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Great Cormorants Western Canada

by Anthony J. Erskine

**Occasional Paper
Number 14**

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**The Great Cormorants
of eastern Canada**
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Acknowledgements

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Introduction

Cormorants are found around most waters of the earth. These large, black diving birds nest near shallow waters with abundant fish, either on islets, cliff ledges or in trees. Van Tets (1965) distinguished two groups of cormorants: 1) birds which breed both by inland waters and on coasts; 2) birds which are exclusively marine. Only species of the first group occupy eastern North America. Here the range of the large species of the eastern hemisphere, *Phalacrocorax carbo*, referred to successively in North American publications as the Common, European, or Great Cormorant, meets that of its smaller North American relative *P. auritus*, the Double-crested Cormorant. This paper refers to these as *carbo* and *auritus*, respectively. The account is largely restricted to the cormorants of the Atlantic Provinces and adjacent coasts of Quebec, with particular reference to *carbo*. *Auritus* received intensive study in eastern North America 30-40 years ago (Lewis, 1929; Mendall, 1936), but information on *carbo* is sketchy (cf. Townsend, in Bent, 1922; Palmer, 1962). Observers, due to inexperience or distance, often confuse these two cormorant species, and their relative and absolute numbers have changed greatly during the past 150 years. This paper summarizes the historical records of numbers and distribution, and presents some details on breeding biology and reproductive success of *carbo* in eastern Canada, as a baseline against which to measure future changes.

Problems in identification

When adult *carbo* and *auritus* are seen side by side, the two species are easily distinguished. *Carbo*, represented in North America by its largest subspecies, is much larger, averaging 15 cm (6 in.) longer than *auritus*. Palmer (1962) gave no weights for North American *carbo*: the adult male *carbo* that I examined weighed 3,850 gm (8.4 lb.) and Audubon (1840) weighed an adult male of 3,400 gm (7.5 lb.), against 1,670–2,100 gm (3.7–4.6 lb.) for *auritus*. In *carbo* the gular (throat) pouch is yellow edged with white feathers; in *auritus* it is orange. From January to June, breeding *carbo* have white patches on each flank, not found in *auritus*. When present, these patches distinguish the species unequivocally. The fully grown non-breeding birds which hang around the colonies are less surely identified except by size. Both year-old birds and flying young-of-the-year, in both species, show light areas on the underside. Most field guides suggest that the greater extent of light areas on the underside, in *carbo*, is distinctive. But this is based on comparisons of winter specimens, and may not be fully reliable in the field either for summer subadults or for well grown juveniles. At a distance, and especially from July to December, most must simply be called "cormorants".

The preconceived ideas of some observers present other problems. Many visitors who have not seen *carbo* elsewhere assume all cormorants they see are *auritus*, unless they see the white head and flank markings of *carbo*. Difficulty in reaching good vantage points for viewing the birds at close range compounds the problem. Some observers, on their first visits to this area, have reported both *auritus* in localities where all other evidence suggests that only *carbo* breeds. On my first visit to a *carbo* colony, on August 10, 1957, I saw young cormorants with the field guide characteristics of both species, but all were the same size.

Distribution and numbers

Cormorants were abundant when Europeans first visited North America, although *carbo* and *auritus* were not distinguished in early accounts. Various travelers, including Champlain (cited in Lewis, 1929), found them common and collected the birds or their eggs for food. On the New England coast, cormorants as breeding species were eliminated by the nineteenth century (Gross, 1944). Collecting of murre eggs for New York and Boston markets began on the Labrador coast¹ before 1833. Probably most sea birds in New England and the Maritimes (nearer to the markets) had by then been decimated. Nuttall (1834; cited by Townsend, in Bent, 1922) stated that *carbo* bred near Boston, Massachusetts, and Audubon heard of breeding around Grand Manan Island, New Brunswick, but their accounts may have been based on former records or relict populations. Audubon apparently met *carbo* as a breeding bird only in 1833 on the Gulf north shore, where both species still nested in thousands. Bryant in 1860 and Stearns in 1881 also wrote of thousands of breeding cormorants, but Frazar in 1884 found only a few hundreds (in Townsend and Allen, 1907). Audubon's prediction that "in less than half a century these wonderful nurseries will be entirely destroyed" was ominously accurate. Vandalism by local fishermen, as claimed by Austin (1932), rather than disturbance by "eggers", may have eliminated the cormorants breeding on the outer coast of Labrador², but there too they were gone soon after 1900. Kumlien reported *carbo* breeding at Cumberland Sound, Baffin Island, in the 1870's, but Hantzsch saw only one bird in 1908–10, and none have been seen since (Soper, 1928), although breeding still occurs in west Greenland.

¹ Labrador Coast is the north shore of the Gulf of St. Lawrence, termed "Gulf north shore" hereafter in this paper.

² The outer coast of Labrador was called "Newfoundland Labrador", by early writers.

Although *auritus* persisted in the northern part of the Gulf of St. Lawrence, *carbo* was thought to have been extirpated from the western hemisphere (Bent, 1922) before protective measures began in the first decades of the twentieth century.

A few small colonies farther south received mention in the years up to 1925. Attempts by *auritus* to nest on Black Horse Ledge off the central Maine coast in 1892–1900 were frustrated by egg collectors (Bent, 1922). Reed (1904) cited a set of *carbo* eggs from this colony, but his measurements agree better with those for *auritus*, which all other references agree was the only species present. However, the only *carbo* eggs known for New Brunswick were collected at Mace's Bay in 1895 (Squires, 1952). Reports that one or both species bred in the Grand Manan group persisted through the 1920's, when A. Moses (in Tufts and Townsend, 1924) and J. S. Lord (letter to P. A. Taverner, May 16, 1923) claimed to have seen *carbo* nesting on White Horse Island off Campobello Island. H. F. Lewis (in Bayley, 1925) was told in 1912 of a former colony on Seal Island, off the southern tip of Nova Scotia, and he visited a small colony of *auritus* on the gypsum cliffs 10 miles north of Antigonish, N.S., in the spring of 1914. This last site, the Crystal Cliffs colony, has been followed intermittently ever since and was the site of most of my own observations. The history of cormorants, as of all colonial water birds on the Maritimes coasts is obscure up until 1935. Few local residents were interested, and ornithological travelers from other areas bypassed the Maritimes for the famous sea bird colonies of the Gaspé, the Gulf north shore, or Newfoundland.

Interest in protecting sea birds began to increase in the 1920's. *Auritus* was still fairly common in the northern Gulf of St. Lawrence (e.g. Townsend, 1920; Lewis, 1925d), and a few *carbo* had likely been missed in previous years.

Lewis (1924) suspected that this species still bred on Anticosti Island, although this was not confirmed until 1928 (Taverner, 1929). This island was perhaps the principal refuge for this species in North America. On July 17, 1923, H. F. Lewis (1925a) found a small colony of *carbo* at Lake Island in the Wapitagan group, near Cape Whittle on the Gulf north shore. This colony was one of those studied by Audubon and Frazar 90 and 40 years before, and Townsend (1918) identified one *carbo* when he sailed past the island in 1915. Lewis (1925b) found another tiny *carbo* colony on May 15, 1924, at Entry Island in the Magdalen group, and Bayley (1925) reported a larger one, with 100 pairs of *carbo* and 25 of *auritus*, at Hertford Island off the eastern coast of Cape Breton Island, Nova Scotia. Lewis (1929) also had reports of *auritus* colonies at Crystal Cliffs, N.S., in 1924, and at Saltkill and Heron Islands, off the south and north shores of New Brunswick, in 1927 and 1929, but we have no other Maritimes records from this decade. About 1925, *auritus* apparently recolonized the Maine coast, as by 1931 the five known colonies numbered over 1,700 birds, an amazing increase (Gross, 1944). This explosive increase continued until control measures were instituted in 1944, when 31 colonies contained over 10,000 *auritus* nests. The account of cormorants in New England may be left at that point, as there have been no suggestions that *carbo* has bred on the coasts of the Bay of Fundy or the Gulf of Maine since 1927.

Lewis (1929) summarized the distribution and numbers of northeastern *auritus* colonies, and Gross (1944) documented the subsequent growth of the Maine population. In 1940, Lewis (1941) made a careful survey of the little-known *carbo* colonies on Anticosti which, with reports from other areas, enabled him to estimate the North American breeding population of this species at 2,172 birds, or 1,086 occupied nests. More than

half of this total was on Anticosti, which has not been completely surveyed since 1940. Lewis also followed the growth of the *carbo* population on the Gulf north shore (Table 1), and some data are provided by the censuses, every 5 years, of the bird sanctuaries in this region.

Observers from the United States Fish and Wildlife Service³ visited a number of cormorant colonies in the Maritimes during their investigations of waterfowl breeding conditions there, starting in 1935. These observers reported the change from *auritus* to *carbo* at the Crystal Cliffs colony, but the account is confused. It is certain only that the change occurred. The known history of this colony is summarized in Table 2, with comments hereafter. The tenfold increase from 1924 to 1936 was corroborated by a local resident, B. Sweet (letter Jan. 11, 1971), who often took visitors to see the colony; he wrote that there were 2,000 birds at the colony in 1937, and implied that the growth had occurred when fishermen were not active along this shore owing to low prices for lobster during the depression years. The 1936 report of "Common Cormorants" is ambiguous; this name was used for *carbo* prior to the 1931 A.O.U. Check-list, but the observers may have meant only the common species, which, in absence of other reports, they may have assumed to be *auritus*. Peters' data for 1937 suggest that *carbo* was then present although he reported *auritus* only (Peters, 1940a). This was his first opportunity for close contact with the larger species, and may have been his first visit to a major cormorant colony. He banded 100 young cormorants, stated to be *auritus*, on June 8, 1937, — an improbably early date (see p. 16) for this many young *auritus* to be hatched and large enough for banding. Peters accompanied Lewis on part of the Gulf north shore survey in 1938,

where he was shown the two cormorant species together. The next year he detected *carbo* at Crystal Cliffs, and reported that three or four *carbo* were already banded. None of these was collected, but in 1940 he reported several banded cormorants of *unstates species* (italics mine), and collected one — species not stated — that he had banded in the same colony in 1937. The only *carbo* known to have been banded in North America were those handled on the Gulf north shore by Lewis (1937a). My inference is that all banded cormorants seen at Crystal Cliffs in 1939 and 1940, some or all of which were *carbo*; were banded there by Peters in 1937. The apparent rapid change from *auritus* to *carbo* in 1937 to 1943 may merely reflect his increasing awareness of the differences between the species. With 500 or more cormorants around the colony, the large proportion not individually identified would tend to be assigned to whichever species was believed more common, i.e. *auritus* in the early years and *carbo* later. The 1944 data are inexplicable except by some such assumption; Tufts had apparently not visited the colony since 1940, when everyone thought *carbo* was unusual. Sweet and Lewis (*in litt.*) both indicated that the decrease after 1944 was partly owing to persecution by fishermen following resumption of lobster fishing⁴. But it was obvious in 1960 that the colony could not possibly accommodate the 300 or more nests reported in the early 1940's, and Sweet confirmed my inference that a major cliff fall had occurred between 1944 and 1956 — the colony is on the only gypsum outcropping in a long stretch of eroding sandstone cliffs. The Monk's Head and Cape George colonies were apparently founded during the period of peak numbers, and both survived in 1956 after the main colony had

⁴ Cormorants would not affect the lobsters, but were blamed for stripping the nets used to catch bait for lobster traps.

Table 1
Growth of Great Cormorant colonies on the north shore of the Gulf of St. Lawrence, 1923–65. No data for unlisted years.

Year	No. of occupied nests at			Source
	Lake Island	Outer Wapitagan Island	Cliff Island	
1923	11	0	0	Lewis, 1925a
1924	22	0	0	Lewis, 1925c
1925	21	0	0	Lewis, 1927
1926	33	0	0	Lewis, 1927
1927	32	0	0	Lewis, 1928a
1928	48	0	0	Lewis, 1928b
1929	49	0	0	Lewis, 1930
1930	63	0	several	Lewis, 1931, 1934
1931	70	0	4	Lewis, 1934
1932	97	0	5	Lewis, 1934
1933	112	0	13	Lewis, 1934
1934	102	0	22	Lewis, 1937b
1935	83	12	30	Lewis, 1937b
1936	73	25	32	Lewis, 1938
1937	58	48	55	Lewis, 1938
1938	127 (253 adults)		many	Peters, 1938
1939	110 combined		66	Lewis, 1941
1940	140	6	86	Lewis, 1941
1945			180	Hewitt, 1950
1947	85	45	173	Gabrielson, 1952
1950			245	Tener, 1951
1955			339	Lemieux, 1956
1960			277*	Moisan, 1962
1965			182*	Moisan and Fyfe, 1967

*Observers called all birds here *carbo* in 1960, and divided them between *carbo* and *auritus* in 1965; only *carbo* records given.

dwindled. The Monk's Head colony vanished before 1960, but the one near Cape George was occupied in 1971 (W. A. Sims, letter May 13, 1971).

Peters (1942a) also reported the Cape Tryon colony on Prince Edward Island. This is the only

Table 2
Known history of Crystal Cliffs cormorant colony, Antigonish County, Nova Scotia, 1914–65. No data available for unlisted years.

Year	Data reported	Source
1914	<i>auritus</i> only; less than 50 nests	H. F. Lewis, letter Dec./70
1924	<i>auritus</i> only; 42 nests	A. C. Cox, in Boswell and Atkinson, 1936
1936	500 Common Cormorants nesting	Peters, 1940a
1937	<i>auritus</i> only; 300 nests; 100 young banded	H. Lloyd, in Peters, 1940a
1938	both species present	Peters, 1939; Peters, 1940a
1939	both species present — <i>carbo</i> 1/4–1/5 of adults; 212 nests	Peters, 1940b
1940	both species present — <i>carbo</i> 1/6–1/5 of adults; 100 young banded	Peters, 1941
1941	both species present — <i>carbo</i> more than 1/2 of adults; 275 nests	Peters, 1943
1943	<i>carbo</i> only; 331 nests	Tufts, 1962
1944	both species — <i>carbo</i> 80 pairs of total 250 pairs*	Lewis, 1957
1956	<i>carbo</i> only; 18 nests*	MNR (Erskine, Van Tets)
1960	<i>carbo</i> only; 30 nests	MNR (Erskine)
1961	<i>carbo</i> only; 22 pairs	MNR (Erskine)
1962	<i>carbo</i> only; 26 nests	MNR (Erskine)
1963	<i>carbo</i> only; 29 nests	MNR (Erskine)
1965	<i>carbo</i> only; 29 nests	MNR (Lorimer, Erskine)

*Satellite colonies of *carbo* only were noted. At Monk's Head there were 30 nests in 1944 and 20 in 1956. At Cape George there were 9 nests in 1956.

locality in the Maritimes where both species have been found on all visits by various observers (Table 3). Peters' visits in 1942–45 were usually in early May, before *auritus* was laying, while most recent visits were in July. This colony is on a vertical cliff 100 or more feet high, so is much less easily inspected — and disturbed — than many others, which partly explains the few detailed counts.

³ Including the former Bureau of Biological Survey.

Table 3
Known history of Cape Tryon cormorant colony, Queens County, Prince Edward Island, 1936-68. No data available for unlisted years.

Year	Data reported	Source
1936	colony occupied	W. A. Reddin, in Peters, 1941
1941	both species; 100 nests; about 25% <i>carbo</i>	Peters, 1941; Peters, 1942a
1942	both species; <i>carbo</i> 1/3 of 200 birds	Peters, 1942b
1943	both species; about 200 <i>carbo</i> to 150 <i>auritus</i>	Peters, 1943
1944	both species; more than half <i>carbo</i>	Peters, 1944
1945	both species; 300-350 nests; mostly <i>carbo</i>	Peters, 1945
1952	both species; 35 nests <i>carbo</i> ; 87 nests <i>auritus</i>	Godfrey, 1954
1960	both species; 36 nests <i>carbo</i> ; 108 nests <i>auritus</i>	MNR (Van Tets & Erskine)
1963	both species; about 200 adults	MNR (Thomas)
1964	both species; 4+ nests <i>carbo</i> ; 60 nests <i>auritus</i>	MNR (Vass)
1965	both species; over 200 adults	MNR (Pigot)
1967	both species; 24 nests <i>carbo</i> ; 84 nests <i>auritus</i>	MNR (Thomas)
1968	both species; 258+ adults	MNR (Thomas)

The only other colony in the Maritimes where both species may have been present is that on Hertford Island, Nova Scotia (Table 4). Bayley (1925) reported and described both species, but gave no date(s) for his visit(s) there. Tufts (1962) stated that both species were present in 1940, but other reports since Bayley indicate that only *carbo* was present. Most checklists filled out by naturalists on boat cruises around these Bird Islands are unsatisfactory evidence, for, as explained earlier, many observers have had no previous experience with *carbo* and assume that unidentified birds must be *auritus*.

A new estimate of the total North American breeding population (cf. Lewis, 1941) is not yet possible, but the records for other *carbo* colonies

Table 4
Known history of Hertford Island cormorant colony, Victoria County, Nova Scotia, 1925(?) -65. No data available for unlisted years.

Year	Data reported	Source
1925(?)	both species; 100 pr. <i>carbo</i> ; 25 pr. <i>auritus</i>	Bayley, 1925
1929	75 nests; <i>carbo</i> only	P. A. Taverner, notes in NMC*
1935	50+ nests; <i>carbo</i> only	N. Robbins, notes in NMC*
1940	both species; 39 nests <i>carbo</i> ; <i>auritus</i> also present	Tufts, 1962
1951	<i>carbo</i> only	L. O. Williams, letter, Sept. 1963
1953	<i>carbo</i> only	L. O. Williams, letter, Sept. 1963
1956	<i>carbo</i> only	L. O. Williams, letter, Sept. 1963
1963	200+ <i>carbo</i> ; no <i>auritus</i>	own data
1965	130+ <i>carbo</i> ; no <i>auritus</i> 200+ <i>carbo</i> ; no <i>auritus</i>	own data MNR (Pigot)
1968	700+ <i>carbo</i> ; no <i>auritus</i>	W. Neily (letter, May 1971)

*National Museum of Natural Science, National Museums of Canada.

discovered and/or visited since 1940 (Table 5) may be useful. At least three of the Prince Edward Island colonies (Cape Tryon, East Point, McKinnon Point) were established in the 1930's or even earlier. The lack of early data in other areas is due to the continuing lack of observations. For example, a cormorant colony on Ingonish Island, only 4 miles from Cape Breton Highlands National Park headquarters, has apparently never been visited by an ornithologist; by its location, I expect that it is of *carbo*. The colony at Guilford Island on the Eastern Shore of Nova Scotia was only discovered in 1971 (Ross, 1971), and is probably of recent origin. The Percé Rock colony of this species is certainly recent. *Carbo* was not recorded in this area until 1922, and numbers of non-breeding birds there increased very slowly (Stoddard, 1923; Bond, 1926). Despite huge numbers of interested observers visiting Percé,

Table 5
Known histories of Great Cormorant colonies not listed by Lewis (1941) or in Tables 1 to 4, with recent data on the Anticosti colonies.

Location	Year	No. of nests or pairs	Source
St. Pierre et Miquelon			
Langlade, SW coast	1945	15 adults; nesting reported	Peters and Burleigh, 1951b
	1964	20+ nests	Cameron, 1967
Langlade, SW coast	1964	reported	Cameron, 1967
St. Pierre, NW coast	1964	16 pairs	Cameron, 1967
Newfoundland			
Cape Cormorant	1944	150 pairs	Peters and Burleigh, 1951a
Coal River Head	1944	5 nests	Peters and Burleigh, 1951a
Guernsey Island	1944	25 pairs	Peters and Burleigh, 1951a
Nova Scotia			
Cape Morien	1966	73 nests	MNR (Alward)
	1970	62+ nests	S. MacLean, in Dobson, 1970
Cape Percé	1966	14+ nests	MNR (Alward)
	1967	13+ nests	MNR (Alward)
Cheticamp Island	1960	20 pairs	MNR (Van Tets)
	1961	10+ adults	MNR (Erskine)
	1962	12+ pairs	MNR (Erskine)
	1963	14 nests	own data
Margaree Island	1965	23+ nests	Erskine 1966
Guilford Island	1971	17 nests	Ross, 1971
Prince Edward Island			
East Point	1935-37	first seen	F. Sterns, in Godfrey, 1954
	1946	30-40 nests	Peters, 1946
	1952	34 nests	Godfrey, 1954
	1960	35 nests	MNR (Van Tets)
	1963	57 nests	MNR (Pigot)
	1965	162+ adults	MNR (Neily)
	1966	52+ nests	MNR (Pigot)
	1967	50+ nests	MNR (Pigot)
	1970	40-50 nests	MNR (Smith)

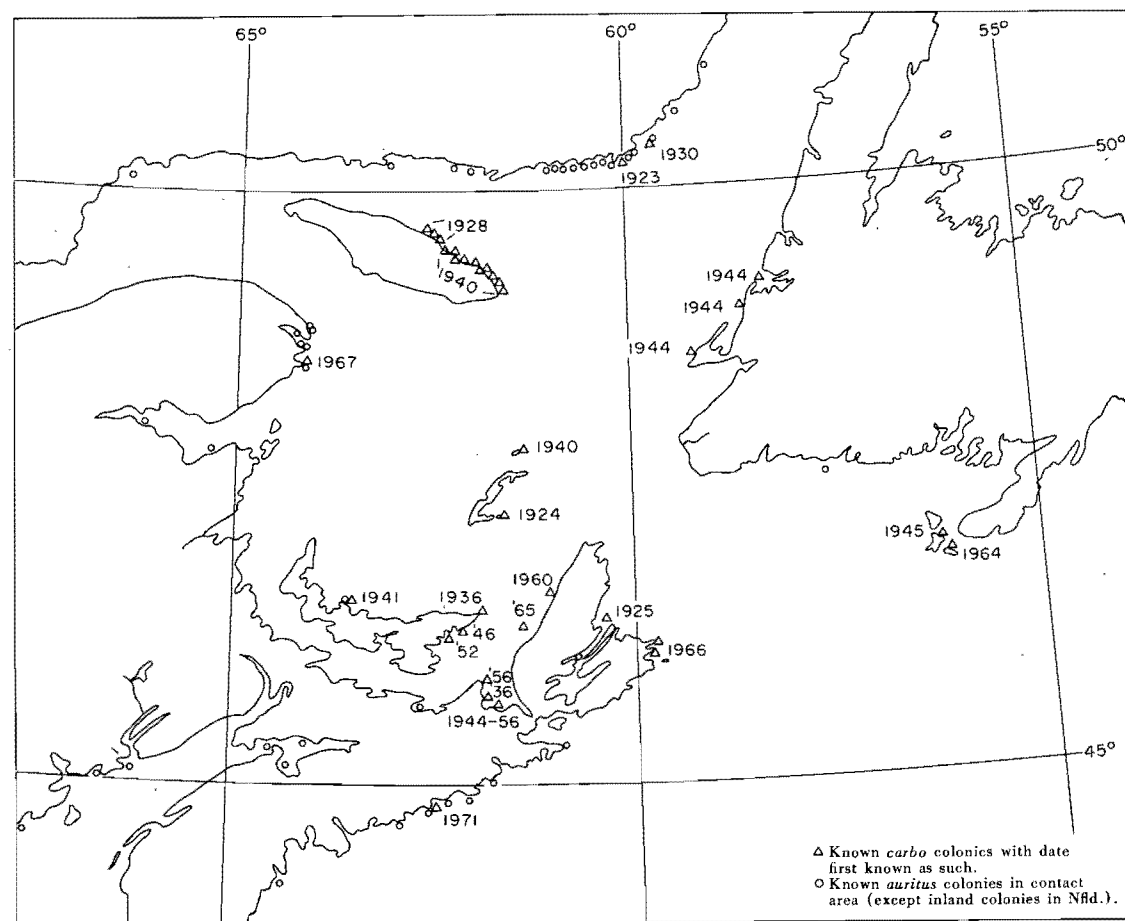
Table 5 cont'd
Known histories of Great Cormorant colonies not listed by Lewis (1941) or in Tables 1 to 4, with recent data on the Anticosti colonies.

Location	Year	No. of nests or pairs	Source
Prince Edward Island cont'd			
McKinnon Point ("Shag Rocks, Little Harbour" in Peters, 1946)	known for many years		F. Sterns, in Godfrey, 1954
	1946	15 nests	Peters, 1946
	1952	31+ nests	Godfrey, 1954
	1960	46 nests	MNR (Van Tets)
	1963	45 nests	MNR (Pigot)
	1966	16+ nests	MNR (Pigot)
Durrell Point	1952	19+ nests	Godfrey 1954
	1960	60 nests	MNR (Erskine, Van Tets)
	1963	27 nests	MNR (Pigot)
	1964	26 nests	MNR (Pigot)
	1966	64 nests	MNR (Pigot, Vass)
Quebec			
Percé Rock	1967	140 nests	H. Ouellet, (unpublished)
	1968	200 nests	H. Ouellet, (unpublished)
	1969	nesting	Y. Edwards, pers. comm.
Anticosti Island Baie des Oiseaux (Gullicliff Bay)	1963	125 adults	Ouellet, 1969
Anticosti Island W of Cap de la Table	1963	135 adults	Ouellet, 1969
Anticosti Island E of Cap Vauréal	1963	120 adults	Ouellet, 1969
Gulf north shore "Brown Barn Islands" (W of Cape Whittle)	1949	17 nests	H. F. Lewis, letter May 1971

carbo was not detected as a breeding species until 1967. The distribution of known *carbo* and *auritus* colonies around the Gulf of St. Lawrence and adjacent areas is shown in Figure 1. Undoubtedly other colonies, probably chiefly of *carbo*, exist in southwestern Newfoundland and eastern Nova Scotia, but few can have been missed in the southwestern part of the Gulf of St. Lawrence.

Figure 1. Distribution of known colonies of Great (*Phalacrocorax carbo*) and Double-crested Cormorants (*P. auritus*) around the Gulf of St. Lawrence and adjacent areas.

Figure 1



The range of *carbo* in North America is thus bounded on all sides by that of *auritus*. Few details are known of the ecology of the two species. The areas occupied by *carbo* are more regularly ice-bound in winter and thus perhaps cooler in spring. *Carbo* winters farther north than *auritus* and starts nesting several weeks earlier, often

when drift ice is close in to the colonies. The breeding distribution of both species is governed partly by the need for undisturbed nesting sites. Although both commonly nest in trees in other parts of their ranges, *carbo* is almost exclusively a cliff dweller in North America. Only Godfrey (1954) found a few nests in low, stunted trees at

the cliff tops in two Prince Edward Island colonies. *Auritus* also nests on cliffs or on the level ground on small islands—especially on the Gulf north shore—but uses trees much oftener than does *carbo*. Therefore, its choice of sites is much less restricted.

The colonies on the Gulf north shore (Table 1) increased gradually for about 20 years, with no clear changes since. Elsewhere the numbers reported have remained relatively constant, except for the marked increases at Crystal Cliffs and Cape Tryon (Tables 2 and 3) during the depression and World War II years. The population seems to have become stable around 1950, with losses from human disturbance counteracting reproductive gains. Although *carbo* apparently displaced *auritus* at Crystal Cliffs in the 1930's, and may now be doing so at Percé and on the Eastern Shore of Nova Scotia, the *carbo* breeding area has scarcely expanded since 1945.

Seasonal chronology

Previous accounts (Townsend, *in* Bent, 1922; Palmer, 1962) were very general, especially north of New England. In the Maritimes, during January and February, I have seen *carbo* only along the southwestern coasts of New Brunswick. I have never seen *auritus* during these months. The annual Christmas bird counts in late December regularly report *carbo* between southern Nova Scotia (Halifax) and northern New Jersey (Barnegat), with most birds observed in Maine and Massachusetts. Lewis (1937a) cited single January recoveries of banded *carbo* on the Gulf north shore and in eastern Prince Edward Island, although most winter recoveries were from the outer coasts of Newfoundland, Nova Scotia and Maine. *Carbo* probably lingers as far north as shallow waters remain unfrozen in winter.

A few birds approach the breeding colonies in March. Three were on an ice edge near Big Bras D'Or, Nova Scotia (20 miles from the Bird Islands) on March 10, 1964, when there was only one small patch of open water in this channel. Tufts (1962), based on his collection of partly incubated eggs at Crystal Cliffs on May 12, 1944, stated that *carbo* begins laying in Nova Scotia during late April. Recent nest records show that this timing is general in Nova Scotia and eastern Prince Edward Island, although nest initiation may vary by two weeks or more between years with warm and cool April temperatures. I have estimated by back-dating from eggs or young of known age that laying at Crystal Cliffs began about April 16 in 1960 and 1962 but not until about April 29 in 1963 and 1965. Peters' (1940b) data suggested that laying did not start until after May 8 in 1940. Laying dates for the east Prince Edward Island colonies are similar, but at Cape Tryon laying began in early May in 1942-44 (Peters, 1942b, 1943, 1944); perhaps this north-facing cliff becomes free of snow and ice later than the other, east-facing sites. Lewis (1925a and

later papers) found *carbo* young on the Gulf north shore on dates suggesting laying in the first week of May. Conditions during laying are often quite rigorous. At Durrell Point, P.E.I., on April 23, 1960, and off Crystal Cliffs, N.S., on May 6, 1961, drift ice was close in while night temperatures were near freezing and daily maxima often below 45°.

Auritus begins nesting appreciably later in the Maritimes. Although Gross (1944) gave data suggesting laying in late April in areas west of Penobscot Bay, Maine, there are no definite April layings farther east. The meagre nest records for the Maritimes show that laying could have begun in the first week of May in warmer areas such as Boot Island (Minas Basin, N.S.) in 1968 and 1969, Abercrombie (Northumberland Strait, N.S.) in 1969 and 1970 and Riordan and Heron Island (Baie des Chaleurs, N.B.) in 1970. These are the extreme earliest dates, so it is quite unlikely that in 1937 (cf. Peters, 1940a) there could have been 100 young *auritus* large enough to band at Crystal Cliffs as early as June 8—a normal date there for bandable *carbo* young.

Our earliest record of hatched *carbo* young was May 23, 1962—an early year—at Crystal Cliffs. Five of 23 nests examined contained small young. The earliest record of flying young was on July 4, 1962, at the same colony. These and other records suggest that first flights may occur as early as age 42–45 days, rather than 50 days (cf. Palmer, 1962). In most years some young are flying by mid July, so counts later on undoubtedly underestimate the actual size of a colony.

Nesting attempts continue, following loss of early eggs. I have seen *carbo* eggs as late as July 22, 1965, at Margaree Island, N.S., and W. Neily (MNR) saw eggs in one nest at East Point, P.E.I., on August 15, 1965. Probably such late eggs are usually abandoned, as we have no young reported in nests later than August 23, also in 1965, at

Bird Island, N.S. (Pigot, MNR). Most colonies are deserted by about mid August, except in late years such as 1965.

Post-breeding cormorant flocks occur in some areas of the Maritimes, but usually the birds are so wary one cannot approach near enough to determine the species. At one flocking area near Conway Narrows, P.E.I., up to 400 birds assemble annually during August (M. and U. Thomas, pers. comm.); we saw at least 100 there on August 2, 1969. B. Sweet (*in litt.*) reported at least 350 near the Crystal Cliffs colony in late July 1970. Concentrations, probably of *auritus*, on outlying reefs along the outer coasts of Nova Scotia are better known. Such rocky ledges are scarce in much of the Gulf of St. Lawrence, where most cormorants rest on sand or gravel bars in late summer and autumn. Some *carbo* stay near the colonies into October. I saw 37 on gravel bars at the mouth of Antigonish Harbour, N.S., on October 3, 1961, and 14 there on October 7, 1968. They normally arrive on the Massachusetts coast in the second week of October (Bailey, 1955).

Clutch size

No intensive studies have been made at breeding colonies in North America, but data from Maritimes nest records allow an estimate of clutch size:

No. of eggs or young seen	No. of nests with		Only young or eggs and young counted (nests found after hatching began)
	Clutch counted on two dates	Clutch counted only once	
1		52	3
2	1	59	15
3	3	69	32
4	3	39	12
5		12	3
6		1	1

Even if one assumes that all one and many two egg sets are incomplete or have already lost eggs, the most frequent clutch is three eggs, with two and four about equally numerous. The value of 4 to 5 or occasionally 6 eggs, quoted by Palmer (1962) from Bent (1922) is evidently unrepresentative, as is Tufts' (1962) figure of 3 to 7, usually 4 to 5, eggs. Audubon (1840) and Godfrey (1966) gave 3 to 4 eggs, and Witherby *et al.* (1940) for Britain 3 to 4, occasionally 5, rarely 6, eggs, which agree with the values found here. *Auritus* clutch sizes in this region are similar to those of *carbo* (Lewis, 1929; Gross, 1944).

Reproductive success

Persecution of cormorants in eastern North America has a long history (e.g. Audubon, 1840; Austin, 1932) and disturbance of breeding colonies continues to this day. Bird students and naturalists have been partly responsible, even though their primary motive is no longer egg collecting. Incautious attempts to inspect colonies to list or photograph a "life bird" can lead to serious losses of eggs or small young, as crows or gulls will approach the nesting cliffs more promptly following such disturbance than will the adult cormorants which were frightened away (cf. Drent and Guiguet, 1961). Until the Bird Islands boat cruise was established about 1958, most naturalists visited Crystal Cliffs (still the only mainland colony of *carbo*). Fortunately, most of these visits occur from late June into August, when young *carbo* are well grown; visits in May and early June would be far more destructive. Fishermen, however, cause most disturbance at other colonies. Some colonies are deliberately raided, either "to protect fishing interests" or simply for vandalism. Much recent disturbance is simply from the presence of men, in boats, setting or tending lobster traps close to the nesting cliffs.

Deliberate destruction of *carbo* eggs was noted twice at Durrell Point, P.E.I. Only six adults were present on July 3, 1960, when all the nests were empty, although about 60 pairs were there in late April (Van Tets and Erskine, MNR). On June 5, 1966, B. Pigot (MNR) found eggs or young in only 10 of 64 nests though over 190 adults were present; he found many broken eggs and a rope dangling over the cliff, indicating deliberate vandalism. Presumably no young were reared in these years. If such raids occurred annually, the colony would probably disappear. *Auritus* and other birds permanently abandoned the Cape Whittle bird sanctuary on the Gulf north shore after prolonged disturbance due to a ship wreck and salvage through one summer and

Summary

lighthouse construction the following breeding season.

The Crystal Cliffs colony was relatively successful in 1962, when 11 of the 26 nests inspected held large or already fledged young by July 4; several other nests may also have succeeded. In contrast, only two nests there had even small young by June 27 in 1963 and few if any young could have been reared that year. The Cheticamp Island and Margaree Island colonies also showed signs of frequent disturbance, with prolonged laying and no obvious nesting peaks. The least accessible colonies are the most successful — Cape Tryon, on a very high cliff with no nearby boat harbour, and the Bird Islands, far from shore, visited only by cruise boats which take care not to unduly disturb the birds. Fortunately cormorants are long lived, and if they have even one successful nesting in two or three years they can probably maintain their numbers. The explosive increase of *auritus* in Maine (Gross, 1944) shows the reproductive potential of a well protected population with adequate food resources. The Maritimes *carbo* colonies have reached their present numbers in spite of limited disturbance. Birds there are protected by provincial laws, although only the Bird Islands colony is a sanctuary (of the Nova Scotia Bird Society). The population would be much larger with more protection.

The scarcity of North American information on the Great Cormorant (*Phalacrocorax carbo*) prompted an examination of recent data, chiefly from the Maritime Provinces of Canada. Historical records often confused this species with the Double-crested Cormorant, so the record of former distribution and numbers is reviewed. Its range once extended from Massachusetts to the outer coast of Labrador, but by 1900 it was believed extirpated in North America. Probably it survived on Anticosti Island and, about 1920, began to recolonize other parts of the Gulf of St. Lawrence. Despite sporadic persecution, it has increased to be a fairly common bird in the northeastern two-thirds of the Gulf, where its numbers are held in check partly by a scarcity of suitable sea-cliff sites for nesting and partly by disturbance of its colonies. Its range is bordered on all sides by the Double-crested Cormorant, with which it shares a few colonies, but it has only displaced the smaller species at one colony in Nova Scotia. The still imperfect knowledge of east coast sea bird colonies suggests that its range has not altered appreciably during the past 25 years.

Eggs are laid from late April or early May until early July, but most laid after early June are later abandoned, and the colonies are usually deserted by mid-August. Laying dates vary in relation to temperatures during April. Clutch size is most often three eggs, with two and four about equally common, and five quite uncommon. Breeding success depends heavily upon freedom from disturbance during May and early June, but the population can apparently maintain itself with one good breeding season in two or three years.

Postscript

(with A. R. Lock; added March 1972)

During May and June 1971, A. R. Lock, with financial assistance from CWS, made a survey and preliminary census of sea-bird colonies in Nova Scotia. Although generally confirming the outline presented in this publication, the following points emerged.

Seven previously unvisited colonies of *carbo* were found along the little known southern shore of Cape Breton Island, three of these being shared with *auritus*. One other colony (besides Guildford Island) off the Eastern Shore and a few pairs of *carbo* in two large *auritus* colonies on southwestern Nova Scotia coasts were also reported for the first time. The main breeding range of *carbo* thus extends as far south as Guildford Island, rather than only to Cape Morien as suggested in the map.

All of the new colonies on the seaward coasts of Nova Scotia were on low, rocky islands, as on the Gulf north shore, rather than on sea cliffs as in northern Cape Breton Island and the southern part of the Gulf of St. Lawrence.

The new data suggest total breeding populations for Nova Scotia of about 2,100 pairs of *carbo* and 4,200 pairs of *auritus*, compared to fewer than 100 pairs of *carbo* in 1940 and 67 pairs of *auritus* in 1929 (from summaries by Lewis). These are similar to the increases already documented for *carbo* on the Gulf north shore and for *auritus* in Maine.

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