Harvest Management of Tundra Swans *Cygnus columbianus* in North America

JEROME R. SERIE and JAMES C. BARTONEK

Sport hunting of Tundra Swans in the U.S. is regulated under provisions of the Migratory Bird Treaty Act of 1918. Management plans cooperatively developed and agreed to between Flyway Councils and Federal wildlife agencies in Canada and the U.S. prescribe allowable harvest levels and provisions for regulating it. Harvests are managed by Eastern and Western Populations. Presently, hunts are authorized in specific locations during fall migration in the States of Alaska, Montana, Nevada, North and South Dakota, and Utah and on wintering areas in the States of New Jersey, North Carolina, and Virginia. A specified number of permits are approved by the USFWS to participating states allowing each applicant to take one Tundra Swan per season. During 1979-88, the number of permits to harvest Western Population swans has averaged 3,552 per year. Of these, 1,075 swans are retrieved and 215 unretrieved. During 1986-88, an average of 6,467 permits have been issued to harvest Eastern Population swans. Of these, an average of 2,617 swans are retrieved and 302 unretrieved. In recent years, about 10,000 permits are issued and account for a total kill of about 4,200 annually, including retrieved and unretrieved. Of this amount, 70% are derived from the Eastern Population and 30% results from the Western Population. These harvest estimates account for less than 3% of the pre-season winter population estimate and are below the 10% harvest rate guideline specified in the management plans. Both Eastern and Western Populations of Tundra Swans have increased in numbers and expanded their distributions over the years since special hunting seasons were first established. Presently, these numbers exceed the populations goals prescribed by various management plans. To better assess the effects of hunting on Tundra Swans, special studies are needed to validate population estimates, identify subpopulations, determine seasonal movements and measure changes in recovery and survival rates.

Sport hunting of Tundra Swans *Cygnus columbianus columbianus* in the United States (U.S.) and Canada is provided for under provisions on the Migratory Bird Treaty of 1916. As implemented in the U.S. by the Migratory Bird Treaty Act of 1918, all ducks, geese and swans in the family Anatidae are identified as migratory game birds and entrusted to the Federal government to regulate their take, possession, transportation and sale. Although swans were hunted prior to the treaty and a strong tradition of hunting swans existed in the U.S., the legal harvest of Tundra Swans was not again permitted by Federal regulations until 1962 when a season was authorized in Utah. Numbers of Tundra Swans had increased steadily over the years since early surveys in the late 1930s (Bartonek *et al.* 1981) and had reached satisfactory levels to warrant a limited harvest. Since the 1950s, the number of Tundra Swans in North America has more than doubled and both Eastern (EP) and Western (WP) populations have shown similar long term increases of about 2% annually (Serie & Bartonek 1991).

In 1984, the U.S. Fish and Wildlife Service (USFWS) considered if hunting was an appropriate tool for managing EP Tundra Swans in the Atlantic Flyway. In the Environmental Assessment "*Proposed Hunting Regulations on Eastern Population of Tundra Swans, 1984*" (USDI 1984), the USFWS concluded that hunting of EP Swans was biologically justified based on numbers of swans occurring in specific habitats during migration and winter. Sport hunting of Tundra Swans is presently authorized in specific locations during fall migration in the States of Alaska, Montana, Nevada, North and South Dakota, and Utah and on wintering areas in the States of New Jersey, North Carolina, and Virginia. The initiation of these seasons marks a new era of swan hunting opportunities and brings new challenges for managing populations

Supplement No. 1 (1991): 359-367

of Tundra Swans into the future.

The hunting of EP and WP Tundra Swans is managed by guidelines cooperatively developed and agreed upon between Flyway Councils, which consist of States and Provinces, and Federal wildlife agencies in Canada and the United States. Sport hunting plans for both the EP and WP prescribe levels of allowable harvest and provisions for regulating it. These hunt plans are axillar to the EP and WP management plans (Ad Hoc Whistling Swan Committee 1982, Schroeder 1983) which prescribe desired population levels, distribution patterns, and habitat requirements to be maintained to provide maximum benefit to society, including aesthetic, education, scientific, and hunting purposes. A goal for the EP is to stabilize the population within a range of between 60,000 and 80,000 swans, based on a three-year average winter population index; and the WP is to be maintained at a level above 38,000 swans. Both management plans are subject to periodic review and revision as appropriate. Population goals identified in the North America Waterfowl Management Plan (CWS & USFWS 1986) are to maintain numerical levels of 80,000 and 60,000 for EP and WP, respectively, until the year 2000.

This paper reviews guidelines of the two sport hunting plans, including harvest objectives, prerequisites for hunts, allocation and regulation of harvests, procedures for evaluating impacts, and potential risks to other protected species such as Trumpeter Swans *Cygnus buccinator.*

Methods

General Guidelines

Proposals to harvest Tundra Swans are developed by State wildlife agencies based on considerations of population status and public interest and submitted to the appropriate Flyway Councils for their endorsement. Proposals are judged on biological merit, general guidelines detailed in the EP and WP hunt plans, and agency's capability for monitoring the harvest and possible changes in population size and distribution. Recommendations regarding the establishment or continuance of a season, either for or against, are received by the USFWS from the Flyway Councils, individual States, organizations and the general public during the annual process of promulgating regulations permitting the sport harvest of migratory game birds. If authorized, swan seasons are designated as being "experimental" for at least three years before "operational" status is considered; however, all seasons are subject to annual review and possible modification or deletion. Seasons vary in length by Flyway, ranging from 60 to 93 days; and in Atlantic and Pacific Flyways, they must run concurrently with those for snow geese.

A special, non-transferable permit allowing the taking of one Tundra Swan per season is issued by the State agency to successful applicants. Costs associated and methods of distributing these permits are the prerogatives of each State Agency. Immediately upon taking a swan, the harvest must be validated according to whatever method is customary for that State and acceptable to the USFWS. Typically, validation involves affixing either a locking, metal tag or seal around the base of the wing or a non-reusable paper tag around the neck or tarsus, the date and location of the harvest are recorded on the permit, and the permittee signs the permit certifying the harvest. Permittees are required to complete a questionnaire to assess: (1) number of sport hunting days, (2) if a swan was harvested, (3) whether the head or neck plumage was white or grey, and (4) how many swans were knocked down but not retrieved. The hunter is either mailed a follow-up questionnaire or telephoned if the initial questionnaire was not received. Data are then compiled by the agencies and reported to the USFWS and Flyway Councils each year prior to the development of annual hunting regulations.

Any State or Province conducting a season must agree to monitor the size and age composition of the population and the timing of migration or wintering use by swans in the hunt area. Adjustments to the number of permits allowed are reviewed during the annual regulation development cycle.

Harvest Strategies

Harvest objectives for both EP and WP hunt plans are to annually harvest the optimum allowable number of swans and still maintain populations at satisfactory levels to meet goals of the various management plans. Without specific information on annual survival and recruitment rates, it is difficult to establish with precision a maximum allowable harvest rate each year. Therefore, to avoid yearly adjustments, a 10% harvest rate of the three-year average winter population index has been established as a guide until more definitive data are available. This allowable harvest objective

includes an estimated 20% crippling or unretrieved loss. Subsistence harvest is assumed to be stable at current levels but can be factored in where information exits. If the three-year average winter population index for EP and WP Swans falls below 60,000 and 40,000, respectively, season closures will be considered. These harvest strategies are subject to periodic review and revision as needed to meet prescribed population objectives set by the various management plans.

The number of permits issued always exceeds the allowable harvest because not all hunters are successful. For the WP, where there is long-term data, a 31% success rate is used to calculate the number of permits issued; but for the EP, a conservative 50% success rate is used until more experience has been gained.

Permit Allocations

Permits are apportioned among all regions frequented by both EP and WP swans to equitably distribute hunting opportunities rather than considering only those areas where Tundra Swans are most numerous. Thus, the allowable harvest for an entire population is divided somewhat arbitrarily among seasonal ranges. For example, permits to harvest EP swans are distributed on the following bases: production areas 33%, migration areas 33%, and wintering areas 34%. For WP swans, production areas receive 10% of the total permits available; migration areas, 70%; and wintering areas, 20%. These percentages are based generally on tradition of harvest, subsistence use, number of States/Provinces potentially sharing permits, access or interest in swan hunting and opportunities to harvest swans. More opportunity exists to harvest swans on migration and wintering areas than on production areas where subsistence harvest has been more traditional.

Any unused allocation of permits is available for redistribution to other regions; but, if a State in that region requests a season, these permits must go back to the area in which they were originally assigned. When this occurs, the number of permits available for redistribution must be recalculated. Any change in the number and distribution of permits must be reviewed by

Table 1. Seasonal length, number of permits, hunter activity, retrieved and unretrieved harvests and percentage of young in bags during combined seasons on WP Tundra Swans, 1962-1988.

Year	Season* Length	Number of Permits Issued	Per cent Hunting	Estimated Number of Hunter days	Estimated Retrieved Harvest	Estimated Number Unretrieved	Average Per cent of Young**
1962	68	1000	0.0%	0	320	81	38
1963	90	1000	0.0%	0	392	62	48
1964	90	1000	94.0%	4600	335	86	37
1965	90	995	92.0%	4700	336	60	45
1966	90	1000	95.5%	4000	491	75	42
1967	90	1000	91.0%	4800	246	69	54
1968	86	1000	93.0%	4300	520	102	58
1969	86	3000	74.2%	11410	1377	266	63
1970	93	3500	70.7%	14100	1199	170	47
1971	93	3495	80.3%	13670	1109	175	34
1972	93	3500	79.0%	13854	1028	118	34
1973	93	3500	79.4%	11605	1191	257	47
1974	93	3500	83.9%	13977	1377	298	43
1975	93	3500	83.3%	13069	1383	241	39
1976	93	3500	83.9%	12032	1109	164	39
1977	93	3488	75.8%	9737	1575	347	45
1978	93	3500	81.9%	10613	1152	375	43
1979	93	3500	83.6%	11551	1293	345	36
1980	93	3500	82.7%	10950	1156	223	41
1981	93	3500	85.7%	10756	1619	377	33
1982	93	3500	84.0%	12743	1244	311	29
1983	93	3650	82.4%	12452	1168	286	39
1984	93	3650	80.7%	13037	1194	126	33
1985	93	3645	74.9%	13527	673	97	31
1986	93	3608	78.3%	12884	947	185	34
1987	93	3593	75.8%	13519	600	66	34
1988	93	3372	74.0%	9656	854	123	33
AVERAGE		2852	78.6%	9909	959	188	41

*Maximum days
**Unweighted

Table 2. Average number of permits issued, retrieved and unretrieved harvests and percentage of young in bags during WP Tundra Swan seasons by State 1979-88.

State	Number of permits issued	Estimated Retrieved Harvest	Estimated Number Unretrieved	Per cent Young***
Utah	2,500	684(27)*	168	41
Nevada	541	169(31)*	26	33
Western Montana	500	221(44)*	20	30
Alaska**	112	15(13)*	0	75

*Success rate in parentheses
**1988-89 Season only in Alaska
***Unweighted

the appropriate Flyway Council and approved by the USFWS.

Results

WP Harvest Program

Season length, number of permits issued, hunter participation, and harvest data on WP Tundra Swans are presented in Table 1. The first season was held statewide in Utah in 1962. In 1969, Nevada was permitted a season in Churchill County, and Lyon and Pershing Counties were added in 1983. The Pacific Flyway portion of Montana was authorized a season in Teton County in 1970, and in Cascade County in 1981, and in Toole, Liberty, Hill and Pondera Counties in 1988. Alaska had its first season on WP Tundra Swans in 1988 on the Seward Peninsula. Swan hunting in Nevada, Montana, and Alaska has been limited to designated areas to reduce the risk of killing Trumpeter Swans.

The number of permits authorized to harvest WP Tundra Swans have been 1,000 during 1962-68, 3,000 in 1969, 3,500 during 1970-82, 3,650 during 1983-87 and 3,950 in 1988. During the 1988-89 season, the allocation of permits was 2,500 to Utah, 650 to Nevada, 500 to Montana and 300 to Alaska. Interest in swan hunting has been high in Western States; and, except for a few areas, exceeds the number of permits available. An estimated 74% of the permittees reported hunting in 1988 and accounted for nearly 10,000 hunter-days in the pursuit of swans.

The estimated yearly number of WP Swans retrieved and unretrieved has varied as the number of permits issued and success rates have changed. In the 27-year history of hunting WP Tundra Swans, an average of 959 swans were retrieved while 188 went unretrieved (Table 1). The average retrieved and unretrieved harvests are shown in Table 2. The percentage of cygnets or "grey plumaged" birds in the retrieved harvests varies considerably, but has averaged 38% yearly. The proportion of young in bags was considerably higher in Alaska than in Utah, Nevada and parts of Montana. At present, Utah harvested 64% of the WP, followed in importance by Nevada 16%, Montana 20%, and Alaska 1%. Hunter-success rates were highest in Montana (60%) and lowest in Alaska (24%).

EP Harvest Program

Season length, number of permits issued, hunter participation, and harvest data on EP Tundra

Table 3. Season length, number of permits, hunter activity, retrieved and unretrieved harvests and Percentage of young in bags during combined seasons on EP Tundra Swans, 1983-88.

Year	Season* Length	Number of Permits Issued	Per cent Hunting	Estimated Number of Hunter days	Estimated Retrieved Harvest	Estimated Number Unretrieved	Average Per cent of Young**
1983	93	109	64.0%	169	34	0	26
1984	93	1108	38.7%	2934	335	22	31
1985	93	6120	74.7%	15345	2551	260	26
1986	93	6170	71.2%	14915	2343	277	28
1987	93	6139	78.4%	14313	2711	324	21
1988	93	7094	71.0%	15344	2797	305	32
Average		4457	72.2%		1795	198	27

*Maximum days
**Unweighted

Table 4. Average number of permits issued, retrieved and unretrieved harvests and percentage of young in bags during EP Tundra Swan seasons by State 1986-88.

State	Number of permits issued	Estimated Retrieved Harvest	Estimated Number Unretrieved	Per cent Young***
Eastern Montana	147	31(21)*	0	41
North Carolina	5,988	2,485(41)*	290	20
North Dakota**	400	187(47)*	25	17
Virginia**	600	117(20)*	9	26

*Success rate in parenthesis
**1988-89 season only in North Dakota and Virginia
***Unweighted

Swans are shown in Table 3. In 1983, the Central Flyway portion of Montana was the first to have a season on EP Tundra Swans. While both North Dakota and South Dakota were also authorized seasons in 1983, they both declined the hunts; and it was not until 1988, that North Dakota chose to exercise this option. In 1984, North Carolina became the first State in the Atlantic Flyway to be granted an experimental season. Experimental seasons were approved for Virginia and New Jersey in 1988, but only Virginia elected to have a swan hunt.

The number of permits available to harvest EP Swans was limited to 109 in 1983 and increased to 1,108 in 1984. In 1985, the number of permits authorized to North Carolina was increased from 1,000 to 6,000 and the total number of EP swan permits rose to 6,120, to 6,170 in 1986 and to 7,094 in 1988. During the 1988-89 season, Montana received 99 permits, North Carolina 6,000, North Dakota 1,000(but issued only 400), and Virginia 600. South Dakota has been approved to issue 500 permits and New Jersey 200 permits if they should decide to offer a season. An estimated 71% of permittees hunted during the 1988-89 seasons and spent more than 15,000 hunter-days in the field.

During the brief six-year history of hunting EP Tundra Swans, the estimated annual retrieved and unretrieved kill has averaged 1,795 and 198 swans, respectively (Table 4). During 1986-88, the average estimated numbers retrieved and unretrieved are shown in Table 4. Over this same time, hunter success averaged 40% and the percentage of young bagged averaged 26%. During the most recent three-year period (only 1988-89 season for North Dakota and Virginia), North Carolina accounted for 88% of the EP harvest, followed by North Dakota (7%), Virginia (4%), and Montana (1%) (Table 4). Hunter-success rates are difficult to compare for North Dakota and Virginia since data are limited to a single season; however, hunter success appears to be higher in North Carolina on wintering grounds than in Montana during migration. Also, hunter success seems to be highest early in the season than later when swans are more wary. Unretrieved losses approximate 10% of the total harvest and seem to be similar among harvest areas.

Total Harvests

The number of permits issued and the average combined annual harvest of EP and WP Tundra Swans are shown in Table 5. These estimates

Table 5. Average number of permits issued, retrieved and unretrieved harvests and percentage of young in bags during EP and WP Tundra Swan seasons in North America.

State	Number of permits issued	Retrieved Harvest	Number Unretrieved	Total Kill
Eastern Population**	6,467	2,617(40)*	302	2,919
Western Population***	3,552	1,075(30)*	215	1,290
Total	10,019	3,692(37)*	517	4,209

*Success rate in parenthesis
**3-Year average
***10-Year average

indicate that in recent years about 10,000 permits are issued and 3,692 swans are retrieved and 517 unretrieved for a total average kill of about 4,209 each year. Of this amount, 70% are derived from the EP while 30% occur from the WP. Crippling or unretrieved losses account for an estimated 12% of the total harvest. An estimated 70% of permittees hunted and spent more than 25,000 hunter-days in the field during the 1988-89 season. Hunter success was estimated to be higher on EP than on WP Swans.

Discussion:

Evaluations of Hunting Programs

Population indices from the Midwinter Waterfowl Surveys in January (Serie & Bartonek 1991) and from periodic surveys conducted in the hunt areas are used to evaluate impacts from hunting programs. The 1987-89, three-year-average, winter population index for EP and WP Tundra Swans is 87,065 and 63,751, respectively, which exceed objective levels of 80,000 and 60,000 in the North American Waterfowl Management Plan (CWS & USFWS 1986) and 60,000-80,000 and 38,000, in EP and WP Tundra Swan Management Plans (Ad Hoc Whistling Swan Committee 1982, Schroeder 1983), respectively. Actually, the average annual rate of increase in WP swans was significantly greater ($t= -7.076$, $P<0.001$) after the initiation of swan hunting seasons in 1962-89, than for the period 1955-61, prior to any sport hunting. Since 1980, winter population indices for WP swans seem to be declining; however, little change can be detected from the long-term trends due to the extreme variability of these data. Breeding survey indices of the WP in Alaska (Conant *et al.* 1991) show no evidence of a decline in breeding populations.

In North Carolina, Midwinter Waterfowl Surveys show that EP Tundra Swans have increased by about 12,000 birds or 30% from the 1980-84 average during the pre-hunt period to the 1985-89 average during the post-hunt period. While population comparisons are yet limited in other areas where EP swans are hunted, population trends during 1980-89 continue to increase at a pace which exceeds the 1955-89 long-term trend (Serie & Bartonek 1991). Although hunting of EP swans is much more recent than on WP swans, there is little direct evidence that hunting has had any significant negative impact on their numbers. Without more banding and marking data to substantiate changes in survival rates, measurable impacts on the population status of Tundra Swans resulting from harvest programs will be difficult to fully assess.

Total harvests of Tundra Swans, (including retrieved and unretrieved kill) resulting from special seasons have been considerably below the 10% guidelines in the EP and WP hunt plans. Currently, these harvest estimates account for about 3% and 2%, respectively, of the 1987-89 average winter population indices for EP and WP Tundra Swans. Thus, less than 3% of the continental preseason population of Tundra Swans is harvested each year. While these harvest rates are low, the hunt plans assume hunting mortality to be additive, and therefore, must be considered along with other mortality factors (Bartonek *et al.* 1991). The lack of precise estimates of subsistence harvests, vandalized killing, and losses annually to disease, lead poisoning, and accidental death, complicates any attempt to calculate more meaningful harvest rates. Therefore, the current hunt plans for EP and WP Tundra Swans must remain conservative in their approach to harvest optimum allowable numbers until refinements in our database can be made.

An Assessment of Swan Hunting

Prior to the mid-1800's, many observers reported swans to be relatively numerous (Banko 1960); but subsequent over-harvesting was suspected as being a major factor in the declines of both Tundra and Trumpeter Swans, with some populations of Trumpeter Swans being extirpated and others nearly so. Both Banko (1960) and Forbush (1912) give extensive accounts of the demise of swans at the hand of man. Between 1853 and 1877, more than 17,671 swan skins were reported sold to the Hudson Bay Company and by 1889, the number had dwindled to just 33 as swan numbers declined. While early sportsman regarded swans as worthy quarry and often made note of their shooting experiences, the combined seasonal killing of swans by natives and non-natives for food, market, or sport likely exceeded recruitment annually. With the Migratory Bird Treaty Act of 1918, both species of swans received the much-need nation-wide protection but, nonetheless, retained their status as "game birds."

Interest in the sport hunting of Tundra Swans has changed over the years as their numbers have increased and as some populations have become locally abundant. Before the initiation of the first regulated season in Utah, Sherwood

(1960) reported that wildlife agencies in most western States were opposed to hunting swans. He feared that with hunting, swan numbers would not continue to grow in North America and that due to their relative size, crippling losses would be high. Also, he expressed concern that such hunting would unduly jeopardize the restoration of Trumpeter Swan populations and, further, would conflict with the aesthetic values society has assigned to swans. Although his concerns and those of many others at that time were understandable, the eventuality of swan seasons in western States and the newly acquired information gathered from seasons in eastern States do not support most fears.

Both EP and WP Tundra Swans have increased in numbers and expanded their distributions over the years since special hunting seasons were first established. Estimates of unretrieved losses have ranged from 10% to 17% and averaged near 12%, which is lower than the estimated 18% for other waterfowl. These estimates were obtained from hunter questionnaires and may contain some bias. Obviously, hunting methods used to harvest swans vary regionally based on the season, hunter access and habits of the birds and likely have an effect on the incidence of crippling. Montana, for example, requires swan hunters to use either a dog, boat or chest wader when hunting swans in certain areas to facilitate retrieval. Swans are strong flyers and perhaps can carry more shot than other waterfowl, and as a result, fears of crippling may be valid, particularly if it increases risks of other mortality. Also, given the fact that these large white birds are easily observed, extensive crippling may elicit strong public reaction. More study of hunting methods, shot-shell effectiveness and killing efficiency in areas where swans are hunted should be encouraged. This information would be extremely helpful in developing future harvest guidelines.

Potential conflicts of Tundra Swan hunting programs with efforts to restore Trumpeter Swans numbers exist in certain locations, particularly on breeding grounds and during migration. The problem is more acute with WP than with EP swans, although with Trumpeter Swan restoration efforts in the Midwest this situation could change. Both EP and WP Tundra Swan management plans, including hunt plans, and the Trumpeter Swan management plan recognize that potential for conflict exists and acknowledge that incidental harvests of Trumpeter Swans will likely occur during these seasons as with some goose seasons. Such losses would likely occur regardless of Tundra Swan seasons as Trumpeter Swan numbers increase and their distribution expands. All plans seek reconciliation of conflicting management activities. As clarified in a recent policy, the USFWS intends to avoid the hunting of swans at times or in places where Trumpeter Swans are known to occur and has urged Flyway Councils to give strong consideration to finding ways of avoiding the chance-killing of Trumpeter Swans when Tundra Swan seasons are proposed. At present, there is no evidence to suggest that efforts to restore Trumpeter Swans have been impeded by hunting of Tundra Swans; however, the USFWS has indicated that it will deal with such conflicts on a case-by-case basis as they arise.

Swans are aesthetically valued by the public for viewing and photographing as are many other species of waterfowl. As large birds, they attract considerable attention, especially when in large migrating flocks and in concentrations near urban centers. As a game species, they evoke strong emotion and considerable public sentiment exists regarding the hunting of swans. Those opposed to the hunting of swans feel that swans are too beautiful and symbolic to warrant hunting. Those favoring a season believe numbers of Tundra Swans are adequate to biologically justify a limited harvest in specific areas to stabilize population size and still meet the other demands of society. While these diverse views were considered in detail during the preparation of the environmental assessment that preceded EP swans being hunted (USDI 1984), the decision to authorize these seasons was based primarily on their population status and only secondarily on possibilities for recreational opportunities. Since swans were among those species hunted prior to 1918, a tradition did exist in many areas for harvesting swans. Many waterfowl hunters regard Tundra Swans as a trophy game species and place high value on the opportunity to hunt them.

In some localized areas of the Atlantic Flyway, swans winter in large concentrations and cause damage to agricultural crops by feeding in fields (Munro 1981). Although this recently acquired feeding behaviour is thought to have considerable nutrition value (Bortner 1985) and may enhance seasonal survival, monetary losses have created local opposition to the presence of the birds. In North Carolina, some farmers have resorted to shooting swans illegally in an attempt to disperse them from their fields (D. C. Luszcz, pers. comm.). In these isolated instances, swan hunting to allow a limited harvest by special

permit has helped to alleviate local problems. However, in most portions of their range, Tundra Swans pose few social or economic problems.

In conclusion, the status of EP and WP Tundra Swans appears to be adequate at the present time to provide maximum benefits to society, which includes continuance of a limited hunting program. As long as populations remain above objective numbers and special hunts are conducted in accordance with the guidelines established in each of the hunt plans, a limited harvest seems biologically justifiable. Banding and marking studies are needed for both EP and WP swans to validate population estimates, assess seasonal movements and site fidelity, and document recovery and survival rates. Answers to these questions are of particular importance since swans have considerable aesthetic value, are long lived, and have low recruitment. Expansion of harvests beyond existing levels will likely be limited in the years ahead. Possibly, the Northwest Territories may seek a season and South Dakota may avail itself of its authorized season, but other States and Provinces likely will not seek a season for various reasons. Overall, it will be the responsibility of the Federal and State/Provinces wildlife agencies and Flyway Councils to monitor populations and their distributions carefully and to modify these hunt plans where necessary to ensure that adequate numbers remain for future generations to enjoy.

We wish to thank T. W. Aldrich, Utah Division of Wildlife Resources, J. Herbert, Montana Department of Fish, Wildlife and Parks, T. Retterer, Nevada Department of Wildlife, T. Rothe, Alaska Fish and Game, M. A. Johnson, North Dakota Game and Fish Department, and D. C. Luszcz, North Carolina Wildlife Resources Commission, for providing annual harvest data and evaluation reports from each of the participating States. We acknowledge the efforts of the many State and Federal biologist who participated in the development and the implementation of the EP and WP Tundra Swan Hunt Plans. We are grateful A. Davenport for technical assistance on data presentation and we thank L. A. Pickard for preparing tables and typing portions of this manuscript. We appreciate the editorial assistance of R. J. Blohm, K. E. Gamble, W. N. Ladd, and M. M. Smith on various drafts of this manuscript.

References

Ad Hoc Whistling Swan Committee. 1982. Management plan for the eastern population of Whistling Swans. [Atlantic Flyway Council, Mississippi Flyway Council, Central Flyway Council, and Pacific Flyway Council.] Unpubl. Rept. 23 pp.

Banko, W. E. 1960. *The Trumpeter Swan: its history, habits and population in the United States.* North Am. Fauna 63. U. S. Fish and Wildl. Serv., Washington D. C. 214pp.

Bartonek, J.C., Serie, J.R. & Converse, K.A. 1991. Mortality in Tundra Swans, *Cygnus columbianus.* In: J. Sears & P.J. Bacon (eds.). *Proc. 3rd Int. Swan Symp.,* Oxford, 1989. *Wildfowl* (Special Supplement no.1).

Bartonek, J. C., Blandin, W. W., Gamble, K. E., and Miller, H. W. 1981. Numbers of swans wintering in the United States. Pp. 19-25 In: G. V. T. Matthews, & M. Smart, (eds.), *Proc. 2nd Int. Swan Symp.,* Sapporo, 1980. IWRB, Slimbridge.

Bortner, J. B. 1985. *Bioenergetics of wintering Tundra Swans in the Mattamuskeet Region of North Carolina.* Univ. of Maryland, M. S. Thesis. 64pp.

Canadian Wildlife Service & U. S. Fish and Wildlife Service. 1986. *North American waterfowl management plan.* The agencies, Ottawa and Washington, D.C. 19 pp.

Conant, B., Hodges, J.I. & King, J.G.. 1991. Continuity and advancement of Trumpeter Swan *Cygnus buccinator*, and Tundra Swan, *C. columbianus*, population monitoring in Alaska. In: J. Sears & P.J. Bacon (eds.), *Proc. 3rd Int. Swan Symp.*, Oxford, 1989. *Wildfowl* (Special supplement no.1).

Copp, J. D. [1989]. *Results of the 1987 survey of waterfowl hunting on the Yukon-Kuskokwim Delta, Alaska.* Oregon State Univ., Corvallis, Oreg. Unpubl. Rept. 40 pp + appendices.

Forbush, E. H. 1912. *A history of the game birds, wildfowl, and shore birds of Massachusetts and adjacent States.* Massachusetts State Board of Agriculture. 622pp.

Munro, M. E. 1981. Traditional return of *Cygnus columbianus columbianus* to wintering areas in

Maryland's Chesapeake Bay. Pp. 81-98 In: G. V. T. Matthews & M. Smart, (eds.), *Proc. 2nd Int. Swan Symp.*, Sapporo, 1980. IWRB, Slimbridge.

Schroeder, L. (Chmn.) 1983. *Pacific Flyway management plan for the western population of Whistling Swans.* Subcommittee on Whistling Swans, Pacific Flyway Study Committee, Portland, Oregon. Unpubl. Rept. 27 pp.

Serie, J. R. & Bartonek, J. C. 1991. Population status and productivity of Tundra Swans, *Cygnus columbianus*, in North America. In: J. Sears & P. J. Bacon, (eds.), *Proc. 3rd Int. Swan Symp.*, Oxford, 1989. *Wildfowl* (Special Supplement no.1).

Sherwood, G. A. 1960. The Whistling Swan in the west with particular reference to Great Salt Lake Valley, Utah. *The Condor* 62(5):370-377.

USDI. 1984. *Environmental Assessment: Proposed hunting regulations on eastern population of Whistling(Tundra) Swans*,1984 USFWS, Unpubl. Rept. 11 pp.

Jerome R. Serie, Atlantic Flyway Representative, U.S. Fish and Wildlife Service, Laurel, Maryland. USA.
James C. Bartonek, Pacific Flyway Representative, U.S. Fish and Wildlife Service, Portland, Oregon. USA.