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Black Duck Joint Venture Helicopter Survey in Québec

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2001 Black Duck Joint Venture Helicopter Survey – Québec

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To find out more about the American Black Duck and many other waterfowl species, and to follow up the Black Duck Joint Venture activities in Québec, visit our Web site at the following address:

http://www.qc.ec.gc.ca/faune/sauvagine/html/waterfowl.html

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1.0 Introduction

The main objective of the Black Duck Joint Venture (BDJV) survey is to provide statistically reliable indices of breeding population trends and relative densities of American Black Duck (hereafter, Black Duck) and other waterfowl species throughout the primary breeding range of the Black Duck. The BDJV study area in Canada includes the provinces of New Brunswick, Nova Scotia, Newfoundland (including part of Labrador), Québec (southern part) and Ontario (east-central). This huge territory was divided in 4 strata to reflect the distribution of 3 different Black Duck populations according to banding reference units, and ecozones. Stratum 1 is in the Atlantic Maritime ecozone. The 3 other strata are in the Boreal Shield ecozone which was divided approximately according to the banding reference limits in Canada. The 70°30' west meridian of longitude divides Stratum 2 (Eastern Boreal Shield) from Stratum 3 (Central Boreal Shield). 76°30' W divides Stratum 3 and the Stratum 4 (Western Boreal Shield). Strata 1 and 2 are part of the same banding reference unit. Each spring, the study area is surveyed twice, (a) by the Canadian Wildlife Service (CWS) using helicopter and (b) by the U.S. Fish and Wildlife Service (USFWS) using aircraft (usually referred as the fixed-wing survey). This report deals with the BDJV helicopter survey in Québec.

2.0 Methods

The BDJV helicopter survey covers approximately 503 800 km^2 of the Black Duck's main breeding grounds in Québec. The study area includes most of the Boreal Shield Ecozone (Bird Conservation Region [BCR] 8, Boreal Softwood Shield, and BCR 12, Boreal Hardwood Transition) and the northern part of the Atlantic Maritime Ecozone (BCR 14, Atlantic Northern Forest; Figure 1). Québec's coverage of the eastern Canada survey includes parts of Strata 1, 2 and 4, and all of Stratum 3. The survey began in 1990 with 83–10×10 km (100 km^2) plots systematically distributed within the study area. Beginning in 1996, plot size was reduced to 5×5 km (25 km^2) and a rotational plot design was implemented whereby each of the 156 plots are surveyed twice over a 4-year period. The transition to this new system was made possible without loosing long-trend analysis capability by keeping most of the southwest 5×5 km quadrants from the original set of 100 km^2 plots. In the rotational design, a letter (A, B, C or D) was randomly assigned to the plots of each stratum. Half of the plots (78) are surveyed each year beginning with Plots A and B in the first year, B and C in the second year, etc. The 78 plots surveyed in 2001 were exactly the same as those surveyed in 1997 (Plots B and C).

The same survey method was used throughout the 1990–2001 period. Surveys were flown in a Bell 206L (Long Ranger) helicopter equipped with skids and bubble windows to enhance observer visibility. All waterbodies and wetlands within the plots were surveyed. Depending of the habitat and topography, surveys were flown at 15–50 m above ground level and at 60–100 km/h. The survey crew consisted of 2 observers in Stratum 1, and 3 observers in Strata 2, 3 and 4. All waterfowl observations (see Appendix 1 for scientific names of species) as well as some other aquatic birds,

mammals and reptiles were directly recorded by the front seat observer on 1:50 000 topographic maps of the plots and later entered into a computer database. Basic data recorded for each individual or group of birds observed (i.e. one record per observation) were: 1) plot identification; 2) date; 3) location of the birds (UTM); 4) species code; 5) number of males; 6) number of females; 7) number of birds of unknown sex. Indicated pairs in this report were calculated using the standardized method developed for the BDJV helicopter survey in Eastern Canada (Appendix 2).

The survey is carried out during the nest-initiation and the beginning of incubation period of the early nesting ducks. To determine the timing of the survey relative to nest initiation, we calculated a phenology index (PI) which is the ratio of the number of paired males (1 male + 1 female) to that of unattended males (lone and flocked drakes). A PI of 1.0 is considered optimal for the Black Duck and other species with sex ratios closed to 1.0 and should be indicative of a survey made when half the pairs involved in nest initiation and the other half had started incubation. A PI value much greater than 1.0 should indicate a survey early in the breeding season where migrants are still in the area and breeding pairs may not be on their nesting territories, which could result in an overestimation of the breeding population. On the opposite side, a very small PI should indicate a late survey relative to the nesting phenology where some pairs may be missed because drakes are abandoning the nesting hens (for most species, incubating females cannot be counted from the helicopter). The latter situation leads to underestimation of the indicated pair numbers.

3.0 Spring Conditions

Early spring was cold and dry. The weather then warmed up in May but precipitation remained very low. Snow melt which started slowly sped up in May resulting in only one plot having some lakes (50% of the lakes) completely frozen during the survey. Overall, the nesting conditions appeared fair in the boreal forest but low water level of lakes and rivers might have had some negative impacts on waterfowl reproduction in some areas.

4.0 Results

Every plot was surveyed by experienced observers. Daniel Bordage, Christine LePage and Shirley Orichefsky covered all plots in Strata 2, 3 and 4. The 4 plots of Stratum 1 were covered by Myrtle Bateman and Randy Hicks. The survey was undertaken between 6 May and 30 May 2001 (1990–2001 average = 7–29 May; Table 1). Mean, minimal, and maximal temperatures were all above the long term 1990-2000 average values (respectively 9°C, -2°C and 23°C; Table 1). Times on plots were similar to those recorded in previous years (1990–1999 average = 32 min). The Lake Saint-Jean ice thaw which gives us an idea of spring conditions in central Québec (Stratum 3) was two days later this year than in 2000 and one day earlier than the long term average (1990–1999 average = 10 May; Table 1).

Numbers of indicated pairs are shown in Table 2 for all loons, geese and ducks species breeding in the study area and that were consistently observed during the survey. With a total of 327 729 indicated pairs, 2001 had the third highest count on record since the

beginning of the survey in 1990 (Table 2). This total population is 29% below the record high of 463 777 indicated pairs observed in 2000 (Table 3). However, the 2001 estimation remains 18% above the long term 1990-1999 mean of 276 662 indicated pairs. This year decline compared to last year was observed both for the total IP numbers of dabblers (*Cairinini* and *Anatini*; -33%) than for the divers (*Aythyini* and *Mergini*; -25%). All species declined in 2001 compared to 2000 (Table 3) with the exception of Wood Duck (record high level), Surf Scoter (record high level), Barrow's Goldeneye (record high level), and Common Merganser (third highest number of indicated pairs). Nevertheless, most indicated pair numbers in 2001 remained above the long term 1990-1999 average. Seven species had 2001 numbers below the long term 1990-1999 mean (Table 3): Northern Pintail, American Wigeon, Greater Scaup, Lesser Scaup, Black Scoter, Bufflehead, and Red-breasted Merganser. However, any of these uncommon breeders in the study area were observed in 2001 (indicated pairs), but the American Wigeon (1 male and 1 pair).

Each year we estimate the size of clutches in Canada Goose nests observed from the helicopter. Twenty two nests were observed in 2001 (Table 4). The number of nests recorded per 100 km^2 in 2001 was the highest since 1990 but the average clutch size (4.56 eggs) was just slightly above the 1990–1999 long term average (4.40 eggs).

The phenology index was 0.50 for Black Duck in 2001 (1990–1999 mean = 1.77; Table 5). This record low value indicates a survey timing a little late probably resulting in a situation where most females were in early or mid-incubation. As in the case of the Black Duck, most species had lower phenology indices in 2001 compared to 2000.

The 1990–2001 trends of the various species surveyed are shown in Figures 2 to 27. Overall total number of ducks showed an increase in 1999 and 2000 then a decline in 2001 to get back to a population level close to the numbers recorded in the relatively stable 1990-1998 period (Figure 2). The 2001 decline was observed both for dabblers and divers.

The number of Common Loon indicated pairs seems to have leveled since 1995 to a breeding population twice that observed in 1990–1992 (Figure 3). Recall that the low estimation of 1996 resulted from late ice thaw that year for many large lakes used by loons. Following a steady decline from 1990 to 1995, the Canada Goose breeding population, at their southernmost part of distribution range, had increased considerably since the hunting season was closed in 1995 (Figure 4). However, a decline was observed in 2001 for the first time since 1997. Overall, both the Atlantic Population (AP; Strata 3 and 4) and the North Atlantic Population (NAP; Stratum 2) showed a similar rising trend since 1995 but the NAP did not seem to have declined between 1990 and 1995 as the AP did (Figure 5). Both populations declined in 2001. The number of nests recorded (stated as number counted per 100 km^2 to account for differential yearly sampling effort) showed similar patterns than the indicated pair trends but unlike the latter, the nest density kept rising to a record high in 2001 (Figure 6). On the other hand, the clutch size estimated from the air did not vary much around the 1990-1999 long term average of 4.40 eggs/nest (Figure 7). The Black Duck breeding population in

the study area declined in 2001 with an indicated pair estimate close to those recorded at the beginning of the survey in 1990 (Figure 10). However, the 12-year trend is still showing an overall increasing Black Duck breeding population. Mallard IP numbers rose quite consistently since 1990 despite a decline in 2001 (Figure 11). The second most abundant waterfowl species in the study area, the Ring-necked Duck, also dropped down in 2001 to a breeding population estimate comparable to the 1990-1998 stable numbers (Figure 15). The Common Goldeneye (Figure 22) and the Hooded Merganser (Figure 25) showed a similar trend pattern. The Lesser Scaup (Figure 17) and the Bufflehead (Figure 24) have experienced the most dramatic declines in the past 12 years resulting in no indicated pairs observed in 2001. However, these two species are uncommon breeders in the study area and the precision of the annual estimates is poor (large SE).

5.0 Discussion

The BDJV helicopter survey allows us to evaluate breeding population trends and relative abundance of 20 species of loons and waterfowl in southern Québec. A look at the trends figures reveals acceptable year-to-year variations as well as fairly smooth tracks of yearly population changes for most species. The precision of annual indicated pairs estimates (see SE) is good for many surveyed species. Annual coefficients of variation were usually below 10% for Black Duck and below 20% for many other abundant species.

The Black Duck indicated pairs decline observed this year was expected. Even if a record high indicated pair number was observed last year (as for most species), the 2000 summer was cool and rainy resulting in poor reproductive success for many species. As an example, the Black Duck age ratio from Québec's banding data was 1.14 (youngs/adults) in 2000, the lowest ratio since the beginning of the BDJV survey in 1990. On the other hand, the decline observed in Canada Goose indicated pair numbers in their southern part of distribution range in Québec was more unexpected. Record high numbers of Canada Geese were observed in 2001 in northern Québec.

Over the years, the BDJV helicopter survey proved to be a valuable and effective tool for evaluating population trends and relative abundance of Common Loon and waterfowl species breeding in southern Québec. 2001 was the twelfth consecutive year of the BDJV survey program in Canada.

Table 1. Sample plot size, sampling effort, habitat and weather conditions recorded during the Black Duck Joint Venture Helicopter Survey in Québec 1990–2001.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Plot size (km)	10×10	10×10	10×10	10×10	10×10	10×10	5×5	5×5	5×5	5×5	5×5	5×5
Surveyed area (km^2)	8200	8200	8200	4300	4300	3500	1950	1950	1950	1950	1950	1950
Sampling effort (%)	1.6	1.6	1.6	0.9	0.9	0.7	0.4	0.4	0.4	0.4	0.4	0.4
Beginning of survey	2 May	4 May	8 May	10 May	10 May	11 May	6 May	12 May	5 May	6 May	4 May	6 May
End of survey	24 May	23 May	27 May	28 May	4 June	1 June	24 May	6 June	29 May	31 May	2 June	30 May
Saint-Jean Lake ice thaw	9 May	7 May	15 May	10 May	20 May	14 May	12 May	7 May	3 May	8 May	7 May	9 May
Mean temperature (°C) (min–max)	8 (-4–21)	8 (-4–22)	11 (-4–29)	9 (0–30)	10 (-3–24	8 (1–18)	5 (-8–14)	8 (1–18)	13 (2–22)	13 (-2–25)	9 (-5–25)	13 (0–25)
Mean time on plot (min.) (min–max)	87 (42–192)	83 (20–147)	81 (33–134)	87 (32–145)	97 (40–161)	92 (44–168)	24 (13–44)	34 (17–59)	31 (14–51)	36 (20–58)	36 (19–64)	32 (15–55)

Table 2. Breeding population estimates from the Black Duck Joint Venture Helicopter Survey in Québec 1990–2001.

Species	Population estimate (total indicated pairs / 503 800 km^2)											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
LOONS												
Common Loon	11 673	10 568	8 970	14 997	18 980	23 463	10 851	25 319	18 860	24 286	21 185	19 894
GEESE												
Canada Goose	18 800	17 817	17 572	14 294	14 763	12 091	22 477	17 052	22 477	35 137	37 462	33 587
DABBLERS												
Wood Duck	3 133	1 167	676	1 054	3 632	5 038	2 325	2 325	1 292	4 134	5 684	6 201
Green-winged Teal	17 449	18 309	11 243	7 030	16 051	7 053	23 252	14 468	11 109	18 860	41 854	17 568
American Black Duck	111 389	93 479	83 803	63 209	64 732	65 422	106 056	94 947	107 736	155 145	158 116	121 300
Mallard	8 663	5 775	6 697	6 913	11 365	9 932	18 860	9 818	8 267	19 635	25 578	14 210
Northern Pintail	430	123	369	117	0	0	2 067	258	0	0	258	0
Blue-winged Teal	553	430	676	586	1 172	288	517	1 033	517	775	1 550	1 033
American Wigeon	676	492	246	469	1 289	576	1 033	1 550	0	775	7 173	517
Subtotal	142 293	119 775	103 710	79 378	98 241	88 309	154 110	124 399	128 921	199 324	240 213	160 829
DIVERS												
Ring-necked Duck	54 312	50 933	45 219	44 756	55 301	55 562	40 821	55 289	39 012	67 690	83 967	52 705
Greater Scaup	246	860	1 290	1 757	703	288	1 033	258	0	0	4 909	0
Lesser Scaup	1 782	5 837	1 966	586	2 812	0	517	517	0	0	258	0
undentified scaup	553	123	307	0	2 226	1 295	258	0	0	0	4 134	0
Black Scoter	430	1 966	1 229	1 172	0	720	517	258	258	775	775	0
Surf Scoter	1 966	2 949	2 335	3 398	2 578	1 727	1 809	3 875	8 009	5 942	5 684	9 301
Common Goldeneye	42 884	44 482	37 109	40 421	46 748	35 698	39 271	42 371	32 295	49 605	57 614	45 213
Barrow's Goldeneye	922	2 396	1 536	1 406	117	864	1 033	1 292	2 842	517	258	2 842
Bufflehead	4 546	4 731	3 318	351	2 226	576	3 617	2 067	0	517	1 292	0
Hooded merganser	11 981	11 305	7 127	9 842	14 411	15 258	12 660	12 660	12 918	26 611	23 252	15 243
Common Merganser	42 209	47 984	41 410	28 002	35 852	32 531	26 094	40 046	33 845	34 620	41 079	41 596
Red-breasted Merganser	799	1 352	676	2 109	2 929	1 152	0	0	0	0	342	0
Subtotal	162 630	174 918	143 522	133 800	165 903	145 671	127 630	158 633	129 179	186 277	223 564	166 900
Total ducks	304 923	294 693	247 232	213 178	264 144	233 980	281 740	283 032	258 100	385 601	463 777	327 729

Table 3. Change (%) between the number of indicated pairs observed in 2001 compared to 2000 and 1990-1999 mean; species in decreasing 1990–2001 mean IP population estimates from the Black Duck Joint Venture Helicopter Survey in Québec 1990–2001.

		Mean IP Density / 100 km^2		Mean IP Population (503 800 km²)		% Change in 2001 compared to	
#	Species	1990–1999	1990–2001	1990–1999	1990–2001	2000	1990–1999 mean
1	American Black Duck	18.8	20.3	94 592	102 111	-23	+28
2	Ring-necked Duck	10.1	10.7	50 889	53 797	-37	+3.6
3	Common Goldeneye	8.2	8.5	41 088	42 809	-21	+10
4	Common Merganser	7.2	7.4	36 259	37 106	+1.3	+15
5	Canada Goose	3.8	4.4	19 248	21 961	-10	+74
6	Common Loon	3.3	3.5	16 797	17 421	-6.1	+18
7	Green-winged Teal	2.9	3.4	14 483	17 021	-58	+21
8	Hooded Merganser	2.7	2.9	13 477	14 439	-34	+13
9	Mallard	2.1	2.4	10 593	12 143	-44	+44
10	Surf Scoter	0.69	0.82	3 459	4 131	+64	+169
11	Wood Duck	0.49	0.61	2 478	3 055	+9.1	+150
12	Bufflehead	0.44	0.38	2 195	1 937	-100	-100
13	Barrow's Goldeneye	0.26	0.27	1 292	1 335	+1000	+120
14	American Wigeon	0.14	0.24	710	1 233	-93	-27
15	Lesser Scaup	0.28	0.24	1 402	1 190	-100	-100
16	Greater Scaup	0.13	0.19	644	945	-100	-100
17	Red-breasted Merganser	0.18	0.15	902	780	-100	-100
18	Blue-winged Teal	0.13	0.15	655	761	-33	+58
	undentified scaup	0.09	0.15	476	741	-100	-100
19	Black Scoter	0.15	0.13	732	675	-100	-100
20	Northern Pintail	0.07	0.06	336	302	-100	-100
	Dabblers	24.6	27.1	123 846	136 480	-33	+30
	Divers	30.3	31.7	152 816	159 878	-25	+9.2
	Total ducks	54.9	58.8	276 662	296 358	-29	+18

Table 4. Number of Canada Goose nests and clutch size estimates from the Black Duck Joint Venture Helicopter Survey in Québec 1990–2001.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Number of nests	27	39	37	19	12	9	9	5	8	15	18	22
Number of nests / 100 km²	0.33	0.48	0.45	0.44	0.28	0.26	0.46	0.26	0.41	0.77	0.92	1.13
Number of nests with recorded clutch size	19	37	26	12	11	7	6	4	5	14	18	18
Mean clutch size (SE)	4.32 (0.31)	4.62 (0.20)	4.23 (0.26)	4.17 (0.49)	4.73 (0.33)	4.00 (0.44)	5.67 (0.21)	4.25 (0.75)	4.60 (0.51)	3.79 (0.41)	4.61 (0.29)	4.56 (0.18)

Table 5. Phenology indices (PI) of duck species observed during the Black Duck Joint Venture Helicopter Survey in Québec 1990–2001.

Species	Phenology Index											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
DABBLERS												
Wood Duck	0.88	3.25	2.67	0.50	0.35	1.92	3.50	0.60	0.25	0.60	1.57	0.92
Green-winged Teal	6.03	10.2	3.94	0.96	1.63	0.88	6.09	0.57	0.62	1.28	5.09	0.50
American Black Duck	2.44	1.81	2.08	0.78	1.15	1.13	5.22	1.16	0.88	1.03	1.77	0.50
Mallard	1.06	0.49	0.56	0.10	0.35	0.23	0.35	0.27	0.20	0.28	0.62	0.19
Northern Pintail	-[1]	-[1]	1.00	0[2]	-[1]	-[1]	0.20	-[1]	-[1]	-[1]	-[1]	-[1]
Blue-winged Teal	2.00	6.00	2.67	1.50	4.00	-[1]	-[1]	0[2]	-[1]	-[1]	2.00	3.00
American Wigeon	3.50	3.00	0.33	0[2]	1.25	3.00	-[1]	0.50	-[1]	-[1]	-[1]	1.00
DIVERS												
Ring-necked Duck	3.42	3.27	2.53	1.85	1.18	1.21	1.33	1.68	1.67	3.14	2.64	3.16
Greater Scaup	1.00	2.50	1.00	1.17	0[2]	0[2]	-[1]	0[2]	-[1]	-[1]	1.67	-[1]
Lesser Scaup	0.90	4.26	1.63	-[1]	0.75	-[1]	-[1]	0[2]	-[1]	-[1]	0[2]	-[1]
undentified scaup	-[1]	1.00	4.00	-[1]	1.00	-[1]	-[1]	-[1]	-[1]	-[1]	2.67	-[1]
Black Scoter	-[1]	30.0	0.33	2.00	-[1]	-[1]	1.00	-[1]	-[1]	-[1]	0[2]	-[1]
Surf Scoter	1.30	5.33	2.11	1.43	0.79	-[1]	-[1]	-[1]	5.00	3.60	8.00	-[1]
Common Goldeneye	1.77	1.73	1.65	0.87	0.92	1.31	1.35	0.68	0.97	1.54	1.67	1.17
Barrow's Goldeneye	2.67	3.50	1.00	1.00	-[1]	1.00	3.00	0.67	0.33	-[1]	-[1]	1.75
Bufflehead	7.57	4.69	3.78	-[1]	2.25	3.00	0.60	5.00	-[1]	-[1]	1.50	-[1]
Hooded merganser	1.09	1.81	1.29	1.76	0.93	1.29	1.47	2.36	1.00	1.39	1.57	1.45
Common Merganser	1.38	1.68	1.23	1.20	1.20	0.82	1.14	1.22	0.81	1.08	1.60	1.23
Red-breasted Merganser	0.80	2.00	-[1]	6.00	0.85	1.00	-[1]	-[1]	-[1]	-[1]	-[1]	-[1]

[1] no unattended male observed.
[2] at least one unattended male observed but no paired male observed.

Figure 1. Study area of the Black Duck Joint Venture helicopter survey in Québec 1990–2001.

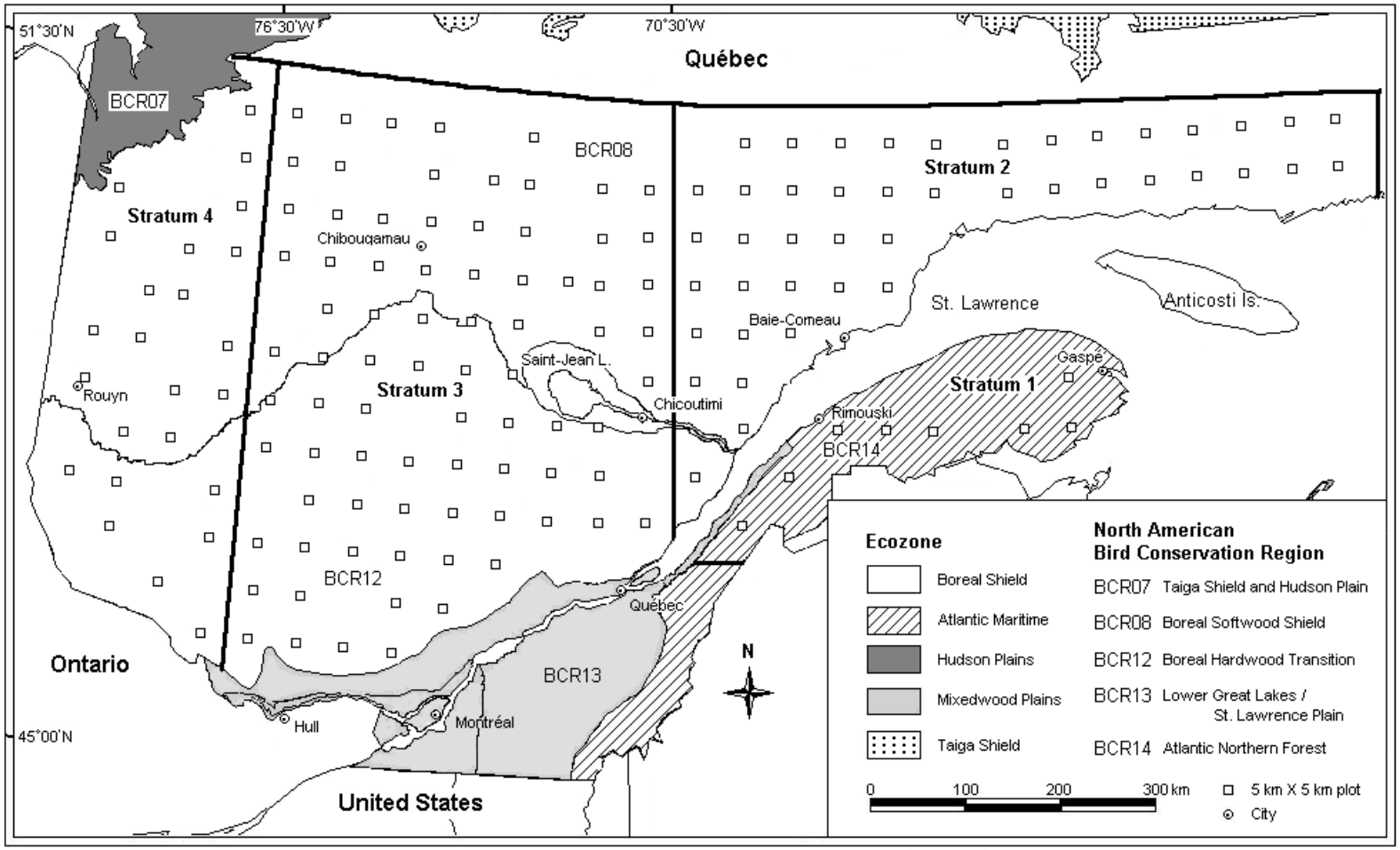


Figure 2. Trend in the breeding waterfowl population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

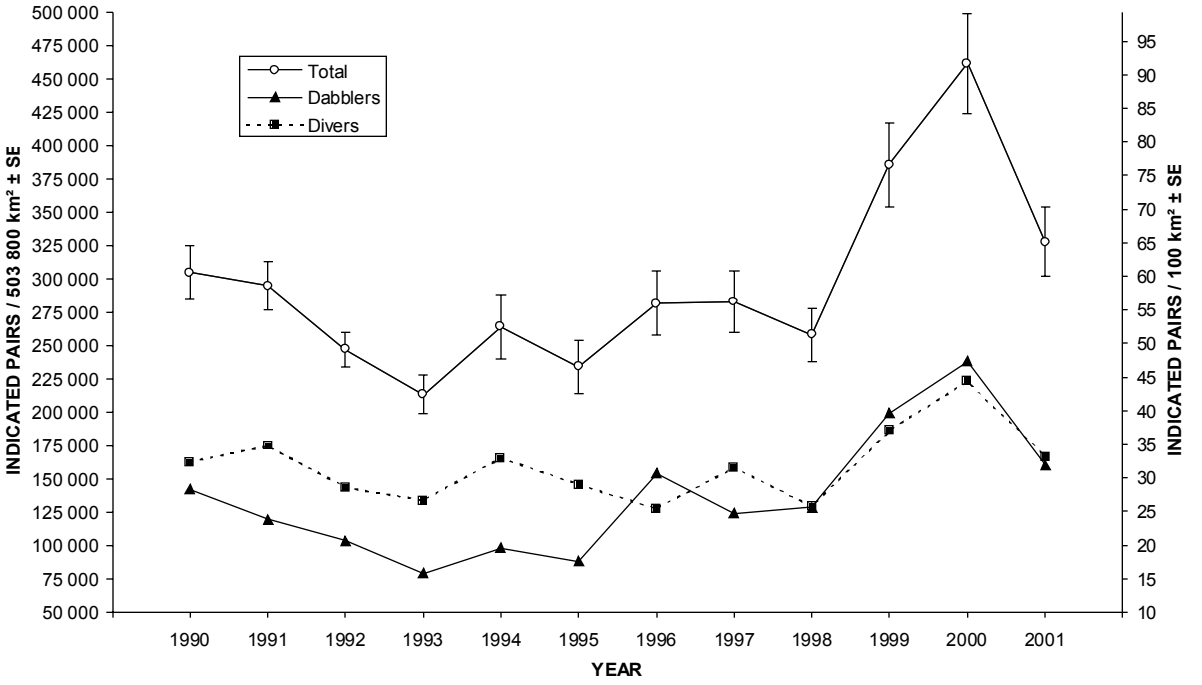


Figure 3. Trend in the Common Loon breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

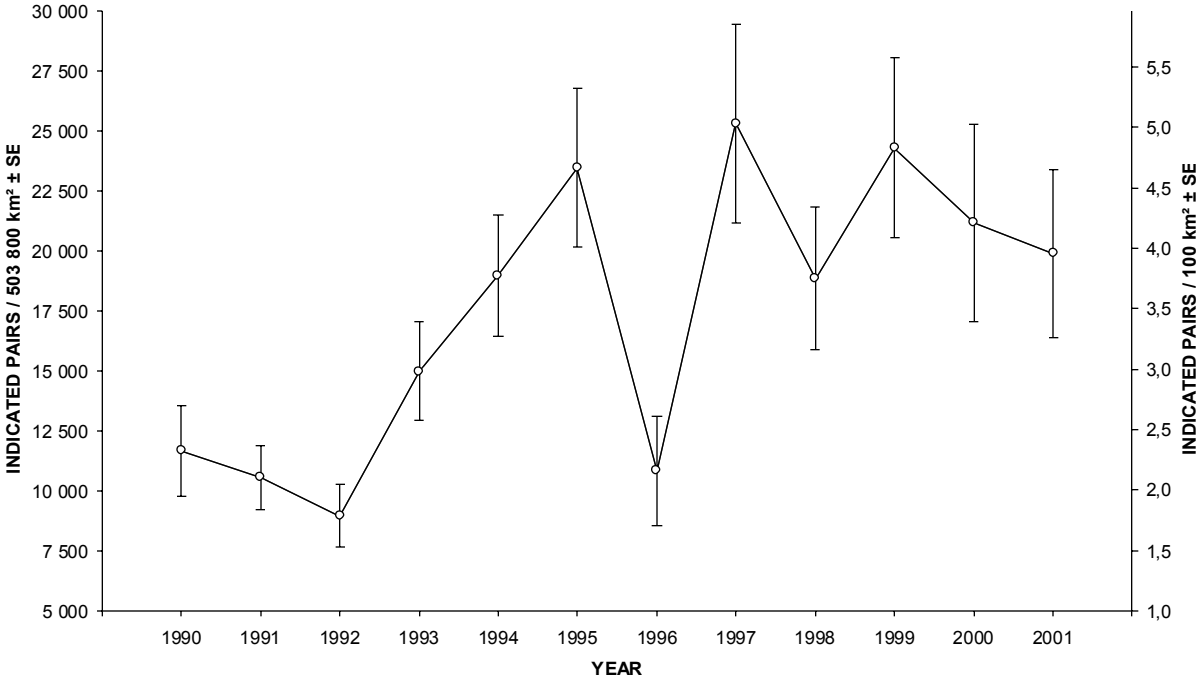


Figure 4. Trend in the Canada Goose breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

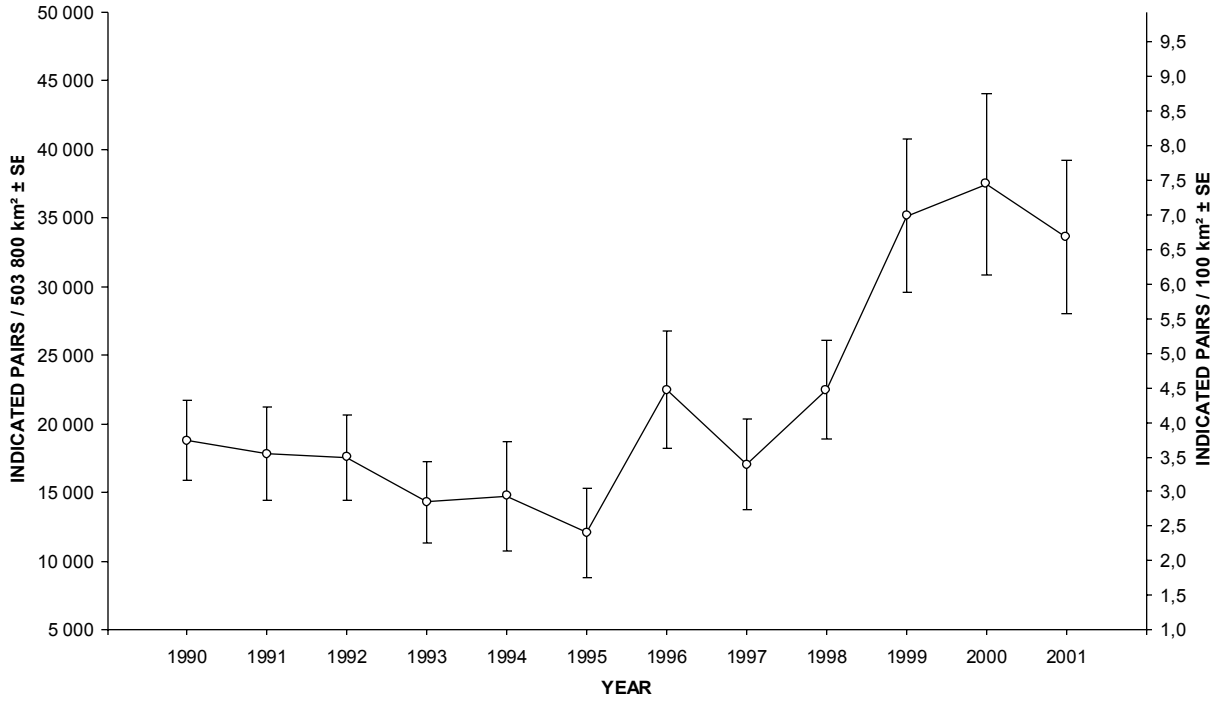


Figure 5. Trend in the Atlantic and North Atlantic Canada Goose populations in southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

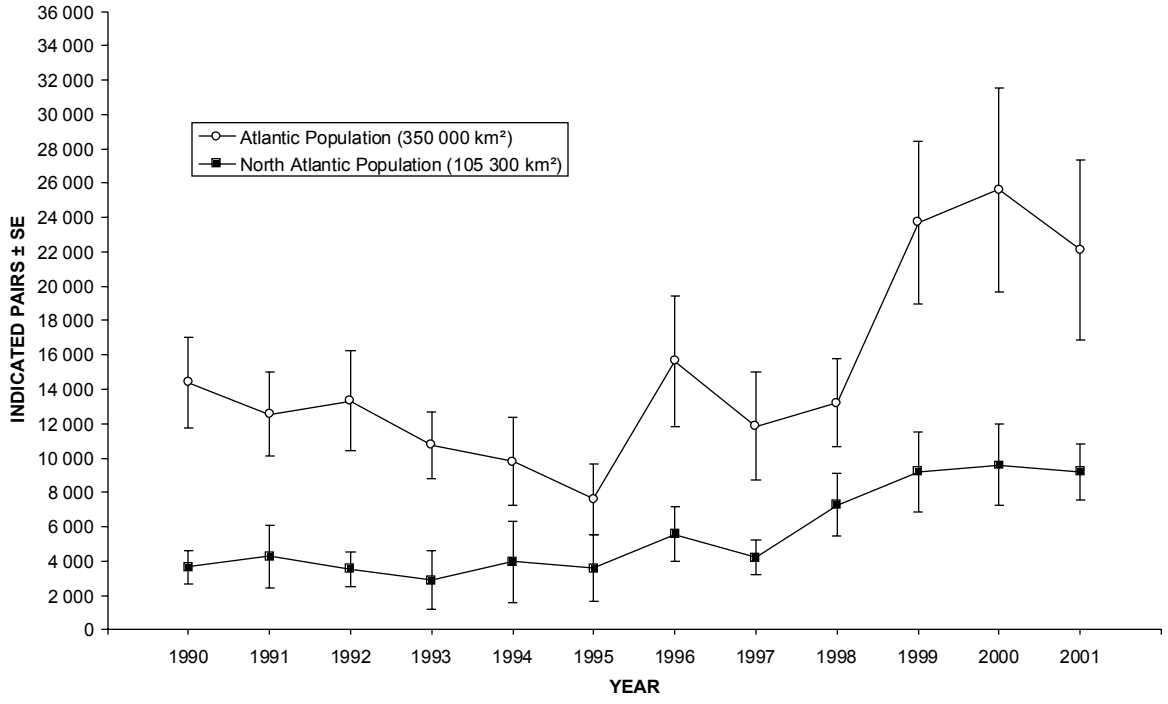


Figure 6. Trend in the number of nests of Canada Goose in southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

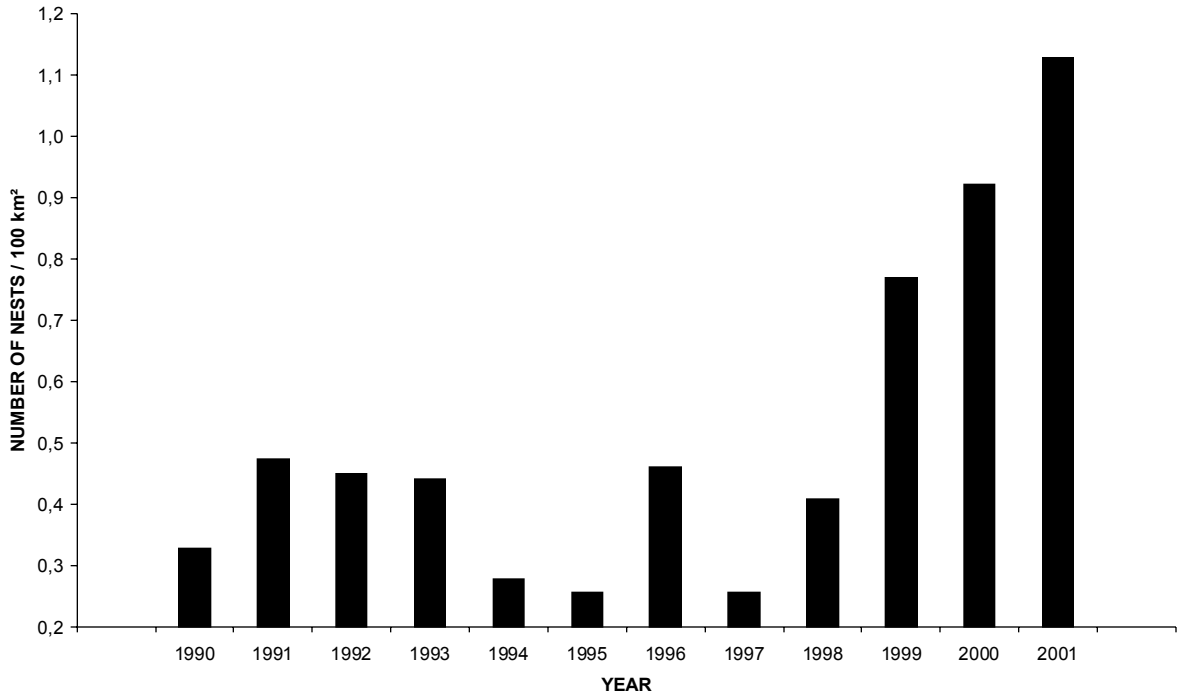


Figure 7. Trend in the Canada Goose clutch size in southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

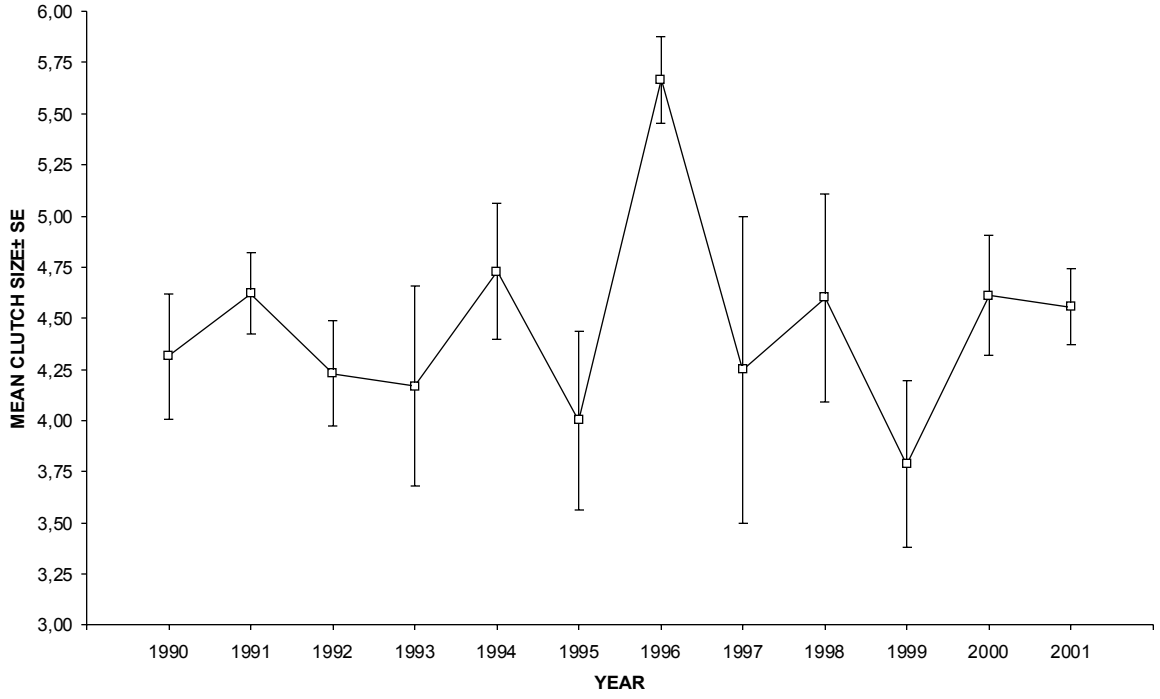


Figure 8. Trend in the Wood Duck breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

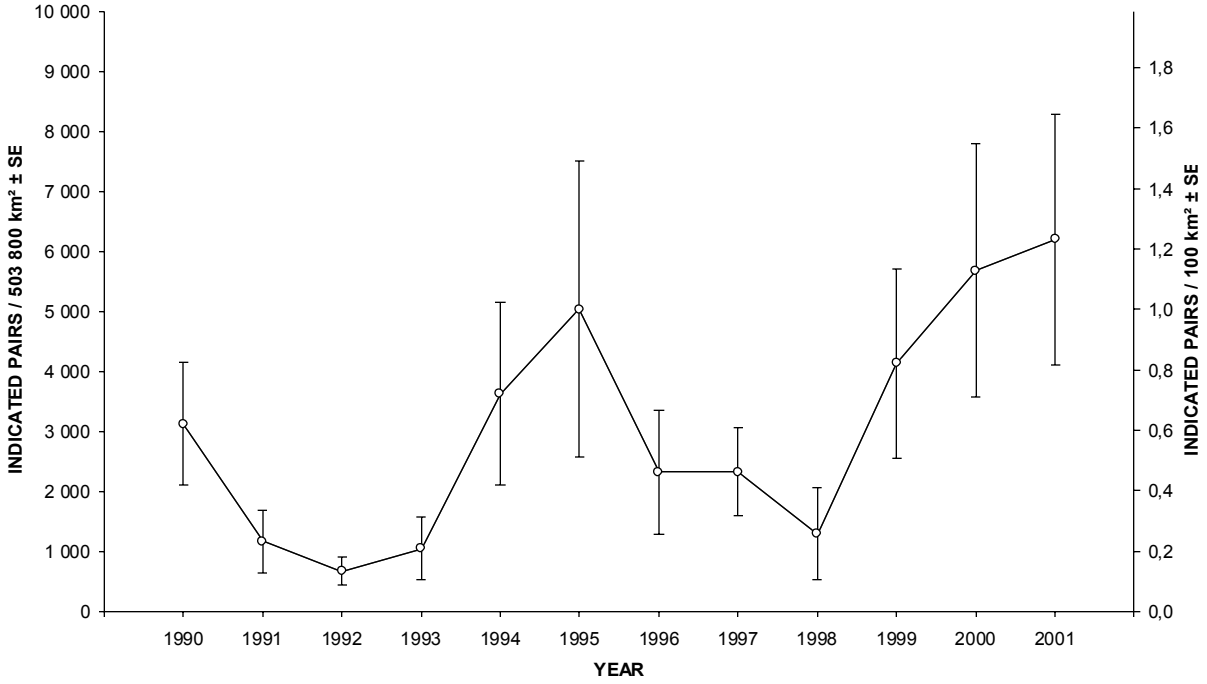


Figure 9. Trend in the Green-winged Teal breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

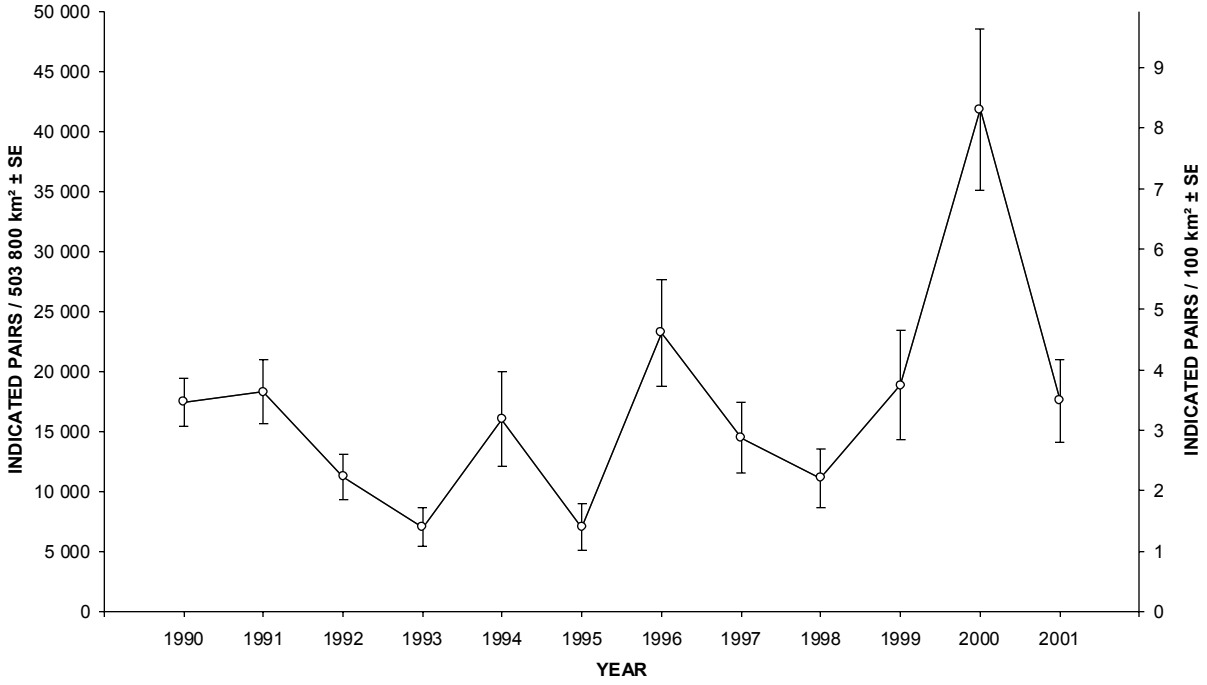


Figure 10. Trend in the American Black Duck breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

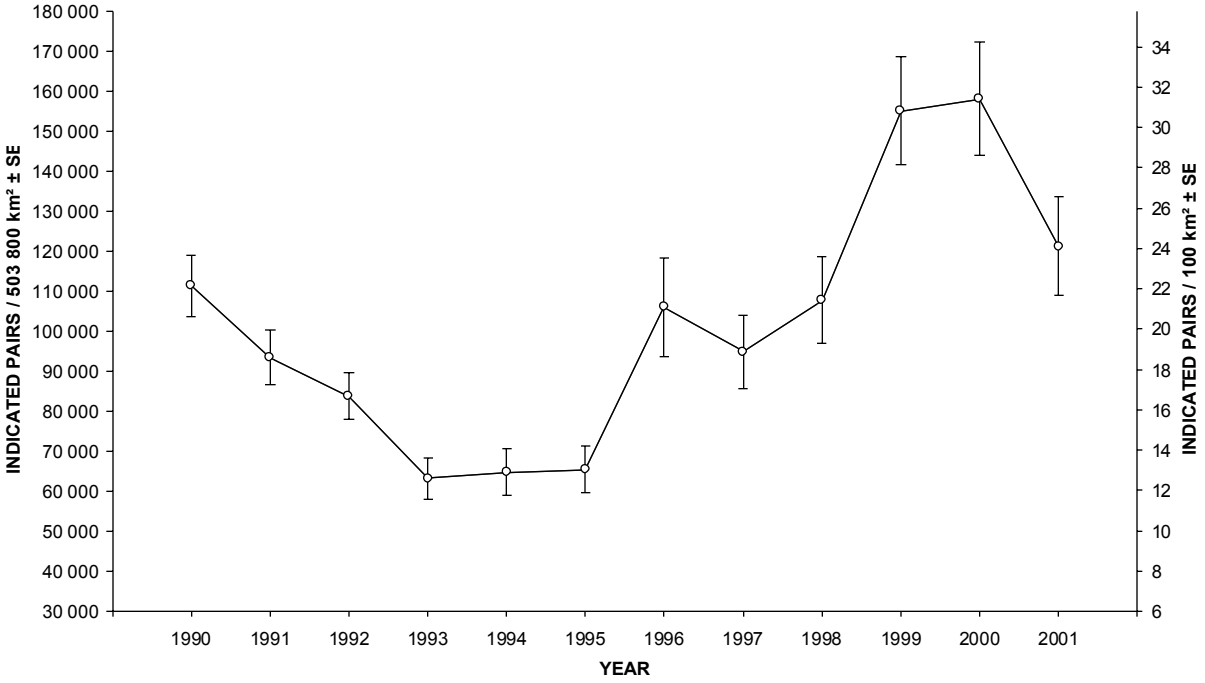


Figure 11. Trend in the Mallard breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

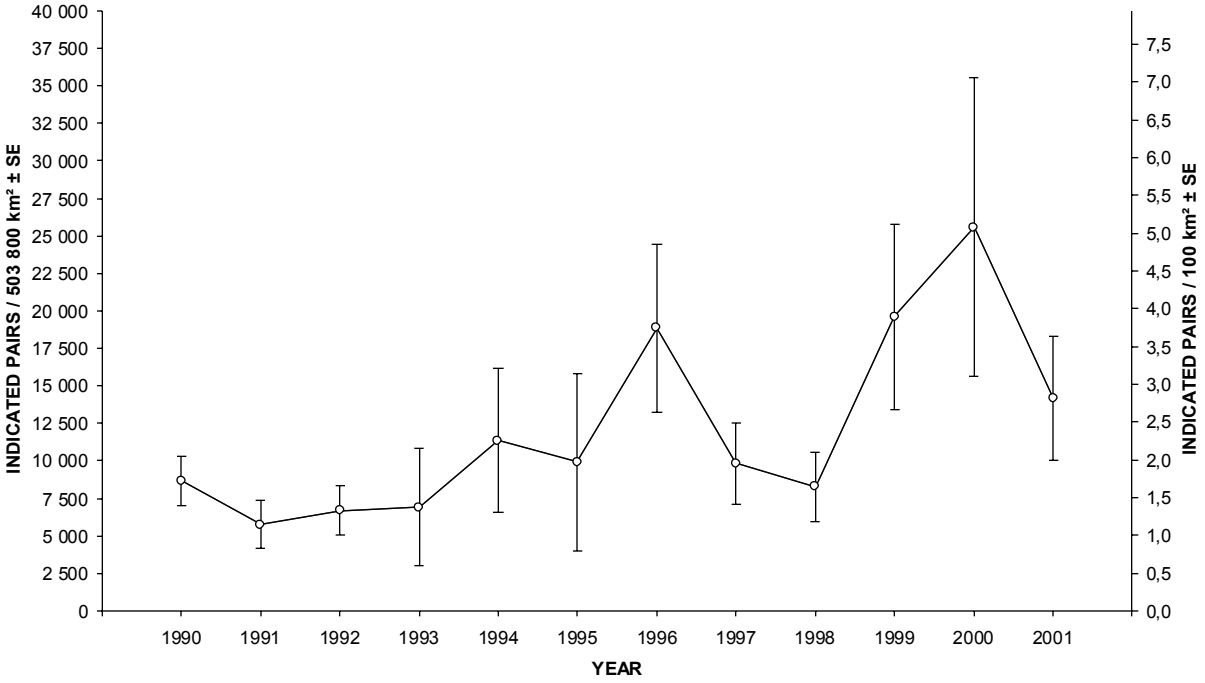


Figure 12. Trend in the Northern Pintail breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

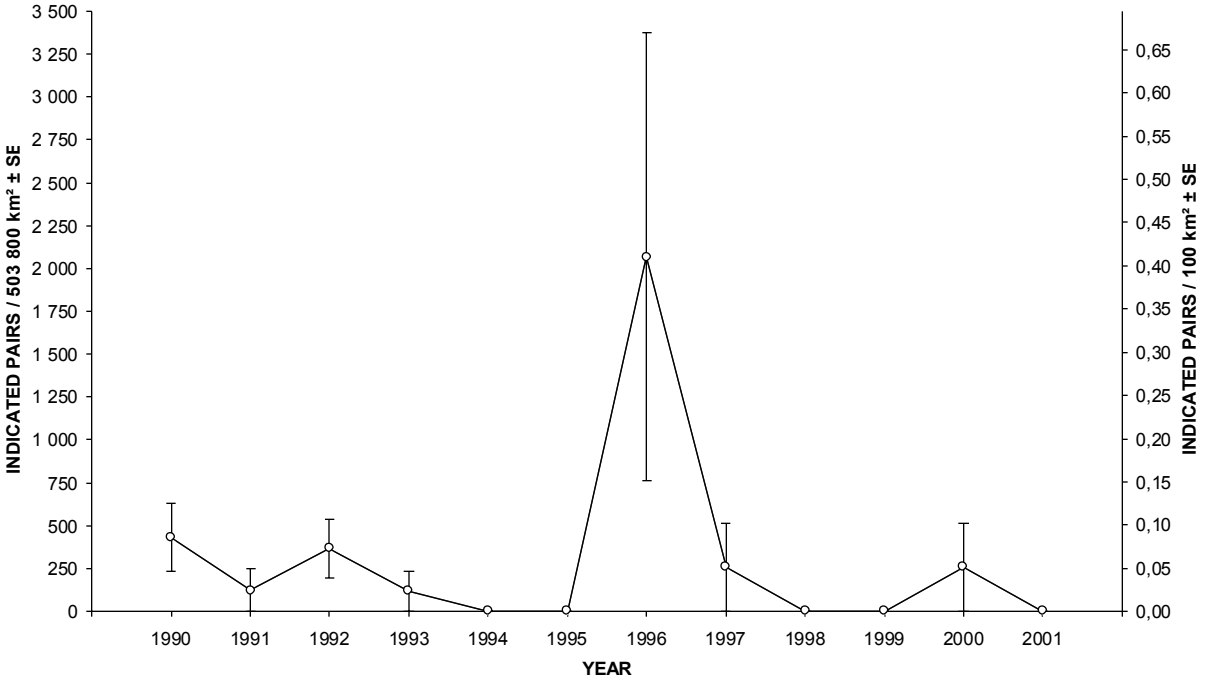


Figure 13. Trend in the Blue-winged Teal breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

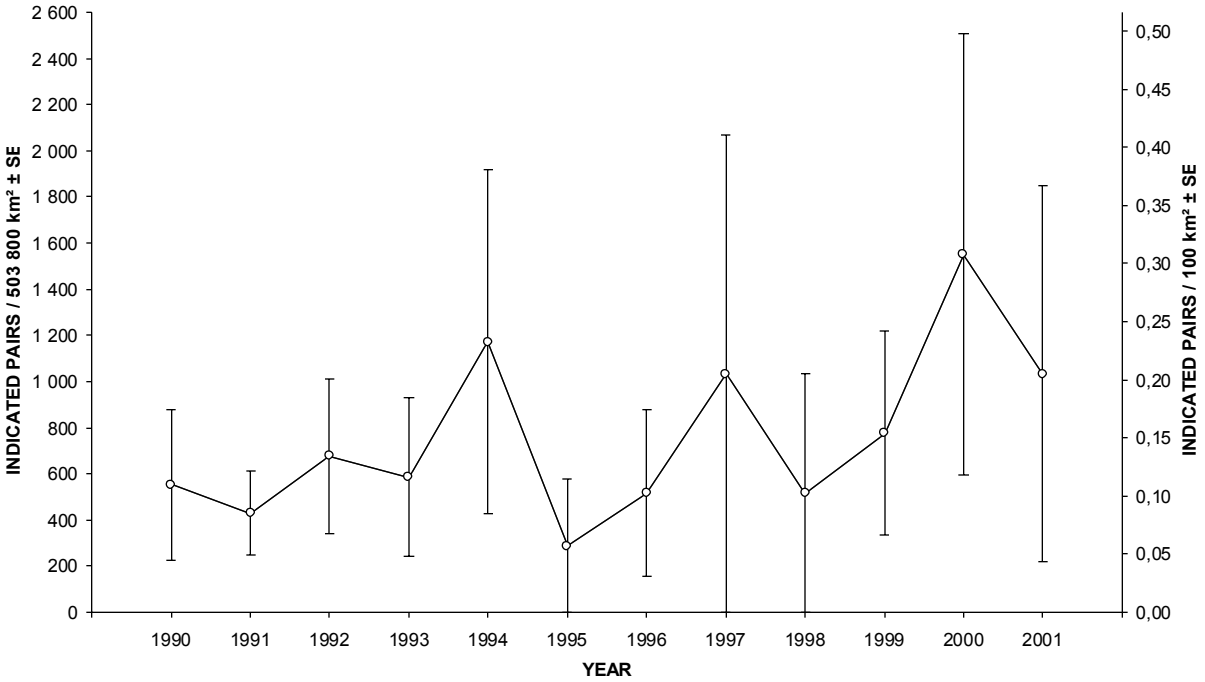


Figure 14. Trend in the American Wigeon breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

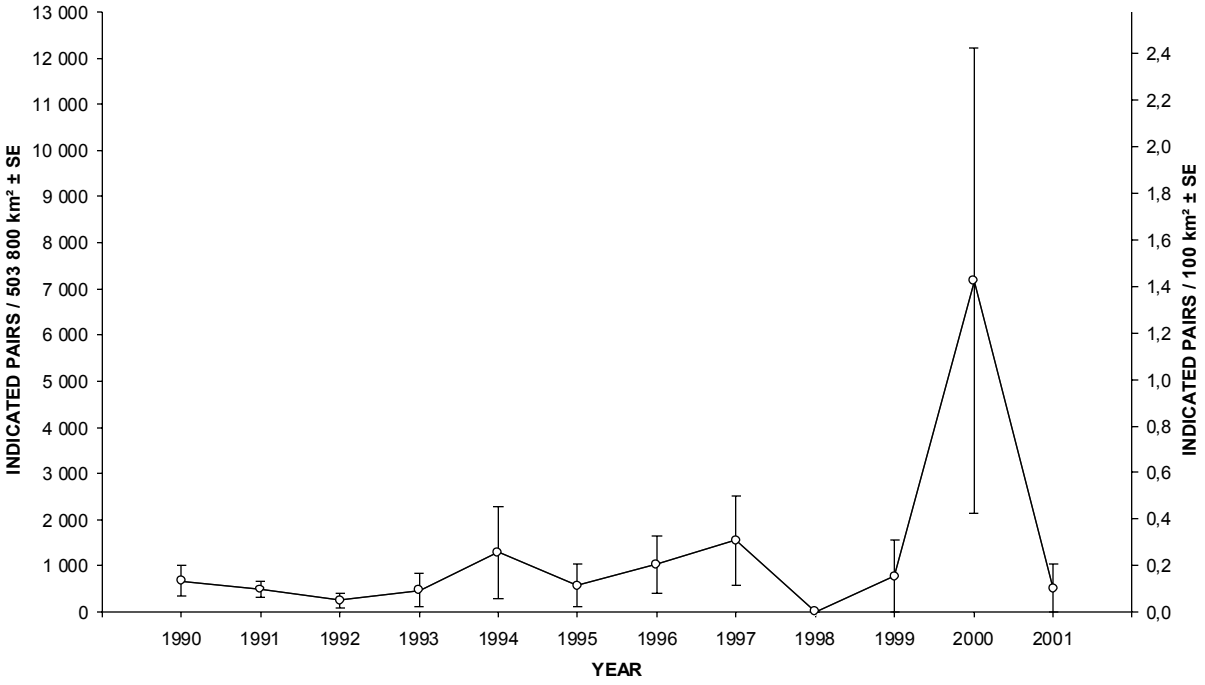


Figure 15. Trend in the Ring-necked Duck breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

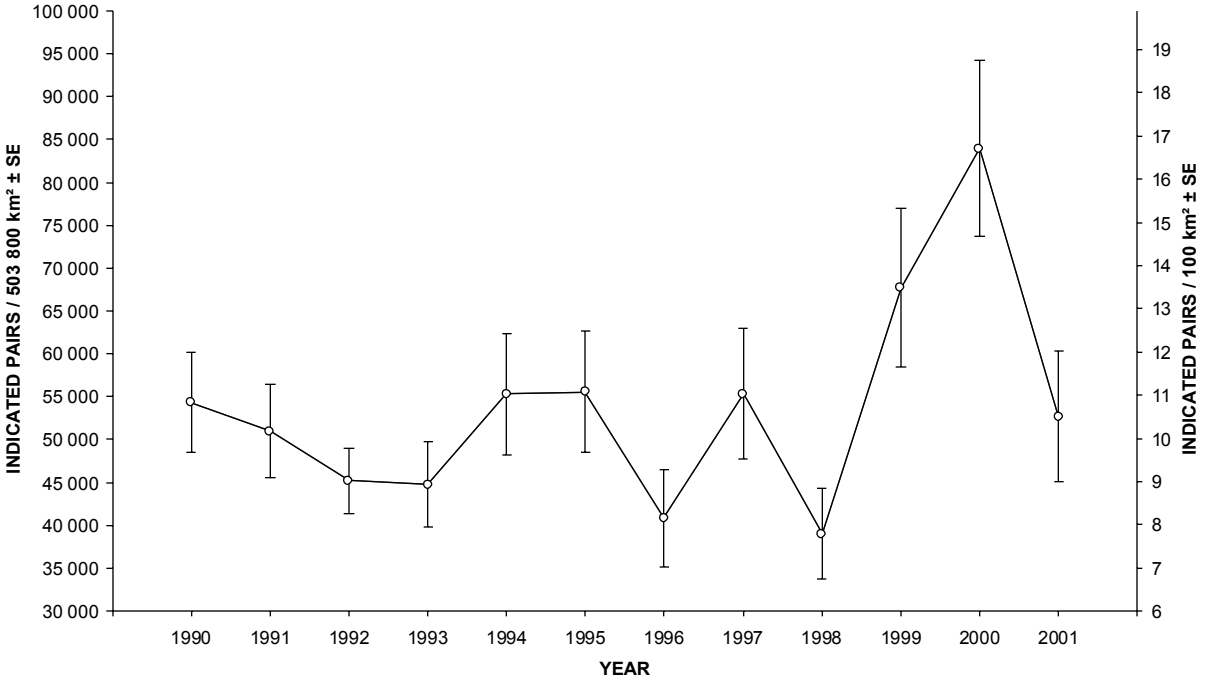


Figure 16. Trend in the Greater Scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

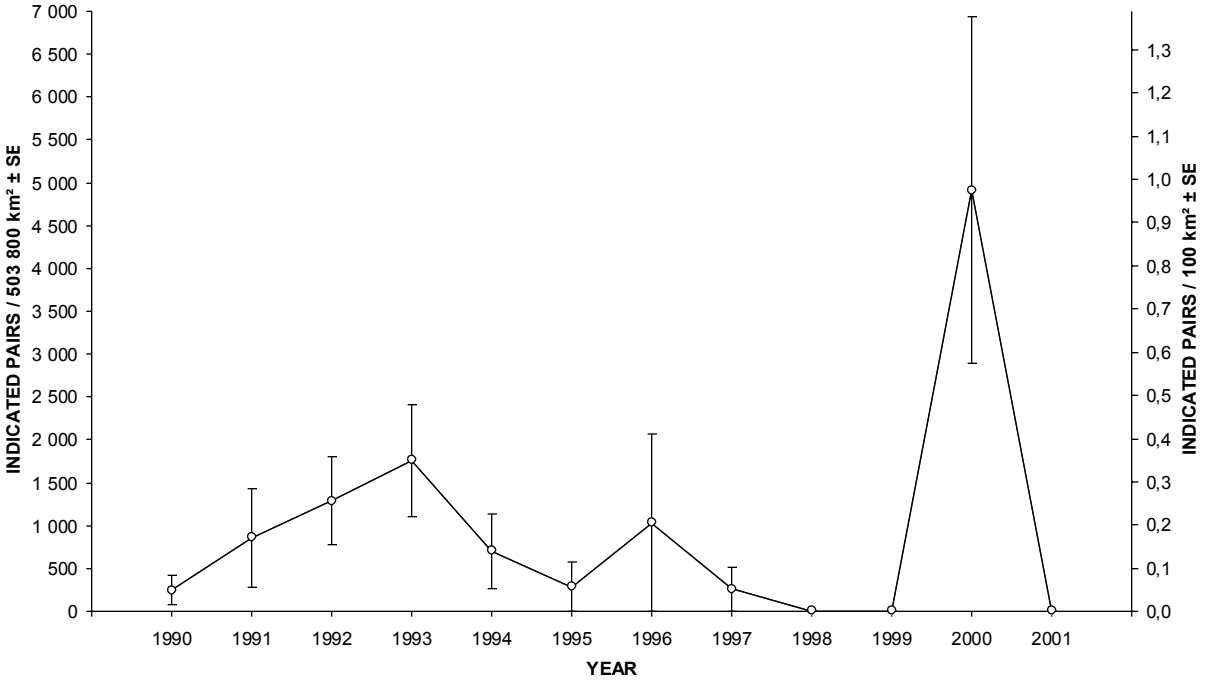


Figure 17. Trend in the Lesser Scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

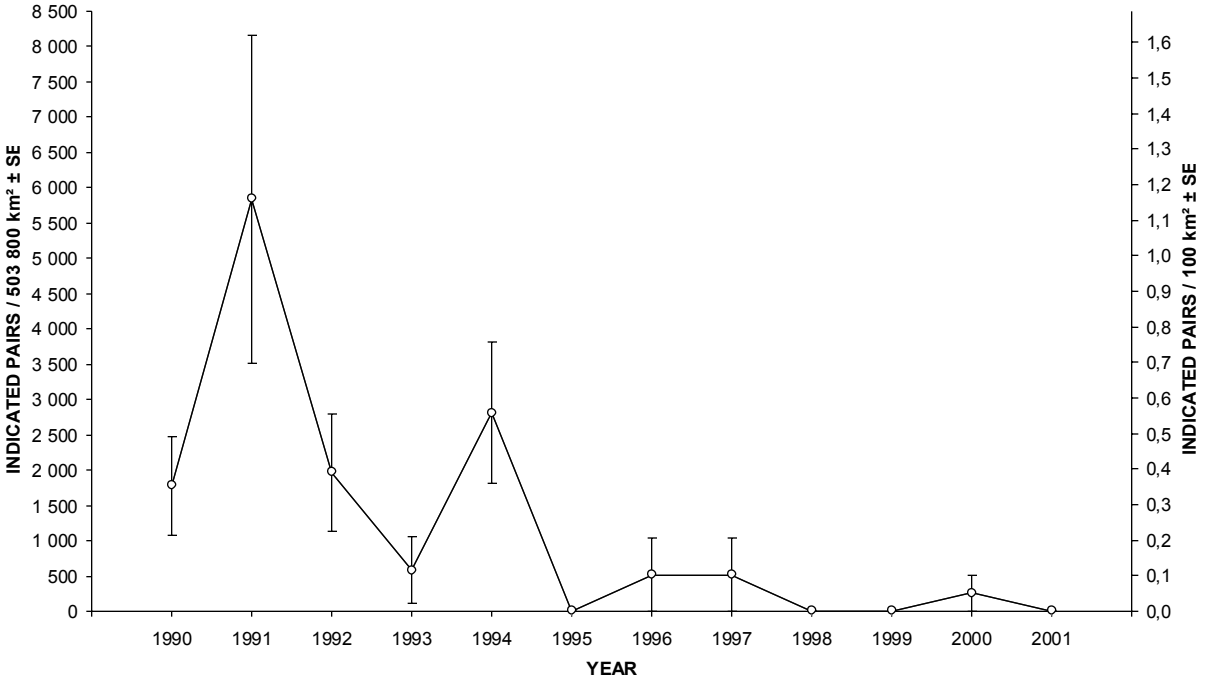


Figure 18. Trend in the unidentified scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

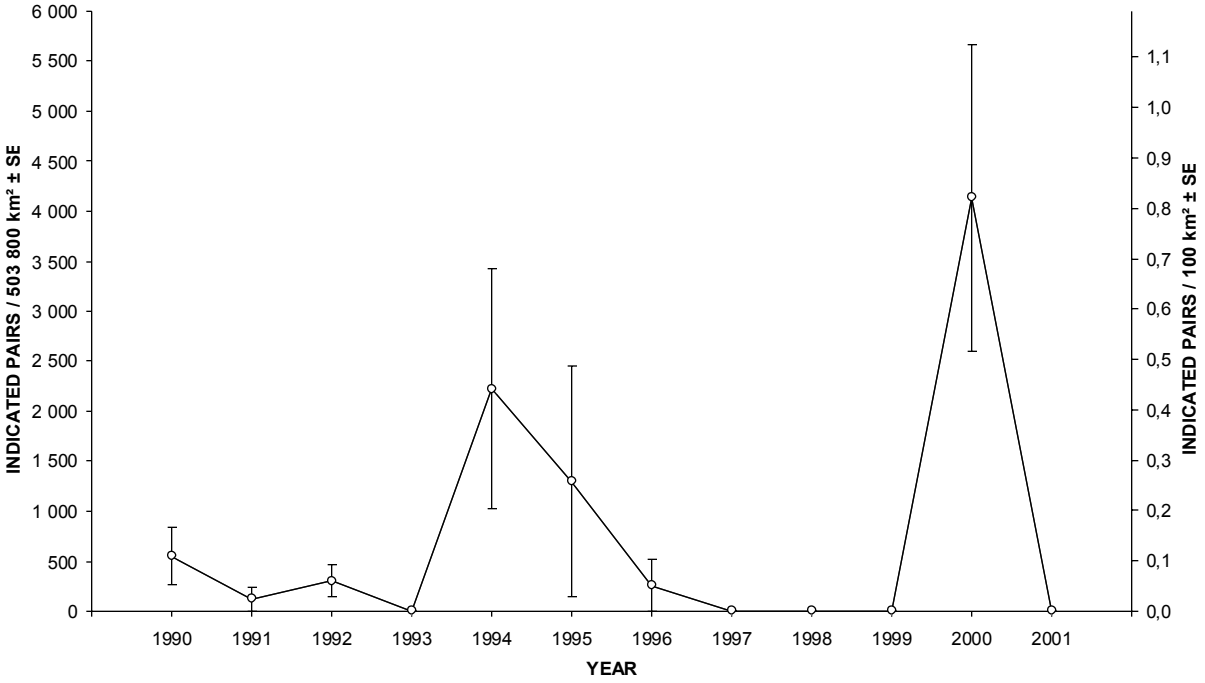


Figure 19. Trend in the scaup breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001; LESC = Lesser Scaup, GRSC = Greater Scaup, USCA = unidentified scaup, solid line = total scaup.

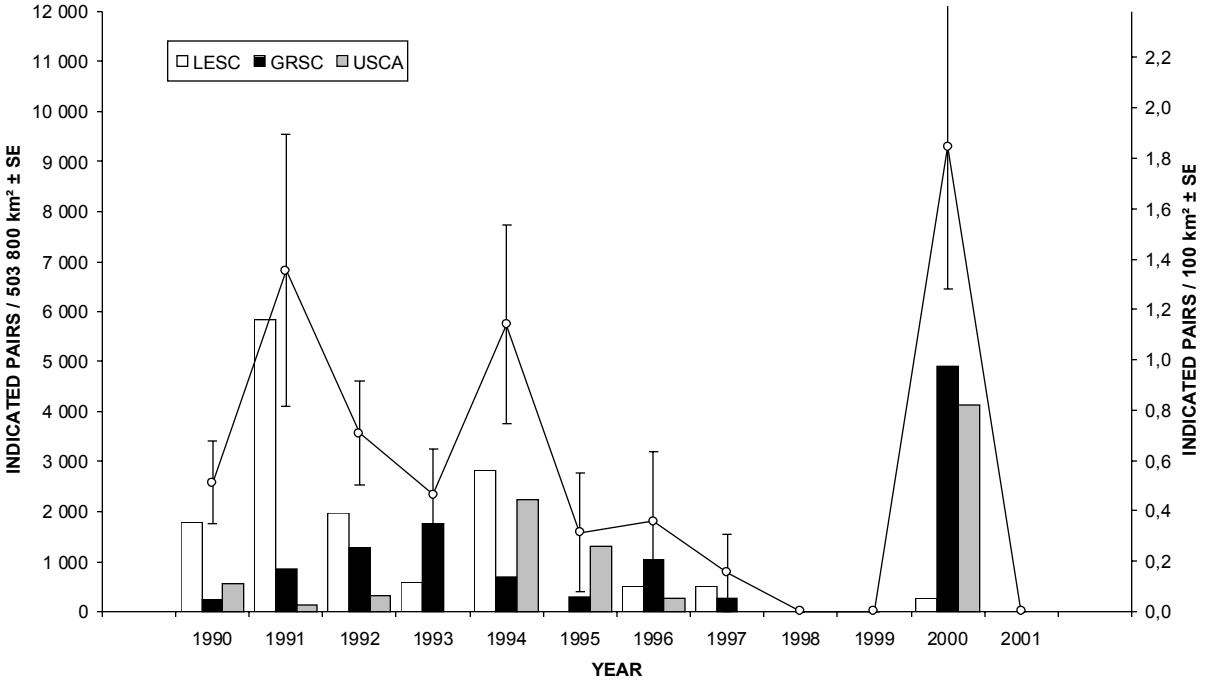


Figure 20. Trend in the Black Scoter breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

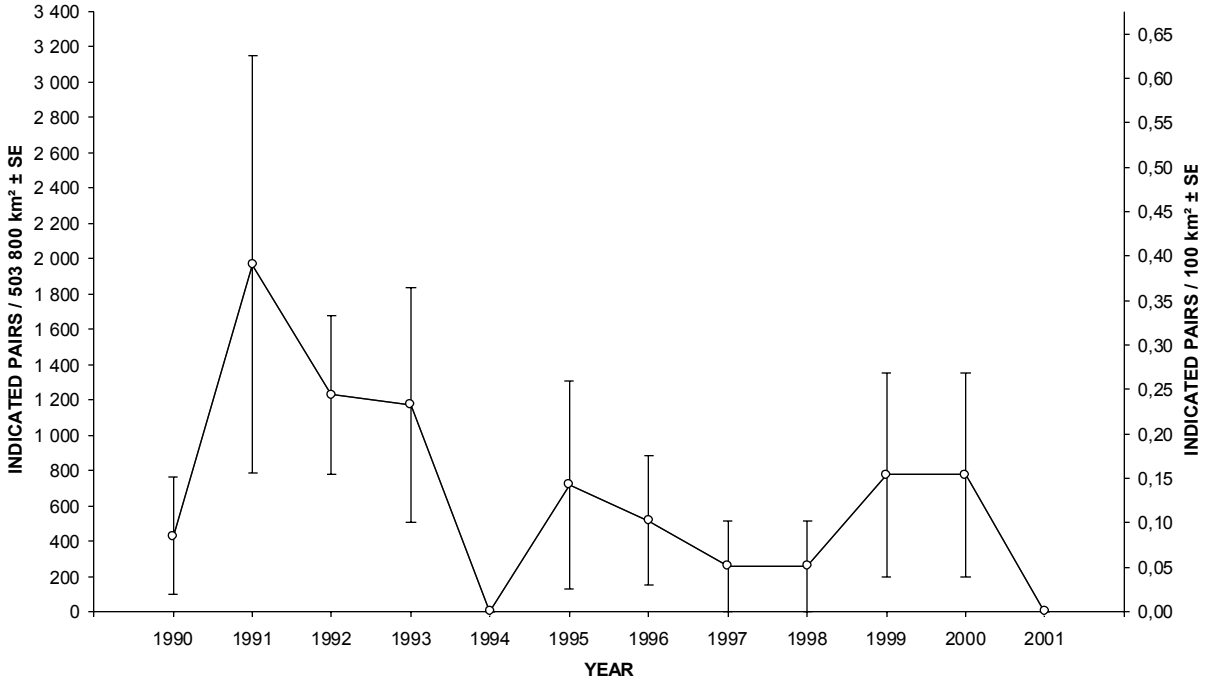


Figure 21. Trend in the Surf Scoter breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

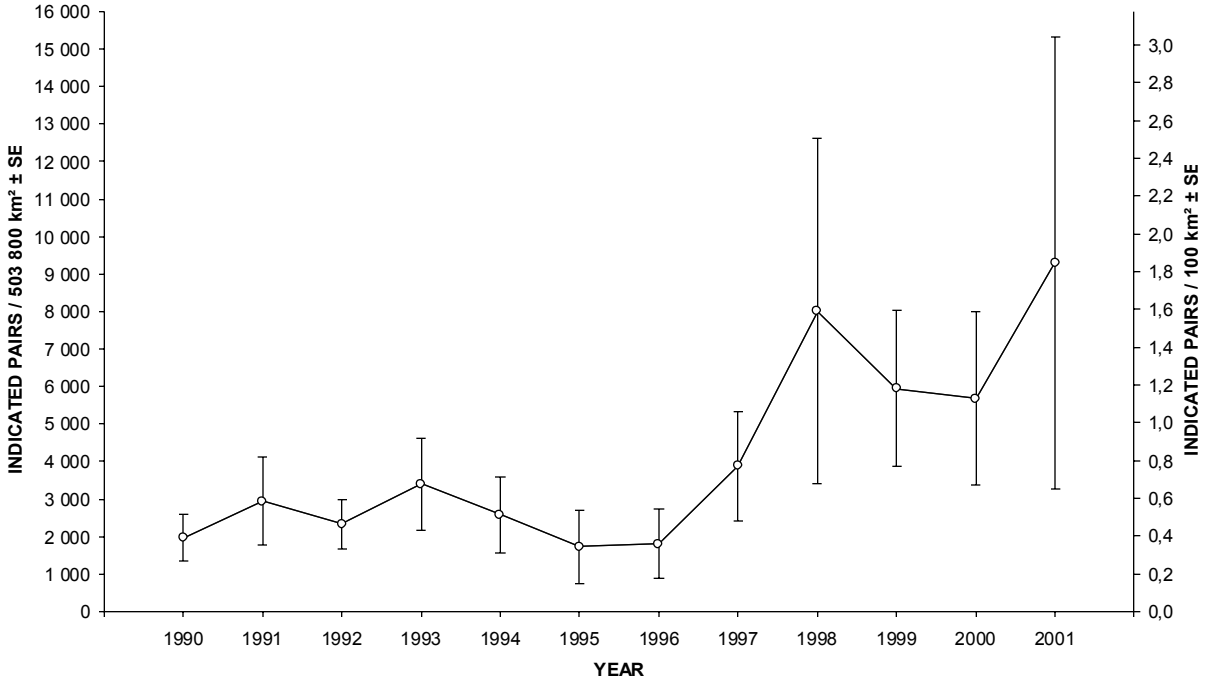


Figure 22. Trend in the Common Goldeneye breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

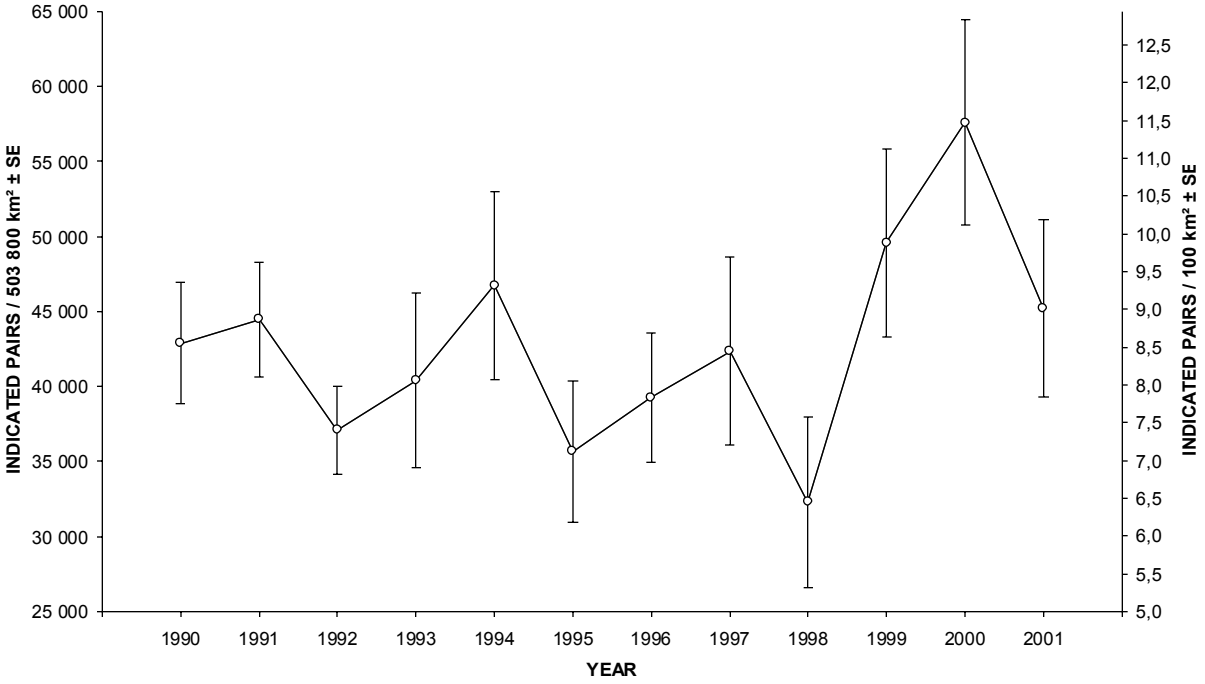


Figure 23. Trend in the Barrow's Goldeneye breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

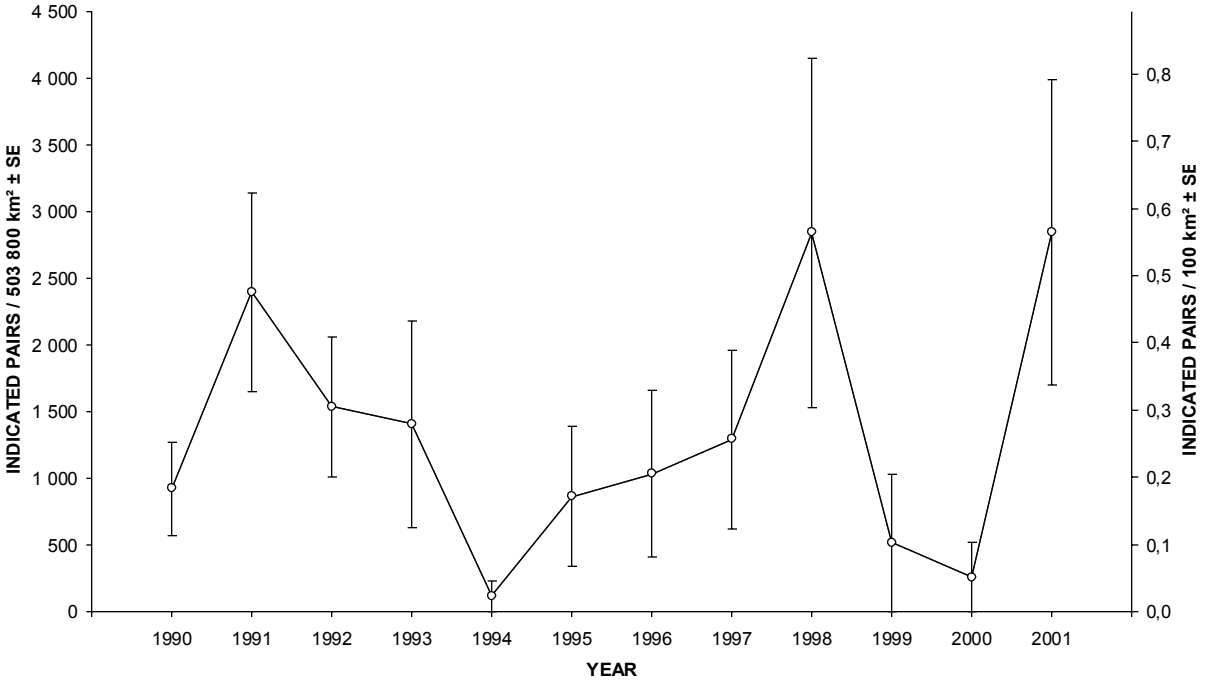


Figure 24. Trend in the Bufflehead breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

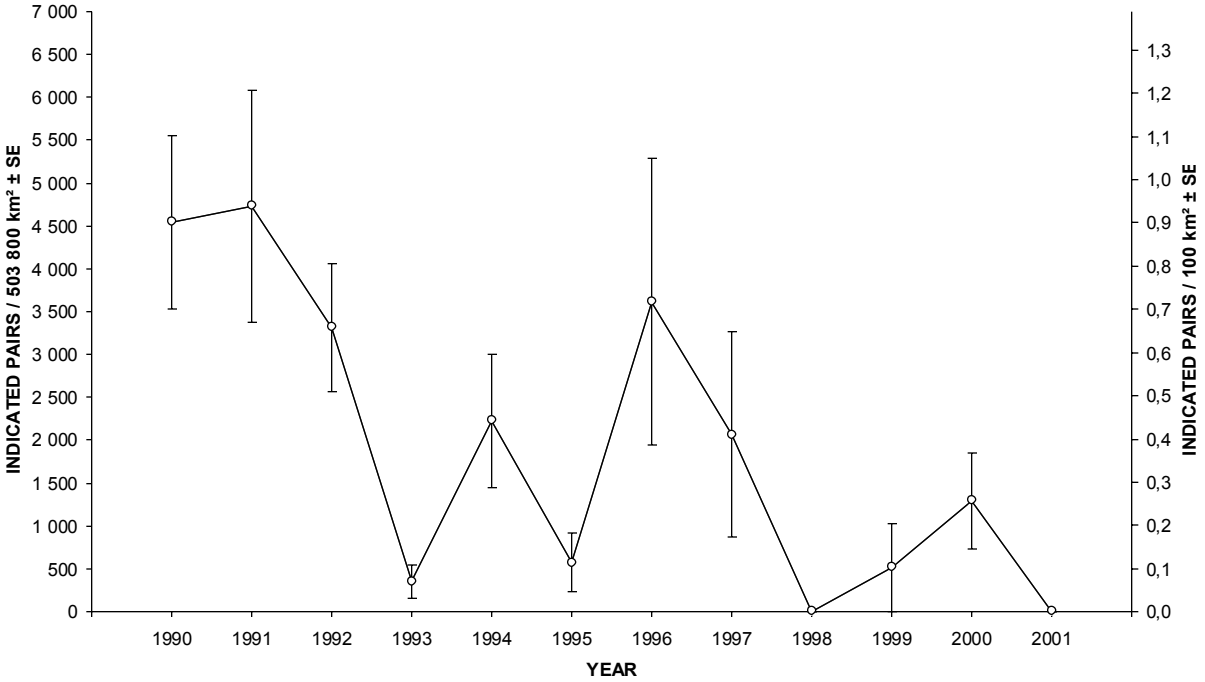


Figure 25. Trend in the Hooded Merganser breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

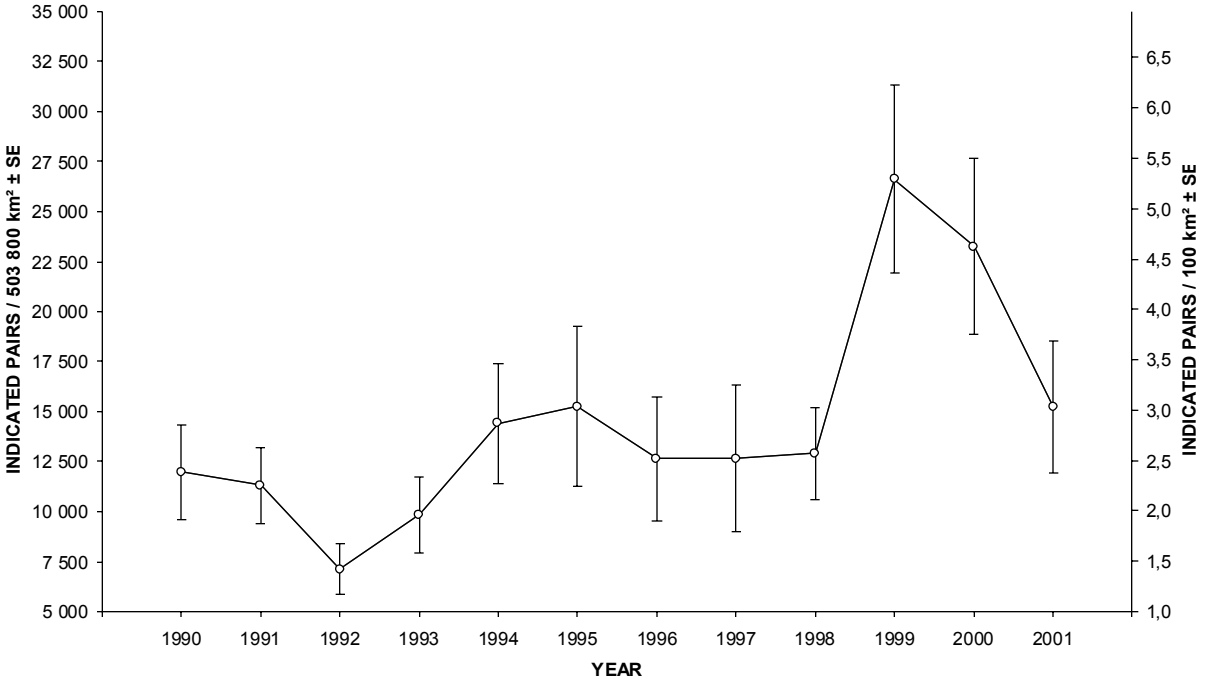


Figure 26. Trend in the Common Merganser breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.

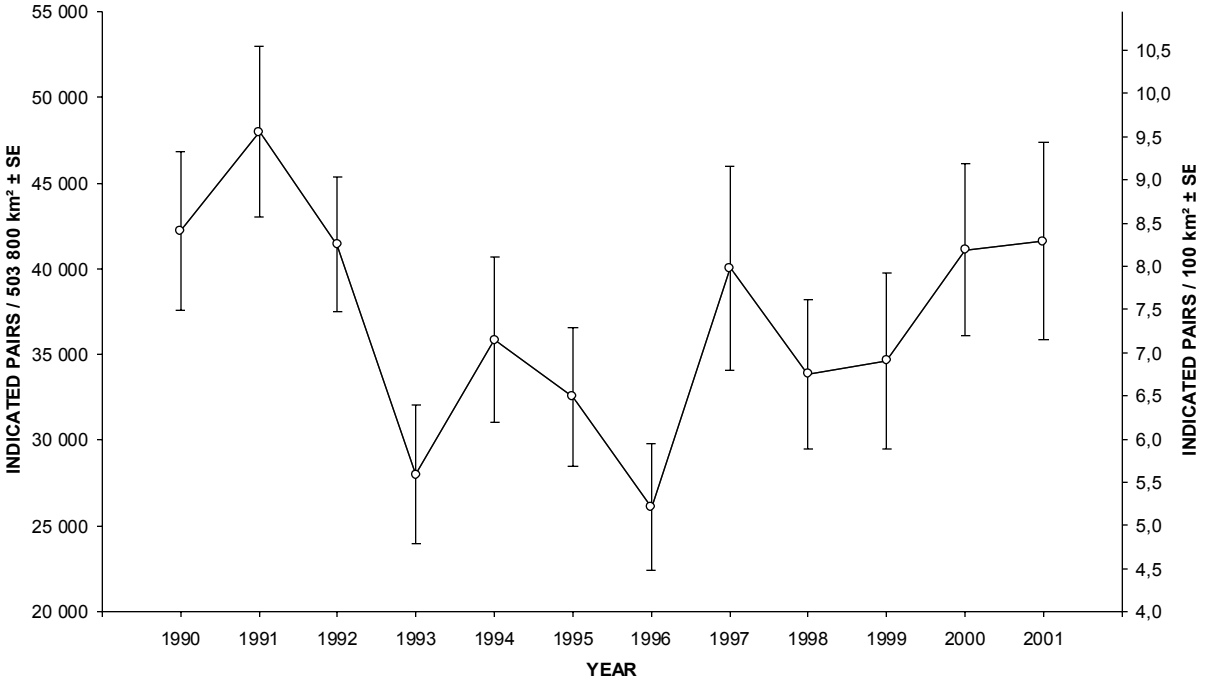
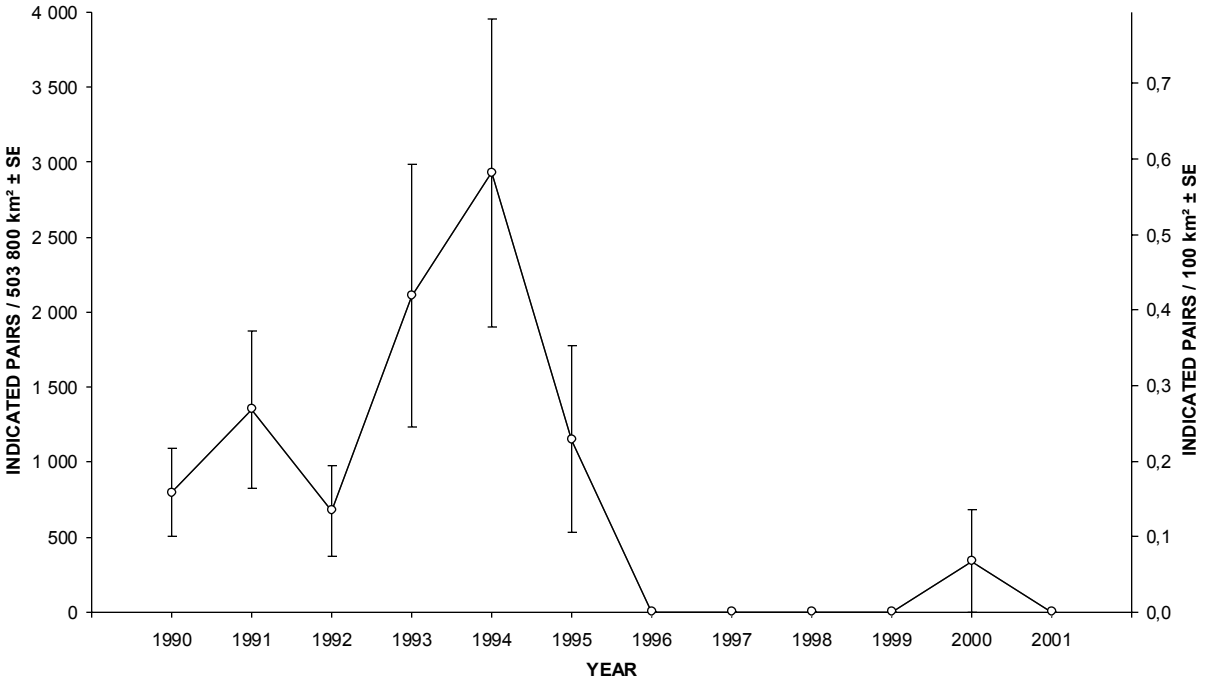


Figure 27. Trend in the Red-breasted Merganser breeding population of southern Québec recorded from the Black Duck Joint Venture helicopter survey 1990–2001.



Appendix 1. English, French, and Scientific names of species covered by the Black Duck Joint Venture helicopter survey in southern Québec.

English	French	Scientific
Common Loon	Plongeon huard	*Gavia immer*
Canada Goose	Bernache du Canada	*Branta canadensis*
Wood Duck	Canard branchu	*Aix sponsa*
Green-winged Teal	Sarcelle d'hiver	*Anas crecca*
American Black Duck	Canard noir	*Anas rubripes*
Mallard	Canard colvert	*Anas platyrhynchos*
Northern Pintail	Canard pilet	*Anas acuta*
Blue-winged Teal	Sarcelle à ailes bleues	*Anas discors*
American Wigeon	Canard d'Amérique	*Anas americana*
Ring-necked Duck	Fuligule à collier	*Aythya collaris*
Greater Scaup	Fuligule milouinan	*Aythya marila*
Lesser Scaup	Petit Fuligule	*Aythya affinis*
Black Scoter	Macreuse noire	*Melanitta nigra*
Surf Scoter	Macreuse à front blanc	*Melanitta perspicillata*
Common Goldeneye	Garrot à œil d'or	*Bucephala clangula*
Barrow's Goldeneye	Garrot d'Islande	*Bucephala islandica*
Bufflehead	Petit Garrot	*Bucephala albeola*
Hooded Merganser	Harle couronné	*Lophodytes cucullatus*
Common Merganser	Grand Harle	*Mergus merganser*
Red-breasted Merganser	Harle huppé	*Mergus serrator*

Appendix 2. Standardized method of calculating indicated pair (IP) from Black Duck Joint Venture helicopter survey in Eastern Canada.

Sighting Combination[1]				Number of Indicated Pairs (IP)					
				Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
M	F	U	T	Dabbler (except Black Duck)	American Black Duck	Diver (except Ring-necked Duck)	Ring-necked Duck	Canada Goose	Common Loon
1	0	0	1	1	1	1	1	1	1
0	1	0	1	0	1	0	0	1	1
0	0	1	1	0	1	0	0	1	1
2	0	0	2	2	1.5	2	2	1	1
1	1	0	2	1	1.5	1	1	1	1
1	0	1	2	1	1.5	1	1	1	1
0	2	0	2	0	1.5	0	0	1	1
0	1	1	2	0	1.5	0	0	1	1
0	0	2	2	0	1.5	0	0	1	1
3	0	0	3	3	3	3	3	1	0
2	1	0	3	2	3	2	2	1	0
2	0	1	3	2	3	2	2	1	0
1	2	0	3	1	3	1	1	1	0
1	1	1	3	1	3	1	1	1	0
1	0	2	3	1	3	1	1	1	0
0	3	0	3	0	3	0	0	1	0
0	2	1	3	0	3	0	0	1	0
0	1	2	3	0	3	0	0	1	0
0	0	3	3	0	3	0	0	1	0
4	0	0	4	4	4	4	4	0	0
3	1	0	4	0	4	3	3	0	0
3	0	1	4	3	4	3	3	0	0
2	2	0	4	2	4	2	2	0	0
2	1	1	4	2	4	2	2	0	0
2	0	2	4	2	4	2	2	0	0
1	3	0	4	1	4	1	1	0	0
1	2	1	4	1	4	1	1	0	0
1	1	2	4	1	4	1	1	0	0
1	0	3	4	1	4	1	1	0	0
0	4	0	4	0	4	0	0	0	0
0	3	1	4	0	4	0	0	0	0
0	2	2	4	0	4	0	0	0	0
0	1	3	4	0	4	0	0	0	0
0	0	4	4	0	4	0	0	0	0
1	x	x	>4	0	0	0	1	0	0
2	x	x	>4	0	0	0	2	0	0
3	x	x	>4	0	0	0	3	0	0
4	x	x	>4	0	0	0	4	0	0
>4	x	x	>4	0	0	0	0	0	0

[1] M : male ; F : female ; U : unknown sex; T : total.

North American Waterfowl
Management Plan

Black Duck
Joint Venture