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STATE
of ALASKA

MEMORANDUM

TO: See Distribution Below

DATE: January 24, 1978

FILE NO:

TELEPHONE NO:

FROM: Dan Timm
Waterfowl Coordinator
Anchorage

SUBJECT: Duck Migration Along the Pacific Coast

Thanks go to most of you who provided information on migration of mallards and pintails along the Gulf Coast. The enclosed report contains much of the data which you provided.

Rather than pulling out the section on migration from the report, I chose to send each of you the whole thing. It represents alot of paper, but most of you will be interested.

Thanks again.

cc: Paul LeRoux
Dave Harkness
Dimitri Bader
Dave Hardy
Paul Arneson
Jack Didrickson
Julius Reynolds
Chris Smith
Jack Lentfer
Loyal Johnson
Bob Wood
Dave Zimmerman
Harry Merriam

THE CASE FOR RETENTION OF
LEAD SHOT IN ALASKA FOR WATERFOWL
HUNTING

Ronald O. Skoog, Commissioner
Alaska Department of Fish and Game
December 1977

Prepared by: Daniel Timm, Waterfowl Biologist

INTRODUCTION

In January 1976 the U.S. Fish and Wildlife Service prepared a final environmental impact statement regarding the lead poisoning of waterfowl in the United States from the ingestion of shot pellets. This document outlined a plan for the gradual conversion to non-toxic shot for waterfowl hunting in problem areas. In the Pacific Flyway this conversion was to occur during the 1978-79 waterfowl season.

In the Federal Register, Volume 42 - Number 226, published November 23, 1977, the U.S.F.W.S. proposed that on all areas within 10 miles of saltwater in Upper Cook Inlet, north and east of a line due south from Tyonek to the Kenai Peninsula, which incorporates Knik and Turnagain Arms, only non-toxic shot can be used for hunting waterfowl in 1978. It was further stated that this area is proposed because "the deposits of lead shot by waterfowl hunters and the ingestion of lead shot by waterfowl is sufficiently high to represent a serious problem with regard to lead poisoning."

The U.S.F.W.S. has indicated that the designation of steel shot areas would be based on four criteria: 1) significant demonstrated mortality from lead shot poisoning; 2) presence and availability of lead shot in waterfowl feeding areas; 3) hunting pressure as an indicator of shot deposition; and 4) the ingestion rates of shot for mallards and pintails. Mr. Kahler Martinson, Region I Director, U.S.F.W.S., said he believes that the ingestion rate for these two species should be reduced to below 5 percent on problem areas in the Pacific Flyway within the next 5 years.

Although high rates of shot ingestion have been documented for other species across the country - particularly for divers - only mallards and pintails are used as indicator species in the Pacific Flyway. This is because the diets of divers and other species negate the harmful effects of ingested lead pellets.

On August 22, 1977 the Department sent a letter to Mr. Kahler Martinson in which we described the results of our studies since 1974. These efforts are described in detail in A.D.F.&G. Waterfowl S & I Reports, 1974-77, and only a summary of our findings pertaining to Cook Inlet will be presented here. In the letter to Mr. Martinson we explained why we felt an additional year of study was needed before a rational decision on the use of steel shot in Alaska could be made. In a second letter September 9, 1977, we again requested an additional year for study in view of the possibility that the special shot could not be supplied to retail stores in Alaska before the 1978-79 season.

In this report we will demonstrate that the continued use of lead shot is warranted since lead poisoning is not a serious problem for waterfowl using Upper Cook Inlet marshes.

We wish to thank numerous people in Alaska, British Columbia, Oregon, Washington and California who provided data on waterfowl migration chronology. We also thank Dr. Robert I. Smith, U.S.F.W.S., who gave us unpublished data from the Patuxent Wildlife Research Center on retention

rates of lead pellets. We regret that more in-depth data analyses were impossible due to the December 31, 1977 deadline for comments on the Service's proposal.

COOK INLET STUDIES

Ingested Lead Shot

During the four hunting seasons 1974-77, 620 duck gizzards were collected in Upper Cook Inlet and analyzed for ingested lead pellets. Of this total, 297 gizzards were known to be from mallards or pintails. Seventy-eight of these 297 gizzards (26 %) contained ingested lead pellets (Table 1).

Although the overall incidence of shot ingestion for mallards and pintails was 26 percent; the Palmer Hay and Susitna Flats had the highest rates with 36 percent and 19 percent, respectively. Gizzards containing one lead pellet represented 28 percent of all gizzards with ingested shot and 32 percent had ten or more ingested pellets.

A comparison of ingestion rates by time periods indicates that disproportionate rates of shot ingestion occur in Upper Cook Inlet. Thirty-seven percent of the mallards and pintails taken during the period September 1-15, had eaten shot. For birds taken September 16 - 30 the rate dropped to eight percent and from October 1 through the remainder of the season the rate was 13 percent.

We believe that these differential rates in part reflect the extended exposure of birds produced locally on the Palmer Hay and Susitna Flats to shot in the environment. A large proportion of locally produced ducks, shot in early September, would predictably have ingested shot because they were present on these areas for several months. The

Table 1. Results of Ingested Lead Shot Studies in Upper Cook Inlet, Alaska 1974-1977.

	Total Gizzards		Mallards and Pintails											
					Percent of Gizzards With:					% Ingestion By Time Period			Total[1/] Duck	Total[1/] Duck
Area	No.	Percent With Shot	No.	Percent With Shot	1 Shot	2	3-5	6-9	10+	Sept. 1-15	16-30	Oct. on	Harvest/mi^2	Harvest
Palmer-Hay Flats	287	19.9	159	35.8	15.8	10.5	19.3	15.8	38.6	45.1	11.1	6.7	145	6,200
Susitna Flats[2/]	227	11.9	77	19.5	53.3	13.3	6.7	6.7	20.0	31.0	7.1	16.7	75	10,250
Potter Marsh	59	5.1	33	9.1	66.7	0	0	33.3	0	9.7	0	0	333	1,000
Eagle River Flats	22	9.1	14	14.3	100.0	--	--	--	--	--	--	--	90	900
Chickaloon Flats	24	4.2	13	7.7	100.0	--	--	--	--	--	--	--	38	1,500
Portage Flats	1	0	1	0	--	--	--	--	--	--	--	--	76	1,385
Total Upper Cook Inlet	620	15.6	297	26.3	28.2	10.3	15.4	14.1	32.0	36.8	8.3	13.3	90	21,235

1/ Six year average from ADF&G mail survey
2/ Large number of gizzards were collected by general public, these were unknown species.

high rate in early September versus lower rates later in the season may also reflect the tendency of early migrants to remain longer in Cook Inlet than migrant birds do later in September and in October. This contention is supported by the average number of pellets per gizzard during the September 1-15 period which was 12.6. From September 16 on, the average was 2.8 pellets per gizzard for birds with ingested shot.

A third (and likely the most significant) factor involved is the tendency of ducks to use different areas in August than during the hunting season. Before September 1 duck use in Upper Cook Inlet is about evenly divided between shallow ponds located in occasionally flooded, sedge-covered flats and inter-tidal mud flats which are covered almost daily by tides. The mud-silt substrate is very soft and it is continually mixed and moved by tidal action.

After opening day (September 1) ducks concentrate along the tide line on these mud flats. Only a small proportion of the birds use the ponds in the upland sedge flats (to the chagrin of duck hunters), except on relatively infrequent windy days. Shot are much more available to ducks on pond bottoms and in other shallow water areas on the sedge flats than they are on the very soft silt-mud intertidal areas. Also, there are more shot on the sedge flats because that is where hunting pressure is concentrated. About 75 percent of all ducks with ingested shot were collected opening day when birds are most vulnerable to hunters.

If we based our position regarding use of steel shot in Alaska solely on the incidence rates of ingested shot, the Department would support the Service's proposal. However, there are other, overriding factors.

Known Mortality From Lead Shot Poisoning

To our knowledge not one duck which has died from lead shot poisoning has been found in Alaska, even though biologists spend a considerable amount of time on the areas where we found high rates of shot ingestion. We recognize, however, these areas are large and predators are abundant. Also, we do not have specific areas where poisoned birds would tend to be found, such as in a closed area surrounded by an area open to hunting.

Presence and Availability of Lead Shot in Waterfowl Feeding Areas

We have sampled soils only from the Palmer Hay Flats - the area of highest ingested lead shot incidence in the state. Because, sample size was small we don't place much credence in the results - occurence of a projected 19,150 pellets/acre.

Soil sampling for lead shot in Alaska has more academic interest than practical value. Alaska is an immense state with only a few areas of concentrated hunting activity. For example, we have only 10 specific locations where 1,000 or more ducks are consistently harvested each year. It is evident that birds are getting the shot at these locations even though they are widely dispersed.

In Cook Inlet as a unit, we know that birds move back and forth between areas of high hunting pressure. However, as discussed in the section on ingested lead shot, after September 1 many ducks use areas where lead shot is not as available as it is before September 1.

Hunting Pressure as an Indicator of Lead Shot Deposition

There is no linear correlation between the total average duck harvests and data on ducks shot per square mile for major hunting areas in Upper Cook Inlet (Table 1) and the shot ingestion rates found on each area. In addition, there are other areas in Alaska where hunting pressure is relatively high, but where the incidence of ingested shot is low. Obviously "hot spot" areas cannot reasonably be identified in Alaska through harvest data. Other factors are involved such as numbers of birds present, their length of stay in each area, availability of lead pellets, hunter dispersion and bird behavior.

Tissue Lead Levels as an Indicator of Lead Shot Poisoning

After our first year of collecting and analyzing gizzards (1974), we were impressed with two things: 1) the high incidence of ingested lead shot on the Palmer Hay and Susitna Flats and 2) the large number of ingested shot per gizzard. For ducks with ingested shot, the average number of pellets per gizzard was 10.9. Numerous studies have demonstrated that mortality up to 80 percent occurs when mallards are fed only one #6 shot. Of the 78 mallards and pintails with ingested shot from Cook Inlet, only two (2.6 percent) had even initial symptoms of lead poisoning (abnormal gizzard stains).

It was obvious that ducks with ingested shot were not being poisoned and we believed the reason for this was diet. Jordon and Bellrose (1950) reported no mortality when mallards were fed one #6 shot and kept on a diet of mixed grains and coontail. They also reported that ducks which were on a small seed diet were much less susceptible to lead poisoning than were those on a corn diet. Andrews et al. (In U.S.D.I. 1976) reported only three percent mortality for mallards fed eight #6 shot and kept on a commercial duck ration. None of the ducks on the same diet died that were fed three #6 shot. Andrews et al. postulated that the commercial duck ration probably contained one or more ingredients which mollified the effects of 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) reported that grit increased erosion rates of shot in the gizzards of mallard ducks. Beer and Stanley (1965), however, postulated that excess grit rapidly passes through the birds, taking any pellets with it. Longcore et al. (1974) demonstrated that presence of grit and the type of grit influenced toxicity of lead shot. In ducks provided grit a rapid rate of shot erosion was somewhat offset by voidance of the lead pellets present. This resulted in less extensive 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 dietary calcium and phosphorus on lead deposition in body tissues and subsequent mortality is well documented (U.S.D.I. 1976). Lead storage is decreased by a high calicum diet and increased by a low calcium diet. Sobel et al. (1940) concluded that the effect of calicum on lead deposition is competitive, because it tends to remove phosphorus available for lead deposition. Another example of the mollifying effect of calcium on lead deposition was reported by Finley et al. (1976). These investigators found that after laying eggs female mallards had about 10 times the lead levels in wing bones as did males. This was a result of calcium from bones being mobilized for egg shell construction.

Although we made no qualitative assessments of foods present while we were examining the gizzards from Cook Inlet for lead shot, we noticed that nearly all gizzards contained fragments of clam shells, snails and various crustaceans. As would be expected, none of the gizzards contained small grains such as oats, corn, rice or barley. Soft vegetation was found in many gizzards along with numerous seeds from *Carex*, *Rumex* and other aquatic plants.

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

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

Analysis of lead deposition levels in wing bones is the most often 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, livers and possibly other tissues are needed to determine 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 applicable to our analyses of Alaskan birds because the presence or absence of ingested pellets was unknown in most other studies.

Lead deposition 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 (pers. comm.) 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.

In 1975 the livers and wingbones from 35 ducks collected in Cook Inlet were sent to W.A.R.F. Institute in Wisconsin for lead content analyses. Six of these birds had ingested no shot and 29 had ingested from 1 to 98 pellets.

Background lead levels in livers from ducks in Alaska ranged from less than 0.02 to 0.23 ppm. Background levels of lead in the livers of 11 species of waterfowl from areas outside Alaska ranged from 0.5 to 1.5 ppm (Bagley et al. 1967).

R. C. Stendell (unpubl. data, Patuxent Wildl. Res. Center, U.S. Fish and Wild. Serv.) found lead residues in livers of ducks, which had ingested one #4 lead shot and had been on a corn diet, of 30.84 $\pm$ 8.5 ppm. For ducks from Cook Inlet which had ingested one pellet we found an average of 0.7 ppm lead in livers.

In seven other experimental studies (U.S.D.I. 1976) lead levels in mallards poisoned by lead shot ingestion averaged 35 ppm (average range 15-55 ppm). For 11 mallards from Alaska which had ingested from 1 to 18 pellets, the average liver contained 2.5 ppm lead (range 0.22 to 9.3 ppm).

R. C. Stendall (*In* U.S.D.I. 1976) studied lead deposition in wing bones relative to the number of ingested lead pellets and diet. For ducks on a corn or rice diet, the average lead concentrations relative to the number of ingested shot were: 1 shot - 70 ppm; 2 shot - 121 ppm; 3 shot - 71 ppm; and 4 shot - 98 ppm. The average amount of lead in duck wing bones from Alaska was: 1 shot - 6.1 ppm; 2 shot - 3.5 ppm; 3 shot - 4.7 ppm; 4 shot - 2.6 ppm (N =11).

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

What level of pellet ingestion must occur on Cook Inlet marshes before birds may be weakened and/or killed? Longcore et al. (1974) reported that no single lead level in 11 duck tissues was clearly diagnostic of death from lead poisoning. They also reported, however, that a level of 6 to 20 ppm in liver tissue indicated acute exposure to lead. Lead concentrations in wing bones varied widely and were probably not suitable for detecting acute lead poisoning.

It is likely that the 6-20 ppm range for a liver lead level would be conservative if used as an indicator of birds that actually will die from lead poisoning. For example, seven different studies (U.S.D.I. 1976) have shown that the average concentration necessary to kill a bird was 35 ppm. However, a sublethal concentration in the 6 to 20 ppm range may weaken a bird and predispose it to other mortality factors (Bellrose 1959). The studies by Bellrose were conducted in Illinois where ducks were on a predominately corn diet and consequently their results are not applicable to Alaska.

It is possible to predict concentrations of lead in livers and wing bones if the number of ingested shot are known. Using combinations of: regression analyses for # pellets vs. ppm lead in livers; # pellets vs. ppm lead in wing bones; and ppm lead in livers vs. ppm lead in wing bones, our best estimate is that it takes 47 or more ingested pellets to be harmful while ducks are on diet of vegetation, small seeds and foods high in calcium (see Timm 1976 for details). Of 78 mallards and pintails from Cook Inlet with ingested shot, five (6.4 percent) had 47 or more pellets present.

Using the total average incidence of ingested shot in Upper Cook Inlet of 26.3 percent for mallards and pintails (Table 1), we can calculate that 1.7 percent or less of the birds may be harmed while they are not on a corn or rice diet. Ingestion rates vary by time period so the following are the calculated percentages of birds using Cook Inlet during a given time period which may be harmed: to September 15 - 2.4 percent; September 16 -30 - 0.5 percent and October 1 on - 0.9 percent.

Based on data collected since 1974, we conclude that, although ducks from Cook Inlet have relatively high rates of ingested lead shot, their diet limits the potential harmful effects to a insignificant number of birds. The nearest place where a diet change to corn, rice or similar grains could occur for these coastal migrating birds is the Frazier River Delta in British Columbia, 1400 airline miles from Cook Inlet. To understand the potential for lead poisoning once these birds have left Cook Inlet we must know: 1) how long it takes for lead shot to pass from a duck's gizzard and 2) how long it takes for ducks to migrate to the Frazier River Delta and areas further south?

GIZZARD SHOT RETENTION RATE

In his classic study on waterfowl poisoning from ingested lead Bellrose (1959), found that wild mallards ingesting shot either died or recovered within four weeks. Most which died did so within two to three weeks after ingesting shot. Bellrose also reported that "observations in the field and in the laboratory indicate that a mallard that survives ingestion of lead will have eliminated the lead 18 days, on the average, after ingestion." For wild mallards he found this 18-day average expulsion rate to also hold for the ingestion of two or four pellets. Twenty-one percent of the birds which had died from lead poisoning had eliminated all pellets from their gizzards before death.

In a study by M. P. Dieter at the Patuxent Wildlife Research Center (In U.S.D.I. 1976), one #4 pellet was completely eroded two to three weeks after ingestion by adult mallards. Another study at the Research Center (In U.S.D.I. 1976) showed that one #4 pellet was completely eroded after six weeks. However, birds in that study were not sacrificed until a six-week period had elapsed.

Still another study at the Center by M. Finley, M. Dieter and Locke (unpubl. data) found that 8.3 percent of mallard ducks fed one #4 shot voided the pellet after one week. In another unpublished study at the Center, R. C. Stendell found that within three weeks 71 percent of the mallards fed one #4 shot had voided the pellet.

G. C. Sanderson and F. C. Irwin, in a study at the Illinois Natural History Survey (unpubl. data) found that for mallards fed five #4 pellets, in a 15-21 day interval 1/3 of the shot had been expelled. The remaining pellets had erroded to only 31 percent of their original weight.

The ability of a mallard to pass and/or erode shot from its gizzard may be impaired when the bird is experiencing the effects of lead poisoning as demonstrated by M. Finley and M. Dieter (unpubl. data, Patuxent Wildlife Research Center). For mallard ducks fed one #8 pellet, 35 percent mortality occurred within four weeks. However, at the end of three and four weeks, 65 and 77 percent of the survivors, respectively, had passed the shot. For other ducks fed two or four shot pellets, death came within four and two weeks, respectively, and almost all birds retained all of the shot pellets.

Many studies have demonstrated that although shot may pass from the gizzard birds may still die after this occurs. Of possible concern for ducks from Alaska is that the low levels of lead stored in tissue may adversely affect the ducks after they fly south and a diet change occurs. However, J. J. Koranda of the Lawrence Livermore Labortory (pers. comm.) believes that a remobilization of lead stored in organs would not occur after a change of diet unless the diet contained something with chelating properties. This property is lacking in corn, rice and other cereal grains.

Conclusions

Other investigations support Bellrose's (1959) statement that mallards which survive an ingested shot will pass the pellet in an average of 18 days. There are conflicting data regarding the rate at which shot will be voided when several pellets are ingested. However, in most experiments mallards were fed corn and high and rapid mortality rates occurred when several shot were fed to ducks. As several investigators demonstrated, the greater the effect of lead poisoning and subsequent high mortality rates, the less likely shot are to be voided from gizzards. Our data show that until a diet change occurs for ducks from Alaska only a very small proportion of ducks with ingested shot may be harmed. We are unaware of studies where the rate of shot expulsion was documented for ducks on a diet high in calcium, small seeds and soft vegetation, however.

MIGRATION CHRONOLOGY

It is nearly impossible to determine exactly how long it takes individual birds to migrate from Cook Inlet to areas south where a diet change occurs. However, an analysis of band recovery and return data, and migration chronology information provides a reasonable picture of the timing of mallard and pintail coastal migrations. In the following analyses we assume that once birds are in the Cook Inlet area during the fall, they will continue along the coast at least as far as the Frazier River Delta in British Columbia, 1400 air miles from Anchorage, the first place where a change in diet could occur. Band recovery data support this assumption. We also assume that in the fall pintails in

Southeast Alaska, British Columbia and on the Frazier and Sacramento River Deltas originate predominately from Alaska. We also assume the same for mallards in Southeast Alaska and to a lesser degree on the Skagit River Delta.

Mallard

Band Recoveries

The distribution of band recoveries by area for mallards and pintails banded in the summer in Alaska is given in Table 2. Over 64 percent of the recoveries for both species occurred in Alaska and British Columbia, followed by Washington and Oregon with 20 percent and 7 percent, respectively. Mallards from Alaska are obviously oriented to northern portions of the Pacific Flyway.

There have been 11 recoveries of mallards banded in the immediate Anchorage area. These birds were banded during August and most were produced locally on Lake Hood. Eight of the 11 birds were shot in Upper Cook Inlet; recovery dates ranged from September 1 to November 12. Two of the remaining three birds were direct recoveries in Alaska. One bird was shot during October in Southeast Alaska and the other recovery occurred on Kodiak Island December 18. The remaining bird was shot in Oregon

Table 2. Percent mallard and pintail band recoveries for summer-banded birds by area of recovery*.

Recovery Area	Percent of Total	
	Pintail	Mallard
Alaska	8.2	33.3
British Columbia	6.7	31.1
Washington	11.1	20.0
Oregon	9.3	6.7
California	40.7**	2.2
Other Pacific Flyway-Canada	9.4	5.5
Central Flyway-Canada	8.4	1.1
Mississippi Flyway-Canada	3.0	-
Mexico-Central America	2.7	-
Other	0.5	-
	SS=668	SS=101

* Hunter shot or found dead in season

** Only 6 percent of total pintail recoveries came from Tule Lake area during late December, two hunting seasons after it was banded.

The distribution of mallard band recoveries by area and time period for summer - banded birds in Alaska is presented in Table 3. These data are also presented graphically in Figures 1 and 2. In Figure 1 recovery chronology is plotted by four areas: Northern Alaska; Southeast Alaska - Northern British Columbia; Southern British Columbia and Washington. Figure 2 combines southern British Columbia and Washington. Northern and southern British Columbia refer to portions north and south of 50° latitude, the latitude just north of the Frazier River Delta where a diet change would first occur for coastal migrating birds.

As seen in Table 3 and Figures 1 and 2, about 70 percent of the total recoveries in northern Alaska occurred before October 1. However, no birds were recovered before October 1 in Southeast Alaska and Northern British Columbia, even though the hunting season opens September 1 in Southeast Alaska. Seasons in northern British Columbia open between September 1 and October 1, while in the southern parts of the province the seasons usually open during the first week of October. It appears that few birds from northern Alaska reach Southeast Alaska and northern British Columbia before October, and that most birds present in those areas in September are produced locally.

In Figure 1, "peaks" of band recoveries can be readily seen. The peak in northern Alaska occurs September 1-15; in Southeast Alaska - Northern British Columbia it occurs one month later; in Southern British Columbia one month after that; and in Washington one month after the Southern British Columbia peak. More than 50 percent of the banded birds shot south of the Frazier River Delta were taken after November 16.

Population Counts

The relative abundance of mallards by area and time period is shown in Table 4 and Figure 3. Thirty-three people, knowledgable about waterfowl migrations along the coast of the Pacific Flyway, were requested to provide population count data or their best estimates of relative mallard and pintail abundance in their areas. Data in Alaska are based on a combination of survey data and general field observations. Data for the Skagit River Delta represent a 17-year average of population surveys, and data for California represent average populations for the past five years.

As seen in Table 4 and Figure 3, mallards are not abundant in the Cook Inlet area until late September through late October. Peak numbers occur usually from October 5-15. In Southeast Alaska the numbers of birds build gradually to peak populations in late October and many mallards remain for the winter. Mallard populations on the Skagit River Delta build gradually and peak during the first two weeks of November.

Fall Populations - Cook Inlet

The past three-year average breeding population of mallards on Upper

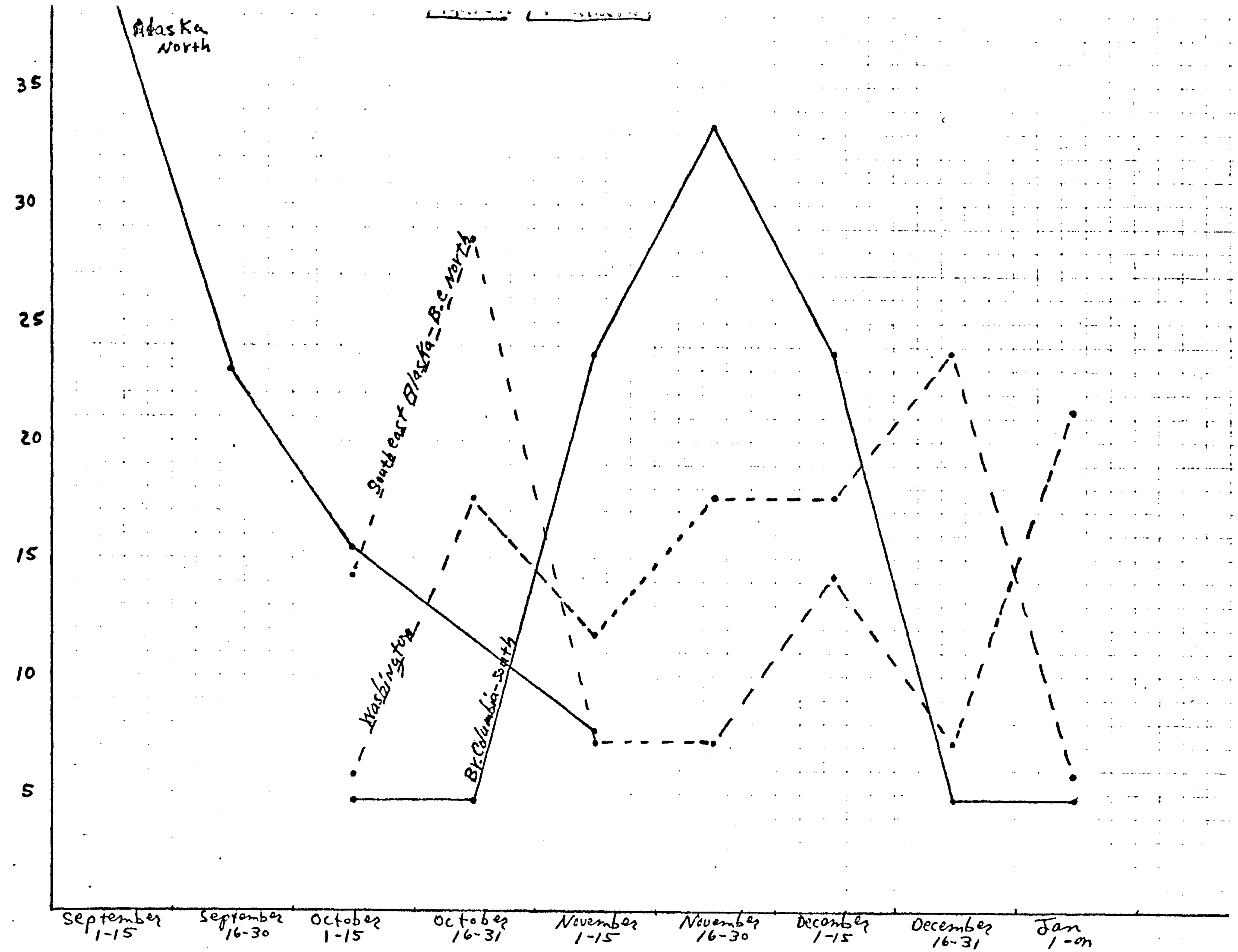
Cook Inlet coastal marshes was 4,500 birds. Assuming 1:1 production, 9,000 mallards are in the fall flight from this area.

It is impossible to determine the precise number of migrant birds in the fall and how long the average bird stays in Cook Inlet. Nevertheless, considering: relative numbers of birds seen in censuses and from random field observations; the 10-year average fall flight of 400,000 mallards from Alaska (U.S.F.W.S. surveys and 1:1 production assumed); and the fact that most mallards come from the Yukon Flats, Tanana-Kuskokwim Valley and the Yukon Delta; we estimate that 50,000 to 75,000 mallards use Upper Cook Inlet marshes during the fall.

Wintering Populations

We conservatively estimate that during an average winter the following numbers of mallards overwinter in areas north of 50° latitude - the place where a change in diet for coastal migrating birds could occur:

Kachemak Bay	-	4,000	
Prince William Sound	-	8,000	
Kodiak-Afognak Isls.	-	5,000	
Alaska Pen.-Aleutian Isls.	-	5,000+	
Southeast Alaska	-	150,000+	
British Columbia	-	29,000	(1977 Survey)
TOTAL		201,000+	



Alaska North
Southeast Alaska - B.C. North
Washington
Br. Columbia - south
35
30
25
20
15
10
5
September 1-15
September 16-30
October 1-15
October 16-31
November 1-15
November 16-30
December 1-15
December 16-31
Jan 1-on

Figure 2. Mallard

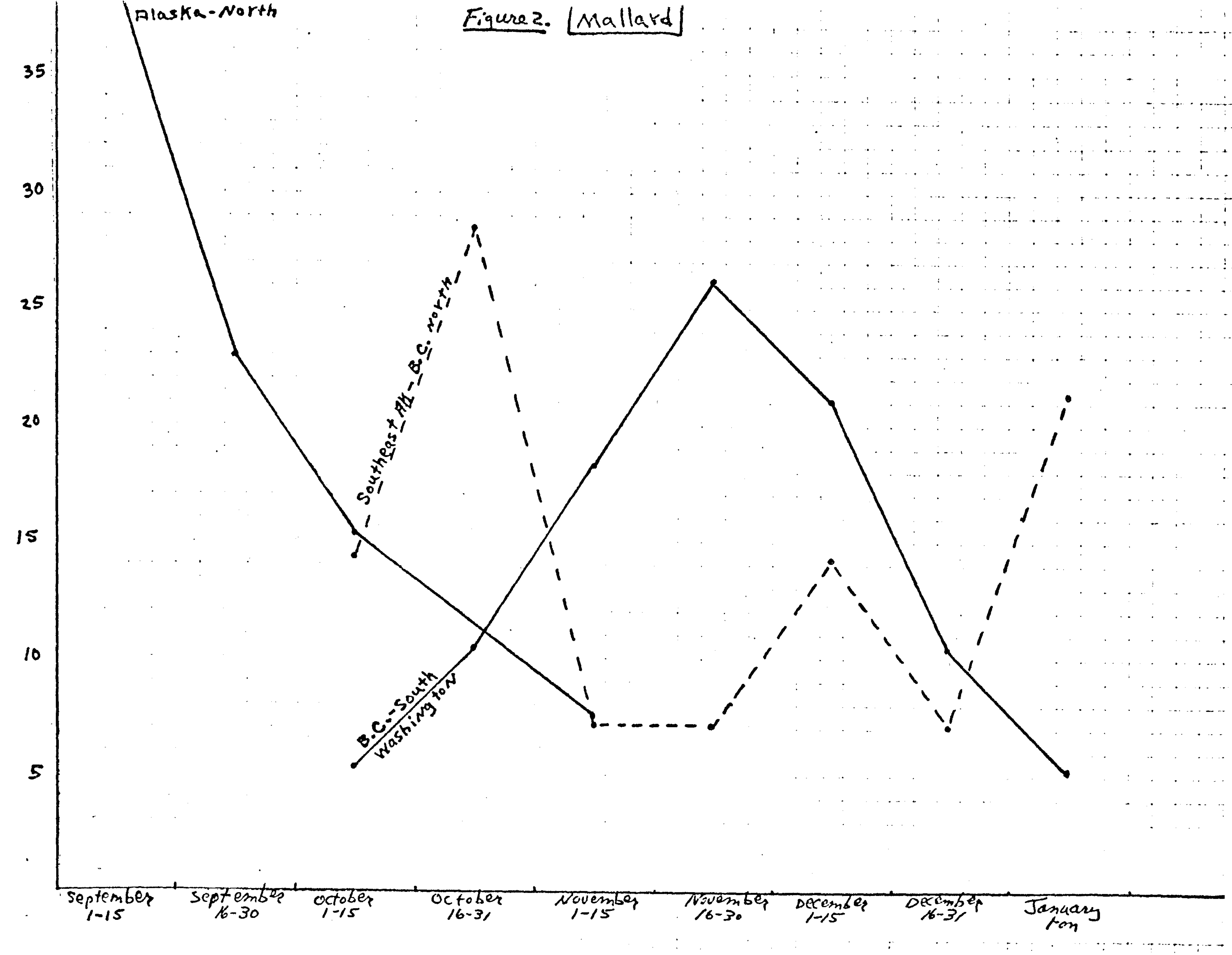
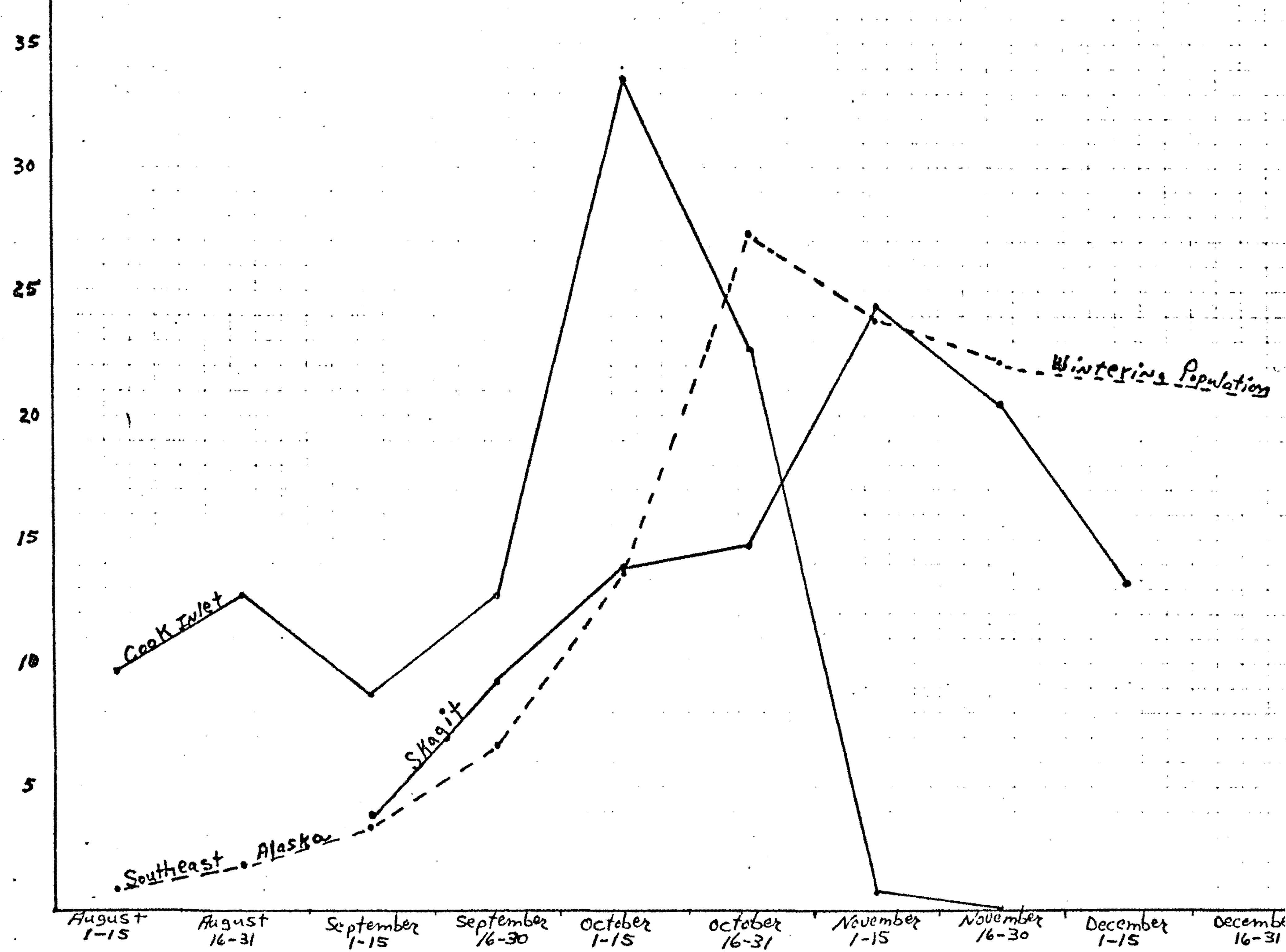


Figure 3. Mallard



These estimates are based on surveys in all areas except the Aleutian Islands where only random observations have been made. It is apparent that a large number of mallards overwinter in the northern Pacific Flyway where a change in diet cannot occur.

Conclusions

We conclude that very few mallards using Upper Cook Inlet reach Southeast Alaska or more southern areas until October 1 or later. We also conclude that it takes most mallards about two weeks to get from Cook Inlet to Southeast Alaska and another two weeks to get from there to southern British Columbia - Skagit River Delta areas. However, these time interval estimates cannot be precise because birds counted in areas to the south are not exclusively Cook Inlet mallards, (i.e. increasingly more ducks from areas other than Cook Inlet are present the farther south one goes). However, chronology of band recovery data support a two-week or greater time lag in migration. We also conclude that a large proportion of mallards from Alaska never do reach areas where ingested lead shot would be harmful.

Pintail

Band Recoveries

The distribution of band recoveries by area for over 7,000 pintails banded in Alaska during the summer is given in Table 2. The largest proportion of recoveries was from California with 40.7 percent of the total recoveries. However, only 6 percent of the California recoveries came from northcentral (Tule Lake area) and northeastern California. Most of the pintails from Alaska are associated with the Sacramento River Delta and Sacramento and San Joacquin Valleys. Over 85 percent of all pintails banded in Alaska were recovered within the Pacific Flyway.

There have been 8 recoveries of pintails banded in the immediate Anchorage area. These birds were captured during July and early August and all but 1 were produced locally. Five of the 8 recoveries occurred in the Anchorage area and all birds were shot on September 1 (opening day of the hunting season). Two recoveries were from Washington near the mouth of the Columbia River on October 31 and November 8. The remaining recovery came from California on November 2.

The distribution of recoveries for summer-banded pintails by time period and area is presented in Table 5 and 6 and graphically portrayed in Figures 4 and 5. Figure 5 combines recovery areas into four groups: Alaska north; Southeast Alaska - British Columbia north of 50° latitude; British Columbia south of 50° latitude - Washington; and Oregon-California.

As seen in Table 5 and Figures 4 and 5, 72 percent of the recoveries were made in northern Alaska before September 16 and only 20 percent were from Southeast Alaska-Northern British Columbia during the same time period. The bulk of recoveries in Southeast Alaska-Northern British Columbia occurred two to four weeks after northern Alaska recovery "peaks"; the major recovery period in Southern British Columbia occurred two to four weeks after the peak just to the north. The major recovery period in Washington occurred two to five weeks after the peak in southern British Columbia. Because hunting seasons do not open uniformly throughout the flyway, Figures 4 and 5 can not portray actual bird abundance. However, in all areas south of Cook Inlet peak recovery periods occur several weeks after the seasons open, indicating these Figures do portray a reasonable picture of bird abundance.

Early, direct pintail band recoveries south of Alaska are presented in Table 6. These birds were either recaptured in banding operations or shot illegally. These data, although few, document that some pintails do not spend much time in Alaska after they molt in mid to late summer. However, one bird was recaptured in late September near the area of banding in Interior Alaska.

Fishermen near the Sacramento River Delta have observed large numbers of pintails offshore and coming from the north in late August (F. Kozlik, pers. comm.). These observations also indicate that some northern pintails arrive in California during late summer. However, the number of birds is unknown as are their exact origin, how long they might have stayed in Upper Cook Inlet before flying south and whether they have ingested shot.

Population Counts

The relative abundance of pintails by area and time period is shown in

Table 7 and Figure 6. These data were obtained like that information which is presented for mallards. Although no systematic fall surveys are conducted in British Columbia, B. Munro and G. Kaiser (pers. comm.) reported that the first pintails appear in southern British Columbia during late August to early September. Most birds arrive in late September and early October.

As is seen in Table 7 and Figure 6, peak pintail numbers occur in Upper Cook Inlet during August, with another population peak occuring the last two weeks of September. In Southeast Alaska the first population peak occurs in early September, but the second and largest peak occurs the first two weeks of October. These peaks follow closely those which occur in Cook Inlet, but they lag by a two-week period. The Skagit River Delta pintail population builds to maximum numbers during the last half of October and resembles Cook Inlet and Southeast Alaska population curves, except with lag time of two-and-four-weeks, respectively. Peak populations on the Sacramento Delta in California also occur during late October, while the peak at Tule Lake occurs November 1-15. However, as explained previously, the proportion of pintails from Alaska in the total population at Tule Lake is small.

Fall Populations - Cook Inlet

The past three-year average breeding population of pintails in Upper Cook Inlet was 8,800 birds. Assuming 1:1 production, 17,600 pintails are in the fall flight from this area.

Table 5. Percent of total pintail band recoveries by area, by time period for birds banded in Alaska.

Area	Time Period and Percent of Total								
	9/1-15	9/16-30	10/1-15	10/16-31	11/1-15	11/16-30	12/1-15	12/16-31	1/1 on
Alaska North	71.9	18.8	3.1	6.2	-	-	-	-	-
Southeast AK & Br. Columbia North*	20.0	30.0	30.0	10.0	10.0	-	-	-	-
British Columbia South**	-	-	7.5	32.5	15.0	12.5	12.5	5.0	15.0
Washington	-	-	10.7	14.3	23.2	16.1	19.6	7.2	8.9
Oregon	-	-	-	5.7	22.6	18.9	24.5	22.6	5.7
California	-	-	6.1	18.3	19.5	8.6	15.8	14.6	17.1

* British Columbia north of the Frazier River Delta (50°)
** British Columbia south of 50°

Table 6. Incidences of early, direct pintail band returns from Alaskan banded birds.

Banded		Age-Sex	Returns	
Innoko River	July 23, 1949	Ad. Male	Innoko River	September 24, 1949
Innoko River	July 29, 1949	Im. Female	Modesto Area	October 15, 1949
Innoko River	July 29, 1949	Ad. Female	Tule Lake	September 30, 1949*
Innoko River	July 14, 1950	Im. Female	Gridley Area	October 10, 1950
Tetlin	July 16, 1960	Ad. Male	Tule Lake	August 25, 1960
Tetlin	August 14, 1961	Ad. Male	Sauvie Isl.	September 9, 1961

* Shot illegally

Table 7. Abundance of pintails by area, by time period based on percent of total birds present.

Area	Time Period and Percent of Total								
	8/1-15	8/16-31	9/1-15	9/16-30	10/1-15	10/16-31	11/1-15	11/16-30	12/1-15
Cook Inlet-Alaska	15.6	26.6	18.8	23.4	12.5	3.1	-	-	-
Southeast Alaska	6.8	13.6	20.4	13.6	23.8	17.0	3.4	1.4	-
Skagit River Delta	-	-	7.3	18.1	19.4	24.2	17.6	8.5	4.9
Delta Areas-California	-	-	-	-	16.6	37.5	19.9	11.3	14.7
Tule Lake-California	-	-	-	-	19.1	26.1	30.0	15.6	9.2
Sacramento Valley-Calif.	-	-	-	-	10.0	15.8	21.2	32.4	20.6
San Joaquin California	-	-	-	-	8.6	11.9	21.4	25.4	32.7

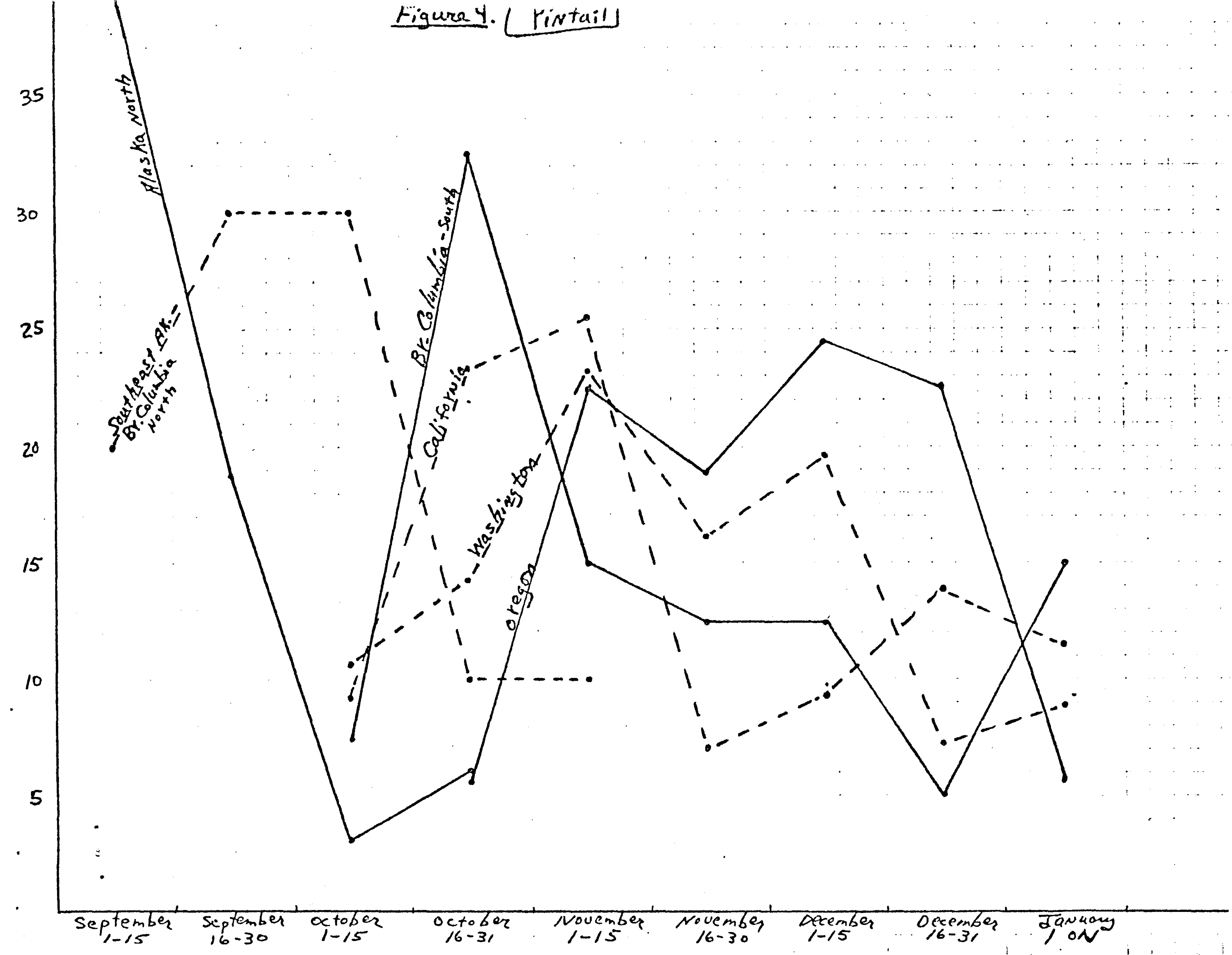


Figure 4. (Pintail)
35
30
25
20
15
10
5
Alaska North
Southeast Ak.-Br. Columbia North
Br. Columbia-South
California
Washington
Oregon
September 1-15
September 16-30
October 1-15
October 16-31
November 1-15
November 16-30
December 1-15
December 16-31
January 1 on

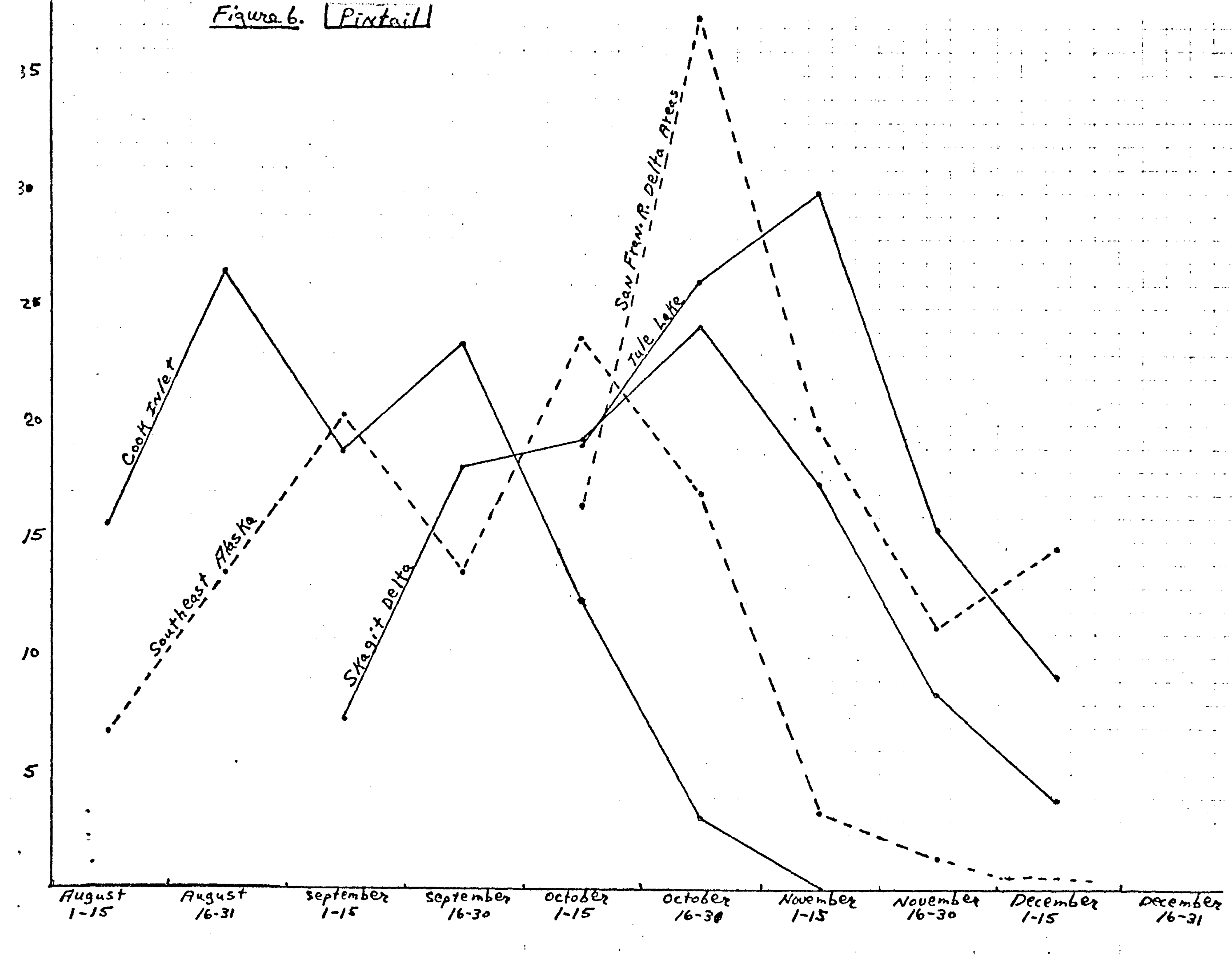


Figure 6. Pintail
35
30
25
20
15
10
5
Cook Inlet
Southeast Alaska
Skagit Delta
San Fran. R. Delta Areas
Tule Lake
August 1-15
August 16-31
September 1-15
September 16-30
October 1-15
October 16-31
November 1-15
November 16-30
December 1-15
December 16-31

It is impossible to determine the precise number of migrant pintails and how long the average bird stays in Cook Inlet. However, considering the 10-year average fall flight from Alaska of about 1,824,000 pintails (U.S.F.W.S. surveys and 1:1 production assumed), and the relative number of birds seen in censuses and from field observations in Cook Inlet; we estimate that 150,000 to 200,000 pintails use Upper Cook Inlet marshes during the fall. Although pintails are only about 1.5 times as prevalent in the harvest as mallards are, field observations indicate that they are actually three or more times more abundant in the wild.

Wintering Populations

The number of pintails wintering north of 50° latitude is insignificant compared to the fall flight from Alaska. Perhaps 5,000 birds overwinter in Alaska and a 1977 winter inventory in British Columbia showed about 3,100 birds present there.

Conclusions

We conclude that the "average" pintail using Cook Inlet in the fall takes about two weeks to reach Southeast Alaska and then an additional two weeks or more to reach areas where a change of diet could occur. However, like mallards, these time intervals cannot be precisely estimated because the probability of a bird being from Alaska and being counted in southern areas decreases the farther south one goes. We also conclude that some birds using Cook Inlet may be making a more rapid migration to

California and other areas in August. The actual number of birds doing this is unknown, but based on band recovery data and population counts the proportion is less than five percent of the total number of birds using Cook Inlet.

SUMMARY AND CONCLUSIONS

1. An analysis of 297 gizzards from mallards and pintails collected in Upper Cook Inlet since 1974 showed an ingested lead shot rate of 26.3 percent. Ingestion rates varied significantly by time period. Using: upper level population estimates of 200,000 pintails and 75,000 mallards in Upper Cook Inlet during the fall; estimates of bird abundance by time period (Tables 4 and 7); and ingested lead shot rates by time period (Table 1), we estimate the actual incidence of ingested shot in Upper Cook Inlet is about 24.7 percent for mallards and pintails.

2. In Alaska the most reliable criterion to use in assessing the potential effects of ingested lead shot is lead levels in tissues, not the incidence of ingested shot, known mortality from lead shot poisoning, incidence of lead in soil samples or hunting pressure on selected areas.

3. Livers and wing bones from ducks collected in Upper Cook Inlet were analyzed for presence of lead. These analyses showed that because of diet, only a very small number of ducks may be harmed from ingested lead shot while they are on a diet of small seeds, soft

vegetation and foods high in calcium. Using regression analyses we calculated that it takes 47 or more ingested pellets before a duck may be harmed. This represents 6.4 percent of all ducks with ingested shot and about 1.6 percent of all mallards and pintails using Upper Cook Inlet.

4. An analysis of mallard band recoveries and bird abundance information for coastal areas of the Pacific Flyway shows that a large proportion of the mallards from Alaska overwinter in areas where a change in diet does not occur. These birds would be uneffected by ingested shot which they might have obtained from Cook Inlet. These data also show that it takes the "average" mallard about two weeks to get from Cook Inlet to Southeast Alaska and another two weeks to get from there to areas where a change in diet may occur. Since the average time for ingested pellets to pass from the gizzard is about 18 days, nearly all mallards which do migrate farther south have voided the shot by the time they reach areas where a dietary change occurs.

5. An analysis of pintail band recoveries and population estimates indicates that it also takes these ducks an average of four weeks to travel from Cook Inlet to areas where a change in diet could occur. Early band returns and field observations in California have shown that some pintails arrive there in August and September. However, the exact proportion of those birds which may be from Cook Inlet is unknown, but but it is believed to be small. We believe

that only a very small proportion of pintails reach areas to the south before a change in diet occurs, and are harmed by ingested shot which they might have obtained in Cook Inlet.

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January 6, 1978

Mr. Lynn A. Greenwalt, Director
U.S. Fish and Wildlife Service
Department of the Interior
Washington, D.C. 20240

Dear Lynn:

This letter and the attached document, "The Case for the Retention of Lead Shot for Waterfowl Hunting in Alaska," will serve as the Alaska Department of Fish and Game's comments on the proposal by the Fish and Wildlife Service to implement the use of steel shot in Alaska in 1978. The proposal, published in the November 23, 1977, Federal Register, calls for non-toxic shot to be used in Upper Cook Inlet within ten (10) miles of salt water.

The Department is opposed to your proposal. The attached report attempts to substantiate our position that the continued use of lead shot for waterfowl hunting throughout Alaska is justified. The need to impose non-toxic shot for 12-guage guns on certain hunting areas in Alaska cannot be substantiated. Such regulation is unnecessary and needlessly burdensome to hunter, enforcement agent, and ammunition retailer. Its effectiveness is questionable since 16 and 20 guage shotgun shooters are not so constrained.

This Department is well aware of its responsibilities in the conservation and management of Alaska's waterfowl, and we are concerned. We began ingested-shot studies here in 1974, long before the Service initiated such studies on Alaska's refuges. Given ample justification we are more than willing to support the USFWS on the lead-shot issue whereever definite problems can be identified to our mutual satisfaction. However, I believe the criteria laid down by your agency for the identification of such problem areas are too simplistic for practical application and there is need for additional guidelines. In August and September of this year I sent letters and supporting data to Kahler Martinson explaining why at least one additional year of study was needed in Alaska before a rational decision on the use of steel shot could be made. We were hoping for a preliminary review and discussion of our position prior to the actual publication of a proposed rulemaking. For some reason this apparently was not possible.

Personally, I believe the USFWS is attacking the lead-shot issue in an unrealistic manner, and in the process precipitating unnecessary problems with all concerned. There is little question in my mind that it would be desirable to stop "shooting lead" into the environment: <u>everywhere</u>. Why not decide that <u>all</u> lead shot must go and establish a phase-out period--perhaps five (5) years--after which time only steel shot would prevail? I realize that waterfowl hunting is your only tie-in, but that alone probably could determine the fate of lead-shot availability on the entire retail market. Given such action, everyone would have ample time to adjust to steel shot, including the manufacturers, who no doubt could come up with a fairly cheap <u>and</u> effective product given enough time. It is doubtful that the waterfowl resource would be affected much during the interim period of change and adjustment. My thought for the day, Lynn!

You are no doubt familiar with the classic study by Bellrose in 1959. As part of his work he banded ducks having no ingested pellets and ducks with pellets introduced into the digestive tract. He then compared recovery rates, differential vulnerability, and mortality rates and distances migrated for both groups. If interested, we are prepared to assist the Service with a similar study in Cook Inlet. A 2 or 3-year banding effort and subsequent data analysis should reveal unequivocally whether or not steel shot is warranted. Another alternative would be to expand on our studies of lead levels in tissues in order to evaluate the incidence of actual lead poisoning. If this general concept is agreeable to you, I recommend that our respective waterfowl specialists should begin work as soon as possible on fleshing-out the study guidelines, objectives and goals. Let me know.

Sincerely,

RS

Ronald O. Skoog
Commissioner

Attachment