



U.S. Fish & Wildlife Service

The 2015 North American Trumpeter Swan Survey



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The 2015 North American Trumpeter Swan Survey

A Cooperative North American Survey

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Abstract: The North American Trumpeter Swan Survey (NATSS) has been conducted approximately every five years since 1968 to monitor the status of trumpeter swans (*Cygnus buccinator*) in North America. The 2015 NATSS was conducted in January–September (primarily April–September) by numerous federal, state, provincial, and private cooperators throughout the northern United States and Canada. The primary survey objective in 2015 was to estimate the abundance of adult and subadult trumpeter swans (“white swans”) in North America and within the three recognized trumpeter swan populations: Pacific Coast (PCP), Rocky Mountain (RMP), and Interior (IP). For the first time since the survey’s inception, the collection of cygnet-abundance and other productivity data was optional. Methods varied among regions but were generally similar to 2010 surveys within regions. Notable exceptions included Minnesota, Wisconsin, and Michigan, where cooperators switched from censuses to sampling designs involving transects. Cooperators performed aerial surveys, ground counts, or a combination of the two. The 2015 continental estimate of white swan abundance was 63,016, which was a substantial increase since 2010 and the highest estimate recorded since the surveys began in 1968. The estimated average annual growth rate during 1968–2015 was +6.6% ($P < 0.01$). Each of the three populations reached record-high abundance levels in 2015. The 2015 white swan abundance estimates for the PCP, RMP, and IP were 24,240 (SE = 1,195), 11,721, and 27,055, respectively. Abundance objectives established for the three populations by the Pacific, Central, and Mississippi Flyway Councils were met for the PCP and IP in 2015; while the RMP met the overall white swan abundance objectives for the Canadian and U.S. Breeding flocks, several state- and region-specific objectives have not yet been achieved.

INTRODUCTION

The North American Trumpeter Swan Survey (NATSS) is a cooperative, range-wide survey to monitor the status of trumpeter swans (*Cygnus buccinator*) in North America. It was first conducted in 1968 and has been repeated at five-year intervals since 1975. The NATSS is accomplished by numerous cooperators from federal, state, and provincial agencies across the northern United States and Canada, as well as volunteers from non-governmental organizations and the general public (Appendix A). The survey results have been used by the Flyway Councils, wildlife management agencies, and others to monitor trumpeter swans and to evaluate the trumpeters’ status relative to various management and conservation objectives.

From 1968–2010, the objectives of the NATSS were to estimate the abundance, productivity, and distribution of trumpeter swans in late summer–early fall, when the swans were dispersed on breeding territories and cygnets were close to fledging. Estimates were obtained for the abundance of white swans (adults and subadults), cygnets, and total swans, as well as the number of broods, mean brood size, and the percentage of cygnets in the total swan population. The trumpeter swans’ summer range was also delineated, though generally at a small scale and low resolution. Starting in 1985, these survey objectives were applied individually to the three trumpeter swan populations that had recently been defined (and are still used) for management purposes: the Pacific Coast Population (PCP), the Rocky Mountain Population (RMP), and Interior Population (IP; Figure 1).

Financial and logistical constraints have always at least partially influenced the degree to which cooperators have been able to meet the various survey objectives. However, in recent years rising survey costs have become an especially difficult challenge, as trumpeter swans have continued to increase in number and expand their range. In July 2012, the International Trumpeter Swan Survey Steering Committee (ISC) was assembled within the Flyway Council framework to facilitate the planning and coordination of the 2015 survey. The ISC worked with cooperators and the Flyway Councils to review the 2015 survey objectives and identify needs for

funding or logistical assistance. To make the survey more cost-effective, productivity was dropped as a primary survey objective in 2015, and the highest priority was placed on obtaining abundance estimates of white swans. Cooperators that opted to collect productivity data could report it if desired. Summer distribution was retained as a secondary objective, with acknowledgment that the accuracy, scale, and resolution would vary by region as it has in the past.

In addition to facilitating the 2015 survey, the ISC was tasked with conducting a comprehensive review of the NATSS to ensure that future surveys are cost-effective, technically sound, and meet current management needs and objectives. The ISC, citing a lack of sufficient time before the 2015 survey, postponed the review, but it will reconvene in the near future to move forward with this important task.

SURVEY AREA

Similar to previous quinquennial surveys, the goal for survey coverage in 2015 was to include all habitats known or likely to host trumpeter swans during the breeding season. However, as in past years, coverage was not complete. Some areas of low swan density were excluded, as were some areas with suitable habitat but as-yet-undocumented swan occurrence. Due to funding constraints, Saskatchewan, northern Ontario, and most of Manitoba were not surveyed. (To put these regions into context, a total of 78 white swans were counted in Saskatchewan and Manitoba in 2005 [Moser 2006]; no previous data exist for northern Ontario.) In Alaska, some areas were excluded where both trumpeter swans and tundra swans (*Cygnus columbianus*) occurred, because observers could not differentiate them from the aerial survey platform.

A few new areas were added in 2015, including the state of Pennsylvania, Modoc National Wildlife Refuge (NWR) in northeastern California, and Wood Lake NWR in northeastern North Dakota.

METHODS

Cooperators within each region determined their own survey designs and methods to obtain estimates of white swan abundance and summer distribution (Appendix B). Survey designs were influenced by the availability of staff, funding, and cooperators' own regional objectives. PCP and RMP cooperators used similar methods as in 2010, but some major changes occurred within the IP. In Minnesota, Wisconsin, and Michigan, cooperators switched from using various combinations of aerial and ground counts to using white swan data collected during their spring 2015 waterfowl breeding population aerial transect surveys (Cordts 2015, Van Horn *et al.* 2015, Michigan Department of Natural Resources, unpublished data). Because the spring waterfowl surveys were designed to estimate duck abundance, they did not necessarily provide optimal survey coverage for trumpeter swans. Therefore, in Minnesota and Wisconsin, the breeding population survey transects were supplemented with additional aerial transects to increase the sample sizes and better cover important trumpeter swan habitats (Herwig and Giudice 2015, Gatti and Van Horn 2015). The change in survey methodology for Minnesota represented a major shift in survey timing, which previously had been the month of January when swans were concentrated on wintering areas.

The 2015 survey was conducted between 12 January and 30 September (Appendix B). The median starting and ending dates were 26 August and 4 September, respectively. Most cooperators surveyed their regions within the goal period of spring through early fall, when white swans were present on the breeding grounds. One exception was in southern Ontario, where the survey was conducted in January 2015 to take advantage of the birds being concentrated on wintering areas. The extent to which the swans counted in January might also have been counted elsewhere during the spring–fall survey window is unknown.

Population estimates that were obtained from statistical samples were reported by cooperators with associated estimates of precision. All other estimates were treated as though they were measured without error. Because survey methods varied among regions and years, and in some IP areas changed substantially in 2015, results by region and year were not always directly comparable. For flocks surveyed with sampling designs in both 2010 and 2015, two-sample *z*-tests were performed to evaluate differences between the 2010 and 2015 estimates (Thompson *et al.* 1998). For all flocks and populations, trends in abundance were assessed by regressing the natural logarithm of the survey estimates on year. The estimated annual growth rates (regression slopes) from the regressions were then tested for equality to zero (*t*-test). An alpha level of 0.05 was selected for all tests of significance. Note that in some regions, wild swan populations were supplemented through restoration releases; therefore, reported growth rates likely overestimate intrinsic growth.

Population and flock terminology in this report follows population-specific management plans, with one exception (Subcommittee on the Interior Population of Trumpeter Swans 1997, Pacific Flyway Council 2006, Subcommittee on Rocky Mountain Trumpeter Swans 2012; Figure 1). A group of small flocks in the western U.S., known as “Restoration Flocks” in the RMP Trumpeter Swan Management Plan, was placed in a broader category labeled “Other U.S. Flocks.” “Other U.S. Flocks” included all trumpeter swans observed south of the Canadian border and west of the Rocky Mountains during the NATSS, except swans in the Tri-state Area Flock. In 2015, “Other U.S. Flocks” included swans from the “Restoration Flocks” (Ruby Lake, NV; Malheur NWR, OR; Summer Lake Wildlife Management Area, OR; and Flathead Valley, MT); Turnbull NWR, WA; Modoc NWR, CA; and Blackfoot Valley, MT.

RESULTS AND DISCUSSION

North America

The 2015 estimate of white swan abundance in North America was 63,016 (Table 1, Figure 2). The 2015 estimate was substantially higher than the 2010 estimate (34,249) and was the highest estimate since surveys began in 1968. Survey results from 1968–2015 suggest that the number of white swans increased continually throughout the 47-year period, at an estimated average rate of 6.6% per year ($P < 0.01$; Table 2).

The estimated summer range of trumpeter swans in 2015 is shown in Figure 1. This range delineation likely omits some areas where trumpeters occurred, because not all potential trumpeter swan habitats were surveyed. For example, distribution in Saskatchewan and

Manitoba was not updated because these areas were minimally or not surveyed in 2015. In Alaska, it is unknown if distribution has expanded, because the 2015 survey area was the same as that used in 2005 and 2010. In the Yukon-northwest British Columbia (Yukon-nw BC) region, a few trumpeter swans have been documented in scattered locations beyond the 2015 survey area; the 2015 range was thus delineated using the 2015 survey results, additional documented occurrences (J. Hawkings, Canadian Wildlife Service, personal communication), and data from the British Columbia Breeding Bird Atlas (Davidson *et al.* 2015). In Ontario, trumpeter swans have been documented in the southern part of the province, but the northern part has not been surveyed.

Pacific Coast Population (PCP)

The 2015 white swan abundance estimate for the PCP was 24,240 (SE = 1,195), which was slightly higher than the 2010 estimate of 20,779 (SE = 969, $P < 0.05$; Table 1). The number of swans in the Alaska flock, estimated at 22,015 in 2015 (SE = 1,113), was not statistically different from that of 2010 (19,638, SE = 923, $P > 0.05$). However, the Yukon-nw BC flock did show a significant increase, up from 1,141 white swans (SE = 294) in 2010 to 2,225 (SE = 436) in 2015 ($P < 0.05$).

White swans in the PCP increased at an average rate of 5.5% per year from 1968–2015 ($P < 0.01$; Table 2, Figure 3). The overall growth rate was heavily weighted by the Alaska flock, which comprised 91% of the PCP in 2015. The Alaska flock increased an average of 5.3% annually from 1968–2015 ($P < 0.01$). Its growth rate declined over time, from +8.8% per year during 1968–1985 ($P < 0.01$) to +3.0% per year during 2000–2015 ($P < 0.05$). It is possible that the flock, which now occupies a majority of the forested wetland habitats in Alaska, is approaching carrying capacity in some parts of the state. In the Yukon Territory and British Columbia, where suitable habitats remain readily available, the Yukon-nw BC flock increased 14.5% annually from 1985–2015 ($P < 0.01$).

See Appendix B for productivity data submitted by PCP cooperators.

Rocky Mountain Population (RMP)

The abundance of white swans in the RMP reached a record high of 11,721 in 2015, a substantial increase over the 2010 estimate of 6,316 swans (Tables 1, 3). The three flocks that comprise the RMP all increased from 2010–2015. The Canadian flock nearly doubled, increasing from 5,773 (SE = 295) white swans in 2010 to 10,957 (SE = 227) in 2015 ($P < 0.01$). The Tri-state Area estimate (548 in 2015, up from 380 in 2010) was notable in that it exceeded the 1968 estimate for the first time since 1990. The 2015 estimate for “Other U.S.” flocks was 216 white swans, up from 163 in 2010. Part of the increase in “Other U.S.” flocks was due to the release of captive stock as part of ongoing restoration efforts.

The growth rate of white swans in the RMP averaged +6.5% per year from 1968–2015 ($P < 0.01$; Table 2, Figure 4). The growth rate increased over time, from +2.3% per year during 1968–1985 ($P < 0.05$) to +10.8% per year during 2000–2015 ($P < 0.01$). Among the individual flocks, growth rates varied substantially. The Canadian flock increased at a fairly consistent rate

throughout the survey period, averaging +11.5% per year from 1968–2015 ($P < 0.01$). The Tri-state Area and “Other U.S.” flocks showed no statistically significant long-term trends; however, both flocks increased in abundance after 2005 and were largely responsible for the increase in the overall RMP growth rate during 2000–2015.

See Appendix B for productivity data submitted by RMP cooperators.

Interior Population (IP)

The 2015 IP white swan estimate was 27,055, nearly a four-fold increase over the 2010 estimate (7,154; Tables 1, 4). The Mississippi and Atlantic Flyways flock accounted for most of the growth, where white swan estimates increased from 6,770 in 2010 to 26,591 in 2015. Because survey methods changed substantially in Minnesota, Wisconsin, and Michigan in 2015, the 2010 and 2015 estimates are not directly comparable. Nevertheless, it is undoubtedly safe to conclude that a major increase in abundance occurred. The High Plains flock also increased between 2010 (384 white swans) and 2015 (464 white swans). The 2010 and 2015 High Plains counts were minimum estimates, because only one small area in the Canadian portion of the High Plains range was surveyed. This area, Riding Mountain National Park in Manitoba, hosted 97 white swans in 2015, 185% more than were observed there in 2010.

The average growth rate of white swans in the IP was +14.4% per year from 1968–2015 ($P < 0.01$; Table 2, Figure 5). The growth rate increased substantially in the 1980s, when swan restoration programs established and supplemented the Mississippi and Atlantic Flyways flock by releasing captive birds (Subcommittee on the Interior Population of Trumpeter Swans 1997). Prior to that, the IP growth rate only reflected the trend in the High Plains flock. The High Plains flock, which was only briefly augmented by releases in the early 1960s (Comeau 2015), increased an average of 5.0% per year from 1968–2015 ($P < 0.01$). The supplemented Mississippi and Atlantic Flyways flock, in contrast, increased 23.5% annually from 1980–2015 ($P < 0.01$). Although most of the IP restoration programs ended by the mid-2000s, the Iowa Department of Natural Resources has continued to release swans, including a total of 184 swans from 2010–2015 (Iowa Department of Natural Resources 2016).

See Appendix B for productivity data submitted by IP cooperators.

2015 Trumpeter Swan Abundance vs. Flyway Management Plan Objectives

The 2015 NATSS abundance estimates can be compared to abundance objectives that have been established in the PCP, RMP, and IP trumpeter swan management plans (Subcommittee on the Interior Population of Trumpeter Swans 1997, Pacific Flyway Council 2006, Subcommittee on Rocky Mountain Trumpeter Swans 2012). The PCP abundance objective of $\geq 25,000$ total swans (i.e., white swans and cygnets) was first met in 2010 and was exceeded again in 2015 with an estimate of 31,793 total swans (Appendix B). The IP objective of “at least 2,000 [total] birds and 180 successful breeding pairs by 2001” was reached by the time of the 2000 NATSS (Caithamer 2001); the 2015 white swan estimate (27,055) exceeded the 2,000-total-bird objective by more than 1,200%. Within the RMP, the Canadian flock has done very well and has exceeded the objective of 98 breeding pairs in Alberta. However, the regional objective of 10

breeding pairs in the vicinity of Elk Island National Park, Alberta has not yet been met (G. Raven, Canadian Wildlife Service, personal communication). Similarly, the RMP-U.S. Breeding Segment (i.e., the Tri-state Area and “Other U.S.” flocks combined) met its overall objective of 718 white swans in 2015, but several state- and region-specific abundance, distribution, and productivity objectives have not yet been achieved.

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Table 1. Estimates of white swan (adult and subadult) abundance from the North American Trumpeter Swan Survey, 1968–2015.^{a, b}

Population and Flock	1968	1975	1980	1985	1990	1995	2000	2005	2010	2015
<u>Pacific Coast Population:</u>										
Alaska	1,924	2,993	5,259	7,773	9,742	11,989	13,934	17,245	19,638 (923) ^c	22,015 (1,113) ^c
Yukon and nw British Columbia	---	---	---	35	75	302 ^d	294 ^d	867 (41) ^c	1,141 (294) ^c	2,225 (436) ^c
Total Pacific Coast Population	1,924	2,993	5,259	7,808	9,817	12,291	14,228	18,112	20,779 (969)^c	24,240 (1,195)^c
<u>Rocky Mountain Population:</u>										
Canada	75	88 ^e	276 ^f	429	758	1,445	2,175	3,270	5,773 (295) ^c	10,957 (227) ^c
Tri-state Area	431	457 ^e	462	368	442	309	324	355	380	548
Other U.S. Flocks	99	108	77	68	30	66	49	49	163	216
Total Rocky Mountain Population	605	653	815	865	1,230	1,820	2,548	3,674	6,316	11,721
<u>Interior Population:</u>										
High Plains	43	81	120	95	123	189	267	362	384	464
Mississippi and Atlantic Flyways	---	---	12	44	174	509	1,443	2,858	6,770	26,591 ^g
Total Interior Population	43	81	132	139	297	698	1,710	3,220	7,154	27,055^g
North American Total	2,572	3,727	6,206	8,812	11,344	14,809	18,486	25,006	34,249	63,016

^a Estimates for 1968–1990, 1995, 2000, 2005, and 2010 were from USFWS *et al.* 1994, Caithamer 1996, Caithamer 2001, Moser 2006, and Groves 2012, respectively.

^b "---" denotes the area was not surveyed.

^c Population estimate was obtained from a statistical sample. Standard error of the estimate is in parentheses.

^d Standard error of the estimate is not available.

^e Estimate was derived from data obtained in 1974–1975.

^f Estimate was derived from data obtained in 1978–1982.

^g Several cooperators in the Mississippi Flyway used different survey methods in 2015 than in previous years.

Table 2. Estimated average annual growth rates for adult and subadult trumpeter swans ("white swans"), by population and flock, from the North American Trumpeter Swan Survey, 1968–2015.

Population and Flock	Annual Growth Rate ^{a, b}			
	1968–1985	1985–2000	2000–2015	1968–2015
<u>Pacific Coast Population:</u>				
Alaska	8.8%	4.0%	3.0%	5.3%
Yukon and nw British Columbia	--- ^c	16.8%*	13.5%	14.5% ^d
Total Pacific Coast Population	8.8%	4.1%	3.5%	5.5%
<u>Rocky Mountain Population:</u>				
Canada	11.7%*	11.7%	11.4%	11.5%
Tri-state Area	-0.7%*	-1.5%*	3.3%*	-0.1%*
Other U.S. Flocks	-2.5%*	-0.4%*	12%*	0.9%*
Total Rocky Mountain Population	2.3%	7.5%	10.8%	6.5%
<u>Interior Population:</u>				
High Plains	5.3%*	7.3%	3.5%	5.0%
Mississippi and Atlantic Flyways	--- ^e	27.2% ^f	21.2%	23.5% ^g
Total Interior Population	7.5%	18.3%	19.9%	14.4%
North American Total	7.7%	5.1%	8.3%	6.6%

^a Trend (regression slope) was statistically significant ($P < 0.05$) unless noted with an asterisk.

^b Some flocks were supplemented through releases of captive stock during restoration efforts.

^c Not surveyed.

^d Annual growth rate 1985–2015.

^e First surveyed in 1980.

^f Annual growth rate 1980–2000.

^g Annual growth rate 1980–2015.

Table 3. Estimates of white swan (adult and subadult) abundance for the Rocky Mountain Population of trumpeter swans, 1968–2015, from the North American Trumpeter Swan Survey.^{a,b}

	1968	1975	1980	1985	1990	1995	2000	2005	2010	2015
<u>Canada Flock:</u>										
Eastern Yukon Territory	---	---	68 ^c	87	136	493 ^d	1,057 ^d	1,194 ^d	n/a ^e	n/a ^e
Eastern British Columbia	---	---	44 ^f	59	190	227	246	576	n/a ^e	n/a ^e
Alberta	75	84	138	228	306	563	668	1,173	n/a ^e	n/a ^e
Northwest Territories	---	---	26	51	124	161	204	327	n/a ^e	n/a ^e
Western Saskatchewan	---	4 ^g	---	4	2	1	0	0	---	---
Total Canada	75	88	276	429	758	1,445	2,175	3,270	5,773 (295) ^h	10,957 (227) ^h
<u>Tri-State Flock:</u>										
Montana	242	296 ^g	315	212	245	86	127	112	130	212
Wyoming	101	90 ^g	74	73	95	105	95	107	149	232
Idaho	88	71	73	83	102	118	102	136	101	104
Total Tri-State	431	457	462	368	442	309	324	355	380	548
<u>Other U.S. Flocks:</u>										
Turnbull NWR, Washington	39	27	4	9	3	---	1	---	2	8
Washington - Other	---	---	---	---	---	2	0	---	---	---
Ruby Lake NWR, Nevada	20	36	35	23	8	15	26	17	---	2
Malheur NWR, Oregon	40	45	38	36	19	11	10	20	6	4
Summer Lake WMA, Oregon	---	---	---	---	---	23	3	3	11	20
Oregon - Other	---	---	---	---	---	13	9	9	11	---
Flathead Valley, Montana	---	---	---	---	---	---	---	---	95	144
Blackfoot Valley, Montana	---	---	---	---	---	---	---	---	38	36
Modoc NWR, California	---	---	---	---	---	---	---	---	---	2
Lower Klamath Lake, California	---	---	---	---	---	2	0	---	---	---
Total Other U.S.	99	108	77	68	30	66	49	49	163	216
Total Rocky Mountain Population	605	653	815	865	1,230	1,820	2,548	3,674	6,316	11,721

^a Estimates for 1968–1990, 1995, 2000, 2005, and 2010 were from USFWS *et al.* 1994, Caithamer 1996, Caithamer 2001, Moser 2006, and Groves 2012, respectively. Some of the historical estimates differ slightly from those reported in USFWS 2016.

^b "—" denotes the area was not surveyed.

^c Estimate was derived from data obtained in 1978–1982.

^d Included extreme northern British Columbia.

^e A stratified random sample design was used starting in 2010, which provided a combined estimate for YT, BC, AB and NT.

^f Estimate was derived from data obtained in 1978–1981.

^g Estimate was obtained in 1974.

^h Standard error of the estimate is in parentheses.

Table 4. Estimates of white swan (adult and subadult) abundance for the Interior Population of trumpeter swans, 1968–2015, from the North American Trumpeter Swan Survey.^{a,b}

	1968	1975	1980	1985	1990	1995	2000	2005	2010	2015
<u>High Plains Flock:</u>										
South Dakota	43 ^c	81 ^c	55	42	46	34	33	73	36	54
Nebraska	--- ^c	--- ^c	65	53	73	119	200	211	312	311
Wyoming	---	---	---	---	4	15	2	0	2	0
Saskatchewan	---	---	---	---	---	21	32 ^d	53	---	---
Manitoba	---	---	---	---	---	---	--- ^d	25	34 ^e	97 ^e
North Dakota	---	---	---	---	---	---	---	---	---	2
Total High Plains	43	81	120	95	123	189	267	362	384	464
<u>Mississippi and Atlantic Flyways Flock:</u>										
Ontario	---	---	---	3	12	77	277	454	683 ^f	1,471
Minnesota	---	---	12	37	123	247	612	1,421	4,480 ^g	17,021 (2,589) ^{h,i}
Wisconsin	---	---	---	---	24	75	86	186	672	4,695 (1,001) ^{h,i}
Michigan	---	---	---	---	9	92	274	540	580	3,021 (879) ^{h,j}
Iowa	---	---	---	---	---	18	130	202	213	204
Ohio	---	---	---	---	---	---	51	45	117	154
New York	---	---	---	---	---	---	13	10	25	22
Pennsylvania	---	---	---	---	---	---	---	---	---	3
Missouri	---	---	---	4	6	---	---	---	---	---
Total Mississippi and Atlantic Flyways	---	---	12	44	174	509	1,443	2,858	6,770	26,591
Total Interior Population	43	81	132	139	297	698	1,710	3,220	7,154	27,055

^a Estimates for 1968–1990, 1995, 2000, 2005, and 2010 were from USFWS *et al.* 1994, Caithamer 1996, Caithamer 2001, Moser 2006, and Groves 2012, respectively.

^b "—" denotes the area was not surveyed.

^c Estimates for South Dakota and Nebraska were combined.

^d Estimates for Saskatchewan and Manitoba were combined.

^e Survey area was limited to Riding Mountain National Park.

^f Excluded nw Ontario.

^g Included nw Ontario.

^h Population estimate was obtained from a statistical sample. Standard error of the estimate is shown in parentheses.

ⁱ Lone swan observations were not doubled when calculating abundance estimates.

^j Lone swan observations were doubled when calculating abundance estimates.

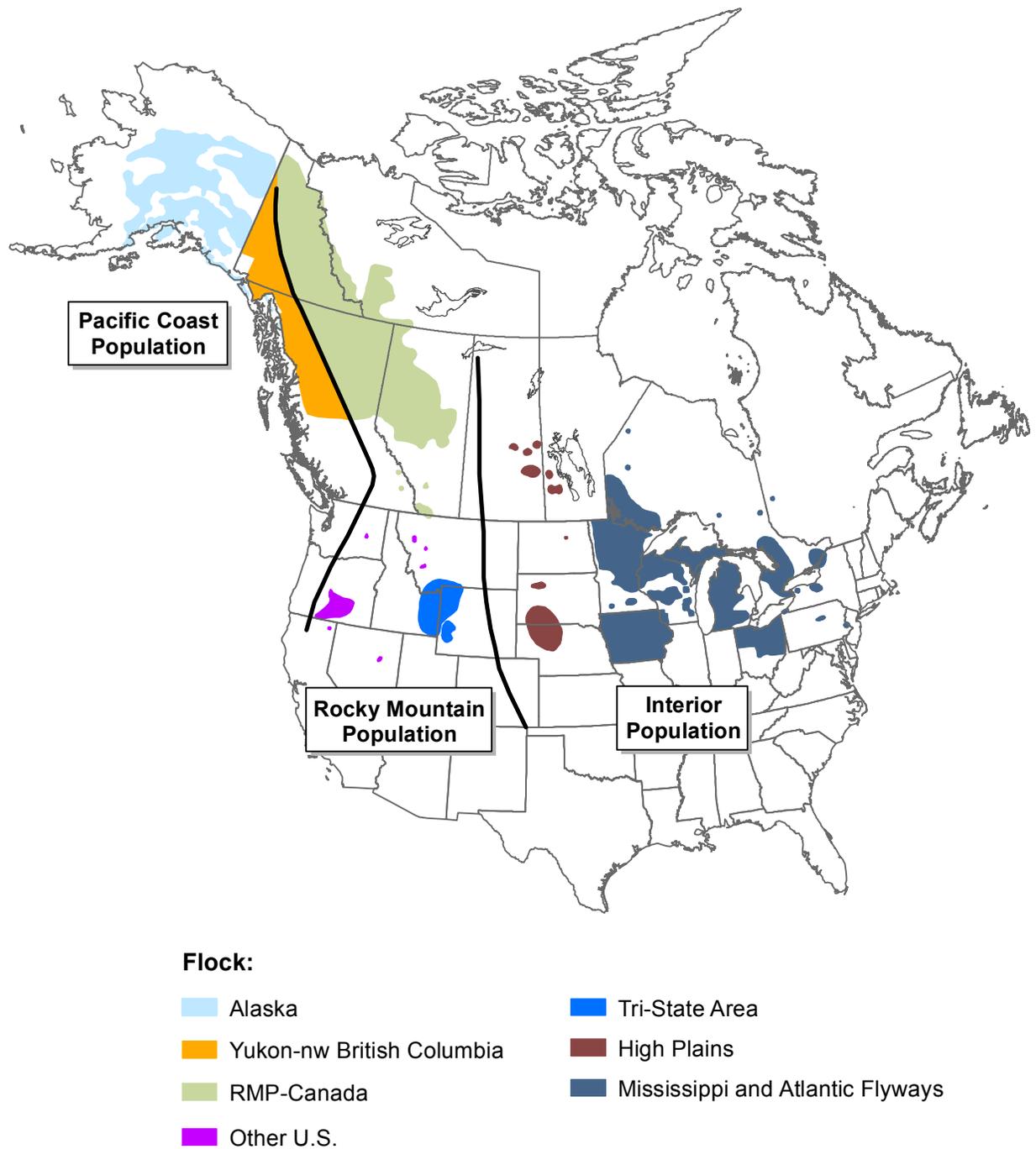


Figure 1. Approximate summer range of Pacific Coast, Rocky Mountain, and Interior populations of trumpeter swans, as reported by 2015 North American Trumpeter Swan Survey (NATSS) cooperators. The range in British Columbia was delineated using data from the 2015 survey and the British Columbia Breeding Bird Atlas (2015). Alaska, Saskatchewan, and Manitoba ranges were based on 2005 NATSS data.

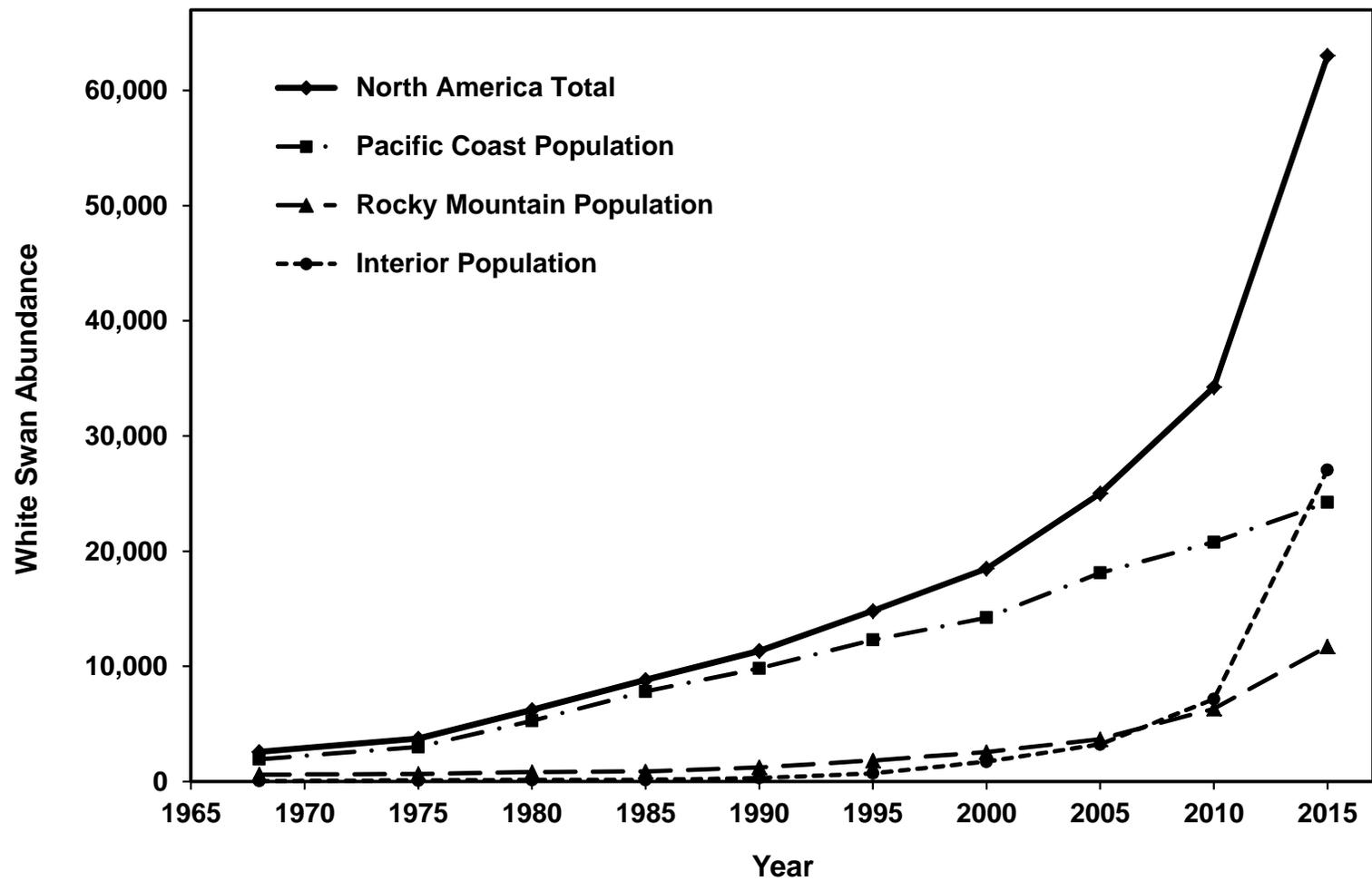


Figure 2. Trends in the abundance of adult and subadult trumpeter swans ("white swans") in the Pacific Coast, Rocky Mountain, Interior, and total North American populations, 1968–2015, from the North American Trumpeter Swan Survey.

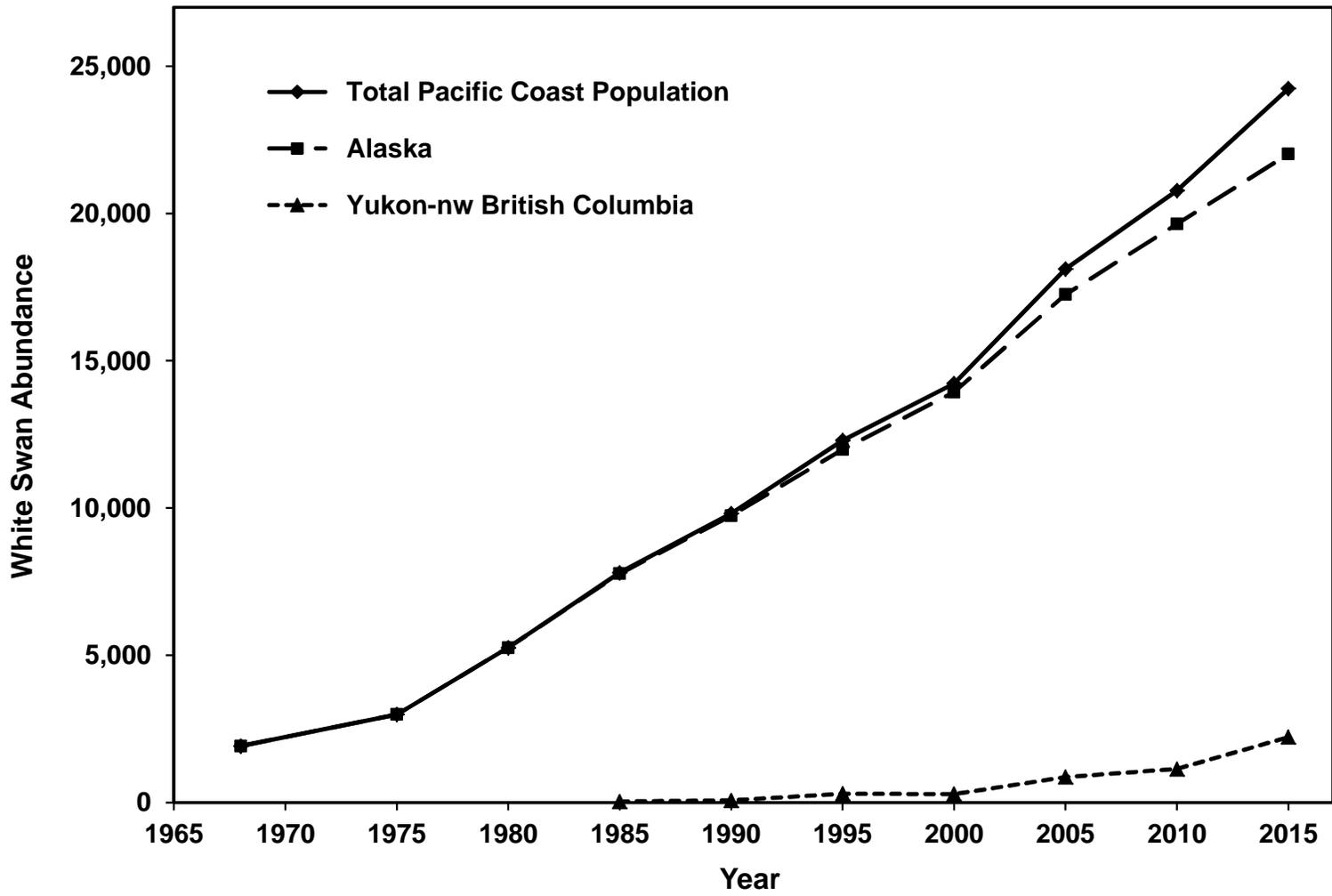


Figure 3. Trends in the abundance of adult and subadult trumpeter swans ("white swans") in the Pacific Coast Population, 1968–2015, from the North American Trumpeter Swan Survey.

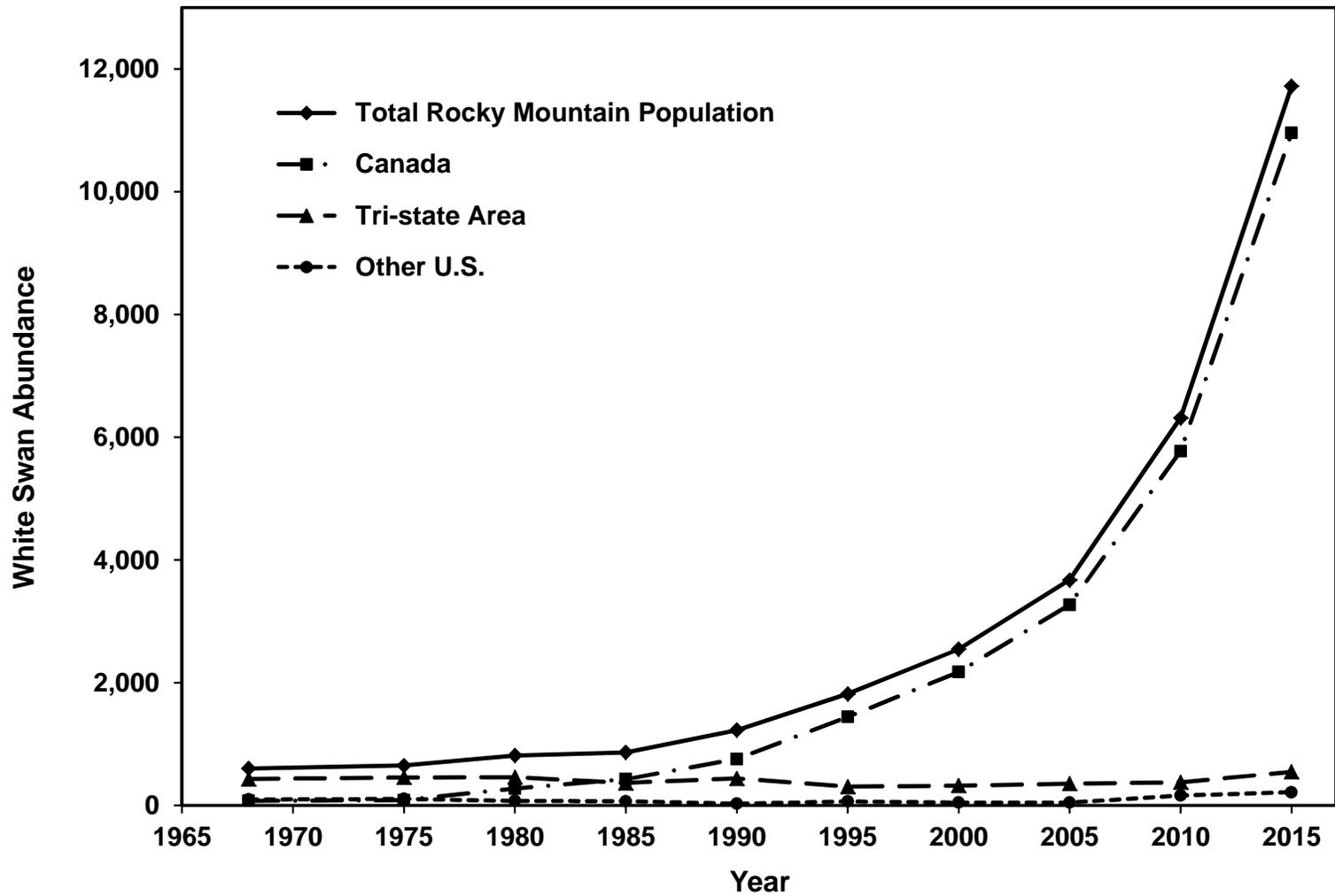


Figure 4. Trends in the abundance of adult and subadult trumpeter swans ("white swans") in the Rocky Mountain Population, 1968–2015, from the North American Trumpeter Swan Survey.

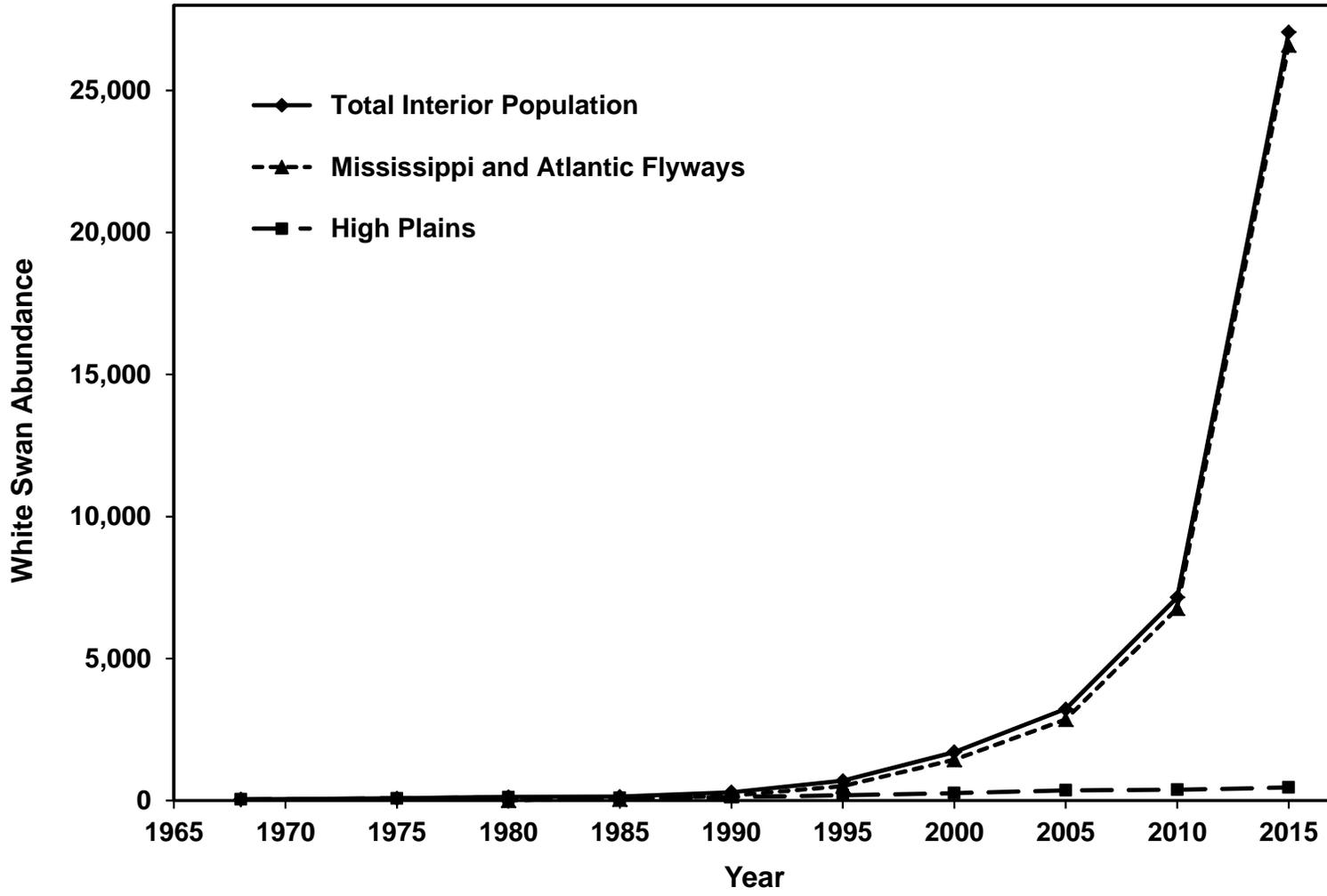


Figure 5. Trends in the abundance of adult and subadult trumpeter swans ("white swans") in the Interior Population, 1968–2015, from the North American Trumpeter Swan Survey.

Appendix A. Participants and cooperators in the 2015 North American Trumpeter Swan Survey.

Adams, C.	New York State Department of Environmental Conservation
Anderson, A.	U.S. Fish and Wildlife Service
Anderson, C.	Private
Anderson, D.	Alberta Environment and Parks
Anderson, L.	Ontario Ministry of Natural Resources and Forestry
Anderson, N.	Alberta Environment and Parks
Ard, S.	U.S. Fish and Wildlife Service
Avers, B.	Michigan Department of Natural Resources
Bachman, D.	U.S. Fish and Wildlife Service
Badzinski, S.	Canadian Wildlife Service
Barlow, B.	Michigan Department of Natural Resources
Barney, T.	Long Point Waterfowl
Baron, L.	Private
Becker, D.	Confederated Salish and Kootenai Tribes
Bennett, K.	Ontario Ministry of Natural Resources and Forestry
Beringer, P.	Wisconsin Department of Natural Resources
Best, D.	Private
Best, S.	Private
Bladder, L.	Choice Aviation
Blanchard, F.	Alberta Environment and Parks
Blohm, R.	The Trumpeter Swan Society
Bortner, B.	U.S. Fish and Wildlife Service
Braagstad, J.	U.S. Fish and Wildlife Service
Breault, A.	Canadian Wildlife Service
Bredy, J.	U.S. Fish and Wildlife Service
Brook, R.	Ontario Ministry of Natural Resources and Forestry
Bryant, J.	U.S. Fish and Wildlife Service
Burns, J.	Private
Burns, T.	Private
Burton, D.	Parks Canada
Buss, E.	Private
Campbell, B.	Canadian Wildlife Service
Campbell, M.	Canadian Wildlife Service
Canney, B.	Private
Castle, J.	Alberta Environment and Parks
Clairmont, S.	Confederated Salish and Kootenai Tribes
Clark, I.	Private
Clark, M.	Private
Clark, P.	Office of Aviation Services
Cole, E.	Delta Helicopters

Appendix A (continued).

Collins, B.	Canadian Wildlife Service
Collins, D.	U.S. Fish and Wildlife Service
Comeau, S.	U.S. Fish and Wildlife Service
Cordts, S.	Minnesota Department of Natural Resources
Cornely, J.	The Trumpeter Swan Society
Crawford, J.	Private
Croak, C.	Private
Culp, C.	Oregon State Police
Cumming, B.	Private
Cumming, D.	Private
Cutting, K.	U.S. Fish and Wildlife Service
Devries, B.	U.S. Fish and Wildlife Service
Didkowsky, M.	Alberta Environment and Parks
Dixon, R.	Private
Donnelly, P.	U.S. Fish and Wildlife Service
Downing, K.	Alberta Environment and Parks
Dubovsky, J.	U.S. Fish and Wildlife Service
Dybas-Berger, B.	Michigan Department of Natural Resources
Earsom, S.	U.S. Fish and Wildlife Service
Eckler, J.	New York State Department of Environmental Conservation
Edwards, R.	Valhalla Helicopters
Fiegen, D.	Private
Fischer, J.	U.S. Fish and Wildlife Service
Fisher, M.	U.S. Fish and Wildlife Service
Flasko, A.	Alberta Environment and Parks
Forester, S.	Private
Garface, B.	Private
Gatti, R.	Wisconsin Department of Natural Resources
Geving, B.	Minnesota Department of Natural Resources
Gillette, L.	The Trumpeter Swan Society
Giudice, J.	Minnesota Department of Natural Resources
Gregg, I.	Pennsylvania Game Commission
Groves, D.	U.S. Fish and Wildlife Service
Hagey, S.	Ontario Ministry of Natural Resources and Forestry
Hague, K.	Ontario Parks
Hajdukovich, N.	U.S. Fish and Wildlife Service
Hale, G.	Alberta Environment and Parks
Handrigan, S.	Ontario Trumpeter Swan Restoration Team
Hansen, J.	Montana Fish, Wildlife and Parks
Havers, D.	Private

Appendix A (continued).

Hawrys, D.	Ascent Helicopters
Heckbert, M.	Alberta Environment and Parks
Heerkens, S.	New York State Department of Environmental Conservation
Heineman, J.	Minnesota Department of Natural Resources
Heise, J.	Michigan Department of Natural Resources
Henderson, C.	Minnesota Department of Natural Resources
Hensen, J.	Brantford Flying Club
Herwig, C.	Minnesota Department of Natural Resources
Hodges, J.	U.S. Fish and Wildlife Service (retired)
Hoffman, D.	Iowa Department of Natural Resources
Hogan, D.	Canadian Wildlife Service
Hogg, S.	Three Rivers Park District, Minnesota
Horvat, C.	Private
Howat, J.	Canadian Wildlife Service
Howes, W.	Private
Hughes, C.	Private
Hughes, J.	Canadian Wildlife Service
Ingram, J.	Canadian Wildlife Service
Intini, K.	Ontario Trumpeter Swan Restoration Team
Ironside, L.	Private
Jennings, S.	Oregon State Police
Johnson, D.	Private
Johnson, P.	U.S. Fish and Wildlife Service
Johnston, A.	Private
Jones, K.	Bird Studies Canada
Jones, O.	Iowa Department of Natural Resources
Kalejs, N.	Michigan Department of Natural Resources
Kearns, L.	Ohio Department of Natural Resources
Keating, J.	U.S. Fish and Wildlife Service
Kee, J.	Ontario Trumpeter Swan Restoration Team
Kelley, J.	U.S. Fish and Wildlife Service
Kennedy, K.	Private
King, J.	Michigan State Police
Kingdon, B.	Ontario Trumpeter Swan Restoration Team
Kingdon, R.	Ontario Trumpeter Swan Restoration Team
Kluge, P.	Private
Koneff, M.	U.S. Fish and Wildlife Service
Kramar, A.	Private
Lawrence, J.	Minnesota Department of Natural Resources
Lawrence, P.	Michigan State Police

Appendix A (continued).

Lemon, J.	Private
Lepage, D.	Bird Studies Canada
Lewis, D.	Private
Li, Z.	Canadian Wildlife Service
Linck, M.	Three Rivers Park District, Minnesota
Lockhart, J.	Alberta Environment and Parks
Loosen, A.	Waterton Biosphere Reserve Association
Lucas, C.	Michigan Department of Natural Resources
Lumsden, H.	Ontario Trumpeter Swan Restoration Team
Luukkonen, D.	Michigan Department of Natural Resources
Mallek, E.	U.S. Fish and Wildlife Service
Maples, T.	Michigan Department of Natural Resources
Marks, D.	U.S. Fish and Wildlife Service
Martin, L.	Private
Matteson, S.	Wisconsin Department of Natural Resources
Mayhew, S.	Michigan Department of Natural Resources
McCloud, M.	Discovery Fire Air Service
McConnell, C.	Private
McFadden, T.	Michigan Department of Natural Resources
McIntyre, C.	National Park Service
McNamara, J.	Ontario Ministry of Natural Resources and Forestry
Meaney, J.	Private
Meyer, S.	Canadian Wildlife Service
Millar, R.	Private
Mitchell, A.	Ontario Ministry of Natural Resources and Forestry
Mitchell, D.	Private
Moriarty, J.	Three Rivers Park District, Minnesota
Morlock, F.	New York State Department of Environmental Conservation
Moulton, C.	Idaho Department of Fish and Game
Neudecker, G.	U.S. Fish and Wildlife Service
New, D.	Private
Olson, D.	U.S. Fish and Wildlife Service
Padding, P.	U.S. Fish and Wildlife Service
Pakela, M.	Sky Aviation
Palferman, J.	Long Point Waterfowl
Park, J.	Private
Parrish, D.	Highland Helicopters
Patla, S.	Wyoming Game and Fish Department
Poon, F.	Canadian Wildlife Service
Popowich, T.	Discovery Fire Air Service

Appendix A (continued).

Poropat, E.	Private
Ramsey, _.	Private
Rave, D.	Minnesota Department of Natural Resources
Raven, G.	Canadian Wildlife Service
Read, B.	Private
Read, M.	Private
Read, V.	Private
Rees, J.	Wisconsin Department of Natural Resources
Reishus, B.	Oregon Department of Fish and Wildlife
Richkus, K.	U.S. Fish and Wildlife Service
Rhodes, W.	U.S. Fish and Wildlife Service
Richardson, S.	Private
Robinson, P.	Parks Canada
Robison, J.	Michigan Department of Natural Resources
Rockhill, A.	U.S. Fish and Wildlife Service
Rosenberg, D.	Alaska Department of Fish and Game
Ruby Lake NWR	U.S. Fish and Wildlife Service
Rule, M.	U.S. Fish and Wildlife Service
Russell, M.	Alberta Environment and Parks
Russell, R.	Canadian Wildlife Service
Sallows, T.	Parks Canada
Sanders, T.	U.S. Fish and Wildlife Service
Scharenbroich, C.	Minnesota Department of Natural Resources
Scianitti, T.	Delta Helicopters
Scotton, B.	U.S. Fish and Wildlife Service
Secord, E.	Bird Studies Canada
Sharp, C.	Canadian Wildlife Service
Shoal Lake Air	
Shults, B.	U.S. Fish and Wildlife Service
Small, S.	Cornwall Aviation
Smith, C.	The Trumpeter Swan Society
Smith, D.	National Park Service
Smith, L.	Discovery Fire Air Service
Smith, M.	The Trumpeter Swan Society
Smith, P.	Canadian Wildlife Service
Snyder, R.	Confederated Salish and Kootenai Tribes
Sova, B.	Michigan Department of Natural Resources
Sprenger, M.	U.S. Fish and Wildlife Service
St. Louis, M.	Oregon Department of Fish and Wildlife
Stempka, J.	Pennsylvania Game Commission

Appendix A (continued).

Stevens, J.	Private
Stevenson, K.	Private
Stewart, B.	Bird Studies Canada
Stiller, J.	New York State Department of Environmental Conservation
Swenson, A.	Alpine Aviation
Swift, B.	New York State Department of Environmental Conservation
Taylor, E.	U.S. Fish and Wildlife Service
Thomas, M.	Private
Thorpe, P.	U.S. Fish and Wildlife Service
Tozer, D.	Bird Studies Canada
Van Horn, K.	Wisconsin Department of Natural Resources
Vander Vennen, L.	Alberta Environment and Parks
Vanneste, S.	Canadian Wildlife Service
Vaughn, O.	Private
Vilneff, M.	Private
Warren-Pierorazio, H.	Private
Wasilco, M.	New York State Department of Environmental Conservation
Waskow, L.	Wisconsin Department of Natural Resources
Weeber, R.	Canadian Wildlife Service
Whittam, T.	Private
Williams, A.	U.S. Fish and Wildlife Service
Wilson, H.	U.S. Fish and Wildlife Service
Wood, D.	Private
Wood, M.	Private
Wright, B.	Minnesota Department of Natural Resources
Xamin, P.	Private
Young, C.	Canadian Wildlife Service
Young, R.	Private
Zeller, T.	U.S. Fish and Wildlife Service

Appendix B. 2015 North American Trumpeter Swan Survey results by region. Standard errors are in parentheses for estimates obtained from a statistical sample.^a

Population	Flock	Region	State or Province	2015 Start	2015 End	Method ^b	Coverage ^c	White Swans ^d	Cygnets	Total Swans	Percent Cygnets
Pacific Coast	AK	AK	AK	3-Aug-15	1-Sep-15	1	4	22,015 (1,113)	6,793 (487)	28,808 (1,431)	23.6
Pacific Coast	Yukon-nw BC	w YT/nw BC	YT/BC	28-Jul-15	18-Aug-15	1	4	2,225 (436)	760 (147)	2,985 (510)	25.5
Pacific Coast Total								24,240 (1,195)	7,553 (509)	31,793 (1,519)	23.8
Rocky Mountain	Canada	e YT/e BC/AB/NT	YT/BC/ AB/NT	28-Jul-15	1-Sep-15	1	2	10,957 (227)	5,186 (114)	16,143 (269)	32.1
Rocky Mountain	Tri-state Area	MT	MT	18-Sep-15	22-Sep-15	1	1	212	60	272	22.1
Rocky Mountain	Tri-state Area	WY	WY	18-Sep-15	22-Sep-15	1	1	232	68	300	22.7
Rocky Mountain	Tri-state Area	ID	ID	15-Sep-15	19-Sep-15	1	1	104	47	151	31.1
Rocky Mountain	Other U.S.	Turnbull NWR	WA	Sept	Sept	2	1	8	4	12	33.3
Rocky Mountain	Other U.S.	Ruby Lake	NV	Sept	Sept	2	1	2	0	2	0.0
Rocky Mountain	Other U.S.	Malheur	OR	9-Sep-15	10-Sep-15	1	1	4	1	5	20.0
Rocky Mountain	Other U.S.	Summer Lake	OR	9-Sep-15	10-Sep-15	1	1	20	2	22	9.1
Rocky Mountain	Other U.S.	OR - other	OR	Not surveyed	--	--	--	--	--	--	--
Rocky Mountain	Other U.S.	Flathead Valley	MT	Sept	Sept	1	1	144	72	216	33.3
Rocky Mountain	Other U.S.	Blackfoot Valley	MT	Sept	Sept	2	1	36	3	39	7.7
Rocky Mountain	Other U.S.	Modoc NWR	CA	3-Sep-15	3-Sep-15	1	1	2	0	2	0.0
Rocky Mountain Total								11,721	5,443	17,164	31.7

^a "--" denotes missing information.

^b Survey method (1= aerial, 2=ground, 3=other, 5=combination of methods).

^c Extent of survey coverage (1=direct count within entire range, 2=sample of entire range, 3=direct count within of part of range, 4=sample of part of range).

^d Adults and subadults.

Appendix B (continued).^a

Population	Flock	Region	State or Province	2015 Start	2015 End	Method ^b	Coverage ^c	White Swans ^d	Cygnets	Total Swans	Percent Cygnets
Interior	High Plains	SD	SD	1-Sep-15	1-Sep-15	1	3	54	14	68	20.6
Interior	High Plains	NE	NE	31-Aug-15	2-Sep-15	1	3	311	104	415	25.1
Interior	High Plains	WY	WY	2-Sep-15	2-Sep-15	1	1	0	0	0	--
Interior	High Plains	Riding Mt. Natl. Pk.	MB	20-Aug-15	23-Aug-15	1	1	97	54	151	35.8
Interior	High Plains	SK	SK	Not surveyed	--	--	--	--	--	--	--
Interior	High Plains	Wood Lake NWR	ND	18-Sep-15	18-Sep-15	2	3	2	6	8	75.0
Interior	MS&AT Flyways	ON	ON	12-Jan-15	5-Sep-15	5	3	1,471	529	2,000	26.5
Interior	MS&AT Flyways	MN	MN	3-May-15	15-Jun-15	1	2	17,021 (2,589)	--	--	--
Interior	MS&AT Flyways	WI	WI	27-Apr-15	19-May-15	1	2	4,695 (1,001)	--	--	--
Interior	MS&AT Flyways	MI	MI	24-Apr-15	13-May-15	1	4	3,021 (879)	--	--	--
Interior	MS&AT Flyways	IA	IA	1-Jul-15	1-Oct-15	2	3	204	136	340	40.0
Interior	MS&AT Flyways	OH	OH	6-Jul-15	7-Jul-15	5	3	154	142	296	48.0
Interior	MS&AT Flyways	NY	NY	1-Aug-15	30-Sep-15	5	3	22	2	24	8.3
Interior	MS&AT Flyways	PA	PA	1-Jun-15	30-Sep-15	3	3	3	0	3	0.0
Interior Total								27,055	--- Insufficient Data		---

^a "---" denotes missing information.

^b Survey method (1= aerial, 2=ground, 3=other, 5=combination of methods).

^c Extent of survey coverage (1=direct count within entire range, 2=sample of entire range, 3=direct count within of part of range, 4=sample of part of range).

^d Adults and subadults.

Appendix B (continued).

Population	Flock	Region	State or Province	Pairs	Pairs	Total Pairs	Singles	Singles	Total Singles	Flocked	Flocks	Broods	Mean Brood Size	n for Brood Size ^e
				with Cygnets	without Cygnets		with Cygnets	without Cygnets						
Pacific Coast	AK	AK	AK	2,199 (147)	5,704 (296)	7,903 (376)	75 (16)	1,912 (132)	1,987 (132)	4,222 (535)	644 (65)	2,277 (150)	2.98	701
Pacific Coast	Yukon-nw BC	w YT/nw BC	YT/BC	218 (41)	470 (155)	688 --	5 0	115 (34)	120 --	729 (160)	191 (46)	223 (45)	3.41	52
Pacific Coast Total				2,417 (153)	6,174 (334)	8,591 --	80 (16)	2,027 (136)	2,107 --	4,951 (558)	835 (80)	2,500 (157)	3.02	753
Rocky Mountain	Canada	e YT/e BC/AB/NT	YT/BC/ AB/NT	1,455 (144)	2,311 (236)	3,766 --	31 (12)	667 (108)	698 --	2,726 (422)	387 (73)	1,483 (155)	3.50	382
Rocky Mountain	Tri-state Area	MT	MT	--	--	--	--	--	--	--	--	--	--	--
Rocky Mountain	Tri-state Area	WY	WY	--	--	65	--	--	7	95	8	--	--	--
Rocky Mountain	Tri-state Area	ID	ID	--	--	26	--	--	10	42	5	--	--	--
Rocky Mountain	Other U.S.	Turnbull NWR	WA	1	0	1	0	0	0	6	1	1	4.00	1
Rocky Mountain	Other U.S.	Ruby Lake	NV	0	1	1	0	0	0	0	0	0	--	--
Rocky Mountain	Other U.S.	Malheur	OR	--	--	--	--	--	--	--	--	1	1.00	1
Rocky Mountain	Other U.S.	Summer Lake	OR	--	--	--	--	--	--	--	--	--	--	--
Rocky Mountain	Other U.S.	OR - other	OR	--	--	--	--	--	--	--	--	--	--	--
Rocky Mountain	Other U.S.	Flathead Valley	MT	--	--	--	--	--	--	--	--	--	--	--
Rocky Mountain	Other U.S.	Blackfoot Valley	MT	--	--	--	--	--	--	--	--	--	--	--
Rocky Mountain	Other U.S.	Modoc NWR	CA	0	1	1	0	0	0	0	0	0	--	--
Rocky Mountain Total				----- Insufficient Data -----										

^e Number of broods of known size observed.

Appendix B (continued).

Population	Flock	Region	State or Province	Pairs	Pairs	Total Pairs	Singles	Singles	Total Singles	Flocked	Flocks	Broods	Mean Brood Size	n for
				with Cygnets	without Cygnets		with Cygnets	without Cygnets						Brood Size ^e
Interior	High Plains	SD	SD	6	10	16	0	2	2	20	5	6	2.33	6
Interior	High Plains	NE	NE	42	74	116	2	20	22	57	10	44	2.36	44
Interior	High Plains	WY	WY	0	0	0	0	0	0	0	0	0	--	--
Interior	High Plains	Riding Mt. Natl. Pk.	MB	--	--	--	--	--	--	--	--	17	3.18	17
Interior	High Plains	SK	SK	--	--	--	--	--	--	--	--	--	--	--
Interior	High Plains	Wood Lake NWR	ND	1	0	1	0	0	0	0	0	1	6.00	1
Interior	MS&AT Flyways	ON	ON	--	--	--	--	--	--	--	--	--	--	--
Interior	MS&AT Flyways	MN	MN	--	--	--	--	--	--	--	--	--	--	--
Interior	MS&AT Flyways	WI	WI	--	--	--	--	--	--	--	--	--	--	--
Interior	MS&AT Flyways	MI	MI	--	--	--	--	--	--	--	--	--	--	--
Interior	MS&AT Flyways	IA	IA	46	26	72	1	7	8	52	9	46	2.96	46
Interior	MS&AT Flyways	OH	OH	39	24	63	3	3	6	22	4	42	3.38	42
Interior	MS&AT Flyways	NY	NY	1	7	8	0	1	1	5	1	1	2.00	1
Interior	MS&AT Flyways	PA	PA	0	0	0	0	3	3	0	0	0	--	--
Interior Total				----- Insufficient Data -----										

^e Number of broods of known size observed.