

1/ Total harvest from ADFG mail survey

2/ Percent species composition from 1975 FWS wing collection data (Sorensen et al. 1976) except for other duck species

3/ Mergansers, eiders, scoters, old squaw, harlequin

Although hunters were not asked to report goose kill by species in the 1971-72 mail questionnaire, they were asked to do so in the 1972-75 surveys. Table 7 presents calculated goose harvest by species and by harvest area for 1975-76. Canada geese made up 62 percent of the reported state goose harvest and emperor geese comprised 16 percent of the total bag. Black brant, white-fronted geese and snow geese made up 10, 5 and 7 percent, respectively, of the total goose harvest.

Crane Harvest

Hunters reported taking an average of 0.16 cranes per active hunter, as compared to 0.06 birds per hunter in 1973. The statewide calculated crane harvest was 1,642 birds, compared to 640 the previous year. Table 2 summarizes crane harvest by area. The 1975-76 harvest was substantially above the harvests for the previous four hunting seasons.

Snipe Harvest

An average of 0.41 snipe reported per active hunter resulted in a calculated statewide harvest of 4,318 birds. During the 1974-75 season hunters reported 0.21 birds per person, for a total harvest of 2,205 snipe. Table 2 summarizes snipe harvest by area. The 1975-76 snipe harvest was the largest attained during the past five hunting seasons.

Hunter Opinion

Although the reliability of opinion surveys may be questionable, the results of asking hunters whether they favored increased game duck bag limits were surprising. For those people purchasing duck stamps 45 percent did not favor a bag limit increase, 19 percent did favor an increase, 2 percent favored an increase only if populations warranted, and 34 percent did not state an opinion. Hunters in more remote areas generally favored such an increase.

DISCUSSION

Bias corrections for reported season duck bags were made using the same methods as last year and the same as the FWS method. Reported harvest was reduced by 15 percent as described by S. Carney (pers. comm.). The FWS uses a constant 15 percent reduction factor in Alaska. This represents a long-term average rate which was derived by using the Williams (1953) method.

Although the FWS does not correct for hunter bias in reported days hunted per season (S. Carney, pers. comm.), bias corrections were made in the ADF&G survey. Carney believes that if a hunter can remember anything about his hunting, he can remember the number of days he hunted. A review of the frequency of reported days hunted per season in Alaska indicates this may be a false assumption. People report hunting those number of days divisible by five (5, 10, 15, 20 etc.) much more frequently than other day classes. Also, very few people report hunting 13 days during the season (superstition bias). Therefore, bias corrections for days hunted were made as described by Williams (1953), which resulted in a 7 percent reduction in reported days hunted.

Table 7. Calculated goose harvest by species by harvest area, 1975-76.

Area	SPECIES AND NUMBER											
	Canada		Emperor		Brant		Snow		Whitefront		Total	
	No.	% of species total	No.	% of species total	No.	% of species total	No.	% of species total	No.	% of species total	No.	% of total harvest
North Slope	-	-	-	-	33	1.8	-	-	-	-	33	0.2
Seward Pen.	404	3.5	17	0.6	338	18.3	34	2.4	122	13.1	915	4.9
Yukon Valley	162	1.4	-	-	50	2.7	-	-	168	18.0	380	2.0
Central	1,166	10.1	-	-	-	-	-	-	108	11.6	1,274	6.8
Yukon Delta	854	7.4	194	6.7	609	33.0	1,073	74.7	168	18.0	2,898	15.5
Cook Inlet	1,501	13.0	-	-	-	-	34	2.4	199	21.3	1,734	9.3
Gulf Coast	2,737	23.7	-	-	68	3.7	103	7.2	91	9.8	2,999	16.1
Southeast	1,790	15.5	-	-	-	-	103	7.2	77	8.2	1,970	10.6
Kodiak	-	-	32	1.1	-	-	-	-	-	-	32	0.2
Alaska Pen.	2,933	25.4	2,599	89.9	749	40.5	89	6.1	-	-	6,370	34.1
Aleutian Chain	-	-	49	1.7	-	-	-	-	-	-	49	0.3
Statewide	11,547	100.0	2,891	100.0	1,847	100.0	1,436	100.0	933	100.0	18,654	100.0

A comparison of the results of our 1975 mail survey and the 1975 estimates of waterfowl harvest and hunter activity made by the FWS (Carney et al. 1976) shows, except for duck and goose harvests, fairly close correlation (Table 8). Our total goose harvest estimate was 71 percent above their harvest estimate. Also, the species harvest estimates for emperor geese, brant and snow geese were quite different. The federal species composition data were derived from only 129 goose tails, however. Calculated hunter days were nearly identical in both surveys.

The ADF&G mail survey, since its conception in 1971, has consistantly projected higher goose harvests than the FWS survey. This is due, in part, to the FWS correcting for bias in reported goose bag. However, we believe there is a more significant factor involved. The state survey probably is more random in sampling, as the FWS derives most of their hunter sample from the larger cities and towns in Alaska. The ADF&G survey samples a cross section of license buyers including subsistence license buyers.

Another factor related to the above explained deficiency in the FWS survey is the apparent trend for more natives to report what they shot during the season, especially on the Yukon Delta. Native regional corporations have, in recent years, been conducting harvest surveys to document the magnitude and importance of subsistence hunting. Also, on the Y-K Delta natives have been requested to turn in bird bands. These factors are apparently contributing to an increased reporting rate for this survey, at least on the Y-K Delta. For example, the 1971-74 4-year average calculated harvests of ducks and geese on the Y-K Delta were 1,230 and 427 birds, respectively. The 1975 calculated harvest for ducks was 1,514 and for geese, 2,898 birds. Another contributing factor may be increased numbers of people traveling to the Y-K Delta during the hunting season in conjunction with activities resulting from the Alaska Native Lands Claim Settlement Act. However, more years of data collection are needed to substantiate these hypotheses. FWS data on region of goose harvest are unavailable at this time.

It is believed that our mail survey provided the best estimate of goose harvest by species in Alaska during the 1975-76 season. The FWS has considered going to a hunter reporting system to estimate goose harvest by species, as opposed to the present system where people send in goose tails. For various reasons they are not satisfied with the present system (S. Carney, pers. comm.).

The Alaska Peninsula was, as it has been the past 5 years, the major goose harvest area in the state. About one-third of the total harvest occurred there. Still relatively unknown to people outside Alaska, the Alaska Peninsula has some of the world's best goose hunting. Reeve Aleutian Airlines has, in recent years, sponsored two, 2-day charters to Cold Bay for about 65 hunters on each trip. In 1976 these charters will be expanded to 3-day trips.

The Copper River Delta has also been increasing in popularity as a waterfowl hunting area. For example, the 1971-74, 4-year average calculated number of ducks and geese harvested was 4,544 and 870, respectively.

Table 8. A comparison between ADF&G and F&WS waterfowl hunter success surveys, 1975-76[1/].

	ADFG	FWS[2/]
Percent active hunters	69.3	71.6
Number of active hunters	10,480	10,834
Days per active hunter	5.4	5.2
Total hunter days	57,011	56,136
Duck bag per active hunter	8.38	6.09
Total duck harvest	87,822	65,971
Goose bag per active hunter	1.78	1.00
Total goose harvest	18,654	10,894

Goose harvest by species:	No.	% of total	No.	% of total
Canada	11,547	61.6	9,118	83.7
Emperor	2,891	15.9	338	3.1
Black brant	1,847	9.7	251	2.3
Snow	1,436	5.4	-0-	-0-
White-fronted	933	7.4	1,187	10.9

1/ For hunter 16 years or older

2/ Carney et al, 1976

In 1975, a calculated 6,148 ducks and 2,350 geese were shot on the delta.

Statewide, the goose harvest increased by 5,320 from 13,334 birds in 1974 to 18,654 geese in 1975. About 83 percent of this increase can be accounted for by harvest increases on the Y-K and Copper River Deltas.

Although there are some well-known duck hunting areas in Alaska, such as Susitna Flats and Minto Flats, about 35 percent of the harvest occurred on lesser known areas. As seen in Table 3, 65 percent of the harvest occurred at the "big 28" duck hunting places in Alaska. Estimates in Table 3 are probably minimal, as some hunters do not report the area of most hunting activity.

This survey did not sample hunters under age 16 who did not purchase a hunting license. Mr. Sam Carney (pers. comm.) estimates that an additional 8 percent total hunter days and 5 percent total duck harvest can be attributed to juveniles.

SUMMARY

1. Total calculated duck, goose, crane and snipe harvests in Alaska during the 1975-76 season were: 87,822; 18,654; 1,642 and 4,318 birds, respectively.

2. Hunters spent a calculated 57,011 days hunting waterfowl in Alaska during the 1975-76 season; an increase of 6 percent from the 1974-75 season.

3. Hunters harvested an average of 8.4 ducks each, and hunted an average of 5.4 days during the season.

4. Pintails, mallards, widgeons and green-winged teal constituted about 77 percent of the total duck harvest.

5. Canada geese comprised about 62 percent of the state's goose harvest.

6. Most of the increased goose harvest occurred on the Copper River and Y-K Deltas.

DUSKY CANADA GOOSE STUDIES

Production, Fall Flight and 1976 Breeding Population

The January 1975 mid-winter inventory of 26,550 dusky Canada geese (*B.c. occidentalis*) in Oregon's Willamette Valley represented the highest post-season population ever recorded, and is above the post-season population goal of 20,000-25,000 geese (Pacific Flyway Council 1973).

In 1975 spring chronology on the Copper River Delta was about one week "late." Bob Bromley, University of Alaska graduate student, found nest initiation later than normal and clutch size much reduced. He also reported heavy nest predation by gulls throughout the incubation period.

On July 25, 1975 biologists from ADF&G and the FWS and Bob Bromley counted 8,990 adult geese and 982 goslings for an observed ratio of 9.8 percent young. After applying a visibility correction factor of 50 percent for young (Timm 1971, unpubl. memo. Ak. Dept. Fish & Game, Anchorage), there was a calculated 17.9 percent young in the population. The 1975 calculated fall flight of dusky geese was 31,140 birds.

The 1976 mid-winter inventory in Oregon did not provide a reliable estimate of the post season dusky goose population (Jarvis and Rogers 1976). The number of lesser Canada geese in the Willamette Valley and along the Columbia River has been increasing in recent years which makes the identification of dusky geese difficult. Therefore, two spring surveys were flown (see section on Copper River Delta Coop. Mgmt. Agreement) on the delta in an attempt to better assess the breeding population. The first survey on May 19, 1976 indicated a population of 13,900 geese. However, the proportion of geese seen in flocks was too low which indicated birds were missed. On June 7, 1976 the survey was repeated resulting in a calculated breeding population of 21,300 geese, which is assumed to be the 1976 breeding population. Visibility factors were assumed to be: singles-50 percent; pairs-75 percent; flocked birds-80 percent.

Table 9 summarizes the breeding population, calculated age composition in the population, fall flight and harvest by year since 1971.

Banding and Recoveries

During summer 1975, 868 dusky geese were banded by personnel from the A.D.F.&G., the U.S.F.W.S., the U.S.F.W. and the University of Alaska. Birds were captured by drives using a super cub to move geese into sloughs and by large numbers of people on shore herding geese into sloughs.

The following number of geese were banded in 1975 and recovered during the 1975-76 season:

	Leg Banded Only		Neck-Collared Birds	
	Adults	Young	Adults	Young
Number Banded	373	133	100	262
Number Recovered	30	11	13	43
Percent Recovered	8.0	8.3	13.0	16.4

Table 9. Summary of population data for dusky Canada geese - 1971-1976.

Year	Mid-winter Inventory	Breeding Population[1]	From Aerial Survey		No. Yg. Produced	Fall Flight	Harvest[4]
			% Young	% Non-prod.ad[3]			
1971	20,850	20,065	16.2	79.8	3,880	23,945	5,995
1972	17,950	17,275	10.6	71.7	2,050	19,325	3,450
1973	15,875	15,280	36.0	64.6	8,595	23,875	5,255
1974	19,000[2]	18,290	51.4	35.7	19,345	37,635	12,070
1975	26,550	25,565	17.9	84.5	5,575	31,140	9,010
1976	22,130[2]	21,300	--	--	--	--	--

1) Mid-winter inventory less .0375 percent natural mortality.
2) Derived from breeding grounds survey.
3) Percent of adult geese in flocks having no young.
4) Fall flight less following year's mid-winter inventory.

First year recovery rates for birds banded 1970-1974 were as follows:

		1974	1973	1972	1971	1970
Adult	leg band only	7.2	2.9	7.7	2.8	9.5
Young	leg band only	16.7	10.0	--	--	20.9
Adult	neck collared	3.4	6.1	--	--	--
Young	neck collared	15.3	--	--	--	--

The 1975 first year recovery rate for adult geese was high and reflects the relatively low number of young in the fall flight, but fairly high total harvest.

The recovery distribution by area in 1975-76 of 193 hunting season band recoveries, as calculated from all years of band recoveries was: Oregon - 67.4 percent; Alaska -14.0 percent; Washington - 13.5 percent; and British Columbia - 5.2 percent. These ratios have remained relatively constant since 1973.

COPPER RIVER DELTA COOPERATIVE MANAGEMENT AGREEMENT

Breeding Waterfowl Survey - 1976

One of the responsibilities assumed by A.D.F.&G., under the cooperative management agreement, was to assess the size, species composition and distribution of breeding ducks on the Copper River Delta (CRD). Surveys were made in 1974, 1975 and in 1976.

Procedures:

On May 19, 1976 Dan Timm and Julius Reynolds flew a breeding waterfowl survey over flight routes as depicted in Fig. 3. These same survey lines were flown in 1974 and 1975. However, in 1974 data were recorded by 38, 3-mile segments while during the past two surveys data were recorded and analyzed by 29, 4-mile segments.

Data were analyzed for the survey area and then expanded by a factor of 10.62 for the entire delta (9.416 percent sample of 308 square miles of habitat). Visibility rates were applied for each species. The rates for Alaska were furnished by Jim King, USFWS.

A second survey was flown on June 7, 1976 to specifically count dusky Canada geese. It was believed that the goose counts on the May 19 survey did not accurately reflect the size of the dusky goose population.

Results:

The 1976 breeding duck population on the Copper River Delta was calculated to be 19,553 birds. There were also a calculated 21,300 Canada geese, 595 swans and 715 loons (all red-throated) present. Table 10 presents a comparison between the 1976 duck population and 1975, 1974 and pre-1964 populations.

Table 11 provides the calculated densities of ducks, geese and swans on the 29, 4-mile segments covered in the survey (Fig. 3). Table 12 provides 1975-1976 2-year average densities for these same species on the 29, 4-mile segments. Figs. 4 and 5 show relative densities of ducks and geese on the CRD.

Discussion and Conclusions

The 12.5 percent indicated increase in breeding duck populations on the CRD may be a reflection of the statewide increase of about 22 percent (King and Sarvis 1976). Although the 1976 CRD survey was flown on May 19, - perhaps too early in normal years - the results probably reflect actual breeding duck populations. Spring chronology over much of Interior Alaska was about 10 days advanced, so most of the late migrants should have left the CRD before May 19. Future breeding duck population surveys should probably be planned for about June 1, but yearly variations up to 1 week either side of the 1st may be necessary, depending on spring chronology.

Surveys conducted in 1975 and 1976 over the 29, 4-mile segments have provided data used to construct Figs. 4 and 5. An appreciation of important areas within the total 308 mi^2 area can be readily

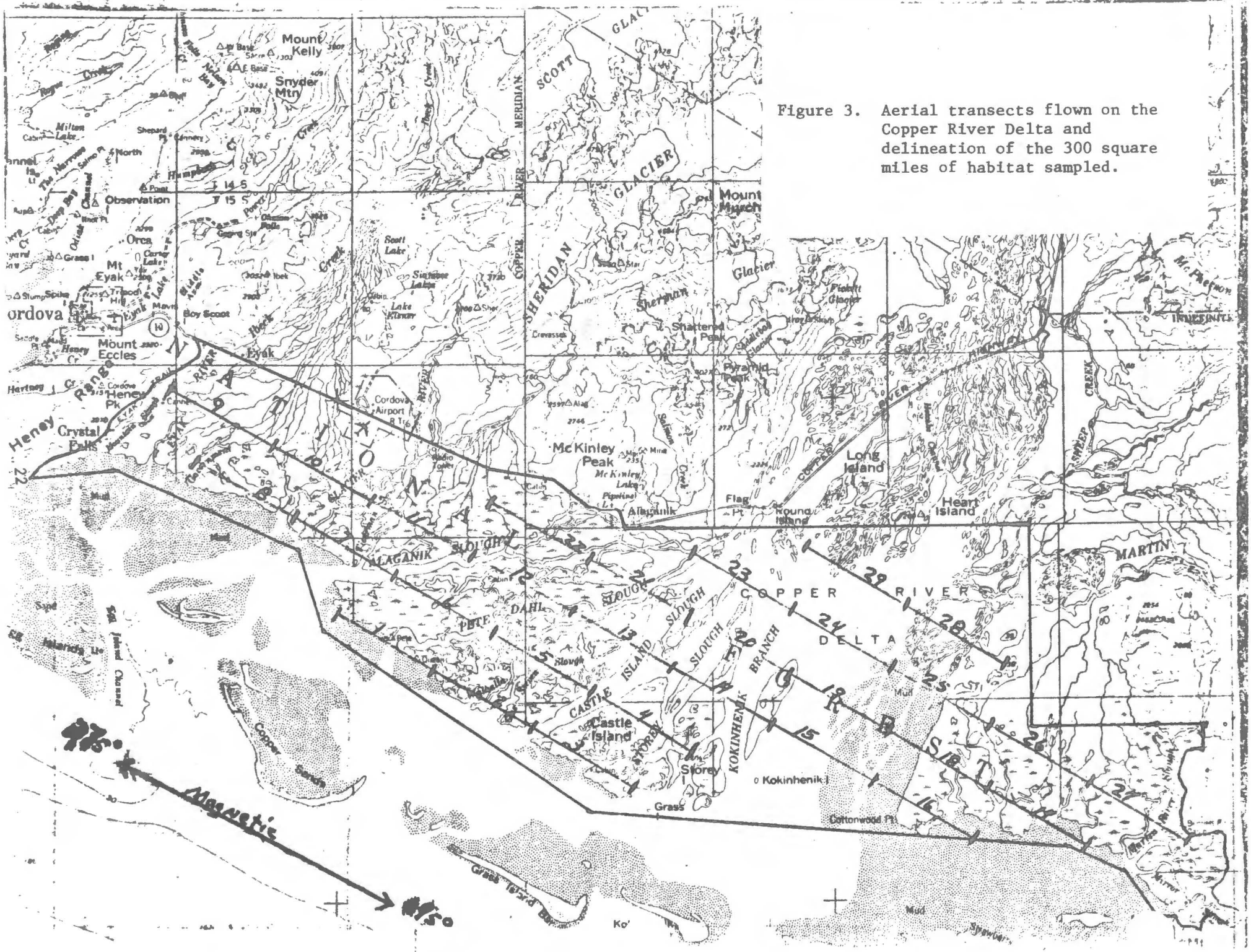


Figure 3. Aerial transects flown on the Copper River Delta and delineation of the 300 square miles of habitat sampled.

Table 10. Breeding duck populations on the CRD - 1976, 1975, 1974 and the pre-1964 seven-year average.

Species	1976		1975		1974		Pre-64 Avg.	
	No.	%	No.	%	No.	%	No.	%
Pintail	5,765	29.5	5,512	31.7	7,370	34.2	6,800	24.6
Widgeon	3,108	15.9	2,294	13.2	2,100	9.7	1,200	4.4
Mallard	2,787	14.2	2,018	11.6	2,563	11.9	5,600	20.3
Green-winged Teal	2,595	13.3	3,038	17.5	2,059	9.6	800	2.9
Shoveler	1,713	8.8	1,136	6.5	1,161	5.4	500	1.8
Gadwall	--	--	106	0.6	103	0.5	200	0.7
Total Dabbler	15,968	81.7	14,104	81.1	15,356	71.3	15,100	54.7
Scaups	3,428	17.5	2,315	13.3	4,329	20.1	10,000	36.2
Goldeneyes	157	0.8	520	3.0	1,189	5.5	1,700	6.2
Canvasback	--	--	106	0.6	315	1.5	200	0.7
Bufflehead	--	--	--	--	350	1.6	200	0.7
Oldsquaw	--	--	340	2.0	--	--	--	--
Scoter	--	--	--	--	--	--	400	1.5
Total Divers	3,585	18.3	3,281	18.9	6,183	28.7	12,500	45.3
Total Ducks[1/]	19,553	100.0	17,385	100.0	21,539	100.0	27,600	100.0

1) Does not include mergansers.

Table 11. Calculated densities per square mile of ducks, geese and swans on the CRD, 1976.

Segment Number	1976				
	C. geese	Dabbler	Diver1/	Total ducks1/	Swans
1	160	66	--	66	--
2	260	129	--	129	--
3	221	203	34	237	--
4	8	18	--	18	2
5	201	10	9	19	--
6	236	99	28	127	--
7	299	62	28	90	--
8	162	77	93	170	7
9	54	14	6	20	--
10	67	23	6	29	2
11	112	--	3	3	8
12	105	18	--	18	7
13	14	10	--	10	4
14	4	--	--	--	9
15	--	--	--	--	--
16	--	--	--	--	--
17	--	49	--	49	--
18	43	416	--	416	5
19	--	--	--	--	2
20	7	--	34	34	2
21	21	58	6	64	--
22	47	64	--	64	--
23	--	--	--	--	--
24	--	--	--	--	--
25	3	32	--	32	4
26	8	32	--	32	4
27	--	--	--	--	--
28	9	--	--	--	--
29	4	--	--	--	--
Averages	69.8	51.7	11.6	63.3	1.9
1975	37.8	45.8	10.7	56.5	1.2
1974	57.8	49.8	20.1	69.9	1.8
Pre-64	--	49.0	40.6	89.6	--

1) Does not include mergansers.

Table 12. Calculated densities per square mile of ducks, geese and swans on the CRD, 1975-76 two-year average.

Segment Number	1975-1976 Two-Year Average				
	C. geese	Dabbler	Diver1/	Total Ducks1/	Swans
1	129	33	--	33	--
2	165	215	5	220	--
3	168	132	40	172	--
4	4	15	3	18	1
5	151	26	12	38	1
6	175	106	24	130	--
7	244	63	22	85	1
8	139	80	65	145	3
9	37	17	8	25	--
10	56	57	3	60	1
11	93	21	2	23	4
12	73	31	5	36	5
13	9	9	--	9	3
14	4	--	--	--	5
15	--	--	--	--	--
16	11	52	--	52	--
17	9	26	--	26	--
18	22	232	17	249	3
19	--	--	--	--	1
20	9	--	20	20	2
21	21	39	3	42	3
22	35	100	8	108	1
23	--	4	--	4	--
24	--	--	--	--	--
25	1	16	2	18	4
26	6	32	--	32	5
27	4	--	--	--	--
28	5	25	--	25	2
29	2	--	--	--	--
Averages	53.8	48.7	11.2	49.9	1.6

1) Does not include mergansers

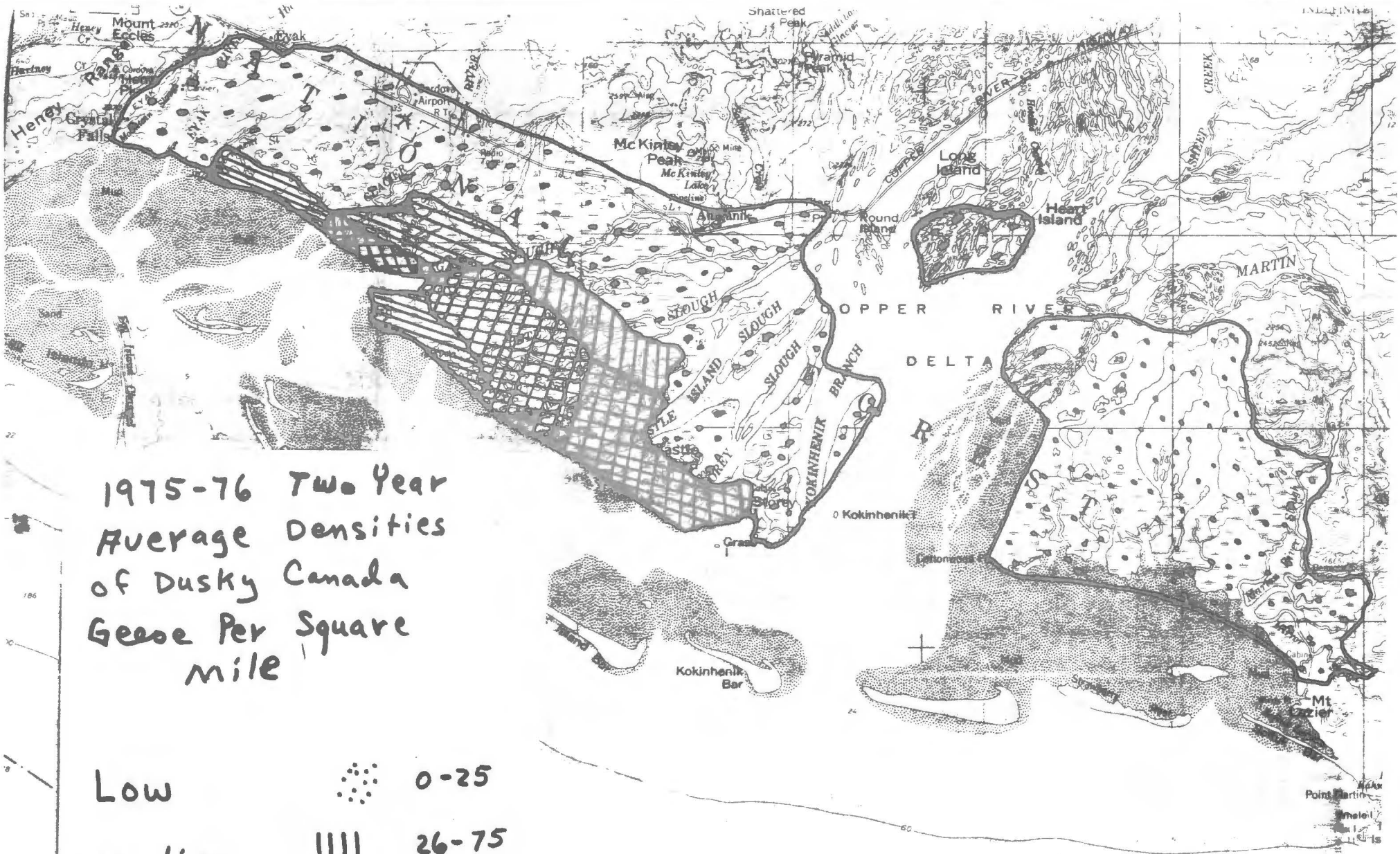

1975-76 Two Year
Average Densities
of Dusky Canada
Geese Per Square
Mile
Low 0-25
Medium 26-75
High 76-150 A
Very High 150+
Mount Eccles
Henry Cr
Hartney
Crystal Falls
Shattered Peak
Pyramid Peak
Mc Kinley Peak
Mc Kinley Lake
Long Island
Heart Island
Round Island
COPPER RIVER DELTA
SLOUGH
ISLAND
KOKINHENIK BRANCH
Kokinhenik
Kokinhenik Bar
Mt Ozier
Point Martin
MARTIN
CREEK

Figure 4.


1975-76 Two Year
Average Breeding
Duck Population
Densities
Low 0-35/mi²
Medium 36-75/mi²
High 76-100/mi²
Very High 101+/mi²
Cordova
Heney
Crystal Falls
Mc Kinley Peak
Mc Kinley Lake
Pipeline
Alaganik
Flag
Round Island
Long Island
Heart Island
MARTIN
COPPER RIVER
DELTA
Castle Slough
Kokinhenik Bar
Kokinhenik
Mt Eyrie
Point

Figure 5.

gained from a review of these two figures. To more accurately assess specific areas, additional surveys should be flown north and south so a grid pattern could be constructed.

It is believed that adequate data are now available on breeding waterfowl populations on the CRD on which to base future land use decisions. Future plans are to conduct a breeding duck survey once every 3 years (1979, 1982, etc.) for monitoring purposes. However, for at least the next few years, an early June survey will be flown to assess the size of the dusky Canada goose population. As the number of lesser Canada geese wintering in Oregon's Willamette Valley increases, it becomes more difficult to accurately measure the size of the mid-winter dusky Canada goose population, thus making breeding grounds surveys necessary.

COOK INLET WATERFOWL SURVEYS

Breeding Waterfowl Survey

As part of an effort to document waterfowl values on coastal marshes of Cook Inlet, especially in view of the recently created and proposed refuges on some of these areas, a breeding waterfowl survey was made on May 24 and 25, 1976. Areas surveyed in 1976 were: Palmer-Hay Flats, Goose Bay, Susitna Flats, Trading Bay, Redoubt Bay, Fox River Flats, Chickaloon Flats, Portage Area and the Jim-Swan Lakes area. These areas were also surveyed in 1975 except for Trading and Redoubt Bays, Fox River Flats and the Portage area. Spring chronology in the Cook Inlet area in 1976 was 7-10 days "early," and nesting conditions should have been excellent.

Procedures:

The coastal waterfowl habitat (sedge flats) and the Jim-Swan Lakes area were first encompassed by lines drawn on 1 inch:4 mile maps (Figs. 6, 7, 8, 9, 10, 11). The land area within these lines was then determined using a planimeter.

Transect lines were drawn on the maps in an attempt to sample representative habitat types in each area.

Each transect was broken into 4-mile segments which were individually numbered. More precise duck distribution data could be attained from these small segments.

Dan Timm, Dimitri Bader and Dave Erikson (all A.D.F.&G.) flew the surveys on flight routes as depicted in Figs. 6-11. The same survey techniques were used as are employed by the USFWS except the pilot did no counting. There were two observers on each of the two survey days.

Data were analyzed for each survey area and then expanded for a total of all areas. Visibility rates were applied for each species; rates were provided by Jim King, USFWS.

Results:

Total 1976 calculated duck breeding populations were: Palmer - 2,076; Goose Bay - 427; Susitna - 13,097; Trading Bay - 10,828; Redoubt Bay - 18,541; Fox River - 765; Chickaloon - 834; Portage - 2,259; Jim Swan - 1,793. Dabblers (43,843) comprised 87 percent of the 50,620 ducks on all areas. Pintail, green-winged teal and mallard were the most abundant species. Table 13 summarizes species composition and number of birds for all areas surveyed.

Portage Flats had the greatest density of breeding ducks (123.4/mi^2) while Chickaloon Flats (as in 1975) had the lowest (21.4/mi^2). The average density of ducks on all coastal habitat was 79.2 birds/mi^2 (excluding Jim-Swan Lakes area).

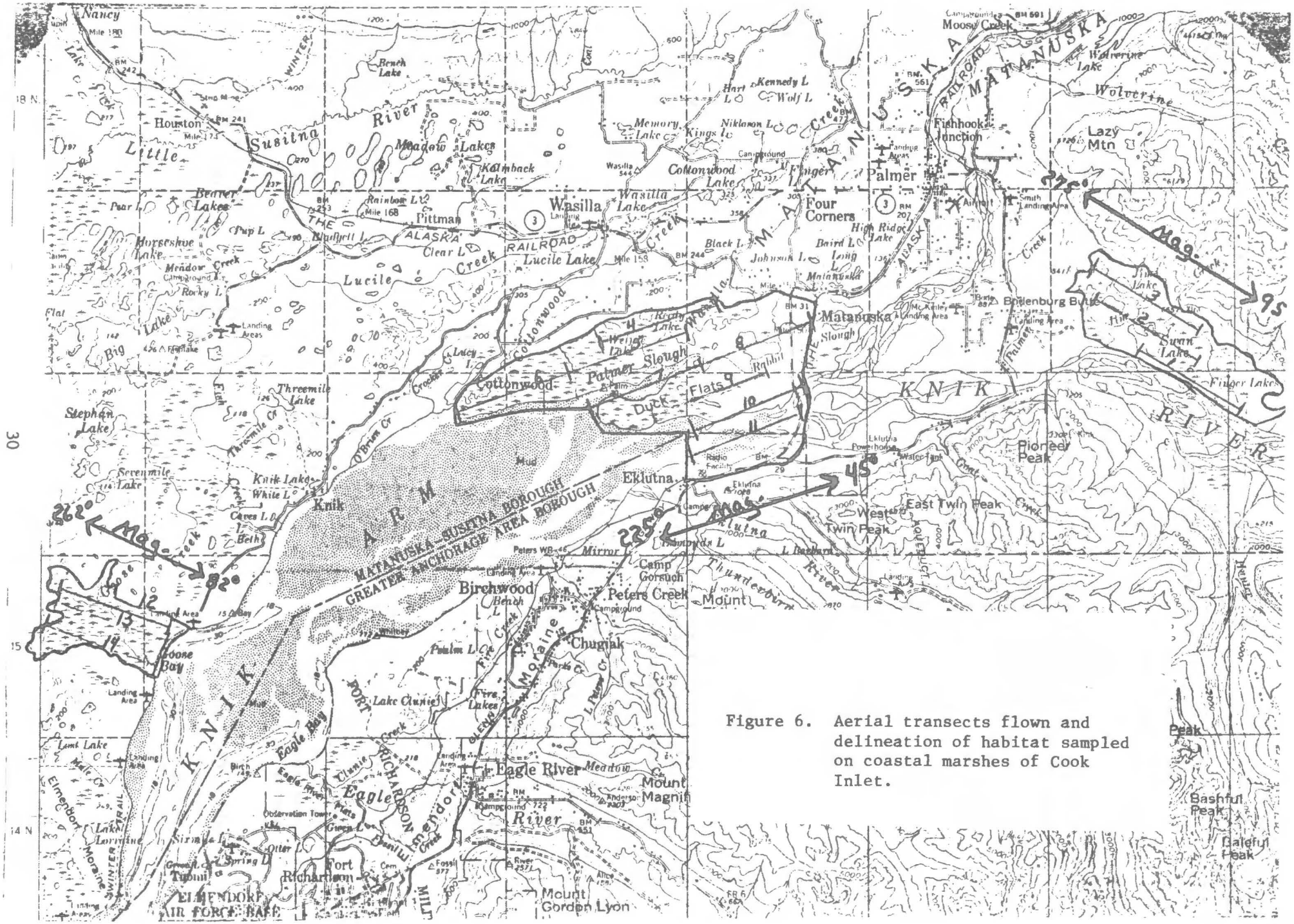
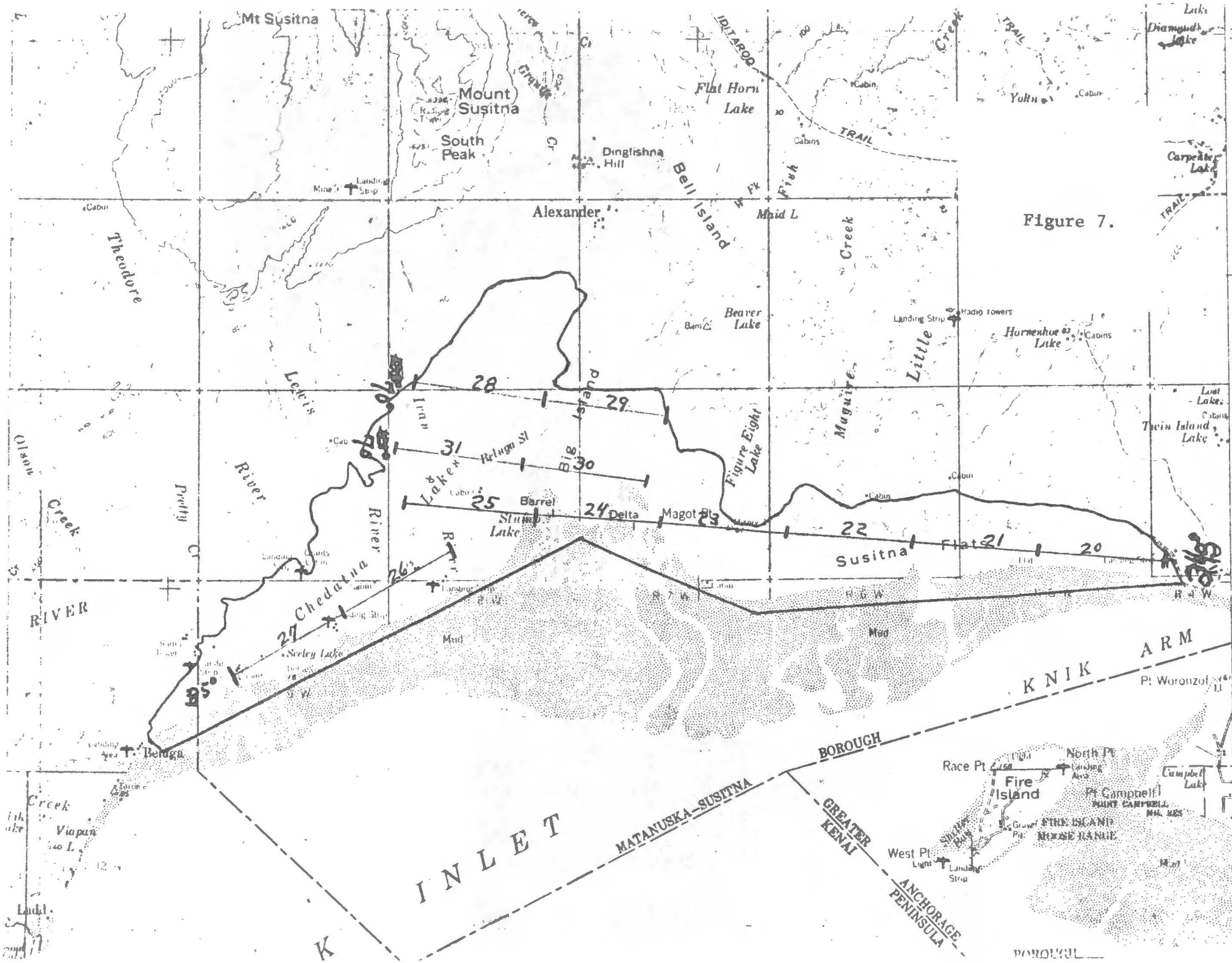


Figure 6. Aerial transects flown and delineation of habitat sampled on coastal marshes of Cook Inlet.


Mt Susitna
Mount Susitna
South Peak
Dinglishna Hill
Alexander
Flat Horn Lake
IDITAROD
TRAIL
Bell Island
Fish Creek
Maid L
Theodore
Lewis
River
Beaver Lake
Radio Towers
Landing Strip
Horseshoe Lake
Cabins
Little
Maguire
Creek
Figure Eight Lake
Big Island
Ivan
Lakes
Beluga Sl
Barrel
Stump Lake
Delta
Magot Pt
Susitna
Flats
Twin Island Lake
Carpenter Lake
Diamond Lake
Olson Creek
Pretty Cr
River
Chedatna
Seeley Lake
Mud
RIVER
Beluga
Creek
Viapan
Ladd
K
INLET
KNIK ARM
MATANUSKA-SUSITNA
BOROUGH
GREATER KENAI
ANCHORAGE PENINSULA
Pt Woronzof
Race Pt
North Pt
Fire Island
Pt Campbell
POINT CAMPBELL
FIRE ISLAND
MOOSE RANGE
West Pt
Campbell Lake
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15'
30'

Figure 7.

Figure 8.

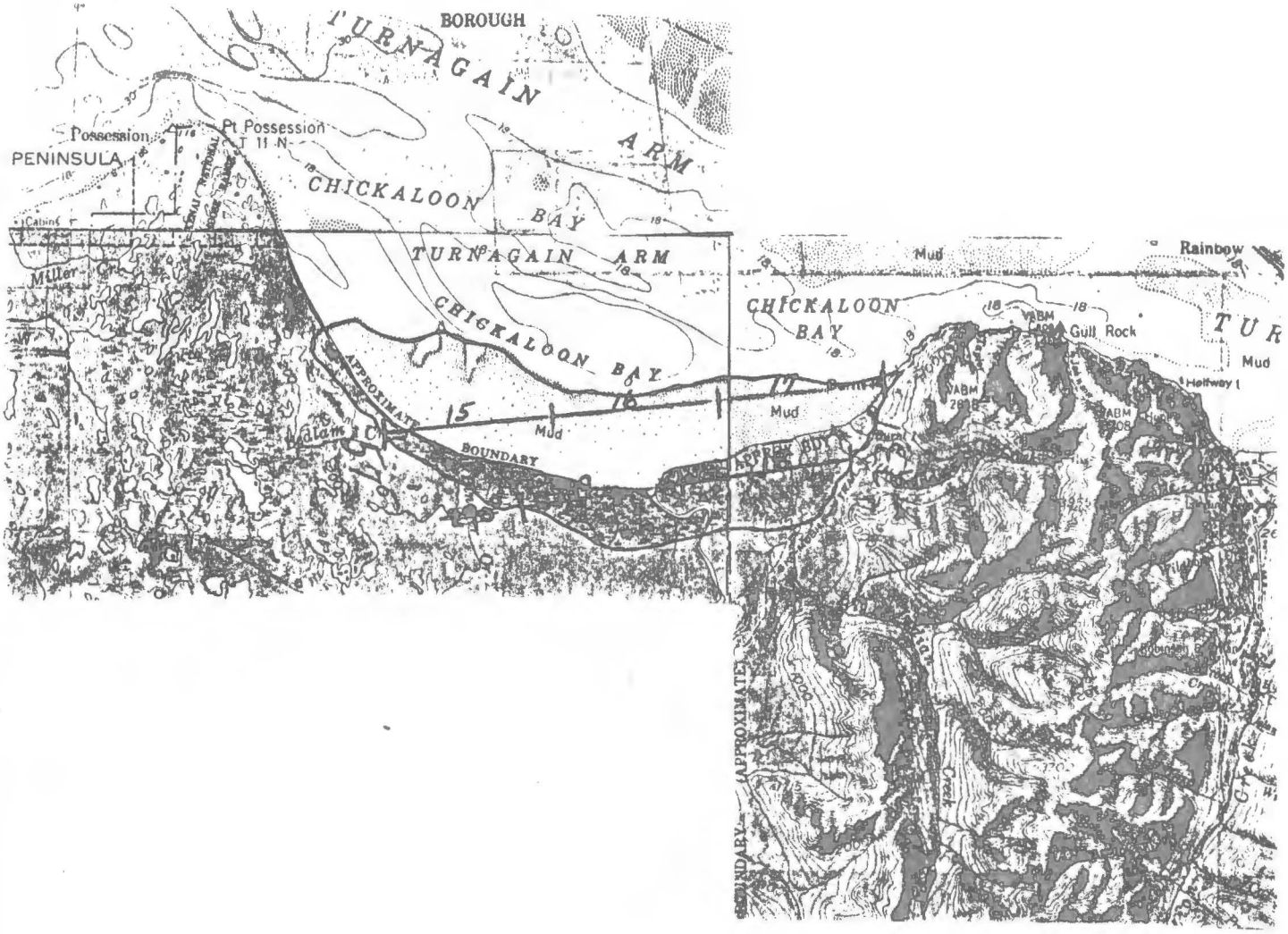
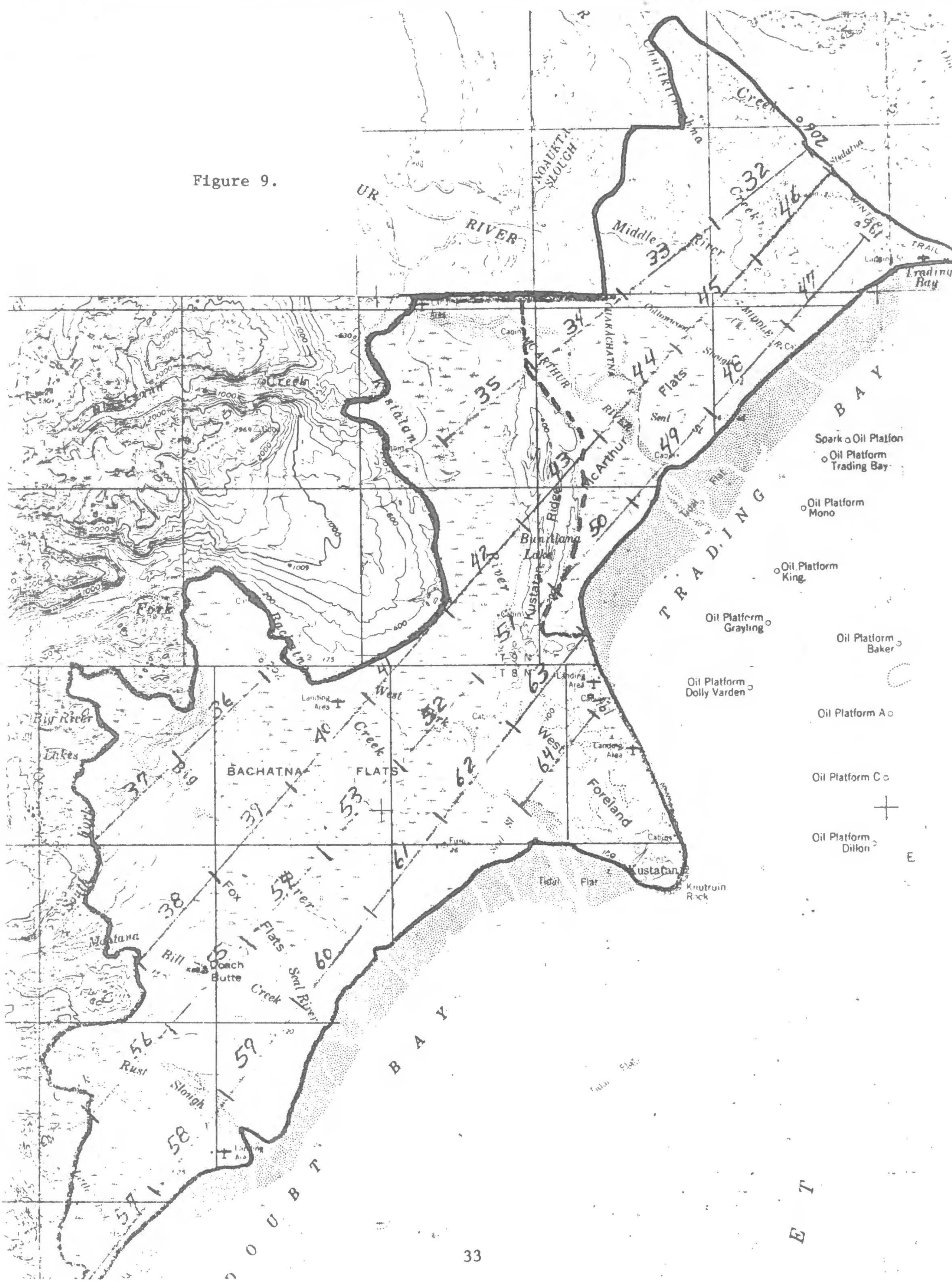

BOROUGH
TURNAGAIN ARM
Possession
PENINSULA
Pt Possession
T 11 N
CHICKALOON BAY
TURNAGAIN ARM
Miller Cr
CHICKALOON BAY
APPROXIMATE
15
16
17
Mud
Salamatof
BOUNDARY
Mud
Rainbow
CHICKALOON BAY
VABM
Gull Rock
TUR
Mud
Halfway I
VABM
APPROXIMATE
Creek

Figure 9.



TRADING BAY
Trading Bay
Spark Oil Platfon
Oil Platform Trading Bay
Oil Platform Mono
Oil Platform King
Oil Platform Grayling
Oil Platform Baker
Oil Platform Dolly Varden
Oil Platform A
Oil Platform C
Oil Platform Dillon
BACHATNA FLATS
Big River Lakes
McArthur
Kustatan Ridge
Kustatan
Kustatan
Knutruin Rock
Coach Butte
Middle River
Tidal Flat
West Foreland
Fox River Flats
Rust Slough
Bill Creek
Seal River
DOUBT BAY
WINTER TRAIL
Chuitkilnachna Creek
NOAUKTA SLOUGH
KIRKACHATNA RIVER
Bachatna
Fork
T 8 N
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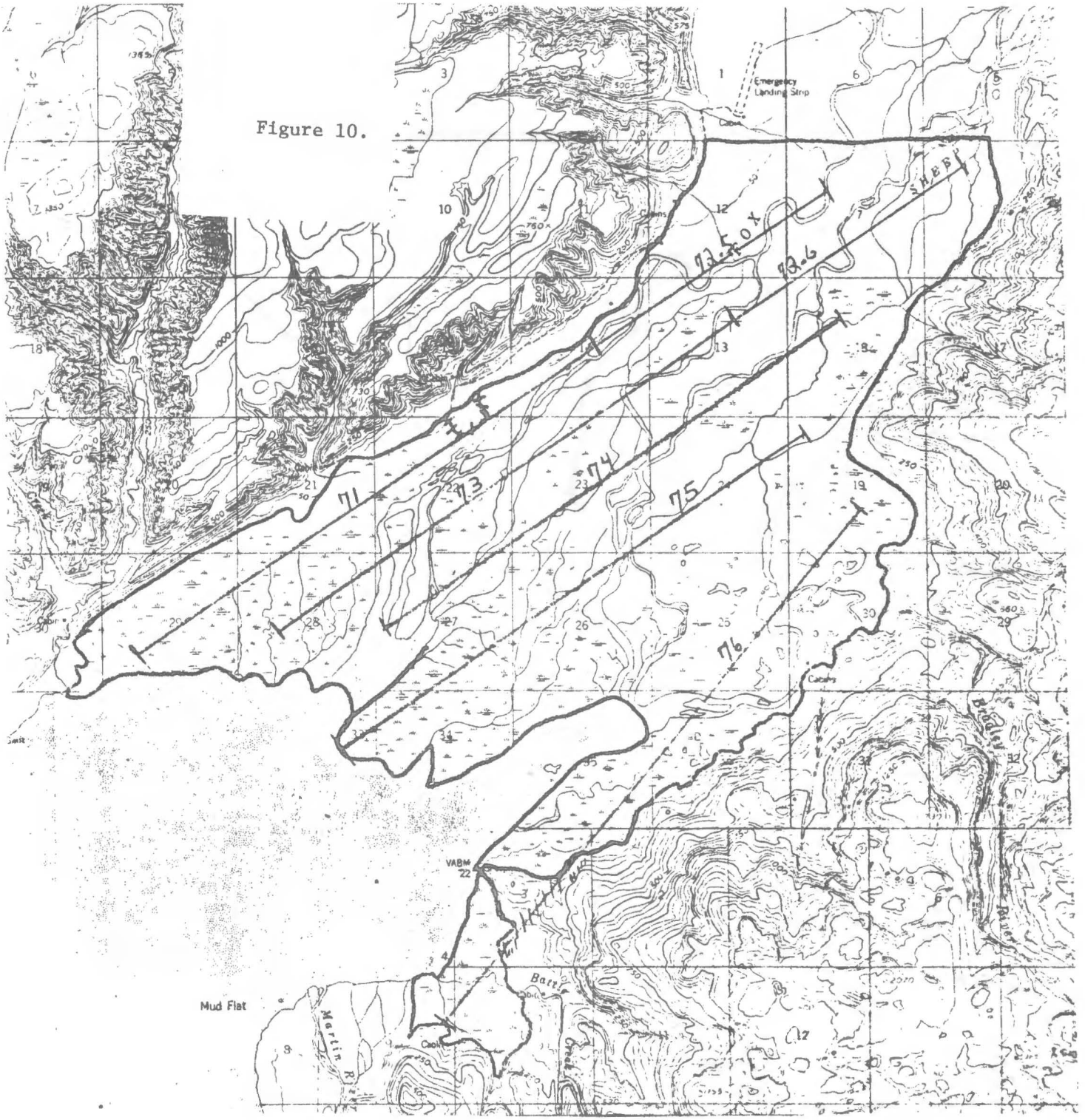
Figure 10.


Emergency Landing Strip
SHEEP
73.5 ox
78.6
71
73
74
75
76
VABM 22
Mud Flat
Marlin R.
Bradley R.

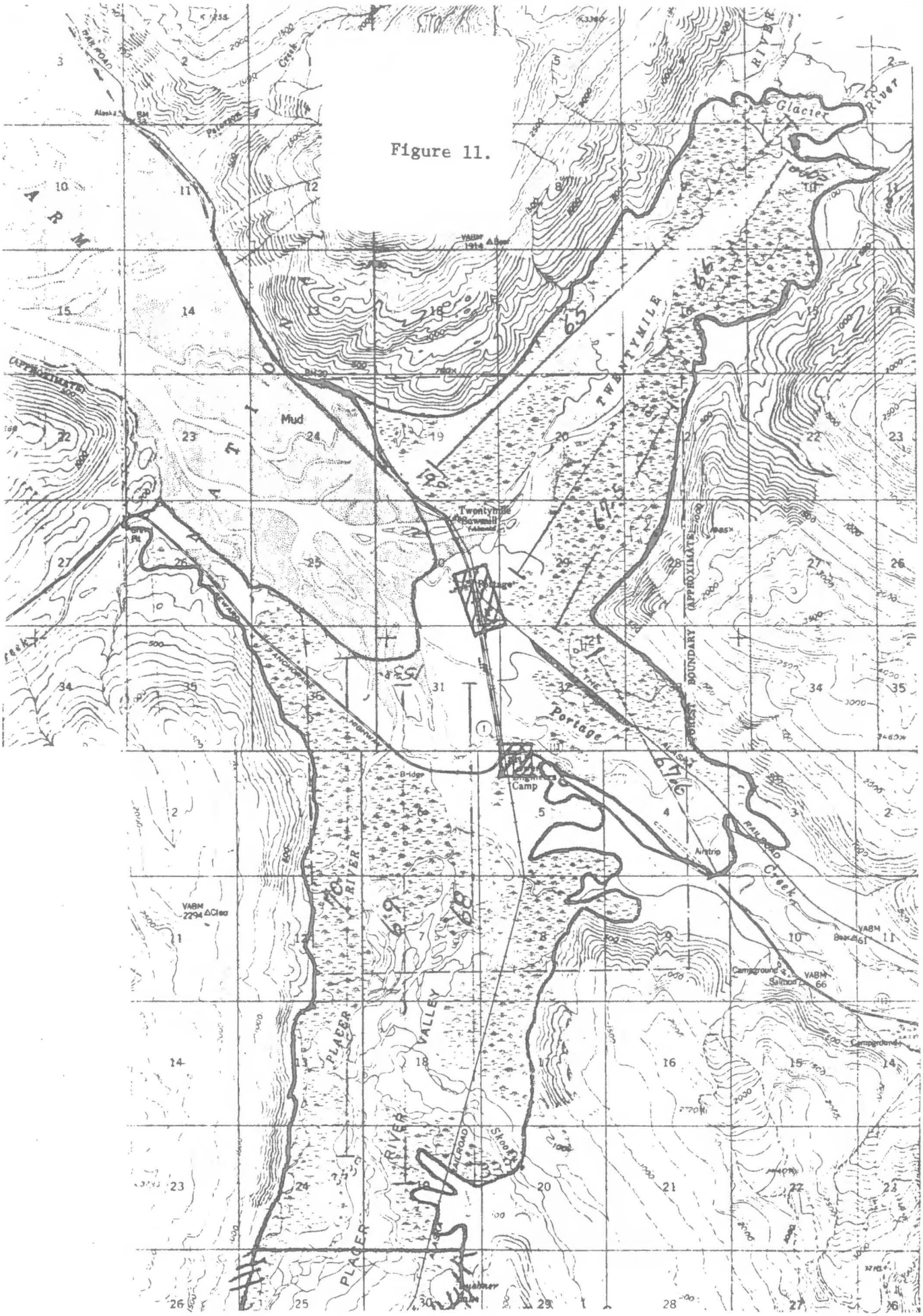

Glacier
River
ARM
Mud
Twentymile
Portage
Bridge
Camp
Airstrip
RAILROAD
Creek
PLACER
RIVER
VALLEY
Campground
Salmon
Campground

Figure 11.

Table 13. Calculated bird populations on Cook Inlet coastal marshes and on the Jim Swan Lakes area, 24 and 25 May, 1976.

Species	Palmer Hay		Goose Bay		Susitna		Trading Bay		Redoubt Bay	
	No.	% of tot.	No.	%	No.	%	No.	%	No.	%
Pintail	497	23.9	120	28.1	6,016	45.9	4,890	45.2	6,015	32.4
G-W Teal	101	4.9	117	27.4	2,164	16.5	2,750	25.4	6,468	34.9
Mallard	235	11.3	58	13.6	1,224	9.4	471	4.3	2,458	13.3
Widgeon	288	13.9	--	--	974	7.4	1,209	11.2	1,110	6.0
Shoveler	411	19.8	95	22.2	782	6.0	578	5.3	--	--
Gadwall	53	2.5	--	--	215	1.6	107	1.0	205	1.1
Total Dabbler	1,585	76.3	390	91.3	11,375	86.8	10,005	92.4	16,256	87.7
Scaups	390	18.8	25	5.9	1,008	7.7	374	3.4	1,100	5.9
Goldeneyes	--	--	--	--	499	3.8	235	2.2	711	3.8
Mergansers	--	--	12	2.8	45	0.4	214	2.0	474	2.6
Canvasback	101	4.9	--	--	170	1.3	--	--	--	--
Bufflehead	--	--	--	--	--	--	--	--	--	--
Total Divers	491	23.7	37	8.7	1,722	13.2	823	7.6	2,285	12.3
Total Ducks	2,076	100.0	427	100.0	13,097	100.0	10,828	100.0	18,541	100.0
Swan	--		--		45		21		356	
Can. Goose	315		--		2,051		--		--	
W-F Goose	--		--		--		289		172	
Sandhill Crane	--		12		45		642		86	
R-T Loon	--		--		--		385		43	
Common Loon	32		25		--		86		--	

Table 13. (continued) Calculated bird populations on Cook Inlet coastal marshes and on the Jim Swan Lakes area, 24 and 25 May, 1976.

Species	Fox R. Flats		Chickaloon		Portage		Jim Swan		Total except Jim Swan	
	No.	% of tot.	No.	%	No.	%	No.	%	No.	%
Pintail	150	19.6	421	50.5	567	25.1	359	20.0	18,676	38.2
G-W Teal	158	20.6	148	17.7	522	23.1	89	5.0	12,428	25.4
Mallard	69	9.0	101	12.1	637	28.2	294	16.4	5,253	10.8
Widgeon	61	8.0	86	10.3	67	3.0	355	19.8	3,795	7.8
Shoveler	--	--	--	--	70	3.1	--	--	1,936	4.0
Gadwall	--	--	78	9.4	--	--	--	--	658	1.3
Total Dabbler	438	57.2	834	100.0	1,863	82.5	1,097	61.2	42,746	87.5
Scaups	--	--	--	--	24	1.1	313	17.5	2,921	6.0
Goldeneyes	183	23.9	--	--	268	11.9	257	14.3	1,896	3.9
Mergansers	144	18.8	--	--	104	4.6	--	--	993	2.0
Canvasback	--	--	--	--	--	--	103	5.7	271	0.6
Bufflehead	--	--	--	--	--	--	23	1.3	--	
Total Divers	327	42.7	--	--	396	17.6	696	38.8	6,081	12.5
Total Ducks	765	99.9	934	100.0	2,259	100.1	1,793	100.0	48,827	100.0
Swan	--		--		12		--		434	
Can. Goose	--		109		9		--		2,484	
W-F Goose	--		--		--		--		461	
Sandhill Crane	--		31		--		--		816	
R-T Loon	--		--		--		--		428	
Common Loon	--		--		12		--		155	

Table 14 presents size of the areas surveyed, percent of each area sampled and duck densities on each area. The records of birds seen on each 4-mile segment (Figs. 6-11) are in the Anchorage A.D.F.&G. files.

Discussions and Conclusions:

The 1976 survey confirmed what was found in 1975 - coastal marshes in Cook Inlet are much more important to breeding birds than surrounding habitats of similar size. King and Lensink (1971) estimated an average of 12.1 ducks present per square mile in Kenai-Susitna habitat, or 26,700 birds in 2,200 square miles of habitat. In 1976 we found 50,620 ducks in 630.8 square miles of habitat, or 80.2 ducks per square mile.

The large breeding duck populations in late May 1976 tend to negate the theory suggested last year that drakes may come to the coast after breeding activities on inland areas. The proportion of lone male dabblers observed in 1976 was less than in 1975. The survey was made 1 week earlier in 1976, but spring chronology was about 10 days earlier. The ratios of birds observed to be in pairs, flocks or as lone males each year were as follows:

	Lone Male		Pairs		Flocked Birds	
	1975	1976	1975	1976	1975	1976
Dabbler	61%	54%	24%	28%	15%	18%
Diver	10%	14%	38%	39%	52%	47%

Additional spring surveys are planned for 1977. Also, aerial surveys are planned for some areas to assess production, and ground studies may be conducted on the Palmer Flats, Goose Bay, and Susitna Flats.

The calculated Canada goose population in Cook Inlet was 2,484 birds. This may be high because Susitna Flats probably doesn't have 2,051 geese as the 1976 survey indicated. However, it does give credence to the estimated population of 2,000 geese which was made in 1974 after a mid-summer aerial survey. In 1976 Potter Marsh wasn't surveyed and at least 50 adult geese were known to have rested there; raising 150 or more young.

Duck Banding

In our continuing efforts to learn more about the distribution of ducks raised in the local Anchorage area, 69 birds were banded on Lake Hood, 7 on Potter Marsh and 12 on Elmendorf AFB by Air Force personnel in 1975. However, some of the birds banded on Lake Hood and EAFB may have been migrants as the birds were captured in late August. In 1974, 87 ducks were banded on Potter and Lake Hood for a 2-year total of 175 birds.

Table 14. Total area, sample size and breeding birds per square mile on Cook Inlet coastal marshes and Jim Swan Lakes area, 1976 and 1975.

Area	Size in Mile^2	% of Area Sampled	Birds per mile^2					
			Dabblers		Divers		Total	
			1976	1975	1976	1975	1976	1975
Palmer Hay	42.7	18.7	37.1	62.1	11.5	14.4	48.6	76.5
Goose Bay	9.2	32.6	42.4	70.1	4.0	3.7	46.4	73.8
Susitna	136.0	8.8	83.6	54.2	12.7	6.7	96.3	60.9
Chickaloon	39.0	12.8	21.4	39.4	-0-	-0-	21.4	39.4
Trading Bay	107.0	9.3	93.5	NS	7.7	NS	101.2	NS
Redoubt Bay	248.0	10.1	65.5	NS	9.2	NS	74.7	NS
Fox R. Flats	16.6	36.1	26.4	NS	19.7	NS	46.1	NS
Portage	18.3	32.8	101.8	NS	21.6	NS	123.4	NS
Total Coastal Areas	616.8	11.8	69.3	NA	9.9	NA	79.2	NA
Jim Swan	14.0	21.4	78.4	124.4	49.7	17.0	128.1	141.4

Note: NS = Not surveyed.

The number of ducks banded in 1975 and accumulated totals are:

	Birds of the Year		Adults		Total	
	1975	Total 74 & 75	1975	Total	1975	Total
Mallard	48	66	26	37	74	103
Pintail	4	29	--	1	4	30
Widgeon	6	20	2	5	8	25
G-W Teal	2	16	--	1	2	17
						175

The following is a summary of the recovery patterns for mallards banded in both years which represents two hunting seasons. There have been no additional recoveries of other species from those reported by Timm (1975).

Mallard - total of 8 recoveries, three adults and five young. Five birds were shot near Anchorage before September 15; one bird (young) was shot on the northwest side of Prince of Wales Island in October; one bird (young-of-the-year) was shot at Women's Bay on Kodiak in mid-December; and one bird was shot along the Columbia River in eastern Oregon. All of the recoveries except one came from 1975 banded birds. The 1974 bird was banded as an adult male and recovered in Oregon.

In several years, when more birds have been banded and recoveries received, a more thorough assessment will be made.

LESSER CANADA GOOSE STUDIES

Cook Inlet

An aerial survey in 1974 documented a large (estimated 2,000) population of lesser Canada geese summering on tidal areas of upper Cook Inlet (Timm 1975). Further efforts to document aspects of these birds' life history were conducted in 1975 through goose banding on the Palmer Hay Flats.

On July 22, 1975, 53 Canada geese (probably *B. c. parvipes*) were captured and banded near Eklutna. One 2-year-old white-fronted goose was also banded. Of the 53 Canada geese 35 (66 percent) were locals and 18 were adults. A helicopter was used to herd the birds into a trap (Timm and Bromley, manuscript in prep.). In addition to the 53 wild Canada geese, 9 goslings raised in captivity were banded and released on Potter Marsh.

There was only one recovery from the 53 birds banded near Eklutna during the 1975-76 season. This occurred near Baskett Slough NWR in Oregon's Willamette Valley. However, four of the nine hand-reared birds were shot by hunters during the first season. Two were recovered in the Anchorage area on September 13, 1975; one was shot on the west coast of Queen Charlotte Island on October 14, 1975 and the other goose was taken near Baskett Slough.

Seven of the lesser Canadas banded in 1974 on Potter Marsh, were recovered during the 1975-76 season for a total of 15 recoveries from two hunting seasons. Thirteen of the total have come from near Baskett Slough while the other two were shot in Washington along the Columbia River. It is interesting that none of the wild Canada geese banded in Cook Inlet have been recovered in Alaska.

Cold Bay

Another unsuccessful attempt was made to band some of the estimated 100,000 lesser Canada geese fall staging on Izembek Lagoon. Two oat fields were planted by FWS personnel on islands in the lagoon. During 1976 an additional field will be planted on shore which will hopefully be more conducive to banding geese.

During fall 1975 an extensive set of measurements were taken on Canada geese in hunter's bags. These data will be used to better define what subspecies of goose is using the area and will also help to better differentiate Aleutian Canada geese from other subspecies.

Two aerial assessments of Canada geese in the Cold Bay area were made. The first count on October 11, 1975 indicated a population of 28,855 birds and on October 26, 1975 a total of 73,523 birds was counted. Significant numbers of geese were probably missed on both counts. Large numbers of Canadas moved into the area, however, between the two surveys. Several A.D.F.&G. and U.S.F.W.S. personnel participated in both surveys.

INGESTED LEAD SHOT IN ALASKAN WATERFOWL - 1975 HUNTING SEASON

During the 1974 season the first ingested lead shot study in Alaska was conducted (Timm 1975). The results of that study indicated that on many areas in Alaska ducks were not ingesting lead shot through normal feeding activities. However, a few of the heavily hunted areas in southcentral Alaska were identified as being possible problem areas. For example, 25.3 percent of all duck gizzards collected from the Palmer-Hay Flats carried ingested shot. Also, those ducks in Alaska found with shot apparently had the highest average number of pellets per gizzard of any birds examined anywhere. However, from the birds' good physical condition and lack of gizzard stress, it appeared that ducks in Alaska were not being poisoned by the ingested pellets.

The main objectives for the 1975 study were: 1) to document the high rate of shot ingestion on some areas; 2) to expand the gizzard collection activities to the remaining heavily hunted areas where no gizzards had been collected; and 3) to determine whether ducks with ingested shot were storing lead in their body tissues and if so, to what degree.

Methods

The instructions to gizzard collectors; the method for determining presence of ingested shot; and the method for determining the number of shot per gizzard were identical to the 1974 study described by Timm (1975). Gizzard collection sites are shown in Fig. 12. Personnel collecting gizzards were also requested to note any external signs of stress which birds may have exhibited (none were noted).

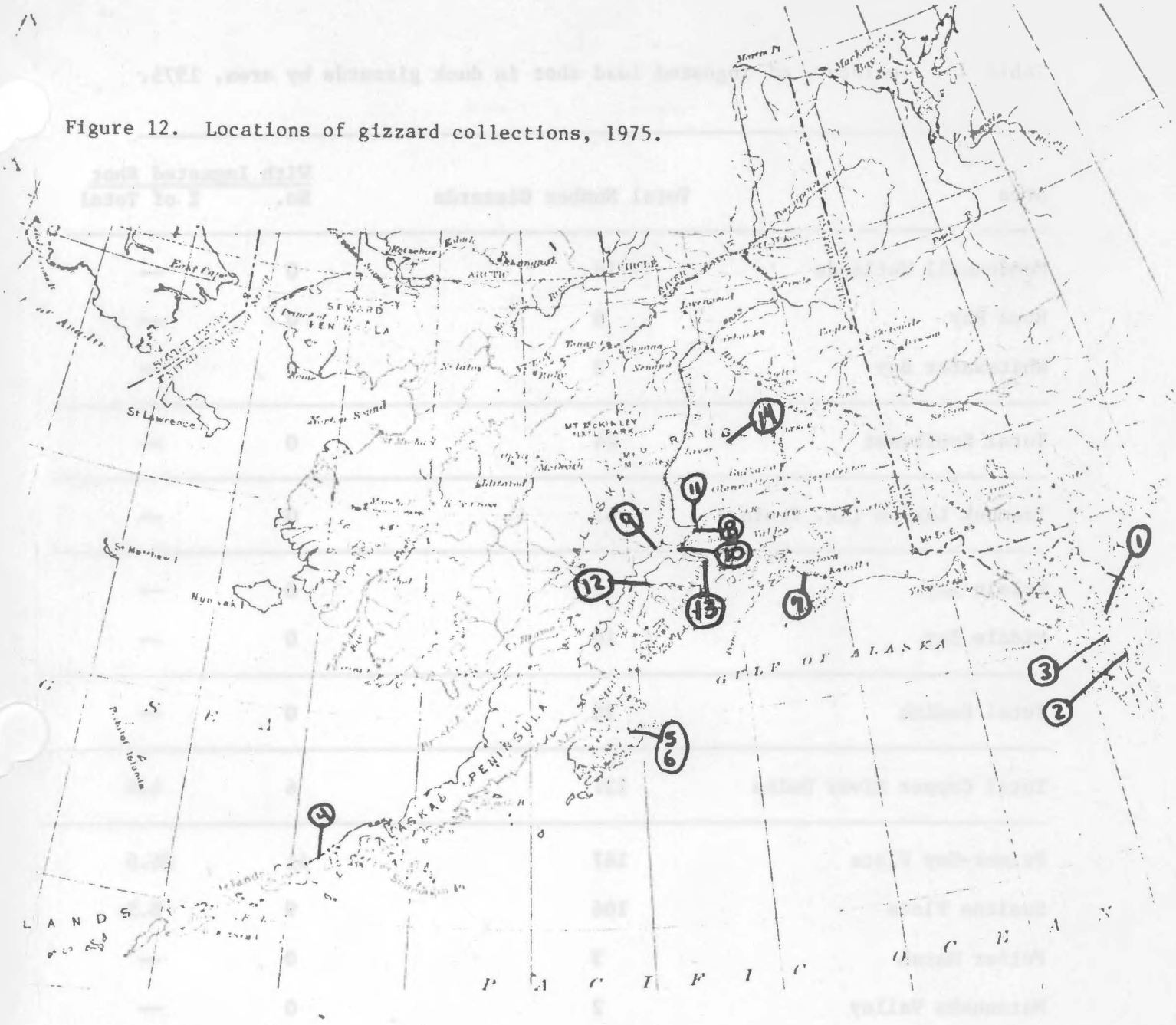
The liver and one wing were collected from some ducks and kept with the gizzard. The instructions for liver and wing collection and storage were provided by the WARF Institute, Madison, Wisconsin. Livers and wings were only collected from ducks shot on the Palmer-Hay Flats and Susitna Flats, where high incidences of shot ingestion were expected. The WARF Institute analyzed the livers and wing bones for lead content and provided these data in ppm. The number of wings and livers analyzed was limited by cost - $25.00/wing and $20.00/liver.

Results

Table 15 provides a numerical summary of the gizzards collected by location, percent of the gizzards having ingested lead shot and a summary of these data by geographic regions of the state. Only ducks from the Palmer-Hay Flats (24.6 percent ingestion rate), Susitna Flats (8.5 percent) and the Copper River Delta (4.4 percent) had ingested lead shot. For Cook Inlet, 17.9 percent of all gizzards collected carried ingested shot (n = 280).

Table 16 provides a numerical summary of the gizzards collected and the rate of shot ingestion by duck species on the three areas where ingested lead pellets were encountered. Scaup - as in 1974 - had the highest ingestion rate (42.9 percent) for the three areas, followed by canvasback (40.0 percent), pintail (22.6 percent), mallard 21.8 percent) and shoveler (2.4 percent). Divers had about 2.5 times the ingestion rate of dabblers (32.0 percent vs. 12.6 percent), but the total sample size of divers on the three areas was only 25 birds.

Figure 12. Locations of gizzard collections, 1975.



Collection Locations

1. Mendenhall Wetlands
2. Hood Bay
3. Whitewater Bay
4. Izembek Lagoon
5. Kalsin Bay
6. Middle Bay
7. Copper River Delta
8. Palmer-Hay Flats
9. Susitna Flats
10. Potter Marsh
11. Matanuska Valley
12. Kenai River Flats
13. Portage Area
14. Denali Highway

Table 15. Incidence of ingested lead shot in duck gizzards by area, 1975.

Area	Total Number Gizzards	With Ingested Shot	
		No.	% of Total
Mendenhall Wetlands	16	0	--
Hood Bay	6	0	--
Whitewater Bay	2	0	--
Total Southeast	24	0	--
Izembek Lagoon (Ak. Penin.)	61	0	--
Kalsin Bay	16	0	--
Middle Bay	10	0	--
Total Kodiak	26	0	--
Total Copper River Delta	137	6	4.4
Palmer-Hay Flats	167	41	24.6
Susitna Flats	106	9	8.5
Potter Marsh	3	0	--
Matanuska Valley	2	0	--
Kenai River Flats	1	0	--
Portage Area	1	0	--
Total Cook Inlet	280	50	17.9
Total Interior (Denali Highway)	6	0	--
	534		

Table 16. Incidence of ingested lead shot in duck gizzards by species and by area, 1975 [1/].

Species	Total Number Gizzards By Area			Percent With Ingested Shot			
	Palmer-Hay	Susitna	Copper Delta	Palmer-Hay	Susitna	Copper Delta	Total
Pintail	56	19	31	35.7	15.8	3.2	22.6
Mallard	39	11	37	43.6	18.2	0	21.8
Am. Widgeon	7	11	37	0	0	0	--
G-W Teal	26	1	6	0	0	0	--
Shoveler	19	8	15	0	0	6.7	2.4
Gadwall	0	1	3	0	0	0	--
B-W Teal	0	0	2	0	0	0	--
Unk. Dabbler	0	51	0	0	7.8	0	7.8
Total Dabbler	147	102	131	25.2	8.8	1.5	12.6
Scaup (both)	6	2	6	33.3	0	66.7	42.9
Goldeneye (both)	2	2	0	0	0	0	--
Scoter (all)	0	0	0	0	0	0	--
Canvasback	5	0	0	40.0	0	0	40.0
Redhead	1	0	0	0	0	0	--
Bufflehead	1	0	0	0	0	0	--
Harlequin	0	0	0	0	0	0	--
Total Diver	15	4	6	26.7	0	66.7	32.0

1) Excludes birds if not known to be dabbler or diver.

Of the 43 known age pintails, mallards and shovelers on the three areas having ingested lead shot, 41 (95 percent) were immature and 2 (5 percent) were adults. There were 158 known age birds representing these three species not having ingested shot, of which 85 percent were immature and 15 percent were adults.

There were 8 known age divers carring shot while 8 did not have ingested shot on the three areas. For the lead positive birds, 75 percent were immature and for the lead negative birds 88 percent were young-of-the-year.

In Table 17 a comparison is made between ingested shot rates for ducks collected in September versus those shot in October and later, for the Palmer-Hay Flats, Susitna Flats and the Copper River Delta. For all areas both dabblers and divers had higher ingestion rates in September than later, except that on the Palmer-Hay Flats divers had a higher rate in October-November than in September. On the Palmer-Hay Flats a total of 41 ducks had ingested shot; 30 of these (73 percent) were collected opening day (September 1, 1975).

In Table 18 the incidence of ingested lead pellets by number of pellets per gizzard is given for 1975 and for 1974-1975 combined. The most frequent number of pellets encountered was 1 (25 percent in 1975) while the most pellets encountered in 1975 was 98 and in 1974, 154. The average number of pellets per gizzard in 1975 was 9.8 and in 1974, 10.9.

Two of the gizzards collected in 1975 had an abnormal amount of green stain on the inner lining of that organ. One was a young male pintail shot on the Hay Flats opening day which carried 98 ingested pellets. The other bird was also a young male pintail shot September 9 on the Hay Flats which had ingested 43 pellets.

In Table 19 comparisons are made between rates of ingested shot by area for 1974 and 1975. For 1974 compared to 1975, the ingested shot rates were: Palmer-Hay Flats - 25.3 percent vs. 24.6 percent; Susitna Flats - 12.5 percent vs. 8.5 percent; and for the Copper River Delta - 2.4 percent vs. 4.4 percent, respectively. In 1974 ingested shot was found in ducks from Kodiak, Potter Marsh and the Eagle River Flats. None was found from these areas in 1975, but sample size was much reduced. Table 19 also provides rates of ingested shot by area with 1974 and 1975 data combined.

As discussed previously, WARF Institute analyzed livers and wings from 35 different ducks collected in 1975 (Table 20).

Lead levels in livers varied from less than 0.02 ppm to 0.17 ppm for birds which had not ingested lead shot (n=6). For birds which had ingested shot, levels ranged from 0.07 ppm to 48.1 ppm.

Wing bone lead varied between less than 0.5 ppm to 4.78 ppm for ducks having no ingested shot and from 0.5 ppm to 223 ppm for birds with ingested shot.

Table 17. Incidence of ingested lead shot in duck gizzards by time period, by area, and by species, 1975.

Area and Species[1]	September		October-November	
	No. Collected	% With Shot	No. Collected	% With Shot
Palmer-Hay Flats				
Dabbler	131	27.5	16	6.2
Diver	9	22.2	6	33.3
Total	140	27.1	22	13.6
Susitna Flats				
Dabbler	102	8.8		
Diver	4	0	NONE COLLECTED	
Total	106	8.5		
Copper River Delta				
Dabbler	107	1.9	24	0
Diver	6	66.7	0	--
Total	113	5.3	24	0

1) Excludes birds if not known to be dabbler or diver.

Table 18. Incidence of ingested lead pellets by number of pellets per gizzard, 1975 and 1974-75 combined.

Number of Ingested Pellets	Number of Birds		Percent of Total	
	1975	1974 & 1975	1975	1974 & 1975
1	14	25	25.0	26.3
2	9	13	16.1	13.7
3	4	9	7.1	9.5
4	5	7	8.9	7.4
5	2	3	3.6	3.2
6	4	5	7.1	5.3
7	2	2	3.6	2.1
9	3	3	5.4	3.2
11	2	6	3.6	6.3
12	1	2	1.8	2.1
13	1	3	1.8	3.2
14	--	2	--	2.1
15	1	2	1.8	2.1
18	1	1	1.8	1.0
19	1	2	1.8	2.1
21	--	1	--	1.0
22	1	1	1.8	1.0
28*	1	1	1.8	1.0
33*	--	1	--	1.0
43*	1	1	1.8	1.0
58*	1	1	1.8	1.0
64*	1	1	1.8	1.0
84*	--	1	1.8	1.0
98*	1	1	1.8	1.0
154*	--	1	--	1.0
Totals = 1040	56	95	100.2	99.6
Average	9.8	10.9		
Average*	5.5	5.5	(Less these incidences)	

Table 19. Incidence of ingested lead shot by area, 1974 compared to 1975.

Area	1974		1975		1974 and 1975	
	% with ingested shot	sample size	% with shot	sample size	% with shot	sample size
Total Kodiak	5.9	17	0	26	2.3	43
Total Copper R. Delta	2.4	83	4.4	137	3.6	220
Potter Marsh	4.5	22	0	3	4.0	25
Palmer-Hay Flats	25.3	91	24.6	167	24.8	258
Susitna Flats	12.5	88	8.5	106	10.3	194
Eagle River Flats	16.7	6	--	0	16.7	6
Total Cook Inlet	13.8	250[1/]	17.9	280[1/]	16.2	530[1/]

1) Includes all areas in Cook Inlet.

Table 20. Results of liver and wing bone analyses for lead content related to number of ingested lead shot, 1975.

Species	Age	Sex	Date Collected	No. Ingested Shot	Parts Per Million Lead	
					Liver	Wing Bone
Pintail	IMM	F	10/13	0	0.17	0.50
Pintail	"	M	9/1	0	0.02	*
Pintail	"	M	9/1	0	0.23	2.94
Pintail	"	M	9/10	0	0.03	0.50
Mallard	AD	F	10/15	0	0.04	0.50
Redhead	IMM	M	9/13	0	0.15	4.78
Pintail	"	M	9/6	1	0.24	15.30
Pintail	"	F	9/8	1	0.96	3.47
Mallard	"	F	9/6	1	0.22	5.28
Mallard	"	F	9/1	1	2.03	0.50
Canvasback	AD	F	10/13	1	0.07	21.10
Pintail	IMM	F	9/1	2	0.09	1.49
Pintail	"	F	9/1	2	0.09	2.71
Mallard	"	F	9/1	2	0.71	*
Mallard	"	M	9/1	2	0.55	7.98
Canvasback	"	M	9/13	2	0.40	1.96
Mallard	"	M	9/1	3	0.30	4.66
Mallard	"	F	9/1	4	0.27	2.65
Pintail	AD	M	9/1	5	0.03	2.06
Mallard	IMM	M	9/1	6	6.93	*
Mallard	"	F	9/1	6	2.83	20.10
Pintail	"	F	9/6	7	2.27	*
Mallard	"	M	9/1	9	2.97	61.40
Mallard	"	F	9/1	9	1.92	7.17
Gr. Scaup	AD	F	9/1	9	1.86	6.93
Pintail	IMM	F	9/1	11	0.61	18.10
Pintail	IMM	F	9/1	12	2.91	42.60
Pintail	"	M	9/1	15	0.40	0.50
Mallard	"	F	9/1	18	9.30	182.00
Pintail	"	F	9/1	19	1.54	12.10
Pintail	"	M	9/1	28	5.99	88.30
Pintail	"	M	9/9	43	48.10	*
Pintail	"	F	9/1	58	4.61	42.00
Pintail	"	F	9/1	64	5.39	63.00
Pintail	"	M	9/1	98	15.10	223.00

* Samples not usable - shot in wing bone

Five of the wing bones analyzed showed extremely high lead concentrations. However, these were noted by WARF as being broken and/or having a pellet present. Abnormal lead levels would occur under these circumstances and consequently these samples were not used in subsequent analyses.

Fig. 13 demonstrates the regression-relationship between the number of ingested lead shot and corresponding ppm lead levels in livers. Although a positive relationship exists, there is fairly weak correlation (r^2=0.2504). Only 25 percent of the variability in ppm lead in livers is accounted for by ingested lead shot.

A more positive relationship exists between the number of ingested pellets and corresponding wing bone lead levels (Fig. 14). The r^2 value of 0.5174 shows twice the variability accounted for in wing bone lead than for ppm liver lead.

A very strong correlation exists between ppm lead in livers and ppm lead in wing bones (r^2=0.9297). Fig. 15 depicts this relationship.

Discussion

It is apparent that the first objective of the 1976 study was achieved: to document the high rate of shot ingestion on some areas in Cook Inlet, primarily Palmer-Hay Flats and Susitna Flats. A much lesser rate on the Copper River Delta was also documented. Sample sizes in 1975 on Kodiak, Potter Marsh and Eagle River Flats were inadequate to determine whether 1974 shot ingestion rates were reliable (Table 19).

The second objective, to expand the collection program to other heavily hunted areas, was not met. Only 16 gizzards were collected on the Mendenhall Wetlands and none were obtained from Minto Flats. Of the 16 gizzards collected on Mendenhall Flats, only one was from a mallard. The other 15 were from species which were unlikely to have ingested shot (scoters, widgeon and green-winged teal). Hopefully the 1976 collection program will provide adequate data from these two areas plus additional information for the Stikine Flats, Potter Marsh, Kodiak and Eagle River Flats.

The third objective of the 1975 study - to determine whether ducks with ingested shot were storing lead in their body tissues and if so, to what degree - was the most interesting and enlightening aspect of the 1975 study.

There have been numerous studies which documented the effects of ingested lead shot. The Final Environmental Impact Statement (U.S.D.I. 1976) for the proposed use of steel shot for waterfowl hunting provides a comprehensive review of many such studies. Jordan and Bellrose (1950) showed that the ingestion of one #6 shot would kill 60-80 percent of a group of captive wild mallards on a corn diet. Longcore et al. (1974) observed 19 percent mortality in a group of 80 mallards fed one #4 shot. These investigators also found that mortality ranged from 93-100 percent when mallards were fed eight #6 shot and were kept on a corn diet.

Many people have studied the relationship between the level of lead dosage and diet to toxic effects on waterfowl. Jordan and Bellrose

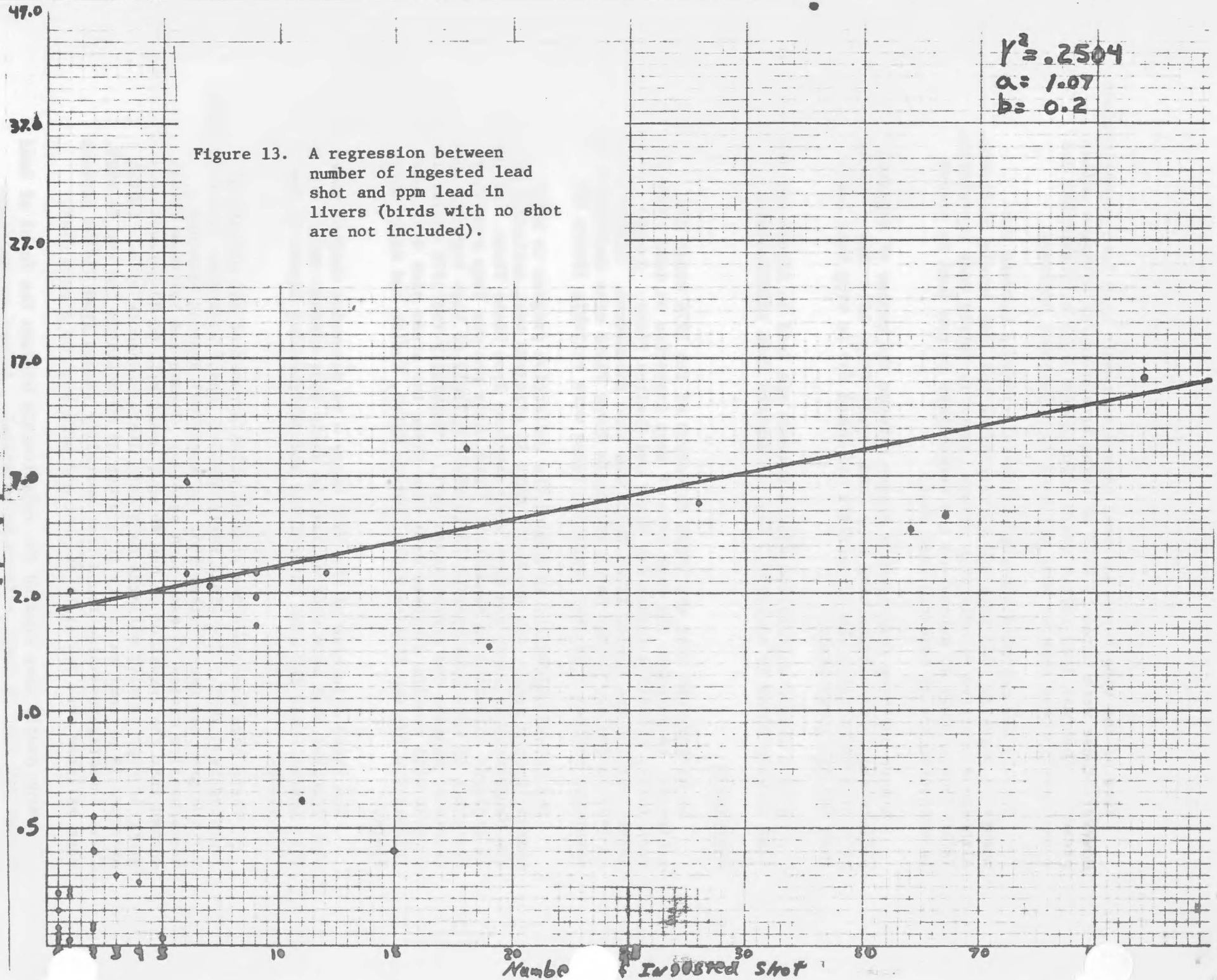


Figure 13. A regression between number of ingested lead shot and ppm lead in livers (birds with no shot are not included).

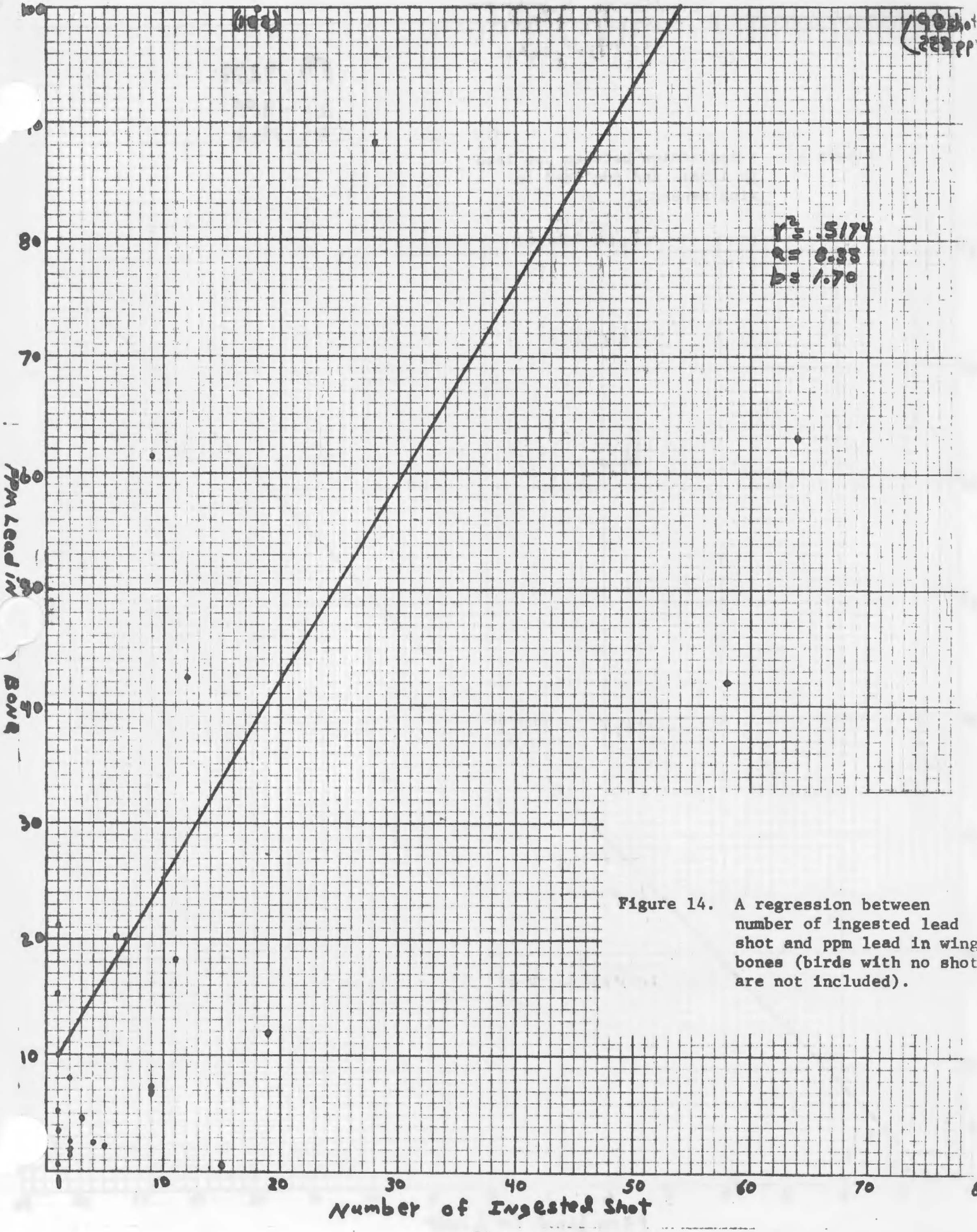


Figure 14. A regression between number of ingested lead shot and ppm lead in wing bones (birds with no shot are not included).

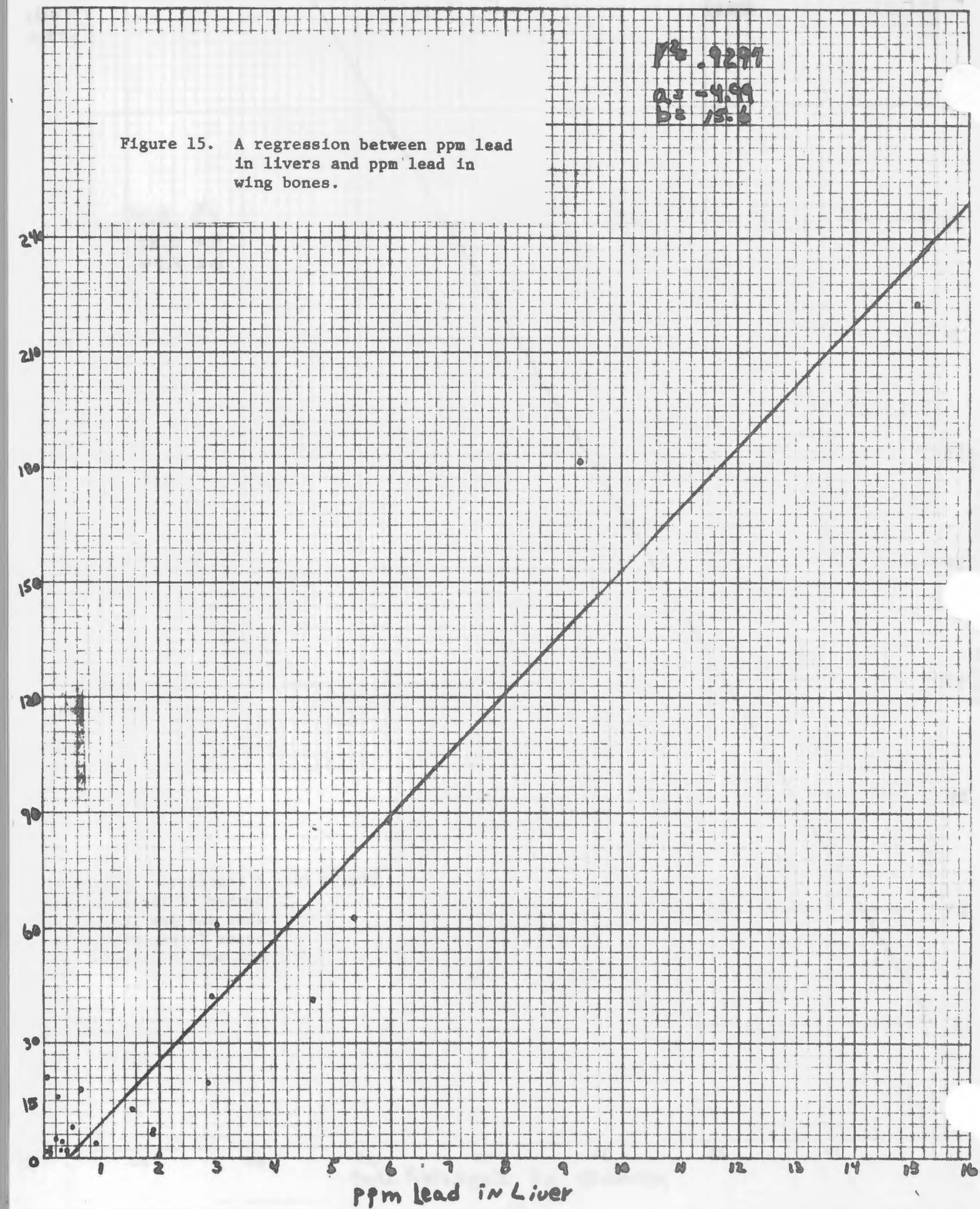


Figure 15. A regression between ppm lead in livers and ppm lead in wing bones.

(1950) found no mortality when mallards were fed one #6 shot and kept on a diet of mixed grains and coontail. Andrews et al. (In U.S.D.I. 1976) found only 3 percent mortality for mallards fed eight #6 shot and kept on a commercial duck ration while no ducks on the same diet died that were fed three #6 shot. Andrews postulated that commercial duck ration probably contained one or more ingredients which mollified the ingested shot. Selium was identified by J.H. Wedig, of the Olin Corporation, as one of these mortality reducing ingredients.

The effects of grit on duck mortality from ingested lead shot have also been thoroughly studied. Jordan (1952) found that grit increased erosion of shot in the gizzards of mallard ducks while Beer and Stanley (1965) postulated that excess grit rapidly passes through the birds, taking any pellets with it. Longcore et al. (1974) showed that grit and the type of grit influenced toxicity of lead shot. In ducks with grit a rapid rate of shot erosion was somewhat offset by voidance of the lead pellets present. This resulted in less but more rapid mortality of ducks with grit than in ducks without grit. Ducks fed oystershell experienced a much lower mortality rate than those birds receiving other types of grit.

The influence of calcium and phosphorus in a birds' diet on lead deposition in body tissues and subsequent mortality is well documented (U.S.D.I., 1976). Lead storage is decreased by a high calcium diet and increased with a low calcium diet. Sobel et al. (1940) concluded that the effect of calcium on lead deposition is competitive, because it tends to remove phosphorus available for lead deposition. It appears that the lead deposition in ducks collected from Palmer-Hay Flats and Susitna Flats in Alaska during 1975 was strongly influenced by diet or other factors.

The concentration of lead in the liver has been considered to be the best measurement for diagnosis of acute lead poisoning (Longcore et al. 1974 and others). According to Longcore, "lead levels that range between 6 to 20 ppm in the liver should be considered as an indication of recent, acute lead intoxication."

Background levels of lead averaged 0.5 to 1.5 ppm in the livers of 11 species of waterfowl which had no known history of lead exposure (Bagley et al. 1967). Background lead levels in livers from ducks in Alaska ranged from < 0.02 to 0.23 ppm (Table 20).

In Table 21 the lead levels in livers from mallards poisoned during seven different experiments are compared to levels found in 11 mallards from Alaska with ingested shot. The average level of 35 ppm lead for experimental studies compares to 2.5 ppm for 11 mallards in Alaska. The ppm range for poisoned birds varied between 15 and 55 ppm while the birds from Alaska varied from 0.22 ppm to 9.3 ppm. The bird with 9.3 ppm lead had ingested 18 lead pellets.

An analysis for lead deposition in wing bones is the most used method to determine the extent of lead poisoning in North American waterfowl. Studies which determine the number of ingested shot in gizzards can only identify possible problem areas. Analyses of wings,

Table 21. Lead concentrations in livers of lead poisoned mallards, and in mallards from Alaska[1].

Source	Amount Lead in ppm	
	Average	Range
Experimental	33	20-64
Experimental	44	23-80
Experimental	12	8-14
Experimental	40	11-61
Experimental	51	16-76
Experimental (Corn Diet)	39	8-66
Experimental (Commercial Mix)	23	19-26
Averages	35	15-55
Alaska[2]	2.5	0.22-9.3

1) Longcore et al, 1974.
2) From 11 mallards where ingested lead shot in gizzards was found.

livers and possibly other tissues are needed to ascertain whether lead is actually being absorbed and stored in the birds. Wings have been widely used because of their availability from the FWS Parts Collection Survey, check stations, etc. Unfortunately most of the data available for ppm wing lead are not comparable to Alaska birds analyzed because the presence or absence of ingested pellets was unknown in many other studies.

Lead levels in bone may result from either acute, high-level exposure or chronic, low-level exposure. Nevertheless, wing bone lead is generally associated with chronic exposure (Longcore et al. 1974). Background levels of lead in duck wing bones (no history of ingested shot) can also be abnormally high, depending on the area. F. Kozlik (via voca) reported background lead levels of over 50 ppm for some areas in California. He suspects that lead from automobile emissions, industrial wastes and other sources is responsible.

R.C. Stendall (In U.S.D.I. 1976) studied lead deposition in wing bones relative to number of ingested lead pellets and diet. The results of this study, compared to data from the 1975 study in Alaska, are presented in Table 22. Data from Alaska are similar to what Stendall found for ducks on a commercial ration diet. The average ppm wing bone lead for ducks having 1-4 ingested pellets in Alaska was 4.2, while ducks eating a commercial ration averaged 4.8 ppm lead. For ducks on corn and rice diets the average was 98.8 ppm and 81.4 ppm lead, respectively.

It is apparent that diet is strongly influencing the rate of lead deposition (and thus rate of poisoning) in livers and wing bones of ducks from Alaska. We assume that high calcium intake is responsible for the low levels of lead found in duck livers and wing bones from Alaskan birds.

No qualitative assessments of foods present were made while examining the gizzards for lead shot. However, nearly all gizzards examined contained fragments of clam shells, snails and various crustaceans. Also, none of the gizzards contained small grains such as oats, corn or barley. Soft vegetation was found in many gizzards along with numerous *Carex*, *Rumex* and other seeds from aquatic plants.

During the winters of 1971-1974, 33 mallards were collected in Southeastern Alaska and on Kodiak Island and analyzed for food content. Eighty-two percent (27) of the birds had mollusk shells, insects, crustaceans or other animal matter in their esophagus and/or gizzard; 18 percent (6) had only soft vegetation or seeds from aquatic plants (unpubl. data, Ak. Dept. Fish and Game, Anchorage). For an additional 28 mallards only inorganic grit was present or food habits analysis was impossible.

Knowing that diet is having a significant mollifying effect on the rate of lead deposition in ducks which use Cook Inlet, it is interesting to postulate what level of pellet ingestion must occur before the birds may be weakened and/or killed. Longcore et al. (1974) stated that "the diagnosis of lead poisoning in wild waterfowl is commonly based on the presence of one or more of the following: ingested lead shot, bile staining of the gastrointestinal tract (particularly the gizzard), crop impaction, and elevated lead levels in tissues." These investigators further explained that from their studies they could not determine a

Table 22. A comparison between ppm wing bone lead in Alaskan ducks, 1975 and wing bone lead in a study by the FWS1/.

Number of Shot in Gizzard	Average ppm Lead in Wing Bones and Diet			
	Alaska	Commercial Duck Ration 1/	Corn 1/	Rice 1/
0	2.2	0.8	1.6	3.5
1	6.1	2.3	67.0	73.6
2	3.5	2.3	142.0	99.4
3	4.7	6.3	71.4	70.6
4	2.6	8.4	115.0	82.2
5	No Data	9.8	112.0	104.0
Avg. (1-4 pellets)	4.2	4.8	98.8	81.4

1/ Study by R.C. Stendell In U.S.D.I., 1976.

lead level in 11 duck tissues that was clearly diagnostic of death. However, they found that a level of 6 to 20 ppm in liver tissue indicated acute exposure to lead. They found that lead concentrations in wing bones varied widely and were probably not suitable for detecting acute lead poisoning. However, its presence does indicate exposure to lead of some form.

Of the 56 ducks in Alaska with ingested shot in 1975, 2 (3.6 percent) had gizzards with abnormal green staining (0.37 percent of total gizzards). In 1974, 39 of 664 gizzards had ingested shot, but no abnormal staining in the 39 gizzards was observed. The two birds with abnormally stained gizzards had ingested 43 and 98 shot, respectively. No crop impaction was detected either in 1975 or 1974.

It is likely that the 6-20 ppm range for a liver lead level would be conservative if used as an indicator of birds actually dying from lead poisoning. For example, seven different studies have shown that levels of 8 to 80 ppm lead were necessary to kill mallard ducks (Table 21). The average concentration necessary to kill a bird was 35 ppm in these seven studies. However, a sublethal concentration in the 6 to 20 ppm range may weaken a bird and make it more susceptible to other mortality factors. This facet of lead poisoning (weakened birds) apparently has not been studied.

It is possible to predict concentrations of lead in livers, if the number of ingested shot are known, by using Figure 13. However, this can not be done with reliable accuracy (r^2=0.2504). If it is assumed that 6 ppm or more lead in livers constitutes a threat to ducks, 24 or more ingested pellets are necessary to achieve this level of stored lead (a=1.07, b=0.2). Of the 95 total gizzards with ingested lead shot in 1974 and 1975 (Table 18), 8 (8.4 percent) had 24 or more pellets.

An indirect, but possibly more accurate method of determining the lethal number of ingested lead shot can be made by using Figs. 14 and 15. There is strong correlation between ppm lead in livers and ppm lead in wings ($r^2$0=.9297). From Fig. 15, 88.6 ppm lead in wing bone is indicated when 6 ppm lead is present in a liver (a=-4.99, b=15.6). Using Fig. 14, an indicated 47 ingested pellets are necessary to achieve 88.6 ppm lead in a wing. Of the 95 total gizzards with ingested shot in 1974 and 1975 (Table 18), 5 (5.3 percent) had 47 or more pellets present.

Assuming that the diets of nearly all ducks in Alaska using major hunting areas are comprised of either soft vegetation, seeds from aquatic plants or animal matter high in calcium, we have three estimates of the proportion of birds with ingested shot which are actually being harmed: 3.6 percent (from gizzard staining); 5.3 percent (from # shot vs. ppm lead in wing bones); and 8.4 percent (from ppm lead in liver vs. # shot ingested). We believe that the assumption of similar food habits is valid due to the scarcity of agricultural grain crops in Alaska.

Conclusions

Most hunting areas in Alaska do not have ingested lead shot problems. To date, on six areas ingested shot has been found in ducks, with rates

ranging from 2.3 percent to 24.8 percent of the ducks examined (Table 19). Adequate samples have not been obtained from several major hunting areas and these deficiencies will hopefully be corrected during the 1976 season.

Three estimates of the actual rate of lead shot poisoning for birds with ingested shot range from 3.6 percent to 8.4 percent. The most reliable rate appears to be 5.3 percent. Using the incidence of ingested shot rates by area for 1974-75 found in Table 19, the following are calculated percentages of total hunter-harvested birds by area which would have been harmed by ingested shot: Palmer-Hay Flats - 1.3 percent; Susitna Flats - 0.5; Eagle River Flats - 0.9; Potter Marsh - 0.2; Copper River Delta - 0.2; Kodiak (Kalsin Bay) - 0.1. These are liberal estimates due to factors explained previously.

The conclusion from data collected in 1974 and 1975 is that although ducks from a few areas in Alaska are experiencing relatively high rates of ingested lead shot, diet is limiting the potential harmful effects to a very small percentage of birds. Consequently, our tentative conclusion is that the use of steel shot on some areas in Alaska is not warranted. However, this conclusion may change after the 1976 season and a thorough assessment of all data is made. Also, band recoveries will be studied to determine migration chronology and whether ducks with ingested shot from Alaska may reach lower Pacific Flyway areas where their diet would change before pellets pass from their gizzards.

LITERATURE CITED

Bagley, G.E., L.N. Locke and G.T. Nightingle. 1976. Lead poisoning in Canada geese in Delaware. Avian Diseases. 11(4): 601-608.

Beer, J.V. and P. Stanley. 1965. Lead poisoning in the Slimbridge Waterfowl Collection. Wildfowl Trust 16th Annu. Rept. 30-34.

Carney, S.M., M.F. Sorensen and L.D. Schroeder. 1976. Waterfowl harvest and hunter activity in the United States during the 1975 hunting season. U.S. Fish and Wildl. Serv. Admin. Rept. July 6, 1976. 27pp.

Jordan, J.S. 1952. Lead poisoning in migratory waterfowl, with special reference to the mallard. Anas platyrhynchus L. Ph.D. Thesis. Univ. of Mich., Ann Arbor. 144pp.

Jordan, J.S. and F.C. Bellrose. 1950. Shot alloys and lead poisoning in waterfowl. Trans. N. Am. Wildl. Conf. 15:155-170.

King, J.G. and C.J. Lensink. 1971. An evaluation of Alaskan habitat for migratory birds. Dept. of Int., Fish and Wildl. Serv., Washington, D.C. 46pp. 17 tables.

_____ and J. Sarvis. 1976. Alaska-Yukon breeding waterfowl pair survey. U.S. Fish and Wildl. Serv., Alaska. 4pp. 5 tables.

Longcore, J.R., L.N. Locke, G.E. Bagley and R. Andrews. 1974. Significance of lead residue in mallard tissues. U.S. Fish and Wildl. Serv. Spec. Sci. Rept. Wildl. No. 182, Wash. D.C. 24pp.

Pacific Flyway Council. 1973. Guidelines for management of the dusky Canada goose. 12pp.

Sobel, A.E., H. Yuska, D.D. Peters and B. Kramer. 1940. The biochemical behavior of lead. I. Difference of calcium, phosphorus, vitamin D on lead in blood and bone. J. Biol. Chem. 132:239-265.

Sorensen, M.F., S.M. Carney and L.D. Schroeder. 1976. Age and sex composition of ducks and geese harvested in the 1975 hunting season in comparison with prior years. U.S. Fish and Wildlife Service Admin. Rept. July 12, 1976. 40pp.

Timm, D. 1972. Report of survey and inventory activities - waterfowl hunter mail questionnaire survey 1971-72. Fed. Aid in Wildl. Rest. Proj. W-17-4, Alaska. 27pp.

_____ 1975. Report of survey and inventory activities - waterfowl. Fed. Aid in Wildl. Rest. Proj. W-17-7, Alaska. 53pp.

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

Williams, C.S. 1953. Procedures suggested for obtaining state waterfowl kill figures from game license stubs - Central Flyway. Printed Rept. 4pp.