

GEESE AND HUNTERS OF ALASKA'S YUKON DELTA: MANAGEMENT PROBLEMS
AND POLITICAL DILEMMAS

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The delta of the Yukon and Kuskokwim (Y-K) Rivers was described in 1951 as America's greatest goose-brant nesting area (Spencer et al. 1951). The U.S. Fish and Wildlife Service (USFWS) began systematic surveys of waterfowl on the Y-K Delta in 1956. J. G. King described his first inventory experiences as follows: "In the earlier years the air was so full of flying geese that as one cruised across at 100 feet there was fear of a strike... The whole scene was overwhelming" (King and Conant 1983).

By the early 1970's, E. J. O'Neill (USFWS) voiced concern about declining numbers of geese stopping at Klamath Basin National Wildlife Refuges (NWR) during autumn migration in northern California. In 1979, publications revealed an alarming decline of cackling Canada geese (Branta canadensis minima) and Pacific white-fronted geese (Anser albifrons frontalis) which nest on the Y-K Delta and winter in California (O'Neill 1979, Timm and Dau 1979). King and Conant (1983) were recording only 1/10 to 1/3 the numbers of geese in the 1980's compared to the late 1950's.

In 1951, Spencer et al. did not believe that hunting on the Y-K Delta had an adverse impact on total bird production, but that there was a depressing effect around villages. By the mid-1960's it was recognized

that the Y-K Delta supported the largest concentration of Eskimo people in the world and that their annual rate of increase was one of the most rapid in the world (Klein 1966). Estimated harvest of geese by these people was about 83,000 (of 5 species) including as much as 15 percent of the spring populations of cackling and white-fronted geese (Klein 1966). Timm and Dau (1979) concluded that the year-around kill of white-fronted geese far exceeded that necessary for a stable population and they urged better rapport between Y-K Delta residents and management agencies. Last year, Director of the USFWS, R. A. Jantzen (1983) acknowledged that subsistence hunting by natives and a diminished population of cackling geese were major problems.

What has happened? The objectives of this paper are to: a) summarize data on goose populations; b) describe actions taken and their effects on goose populations; c) explore some difficulties and misunderstandings between native hunters and sport hunters; d) make recommendations for data gathering, education, and decision-making.

STATUS OF GOOSE POPULATIONS

Geese Which Nest on the Outer Y-K Delta

The outer fringe of the Y-K Delta is the major nesting range for four populations of geese (Table 1). Nearly all cackling geese and Pacific Flyway white-fronted geese winter in California (Nelson and Hansen 1959, Miller et al. 1968, Lensink 1969, King and Lensink 1971). In the 1960's, peak numbers of white-fronted and cackling geese monitored at their major autumn concentration area in the Klamath Basin of California exceeded 450,000 and 350,000, respectively (Fig. 1). Since 1979, numbers of white-fronted geese averaged 81,000 and numbers of

cackling geese averaged 69,000. Cackling geese declined to 36,000 in 1982 and to 26,000 in 1983 (Appendix).

Up to 50 percent of the black brant (Branta bernicla nigricans) which winter along the Pacific Coast of North America (nearly all in Mexico) originate from the outer Y-K Delta (Tech. Comm. Pacific Flyway Council 1978). J. G. King (in Bellrose 1976:173) estimated the late summer population of brant on the Y-K Delta in 1968 at approximately 150,000. The Technical Committee of the Pacific Flyway Council (1978) management plan for brant proposed that hunting seasons be closed if the 3-year moving average winter population size falls below 120,000 geese. The current 3-year (1982-84) average is 121,000 and has declined steadily from the 1979-1981 average of 157,000.

King and Lensink (1971) estimated the autumn population of emperor geese at about 150,000 in the 1960's. Inventories along the Alaska peninsula suggest a decline of emperor geese by as much or more than 34 percent between the 1960's and 1981 (Petersen and Gill 1982).

Geese Which Nest Elsewhere in Alaska

Two small populations of geese nest away from the Y-K Delta and winter in California (Table 1). The Aleutian Canada goose (B. c. leucopareia) was almost extirpated by introduction of arctic foxes (Alopex lagopus) (Jones 1963, Springer et al. 1978). Numbers of these geese have increased 240 percent from 790 in spring 1975 to 2,700 in spring 1982 (Springer et al. 1978, Woolington et al. 1979, Pomeroy and Springer 1982). The tule white-fronted goose (Anser albifrons elgasi, following the taxonomy of Delacour and Ripley 1975), is a distinct race (Krogman 1979) which nests in a restricted range in Cook Inlet, Alaska

(Timm et al. 1982) and winters in central California (Bauer 1979, Timm et al. 1982). Numbers of tule geese inventoried in California increased from about 2,000 to 5,000 between 1978-79 and 1981-82 (Wege 1984).

Canada geese which nest in interior and northern Alaska [Taverner's Canada goose (B. c. taverneri) and lesser's (B. c. parvipes) (e.g., see Johnson et al. 1979)] comprise a significant portion of all Canada geese which winter in Washington and Oregon (Timm 1974, King and Hodges 1979, Parker and McCaughran 1979, Simpson and Jarvis 1979). Numbers of Canada geese in Washington have not varied in a systematic manner between 1970-74 and 1975-81 [averaging $61,300 \pm 7,900$ (S.E.) during 1970-1981, calculated from data in Pacific Flyway Representative (PRF) 1983]. In Oregon, average numbers of Canada geese rose 47 percent from $71,400 \pm 7,600$ (S.E.) during 1970-74 to $104,800 \pm 5,700$ (S.E.) during 1975-82 ($t = 3.553$, $P < 0.01$) (calculated from data in PFR 1983).

White-fronted geese (A. a. frontalis) which nest to the interior and north of the outer Y-K Delta in Alaska and in the western Canadian arctic migrate through the Central Flyway to Texas and Mexico and are classified as the western segment of the mid-continent population (Miller et al. 1968, Lensink 1969). Their numbers have increased over at least the past 15 years and the spring population now exceeds 240,000 compared to 40,000-60,000 during the 1960's (Central Flyway Representative 1982, Benning 1983).

HARVEST AND MANAGEMENT ACTIONS IN RELATION TO POPULATION STATUS

I will report here only on those geese which nest on the Y-K Delta as they are the populations experiencing declines.

Black Brant and Emperor Geese

Annual sport harvest of brant from Alaska through California has averaged $5,570 \pm 1,290$ (S.E.) (range 2,250 - 15,230) (1971-72 through 1981-82) which was 4 percent of the average winter population inventoried during the same time span (calculated from data in PFR 1983). Total harvest of brant in Mexico is unknown but most brant in Mexico are in relatively inaccessible locations. The only readily accessible population is in San Quintin Bay where hunters killed between 1,740 and 6,500 brant during the 1974-75 and 1975-76 hunting seasons, respectively (Kramer et al. 1979). ~~I conclude that sport harvest alone could not be responsible for the recent decline of the entire Pacific population of brant.~~

Washington and Oregon closed their brant seasons for 1983. California closed parts of two bay estuaries to hunting in 1981 and, for 1983, reduced its bag limit to 3 and changed the dates of its hunting season to reduce harvest pressure and shift harvest from adults to immatures. Beginning in 1980, Mexico reduced bag limits on brant and limited hunting to three days a week.

~~Annual sport harvest of emperor geese in Alaska averaged $1,495 \pm 325$~~ (S.E.) (range 307-3,862) during the 1970-82 hunt seasons (calculated from USFWS annual reports on harvest and hunter activity - also see Timm 1974). This harvest is less than two percent of the population and could not be responsible for its decline.

White-fronted and Cackling Geese

~~Approximately 86 percent of the sport harvest of Pacific white-fronted geese (Timm and Dau 1979) and 75-89 percent of the sport~~

harvest of cackling geese [Nelson and Hansen 1959, Calif. Dept. of Fish and Game (CDFG), unpubl. data] occurs in California. Therefore, I will detail here only the data pertaining to California.

From 1975 to the present, the CDFG has closed three large areas to hunting of Canada geese: two counties on the northwest coast for the entire season, parts of the Sacramento Valley (SV) from the opening of the season in late October or early November until Dec. 15, and parts of the San Joaquin Valley (SJV) after Dec. 15. These closures were originally intended to benefit the Aleutian Canada goose (see Springer et al. 1978), but these actions should have also substantially reduced harvest on cackling geese. Closures in the SV reduced the season length to 30-35 days in an area from which 28-47 percent of band recoveries occurred (Nelson and Hansen 1959, CDFG, unpubl. data). When Aleutian Canada geese remained in the SV beyond Dec. 15, the hunting closure was extended. In 1982-83, e.g., the hunting season for Canada geese in the SV special zone was only 9 days long. As cackling geese do not arrive in the SJV until mid-December, closures in this area, which had accounted for 9-16 percent of band recoveries (Nelson and Hansen 1959, CDFG, unpubl. data) were tantamount to a cessation of hunting of cackling geese.

Further restrictions on bag limits and seasons for hunting Canada and white-fronted geese in the Klamath Basin and Central Valley (CV) were instituted in 1979 and have been in place in various forms to the present (Table 2). The KB was the location of 16-38 percent of band recoveries of cackling geese (Nelson and Hansen 1959, CDFG, unpubl. data). During 1979 and 1980, hunting of white-fronted geese was not allowed in the

areas closed for hunting of Canada geese described above.

The impact of these restrictions can be assessed partially by examination of harvest estimates provided by the USFWS and CDFG. Hunters are asked how many geese they killed but they are not asked to identify species. Lesser snow geese (Anser caerulescens caerulescens) and Ross' geese (Anser rossii) are both abundant in California (O'Neill 1979, McLandress 1979) and make up large portions of the goose harvest. Therefore, total harvest in relation to restrictions described (Table 3) above provides only an index of the impact of these regulations. Note that estimates of the absolute numbers of geese killed by hunters differ substantially between USFWS and CDFG surveys, but that proportionate declines in kill were nearly identical in each survey. Harvest of geese in California was greatly reduced (67 percent lower in 1979-82 than in 1970-74) and, although numbers of hunters also declined greatly, the kill per hunter was reduced.

Since different subspecies of Canada geese are not identified in USFWS species composition surveys, estimates of harvest of Canada geese cannot be applied to cackling geese. However, subspecies of Canada geese are identified at hunter-check stations on federal and state managed areas in the KB and CV. Harvest of cackling geese was reduced 78 percent in the CV after 1975 and reduced 51 percent in the KB after 1979 (Table 4).

The impact of changing hunting restrictions in California on total harvest of cackling geese can be estimated by applying the data of Table 4 to the distribution of harvest in the state based on recoveries of geese banded in Alaska which were nearly equally divided between the KB

and CV (Nelson and Hansen 1959). Total harvest of cackling geese in California was reduced by 39 percent due to area closures in the CV and 65 percent when these closures were combined with bag limit restrictions in the KB and CV (Table 5). These estimates assume that compliance of hunters on private areas was the same as on agency managed hunting grounds.

Kill of white-fronted geese in California can be calculated using the USFWS species composition survey data (estimates in PFR 1983). Harvest during 1970-78 averaged $42,700 \pm 4,160$ (S.E.) and was reduced 59 percent during 1979-82 to an average of $17,500 \pm 3,090$ (S.E.) ($t = 2.32$, $P < 0.05$). Reduction of harvest on managed areas was also greatly reduced (Table 6) and these data can be used to approximate the reduction of harvest in the state (Table 7) using the procedure defined above for cackling geese. The close agreement between the estimated reduction in harvest from kill and species composition surveys (59 percent) and that provided by use of data from managed areas in conjunction with distribution data from band recoveries (Table 7, 57 percent) suggests that hunters on private lands behaved as those on managed areas.

Other Research on White-fronted and Cackling Geese

Research has not indicated that factors other than harvest were instrumental in the decline of cackling and white-fronted geese. Over 1600 whitefronts were marked with neck-bands between 1979-1981 and over 1400 cackling geese were neck-banded during 1982-83 to allow for more intensive study of the timing of their migrations, distribution during winter and mortality (Ely and Raveling 1980, 1981, 1982; Johnson and Raveling 1983). While analyses are yet incomplete, these studies have

not revealed that changes in migration pattern could account for declines of the magnitude observed. Levels of contamination with toxic materials are far below that presently known to be deleterious (Anderson et al. 1984). Age-ratios of geese trapped or observed at KB in autumn (CDFG, USFWS, unpubl. data) do not indicate problems with production of young. No known die-offs due to disease or starvation have occurred with the consistency or magnitude necessary to account for the long-term population declines. ~~While loss of wetland habitat and changes in agricultural patterns and intensity continue in California, it is my judgment that available areas and food supplies used by the geese are more than adequate to sustain much larger populations.~~

DISCUSSION AND CONCLUSIONS

~~The clear implication is that harvests of geese on the Y-K Delta are excessive for all geese and alarmingly so when combined with harvest in California. This is correlated with a 42 percent increase in the human population of coastal Y-K Delta villages between 1960 and 1980 (Copp and Smith 1981)¹ and rapid advances in availability of modern technology.~~

¹Data are from: Kwigillinok, Kipnuk, Chefornek, Nightmute, Tununak, Newtok, Hooper Bay, Chevak, Scammon Bay, Sheldon's Point, Alakanuk, Emmonak, Kotlik, Stebbins, St. Michael (1960 population = 3,500; 1980 population = 4,985; the human population of the entire Delta increased 67% from ca. 9,000 to > 15,000; geese are also killed in other villages and by people who travel to the coast from more interior locations, especially Bethel.

In the 1950's many people on the Y-K Delta still lived in sod houses and used kayaks and even a one h.p. motor was a luxury (Peterson and Fisher 1955:372, 378, 380). Dog teams were a major means of travel for the spring goose hunt in the 1960's (Klein 1966). By 1972, about 2,000 boxes of shotgun shells were sold in one village of about 550-600 people (D. Eisenhower in Timm and Dau 1979:288). Boats now commonly have motors of 25-75+ h.p. (often twin engines). Most families now have a snow-machine whereas they were a relatively scarce luxury in the mid-1970's (personal observation). This technology enables even short-term hunts to commonly exceed 20 miles in distance from villages (Copp and Garrett 1983).

This is not to suggest that the dramatic declines of white-fronted and cackling geese were due solely to harvest by native peoples. The large-scale reductions in harvest in California are less than the reductions in the size of the populations. Therefore, even this reduced harvest in California may be more adversely affecting these populations than a few years ago because of the greatly diminished numbers of these geese. However, the fact that brant and emperor geese have also declined suggests that harvest by natives themselves is excessive, and when combined with harvest in California is near catastrophic.

This situation has created frustration for managers because: a) useful data on kill of geese by natives are meagre so that judgments on impact are inferential and biologists cannot make meaningful analyses of harvest in relation to population size; b) cultural differences between native and non-native groups contribute to misunderstandings, lack of action or agreement on courses of action; c) California hunters feel

they have made sacrifices without corresponding efforts by other users;
d) resource agencies in Alaska have not provided needed information and are widely perceived as not having vigorously tried to do so.

Harvest by Natives

Harvest of geese by northern natives is an important, traditional activity. Kills of 40-60 geese (up to 130+) per hunter are common (Klein 1966, Boyd 1977, Prevett et al. 1983). Biologists studying geese on the Y-K Delta have witnessed large-scale shooting when geese arrive in spring, flushing geese with snow-machines in order to drive them to hunters, shooting geese on nests, taking of eggs, and shooting or capture of geese with broods. If one contemplates a direct relationship, however small, between the increased human population of the Y-K Delta and their greater mobility and technology in recent years with harvest levels reported by Klein (1966) for the early 1960's, one has no trouble in predicting disaster for the geese. However, we do not have comparable data. Direct observations reveal that harvest continues. For example, Eisenhower (1977) observed one party of hunters who collected 657 eggs and 51 geese in a 10 hour period; hunters were frequently encountered when geese were molting and 10 hunters had killed 215 flightless brant; 7.7 percent of 207 newly banded goslings were killed within 10 days and 4 km from the time and location at which they were originally captured. How wide-spread are these activities and what is their impact on population levels? Why do we not know the answers to these questions?

Pacific Flyway Council Actions. - Minutes of the Technical Committee and Council meetings of the Pacific Flyway reveal that concern over goose populations has long been expressed, but that major declines occurred

before formal actions were recommended (Table 8; compare to Fig. 1). The issue of spring harvest had a long incubation period from concern (1974) to formal Technical Section recommendations (1978) to endorsement by Council (1983). But, Flyway representatives can only recommend; only the Alaska Department of Fish and Game (ADFG), USFWS, and native hunters can take direct action to provide information and limit harvest.

Alaska Fish and Game Actions. - Despite the facts that ADFG created a special Division of Subsistence in recognition of the importance of this activity for rural residents (Kelso 1982) and that some of their own biologists called attention to problems with geese (cf. Timm and Dau 1979, Table 8), I am not aware of any direct effort by ADFG to assess harvest of geese by natives. This issue is complicated by political divisions of responsibility and land holdings in Alaska. Ultimate responsibility for migratory birds rests with the USFWS and, as part of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980, 20 million acres of the Y-K Delta were made into a National Wildlife Refuge. The apparent view that geese are "federal animals" has not done the geese any good - nor the people who use them. ~~I conclude that ADFG has been remiss in fulfilling its responsibilities when faced with knowledge of the rapid disappearance of geese important to their constituency.~~

USFWS Actions. - In ANILCA, Congress explicitly declared its policy was to support continuation of subsistence uses of fish and wildlife on public lands of Alaska consistent with sound management principles and conservation of healthy populations of fish and wildlife. The law also mandated the Secretary of the Interior to undertake research on fish and wildlife and subsistence uses.

The USFWS initiated a study of waterfowl harvest by Y-K Delta natives in 1980. Responsibility for design and conduct of the program was assigned to staff of the Yukon Delta NWR (YKNWR). The study involved interviews of consenting native hunters in a sample of villages on numbers and kinds of waterfowl taken between April 1-June 30. The USFWS contracted with the University of California, Davis (UCD) in 1981 to provide assistance in organization and analysis of data already collected and to make recommendations. This analysis revealed many weaknesses in selection and training of interviewers and sampling procedures (Copp and Smith 1981). The program continued with few changes in 1982 and 1983 and the most recent analysis (Copp and Garrett 1983) revealed the same problems remained, a deterioration in quality of data, differences between harvest observed and reported, and problems with identification or reporting of subspecies of Canada geese. Copp and Garrett (1983) concluded that this program is unlikely to meet its objective and they provided several specific recommendations for improvement.

To assist education and communication between native peoples and agencies, the YKNWR employs a Delta resident as Native Liason Officer. His efforts were vital to explaining refuge programs and facilitating cooperation (cf. Copp and Smith 1981). The refuge also employs native people in both permanent and temporary staff positions. In 1982, an information officer joined the staff at the refuge. The USFWS has sponsored visits by native representatives to California and invited them to meetings.

Gathering of biological data on geese of the Y-K Delta has followed an erratic course. Studies in place through 1979 were ended for 1980 and

new proposals were denied or discouraged. Expansion of refuge programs began in 1981 and a contract was made with UCD to provide assistance and recommendations (e.g., Anonymous 1981, Aldrich and Byrd 1981, Aldrich et al. 1981). An expanded refuge biological program was carried out in 1982 and 1983 which has provided a great deal of new information on the status and biology of geese (e.g., Byrd et al. 1982, Butler 1983, Garrett 1983). This program is heavily dependent on temporary staff and volunteers. The role of research staff of USFWS has been limited to one field study of the status and biology of emperor geese in 1982 and 1983 (Petersen 1982, 1983) with additional support for the UCD field study in 1983.

Refuge programs have been severely hampered by instability in staff tenure and lack of continuity. Since 1976, YKNWR has had significant portions of time in at least two years without a manager, three different managers, and a fourth will be assuming duties in 1984. Similar instability occurred with assistant managers and biologists. This is a deplorable situation for a 20 million acre refuge encompassing the most valuable nesting grounds of geese in the U.S.

Minutes of Pacific Flyway meetings reveal a difference between desires and reality of USFWS programs with respect to subsistence harvest. In March 1979, the USFWS suggested that the problem may be solved with the U.S.-Soviet Treaty recognizing the need for regulated subsistence hunting and the protocol agreement between the U.S. and Canada. In 1980, the USFWS reported that they were giving the subsistence hunting issue high priority and launching a major effort to educate natives to the problems and to reduce take of geese on the Y-K Delta.

Persons of good intentions may disagree on interpretation. I submit the USFWS effort was neither major nor of high priority. I believe the geese would agree with me.

Native Actions - The people of the Y-K Delta are aware and concerned that there are many fewer geese. The Pacific Flyway Council was assured at 1979 and 1980 meetings that natives would reduce their harvest. Natives reported to the Flyway in 1981 that they undertook efforts to urge voluntary restraint of harvest on cackling and white-fronted geese. Notices were sent to villages expressing concern about brant and taking of their eggs.

~~Since there are no adequate baseline data, one cannot evaluate whether or not voluntary actions were effective at the village level. As with California, even if harvest by natives was reduced substantially, the populations are so low that impacts of reduced harvest may be more harmful than in the recent past. Despite assurances provided the Flyway Council, there are indications of increased harvest activity in at least some Tocal areas (personal observations, Garrett 1983).~~

Sport Hunter Actions. - The California Waterfowl Association (CWA) and Waterfowl Habitat Owner's Alliance (WHOA) represent the interests of organized California hunters. Their executives have been active participants at Flyway and other meetings and a CWA representative visited Alaska in 1979 where he was assured that harvest by natives would be reduced to match reductions in California. Frustrated by the lack of meaningful data on harvest in spring-summer and the continuing decline of goose populations despite large-scale reduction of hunting in California, CWA has admonished the Pacific Flyway Council and USFWS for avoiding the

issue and threatened legal actions to require enforcement of the Migratory Bird Treaty. Sharing responsibility is the cornerstone of the Flyway concept.

Recent Agreements. - In recognition of problems with goose populations, the Association of Village Council Presidents (AVCP) of the Y-K Delta formed a Waterfowl Conservation Committee (WCC) in August 1983. During autumn-winter of 1983-84, a series of meetings of the WCC-AVCP with representatives of ADFG, USFWS, CDFG, CWA and WHOA resulted in agreements by the AVCP to stop hunting of cackling geese and to restrict harvest of white-fronted geese and brant to time periods before egg-laying and after resumption of flight in 1984. In exchange, sport hunting of cackling geese would be closed and regulations sought that would reduce kill of white-fronted geese and brant by about 50 percent (already accomplished in California for brant for 1983). As a result of these meetings, California enacted an emergency closure of Canada goose hunting for the last 12 days of their 1983-84 season.

These meetings represent a positive development in communication and education for all organizations. ~~The emperor goose was, however, neglected in these negotiations.~~ If natives direct their hunting to ~~emperor geese to replace harvest of other geese,~~ this species is likely ~~to suffer dramatic declines beyond that already occurring.~~

Cultural Differences

A major difficulty in obtaining data on harvest in Alaska and in effective communication is a result of cultural differences between natives and sport hunters. Misunderstandings contribute to suspicion and

hamper development of effective programs.

Hunting: Needs and Methods. - Sport hunters have difficulty understanding the value of hunting to native peoples. Subsistence is equated to primitive, inefficient methods. Modern technology coupled with harvest of numbers of animals per hunter far in excess of what a sportsman can take conjure up images of unnecessary slaughter; the taking of eggs and killing of adults on nests or with dependent off-spring are considered not only detrimental, but immoral.

These attitudes conflict with the reality of Eskimo life, especially the view that the land and its wildlife is their "grocery store." Technology makes hunting easier, as it has for sport hunters. Although social and economic change is occurring rapidly, wildlife continues to provide essential economic, and cultural benefits to natives (Kelso 1982). Traditions which allowed survival over millenia will not change quickly; e.g., people must kill animals to live and the animals know this and their death is not permanent (cf. Nelson 1980:50, 69, 100, 171). Hunting is life and identity as an Eskimo (Nelson 1973:288, 311; Nelson 1980:50, 97, 172). Taking food for granted and emotional attachment to animals are luxuries afforded only by those who do not gather their own food; as in any society, a highly successful provider gains power and respect (cf. Nelson 1980:9, 34, 52, 60). An abundant harvest is commonly shared not only with immediate family but with others (Nelson 1980:60, 141; Kelso 1982). Although waterfowl are secondary to other game, they provide important variation in diet and, at times (at least in recent memory), an essential supplement arriving at just the right time (Klein 1966, Nelson 1969:154-158). When a non-native thinks it is easy for a

native to substitute foods of another culture, he should ponder how easily he could accept the natives' foods and methods of preparation (Nelson 1969:158). Appreciation of the meaning of culture may then follow.

Sensitivity to the importance of hunting, however, should not stifle recognition of dwindling resources. While the behavior of people in rural, indigenous societies is now commonly recognized as the outcome of adaptations to natural environments (Kelso 1982), it is naive and destructive to ignore the impacts of expanding human populations and technology. Sympathy with the past should not obscure realistic evaluation of changes. A decrease in knowledge of wildlife and skills in hunting and traditional survival abilities by young natives has long been obvious (cf. Nelson 1969:383). Many hunts have taken on a sport character when one considers the cost of machines and fuel and amazing waste of costly ammunition in relation to some harvests (personal observations; see also Macauley and Boag 1974). Failure to deal with these issues will result in collapse of the resource bases which form the goal of subsistence policy to maintain productivity for human use.

Some observers have cautioned against overemphasis on harvest as this may lead to misleading characterization of ecosystem dynamics (Kelso 1982) such as confusion of correlation with cause and effect and negligence in recognizing other potential causative factors (Copp and Garrett 1983). These concerns are legitimate and caution is wise as a principle. However, in this case, they have far less basis for concern than that on harvest. ~~The fact remains that it is only the harvest that we can control in the short term.~~

Native hunters have difficulty understanding the value of hunting to sport hunters who are considered wealthy and do not need to hunt. Commercial exploitation is suspected, as easily witnessed by the ubiquity of goose-down clothing.

These attitudes also conflict with reality as they fail to respect intense, emotional relationships that tie sport hunters to wildlife. Native and sport hunters share many traits and rewards (Copp 1975, 1979). Native hunters need to recognize that licenses, fees and special taxes paid by sport hunters support acquisition and management of habitat and studies of the status of waterfowl. Approximately 69 percent of the remaining wetland habitat in California is maintained by private owners to provide waterfowl hunting (Gilmer et al. 1982). Without hunting, most of that land would be converted to agricultural uses. Since 1970, the numbers of waterfowl hunters in California have declined 44 percent from 189,000 to 107,000 which represents a major loss of revenue and support for waterfowl programs. The staff of the Waterfowl Section of CDFG has dwindled from 12 to five at a time when we need them more than ever.

The commonly expressed concern about commercial exploitation illustrates how far we have to go in providing meaningful education in the native community. It is, of course, not true, but that fact will not help until native peoples understand that.

Legality. - The fact that spring hunting violates the Migratory Bird Treaty with Canada hampers data collection and working together. The treaty is a classic example of a law made by groups remote from, and without consultation with, all people affected. Native hunters had no choice but to consider a law affecting their ability and right to gather

food as an intrusion or irrelevant. Such a law is a failure because it compells illegal activity (Kelso 1982), is politically unenforceable in the north (Boyd 1977), and fails to recognize spring-summer harvest as a necessary component to rational management.

The obvious long-term solution is to proceed with modification of the Migratory Bird Treaty with Canada. There are serious concerns over wording of the treaty amendment (cf. Copp 1981) that need to be addressed, but it has been more than four years since the process began. The costs of the delay are serious; we do not have a legal foundation for acquiring data and formulating management policy. The problem is obvious. A short-term solution is needed to help goose populations long before a long-term solution can be effective.

Recommendations

Educational Needs. - Native people must understand that they share responsibility with other groups for the welfare of migratory bird populations. The issues are far more complex than that of gathering and presenting data as they involve special problems in communication, beliefs, trust, and politics. Resource agency personnel generally have little or no formal training or expertise in these matters. Educational materials should be designed by experts who understand native culture, human psychology, and effective use of communication media in cooperation with native representatives.

Sport hunters need to recognize that they share responsibility for depleted goose populations and that their views of native life are often ill-informed. Agencies have been painfully slow to provide in-depth analyses of data on population and harvest statistics, reticent about

suggesting that sport harvest can be a problem, and relatively inactive in communicating concerns through their own or public information channels. The seriousness of the decline of the geese warrants a greater effort.

Data Gathering - Attempts to survey harvest by natives have provided some benefits and insights, but have been a failure in terms of the major goal. The USFWS must either devote the money and expertise needed to upgrade the effort or consider alternative programs. Interview research must be designed and conducted by experts in this type of study and by those who understand the social dynamics of native peoples. Biologists and managers know what kind of information is needed but, regardless of dedication and intelligence, they are ill-prepared to conduct this type of research. Copp and Garrett (1983) provided a detailed critique of the program and recommendations for improvement that should be implemented.

Regardless of the fate of the harvest-survey study, there are many other more indirect studies which could provide needed insights and be of value in assisting understanding by natives of their impact on wildlife. Examples include the effect of human disturbance on nest success, distribution and success of geese in relation to distribution of human activity, the impact of harvest by age-sex class and time of year (eggs, goslings, adults, summer and winter), and the role of waterfowl in the present economy of natives.

The recently expanded refuge biological data gathering program represents a positive response to needs for information. These data are vital to providing the baseline upon which to measure future responses of populations to management actions. Continuity in methods, and direction

is vital and the program could be usefully assisted by more support, as could the involvement of the research branch.

Organizational Needs. - The Pacific Flyway in general, and these geese in particular, have been relatively neglected. The complexity of the problem has exceeded the ability of agencies to deal with it as add-on responsibilities to already over-loaded personnel. Tasks have been assigned to personnel who do not have the experience, training, authority, or resources needed to effectively complete them, thus placing them in an untenable position. Team-approach and use of expertise beyond that available in-house have not been effectively employed. Methods of selection of personnel compatible with living and working conditions and needs on the Y-K Delta should receive special attention.

An individual, or committee, needs the freedom and authority to devote full-time to the total complex of problems in order to provide continuity and coordination. Redirection of personnel and money is needed. ~~A multi-membership task force, including native representatives could provide oversight similar to that developed for endangered species recovery teams. The parallel is not made loosely; extension of~~ population declines illustrated in Fig. 1 forecast threatened or rare categorization in less time in the future than it has taken us to generally acknowledge and publicize the problem. Perhaps a National Academy of Sciences panel should be convened to make recommendations.

The alternatives to immediate, effective action are unpleasant. Legal actions could increase suspicion and hostility and promote a situation where resources are damaged even further in a power struggle. Yet, lack of effective action leaves no alternative to legal recourse.

The losers are the geese - and the people who cherish them for whatever reason. An entire generation of hunters has begun to pay the price for the past lack of effective action; they will be paying a heavier price for the next 10-20 years even if we take effective action now. Such depleted populations will certainly not foster the maintenance of traditional ties with land by natives or the opportunity to renew those ties by sport hunters.

SUMMARY

Numbers of geese nesting on the Yukon-Kuskokwim (Y-K) Delta, Alaska have declined even though harvest in winter is insignificant (brant, emperor goose) or curtailed by as much as 59-65 percent (Pacific white-fronted goose, cackling Canada goose, respectively). Autumn inventories indicate alarming decreases of 85 percent of Pacific whitefronts from 450,000 to < 100,000 and of cackling geese from 350,000 to < 50,000. Numbers of geese nesting elsewhere in Alaska have increased (Taverner's, lesser and Aleutian Canada geese, tule and mid-continent white-fronted geese). Tule white-fronted geese and Aleutian Canada geese occupy large portions of the winter range in California used by Pacific whitefronts and Cackling geese. Restrictive hunting regulations should have benefitted all these populations.

~~The implication is that impacts of human activity on geese of the Y-K Delta are excessive, and combined with harvest in California, are near catastrophic. This is correlated with a 42 percent increase in the coastal population of Yupic Eskimos since 1960, who now hunt more efficiently with modern means of travel.~~

The remoteness and size of the Y-K Delta, the fact that spring-summer hunting of waterfowl violates the Migratory Bird Treaty with Canada, and cultural differences between native and non-native groups result in great difficulty in gathering pertinent data, recognition of resource problems, and working effectively for solutions. Native hunters consider a law interfering with their right and ability to gather food as an unwelcome intrusion or not applicable. Opponents argue that such needs have been abrogated by changes in law and life-style and threaten legal action to require enforcement of the Migratory Bird Treaty. Both groups frequently exhibit a lack of understanding of the needs of each other and the necessity of working together for mutual interests.

In the long term, modification of the Migratory Bird Treaty is needed to allow for regulated, legal harvest of birds and eggs in spring. This eventuality, however, seems years away. Effective action is needed now. Agencies responsible for protection of migratory bird resources have not devoted sufficient attention to these problems. Better organization, addition and/or redirection of personnel and money is needed. Specific needs include more intensive and extensive efforts to involve native groups at every level of increased data gathering and analysis, problem recognition and solving, and education. These programs need an identifiable and responsible authority and the assistance of experts in fields outside those normally represented in resource agencies (e.g., social scientists, modelers, media consultants).

Lack of immediate, effective action will likely lead to further polarization of viewpoints via political and legal confrontation while

resources continue to suffer. Such depleted populations negate the goal of maintenance of traditional ties of natives to wildlife and the opportunity to renew those ties by sport hunters.

ACKNOWLEDGMENTS

This paper presents information collected over many years by a large number of dedicated biologists. It was my purpose here to collect in one place the results of much of their efforts. It would take several pages to mention all the individuals responsible; they know who they are and I hope this report provides some measure of reward for their toil. Specific mention is, however, due to several individuals for their efforts in drawing together the data and my thoughts: D. P. Connelly (CDFG) for excellent coordination and cooperation in compilation of California and Flyway information; J. C. Bartonek (USFWS) for summarization of data on populations and perspectives on the Pacific Flyway as a whole; D. E. Timm (ADFG) for compiling data for management plans and information for Alaska; D. V. Derksen (USFWS) for coordination and summarization of data and issues in Alaska; R. L. Garrett (USFWS) for designing an excellent expanded program of biological data gathering on the nesting grounds; J. D. Copp for his penetrating insights into the psychology of hunting, research on humans and the culture of native Americans.

I wish to also extend my generous thanks to my Yupic Eskimo guides, friends, and acquaintances who shared with me their love of wildlife and knowledge of the Y-K Delta. Finally, this paper is dedicated to Edward J. O'Neill (USFWS, retired) who experienced so much frustration at trying to convince us to do something about the alarming disappearance of

waterfowl that he was documenting. Hopefully, we will not be too late with too little and that Ed can witness a recovery of these populations to help provide for a fulfilling retirement.

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Figure Legend

Figure 1. Peak numbers of white-fronted and cackling Canada geese recorded during aerial inventories in autumn at Tulelake and Lower Klamath National Wildlife Refuges. Data are expressed as three-year moving averages which smooth out year-to-year fluctuations caused by a variety of factors (e.g., poor weather conditions during surveys). Some values expressed in O'Neill (1979) from the same areas were peak numbers from each refuge from different dates. As geese readily move between these two refuges, some of O'Neill's figures are probable overestimates. The annual peak estimates used for this figure are listed in the appendix.

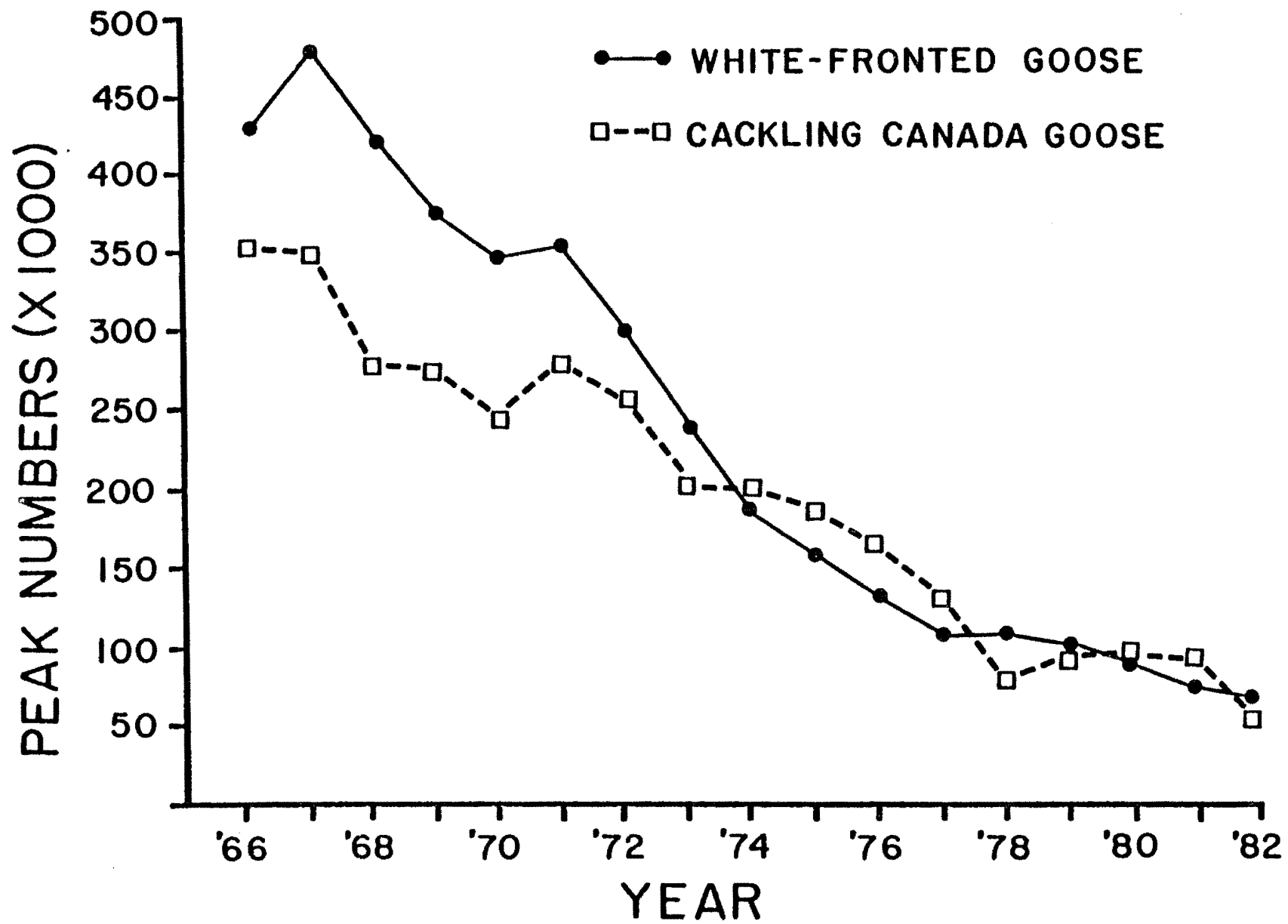


Table 1. Status of most goose populations nesting in Alaska.

Population	Primary Nesting Range ^a	Primary Winter Range ^a	Recent Status ^b
Cackling Canada goose	Outer Y-K Delta	California	Declining, > 85%
Pacific Flyway white-fronted goose	Outer Y-K Delta	California	Declining, > 85%
Black brant	Outer Y-K Delta	Mexico	Declining ^b
Emperor goose	Outer Y-K Delta	Aleutian Islands, Alaska	Declining, <u>></u> 34%
Aleutian Canada goose	Aleutian Islands, Alaska	California	Increasing > 240%
Tule white-fronted goose	Cook Inlet, AK	California	Increasing > 150%
Taverner's and lesser Canada geese	Inner Y-K Delta, Interior and Northern Alaska	Washington and Oregon	Increasing (47% in Oregon)
Mid-continent white-fronted goose	Interior and Northern Alaska; Western Canadian Arctic	Texas and Mexico	Increasing (ca. 380%)

^aSee Bellrose 1976 for summary, and references in text.

^bSee text.

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Table 2. Daily bag and possession limits for dark geese (whitefronts and Canada geese singly or in combination) in California.

Year	Area of State ^a	Season Length	Daily bag	Possession limit
Before 1978	Northeastern ^b	Mid Oct.-mid Jan.	3	6
	Balance of state	3rd weekend of Oct. thru 3rd weekend of Jan.	3	6
1979	Northeastern ^b	Oct. 27-Jan. 13	2	4
	Balance of state	Oct. 20-Jan. 20	1	1
1980-83	Northeastern	Mid-Oct.-mid Jan.	1	2
			for first 14 days	
	Balance of state	1st week of Nov. - 3rd week of Jan.	2	2
			for balance of season	
			2	4
			in 1980	
			2	2
			in 1981-83	

^aLarge portions of state closed to hunting of Canada geese - see text.

^bPrimary concentration area is the Klamath Basin.

^cFor this report, refers to other locations in which cackling and white-fronted geese concentrate.

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Table 3. Estimates of harvest of geese (all species) and numbers of hunters in California (x 1000).

Time Period	Harvest Estimates ^a		No. of hunters ^b	Kill Per Hunter ^c	
	State	Federal		State	Federal
1970-1974	349.1 \pm 14.5 ^d (296.7 - 377.7) ^e	240.5 \pm 26.7 (173.3 - 331.2)	161.8 \pm 8.4 (144.6 - 188.9)	2.17 \pm 0.09 (1.95 - 2.42)	1.48 \pm 0.66 (1.16 - 1.75)
1975-1978	243.0 \pm 24.7 (188.6 - 297.0)	173.7 \pm 25.2 (112.9 - 235.4)	132.8 \pm 4.2 (124.1 - 143.3)	1.82 \pm 0.15 (1.52 - 2.20)	1.30 \pm 0.17 (0.91 - 1.74)
1979-1982	115.6 \pm 8.0 (100.2 - 137.8)	80.6 \pm 11.4 (53.2 - 108.8)	113.3 \pm 3.6 (107.2 - 122.8)	1.02 \pm 0.08 (0.93 - 1.27)	0.71 \pm 0.10 (0.50 - 1.00)
1970-74 vs. 1975-78					
Statistical testing	$\underline{t} = 3.90, \underline{P} < 0.01$	$\underline{t} = 1.78, \underline{P} = 0.12$	$\underline{t} = 2.85, \underline{P} = 0.05$	$\underline{t} = 2.12, \underline{P} = 0.07$	$\underline{t} = 0.89, \underline{P} < 0.4$
1975-78 vs. 1979-82					
	$\underline{t} = 4.90, \underline{P} < 0.01$	$\underline{t} = 3.37, \underline{P} < 0.002$	$\underline{t} = 3.53, \underline{P} < 0.02$	$\underline{t} = 4.78, \underline{P} < 0.001$	$\underline{t} = 2.94, \underline{P} < 0.05$
Magnitude of Changes Among Time Periods					
1970-74 vs. 1975-78	-30%	-28%	-18%	-16%	-12%
1975-78 vs. 1979-82	-52%	-54%	-15%	-44%	-45%
1970-74 vs. 1974-82	-67%	-67%	-30%	-53%	-52%

^aState from Calif. Dept. Fish and Game (1983); federal from U.S. Fish and Wildl. Serv. annual reports on waterfowl harvest and hunter activity.

^bFrom sales of migratory bird hunting and conservation stamps.

^cHarvest \pm no. of hunters.

^dMean \pm standard error of mean.

^eRange.

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Table 4. Harvest of cackling Canada geese on state and federal waterfowl management areas in California^a.

Time period	Location	Kill ^b	Statistic	Change
1970-74	Central Valley	2038 \pm 276 (1507 - 3076)		
1975-82	Central Valley	456 \pm 121 (148 - 1183)	$\underline{t} = 6.02,$ $\underline{p} < 0.001$	-78%
1970-78	Klamath Basin	2596 \pm 330 (1580 - 3250)		
1979-82	Klamath Basin	1280 \pm 199 (960 - 1790)	$\underline{t} = 2.65,$ $\underline{p} < 0.05$	-51%

^aFrom data compiled by Pacific Flyway Representative (1983).

^b $\bar{x} \pm$ S.E. (Range).

Table 5. Estimated reduction of harvest of cackling geese in California in response to hunt season restrictions.

Time period	<u>Proportionate harvest in:</u>		Total harvest	Change
	Klamath Basin	Central Valley		
1970-74 ^a	50 ^b	50 ^b	100	
1975-78 ^c	50	11 ^c	61	-39%
1979-82 ^d	24 ^d	11 ^d	35	-65%

^aBefore restrictions of recent years.

^bDistribution of harvest based on band recoveries (Nelson and Hansen 1959).

^cArea closures in Central Valley reduced harvest by 78 percent (from Table 3; $50 \times 0.78 = 39$; $50 - 39 = 11$).

^dRestrictions in Klamath Basin reduced harvest by 51 percent (from Table 3; $50 \times 0.51 = 25.5$; $50 - 25.5 = 24$).

Table 6. Harvest of white-fronted geese on state and federal waterfowl management areas in California^a.

Time period	Location	Kill ^b	Statistic	Change
1970-78 ^c	Klamath Basin	9,804 \pm 856 (7,270 - 14,930)		
1979-82 ^d	Klamath Basin	3,350 \pm 497 (2,190 - 4,520)	$\underline{t} = 4.867,$ $\underline{P} < 0.0001$	-66%
1970-78 ^c	Central Valley	1,306 \pm 160 (543 - 2,005)		
1979-82 ^d	Central Valley	622 \pm 110 (311 - 793)	$\underline{t} = 2.673$ $\underline{P} < 0.05$	-52%

^aFrom data compiled by Pacific Flyway Representatives (1983).

^b $\bar{x} \pm$ S.E. (Range).

^cBefore restrictions of recent years.

^dArea closures in 1979-80 and 1980-81 and bag limit and season length restrictions (see text and Table 2).

Table 7. Estimated reduction of harvest of white-fronted geese in California in response to hunt season restrictions.

Time period	<u>Proportionate harvest in:</u>		Total harvest	Change
	Klamath Basin	Balance of State		
1970-78 ^a	35 ^b	65 ^b	100	
1979-82	12 ^c	31 ^d	43	-57%

^aBefore recent restrictions.

^bDistribution of harvest based on recoveries of geese banded in Alaska (data in Pacific Flyway Representative 1983). White-fronted geese were included in the Central Valley area closures of hunting for Canada geese in 1979 and 1980 but not in other years.

^cRestrictions in Klamath Basin reduced harvest by 66 percent (from Table 5; $35 \times 0.66 = 23$; $35 - 23 = 12$).

^dRestrictions in the rest of the state away from the Klamath Basin reduced harvest by 52 percent based on data from Central Valley management areas (from Table 5; $65 \times 0.52 = 34$; $65 - 34 = 31$).

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Table 8. Consideration of problems and recommendations of the Technical Committee and Council of the Pacific Flyway with respect to white-fronted and cackling geese.

Year	Actions by Pacific Flyway Technical Committee (TC) and Council (C)
1974	TC - AK thought harvest of white-fronted geese (WFG) excessive.
1976	TC - AK recommended additional research on WFG.
1977	TC - AK reported on policies with respect to spring hunting of waterfowl.
1978	TC - recommended resolution to request USFWS and AK seek cooperation of Y-K Delta residents to refrain from taking snow, cackling (CG), WFG geese and brant (B) in recognition of their diminished numbers and actions by states to decrease harvest on these geese; C - deferred action.
1979	TC - briefing on protocol with Canada with respect to subsistence hunting; C - opposed regulations which would legalize subsistence harvest of waterfowl in excess of current levels until impacts are determined; TC - proposed additional restrictions for hunting, additional aerial inventories and recommended work with AK to reduce harvest of B, CG, and WFG on Y-K Delta; C - accepted recommendations for sport hunting restrictions and discussed, but did not act on, subsistence issue.
1980	TC - recommended yet additional coordinated inventories of geese over a broader area and further discussed subsistence issue; C - accepted inventory recommendation.
1981	TC - formed a C/WFG subcommittee and recommended 6 additional research programs including measurement of harvest on Y-K Delta; C - adopted recommendations.
1982	TC - recommended additional research on CG; C - action not required.
1983	TC - recommended specific research and management programs and two resolutions: a) an urgent effort to evaluate the USFWS subsistence survey and to use expertise of social scientists to assure effective data gathering; b) hunters of the Y-K Delta, the USFWS and AK take actions necessary to significantly reduce take of CG and WFG; C - adopted both resolutions.