Size and trends of Black-legged Kittiwake (*Rissa tridactyla*) populations in the Gulf of St. Lawrence (Quebec) 1974–1985

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THE RANGE OF THE BLACK-legged Kittiwake during the breeding season extends over the coasts and islands of the arctic and boreal regions of the northern hemisphere. Colonies in the British Isles have been surveyed regularly, and the results indicate a total population increase in the order of four percent per year between 1930 and 1969. For the period 1969–1979, the annual growth rate was two percent (Coulson 1985). In southern Norway, the population expanded by six to 8.5 percent (Barrett 1985) from 1967 to 1975 and between four and five percent from 1977 to 1983. For the colonies in northern Norway, the annual increase was only one percent over the same period (Barrett 1985).

In Canada, there are fragmentary data that tend to indicate positive growth for Black-legged Kittiwake populations in the last 15 years (Chapdelaine 1980; Brown and Nettleship 1984; Chapdelaine and Brousseau 1984; Lock 1986). However, since the surveys do not cover the entire territory, it is difficult for us to specify the area in the western Atlantic where the increase initially occurred or the rate at which the colonies have expanded.

The purpose of this study was to provide updated information on the range and abundance of the Black-legged Kittiwake in the Gulf of St. Lawrence in Quebec and to measure the growth rate of colonies for which historical data exist.

Methods

We used the Atlas of Eastern Canadian Seabirds (Brown *et al.* 1975) as a basic reference with regard to the abundance and distribution of the kittiwake colonies for the year 1974. All the colonies identified in the Atlas and 18 new colonies have been surveyed systematically since then. Essentially, two census techniques were used in surveying the colonies: systematic counts of occupied nests from the shore or a boat; and systematic counts of nests on aerial photographs.

In 1985, using a 6X7 Pentax camera with a 105-millimeter lens and PXP 120 black-and-white film, eight colonies including 78.8 percent of the total Gulf population were photographed. Quality of photographs was excellent, and counts were made from 20 X 20 cm enlargements with a stereoscope (10X) and a semiautomatic counter. Table 1 indicates the census techniques for each of the colonies. The surveys were all conducted during the chick-rearing period, in June and early July.

Figure 1. *Herring Gull predation on kittiwake young in the nest accounts for 60 percent of chick loss. Photograph/Gilles Chapdelaine.*

TABLE 1. Distribution and abundance of Kittiwakes (*Rissa tridactyla*) in the estuary and Gulf of St. Lawrence (Quebec).

Colony Site	*Coordinates*	*Year of last survey*	*Number of pairs*	*Methods*[1]	*Authority*[2]
Estuary					
Bicquette reefs	48°25′N, 68°53′W	1984	54	TC	1
Bicquette Island	48°25′N, 68°53′W	1986	135	TC	1
Brandy Pot Island	47°52′N, 69°41′W	1986	12	TC	4
Gulf					
Corossol Island	50°05′N, 66°23′W	1985	4,013	TC	1
Manowin Island	50°06′N, 66°24′W	1985	37	TC	1
Grosse Boule Island	50°08′N, 66°18′W	1985	47	TC	1
Petite Boule Island	50°10′N, 66°18′W	1985	145	TC	1
Île aux Bouleaux du Large	50°14′N, 63°59′W	1983	1,222	TC	1
L'Îlot	50°12′N, 64°09′W	1983	7	TC	1
Betchouane	50°14′N, 63°10′W	1982	12	TC	1
Pointe du Renard	49°18′N, 61°50′W	1985	114	TCP	1
Table Head	49°12′N, 61°44′W	1985	1,666	TCP	1
Falaise aux Goélands	49°09′N, 61°42′W	1985	22,840	TCP	1
Pointe de l'Est	49°08′N, 61°40′W	1985	1,061	TCP	1
Île du Lac	50°11′N, 60°05′W	1977	few	—	1
Îles Sainte-Marie	50°19′N, 59°39′W	1982	74	TC	1
Forillon Peninsula	48°45′N, 64°10′W	1982	5,467	TC	2
Les Trois Soeurs	48°32′N, 64°13′W	1985	1,483	TCP	1
Rocher Percé	48°31′N, 64°12′W	1979	90	TC	1
Bonaventure Island	48°39′N, 64°07′W	1985	23,544	TCP	1
Cap d'Espoir	48°25′N, 64°19′W	1985	3,576	TCP	1
Falaise Sainte-Thérèse	48°24′N, 64°26′W	1979	45	TC	1
Port-Daniel	48°11′N, 64°56′W	1979	13	TC	1
Rocher aux oiseaux	47°51′N, 61°12′W	1984	3,690	TCP	1
Brion Island	47°48′N, 61°29′W	1985	2,003	TCP	1, 3
Île d'Entrée	47°17′N, 61°42′W	1976	40	TCP	1
TOTAL			71,390		

1 TC = Total count; TCP = Total count in photos.

2 Data are from: (1) Canadian Wildlife Service file; (2) H. Briard Parks Canada; (3) A. Codère; (4) J. Bédard.

Results and Discussion

We compared the distribution of kittiwake colonies in the Gulf of St. Lawrence for 1974 with that recently revised in 1985. In 1974, 11 colonies were acknowledged with a total population of 43,000 pairs (Brown *et al.* 1975), in contrast to 26 colonies and 71,390 pairs in 1985 (Table 1). The Bonaventure Island and Falaise aux Goélands represented 66.5 percent of the total breeding population in 1985, compared with 78 percent in 1974. Currently, these two colonies account for 23,544 and 22,840 pairs respectively. Nine colonies number between 1000 and 6000 pairs and account for 34 percent of the population, while 15 others have under 500 pairs and represent only one percent of the total population size.

We also examined the population growth of eight colonies with regards to colony size (Table 2). The growth percentage allows us to assess population change, while the compound annual growth rate (r) provides a more accurate indication of the speed of annual growth in the colonies (Ricklefs 1975). It can be noted that the colonies with high initial counts, such as Bonaventure Island and Falaise aux Goélands, exhibited smaller growth rates than the colonies with low initial counts. If we establish a linear relationship between the natural logarithms of the initial colony counts (x) and of the growth percentage (y), we obtain $y = 0.44 - 0.04\,x$ ($r_s = -0.65$; $p = 0.05$). In general terms, the small colonies grow more rapidly than the large colonies. This observation is consistent with that made by Coulson (1983) regarding the growth of 45 colonies in the British Isles during the period from 1959 to 1969, where small colonies expanded more quickly. For the same period, Coulson

Figure 2. *Section of kittiwake colony at Anticosti Island. Notice small gannet colony on upper part of the point in left foreground. Photograph/Pierre Brousseau.*

reported an annual growth rate in the order of four percent for the total kittiwake population of the British Isles. This rate is very similar to the five percent figure obtained for the Gulf of St. Lawrence although, in the latter case, the period under consideration is 1974 to 1985.

The current review shows clearly that the kittiwake population in the Gulf of St. Lawrence has increased over the last 12 years. This increase follows rises reported elsewhere in the boreal waters of the North Atlantic during the past 25 years (Barrett 1985; Coulson 1985; Lock 1986). It is very difficult to establish with certainty the causes of this increase because of the lack of basic data on the net productivity of each of the colonies, the adult and subadult rates of survival, and the abundance of prey before and during the breeding season over this 12-year period.

At present, the only data available on kittiwake net productivity in the Gulf are from a study conducted at Corossol Island in 1985. After daily monitoring of 291 nests during the breeding season (May to August) we recorded an average of 1.9 eggs per nest, a hatching success of 69.5 percent, and a fledging success of only 32.2 percent, or 0.62 fledgling per nest (Chapdelaine et Brousseau, *in prep.*). If we apply to these figures a survival rate to breeding age of 0.426 and an adult survival rate of 0.81 (Coulson and Wooller 1976), we find that productivity at Corossol Island in 1985 was below the threshold value of 0.88 fledgling per nest required to maintain the population at its current level. The poor fledging success of this colony was attributed to predation by Herring Gulls (*Larus argentatus*) on chicks in the nest (Fig. 1). Such predation accounted for over 60 percent of the chicks lost. It should be noted that the Corossol Island Herring Gull population is 7254 pairs, while the kittiwake population is 4013 pairs, (Brousseau et Chapdelaine, 1987) and that the low, stepped cliffs with gentle slopes favorable for wandering gulls facilitate their predation.

Figure 3. *Typical young kittiwake chick at nest site. Photograph/Pierre Brousseau.*

However, this situation is peculiar to this colony. Among the 26 colonies listed in Table 1, 20 are characterized by high, vertical cliffs with very narrow ledges that limit predator access (Fig. 2). Moreover, the kittiwake populations in these colonies greatly exceed the local Herring Gull populations. Thus there is reason to believe that the net productivity of the other colonies in the Gulf is higher, since conditions are more favorable for nesting.

Availability of food during the 1985 breeding season at Corossol Island appeared to be satisfactory, since the average chick growth rate was 18.6 g/day (clutches of one, two, and three eggs), which is comparable to or greater than the figures for other study sites in the North Atlantic (Maunder and Threlfall 1972; Barrett and Runde 1980; Coulson and Porter 1985). Even the chicks that were lost through gull predation exhibited a perfectly normal growth rate until the day of their demise (Fig. 3). In England, Coulson (1985) reported stability in average chick growth rates between 1954 and 1982, which suggests an abundance of food during all these breeding seasons. Nonetheless, the British Isles population growth rate tapered off between 1969 and 1979, and some colonies showed declines (Coulson 1983). According to the same author (Coulson 1985), this drop may be explained by a reduction in fish stocks outside the breeding season, which has led to lower adult survival and reproductive success.

In the western Atlantic, Lock (1986) concluded that the new colonies at Cape Breton, Nova Scotia, were formed by young kittiwakes that had frequented the fish-filled local waters during their subadult stage. When they reached maturity, the birds inhabited the cliffs near these waters, where food was abundant. Informa-

TABLE 2. Growth percentage and compound annual growth rate (r) for eight kittiwake colonies breeding in the Gulf of St. Lawrence.

Colony	*Period*	*Initial counts*	*Last counts*	*Growth percentage*	r^1
Bonaventure Island	(1974–1985)	14,849	23,544	58.5%	4.6%
Falaise aux Goélands (Anticosti Island)	(1972–1985)	18,468	22,840	27.5%	1.8%
Forillon Peninsula	(1973–1982)	684	5,467	699.0%	26.8%
Corossol Island	(1965–1985)	160	4,013	240.8%	13.4%
Île aux Bouleaux	(1965–1985)	137	1,222	791.9%	12.8%
Les Trois Soeurs	(1974–1985)	174	1,483	752.2%	21.5%
Cap d'Espoir	(1974–1984)	121	3,576	2,855.3%	35.0%
Îles Sainte-Marie	(1977–1982)	24	74	208.3%	28.2%

1 $r = \frac{\log_e N(t) - \log_e N(o)}{t} 100\%$.

tion from the fisheries sector indicated a significant increase in sand lance (*Ammodytes*) stocks on the Georges Bank, in the Gulf of Maine, and on the Newfoundland Grand Banks (Sherman *et al.* 1981). For the Gulf of St. Lawrence, we do not have information on non-commercial species such as capelin (*Mallotus villosus*) or sand lance. However, we are aware that during the breeding season diet of the kittiwake is essentially composed of these two species (Chapdelaine and Brousseau, *in prep.*). If the abundance of such fish has led to expansion of the kittiwake population in the Gulf of St. Lawrence, it would be interesting to determine whether other seabird species with similar diets have also increased their numbers. A number of species of Alcidae and Laridae present in the Gulf feed mainly on capelin and sand lance (Bradstreet and Brown 1985; Chapdelaine *et al.* 1986). A partial review of surveys conducted between 1974 and 1985 shows that the numbers of the Atlantic Puffin (*Fratercula arctica*) and Common Murre (*Uria aalge*) on the Lower North Shore of the Gulf of St. Lawrence increased between 1977 and 1982 (Chapdelaine and Brousseau 1984). The Common Murre now breeds successfully on Corossol Island, where it was absent prior to 1972. In 1975, the Common Tern population of the Gaspe peninsula comprised 100 pairs in a single colony. By 1983, the number had risen to 1000 pairs in four colonies (Canadian Wildlife Service files, Québec Region, unpubl.). For the Arctic and Common tern populations of the Mingan Archipelago, an increase of on the order of nine percent per year was noted between 1978 and 1983 (Brousseau 1984). Moreover, a rise in the observed incidence of sand lance has been observed in the diets of more generalist species such as the Double-crested Cormorant (*Phalacrocorax auritus*) (Hatch 1984) and the Northern Gannet (*Sula bassanus*) (Burton 1980; W. H. Montevecchi, *pers. comm.*) All these observations lead us to infer that the abundance of a food source such as sand lance may have contributed to the kittiwake population increase in recent years. It is impossible to determine, however, whether the abundance of food has had a positive influence on the adult and the subadult survival rate or on the net productivity in the colonies during the last 15 years. It is plausible to assume that these three basic parameters of population dynamics were involved in the increase of kittiwake numbers in the Gulf of St. Lawrence.

Finally, we conclude that the kittiwake can be used as an important marine environment indicator in connection with monitoring programs. This is a species that is easy to survey, with a fairly high reproductive potential (two or three eggs), and reaches sexual maturity more quickly than a number of other specialized species such as the auks. Because of these characteristics, kittiwake population fluctuations and trends can be detected relatively soon after a change to the marine environment food chain.

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