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POPULATION TRENDS IN NESTING DOUBLE-CRESTED AND PELAGIC CORMORANTS IN CANADA

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ABSTRACT—Breeding populations of Double-crested (*Phalacrocorax auritus*) and Pelagic Cormorants (*P. pelagicus*) were surveyed in the Strait of Georgia, British Columbia, in 1983. Double-crested Cormorant numbers have increased 2.4-fold and Pelagic Cormorant numbers 1.1-fold since 1975. Double-crested Cormorant populations are presently not only increasing in British Columbia but all across Canada and in the northeastern United States. These increases are thought to be the result of decreased disturbance and persecution by man.

Drent and Guiguet (1961) provided the first overview of the status of nesting seabirds in British Columbia. Those authors reported population increases for surface-nesting seabirds for which information was available, including the Double-crested Cormorant (*Phalacrocorax auritus*) and Pelagic Cormorant (*P. pelagicus*). Drent and Guiguet (1961) suggested that cormorant increases resulted from climatic amelioration and the cessation of egg collecting by man. Campbell (1976) conducted an extensive survey of nesting seabirds in southern British Columbia in 1974 and 1975 and found that cormorant populations had increased considerably since Drent and Guiguet's survey.

In 1983, we conducted a survey of the breeding populations of Double-crested and Pelagic Cormorants in the Strait of Georgia and southeastern Vancouver Island to continue the assessment of population trends of cormorants. The second objective was to compare population trends of Double-crested Cormorants in British Columbia with those elsewhere in North America.

STUDY SITE AND METHODS

All Double-crested Cormorants in British Columbia nest in the Strait of Georgia (Fig. 1), and Pelagic Cormorant populations are best documented there. The surveys were conducted from 29 May to 13 June 1983, from a small motor boat. Surveys were conducted from the water except on Mandarte Island, where some Double-crested Cormorants could not be seen from the boat. We stayed about 30 m from the nesting locality on land on Mandarte Island to keep disturbance to a minimum. Colonies were counted three times during each survey for the purpose of checking accuracy of counts, and the results were averaged. The nest count took from 5 min to 1 hr, depending on the size of the colony.

RESULTS

Multiple counts of colonies with less than 200 nests showed no deviations in nest numbers. The standard deviations for colonies of 200 to 500 nests varied from 1 to 4 and for those with more than 500 nests ranged from 8 to 14 nests. Double-crested Cormorants more than tripled their numbers between 1960 and 1975 and Pelagic Cormorants at least doubled during the same time period (Table 1). While Double-crested Cormorants continued their increase between 1975 and 1983 (2.4-fold), Pelagic Cormorant numbers showed only a slight increase by 1983 (1.1-fold). The greatest increase of Double-crested Cormorant numbers during the 1983 survey was observed on Mandarte Island and that of Pelagic Cormorants at Bare Point (Table 1).

The numbers of islands used for nesting also increased between 1960 to 1983. Islands used by the Double-crested Cormorants increased from 4 in 1960 to 6 in 1975 to 7 in

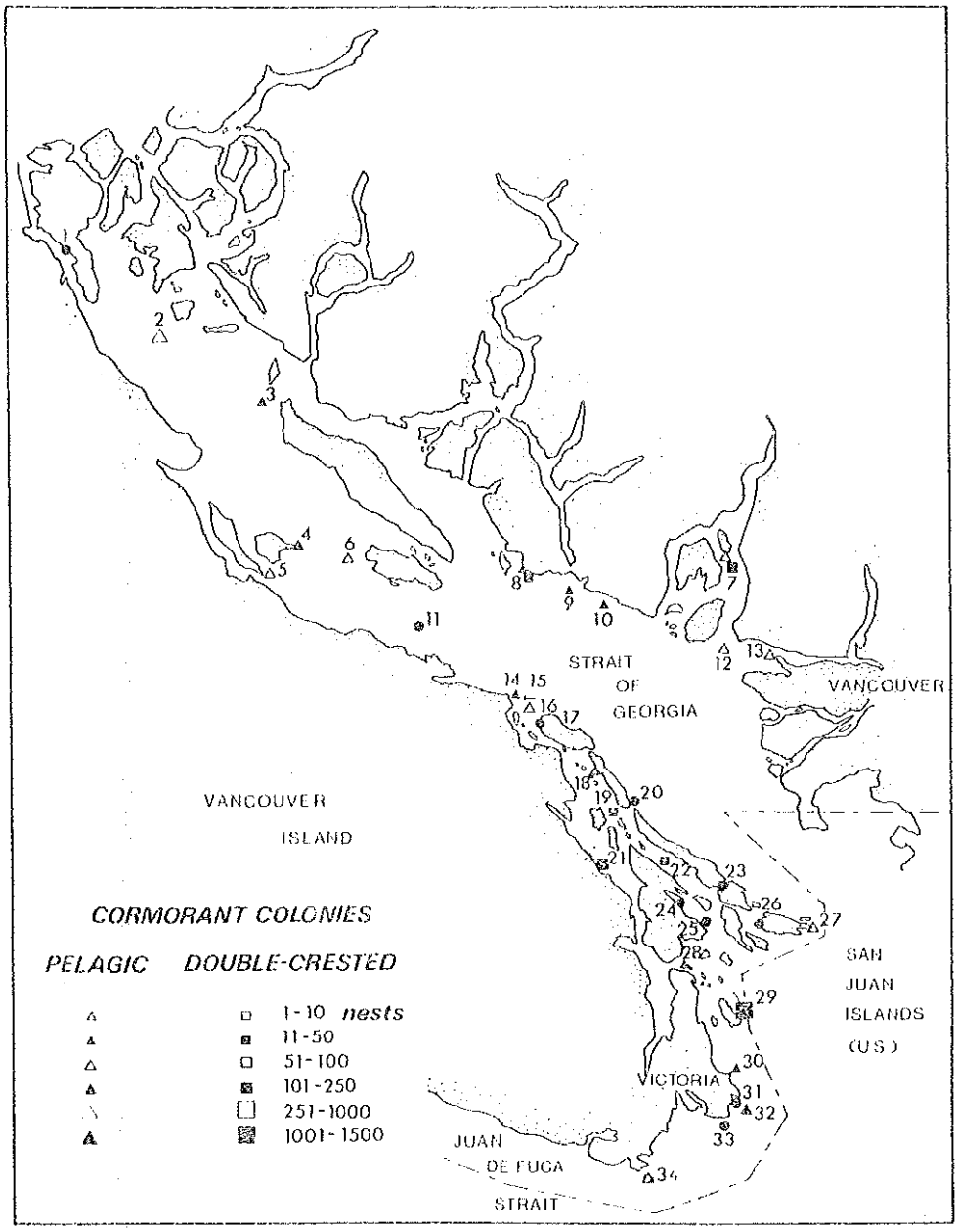

FIGURE 1. Distribution of Double-crested and Pelagic Cormorant nesting sites in the Strait of Georgia and at southeastern Vancouver Island in 1983. Numbered colonies are identified in Table 1. Solid dots indicate colonies abandoned prior to 1983.

1983; those of Pelagic Cormorants increased from 16 in 1960 to 22 in 1975 but remained at 22 in 1983 (excluding one nest at Active Pass). The breeding population trends indicate that Double-crested Cormorant numbers and colonies are still increasing, while those of Pelagic Cormorants are stabilizing.

TABLE 1. Comparison of number of nests of Double-crested and Pelagic Cormorant colonies in the Strait of Georgia and at southeastern Vancouver Island, between 1959–1960 (Drent and Guiguet 1961), 1974–1975 (Campbell 1976) and 1983 (this study).

TABLE 1. Comparison of number of nests of Double-crested and Pelagic Cormorant colonies in the Strait of Georgia and at southeastern Vancouver Island, between 1959–1960 (Drent and Guiguet 1961), 1974–1975 (Campbell 1976) and 1983 (this study).

Colony location	Number of nests					
	Double-crested Cormorants			Pelagic Cormorants		
	1959–1960	1974–1975	1983	1959–1960	1974–1975	1983
1. Quadra Island (Bluffs N.W. Quathiaski Cove)	—	—	—	Nesting in large numbers	—	—
2. Mitlenatch Island	—	—	—	155	286	318
3. Vivian Island and Rebecca Rock	—	—	—	—	25	15
4. St. John Point, Hornby Island	—	—	—	50 (in 1955)	9	127
5. Chrome Island	—	—	—	—	54	78
6. Sisters Islets	—	—	—	—	41	51
7. Christie Islet and Pam Rock	Nests only in 1941	29	120	Colony declining, a few unsuccessful nests	3	80
8. Franklin Rock and Merry Island	—	54	21	—	130	18
9. Trail Islands	—	—	—	—	2	15
10. White Islets	—	—	—	—	4	38
11. Ballenas Islands	—	—	—	Undetermined number of nests	24	—
12. Passage Island	—	—	—	—	48	72
13. Prospect Point	—	—	—	—	—	64
14. Hudson Rocks	—	—	—	38	91	30
15. Five Finger Island	—	—	—	—		115
16. Snake Island	—	—	—	15	22	60
17. Gabriola Island Cliffs	—	—	—	7	367	—
18. Valdes Island Cliffs	—	—	—	6 (in 1955)	—	6
19. Rose Islets	—	80	12	—	—	—
20. Canoe Islet	—	12	—	—	—	—
21. Bare Point (Chemainus)	—	—	198	50	118	373
22. Ballingall Islets	28	14	20	11	—	—
23. Active Pass	—	—	—	—	1	—
24. Second Sister Island (Chain Islands)	9	—	—	—	—	—
25. Channel Islands	16	—	—	—	—	—
26. Elliot Bluff, Saturna Island	—	—	—	—	10	—
27. East Point, Saturna Island	—	—	—	—	54	53
28. Arbutus Island	—	—	—	—	—	16
29. Mandarte Island	150	482	1100	375	443	550
30. Gordon Head	—	—	—	20 (in 1956)	20	13
31. Harris Island and Lewis Reef	—	—	—	—	54	—
32. Chain Islets	—	—	135	74	183	203
33. Trial Island	—	—	—	107	—	—
34. Race Rocks	—	—	—	45	160	143
Total number of nests observed	203	671	1606	933	2149	2438

Discussion

Reaction of Cormorants to Disturbance and Predation

The increases of Pelagic Cormorants at Bare Point, Hudson Rocks, Five Finger Island, and Snake Island may have partly or wholly resulted from a movement of cormorants from Gabriola Island cliffs, which had 367 pairs in 1974–1975 and none in 1983. The above nesting localities are near one another (Fig. 1). The disappearance of cormorants at Gabriola Island cliffs may have been caused by disturbance. Other colonies such as those on Ballingall and Rose Islets are known to have decreased as a result of disturbance by pleasure boaters (*Times-Colonist* newspaper, 23 February, 1983, Victoria). The Pelagic Cormorant colony on Trial Island, with 107 breeding pairs in 1960, was wiped out by lighthouse activities and pets (N. K. Dawe, pers. comm.).

Double-crested Cormorants generally nest on slopes and on larger ledges of the upper portions of cliffs while Pelagic Cormorants are chiefly found on smaller ledges and steeper cliff portions in British Columbia. At a few localities, Ballingall Islets and Bare Point, Double-crested Cormorants nest in trees. Undoubtedly ground-nesting Double-crested Cormorants have been more accessible to egg collectors (who caused most disturbance to cormorants in the past, see Drent and Guiguet 1961) than cliff-nesting Pelagic Cormorants, which may explain the smaller number of Double-crested than Pelagic Cormorant colonies in the Strait of Georgia at present. Predator access may still limit the establishment of new Double-crested Cormorant ground colonies. Mammalian predators like river otters (*Lutra canadensis*) are common predators on seabird colonies in the Strait of Georgia (Foottit and Butler 1977, Verbeek and Morgan 1978) and have easier access to the upper than to the lower and steeper cliff portions where cormorants nest.

Present Double-crested Cormorant Increases

Double-crested Cormorant increases in British Columbia cannot be explained without considering population trends in adjacent Washington waters and elsewhere in North America, since there may be recruitment from outside the province. Both Double-crested and Pelagic Cormorant populations recently increased in waters on the inner coast of Washington (Table 2). Undoubtedly there is some interchange of cormorants between British Columbia and Washington, but since the Double-crested Cormorant population on the inner Washington coast is small compared to that in British Columbia (*cf.* Tables 1 and 2), it is not likely that the British Columbia increases resulted mostly from recruitment in Washington. The Double-crested Cormorant population on the outer Washington coast is also relatively small and has not increased significantly over a 70-year period. Varoujean (1979) reported 390 nesting pairs of Double-crested Cormorants there from 1970 to 1975 while Dawson (1908) recorded a population of about 400 pairs in 1905 and 1907.

Double-crested Cormorant populations are rapidly increasing in Alberta (Weseloh et al. 1977), Saskatchewan (Roney 1979, 1982), Manitoba (P. W. Rakowski and W. Koonz, pers. comm.), the Great Lakes Region (Blokpoel et al. 1980, Weseloh et al. 1983), Nova Scotia (Lock and Ross 1973; A. R. Lock, pers. comm.), Quebec (J. L. Desgranges, G. Chapdelaine, and P. Dupuis, pers. comm.), and in Maine and Wisconsin (Korschgen 1979, Matteson 1983). Greatest numerical changes occurred over a relatively short time period in Saskatchewan and Manitoba where populations increased from 5850 to 32,558 breeding pairs during the last decade (Table 3). It is unlikely that Double-crested Cormorant increases in British Columbia resulted from recruitment in the Canadian prairie provinces because the prairie populations migrate in the fall down the Mississippi drainage and winter on the coast of the Gulf of Mexico (Houston 1967, 1968), while those in British Columbia winter on the Pacific coast of North America (Palmer 1962). That suggests that Double-crested Cormorant populations are presently increasing across North America.

TABLE 2. Comparison of nesting Pelagic and Double-crested Cormorants in the Strait of Juan de Fuca, and northern Puget Sound, Washington State, between 1970–1975 and 1978–1979. (1970–1975 data: Manuwal and Campbell 1979, Varoujean 1979; 1978–1979 data: Manuwal et al. 1979, Wahl et al. 1981.)

Colony location	Pelagic Cormorants		Double-crested Cormorants	
	1970–1975	1978–1979	1970–1975	1978–1979
Outer Strait of Juan de Fuca				
Tatoosh Island	200	400*		
Seal and Sail Rocks	—	40*		
Inner Strait of Juan de Fuca				
Jamestown	—	44*		
Protection Island	220	590*	6	0*
Smith Island	40	100*		
Northwest Island, Deception Pass	—	10**		
Castle Island	0	2*		
Coleville Island	80	230**	0	100*
Hall Island	30	24*		
Anacortes to Hule Passage				
Viti Rocks	160	160*	58	60*
Haro Strait				
Bare Island	100	100*		
Rosario Strait				
Bird Rocks	0	0*	60	190**
Williamson Rocks	134	140*	0	146**
South Sister Island	22	22*	4	4
San Juan Islands				
Flower Island	35	0*		
Total number of cormorants (individuals)	1021	1862	128	500

* Manuwal et al. 1979.
** Wahl et al. 1981.

Factors Affecting Double-crested Cormorants

Double-crested Cormorant increases at present may be better understood when factors with adverse effects on their populations are analyzed. Information on Double-crested Cormorant populations in British Columbia became available during the first counts from 1900 to 1920. Populations have since increased in size, and Drent and Guiguet (1961) suggested that climatic amelioration, possible increases in food supply, and the cessation of egg collecting could have caused the increases. Nothing is known about the effects, if any, of the first two parameters but egg collecting may have been critical (Drent and Guiguet 1961). Native people always used cormorant and gull colonies for food while fishermen participated in the "egging" until about the beginning of this century (Drent and Guiguet 1961).

The Double-crested Cormorant populations in the Canadian prairie provinces were first completely censused from 1967 to 1972 (Vermeer 1968, 1969, 1970a, 1973). Many colonies, previously reported, had then disappeared as a result of large scale destruction of eggs and young cormorants by people and by falling lake levels. The destruction by man had the greatest impact. For example, during a 1943–1945 cormorant control program on Lake Winnipegosis, Manitoba, thousands of eggs and nestlings were destroyed

TABLE 3. Comparison of Double-crested Cormorant breeding populations across Canada and in Maine and Wisconsin over the last decades.

Region	Number of nests or breeding pairs	Years of observation	Source	Numbers of nests or breeding pairs	Years of observation	Source
Canada						
British Columbia	203	1959–1960	Drent and Guiguet 1961	1606	1983	This paper
Alberta	269	1967–1972	Vermeer 1966, 1973	1573	1976–1977	Weseloh et al. 1977
Saskatchewan	1078	1968	Vermeer 1970a	9877	1983	K. Roney, pers. comm.
Manitoba	4772	1969	Vermeer 1969	22,681	1979	P. W. Rakowski and W. Koonz, pers. comm.
Ontario, Great Lakes	122	1972	D. V. Weseloh, pers. comm.	1175	1982	D. V. Weseloh, pers. comm.
Quebec,						
St. Lawrence north coast	2068	1928–1938	J. L. Desgranges, G. Chapdelaine, and P. Depuis, pers. comm.	1197	1977–1980	J. L. Desgranges, G. Chapdelaine, and P. Depuis, pers. comm.
St. Lawrence estuary	4000	1967–1974	J. L. Desgranges, G. Chapdelaine, and P. Depuis, pers. comm.	6125	1977–1980	J. L. Desgranges, G. Chapdelaine, and P. Depuis, pers. comm.
Nova Scotia	2400–2600	1971	A. R. Lock, pers. comm.	6900	1983	A. R. Lock, pers. comm.
U.S.A.						
Maine	At least 1300	1943	Gross 1944	15,333	1977	Korschgen 1979
Wisconsin	66	1973	Matteson 1983	1028	1982	Matteson 1983

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(McLeod and Bondar 1953). Fishermen and loggers were also engaged, independent of the control program, in the destruction of cormorants at Lake Winnipegosis. There were 36,000 cormorants on just 4 of 17 nesting reefs in Lake Winnipegosis at the start of the control program, while only 4656 nests were counted on the whole lake immediately after its termination (McLeod and Bondar 1953). Eighteen years later, the cormorant population on Lake Winnipegosis was reduced to 1403 nests, perhaps resulting from further disturbances (Vermeer 1969). Large scale destruction of nests of Double-crested Cormorants and White Pelicans (*Pelecanus erythrorhynchos*) by fishermen and ranchers also occurred in Saskatchewan during the 1950–1965 period (Houston 1962, Carson 1966). The general attitude at that time was that fish-eating birds were harmful to fishing interests. Vermeer (1968, 1970a, 1970b, 1970c, 1971) urged the protection of Double-crested Cormorants and White Pelicans in the Canadian prairie provinces. Five colonies were given protection in Saskatchewan in 1971, partly as a result of those pleas, and both cormorant and pelican colonies have since increased in the prairie provinces dramatically (see Table 3; Weseloh et al. 1977; Roney 1979, 1982; P. W. Rakowski and W. Koonz, pers. comm.).

Double-crested Cormorants appeared to be abundant at the Great Lakes prior to this century (Lewis 1929). During the first decade of this century no colonies were reported from the Great Lakes, while in 1913 a Double-crested Cormorant colony was observed on Lake Huron (Postupalsky 1978). The cormorants spread from Lake Superior to the other Great Lakes during the next two decades and became subject to persecution by fishermen in the 1940's, who destroyed eggs, young, and adult cormorants (Baillie 1947). Even after the persecution stopped, the cormorants continued to decline during the 1960's (Weseloh et al. 1983). The decline apparently resulted from organochlorine contamination, which was greater there than anywhere else in Canada (Gilbertson and Reynolds 1974; Vermeer and Peakall 1977a, 1977b; Postupalsky 1978). High DDE levels in cormorants caused eggshell thinning and breakage which resulted in extensive reproductive failure. Cormorant reproduction continued to fail in the early 1970's but improved by the mid-1970's (Postupalsky 1978, Weseloh et al. 1983). Presently on the Great Lakes cormorant colony sizes and productivity are well above population levels of the early 1970's (Table 3).

There are two populations of the Double-crested Cormorants on the Saint Lawrence coast of Quebec, one in the estuary and the other on the north coast. The Saint Lawrence estuary, which contains half the Quebec population of Double-crested Cormorants, has grown to over 2000 pairs during the last ten years (Table 3), as a result of improved protection from harassment by people which previously depressed the growth of the population (J. L. Desgranges, G. Chapdelaine, and P. Dupuis, pers. comm.). The cormorant population on the Saint Lawrence north coast is decreasing because of continued egging and vandalism in the colonies in the absence of protection (J. L. Desgranges, G. Chapdelaine, and P. Dupuis, pers. comm.).

The above examples are only a few of the many documented cases of factors disturbing nesting cormorants. Destruction and disturbance of colonies by man appear to have been most harmful to Double-crested Cormorants (see also Lewis 1929, Anderson and Hamerstrom 1967, Erskine 1972, Ainley and Lewis 1974, Kury and Gochfeld 1975, Mitchell 1975, Matteson 1983). With growing public awareness of conservation issues, and the disappearance of egg collecting and persecution, it is not surprising that Double-crested Cormorant numbers are presently increasing across Canada and in the northeastern United States. Climatic changes causing food increases and perhaps better survival of cormorants on the wintering grounds might also be responsible for the present surge of Double-crested Cormorant numbers. However these effects on cormorants have not been substantiated.

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