LASKEEK BAY RESEARCH

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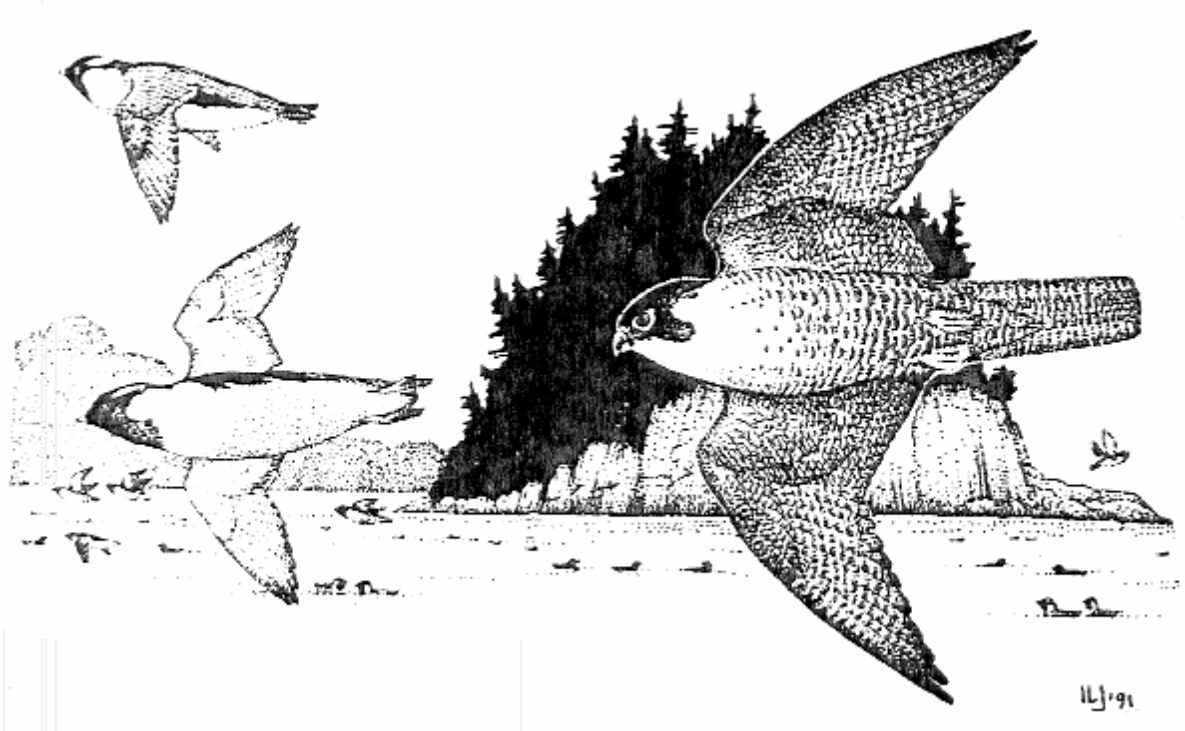
LASKEEK BAY CONSERVATION SOCIETY

ANNUAL SCIENTIFIC REPORT, 1995



November, 1996

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ANNUAL SCIENTIFIC REPORT, 1995

Edited by

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LASKEEK BAY CONSERVATION SOCIETY

The Laskeek Bay Conservation Society is a volunteer group based in the Queen Charlotte Islands. The society is committed to increasing the appreciation and understanding of the natural environment through:

sensitive biological research that is not harmful to wildlife or its natural habitat

interpretation and educational opportunities for residents of and visitors to the Queen Charlotte Islands

Established in 1990, the society is committed to a long-term seabird research programme in the Ancient Murrelet colony at Limestone Island. For further information, contact:

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BACKGROUND

The goals and objectives of the Society are:

1. *To undertake and support research and long term monitoring of wildlife populations, including nesting seabirds and other marine birds, forest birds, marine mammals and introduced species of the Laskeek Bay area (roughly coastal waters of Hecate Strait from Cumshewa Inlet to Lyell Island) of Haida Gwaii, the Queen Charlotte islands.*

2. *To provide information on all aspects of the biology of the Laskeek Bay area for residents of Haida Gwaii, the Queen Charlotte islands, and visitors to the area.*

3. *To encourage students and residents of the area to participate in field programs and to undertake and assist in presentations and other activities that promote better understanding and improved conservation of marine birds and forested and marine ecosystems throughout Haida Gwaii, the Queen Charlotte Islands.*

INTRODUCTION

The Laskeek Bay Conservation Society organizes a volunteer programme each summer to carry out educational activities based on biological monitoring and research. During the past six years, a camp at East Limestone Island has been operated during the spring and early summer. In 1995 it was run from mid-March to mid-July.

The scientific work of the Society continues and extends a programme that was initiated by the Canadian Wildlife Service in 1984. The aim of the work is to provide long term information on the biology and ecology of marine birds. Because they are top predators in marine food webs, marine birds are very sensitive indicators of environmental change. Things like the abundance of zooplankton, that may be difficult and expensive to measure directly over large areas, are reflected in changes to the behaviour and abundance of marine birds. By tracking a variety of species, with different habitat and diet needs, we can obtain an overall measure of the health of the marine ecosystem locally. Because marine waters may be subject to cyclical or directional changes operating at the scale of decades, such observations become most valuable when they are tracked consistently over many years.

In addition to the marine bird work, the Society is undertaking several other studies aimed at better understanding of the marine and terrestrial ecosystems of the Laskeek Bay area. These studies include maintaining records of all marine mammal activities in the area, and monitoring the sea lion haul-outs, gull colonies and Peregrine Falcon eyries. Studies of forest bird populations, including songbirds and woodpeckers, were begun in 1992. Documentation and study of rare plants and introduced mammal species on Limestone Island are also ongoing.

About the 1995 report

This report marks a departure from earlier scientific reports, that gave an overview of all the Society's activities in a given year, along with retrospective analyses of inter-year trends and variations. Because the scope of the Society's research is expanding, and because many of the routinely collected data will not reveal any startling new information from a single season, we have decided to reduce the space devoted to routine

observations and to concentrate on a few, more in-depth analyses of particular topics. These analyses are presented in the form of self-contained "papers" with their authors specified individually, rather than the whole document appearing under the editor's name(s), as in the past. In addition, some regular monitoring data are presented as appendices without methodology or discussion. The methods used in obtaining this routine data are described in earlier reports.

ACKNOWLEDGEMENTS

The Laskeek Bay Conservation Society is a non-profit volunteer-run organization, and could not operate without the generous support from a wide variety of groups and individuals. We gratefully acknowledge the contributions of all our supporters, including the following groups:

•The National Wildlife Research Centre of the Canadian Wildlife Service, for financial support and equipment loans;

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• The W. Alton Jones Foundation for invaluable financial assistance in establishing administrative/fundraising support and building a strong interpretive program

• The Ministry of Environment, Lands, and Parks, Wildlife Branch, for permission to conduct our programs in the Skedans, Limestone, and Reef Islands Wildlife Management Area;

• The Gwaii Haanas Archipelago Management Board for permission to conduct surveys in the southern Laskeek Bay area;

• And finally an enormous appreciation of each volunteer who came to East Limestone Island to discover and to help. We hope to see you again!

CONTENTS

LIST OF FIGURES

SEABIRD DISTRIBUTIONS IN LASKEEK BAY

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ABSTRACT

We carried out surveys of marine bird distributions in waters between the Skedans Islands and the mouth of Selwyn Inlet twice a month during the 1990-95 field seasons, using an inflatable boat and 2-3 observers. The diversity of species recorded was highest in April, when many ducks were present, and lowest in June. The four commonest species recorded were all auks: Ancient Murrelet, Marbled Murrelet, Pigeon Guillemot and Rhinoceros Auklet. Substantial inter-year variation was found in the numbers of all the common species, although Pigeon Guillemots were less variable than the others. Our results demonstrate the possible errors involved in extrapolations from single-year surveys. For all four species, distance from Louise Island (the mainland) was a much more important factor in their distribution than water depth. Marbled Murrelets and Pigeon Guillemots were found almost exclusively within 2 km of the mainland, while virtually all Ancient Murrelets occurred more than 2 km offshore, perhaps because of the risk of predation by Peregrine Falcons and Bald Eagles. Rhinoceros Auklets also occurred predominantly more than 2 km offshore, although high numbers were recorded closer inshore in Skedans Bay. Shelter from rough seas may be a factor in concentrating birds, especially cormorants, to the north of Vertical Point.

Introduction

The waters of northern Laskeek Bay, north of Reef Island, are used by many species of marine birds (Gaston and Jones 1991). Although most of the species of seabirds recorded are common around Haida Gwaii, their distribution in relation to features of bathymetry and distance from land has been little studied. Nor is the timing of peak numbers, or the magnitude of inter-year variation known, although Gaston and Jones found big differences in the frequency of sightings of certain species from year to year.

The Marbled Murrelet, listed as vulnerable by the Committee on the Status of Endangered Species in Canada, is a common bird in inshore waters of Laskeek Bay. Marbled Murrelet populations are very hard to census on the ground and surveys of birds at sea during the breeding season have been

used to obtain estimates of their comparative abundance in different parts of the province. Unfortunately, little is known about how Marbled Murrelet numbers may fluctuate from year to year. To improve knowledge of the habitat requirements of marine birds in the area, and to measure year-to-year variation in the abundance of different species, especially Marbled Murrelets, the Society has carried out systematic surveys of seabird distributions in northern Laskeek Bay since 1990. This paper reports the results of surveys carried out to date, emphasizing broad seasonal trends and the effects of distance from land and water depth on distributions.

Methods

We counted birds on a set of fixed transects (Figure 1) repeated at approximately 2-week intervals from April to July. Coastal transects were run 400 m from the shore, except inside the Limestone islands, where they were run equidistant between those and Louise Island. We used an inflatable boat run at a steady speed, just sufficient to keep it planing (about 20 km/h). One person drove the boat and one or two others recorded the birds, noting the time of each sighting. The time of starting and finishing each transect segment was recorded and the position of each sighting was estimated, assuming a fixed speed over the entire transect. All seabirds were recorded: species, number and age/sex where possible and whether flying, or on the water. Birds estimated to be more than 200 m perpendicular distance from the transect line were recorded as "off-transect".

In order to illustrate the distribution of marine birds in northern Laskeek Bay, we have mapped the occurrence of some of the more common species. For the straight-line transects run in offshore waters we could plot the position of each sighting accurately and have calculated the mean numbers of each species by 1 km segments. For coastal transects, our database did not always record the whereabouts of each sighting within a transect. For those transects where the sightings were not mapped, we calculated average numbers per 1 km over each transect (those labelled D-M; maximum length 3 km) and assigned the mean value (birds/km) for the entire transect to each 1 km segment. These values were combined with exact counts, where available, to calculate mean values for the entire data set. This procedure accounts, to some extent, for the apparently more uniform distribution of

birds on the coastal transects, compared with those offshore.

To analyse the effect of water depth and distance from land on distributions, we measured the water depth at the mid-point of each 1 km transect segment, by interpolation from the hydrographic chart of the area. We also measured the distance from each midpoint to the nearest land and to the nearest point on Louise Island (the "mainland" in this context). For analysis, we lumped water depths into five categories: <20 m (1), 20-24 m (2), 25-29 m (3), 30-34 m (4), and >34 m (5). Distance from Louise Island was divided into four categories: < 1 km (1), 1-2 km (2), 2-4 km (3), >4 km (4).

Figure 1. Seabird survey transects in Laskeek Bay.

Results

The following results are based only on birds counted on transect. Thirty-six surveys, each consisting of one complete transect set (D-M, 1, 3, 5, 7, 8,and 9), were carried out over the six seasons, 2 in March, 9 in April, 14 in May, 11 in June and 2 in July. Altogether, we recorded 25,426 birds, averaging nearly 700 birds per survey. The most common species all belonged to the auk family (Figure 2): Ancient Murrelet (40% of birds seen), Marbled Murrelet (34%), Pigeon Guillemot (8%) and Rhinoceros Auklet (5%). The diversity of species recorded was highest in April, when ducks of 13 species made up 14% (568) of birds sighted. In May, although 11 species of ducks were seen, they made up only 2% of sightings; only 11 ducks of 2 species were seen in June (Figure 3). Likewise, cormorant numbers declined from a peak of 653 (16% of sightings) in April, to only 120 in June.

Figure 2. Seabird surveys, 1990-95, species composition

Figure 3. Seabird surveys, 1990-95, monthly totals, all species

Numbers of both the two commonest species peaked in May, when Ancient and Marbled Murrelets comprised 82% of all birds seen, compared to 47% in April and 72% in June. Rhinoceros Auklets increased throughout the season, being only 2% of birds seen in April and May, but 12% of those recorded in June. A total of 291 loons, mainly Pacific Loons, were recorded in May, boosting the sightings of "other species" in that month.

Inter-year variation

Samples for most species were too small to reveal inter-year variation. Those species identified by Gaston and Jones (1991) as showing major year-to-year fluctuations (Black-legged Kittiwake, Herring Gull, Sooty Shearwater) are all found mainly well offshore, in Hecate Strait, and rarely occurred in the area covered by our transects. Among the four common auks, the maximum numbers counted on surveys varied considerably among years for Rhinoceros Auklets (1-178) and Ancient

Murrelets (86-1726), but were less variable for Marbled Murrelets (212-445) and Pigeon Guillemots (47-129, Figure 4). For all species, the numbers counted per kilometre of survey varied widely, many segments having no sightings at all, while others had scores, or even hundreds (especially Ancient Murrelets on transect 3). Consequently, we could not use statistical tests based on normal distributions to test for inter-year differences. Instead, we took a conservative approach, by using the non-parametric Kruskal-Wallis test to compare whether numbers seen per kilometre varied among years. To illustrate the variation, we have plotted the means and standard errors of data transformed to $\log_{10}$ (Figure 5) and also presented medians and 25-75% range boxes (Figure 6). The median and range plot emphasizes the large overlap between years. Kruskal-Wallis tests for inter-year variation showed that there was significant variation in numbers counted for all species, although variation was lower for the Pigeon Guillemot than for others (Table 1).

Figure 4. Survey count maxima for auks, 1990-95

Figure 5. Inter-year variation- means, standard errors, 95% confidence limits

Figure 6. Inter-year variation - median, 25-75% range, total range

Table 1. Results of Kruskal-Wallis ANOVA among years for numbers seen per kilometre.

	MAMU	ANMU	RHAU	PIGU
Area	<2 km offshore	>2 km offshore	>2 km offshore	<2 km offshore
Kruskal-Wallis "H"	22.1	23.1	19.5	13.0
Probability	0.0005	0.0003	0.0016	0.0231

The significance of inter-year variation is unclear because there was little congruence between species, with high years for Marbled Murrelets (1992, 1993) coinciding with low years for Ancient Murrelets. Moreover, the birds counted in our survey area probably fed over a much wider area and fluctuations may relate to very local differences in the availability of food. The two lowest years for Marbled Murrlets were also the lowest for Rhinoceros Auklets, suggesting that the same events may have affected both species. This is also supported by comparisons of the total numbers of the two species counted on each survey, which are strongly correlated (Figure 7). This is despite the fact that there is very little overlap in the feeding area of the two species (see below). Fluctuations in the local availability of certain prey species common to both birds may account for these similarities.

Figure 7. Comparison of MAMU and RHAU counts, 1990-95, May-July

Distributions

More species were recorded in coastal waters (<1 km from Louise Island) than farther offshore. This applied particularly in April, when most ducks were present along the coast, and especially in the sheltered waters inside Skedans Bay.

Pelagic Cormorant. This species has not bred in Laskeek Bay since the 1980s, when there was a small colony on Reef Island. However, large numbers of non-breeders occur throughout the year and important roost sites are located on Kingsway Rock, on the eastern tip of and on reefs within the Skedans Islands, on rocks in Skedans Bay and on the Sealion Rocks off Reef Island. Hundreds can be seen flying past East Limestone Island in the early morning and evening, apparently commuting between Kingsway Rock and the waters of Skedans Bay and Cumshewa Inlet. Our survey counts included only birds seen on the water, as an indication of feeding areas. During surveys, large numbers were often seen roosting. It is possible that surveys early in

the morning would have revealed higher densities at sea, because a greater proportion of the population may be feeding then.

Numbers seen on surveys were highest in April (Figure 8). Densities were greatest in coastal waters in Skedans Bay and inshore of the Limestone Islands. Numbers south of Vertical Point were relatively low. In June, the only concentration was close to the roost site on the easternmost Skedans Island and may not represent feeding. Their distribution suggests that they prefer sheltered waters.

Sea ducks. The commonest duck seen was the White-winged Scoter, a total of 474 being seen; the next commonest was Harlequin (87). White-winged Scoters were commonest in April and were recorded mainly in the southern part of Skedans Bay and in an area east of Nelson Point (Figure 9). Most other ducks were close to shore, especially in Skedans Bay and north of Vertical Point.

Marbled Murrelets were mainly recorded on coastal and inshore transects (<2 km from Louise Island) and when all survey years were combined, appeared to be rather evenly distributed along the whole coast from Skedans to Haswell Island (Figure 10). However, comparison of May distributions in different years showed that in 1990 highest numbers occurred in the mouth of Skedans Bay, whereas in 1991 numbers were highest south of Vertical Point, and in subsequent years both areas were heavily used (Figures 11 and 12). Because only 2 or 3 surveys were performed in each year, it is hard to know how much of these inter-year differences may have been caused by day-to-day variation. However, the pattern in 1990 was strikingly different from that seen in any subsequent year.

Marbled Murrelets were most numerous within 2 km of Louise Island and were scarcely seen at all more than 4 km from shore (Figure 13). They occurred farther from shore in our surveys than reported for Barclay Sound by H.R. Carter (in Burger 1995). Virtually all records were in water less than 30 m deep, but all transect segments in deeper water were more than 2 km from Louise Island. Few Marbled Murrelets were seen in shallow water more than 2 km from Louise Island. Hence, water depth seemed to have little effect on the distribution of Marbled Murrelets in northern Laskeek Bay, once distance from land was taken into account.

Figure 8. Average number of PECO per kilometre

Figure 9. Average number of WWSC per kilometre.

Figure 10. Average number of MAMU per kilometre

Figure 11. Average number of MAMU per kilometre in May 1990-92

Figure 12. Average number of MAMU per kilometre in May 1993-95

Figure 13. MAMU densities.

Ancient Murrelets were recorded mainly between the Low islands and the Skedans Islands. They were virtually absent south of Vertical Point (Figure 14). The large numbers seen in April and May on the southern portion of transect 3, midway between East Limestone and Low islands, probably included birds assembled to socialize on the gathering grounds which are located in this area. However, those recorded on transect 5 and on the northern half of transect 3, were presumably feeding, as these areas are beyond the normal gathering ground. Very few were seen less than 2 km from Louise Island, in strong contrast to the large numbers seen in the zone 2-4 km from shore (Figure 15). The concentration of birds between the Low and Skedans islands suggests that this area is especially attractive for the species, but the reason for this is unknown.

Figure 14. Average number of ANMU per kilometre

Figure 15. ANMU densities

Pigeon Guillemots are common and widespread in Laskeek Bay, breeding on practically every island, sometimes in large numbers. On our surveys, they were found almost exclusively within 1 km of land, occurring near all the islands, but being commoner to the north of Vertical Point than to the south (Figure 16). Like Marbled Murrelets, their distribution seemed to be little affected by water depth (Figure 17).

Rhinoceros Auklets were seen in large numbers only in June (Figure 18). They do not breed in any numbers in the Laskeek Bay area, although a few pairs probably do so at Reef Island, where birds have often been heard calling at night. On occasions in July, scores of birds have been seen carrying fish, presumably destined for chicks, and as the numbers appear larger than could be breeding locally, we assume that these birds originate from either of the two nearest colonies: Sk'an Gwaii (100 Km away) or Lucy Island, off Prince Rupert (155 km). In either case the distances travelled appear to be substantial.

Like Ancient Murrelets, Rhinoceros Auklets were most commonly found more than 2 km from land in Laskeek Bay (Figure 19). However, large concentrations occurred inshore in Skedans Bay in June. Numbers were highest from south of the Skedans Islands to about half way to South Low Island. These waters are relatively shallow, but overall there appeared to be no association with water depth. Distributions in June were somewhat similar to those of Ancient Murrelets, but with Rhinoceros Auklets commoner within 2 km of land. The correlation between numbers of Rhinoceros Auklets and Marbled Murrelets has already been remarked (Figure 7).

Figure 16. Average number of PIGU per kilometre

Figure 17. PIGU densities

Figure 18. Average number of RHAU per kilometre

Figure 19. RHAU densities

Discussion

Three aspects of our results seem worth highlighting: (1) the inter-year variation, (2) inshore/offshore distributions, and (3) other differences in distribution with Laskeek Bay,.

(1) The range of variation among years demonstrates that results from surveys of this kind may be difficult to generalize if carried out in only a single season. The causes of inter-year variation are hard to assess. Oceanographic conditions in BC waters as a whole were more or less stable during the period covered, but differed from the preceding decade in being similar to what had formerly occurred only for brief periods during "El Nino" events. During 1991, oceanographic conditions developed as they would in a normal El Nino, but they then persisted with little change through to 1995. Such conditions usually mean decreased coastal upwelling and a reduction in local productivity. During 1993, numbers of Marbled Murrelets using Barkley Sound, Vancouver Island were much reduced in

June (Burger 1995) and this coincided with the highest counts recorded so far at Laskeek Bay; much higher than in any other year. It is possible that the high counts recorded in 1993 were due to an influx of birds from further south.

(2) The tendency for marine birds to divide into inshore and offshore species has often been remarked. In the context of Laskeek Bay, the most interesting observation was the almost complete absence of the most numerous species, the Ancient Murrelet, from waters within 2 km of the mainland (Louise Island). This is in contrast to Marbled Murrelets and Rhinoceros Auklets, with which there is a considerable overlap in diet (Sealy 1975, Gaston and Dechesne 1996). Ancient Murrelets do not appear to dive to great depths (Gaston 1992) and there seems to be no reason why they should avoid shallow water. In areas where they were abundant, there was no preference for deeper water. It seems most likely that they avoid coastal waters because of the risk of predation by Peregrine Falcons or Bald Eagles.

(3) For most species, the Skedans Bay area and waters north and east of Limestone Island appeared to be more attractive than the area south of Vertical Point. The main exception was the Marbled Murrelet, which was equally common to the north and south of Vertical Point, except in 1990. With the Skedans Islands forming a partial barrier to the north and Reef Island to the south extending shelter from southeasterly seas, the waters of Skedans Bay and adjacent areas are much more sheltered than those to the south of Vertical Point. This may be a factor in determining the greater densities found in the northern part of the transect area.

The results of our surveys so far provide a good baseline against which to assess changes in marine bird populations in northern Laskeek Bay. They also provide a calibration that can be used to assess the usefulness of single-year surveys carried out in other areas, especially those for Marbled Murrelets. Because the most common species, and those of most conservation interest (Marbled and Ancient Murrelets and Rhinoceros Auklet) are seen in large numbers only from May onwards, there seems to be little reason to continue surveys in April. This is especially so because weather conditions in that month often make surveying difficult. However, an extension

of surveys into Cumshewa Inlet (begun in 1996) should provide information on birds associated with the extensive kelp forests on the south side of the inlet; a habitat not well represented on past surveys.

Acknowledgements

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A TALE OF TWO ISLANDS: COMPARISON OF POPULATION DYNAMICS OF ANCIENT MURRELETS AT TWO COLONIES IN HAIDA GWAII, BRITISH COLUMBIA

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ABSTRACT

Observations and banding of breeding Ancient Murrelets were carried out at Reef Island in 1984-89 and at East Limestone Island in 1989-94. These two colonies are separated by about 6 km of open water. In 1995, we carried out simultaneous observations of several aspects of breeding biology at both colonies. Comparison of population trends, obtained from censuses; and chick production, based on standardized funnel trapping, showed that the population of Reef Island has increased since the mid-1980s, while that of East Limestone Island has remained stable or fallen, presumably because of persistent predation by introduced racoons. Recapture rates at Reef Island of birds banded as chicks at East Limestone Island suggest that prospectors visit either island indiscriminately. Some recruitment from East Limestone to Reef Island was observed, but not in the opposite direction.

Introduction

Reef and East Limestone Islands support relatively small (<10,000 pairs) colonies of Ancient Murrelets (*Synthliboramphus antiquus*, Rodway 1991). Both colonies were censused in the 1980s. In addition, mass-trapping of departing chicks was carried out at Reef Island in 1986-89 and at East Limestone Island in 1990-94 (see Gaston *et al.* 1988 for methods).

Introduced raccoons (*Procyon lotor*) are known to have killed many Ancient Murrelets at East Limestone Island during the past five years (Gaston 1994, Hartman *et al.* in press). There are no raccoons on Reef Island. In 1995, we repeated the censuses and the mass-trapping of chicks to determine the population trends at the two colonies. This comparison should provide an indication of the effects that mortality caused by raccoon predation may be having on the colonies involved. In addition, trapping of adult Ancient Murrelets at both colonies since 1989 has provided evidence of inter-island

movements, allowing us to assess the amount of interchange between populations.

Gathering ground counts:

In 1995, we carried out observations of numbers of birds flying over the gathering grounds off the two colonies (east of Limestone Island, north of Reef Island; these counts are carried out routinely every year at East Limestone Island). Numbers of birds flying over the gathering ground were counted for 10 minutes each evening from both islands. These counts were made to assess the degree to which the gathering ground assemblages off the two islands were comprised of the same birds. If the same population was involved, we might anticipate that when numbers were high at one colony they would be low at the other.

No evidence was found that low numbers at one colony corresponded with high numbers at the other. Rather, the numbers counted fluctuated in parallel at the two colonies (Figure 1). Low numbers on gathering ground counts are generally associated with poor weather conditions (Gaston 1992) and this factor probably accounts for the correlation between the two counts.

Population trends: Reef Island

Census

A systematic census of Ancient Murrelets breeding at Reef Island in 1985 yielded an estimate of 7845 burrows. Occupancy was estimated at 63%, suggesting a breeding population of just under 5000 pairs (Gaston 1992).

In 1995, a repeat census was carried out to determine whether the population had changed. Burrows were counted in circular plots of 50 m^2 placed at 30 m intervals along straight transects spaced 100 m apart (Figure 2) and run from the shore to the interior edge of the occupied colony area. The census was carried out on 3-8 June 1995, when more than 90% of chicks had departed from the burrows. Each plot was searched thoroughly for burrows and only those that showed signs of activity (worn entrance, traces of eggshell or membrane, feathers, etc.) were recorded.

Figure 1. Gathering ground counts compared, 1995.

Figure 2. Reef Island ANMU colony.

We carried out reconnaissance surveys of the whole island and surveyed 129 plots on 23 transects, covering a total of 6,450 m^2. The colony boundaries appeared to be essentially identical with those mapped in 1985. Seventy-two plots were without any burrows, and the remaining 57 contained 164 burrows, giving a mean density of 1.27 burrows/plot; 254 ha^{-1}. The area of the colony was estimated at 41.2 ha, giving an estimate of 10,465 burrows. This suggests an increase in the breeding population of approximately 30% in ten years.

Chick-trapping

Using identical procedures and locations to those used in 1986-89, we trapped 1250 chicks from approximately 15% of the colony area in 1995, compared with a mean of 883 $\pm$ 120 trapped from the same area, using identical methods, during 1986-89 (42% increase, $P < 0.01$, Figure 3).

Figure 3. Chicks trapped, Reef Island.

The difference between 1995 and the 1980s in numbers of chicks trapped is unlikely to be due to differences in reproductive success between years, because production of young per burrow is very constant from year to year (Gaston 1992 and unpubl.). Hence, both the census and the chick trapping indicate an increase in numbers of Ancient Murrelets breeding at Reef Island.

Population trends: East Limestone Island

Census

The population of East Limestone Island in the 1970s was estimated as roughly 5000 pairs (Summers 1974). A detailed census in 1983, using a similar transect method to that described for Reef Island (plots were 7x7 m squares, spaced at 20 m intervals), yielded an estimate of 2376 burrows. This census was repeated, using identical methods, in 1989 and 1995, with estimates of 2850 and 2122 burrows, respectively (Table 1).

Table 1. Estimated number of burrows (+/- s.e.) at East Limestone Island

YEAR	ESTIMATE	S.E.
1983	2376	± 446
1989	2850	± 591
1995	2122	± 568

There is no significant difference among the three census figures, but with the 1995 census being the lowest, an increase in population since 1983 seems unlikely. It also seems likely that the population has declined since Summers' survey in the 1970s.

Chick trapping

Standard chick capture funnels were set up at East limestone Island in 1990 and have been monitored throughout the breeding season every year since. The catchment area of the funnels is estimated to cover about half the colony (total area of colony, 14.9 ha). Highest numbers were captured in 1990 (Figure 4). A sharp drop occurred in 1991, simultaneous with the activities of at least three raccoons on the island (Hartman *et al.* in press). In the fall of 1991, the Wildlife Branch of the B.C. Ministry of Lands,

Environment and Parks removed raccoons from East Limestone Island and adjacent areas of Louise Island. No raccoons were reported on East Limestone Island during the 1992 breeding season and the numbers of chicks trapped rebounded somewhat. However, in subsequent seasons, there was evidence of raccoon activity in all years except 1995, albeit at a lower level than in 1991. The number of chicks trapped has continued a gradual decline.

A comparison of changes in numbers at the different trapping funnels shows that numbers at all funnels showed a sharp drop between 1990 and 1991, and a slight recovery between 1991 and 1992. Subsequent changes have been irregular and lack concordance among plots (Figure 5)

Figure 4. Chicks trapped, East Limestone Island

Figure 5. Changes in trapping, 1990-95.

Predation

In 1990-95, predation remains were counted every six days along fixed transects running through the colony area on East Limestone Island. The numbers found peaked in 1991. In 1992, when no raccoons are thought to have been present on the island, predation remains found were correspondingly reduced (Figure 6). Predation remains, in the form of feather piles, isolated wings, or burrows that had been excavated, were counted in all plots during censuses at both East Limestone and Reef islands in 1995. The density of remains was higher on Limestone Island than on Reef Island, both in absolute density (remains/ha) and relative to burrow densities (remains/burrow, Table 2). Known predators at Reef Island include river otters, ravens and Bald Eagles.

TABLE 2

Predation remains found at Reef and East Limestone islands in 1995

Colony	Remains/ha		
	Wings	Feather piles	Excavated burrows
Reef	10.9	27.9	0
Limestone	10.5	52.6	3.5
	Remains/burrow		
Reef	0.04	0.11	0
Limestone	0.07	0.35	0.02

Inter-island movements

Because of the lack of overlap in banding years at the two islands, there is little information on inter-island movements. However, two second-year and one third-year bird banded as chicks at Reef Island were retrapped as prospectors (without brood patches) at Limestone Island in 1989. In 1995, two second-years banded as chicks at Limestone Island were retrapped as prospectors at Reef Island and two 5-year-olds, banded as chicks at East Limestone Island in 1990, were trapped on Reef Island as breeders. This compares with four birds banded as chicks at Reef Island in 1989, and one each banded there as chicks in 1988 and 1985 retrapped as breeders in 1995. These figures suggest that the recruitment from Limestone Island to Reef Island (2/865 = 0.23%), is not much lower than recruitment from Reef Island itself (1985-89 chicks retrapped as breeders in 1995, 6/4322 = 0.14%; corrected for additional mortality at 23%/annum = 0.29%). Despite the larger numbers of chicks banded at Reef Island, we have not yet retrapped any Reef Island chicks as breeders at East Limestone Island.

Figure 6. Predations on transect, up to 13 June.

Discussion

The census and chick trapping results suggest that the number of Ancient Murrelets breeding at Reef Island increased by approximately 30% between 1985 and 1995. However, similar techniques used at East Limestone Island suggested that the population of Ancient Murrelets there had remained stable, or decreased, over the same period. Recruitment from East Limestone to Reef Island has taken place, but we have not observed birds dispersing in the opposite direction. However, this probably relates to the timing of banding at the two colonies. Trapping at Reef Island has been carried out in only one season (1995) since the start of chick-banding at Limestone Island (in 1990). Predation by raccoons and the disturbance to the colony consequent on raccoon predation behaviour seems to be the most likely explanation for the difference in population trends between the two colonies.

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SHORT REPORTS

FOREST BIRDS

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Wildlife trees and cavity nesters

Casual surveys of Red-breasted Sapsucker nests have been conducted at East Limestone Island since 1990, mainly during the nestling period in late May and early June, when the chicks can be heard calling from the nest from some distance away. Nest trees have been tagged, mapped and photographed. Four species have been recorded using cavities: Northern Flicker, Red-breasted Sapsucker, Hairy Woodpecker and Chestnut-backed Chickadee (Table 1). In 1995, we made some additions to our nest tree survey methods. East Limestone Island was surveyed as four roughly equal areas, each being covered three times between late May and mid-July. West Limestone Island was surveyed once, in late June. We recorded tree diameters at breast height, total tree height, and nest hole height and orientation. A minimum of 20 min was spent watching each occupied nest each week, so that the progress of nesting could be followed.

In 1995, 22 trees were occupied by sapsuckers, a sharp increase over the 14 found in 1994, previously the highest total. The increase is probably the result of increased and more systematic effort, although sapsucker populations in British Columbia are known to fluctuate dramatically (Campbell *et al.* 1990).

Our information on nest trees reveals that sapsuckers and Hairy Woodpeckers at East Limestone Island excavate their nest cavities mostly in dead, weathered, rotting Sitka Spruce snags. These trees are mostly very large (>1 m DBH) and most of the nest holes are more than 10 m up (Table 2). Sites recorded at East Limestone Island contrast with those reported in southern B.C., where 45% of Red-breasted Sapsucker sites are in live trees, 65% are in deciduous trees, and 2/3 are between 3.4-9.1 m above the ground (Campbell *et al.* 1990). However, the timing of breeding in our study, with chicks heard between 18 May and 13 July, is similar to that recorded elsewhere in B.C.

During late May and the first half of June, 9 sapsuckers were mist-netted so that individually recognisable colour bands could

Table1. Active Red-breasted Sapsucker nest trees for 1990-95 (*=RBSA)

Tree	Loc	1990	1991	1992	1993	1994	1995
1	E	*	*	NOFL	*		
2	E		*				
3	E		*				
4	E		*	*		HAWO	
5	E		*	*			*
6	E		*	*			
7	E		*			*	*
8	E		*		CBCH		
9	E			*	*	*	*
10	E			*			
11	E			*	*	*	*
12	E			*	*		
13	E			*	*	*	*
14	E			*			
15	E			*	*		*
16	E				*		
17	E				*	*	
18	E				*		
19	E				*		
20	E					*	*
21	E					*	*
22	E					*	
23	E					*	
24	E					*	
25	E					*	*
26	E					*	*
27	E					*	*
28	E					*	
29	E						*
30	E						*
32	E						*
33	E						*
35	E						*
36	E						*
37	E						*
38	E						*
39	E						HAWO
40	E						*
41	E						*
42	W						*
SUMMARY							
New nests		1	7	7	4	9	11
Occupied nests		**1**	**8**	**10**	**10**	**14**	**22**

E = East Limestone Island; W = West Limestone Island

Table 2. Wildlife tree characteristics.

	1990-1995	*1995 only*
Tree species		
Sitka Spruce	29 (76%)	17 (74%)
Western Hemlock	9 (24%)	6 (26%)
Tree Code		
1	0	0
2	1 (3%)	0
3	0	0
4	12 (32%)	6 (26%)
5	23 (61%)	15 (65%)
6	2 (5%)	2 (9%)
	Mean values	
Attached bark		
(range=0-100%)	46%	46%
Diameter (m)		
(range=0.6-2.6)	1.3	1.2
Tree Height (m)		
(range=10.4-49.0)	24.0	22.4
Nest hole ht. (m)		
(range=7.1-34.5)	n/a	16.3
Sample size (N)	38	23

be placed on the legs. Those marked included three breeding pairs. We also collected faecal sacs produced by nestlings, and dropped by the adults as they departed from the nest. They contained the indigestible parts of ants and beetles. Two nests were collected from fallen nest trees for investigation and display.

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FIRST ARRIVAL DATES FOR SUMMER VISITORS AT EAST LIMESTONE ISLAND

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In all years we have recorded a daily list of the birds seen or heard at East Limestone Island. As a result, we are able to identify the dates of arrival of many of the common species breeding on the island, especially those that sing loudly with easily recognisable songs. These dates give us some indication of whether the year was early or late. The table below lists some dates that we have recorded.

Varied Thrushes, Song Sparrows and Dark-eyed Juncos may be present at East Limestone Island throughout the winter, so the first dates for these species probably represent our first records, rather than actual arrivals. Among the true migrants, the Hermit Thrush is the earliest to arrive (5-14 April) and the very similar Swainson's Thrush, the latest (29 May - 16 June). The two warblers; Townsend's (12-18 April in 4 years) and Orange-crowned Warbler (22-25 April in 4 years, 13 May in a fifth) have been the most consistent in their arrival dates.

In comparing among years, 1994 stands out as being the earliest for migrants arriving, with Rufous Hummingbird, Western Flycatcher, Townsend's Warbler and Fox Sparrow all showing their earliest arrival dates.

Table of first arrival dates for East Limestone Island

SPECIES YEAR

	1990	1991	1992	1993	1994	1995
Camp open	28 March	26 March	13 March	9 April	5 April	15 March
Rufous Hummingbird			20 April		9 April	11 April
Western Flycatcher		25 April	1 May		12 April	29 May
Swainson's Thrush	8 June	7 June	2 June	31 May	16 June	29 May
Hermit Thrush	5 April	14 April	10 April	17 April	5 April	13 April
Varied Thrush		27 Mar	15 Mar	9 April		26 Mar
Orange-crowned Warbler		25 April	22 April	25 April	24 April	6 May
Townsend's Warbler		18 April	14 April		12 April	13 April
Fox Sparrow		27 April	8 April	20 April		
Song Sparrow			15 Mar			31 Mar
Dark-eyed Junco			26 Mar			

REPORT ON RESEARCH ON IMPACTS OF INTRODUCED SQUIRRELS ON LIMESTONE ISLAND, 1995 SEASON

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In 1995 we continued to explore the potential impacts of red squirrel on the breeding forest bird community of Haida Gwaii. We had two objectives: 1 - to analyze the relation between the predation of artificial nests baited with quail eggs, nest visibility and vegetation cover around the nest sites (1m radius and 5m radius). 2 - to develop a standardized method for evaluating squirrel densities and to see whether variation in squirrel density due to habitat differences was related to variation in predation rates on artificial nests.

One hundred and twenty nests were placed on the ground along transects and evenly distributed according to vegetation cover around the nest and habitat type. We defined two main habitat types: forests dominated by conifers and forests dominated by alder. As in previous years, predation rates at the end of the experiments (15 days) were extremely high on East Limestone Island (average of about 90%).

Preliminary analysis of the results suggest: 1 - that there is no relationship between predation rate and vegetation cover around the nest; 2 - that squirrel density is about twice as high in the conifer dominated forests and; 3 - that the predation rate is significantly lower in the alder dominated forests (with lower squirrel densities) than in the conifer dominated forests.

Photographic evidence collected by automated cameras connected to artificial nests confirmed that squirrels seem to be the exclusive predator involved in these experiments. Over 100 pictures were taken and all showed squirrel as the predator. The important next step will be to estimate predation rates on real nests.

BRIEF NOTES

ANCIENT MURRELET CHICK DEPARTURES

The timing of Ancient Murrelet family departures at East Limestone and Reef Island is reflected in the dates at which chicks were trapped. In 1995, chicks departed slightly earlier at Reef Island (median 22 May) than at Limestone Island (23 May). Peak numbers also differed by one day, being on 21 May at Reef and on 22 May at Limestone Island (Figure 1).

During 1990-1994, median dates of departure observed at East Limestone Island were consistently earlier than those that had been observed at Reef Island during 1984-89 (Figure 2). This year's result, the first year when data were available from both colonies, suggests that timing at the two islands is similar and that the difference between results at Reef in the 1980s and Limestone in the 1990s reflects a change in timing of breeding within the region, rather than a consistent difference between colonies. AJG

Figure 1. Peak departure dates

Figure 2. Median departure dates.

ANCIENT MURRELET BREEDING SUCCESS

We monitored the progress of 28 occupied Ancient Murrelet burrows at East Limestone Island in 1995. Twenty burrows were successful and produced a total of 40 chicks, six were deserted and one depredated. Two burrows produced one chick each, the rest produced two. Overall production, 1.43 chicks/occupied burrow, was slightly lower than in previous years, but the main finding is that production is rather consistent from year to year, varying from 1.43-1.65 chicks/pair (see Table below). AJG

BREEDING SUCCESS

YEAR	NESTS	CHICKS	CHICKS/NEST
Reef Island (mean, 1988,89)	91	140	1.54
1991	27	42	1.56
1992	27	42	1.56
1993	29	47	1.62
1994	27	40	1.48
1995	28	40	1.43

GATHERING GROUND COUNTS

Mean counts of birds flying over the gathering grounds East of East Limestone Island, made from the camp, were relatively high in 1995, with peak numbers in the middle ten days of May. The peak period was the highest recorded since 1991. Numbers have shown a steady increase since the low in 1992-93 (see Figure below). AJG