LASKEEK BAY RESEARCH

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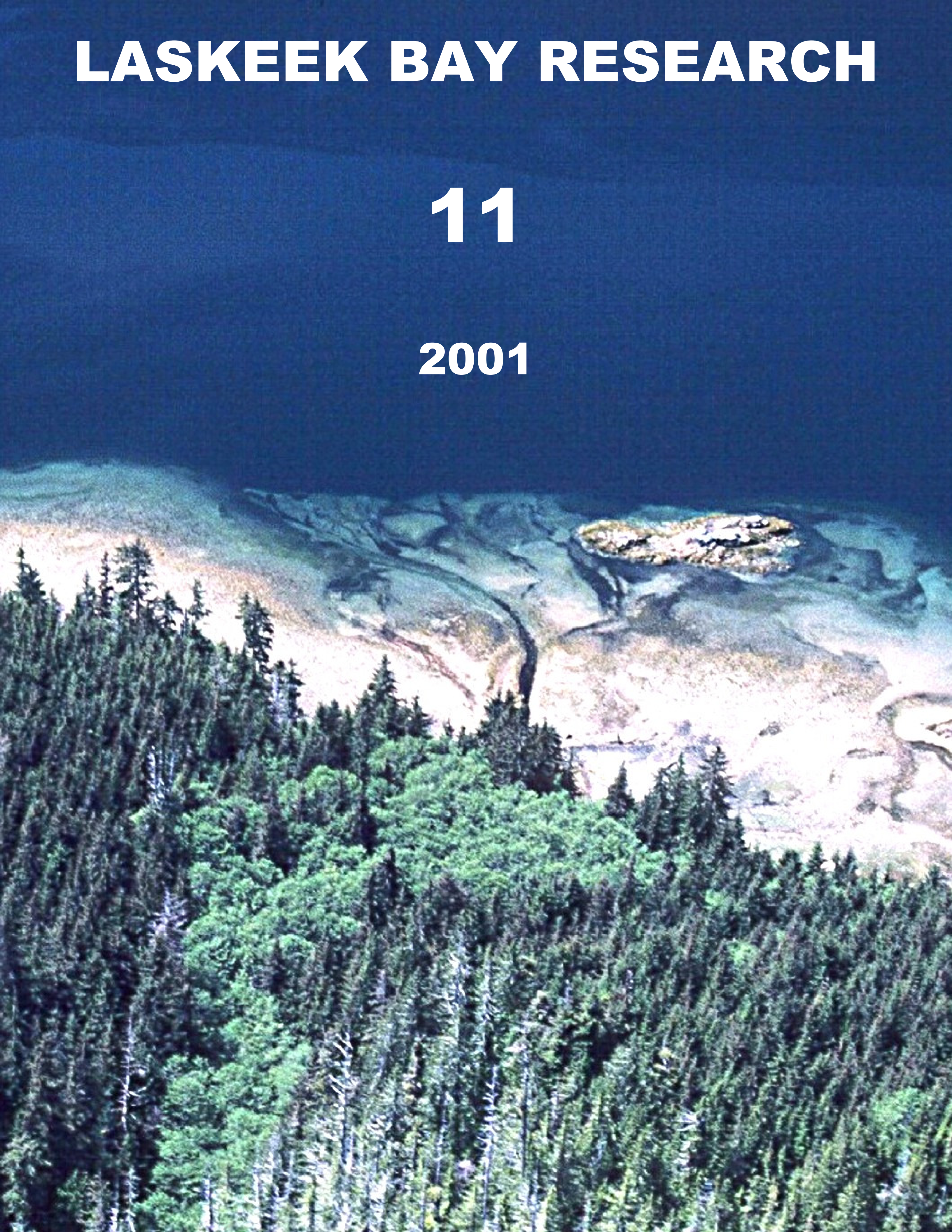

LASKEEK BAY RESEARCH

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LASKEEK BAY CONSERVATION SOCIETY
ANNUAL SCIENTIFIC REPORT, 2001

May 2002

LASKEEK BAY RESEARCH

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LASKEEK BAY CONSERVATION SOCIETY
SCIENTIFIC REPORT, 2001

Edited by

ANTHONY J. GASTON

May 2002

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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

Since 1990, the Society has operated a field research station at East Limestone Island and is carrying out a diverse long-term monitoring, research and interpretation programme in the surrounding islands and waters of Laskeek Bay. We actively involve volunteers from our island communities, many other locations in British Columbia, as well as from overseas. For further information contact:

Laskeek Bay Conservation Society
Box 867, Queen Charlotte City, British Columbia, Canada V0T 1S0
Phone/fax (250) 559-2345; E-mail <laskeek@qcislands.net>

BACKGROUND

The goals and objectives of the Society are:

1. To undertake and support research and long term monitoring of wildlife populations of the marine and terrestrial ecosystems of Haida Gwaii, especially the Laskeek Bay area.

2. *To provide opportunities for non-scientists, especially students and local residents of Haida Gwaii, to participate as volunteers in our field programs, and to offer training to impart necessary field research skills.*

3. *To promote better understanding of the marine and terrestrial ecosystems of Haida Gwaii, especially the Laskeek Bay area, by providing information to youth, local residents, and to the public in general in the form of publications, meetings, and exhibits.*

4. *To promote the conservation of native species and to develop public awareness of the changes caused by introduced species to Haida Gwaii.*

5. *To support and assist other programs aimed at providing better knowledge, management and conservation of ecosystems on Haida Gwaii.*

INTRODUCTION

This year, 2001, marked the 12th year of the Laskeek Bay Conservation Society's volunteer field programme at East Limestone Island, Haida Gwaii. Concentrating mainly within the Laskeek Bay area, the Society's programme includes biological monitoring and research, interpretation for visitors, and learning opportunities for students and volunteers.

The scientific work of the Society is carried out in collaboration with researchers and management agencies who have ongoing interests in the ecology and conservation of Haida Gwaii. The research programme is directed by a Scientific Advisory Committee that works closely with the Society's Board of Directors to develop research that is relevant to the conservation needs of Haida Gwaii and consistent with the goals of the Society. Research activities include marine bird and marine mammals population monitoring, studies of intertidal invertebrates, plants, and forest birds. In addition, the Society is a participant in the Research Group on Introduced Species, an umbrella organization devoted to studies of exotic species in Haida Gwaii and their impact on indigenous ecosystems. This research focuses especially on the impact of introduced mammals, including deer, raccoons and squirrels on island ecosystems.

The overall aim of the Society's research programme is to provide long-term information on the biology and ecology of Haida Gwaii ecosystems. Ongoing monitoring, using simple, standard techniques that allow year-to-year comparisons to be made, and allowing the direct participation of volunteers, is the cornerstone of the Society's approach. By monitoring a variety of indicator species in ocean, inter-tidal and terrestrial ecosystems, we can obtain an overall measure of their health. 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. Such long-term monitoring is becoming increasingly pertinent in the context of global climate change.

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 and apologize to any we may have inadvertently omitted from this list:

The Society gratefully acknowledges the generous financial support provided by:

- Canadian Wildlife Service of Environment Canada (National Wildlife Research Centre, Ottawa)
- Ecoaction and Science Horizons Programs of Environment Canada
- Gwaii Trust Society
- W. Alton Jones Foundation,
- Mountain Equipment Co-op,
- Forest Renewal BC
- Canadian Nature Federation
- Haida Gwaii Museum
- Parks Canada
- Canadian Regional Airlines
- Habitat Conservation Trust Fund
- Calgary Zoological Society
- British Columbia Gaming Commission

... as well as numerous small businesses and private donors.

We also thank the following individuals or groups who gave generously to the Society in many different ways:

- Tony Gaston, Jean-Louis Martin and other members of the Science Advisory Committee for valuable advice and guidance throughout the field season.
- Greg and Kathryn Wiggins, for their donation of a propane range.
- Graeme Ellis for providing us with a camera and film to document Orcas.
- Crew and guests of the vessels Island Roamer and Maple Leaf for generously supporting our project with their visits, purchases and donations.
- Nathalie Macfarlane at the Haida Gwaii Museum, for continuing to provide a venue to promote the Society's work.
- Barb Rowsell, RGIS coordinator, for generous help whenever required.
- All the artists who donated works for our successful “Art of Limestone” exhibit.

- LBCS directors for their time and efforts in maintaining and developing funding, the field camp, and the scientific and educational projects.
- Kevin Borserio and all the students of Project Limestone, Gordon McMahon and the G.M. Dawson School, and Erin Sinclair and the Living and Learning School students.
- All of the volunteers, who participated in the Limestone Island camp, purchased t-shirts, made donations, or helped out in town.

Finally, thanks goes to the owners, staff and crew of South Moresby Air Charters, s/v Anvil Cove, and m/v Tana Bay for their professional services in transporting gear and people from Queen Charlotte City to Limestone

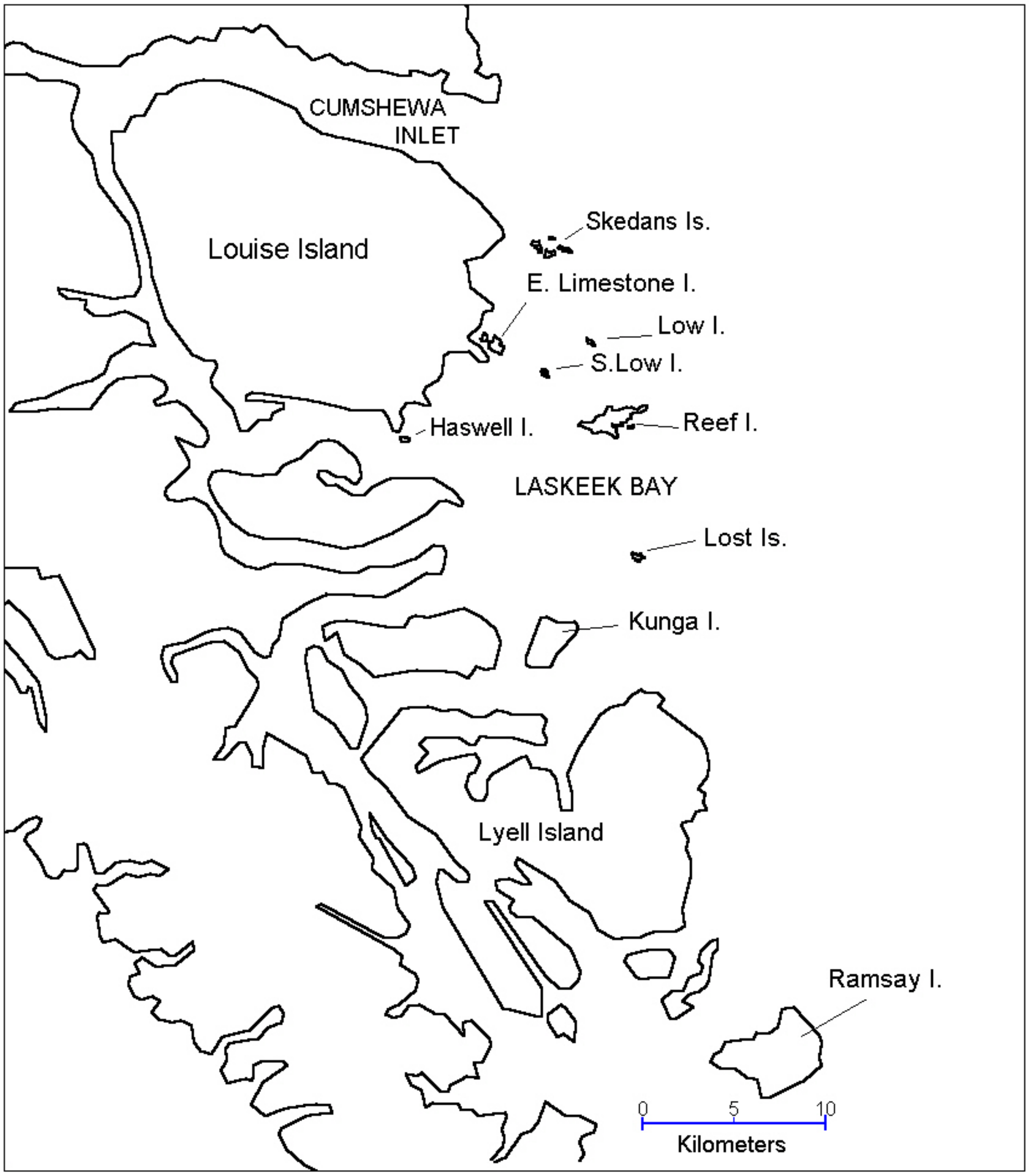
SCIENCE ADVISORY COMMITTEE, 2001

Dr. Anthony Gaston (Chair, marine birds)
Canadian Wildlife Service, National Wildlife Research Centre, 100 Gamelin Blvd., Hull, Quebec K1A 0H3

Dr. Jean-Louis Martin (introduced species, terrestrial birds)
Centre National de Recherche Scientifique, CEPE, Route de Mende, BP 5051-34033, Montpellier-Cedex, France

Kathy Heise (marine mammals)
Department of Zoology, University of British Columbia, 6270 University Blvd., Vancouver, BC, V6T 1Z4

Dr. Tom Reimchen (Haida Gwai ecosystems, fish)
Dept. of Biology, University of Victoria, Victoria, BC, V8W 3N5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INLET
Louise Island
Skedans Is.
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Haswell I.
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LASKEEK BAY
Lost Is.
Kunga I.
Lyell Island
Ramsay I.
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5
10
Kilometers

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EAST LIMESTONE ISLAND FIELD CAMP: REPORT ON THE 2001 FIELD SEASON

Joanna Smith, Charlotte Tarver and Joelle Fournier
Laskeek Bay Conservation Society, Box 867, Queen Charlotte BC, V0T 1S0

SUMMARY

With over 300 visitor and volunteer days in 2001, the interpretation and research program on Limestone Island was a strong success. Three local schools participated in Project Limestone, with children as young as 10 years old seeing an Ancient Murrelet for the first time. We hosted visitors from Gwaii Haanas National Park Reserve, Haida Fisheries, the Research Group on Introduced Species, Island Roamer, Maple Leaf and local residents. We began an outreach program with the Haida Gwaii Watchmen and look forward to more involvement next year. On the island and offshore, our long-term study of the Laskeek Bay ecosystem revealed several interesting results. Thirteen of the monitored Ancient Murrelet burrows (the lowest ever) were occupied and nine were successful. There were lots of murrelets on the water during sea surveys and in June, more than 400 murrelets were observed in Laskeek By. We banded 560 chicks in funnels and caught 181 adults in nets, including adults banded in 1989 and 1990. Ancient Murrelet breeding was disturbed by the presence of at least one predator. Throughout the island, 41 burrows were excavated but the source of the diggings was not found. We installed 100 wooden Ancient Murrelet nest boxes and an additional 10 boxes for Pigeon Guillemots. The first Northern Saw-whet Owl nest (subspecies *brooksi*) was found on Limestone Island and the owls successfully fledged at least one chick. Bald Eagles nested and raised one chick and a Sharp-shinned Hawk pair fledged one chick, the second record for this species. Twenty-five wildlife trees were active with five different species occupying the nests. Offshore, 85 sightings of nine species of marine mammals were made, including the rare Fin and Sei whales. Two collared deer were frequently sighted on the island and the plants in the deer exclosures are showing signs of recovery. It was exciting to discover new information as a result of the continuous long-term research projects and to share this with others through their participation on East Limestone Island. Each year we learn more about the ecology and conservation of the Laskeek Bay ecosystem.

EDUCATION PROGRAMS

This year, 28 students (ages 9 to 18), accompanied by nine teachers, came to Limestone Island. The 37 people came from the Queen Charlotte Junior / Secondary School, G.M. Dawson, and Living in Learning School. During their day visits, Charlotte Tarver demonstrated the techniques used to gather data and explained the various projects we were doing in 2001. Returning before nightfall, the students made their way to the north cove Ancient Murrelet chick catching funnels and were shown how to gently pick up the chicks and put them in chick bags. During the night, the students helped out by accurately recording measurements, weights, and band numbers of the chicks into notebooks. Now in its eleventh year, Project Limestone has brought more than 400 students and 120 teachers to Limestone Island.

Limestone Island is one of the only places in Canada where people can visit a seabird colony with an active research program, and as a result, our program is very popular and highly regarded. Most of the visitors come via tour groups who are also visiting Gwaii Haanas National Park. A daytime orientation to our research projects is offered by staff, and during the Ancient Murrelet chick departure season, a night visit is provided to those who wish to come ashore and assist with chick, and occasionally, adult banding. In 2001, the Island Roamer called in five times (May 8, 17, June 1, 20 and 28), with a total of 66 visitors; the Maple Leaf visited twice (May 23 and 28) with 25 people. Nine people came ashore with Whitney-Smith Kayak Tours on June 15 for an afternoon tour of our songbird and introduced species projects. Total person days of tour groups: 131 (of which 100 were visitors).

Two Gwaii Haanas National Park Reserve staff made a brief, overnight stop on Limestone Island on their way to the Park in May. We gave them an orientation to our projects and they helped us with chick and adult banding. Researchers from the Haida Fisheries, studying the abundance of Northern abalone (*Haliotis kamtschatkana*), a threatened species, stopped by five times in July (12-13, 15, 17-18). Also in the same month, a group from Haida Forestry came to look at the effects of deer on the vegetation. Total person days of these visitors: 16.

On June 27, seven people representing local government organizations came to learn about the five-year study on introduced deer. Dr. Jean-Louis Martin (RGIS), assisted by LBCS staff, guided the group to compare the vegetation on islands with (e.g. Limestone and Reef Islands) and without deer (e.g. Low Island). The group was served lunch on Reef Island and presented with the study results to date. On July 2 and 3, we took part in a Search and Rescue for an overdue kayaker. We provided overnight shelter and food to a kayaker from Denmark and three members of the Queen Charlotte Coast Guard Auxiliary. The missing man was found unharmed the next day. The total number of all visitors for 2001, including Project Limestone, was 279.

ANCIENT MURRELETS

The study and conservation of Ancient Murrelets continues to be important because about one half of the world's population breeds on Haida Gwaii and the species is declining throughout its range. The world population estimate for Ancient Murrelet lies between 1 and 2 million, with approximately 500,000 birds breeding in Haida Gwaii. Ancient Murrelets are listed as vulnerable in Canada by the Council on the Status of Endangered Wildlife in Canada (COSEWIC) and will only be removed from the list when factors that threaten the population are removed (e.g. introduced species and oil pollution).

Introduced predators are a continual threat to Ancient Murrelets on Haida Gwaii. There is an on-going need for vigilance and population control both on and near seabird colonies, to remove raccoons or rats before they gain access to nests and adult birds.

Due to the possible lifting of the oil and gas drilling moratorium in British Columbia, there is heightened concern for those species that reside in the marine environment. Ancient Murrelets are found in the Hecate Strait and other waters off Haida Gwaii from February to September, and in other parts of BC from August to March. Chicks feed exclusively in the protected waters near Haida Gwaii for the first four to six weeks of their life. Oil pollution could have devastating effects on the breeding population of Ancient Murrelets and depending on the conditions, spills have the potential to greatly impact the chick population for the year in they occur.

Ancient Murrelet breeding success and colony attendance were monitored from March 29 until June 20, 2001. The same methods to capture, band, monitor burrows and measure the reproductive success of this seabird were used as in previous years, save for some minor adjustments.

Adult banding

Three large, knock-down flight nets were used to catch adult Ancient Murrelets leaving the colony before dawn. Adults were caught from March 29 to April 11, stopped during egg-laying and then continued from May 16 to June 12, 2001. The nets were opened on 16 nights, for 29.25 hours of banding. We caught 63 adults before egg-laying, and 154 adults afterwards, plus an additional 10 birds in burrows. Total capture was 217 birds however, 46 adults were caught more than once so the actual number of birds was 181 (70 new and 111 retraps) (Table 1).

Table 1
The number of breeding and non-breeding adult Ancient Murrelets caught at three net stations (including ground) and in monitored burrows, East Limestone Island, 2001. Those classified as of "Unknown" breeding status were birds with brood patches 10 to 19 mm

Capture Method	Breeding Status	New	Retrap	All Retraps (with multiple captures)
Net	Breeder: before egg laying	9	48	54
	Breeder: after egg-laying	16	39	63
	Non-breeder: after egg laying	39	13	22
	Unknown	3	5	11
Burrow	Breeder	3	6	7
TOTAL		70	111	157

The average weight (mean ± one standard deviation) of the birds was 199 ± 14 g for breeders, and 184 ± 9.6 g for non-breeders. More birds were caught at the Spring Valley location than at either Cabin or North Cove (120 birds, mean 15 birds/night; 43 birds, 10.75 birds/night; 49 birds, 12.25 birds/night, respectively). The Spring Valley net was used eight times, and Cabin and North Cove nests used four times each.

Ancient Murrelets banded in other years continue to return to East Limestone Island. These birds contribute to our annual survival statistics. A bird banded as an adult in 1989 was recaptured and this is the oldest bird known to date for this colony (minimum 14 years old, presuming it was at least 2 yr old at initial capture). We recorded 101 birds banded as adults from all years, 1989-2000, and 87 percent were breeding. Seven chicks were recaptured, three of them breeders. Chicks from 1993 have still never been recaptured on Limestone Island.

Chick banding

The same system of plastic funnels to weigh and band chicks at six locations was used this year. We replaced 250 of the cedar stakes and all of the plastic sheeting except for Funnel 6 and the end of Funnel 4. Chick trapping began at 22.30 h at the start of the season, but in late May the time of starting was set back to 23.00 because of the later time of sunset. Trapping ended at 02.30 throughout the season. Chicks were first heard calling from the colony on 7 May, so the funnel gates were closed the next night and the first chicks were banded on 10 May. The peak of departures occurred nine days later, on 19 May, when 54 chicks were caught (Figure 1).

We banded and weighed 560 chicks at the funnels, a little less than in 2000 and about the same as in 2001. The overall trend in numbers appears to have levelled off after falling during the period up to 1998 (Figure 2). An additional 11 chicks were banded in monitored burrows (18 May to 9 June). The mean (± SD) weight of the chicks was 26.7 ± 2.5 g.

The peak of chick departures occurred on 17-19 May, which is earlier than normal, but there was a long tail-off , with numbers departing remaining more or less constant from 22 May - 12 June. Consequently, although the median date of departures was quite early, the period during which 50% of chicks departed was more prolonged than in any year on record (15 d, compared to 7-11 d previously; Figure 3). The significance of this distribution is unclear.

Figure 1
Number of chicks trapped in funnels on East Limestone Island, 8 May to 16 June 2001

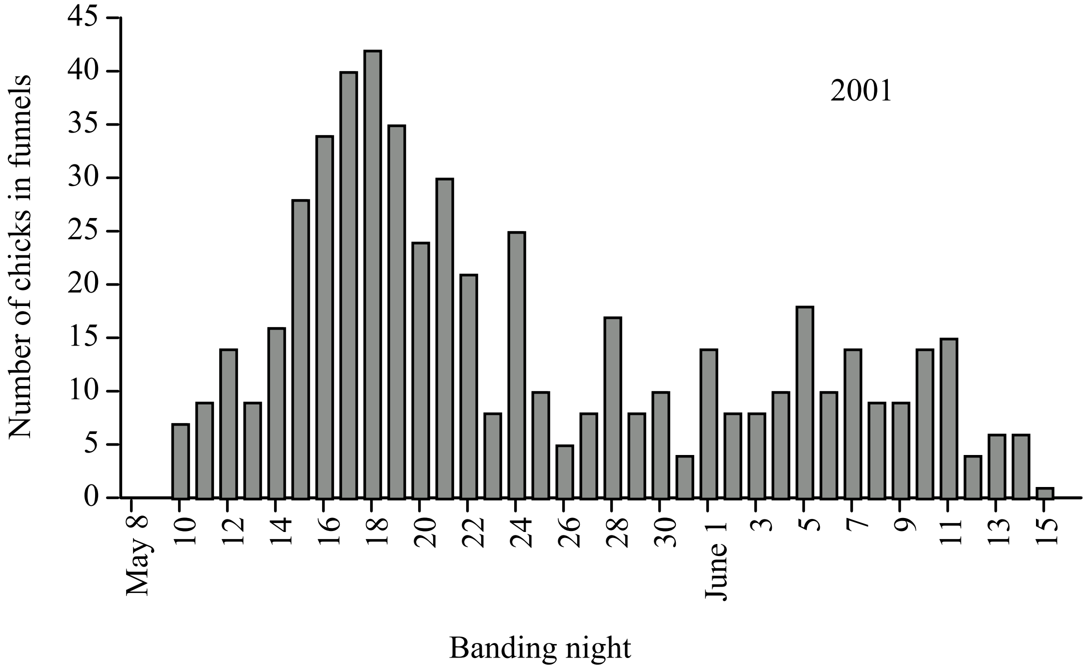


Figure 2
Numbers of chicks captured in funnels on East Limestone Island, 1990 - 2001. The solid line is a fitted polynomial regression, the hatched lines are 95% confidence bands for the mean

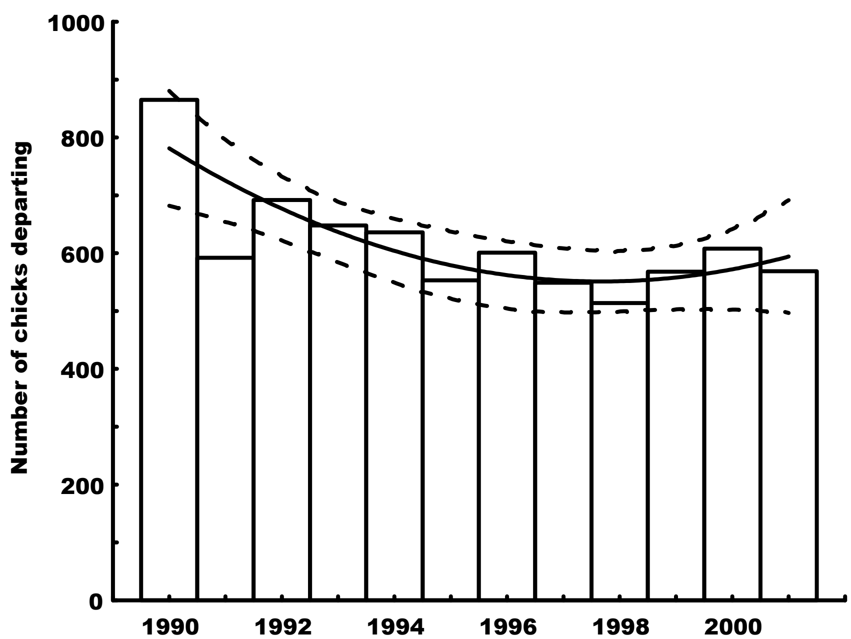
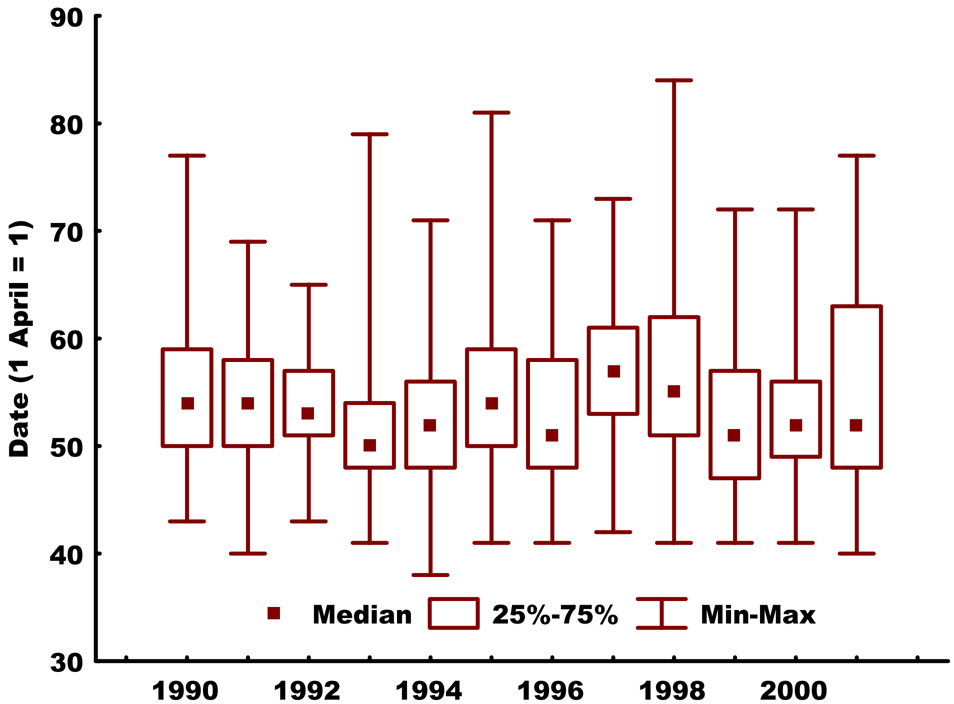


Figure 3
Ancient Murrelet chick departure dates for East Limestone Island 1990 - 2001



Burrow monitoring
Daily nest checks began on April 7, finding three eggs, and resulted in 12 eggs from 13 active burrows (we missed the first egg in burrow C21). Nine burrows successfully fledged one (n=5) or two (n=4) chicks, and four burrows were deserted (1 - one egg, 2 - two eggs and 1 - three eggs). One nest was abandoned after an incubating adult was taken from the burrow and killed (S8); the predator was suspected to be a raven. Despite an intensive search for new burrows to monitor at both the Cabin and Spring Valley plots, no new active nests were found. This year, we had the lowest number of active burrows than of any previous season.

The first chicks hatched in the monitored burrows on May 20. Three days later, to our surprise, we found a burrow with three warm eggs in S-plot during a routine 30-day check (S34). We learned that two different females were incubating the eggs but this unusual nest was not successful because the nest was abandoned before the chicks hatched. We took the eggs from the burrow, measured them and examined their contents. Two eggs were similar in size and colour but the third was smaller and coloured differently. The dissimilar egg contained a rotting embryo while the two similar-looking eggs contained nearly formed chicks.

We spent time in the northern part of the colony this year, setting up a pilot monitoring plot at North Cove. The plot's purpose was primarily to help us find suitable locations for the new Ancient Murrelet nest boxes. We have not monitored burrows at North Cove before and consulted a Canadian Wildlife Service colony census (1985) to mark out a plot. We temporarily marked 41 burrows between Funnel 1 and 4, monitored them for 7 weeks and found 24 active nests.

Gathering Ground count
Ancient Murrelets adults were counted as they gathered on the water on the western side of Low Island. We began counts on April 6 and continued nightly until 19 June. The peak count was 328 murrelets on May 23. The high counts for each month were: 20 April - 220; 23 May - 328; and 1 June - 106. We missed 13 evenings as a result of poor weather or commitments with our visitor program.

Nest boxes

In 2001, we installed 100 wooden nest boxes for Ancient Murrelet, to investigate whether there is a shortage of available nest sites and to create predator-proof nests. Thirty-three boxes were installed at each of the Cabin and Spring Valley plots, and 34 were installed at the North Cove. The boxes were made locally and constructed with a front hatch, a u-shaped tunnel, and a typical burrow entrance. About 20 cm back from the hatch, a small piece of wood was fastened to the floor so that birds would nest and lay their eggs against this structure, instead against of the door - a problem detected with similar boxes at Reef Island. Boxes were checked for activity on 20 May for 10 days. No eggs or birds were found in the boxes but 13 were visited during the period of monitoring.

Predation

In 2001, we found 41 Ancient Murrelet burrows excavated by a predator, but we were not able to confirm its identity. Twice, headless murrelet skins were close to an excavated burrow and one carcass was inside out. Three burrows were found with two eggs on the nest cup. During one search, a partially excavated burrow (the whole entrance and half the tunnel was gone) was found with an adult incubating two eggs; the nest was found abandoned the next day. We suspected that a raccoon was responsible for the diggings but since eggs were not taken from some of the burrows, it was possible that river otters were also involved. As noted by Michelle Masselink and others, the diggings were typical of raccoons and we have not seen this amount of digging for ten years, although river otters have lived on Limestone this entire time. On June 14, 2001, a raccoon survey and burrow-digging report was prepared and sent to Sean Sharpe, Regional Biologist at the Ministry of Environment, Lands and Parks in Smithers. We requested that MoELP initiate a control program on Limestone Island and Vertical Point, as per a 1995 multi-agency agreement. In October, a raccoon control team camped on Limestone Island for five days and removed at least nine animals from Vertical Point; no raccoons were found on Limestone Island.

A Common Raven nest was found near the trail as it crests the hill leading to Boat Cove. At least 25 wings and numerous eggshell fragments were found on the ground at the base of a large Sitka spruce tree. Throughout the entire season, we found many new wings and feather piles in all colony areas. A predator disturbed a burrow that has been active since 1992 and the incubating murrelet was pulled out and killed. We suspect that the predator was a raven because of the way the rocks were set aside, hatch cover moved and the presence of a the feather pile. On Reef Island, Michelle Masselink watched as a raven pulled an adult murrelet out of a burrow during the day and killed it. The murrelet struggled and made many loud calls but was unable to free itself from the raven’s claws. Michelle also found a very large pile of murrelet wings, legs and eggshell fragments on the ground under a large tree on Reef Island.

BLACK OYSTERCATCHERS

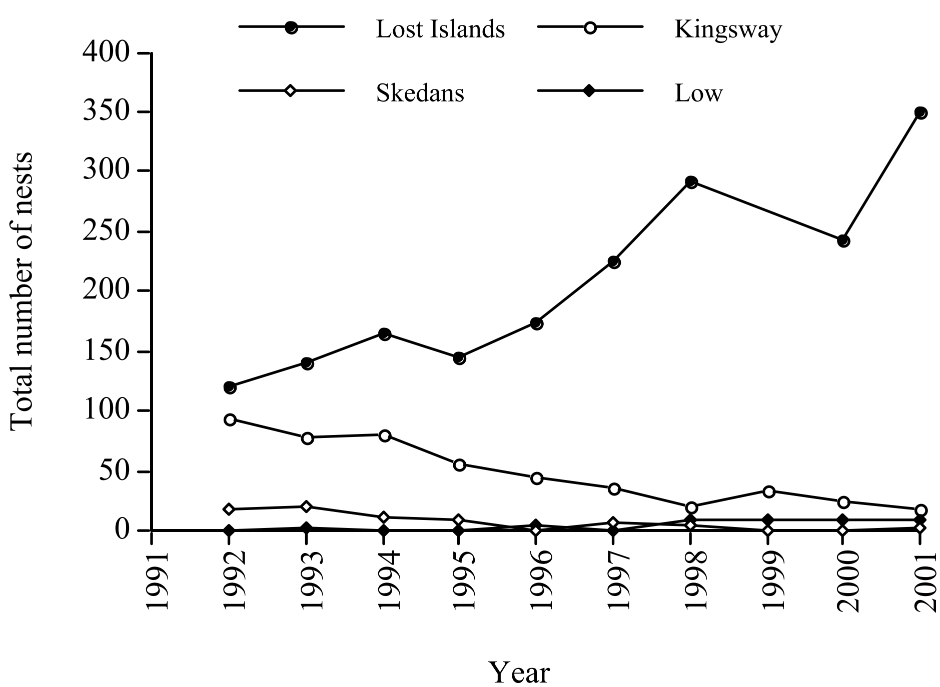
As in earlier years, all Black Oystercatcher nest sites in Laskeek Bay were surveyed for breeding activity and chicks were banded when they reach 100 grams; adults were banded when possible. This marking program helps to track chick survivorship, year-to-year movements and should eventually provide information on the longevity of some oystercatchers. A total of 32 pairs were located on islands in Laskeek Bay: Reef Island 7, Low Island 2, South Low Island 5, the Skedans Islands 6, Kingsway Rock 3, Lost Island 5, West Limestone Island 1 and East Limestone Island 3. No count was made at Cumshewa Rocks, where there are usually 2-4 pairs. Twelve chicks were banded, on Reef, Skedans, Low and Lost islands.

There are three nest sites on Limestone Island that are used each year. On 30 May, nest sites ELI-1 and ELI-2 both had eggs, ELI-3 had no eggs; adults were present at all sites. All nests were re-checked in early June when none had eggs; adults were still nearby. Eggshells were found at the ELI-3 (North Cove) in early June and early July, suggesting that the adults might have laid two clutches. The lack of success by Black Oystercatchers at East Limestone Island in 2001 may be associated with the presence of the unidentified predator: Vermeer *et al*. (1992) found that raccoon predation on oystercatchers was prevalent in Skidegate Inlet.

GLAUCOUS-WINGED GULLS

Nest and adult counts of five Glaucous-winged Gull colonies in Laskeek Bay were made on 18-29 June and on 10-23 July. The trend for increasing numbers of breeding gulls on the Lost Islands continues with 376 nests and 750 adults counted (including 29 juveniles). The colony on Kingsway Rock continues to decline (Figure 4). Numbers of nests were as follows: Lost Islands - 376 (89%), Kingsway Rock - 25 (6%), Low Island - 14 (3%), Skedans Islands - 4 (0.9%), Cumshewa Islet - 3 (0.7%) and Reef Island (SE rocks) - 2 (0.5%). The total number of nests on all colonies was 424, of which 294 (69%) contained three eggs and 39 (9%) were empty. Nests on the Cumshewa Islet and Reef Island colonies were found on 10 and 23 July; no nests were present at those sites during the earlier surveys. Glaucous-winged Gull egg-laying may have been delayed by cool temperatures and stormy weather in May.

Figure 4
Glaucous-winged Gull nest counts for four colonies in Laskeek Bay, 1992-2001. Colony counts from 1999 were not included for the Lost Islands



PIGEON GUILLEMOT NEST BOXES

Ten wooden nest boxes were installed at the Lookout Point, south east of the cabin, to study whether nest sites are limited for Pigeon Guillemots on Limestone Island. The boxes are predator and weather proof, and are basically a short tunnel with a small, dark nest chamber. The nest boxes were carried or raised into permanent locations on the rock cliff, weighted down and filled with a thin layer of soil and pebbles. Two boxes had fresh droppings inside the tunnel entry when they were surveyed in July prior to camp closure.

MARINE SURVEYS

Seabird surveys

In 2001, we did four nearshore surveys (21 April, 21 May, 3-6 June, 23 June) and two offshore surveys (11 June and 1 July). Our data are sent to the Canadian Wildlife Service in Ottawa to become a part of the permanent records of annual seabird counts along the west coast of British Columbia. The transects have been done in Laskeek Bay since 1989 (except Cumshewa Inlet), giving a 13-year-data set. One of the primary purposes of the nearshore survey is to count Marbled Murrelets, a species that is listed in Canada as endangered by COSEWIC. Our project forms an integral part of the information needed to watch this species and is the longest time series for Marbled Murrelets in British Columbia. The peak count was on 23 June, with a total of 165 murrelets for all transects.

Species diversity was good for the late April and May surveys (19 species each), declining to nine and eleven species in June. The complete species list for the nearshore surveys was: Common and Pacific loons, Red-necked Grebe, Double-crested and Pelagic cormorants, White-winged and Surf scoters, Brant, Common Merganser, Harlequin Duck, Bufflehead, Long-tailed Duck (Oldsquaw), Green-winged Teal, Black Oystercatcher, Black Turnstone, Glaucous-winged and Herring gulls, Black-legged Kittiwake, Ancient and Marbled murrelets, Cassin's and Rhinoceros auklets, Pigeon Guillemot, Bald Eagle, Northwestern Crow, and Belted Kingfisher.

Black-legged kittiwakes were recorded in Laskeek Bay in 16 of the 17 weeks of the field season and were seen during all of the nearshore surveys in 2001. Several large flocks of mostly immature birds were noted on or near Kingsway Rock with 80 birds on May 21 and 235 on June 29.

We observed eleven and ten species, respectively, on the two offshore surveys. Sooty Shearwaters were seen on both surveys, with 148 birds on the first and 598 (plus additional 300 off transect) on the second. A dark phase Northern Fulmar was seen on 1 July, as well as five unidentified sandpipers. On 11 June more than 400 Ancient Murrelets were between Low Island and Skedans Islets at 07.50 h; one humpback whale was close by. The bird list for the offshore surveys was: Common Loon, Pelagic Cormorant, Northern Fulmar, Sooty Shearwater, White-winged Scoter, unidentified sandpipers, Glaucous-winged Gull, Herring Gull, Common Murre, Pigeon Guillemot, Ancient Murrelet, Cassin's Auklet, and Rhinoceros Auklet.

Marine Mammal Surveys

In 2001, we had a total of 85 sightings of nine species of marine mammals: the most sightings recorded by the Limestone Island crew since we began collecting records in 1990. The sightings were made from the Limestone cabin, on sea surveys, or during sea watches. We spent 20.5 hours at the Lookout, fewer than in other years, but rough seas in April and May severely hampered our visibility.

Humpback Whales were in seen in Laskeek Bay from 1 April to 27 July, with sightings on 26 days, being seen almost daily between 20 May and 23 June (Table 2). On one sea watch alone, over 20 animals were spotted in the southern portion of Laskeek Bay. At times, there were more than 40 whales feeding in Laskeek Bay, as reported by the Reef Island crew and tour operators on several occasions. Humpbacks may have remained in the area because of an abundance of feed, as all animals were definitely feeding during our observations.

Orcas were encountered twice (17 June and 5 July), both times near the Skedans Islets. The first time, a pod with two males, four females and two calves slowly travelled north. This pod gave an amazing show with body rolls, tail slapping, breaching, somersaults, and spy-hopping displays. Several times, four animals would simultaneously spy-hop. The second encounter with three whales in the lagoon of the Skedans Islets on July 5 lasted for over one hour. We made a recording and took photos of the bull, cow, and calf. At one point, the calls of the bull could be clearly heard through the hull of the boat!

On two occasions (14 and 21 April) a single elephant seal was spotted at the surface near Low Island; on 14 April the elephant seal appeared to be following a large group of Ancient Murrelets. These seals (possibly the same one each time) were probably young males, as they were alone.

Non-breeding Steller's Sea Lions were counted three times at the Reef Island haul-out (28 March, 21 April and 21 May), with the highest count of more than 720 animals on 21 April. This year, we saw very few sea lions at the Skedans Islands, with the peak of 75 on 21 April . The peak numbers at Reef Island were about one month earlier than previous years. One male at Reef Island had a rope caught around its neck and was in poor condition. Our sea lion observations were sent to Parks Canada to be included in their annual Steller's Sea Lion haul-out counts in the South Moresby region of Haida Gwaii.

Other marine mammal species recorded in 2001 included a sighting of two Fin Whales east of Skedans Rock on 1 May; one Sei Whale off Haswell Island on 21 May and 2 Minke Whales on 9 and 10 July. Pacific White-sided Dolphins were seen on seven dates between 21 April - 21 July and 2-3 Harbour Porpoises on six dates between 23 June - 25 July. The number of sightings of Harbour Porpoise is higher than usual. On 21 June, several hundred Harbour Seals were counted at traditional pupping sites (Kinguii, Reef and Cumshewa islands, Kingsway Rock, and elsewhere).

Table 2
All marine mammal sightings in Laskeek Bay in 2001, except for records of groups of <10 Steller's Sea Lions and Harbour Seals

Date	Species	Number	Location	Activity
28/3/01	Steller's Sea Lion	310	Reef I. rocks, SE	hauled out
16/4/01	Humpback	1	off Cabin Cove	traveling N
19/4/01	Pacific W-S Dolphin	20	near Kunga I, Porter Head	foraging, spray
20/4/01	Humpback	7 to 8	SW of Low and Reef	feeding, surface diving, fin slaps, slow moving
14/4/01	Elephant Seal	1	W of Low I 500 m	on surface traveling S
21/4/01	Steller's Sea Lion	>700	rocks SE tip of Reef I	hauled out
21/4/01	Elephant Seal	1	.75 NM ENE of Low I	traveling S
21/4/01	Pacific W-S Dolphin	6 to 7	W side Low I	traveling S
21/4/01	Pacific W-S Dolphin	1	E side ELI, 75 m from shore	traveling N
21/4/01	Steller's Sea Lion	75	Skedans Rock	hauled out
22/4/01	Humpback	2	S end of Low I.	traveling S on surface
22/4/01	Humpback	2 to 3	75 m off ELI cabin	traveling N on surface
23/4/01	Pacific W-S Dolphin	41 to 45	1 to 1.5 nm off ELI cabin	traveling S fast

30/4/01	Humpback	3 to 5	S of Low I.	breaching, rolling, feeding
01/05/01	Fin Whale	2	Hecate Strait, 10 nm off ELI	breaching, blows
01/05/01	Humpback	4	NE Low I., 2 nm	feeding, diving, slapping
01/05/01	Steller's Sea Lion	11	Skedans Rock	hauled out
01/05/01	Fin Whale	2	10 nm NE of ELI	breaching, blows
01/05/01	Harbour Seal	1	E tip S. Low I.	on rock
01/05/01	Humpback	4 to 6	off Porter Head to Helmet I.	feeding, rolling, fin slaps
05/05/01	Humpback	1	off Porter Head	feeding
09/05/01	Humpback	1	Laskeek Bay, Hemming Head	feeding
12/05/01	Humpback	5 to 7	Laskeek Bay, Hemming Head	feeding
20/5/01	Pacific W-S Dolphin	3 to 5	2 nm W of Low I.	feeding on surface
20/5/01	Humpback	2 to 3	4 to 5 nm E of ELI	blows
21/5/01	Humpback	>5	2 to 3 nm E of Low I.	blows
21/5/01	? Sei Whale	1	Haswell I.	surfacing, blows
21/5/01	Steller's Sea Lion	300	Reef I haulout	hauled out
21/5/01	Steller's Sea Lion	33	Skedans I haulout	hauled out
21/5/01	Humpback	1	1.5 nm NE Low I.	pectoral fin slaps
23/5/01	Humpback	>12	E of Low I.	fluke slaps, fin slaps
22/5/01	Humpback	>6	E of Low I.	breaching, tail lob
22/5/01	Humpback	8 to 10	N of Kunga I.	breaching, tail lobs, fin slaps
28/5/01	Humpback	3	W of Reef I.	feeding, head out
28/5/01	Humpback	2	SSW of S Low I.	feeding, blows
28/5/01	Humpback	18 to 20	Skedans Islets to Kinga I.	fin slaps, breaching, diving

28/5/01	Humpback	5	Between Skedans Islets and ELI	blows, breaching, rolling
29/5/01	Humpback	1 to 2	E of ELI 2 nm	blows
29/5/01	Humpback	2	N of Low I.	blows
30/5/01	Humpback	2	NE of Low I.	blows
29/5/01	Humpback	4	N of Low I.	blows
31/5/01	Humpback	2	N of Low I.	blows, tail slaps
05/06/01	Humpback	1	S of Reef I.	blows, tail slaps
05/06/01	Pacific W-S Dolphin	20	between Low and ELI	foraging, traveling
07/06/01	Humpback	2	S of Low I.	blows
08/06/01	Humpback	1	300m off Cabin Cove	blows
10/06/01	Humpback	4 to 6	E of Low I., 1 nm, between Low &Reef	feeding, breaching
11/06/01	Humpback	about 15	off shore transect lines	feeding
17/06/01	Orca	8	1nm E of Skedans Is.	foraging for fish ?, repeated spyhopping
18/06/01	Humpback	7	S &SW of Reef Is, in Laskeek Bay	feeding, breaching, fluke photos taken
23/06/01	Harbour Porpoise	2	400m off Lookout Pt.	moving north
23/06/01	Humpback	3	half way between Low &Reef I.	heading SW
30/06/01	Harbour Porpoise	3	half way tween Low & ELI	feeding in large circles, moving south
04/07/01	Harbour Porpoise	2	300m off NE pt of ELI	moving south
05/07/01	Humpback	3	just E of Reef I.	heading slowly west, inc. 1 juvenile
05/07/01	Steller's Sea Lion	174	outer rock at Reef HO	on rock, inc. 32 juveniles
05/07/01	Orca	3	Skedans Lagoon	hunting seals, no kill, recordings and possible picture
09/07/01	Minke Whale	1 (2?)	half way to Low I.	moving SW
10/07/01	Harbour Seal	12	on Low I.	resting rocks, incl. 4 pups

10/07/01	Minke Whale	2	just off Cabin Cove kelp patch	moving north
11/07/01	Harbour Seal	12	Skedans Lagoon haul out	resting
14/07/01	Harbour Seals	42	Low I.	resting on rocks
14/07/01	Harbour Porpoise	2	just off Cabin Cove	heading south
15/07/01	Orca	5	Skedans Islands	moving through lagoon, no big male, 1 juvenile
15/07/01	Harbour Porpoise	4	off Cabin Cove kelp	heading SE
17/07/01	Harbour Porpoise	2	between Low and ELI	heading SW, feeding in large circles
18/07/01	Harbour Seal	20	on Low I.	resting on rocks
18/07/01	Harbour Porpoise	2	between S Low I. and ELI	heading SW
21/07/01	Pacific W-S Dolphin	2	E of Low I.	heading south
22/07/01	Humpback Whale	1	half way between Lost & Reef islands	heading SE, far out
25/07/01	Harbour Porpoise	2	just off Cabin Cove kelp patch	heading N

FOREST BIRDS

Wildlife Trees

We surveyed 69 wildlife trees in 2001. We confirmed the use of twenty-five trees by cavity nesting birds and of these, 10 were new this year. All 69 wildlife trees were snags (dead, standing trees): 57% (39 trees) Sitka spruce, 35% Western hemlock, 3% Alder and 5% unknown species. Of the 25 active trees, 64% were Sitka spruce, 28% Western hemlock, and 8% Alder.

The bird species using the trees for nesting (chicks heard and/or fledged) were: Red-breasted Sapsucker (21 nests); Brown Creeper (1); Chestnut-backed Chickadee (1); Northern Flicker (1); and Hairy Woodpecker (1), plus later, Northern Saw-whet Owl (1). Wildlife tree 20 (on the trail to the biffy) was active again in 2001 and a Red-breasted Sapsucker pair (one banded) successfully raised their chicks to fledging.

Lee Burles measured all of the trees for height and diameter (DBH) , took GPS bearings on some trees, and wrote detailed directions on location of others. New tags were put on some trees and a few trees were re-numbered to eliminate confusion. New data forms were created to help us track the history of use for each tree, particularly since some trees have been used for more than five years. Full details are given elsewhere in this report.

Songbird Banding

One part of the RGIS project studies songbirds and the impact of introduced species, such as deer and squirrels, on their diversity, breeding success, and numbers in. Staff from Limestone and Reef Islands banded songbirds from 20 June - 25 July, running six stations on Reef, Low, West Skedans, East Limestone and Louise islands (Vertical Point). Eight banding sessions of five hours were carried out at each station, with at least a two-day break between sessions at the same station. The Limestone Island crew banded at East Limestone Island, Vertical Point, and West Skedans Island. More details are provided by Gaston et al. (this report).

Measurements of tarsus, wing and bill were taken from birds captured to contribute to information on geographical variation. Birds were also aged by looking at plumage, feather condition, moult limits, and if necessary, skull formation. The ratio of hatch-year (HY) birds and after-hatch-year (AHY) adults helps us to monitor the breeding success of the population around the banding stations (see Gaston *et al*., this volume).

Much lower numbers than in previous years were trapped at East Limestone Island and West Skedans Island, while numbers trapped at Vertical Point were the highest to date; this was only the second year of trapping at West Skedans Island. On East Limestone Island, 49 birds were banded or recaptured, of which 18% were HY birds. On Vertical Point, 119 birds were caught, with 46% HY. On West Skedans Island 156 birds were trapped, of which 23% were HY. Eleven species of songbirds were caught on East Limestone Island, 12 species at Vertical Point, and 14 species at West Skedans Island. Vertical Point had an unusually high number of Hermit Thrush: 31 out of the 55 HY birds banded.

One female Hermit Thrush, originally banded on Limestone Island in 1998, has been re-trapped each year. Each time she has a brood patch, which means this bird returns to the same area of the island to breed. A Wilson's Warbler was netted at the Low Island on 25 July the first time this species has been banded in Laskeek Bay.

NATURAL HISTORY

Daily Bird Checklist

A daily checklist of birds on Limestone Island and the surrounding area resulted in a total of 73 species in 2001. The maximum species count on a single day was 38 on 11 June. Some interesting highlights were: young of the year Ancient Murrelets off the boat cove on 21 July and a male Blue Grouse calling almost daily from dawn to the middle of the night for 17 weeks. During a storm on 6 May, several thousand Sooty Shearwaters were seen flying south, inside Low Island.

Birds of Prey

This year we found the first Northern Saw-whet Owl (*Aegolius acadicus brooksi)* nest on Limestone Island; this subspecies is found only on Haida Gwaii. The familiar, monotonous calls were not heard until 5 May, much later than normal. However, an owl was frequently sighted at dusk in the area near the cabin and on 20 June, Joelle Fournier saw an owl flew straight into wildlife tree number 1, entering an old Northern Flicker nest cavity. Daily observations of this nest tree revealed that an owl briefly visited the tree every evening, often carrying prey. On 4 July an adult was sighted with its head outside the nest cavity with the other adult sitting on the tree. On 20 July chick(s) were heard calling whenever the adult owl came in carrying prey. Once the chicks had hatched, an adult would frequently come to the nest during the day. Winter Wrens were observed dive-bombing an adult saw-whet owl in the spruce regeneration near the owl's nest. The last check, on 27 July, showed that the chicks were still sticking their heads out of the nest hole. However, by 15 August the chicks had left.

The excitement with nesting raptors continued when a pair of Bald Eagles occupied the nest on Cassin's Tower for the second year in a row. A quick visit to the Tower before egg-laying turned up a Ancient Murrelet band in a fresh eagle pellet - a bird banded on East Limestone Island in 1993. After the first egg was laid, we watched the incubation from behind a tree on the ridge trail. A chick appeared on 9 June, poking its head out from under an adult: we checked the nest weekly thereafter. When camp closed on 27 July, the chick was fully feathered but had not yet fledged. No further checks of the auklet/storm petrel colony were made in 2001.

Sharp-shinned Hawks were occasionally sighted throughout the season and we saw territorial displays by two adults over the channel between the Limestone Islands. On 2 July, a fledgling hawk was heard calling from the cedar trees on the west side of the boat cove and on 8 July, the adults were observed feeding a squirrel to the chick perched on a tree. However, no nest site was located. There was no activity at the Peregrine Falcon eyrie on the south side of Limestone Island. The nest site was checked periodically after 24 May, but no birds were seen.

Plants

An unconfirmed Queen's cup (*Clintonia uniflora*) was found in the woods north of boat cove (seen only once; no pictures). This lily is common in coastal temperate forests but has never been found on the Limestone Islands. The plants in the deer enclosures are growing, with the most obvious change being the extent of ground cover from young huckleberry and false azalea. The rare plants on the cliffs near the boat cove (e.g. *Anemone multifida, Polemonium pulcherrimum*) continue to fare well, as they are out of reach of the deer. In mid-June, the rare Richardson's geranium (*Geranium richardsonii*) was found in bloom at the two sites first located in 1992.

Introduced species

Perhaps the single greatest concern this year was the suspected presence of a raccoon on Limestone Island. For the first time since 1992, we noticed unusual burrow excavations in three parts of the colony. The diggings first appeared on April 23 at the northern end of the island, then more diggings were found towards Lookout Point, in Spring Valley and the northeast colony areas. Michelle Masselink came over from Reef Island and looked for latrines on Limestone and Louise Islands, finding none on Limestone but at least 40 on Louise. In total, there were 41 excavated burrows, with no estimate of adult mortality. As well, two similar sized diggings were found on West Limestone Island. Despite a massive search effort of two midnight spotlight surveys, several daytime shoreline surveys and numerous dawn searches in the colony, no raccoons were found during the field season. Live animal traps were borrowed from Parks Canada and set for 60 trap days. We baited the traps with fresh chicken eggs but failed to catch anything but two red squirrels. In October, a raccoon control crew spent five days on Limestone Island to remove raccoons from Vertical Point and Limestone Island. The crew shot and killed nine animals, probably killed two others, and saw two more, all on Vertical Point/Louise Island. A pair of eyes was seen on Limestone Island but a raccoon was never confirmed, despite one bait pile of fresh fish and two live traps with fresh fish (A. Edie, pers. comm.).

Sitka Black-tailed deer continue to live and breed on East Limestone Island. We recorded the locations of two radio-collared deer from April to June. A yellow/red collared deer was seen 15 times and a white/red collared deer was seen four times. Most of the observations were on the east side of the island but the deer ranged from the boat cove to cabin cove and into Crow Valley regularly. A fawn was found on 13 June near North Cove and at times, the yellow-red deer was accompanied by up to four other animals.

The squirrel surveys were continued this year and we completed ten surveys between 15 May - 13 June. In total, 66 squirrels were seen or heard, 19 of them within the 20 m radius plots.

Other Species

River otters were very active on Limestone Island this year, with numerous observations of young otters frolicking along the shoreline. On two occasions (6 May and 14 June), an otter was seen in the forest. We found an active den on 3 May, on the ridge top, heading towards Lookout Point.

We were excited to see large numbers of a pelagic invertebrate, *Salpa fusiformis*, in the waters around Limestone Island for several weeks in May and June. This salp is solitary but can form long daisy chains, looking a bit like a children's toy.

MENZIES' PIPSISSEWA *CHIMAPHILA MENZIESII*: A WIDESPREAD BUT PREVIOUSLY OVERLOOKED SPECIES ON HAIDA GWAII

Stephen A. Stockton and Liann L. Bobechko
Research Group on Introduced Species, Queen Charlotte City, B.C., V0T 1S0
sstock@science.uottawa.ca

ABSTRACT

Further records of Menzies' Pipsissewa in Haida Gwaii are detailed, confirming earlier suggestions that the plant is widespread in the archipelago.

On July 13, 2001, Menzies' pipsissewa *Chimaphila menziesii* was recorded blooming in the forest interior of Reef Island. On August 6, 2001, it was recorded blooming approximately 120 km north of this point, on Graham Island, in the forest interior near the Golden Spruce Trail, west of Port Clements. These occurrences are the third and fourth records for this species in Haida Gwaii and bear out earlier predictions that this species is widespread in the archipelago (Smith & Buttler 1999, Stockton & Buttler 2001).

While only four and three individuals were found on Reef Island and Graham Island respectively, several hundred individuals were observed on Haswell Island on July 21, 2001. Only sixteen individuals of *C. menziesii* have previously been detected on Haida Gwaii, eight on East Limestone Island (Smith & Buttler 1999), and eight on Haswell Island (Stockton & Buttler 2001), both in Laskeek Bay. The new records of *C. menziesii* demonstrate a substantial increase in the known range and the number of individuals of this species on Haida Gwaii.

In most instances, the habitat in which *C. menziesii* was found is largely consistent with that on Limestone Island: a thick bed of moss, primarily *Rhytidiadelphus squarrosus*, beneath mature Sitka spruce *Picea sitkensis* and western hemlock *Tsuga heterophylla* (Smith & Butler 1999). However, in many cases, individuals grew in *P. sitkensis* or *T. heterophylla* needle litter (Figure 1). Given the ubiquitous nature of these habitats, the occurrence of this species on other islands of the archipelago is expected.

The vegetation on Reef Island, East Limestone Island and Haswell Island, is radically modified by Sitka black-tailed deer *Odocoileus hemionus sitkensis* (Daufresne & Martin 1997). The large number of *C. menziesii* individuals found on Haswell in 2001 is thought to be the consequence of a recent decrease in the intensity of deer browsing on that island. Since June 22, 1999, the vegetation on this island has apparently experienced a small recovery. Many individuals of species known to be highly susceptible to deer browse, western redcedar *Thuja plicata* and red huckleberry *Vaccinium parvifolium* (Pojar *et al.* 1980), previously browsed to the level of the thick moss layer, have since grown several centimetres above this level. Browsed individuals of *C. menziesii* are also thought to have been present beneath this moss layer, but overlooked due to a lack of identifiable leaves and flowers.

As anticipated by Smith & Buttler (1999), browsing of *C. menziesii* appears to constitute a major impediment to the successful identification of this small and inconspicuous plant species.

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Figure 1

Menzies' pipsissewa *Chimaphila menziesii* growing amongst the needle litter of western hemlock *Tsuga heterophylla* in the forest interior of Reef Island. The individual in the foreground is approximately 12 cm tall. Photo by S.A. Stockton near permanent vegetation plot 2 on 13 July 2001.

CAVITY AND BARK NESTERS ON EAST LIMESTONE ISLAND

Joanna Smith
Laskeek Bay Conservation Society, Box 867, Queen Charlotte City, BC, V0T 1S0

ABSTRACT

In an eleven-year study (1990 to 2001) on a 48 ha forested island in Haida Gwaii, 196 nests of six species of primary and secondary cavity nesters were located. Red-breasted Sapsuckers were the most common species to nest on Limestone Island (n=169 nests) with the remaining nests built or occupied by Chestnut-backed Chickadee, Hairy Woodpecker, Brown Creeper, Northern Flicker or Northern Saw-whet Owl. Forty-one percent of all nests were in trees previously occupied, some for as many as eight years. Sixteen nest trees were used by two or more species during the study, four times by two species in the same year. Sapsuckers and other species nested at an approximate density of 0.16 - 0.54 nests/ha or approximately one nest per 2.7 ha. Nest hole heights averaged 15.8 ± 8.2 m for all six species. All but two of 74 nest trees measured were dead coniferous trees greater than 10 m tall and 50 cm in diameter. Sitka spruce was the most common tree species, followed by western hemlock; two nests were in red alder. Red-breasted Sapsuckers generally formed nests in Sitka spruce trees averaging 22.1 ± 10.7 m, and a diameter of 130 ± 46 cm. Observations of nesting phenology for Red-breasted Sapsuckers showed that they began nest excavation mid - late April and incubation in early May. Chicks began calling in late May - early June and fledged as early as 8 June. Twelve colour-banded Red-breasted Sapsuckers were re-sighted, some banded as adults in 1995. This on-going study provides valuable nest tree use information, nest tree characteristics and provides a record for adult longevity and possibly nest site fidelity in Red-breasted Sapsuckers.

INTRODUCTION

Woodpeckers and other cavity nesters depend upon so-called ‘wildlife trees’ for nesting, roosting and feeding (Steeger and Machman 1994). Cavity excavation is generally part of an annual courtship ritual. Many cavity nesters create a new nest each year and consequently, a large number of cavities exist in forested areas. Abandoned cavities may be used by secondary cavity nesters, like owls, chickadees and squirrels, and may be limited by the availability of natural cavities. In virtually all forest habitat types, cavity nesters rely on the presence of trees with decayed heartwood for nesting (Harestad and Keisker 1989). Cavity nesting birds are among those species that are adversely affected by the removal of dead and decaying trees.

Red-breasted Sapsuckers (*Sphyrapicus ruber*) are the most common primary cavity nesting species in the Pacific Northwest. They are considered an uncommon resident along the entire British Columbia coast (Campbell et al. 1990). Red-breasted Sapsuckers nest in a wide range of forested ecosystems, including old growth, from sea level to 1,220 m. Nests occur primarily in dead trees, 3-20 m tall, with a minimum diameter of 30 cm (Steeger et al.). This species is a year-round resident on Haida Gwaii.

Other primary cavity nesting species present on Haida Gwaii are the Hairy Woodpecker (*Picoides villosus picoideus*), Northern Flicker (*Colaptes auratus*) and Chestnut-backed Chickadee (*Parus rufescens*) (Table 1). Hairy Woodpeckers, sub-species *picoideus,* are endemic to Haida Gwaii and on the provincial blue-list (1993) because of concern for declining populations. Hairy Woodpeckers are uncommon residents in BC, occupying all forested types from sea level to 1,900 m (Campbell et al 1990). This species excavates nests in deciduous and coniferous trees with minimum diameter of 25 cm (Steeger et al.). Northern Flickers are common throughout BC and will nest in either old or newly excavated cavities in trees greater than 40 cm in diameter (Steeger et al.). Lastly, Chestnut-backed Chickadees nest in natural or excavated cavities, in trees up to 26 m tall.

Secondary cavity nesters on Haida Gwaii include Northern Saw-whet Owl (*Aegolius acadicus brooksi*) and Red-breasted Nuthatches (*Sitta canadensis*). Northern Saw-whet Owls, sup-species *brooksii*, is an uncommon resident on Haida Gwaii; there are no known nest records for this sub-species of saw-whet owl on Haida Gwaii (see Tarver, this volume). This owl will nest in abandoned woodpecker holes, especially those of Northern Flickers, as well as natural cavities (Ehrlich et al. 1988). Similarly, nuthatches nest in abandoned woodpecker holes but they will excavate their own nests in rotten stumps or branches (Ehrlich et al 1988). Brown Creepers (*Certhia americana*) nest in similar trees to those used by the above cavity nesting species, but these birds are only occasional cavity nesters, preferring to nest under tree bark (Ehrlich et al 1988).

Table 1
Cavity and bark nesting species on Haida Gwaii

Species	Scientific name	Type of Cavity Nester
Red-breasted Sapsucker (RBSA)	*Sphyrapicus ruber*	Primary – annual
Hairy Woodpecker (HAWO)	*Picoides villosus picoideus*	Primary – annual
Northern Flicker (NOFL)	*Colaptes auratus*	Primary – perennial
Chestnut-backed Chickadee (CBCH)	*Parus rufescens*	Natural or Primary
Brown Creeper (BRCR)	*Certhia americana*	Under bark, rarely cavity
Northern Saw-whet Owl (NSOW)	*Aegolius acadicus brooksi*	Secondary
Red-breasted Nuthatch (RBNU)	*Sitta canadensis*	Secondary

Nest tree selection and nest use has been examined for sapsucker and woodpecker species in other part of British Columbia. Harestad and Keisker (1989) found that most cavity nesting species were flexible in their choice of nest trees but preferred certain species if they were available. The decay characteristics of a nest tree seemed to be the most important factor determining nest location, followed by height and diameter (Harestad and Keisker 1989, Dobkin et al 1995). Tall trees provide protection from predators because nests can be placed higher up. On Limestone Island, red squirrels (*Tamiasciurius hudsonicus*) are year round residents on East Limestone Island, having been introduced to Graham Island in 1950 by the BC Forest Commission. Squirrels are secondary cavity nesters and compete with other species for these nest sites. As well, squirrels prey upon the eggs of other cavity nesting species and their presence may influence nesting site selection for cavity nesting birds living on this island.

Despite the extensive alteration of forested habitat on Haida Gwaii, little is known about nest tree characteristics, frequency of nest tree use and timing of nesting for cavity nesting birds. The Laskeek Bay Conservation Society operates a field camp on East Limestone Island each year from late March to early July, which provides an excellent opportunity to monitor wildlife tree use. The objectives of this on-going study are to document the number of bird species using tree cavities on Limestone Island and summarise tree characteristics and annual use. The approximate timing of breeding in Red-breasted Sapsucker was examined because this species is the most numerous cavity nester on the island.

METHODS

The study was conducted on East Limestone Island, Haida Gwaii (52º 54.4’ N, 130º 37.5’W), a 48 ha forested island on limestone bedrock, dominated by Sitka spruce (*Picea sitchensis*), western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*). Willow (*Salix* spp.), Pacific crabapple (*Malus fusca*) and red alder (*Alnus rubra*) occur on rock outcroppings and in open areas. Spruce is the most abundant tree throughout the island, mixed with redcedar along the west, north and east sides. Hemlock is more common in the center of the island, with alders in some of the valleys. The island rises to an elevation of 65 m on the south ridge. A natural fire affected the forest on the southeast slopes and the area now supports mature alder and spruce stunted by years of browsing from introduced deer. This island was never logged.

The study area lies within the Coastal Western Hemlock, wet Hypermaritime subzone, on the eastern side of Louise Island. The eastern side of the island is exposed to strong southeast and northeast winds blowing from the Hecate Strait, but it is protected by Louise Island on the westward side. Limestone Island occurs within a Provincial Wildlife Management Area protecting it from future resource development. The adjacent forested islands to the west (Louise and Moresby) are managed for timber harvesting and nearby slopes support early and advanced successional stage forests.

Beginning in 1990, the LBCS recorded the presence of cavity and bark nesting species on East Limestone Island and their use of specific trees. As nest trees were discovered, they were numbered, tagged, mapped and sometimes photographed. In 1995, the methodology was improved by dividing the island into four roughly equal areas. Each year all four areas were checked for nests three times between late May and mid-July (French 1995). In 2000, the protocol was adjusted so that inactive trees from the previous five years were not checked.

Each year in late April, previously active nest trees from the last five years were watched for 30 minutes for signs of nesting (e.g. excavation, adults nearby) or until activity was observed, whichever time was shorter. Active trees from the April check were re-checked weekly from late May to early June to establish whether chicks had hatched. Opportunistically during this time, trees were watched for copulation and incubation exchanges. Once a nest was known to contain chicks, the tree was checked every five days, for fifteen days, and then every other day until chicks were either seen outside the nest hole or were no longer heard calling from the nest (i.e. presumed fledged). The area under the nest tree was searched for eggshell fragments or any signs of nest predation.

From 1995-2001, a songbird banding project on East Limestone Island allowed for the capture and banding of sapsuckers and other cavity nesters. Red-breasted Sapsuckers were banded with aluminum US Fish and Wildlife Service Bands and plastic, colour-bands. The presence of banded sapsuckers was looked for and noted throughout the study.

In 1995 and 2001, most nest trees were measured for tree height, diameter at breast height (dbh), and classified according to the British Columbia Wildlife Tree Classification System (Guy and Manning 1995) (Table 2). Nest cavity heights were measured in 1995 and 1998.

Table 2
British Columbia Wildlife Classification System

1	Live/Healthy; no decay
2	Live/Unhealthy; internal decay or growth deformities (including insect damage, broken tops); dying tree
3	Dead; needles or twigs may be present; roots sound
4	Dead; no needles/twigs; 50% of branches lost; loose bark; top usually broken, roots stable
5	Dead; most branches/barks absent; some internal decay; roots of larger trees unstable
6	Dead; no branches or bark; sapwood/heartwood sloughing from upper bole; decay more advanced; lateral roots of larger trees softening; smaller ones unstable. Tree approximately 2/3 original height.
7	Dead; extensive internal decay; outer shell may be hard; lateral roots completely decomposed; hollow or nearly hollow shells. Tree approximately 1/2 original height
8	same as 7. Tree approximately 1/3 of original height
9	Dead Fallen; debris; downed trees or stumps

All data were summarized to describe occupancy and nest success. Red-breasted Sapsucker observations were summarized to establish nesting phenology. Descriptive statistics were used (± 1 SD) to summarize nest tree characteristics. Nest trees that were used multiple times were only counted once for each analysis (heights and diameters). Full data are presented in Appendices 1-4.

RESULTS

Species and annual nest counts

Six species of birds excavated or occupied 196 nests in 81 wildlife trees from 1990 to 2001 (Table 3). The number of nests per year ranged from 1 to 26 (mean 16.3 ± 7.7) at a nesting density of 0.16 - 0.54 nests per hectare (mean 0.37 ± 0.13) or approximately one nest per 2.7 hectares. Red-breasted Sapsuckers were the most common species to nest on the island with a total of 169 nests, at a density of 0.16 - 0.46 nests per hectare, mean 0.31 ± 0.11, or 1 nest each 3 hectares. Chestnut-backed Chickadees were the next most numerous species followed by Hairy Woodpeckers, Brown Creepers and Northern Flickers. In 2001, a Northern Saw-whet Owl (sub-species *brooksi*) nested in an abandoned Northern Flicker nest (1992), the first record for this species on Limestone Island and probably Haida Gwaii. A red squirrel was observed to bring nesting material (moss) to a hole in Wildlife Tree 1 in 1994, the only nesting record for this species on the island.

Table 3
Number of nest cavities each year on East Limestone Island, 1990-2001

Year	Number of nests each year						Total nests
	RBSA	HAWO	NOFL	CBCH	NSOW	BRCR	
1990	1						1
1991	8						8
1992	9		1				10
1993	9						9
1994	14						14
1995	22						22
1996	20	2				1	23
1997	16	1		1		1	19
1998	13	1	1	3		2	20
1999	15	2		2			19
2000	21	1		2			24
2001	21	1	1	2	1	1	27
Total	169	8	3	10	1	5	196

Three of the cavity nesting species used the same wildlife tree (WT) more than once for nesting: Red-breasted Sapsuckers, Hairy Woodpeckers and Chestnut-backed Chickadees (Table 4). Nearly 80% (n=125) of all sapsucker nests were excavated in trees that already contained at least one nest from a previous year. Seven trees were used by this species from five to eight times since 1991: WT 7, 12, 13, 20, 33, 34, 43 and 48. Wildlife Tree 34 was used for five consecutive years, 1997 to 2001. Wildlife Tree 7 was active most years from 1991 to 2001, six of them consecutively (1993-1999). Wildlife Tree 43 was used 1996 - 2001, six consecutive years. Sapsuckers nested in Wildlife Tree 13 from 1992 to 1998: it fell down in 1999. WT 20 was continuously occupied for eight years (1994 - 2001). The remaining three species of birds made only one nest in each tree.

Table 4
The number of years the same nest tree was used by cavity nesters on Limestone Island, BC 1990-2001

	Number of years the same tree used								Total nests
Species	1	2	3	4	5	6	7	8	
Red-breasted Sapsucker	35	12	12	6	3	2	1	2	169
Hairy Woodpecker	6	1							8
Northern Flicker	3								3
Chestnut-backed Chickadee	9	1							10
Northern Saw-whet Owl	1								1
Brown Creeper	5								5
All species	58	14	12	6	3	2	1	2	196

During the study period, 64 of the wildlife trees (79%) were occupied by only one species of cavity nester at a time. However, 16 trees were used by two or three species, five times in the same year: 1997 – WT 37; 1998 – WT 7; 1999 – WT 33 and WT 61; 2001 – WT 43 (Table 5). There were two records of nest trees being used by three different species in separate years, WT 1 and WT 33.

Table 5
Cavity and bark nesters that have shared the same nest tree on East Limestone Island, 1990-2001
(* indicates same year)

Species	Frequency	WT Number
Red-breasted Sapsucker & Chestnut-backed Chickadee	6	7*, 17, 18, 19, 43*, 61*
Red-breasted Sapsucker & Brown Creeper	4	5, 24, 30, 37*
Red-breasted Sapsucker & Hairy Woodpecker	3	16, 33*, 39
Red-breasted Sapsucker & Northern Flicker & Hairy Woodpecker	1	33
Red-breasted Sapsucker & Northern Flicker & Northern Saw-whet Owl	1	1
Brown Creeper & Chestnut-backed Chickadee	1	54
All species	16	

Tree species

Three tree species were used for nesting: Sitka spruce, western hemlock and red alder (Table 6); no birds have used western redcedar. All of the nest trees were dead except one, a spruce (WT 16). Of the 74 nest trees measured, Sitka spruce was the most common nest tree (66% of trees), followed by hemlock (31%) and alder (3%). Spruce heights average 21.1 m and hemlock, 22.1 m. Trees were classified as Wildlife Classification 2 - 6 (Figure 1).

Table 6
Summary of diameters and heights of nest trees used by all cavity and bark nesters on Limestone Island, 1992-2001

		Nest tree height (m)		Nest tree diameter (cm)		Wildlife Classification			
	n	Mean	SD	Mean	SD	Mean	SD	Min	Max
Sitka spruce	49	21.1	11.4	121	48	4.9	0.7	2	6
Western hemlock	23	22.1	9.8	95	26	4.3	0.6	3	5
Red alder	2	14.5	5	57	7	5.5	0.7	5	6
All trees	74	21.2	10.8	111	44	4.7	0.7	2	6

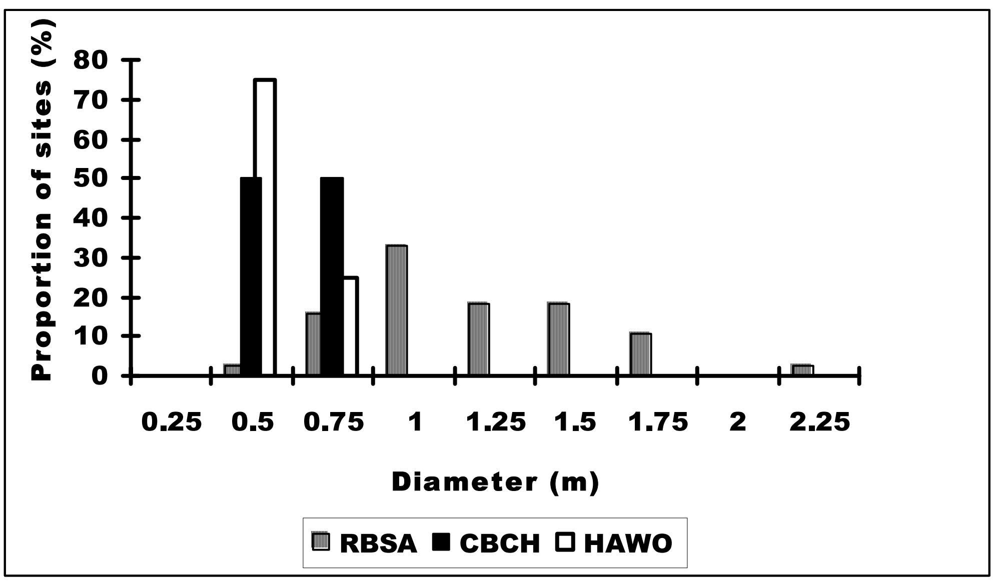
Nest tree heights ranged from 3.7 to 49.0 m with diameters of 47 to 260 cm (Table 7). Red-breasted Sapsuckers nested most often in spruce trees (n=43), with average heights that were 22.1 ± 10.7 m tall with a diameter of 130 ± 46 cm (Figure 1). Northern Flickers, Chestnut-backed Chickadees and a Northern Saw-whet Owl only nested in spruce.

Table 7
Diameters and heights of nest trees used by each cavity or bark nesting species, 1990 - 2001

		Tree height (m)				Tree diameter (cm)			
	n	Mean	SD	Min	Max	Mean	SD	Min	Max
Red-breasted Sapsucker	66	22.1	10.3	7.3	49.0	115	43	47	260
Hairy Woodpecker	7	16.4	10.2	3.7	31.9	74	20	49	110
Northern Flicker	3	18.4	3.5	15.1	22.1	87	37	61	130
Chestnut-backed Chickadee	8	25.0	16.9	6.3	46.6	130	45	65	170
Northern Saw-whet Owl	1	15.1	-	-	-	130	-	-	-
Brown Creeper	4	23.3	16.9	12.5	40.0	145	84	60	260
All species	89	21.8	10.9	3.7	49.0	114	46	47	260

Figure 1
Wildlife tree classes of trees used for cavity nesters on Limestone Island, 1995-2001

Figure 2
Diameter classes (m, DBH) of trees used for nesting by Red-Breasted Sapsuckers (RBSA), Chestnut-backed Chickadees (CBCH) and Hairy Woodpeckers (HAWO) on East Limestone Island, 1995-2001



Nest heights

Forty-four nest heights were measured. Mean nest heights were 15.8 ± 8.2 m for all species (Table 8). Chestnut-backed Chickadees nested in the lowest (5.1 m), and highest cavities (41.3 m). Red-breasted Sapsuckers nested on average 15.7 m above the ground, higher than Northern Flickers but lower than Chestnut-backed Chickadees.

Table 8
Nest and tree heights for cavity and bark nesters on Limestone Island, 1992-2001

		Nest tree height (m)				Nest height (m)			
	n	Mean	SD	Min	Max	Mean	SD	Min	Max
Red-breasted Sapsucker	35	22.1	8.9	9.8	51.2	15.7	6.9	5.3	34.5
Hairy Woodpecker	1	37.2	-	-	-	32.7	-	-	-
Northern Flicker	2	18.5	4.7	15.1	21.8	13.9	6.9	9.0	18.8
Chestnut-backed Chickadee	3	23.7	19.1	6.9	44.4	19.3	19.3	5.1	41.3
Northern Saw-whet Owl	1	15		-	-	9.0	-	-	-
Brown Creeper	2	18.2	2.3	16.6	19.8	9.5	0.4	9.2	9.8
All species	44	22	9.4	6.9	51.2	15.8	8.2	5.1	41.3

Red-breasted Sapsucker nesting chronology

Observations from 1997-2001 show that Red-breasted Sapsuckers began excavating new nest holes in early April (Table 9). Birds copulated on branches near the newly excavated hole from early to mid May. The first incubation exchanges occurred in early - late May, with the last exchanges seen near the end of the same month. Chicks called from nest holes by the third week in May and continued until they fledged, or were presumed fledged, beginning in early June.

Table 9
Timing of nesting of Red-breasted Sapsuckers on East Limestone Island, 1999-2001

Year	Nest excavation	First incubation shifts observed	Last incubation shifts observed	First chicks heard calling	Fledging Dates
1997	Early April			Late May-early June	Start 10 June
1998	11 April			25 May	13-23 June
1999	13 April			5-24 June	18 June – 9 July
2000	Early April	2-6 May			13-24 June
2001	23 April	3-24 May	22-30 May	22 May-16 June	8-25 June

Timing of nesting in other species was not well quantified. However, in 2001, Hairy Woodpecker adults were seen copulating on 26 April. Hairy Woodpecker Chicks were heard calling from a nest hole 6-11 June and had fledged by 18-20 June. Chestnut-backed Chickadee chicks were heard calling from 24 June to 8 July 2001, but were not heard during a survey on 13 July and were presumed fledged.

Red-breasted Sapsucker banding

Of 33 Red-breasted Sapsuckers banded between 1995 and 2001 on East Limestone Island, 13 were sighted in later years (Table 10). One individual, Y/Y-R/M, nested in the same wildlife tree (WT 43) for three years in a row. A second individual, Y/R-G/M, nested in the same tree (WT 20) for two years in a row, with two different mates. One of these mates, Y/Y-Y/M, was seen on three different trees (WT 20, 21 and 39). All of the marked birds had successful nests in the year that they were sighted.

Table 10
Re-sightings of marked Red-breasted Sapsuckers on East Limestone Island

Tree	Nest Year	Nest hole Location	Band Combination	Year banded
20	1997	West, 20 m up	Y/R-G/M, Y/Y-Y/M	1996,1995
20	1998	North, 8 m up	Y/R-G/M, Y/O-Y/M	1996,1998
21	2000	? 3/4 way up	Y/Y-Y/M	1995
29	1995	?	Y/Y-R/M, BR/Y-Y/M	1995,1995
31	1998	Northeast, 0.5 m from top	Y/R-R/M	1996
37	1995	?	Y/W-W/M	1995
39	1999	?	Y/Y-Y/M	1995
40	1995	?	Y/Y-W/M	1995
43	1996	?	Y/Y-R/M	1995
43	1997	North, half way up	Y/Y-R/M	1995
43	1998	?	Y/Y-R/M	1995
44	1998	East, 25 m up	Y/O-W/M	1998
48	1998	East, next to 1997	Y/W-R/M	1995

DISCUSSION

Clearly, cavity nesters on Limestone Island, in particular Red-breasted Sapsuckers, may use the same nest tree for several consecutive years. The longevity of nest trees may be related the availability of suitable nest trees or possibly, rates of decay. The repeated use of the same nest tree may indicate a lack of available trees with the necessary decayed heartwood for nesting. The presence of fungal bodies (conks) on deciduous trees in south-central British Columbia was the most distinguishing characteristic of nest versus non-nest trees (Harestad and Keisker 1989). The presence or absence of conks was not noted for nest trees on Limestone Island, but this feature could be recorded to quickly separate suitable and non-suitable nest trees for various classes of cavity nesters (weak to strong).

Alternatively, slower decay rates on Limestone Island may allow trees to remain in the nest tree pool for a long time. The island is in the rain shadow of Louise Island and enjoys relatively lower levels of annual rainfall than other parts of Haida Gwaii or the mainland coast. Trees suitable for nesting may be available to sapsuckers and other species for many years before breaking off or toppling because the heartwood decays slowly, as suggested by eight consecutive years of sapsuckers nesting in a class 5 tree.

Cavity nesters on Limestone Island nested almost exclusively in coniferous trees (spruce and hemlock). It is not possible to say whether these birds prefer conifer trees, especially spruce, because nest tree availability was not measured. However, all trees, whether coniferous or deciduous, were more than 10 m tall and greater than 50 cm diameter, indicating that this may be a minimum size preference for these species, at this location. The large percentage of nests in spruce trees (66%) most likely reflects the abundance of mature spruce on this island. A study to examine nest tree availability would help in the discussion of whether a certain nest tree type is limited or it is simply preferred.

Most of the nest records on East Limestone Island were of Red-breasted Sapsucker. Nest tree characteristics for this species are consistent with other studies in coastal British Columbia. A two-year study at Mt. Cain, Vancouver Island revealed that Red-breasted Sapsuckers nested in dead coniferous trees with a mean diameter of 93 cm (Joy 2000). Large diameter trees are essential for creating enough space for the adults and nestlings, and larger trees will have more wood to serve as insulation for the nest cavity. Nest trees at Mt. Cain were in decay class 5 and 6, and Joy (2000) determined that this distribution was significantly different than what was actually available. On Limestone Island, Red-breasted Sapsuckers nested in trees in classes 2 to 6, indicating that they are capable of excavating cavities in trees with no visible signs of decay. Harestad and Keisker (1989) found that nest tree preference varied among cavity nesting species and depended upon their strength as nest excavators. Red-breasted

Sapsuckers are classed as strong excavators, which explains their use of the only live wildlife tree in this study. Northern Flickers are weak excavators and nested only in trees in later stages of decay (class 5). Internal decay is necessary for all primary cavity nesters because it allows them to excavate nest holes (Harestad and Keisker 1989).

Sapsuckers in other coastal areas placed nests high in tall trees, probably as an adaptation to avoid predation by terrestrial predators (Dobkin et al. 1995). The heights measured to date at East Limestone Island for Red-breasted Sapsuckers were greater than those reported by Campbell et al. (1990), where 67% of nests were below 9.1 m. Predation by red squirrels, an introduced species, may influence nest cavity excavation in sapsuckers and other cavity nesters. Squirrels on Limestone Island have been seen climbing nest trees and harassing sapsuckers.

The timing of nesting for Red-breasted Sapsuckers on Limestone Island falls generally within the dates provided by other studies, although overall timing may be later because no nests were observed fledged before the beginning of June. Provincial records indicate that Red-breasted Sapsucker nests were completed from 7 May to 21 June, with some eggs found as early as 25 April (Campbell et al, 1990). Fledging dates for sapsuckers ranged from 10 May to 20 July, and a small sample of five nests suggests that the nestling period was 22 days.

That sapsuckers nest in such seemingly high densities and will use the same nest tree for eight consecutive years is probably not well known in British Columbia. As well, the diversity of cavity nesting species, the simultaneous use of the same nest tree by several species and the first Northern Saw-whet owl nest are exciting discoveries. As the LBCS intends to continue work on this island in future years we have the opportunity to assess the surrounding habitat for its suitability for nesting and to gain more information on nest site fidelity and species longevity.

Recommendations for future study

- Compare nest site tess with those available in the surrounding habitat. Measure tree characteristics (height, species, decay class, percent bark) of trees in a plot containing the nest tree to examine the question of preferred vs. available nest tree
- Measure habitat variables to describe nest locations in greater detail. Habitat variables that could be measured include: dominant tree species, index of tree density (basal area), height of the understory vegetation
- Measure nest cavity variables: the horizontal and vertical diameter of the entrance, the compass direction of the nest and entrance height above ground. (see Peterson and Gauthier 1985)
- Continue colour banding to collect further information on nest-site fidelity and longevity
- Record presence or absence of fungal conks on nest trees.

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SONGBIRD BANDING IN LASKEEK BAY, 1998-2001

Anthony J. Gaston
CWS/NWRC 100 Gamelin Blvd., Hull, Quebec, K1O 0H3, Canada

Jean-Louis Martin and Sylvain Allombert
CEFE/CNRS-UPR 9056, 1919 route de Mende, F-34293 Montpellier Cedex 5, France

ABSTRACT

Banding of forest birds was carried out as part of the programme of the Research Group on Introduced Species during the songbird breeding seasons of 1998-2001. Seven sites were used, of which three were on Reef Island and one each at Vertical Point, East Limestone Island, Low Island and West Skedans Island. Only two sites at Reef Island were used after 1998 (sites 13 and 16) : West Skedans Island was used only in 2000 and 2001. More than 2000 birds of 18 species were trapped, the most abundant being Orange-crowned Warbler (399). More than 100 of seven other species (Fox Sparrow, Golden-crowned Kinglet, Hermit Thrush, Song Sparrow, Swainson's Thrush, Townsend's Warbler and Winter Wren) were trapped. Adults made up 51% of those caught and juveniles 49%. Rates of catching were highest at Low and East Limestone islands (about 60 birds/100 net-h). West Skedans Island was intermediate and Vertical Point and the two Reef Island sites the least productive (<30 birds/100 net-h). Capture rates at Low and East Limestone islands were very high in 1998. When this year was omitted, capture rates ranged from 13-45/100 net-h. Proportions of different species captured varied from island to island: Hermit Thrushes were abundant at all sites except Low Island, where they were very uncommon; Golden-crowned Kinglets constituted >20% of captures at East Limestone Island, but were less than half as important elsewhere. Over 100 birds were trapped in more than one year, including 18 trapped in three years and four trapped in every year: 2 Swainson's Thrushes, both caught near camp on Reef Island and 2 Hermit Thrushes, one at East Limestone Island and one at Vertical Point. Four birds were trapped at more than one site, but never in the same year. We also present data on mean mass and wing-length for species where samples were adequate.

INTRODUCTION

From its inception, the research programme of the Research Group on Introduced Species has included a component dealing with the effects of deer browsing and squirrel predation on the reproductive success of terrestrial birds. Initial research involved the placing of artificial nests, baited with Quail eggs, on islands with different combinations of deer and squirrels, to determine whether the presence of these two introduced species affected the likelihood that eggs in an artificial nest would survive the normal nesting period (Martin et al 2001, Martin and Joron in press) . The results of these experiments demonstrated that the presence of squirrels increased rates of predation on artificial nests, as a result of direct predation by the squirrels. At the same time, it was shown that decreased vegetation cover around the nest increased predation risk by native predators suggesting that the presence of deer had the effect of increasing predation , by opening out the understory, making it easier for sight-hunting predators, such as Crows, to find nests. However, increased nest predation does not necessarily cause reduced breeding success for species that lay replacement clutches in the event that the first clutch fails: they may simply make more nesting attempts. Moreover, predation on artificial nests, or on natural nests found by searching, may give an exaggerated idea of the overall impact of predation, because such nests may be easier for predators to find than the average nest.

In order to investigate the overall impact of deer and squirrels on breeding success, we attempted to obtain a comparative measure of reproductive success by observing the proportions of young birds in the population at the end of the breeding season (juveniles as a proportion of all birds trapped). The comparison of juvenile proportions among islands with different combinations of introduced mammals will be reported elsewhere. In this paper, we summarise the results of trapping carried out, in terms of species composition and measurements, and describe the proportion of birds recaptured one or more years after banding.

METHODS

The proportion of juveniles in the population was assessed by trapping birds with mist nets set in standard sites on several islands in Laskeek Bay and examining each individual in order to determine whether or not it had fledged that year. The techniques of Pyle (1997) were used to determine age. For some species, especially thrushes and kinglets, plumage characters were sufficient. For others, the shape of the tail feathers and the presence of residual gape at the margins of the bill were used. If other methods were not conclusive, the skull was examined to determine whether ossification was complete. The sex of most birds was also determined based either on plumage characteristics, on the presence of a cloacal protuberance, or on the presence of a brood patch, which in most species develops only in the female (note that this criterion will distinguish a female with certainty, but birds without brood-patches may be either males or females that have not yet begun incubation). To distinguish Hermit and Swainson's Thrush, the wing formula was used from 2000 onwards (in Hermit Thrush the 9th primary is shorter than the 6th, which is emarginated; in Swainson's Thrush the 9th primary is longer than the 6th, which is not emarginated). A few thrushes trapped in earlier years may have been misidentified.

Birds were trapped in 12 x 2.5 m, 5-shelf, small mesh (32 mm), mist nets, set on aluminium poles in groups of 6-12 and, mostly, left in place with nets furled and tied when not in use. The initial protocol for trapping, based on observations of breeding in earlier years, called for eight 5 h sessions to be carried out at each netting site between mid June and mid July, working on a rotation. For the most part, two teams of banders were used, the one based at Reef Island carrying out banding at Reef and Low islands, and the East Limestone Island team dealing with East Limestone Island, Vertical Point and West Skedans Island. However, three teams were sometimes active simultaneously and some swapping of sites between teams was necessary. Sessions began about 7 am and ended at 12 noon. This time period was selected on the basis of trial sessions run from ½ hour after sun rise to ½ hour before sunset that showed a peak in capture rates between 9 and 11 am.

In 1998, trapping began on 5 May, as mist-net sites were developed and tested, was interrupted at the end of May, during chick rearing and resumed June 12th at a time identified by the monitoring of natural nests as the likely onset of the fledging period for several species. Mist netting continued until 8 July (Table 1). In 1999, observations of nests suggested that the season was much later than in 1998, so trapping started only on 28 June and continued to 23 July. The initial protocol was followed in the earlier year of 2000, when, apart from a test session at West Skedans Island on 8 June, the main trapping period was 18 June - 28 July. In 2001, another late season, trapping was carried out from 20 June - 22 July. A small amount of trapping was carried out prior to the main study period in all years, for training purposes. In this paper we include data on all trapping.

Most birds trapped were weighed (± 0.5 g) on a Pesola spring balance. The length of the wing (from the carpus to tip of longest feather), tarsus and bill (± 0.05 mm) were measured on some individuals, with the wing being measured most commonly in 1998 and 1999 and the tarsus in 2000 and 2001. Tarsus measurements were taken to allow body mass to be corrected for 'size'. On occasions when the trapping rate was high and birds were in danger of being held for more than 10 min, some birds were released without measuring. However, all individuals except hummingbirds were banded.

All birds trapped were banded with a standard metal band, supplied by the Canadian Wildlife Service. In addition, a plastic colour band, made by A.C. Hughes, Ltd., UK, was placed on the same leg, either above (adult), or below (juvenile) the metal band. The colour used was specific to the island: Reef Island (all sites), red; East Limestone Island, blue; Vertical Point, yellow; Low Island, orange; West Skedans Island, green. On hatching-year birds, the metal band was placed above the plastic band. For older birds the order was reversed.

Table 1
Dates of mist-netting sessions at localities in Laskeek Bay in 1998-2001

Year	Month	Dates of netting						
		Reef 13	**Reef 14**	**Reef 16**	**Limestone I.**	**Vertical Pt**	**Low I.**	**W Skedans I.**
1998								
	May	21,22,28	6,7,8,9	8,9,10,11, 12,14	11,12,14,16			
	June	16,17,22, 24,26,30	3	18,25,28	3,4,7,23,25, 28,29	20,21,23, 24,27,29	6,12,19,27	
	July	1,3,6,8		2	1,2	1,4,7	4	
	Total (days)	13	5	10	14	9	5	
1999								
	June	28			29	30		
	July	1,4,8,12, 16,18,20		1,3,6,13, 15,17,19, 22	2,5,7,9,12,14,1 7	4,6,12,14,1 7,19,21	5,7,11,13, 16,20,21,23	
	Total (days)	8		8	8	8	8	
2000								
	June	18,24,28		24,26,30,	24,28	21,26,30	20,22,25, 29	8,23,27
	July	2,6,14,17, 22,28		4,8,11,15,1 9,25	2,6,14,18,21, 25	4,11,15,20, 23	3,7,13,18, 23	1,5,13,17,2 1,26
	Total (days)	9		9	8	8	9	9
2001								
	June	21,25,29		21,25,29	20,25,28	21,25,29	23,28	22,26,30
	July	2,14,16,21, 25		4,11,15,20, 22	3,9,14,16,19	4,10,16,19, 22	1,10,14,18, 20,24	7,11,15,18, 21
	Total (days)	8		8	8	8	8	8
	Total, all yr	38	5	35	38	33	30	17

RESULTS

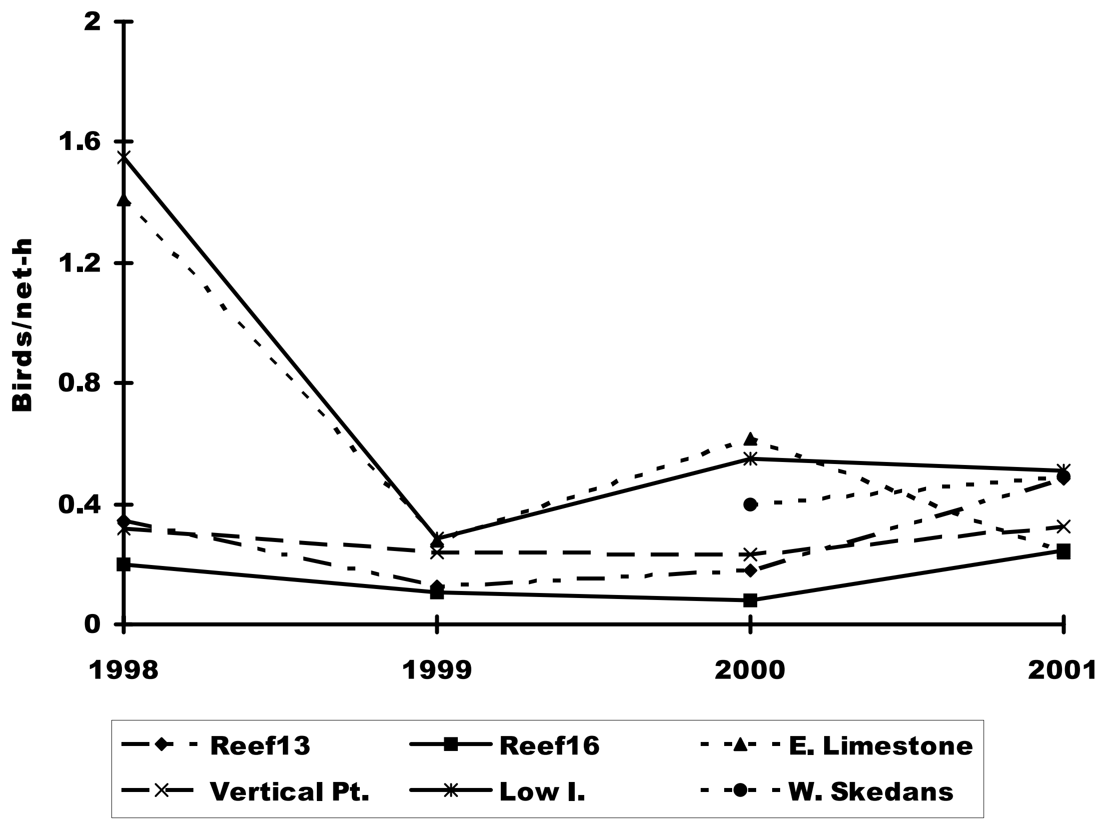
More than two thousand birds were trapped in Laskeek Bay over the four years, with the maximum in one year being in 2000, when nearly 900 were trapped (Table 2). The increase in numbers between 1999 and 2000 was partly the result of a late and partially unsuccessful breeding season in 1999 and partly the result of adding the West Skedans Island banding site in 2000, which produced many more birds than the discontinued sites (14 and 15) used at Reef Island in 1998. The most abundant species trapped was Orange-crowned Warbler (399) and more than 100 were trapped of seven other species (Fox Sparrow, Golden-crowned Kinglet, Hermit Thrush, Song Sparrow, Swainson's Thrush, Townsend's Warbler and Winter Wren). Adults (classified as AHY = after hatching year) made up 51% of those caught and juveniles (HY) 49%. Some birds were trapped more than once in the same year, but not all birds were aged every time they were caught. The total number of captures for which the age was recorded was 2769.

Captures by site

More birds were trapped at Reef Island than at any other island, but this was because two, sometimes as many as four banding localities were used (Table 3). Altogether, there were 77 netting sessions carried out at Reef Island, more than twice as many as at East Limestone Island, the next most frequently used. Among sites used regularly, numbers of birds captured per session were highest at West Skedans Island (39), followed by Low Island (19) and East Limestone Island (17) and lowest at Reef Island (13) and Vertical Point (11).

To obtain a more rigorous comparison of catching rates, we reduced the sample to the period of 24 days following the start of fledging for the majority of species (starting on 15 June in 1998, 1 July 1999, 14 June 2000 and 18 June 2001). To allow for differences in effort among islands, we multiplied the number of nets used by the time deployed, to estimate the total net-hours of effort at each site during this period. We then compared sites on the basis of numbers of birds caught per 100 net-hours. When all years were combined, Low Island and East Limestone Island provided the highest rates of catching (61 and 60 birds/100 net-h, respectively; Table 4), with West Skedans intermediate and Vertical Point and the two Reef Island sites the least productive (26, and 14 birds/net-h at sites 13 and 16, respectively). Much of the difference between Low and East Limestone islands and the rest was based on very high capture rates at these two sites in 1998 (Figure 1). When this year was omitted, capture rates ranged from 13/100 net-h at site 16 on Reef Island to 44/100 net-h at West Skedans Island and 45/100 net-h at Low Island.

Figure 1
Numbers of birds captured per 100 net-hours in relation to netting station and year



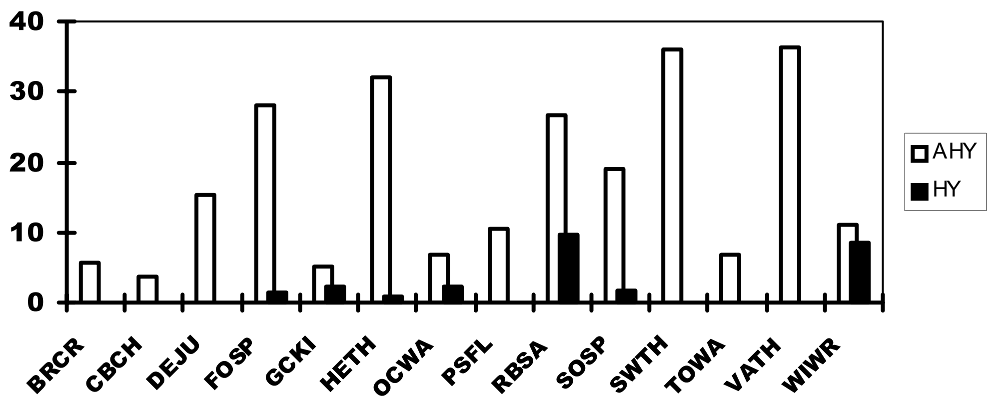
To compare the proportions of different species caught at different netting sites, we examined captures in 2000 and 2001 only, using only captures after 20 June (Table 5). For these two years, the numbers of species trapped at eash site were very similar (range 12-15 species). Nevertheless, there was great variation among sites in the relative proportion of different species trapped. Most striking was the predominance of Hermit Thrushes at Vertical Point where this species comprised 47% of all captures (Table 5): at Low island this species made up only 2% of captures. Conversely, Fox Sparrows constituted >20% of captures on Low and West Skedans islands, but no more than 5% elsewhere: they were not trapped at all at Vertical Point. Also at Vertical Point, 17 Dark-eyed Juncos were trapped: only one was trapped at all other sites combined.

At East Limestone Island, Golden-crowned Kinglets made up 20% of captures, whereas they did not exceed 10% at any other locality. Song Sparrows made up 20% of birds caught at site 16 on Reef Island, but were not trapped at Vertical Point and comprised <1% of those caught at East Limestone Island. Only the Winter Wren made up >3% of captures on every island (Table 5).

Recaptures in later years

Most birds captured were seen in only one year, but 127 individuals were trapped in more than one year, of which 105 were trapped in two years and 18 were trapped in three years (5 Fox Sparrows, 1 Golden-crowned Kinglet, 3 Hermit Thrushes, 1 Orange-crowned Warbler, 1 Red-breasted Sapsucker, 1 Song Sparrow, 4 Swainson's Thushes, 1 Varied thrush and 1 Winter Wren). Four birds were trapped in every year of the study: 2 Swainson's Thrushes, both at site 13 on Reef Island (beside camp) on all occasions, and 2 Hermit Thrushes, one at East Limestone Island and one at Vertical Point.

Figure 2
Proportion (%) of birds trapped in one year which were recaptured in the next.



Considering only recaptures in consecutive years, about 15% (N=782) of birds caught as adults were caught again the next year, with little variation among years (13-18%, Table 6). For obvious reasons, this only includes birds initially trapped in 1998-2000. Comparing species, five had adult recapture rates in the next year of >20%: Fox Sparrow, Hermit Thrush, Red-breasted Sapsucker, Swainson's Thrush and Varied Thrush (Figure 2). The Varied Thrush had the highest recapture rate (36.4%, N=11), with Swainson's Thrush close behind with 35.9% (N=78). The three small warbler-like birds, Townsend's and Orange-crowned warblers and Golden-crowned Kinglet, all had adult recapture rates in the range of 5-7%. Only 2% (N=868) of birds trapped as juveniles (HY = hatching year) were recaptured the following year. The highest recapture rates for juveniles were for Red-breasted Sapsucker (9.5%, N=15) and Winter Wren (8.5%, N=64).

Movements between sites

Only three birds moved between sites, a Fox Sparrow trapped as an adult at East Limestone Island in 1998 and recaptured in 2000 on Low Island, a Pacific Slope Flycatcher trapped as an adult at site 13 on Reef Island in 1999 and recaptured the next year at Low Island, and a juvenile Red-Breasted Sapsucker trapped at East Limestone Island in 1998 and recaptured at Vertical Point the following year. In addition, two Hermit Thrushes carrying red bands, and hence banded on Reef Island, were sighted elsewhere: one on West Skedans Island in 1999 and one on South Low Island in 2000.

Mass and measurements

Mean mass and wing-length for all birds of known age trapped are given in Tables 7 and 8. These tables include repeat captures of the same individuals and a few cases where a bird was caught in one year as a juvenile and in a later year as an adult. The mass and wing-length of juveniles were generally lower than those of adults (Figures 4 and 5), except in the case of the Winter Wren, where juveniles were heavier and had longer wings. Juvenile Townsend's Warblers also had longer wings than adults. Juvenile Hairy Woodpeckers, although weighing much less than adults, had slightly longer wings.

Figure 3
Juvenile mass in relation to adult mass, difference in %.

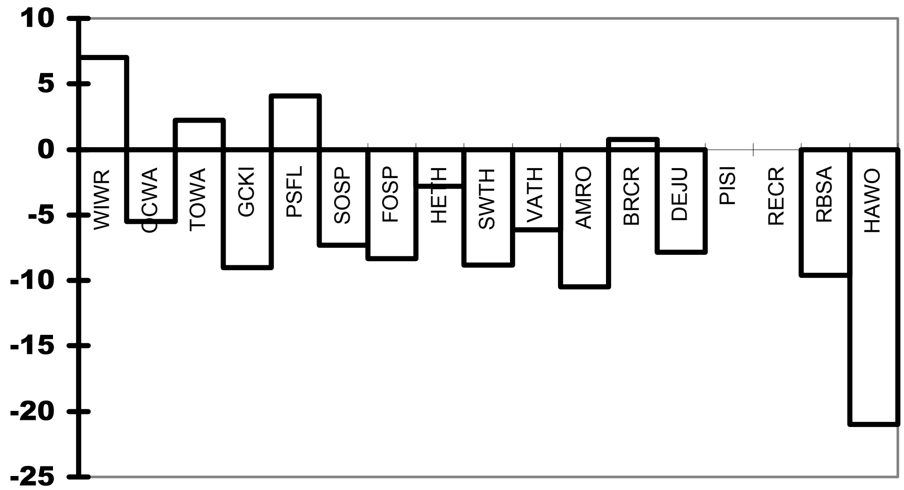


Figure 4
Juvenile wing length in relation to adult wing length, difference in %.

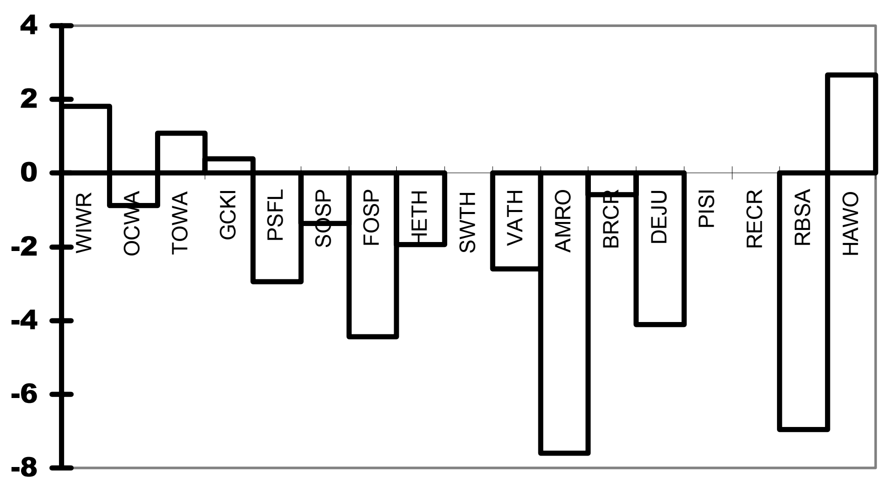


Table 2
Numbers of birds mist-netted on the Islands of Laskeek Bay by the RGIS/LBCS banding project during 1998-2001. In 1998 trapping occurred at East Limestone Island, at Vertical Point, Louise Island, at Low Island and at four sites on Reef Island (13, 14, 15, 16). After 1998, sites 14 and 15 at Reef Island were not used and in 2000 and 2001, a station was added on West Skedans Island.

Species	1998		1999		2000		2001		Totals		Grand
	AHY	HY	AHY	HY	AHY	HY	AHY	HY	AHY	HY	Total
American Robin	2	0	0	1	0	2	0	2	2	5	7
Brown Creeper	13	4	7	10	16	20	4	8	40	42	82
Chestnut-backed Chickadee	7	5	12	5	8	17	9	13	36	40	76
Dark-eyed Junco	7	4	4	1	2	0	8	2	21	7	28
Fox Sparrow	11	3	12	6	34	56	28	25	85	90	175
Golden-crowned Kinglet	34	23	13	2	31	63	9	17	87	105	192
Hairy Woodpecker	2	3	1	3	0	1	1	2	4	9	13
Hermit Thrush	33	45	21	29	32	67	43	68	129	209	338
Orange-crowned Warbler	54	95	31	2	50	84	66	17	201	198	399
Pine Siskin	1	0	0	0	4	0	2	0	7	0	7
Pacific Slope Flycatcher	8	0	12	2	18	8	21	0	59	10	69
Red-breasted Sapsucker	5	7	4	5	6	9	11	10	26	31	57
Red Crossbill	0	0	0	0	3	1	1	0	4	1	5
Song Sparrow	10	25	16	16	16	74	15	28	57	143	200
Swainson's Thrush	21	1	20	0	38	2	52	1	131	4	135
Townsend's Warbler	38	41	29	4	37	20	39	17	143	82	225
Varied Thrush	7	14	4	1	3	7	4	9	18	31	49
Winter Wren	25	25	9	9	34	48	28	20	96	102	198
Totals	278	295	195	96	332	479	341	239	1146	1109	2255
Grand Totals (AHY+HY)		573		291		811		580			

Table 3
Numbers and proportions (%) of birds trapped (including recaptures) by island

Species	Reef 13		Reef 14/15		Reef 16		Reef, total		E. Limestone		Vertical Pt		Low I		W Skedans	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
American Robin	0		0		0		0		0		7	2.0	3	0.4	2	0.4
Brown Creeper	16	2.9	0		6	1.9	22	2.8	28	4.4	25	7.1	4	0.8	11	2.2
Chestnut-backed Chickadee	27	5.0	0		20	6.3	47	5.8	20	3.1	15	4.3	0		0	
Dark-eyed Junco	0		0		0		0		8	1.3	28	8.0	0		0	
Fox Sparrow	21	3.9	0		13	4.1	34	4.3	2	0.3	0		131	**25.0**[1]	109	**21.5**
Golden-crowned Kinglet	31	5.5	2	7.1	24	7.6	56	7.7	137	**21.5**	12	3.4	12	2.4	40	7.9
Hairy Woodpecker	6	1.1	0	0.0	2	0.6	8	1.0	3	0.5	2	0.6	0		0	
Hermit Thrush	75	**13.2**	14	**50.0**	48	**15.2**	134	**22.2**	146	**22.9**	112	**31.8**	6	0.6	49	9.7
Orange-crowned Warbler	87	**16.0**	3	10.7	32	**10.1**	122	**16.7**	43	6.8	11	3.1	191	**35.9**	98	**19.3**
Pine Siskin	0		0		1	0.3	1	0.1	1	0.2	0		0		5	1.0
Pacific Slope Flycatcher	36	6.6	0		13	4.1	49	6.3	4	0.6	13	3.7	3	0.4	14	2.8
Red-breasted Sapsucker	17	2.8	0		3	0.9	18	2.3	26	4.1	18	5.1	0		1	0.2
Red Crossbill	1	0.2	0		4	1.3	5	0.6	0		0		0		0	
Song Sparrow	54	9.7	0		72	**22.8**	125	**15.2**	9	1.4	4	1.1	44	8.3	54	**10.7**
Swainson's Thrush	38	7.0	1	3.6	25	7.9	64	8.4	8	1.3	29	8.2	48	8.5	85	**16.8**
Townsend's Warbler	68	**12.5**	0		26	8.2	94	**12.0**	144	**22.6**	16	4.5	9	1.8	17	3.4
Varied Thrush	12	2.2	3	**10.7**	4	1.3	19	3.6	0		40	**11.4**	1	0.2	1	0.2
Winter Wren	64	**11.6**	5	**17.9**	23	7.3	91	**13.5**	58	9.1	20	5.7	83	**15.7**	21	4.1
Totals	553		28		316		889		637		352		535		507	
Days of trapping	38		5		35		77		38		33		30		13	
Mean birds/day	14.6		5.6		9.0		11.5		16.8		10.7		17.8		39.0	

[1]Percentages in boldface highlight species making up >10% of the total for that island

Table 4
Numbers trapped at different netting stations during the 24 days following the start of the fledging period

Netting station	Usual no. of nets	Total trapped in core period, 1998-2001	Total trapped in core period, 1999-2001	Birds trapped/net-h, all years	Birds trapped/net-h, 1999-2001
Reef 13	12	397	245	25.7	22.3
Reef 16	12	199	168	13.9	13.2
Low I.	6	370	232	60.9	44.7
Vertical Pt.	9	333	207	28.0	25.9
E. Limestone I.	7	473	225	59.7	36.5
W. Skedans	10	249	249	44.0	44.0

Table 5
Numbers trapped at different netting stations after 20 June in 2000 and 2001

Species	Reef I.13	%	Reef I.16	%	East Lime.	%	Low I.	%	Vert. Pt.	%	W. Sked.	%
American Robin	0		0		0		3	0.9	0		2	0.4
Brown Creeper	9	2.9	5	2.4	15	5.6	4	1.2	7	3.4	9	1.9
C-B Chickadee	19	6.0	11	5.4	9	3.3	0		11	5.4	0	
Dark-eyed Junco	0		0		1	0.4	0		17	8.3	0	
Fox Sparrow	19	6.0	11	5.4	2	0.7	93	**28.3**	0		103	**21.3**
G-C Kinglet	20	6.3	17	8.3	53	**19.6**	7	2.1	6	2.9	36	7.4
Hairy Woodpecker	2	0.6	0		0		0		2	1.0	0	
Hermit Thrush	55	**17.5**	36	**17.6**	75	**27.8**	6	1.8	96	**46.8**	46	9.5
O-C Warbler	31	9.8	17	8.3	17	6.3	84	**25.5**	3	1.5	95	**19.6**
Pine Siskin	0		1	0.5	0		0		0		5	1.0
Pacific Slope Flycatcher	21	6.7	10	4.9	3	1.1	3	0.9	7	3.4	14	2.9
R-B Sapsucker	16	5.1	3	1.5	10	3.7	0		11	5.4	1	0.2
Red Crossbill	1	0.3	4	2.0	0		0		0		0	
Song Sparrow	25	7.9	40	**19.5**	1	0.4	33	**10.0**	0		52	**10.7**
Swainson's Thrush	20	6.3	14	6.8	2	0.7	26	7.9	16	7.8	82	**16.9**
Townsend's Warbler	36	**11.4**	21	**10.2**	51	**18.9**	4	1.2	5	2.4	17	3.5
Varied Thrush	6	1.9	2	1.0	0		1	0.3	17	8.3	1	0.2
Winter Wren	35	11.1	13	6.3	31	**11.5**	65	**19.8**	7	3.4	21	4.3
	315		205		270		329		205		484	
Total species trapped	15		15		13		12		13		14	

Numbers in boldface show proportions > 10%

Table 6
Numbers of birds trapped as adults (AHY) in 1998-2000 and numbers recaptured the following year

Species	1998 Banded	1999 Retrap	1999 Banded	2000 Retrap	2000 Banded	2001 Retrap	Totals Banded	Retrap	Proportion retrapped all years
American Robin	2	0	0		0		2	0	0.00
Brown Creeper	13	1	7		16	1	36	2	5.56
Chestnut-backed Chickadee	7	0	12		8	1	27	1	3.70
Dark-eyed Junco	7	2	4		2		13	2	15.38
Fox Sparrow	11	5	12	4	34	7	57	16	**28.07**[1]
Golden-crowned Kinglet	33	2	13	2	31	0	77	4	**5.19**
Hairy Woodpecker	2	0	1		0		3	0	0.00
Hermit Thrush	23	5	21	8	31	11	75	24	**32.00**
Orange-crowned Warbler	51	2	31	1	50	6	132	9	**6.82**
Pine Siskin	1	0	0		4		5	0	0.00
Pacific Slope Flycatcher	8	1	12	3	18		38	4	10.53
Red-breasted Sapsucker	5	1	4	1	6	2	15	4	26.67
Red Crossbill	0		0		3		3	0	0.00
Song Sparrow	10	3	16	3	16	2	42	8	19.05
Swainson's Thrush	20	5	20	7	38	16	78	28	**35.90**
Townsend's Warbler	38	1	29	3	37	3	104	7	**6.73**
Varied Thrush	4	3	4	1	3		11	4	36.36
Winter Wren	21	2	9	2	34	3	64	7	**10.94**
Totals	256	33	195	35	331	52	782	120	15.35

[1] Figures in boldface based on banding totals >50

Table 7
Mean mass of adults and juveniles trapped in 1998-2001. Probabilities in bold face highlight differences between age classes significant at P<0.05

Species	Mass (g)							
	Adults (AHY)			Juveniles (HY)				
	Mean	N	SD	Mean	N	SD	F	P
Winter Wren	8.94	107	1.15	9.56	113	1.57	11.31	**0.001**
Orange-crowned Warbler	9.45	197	0.73	8.92	216	1.36	22.80	**0.000**
Townsend's Warbler	9.79	170	1.37	10.01	85	1.05	1.69	0.195
Golden-crowned Kinglet	6.49	111	2.01	5.90	106	1.30	6.42	**0.012**
Pacific Slope Flycatcher	10.99	63	2.43	11.44	12	1.11	0.39	0.534
Song Sparrow	28.56	61	2.43	26.47	139	3.85	15.24	**0.000**
Fox Sparrow	37.50	116	4.43	34.37	123	5.67	22.41	**0.000**
Hermit thrush	24.22	191	3.89	23.53	271	3.56	3.85	**0.050**
Swainson's Thrush	31.39	180	5.35	28.63	4	6.80	1.04	0.310
Varied Thrush	79.04	20	20.11	74.19	31	19.26	0.74	0.393
American Robin	94.00	3	8.72	84.17	3	6.90	2.35	0.200
Brown Creeper	8.25	40	0.83	8.31	43	0.96	0.10	0.751
Chestnut-backed Chickadee	9.39	37	1.31	8.60	38	3.95	1.31	0.256
Dark-eyed Junco	18.52	23	1.52	17.07	7	0.97	5.62	**0.025**
Pine Siskin	14.21	7	2.06					
Red Crossbill	25.00	1	0.00	36.00	1	0.00		
Red-breasted Sapsucker	57.38	27	7.70	51.86	33	4.85	11.46	**0.001**
Hairy Woodpecker	93.67	3	10.79	74.00	9	7.96	11.76	**0.006**

Table 8
Mean wing-length of adults and juveniles trapped in 1998-2001. Probabilities in bold face highlight differences between age classes significant at P<0.05.

Species	Wing (mm)							
	Adults (AHY)			Juveniles (HY)				
	Mean	N	SD	Mean	N	SD	F	P
Winter Wren	45.32	42	1.69	46.15	106	1.97	5.68	**0.018**
Orange-crowned Warbler	57.96	102	2.25	57.45	208	3.29	1.99	0.160
Townsend's Warbler	62.58	167	2.02	63.25	54	2.06	4.48	**0.035**
Golden-crowned Kinglet	53.50	102	1.88	53.71	40	2.17	0.32	0.572
Pacific Slope Flycatcher	62.98	59	3.14	61.13	4	2.02	1.34	0.252
Song Sparrow	70.11	57	4.42	69.15	43	2.64	1.60	0.208
Fox Sparrow	79.86	114	3.28	76.31	27	4.50	21.88	**0.000**
Hermit thrush	87.21	180	3.44	85.52	94	3.38	15.09	**0.000**
Swainson's Thrush	95.29	177	3.45	97.00	1	0.00	0.24	0.622
Varied Thrush	127.83	18	3.37	124.50	17	3.28	8.79	**0.006**
American Robin	139.33	3	6.03	128.75	2	6.01	3.71	0.150
Brown Creeper	61.65	40	2.05	61.29	19	1.66	0.45	0.507
Chestnut-backed Chickadee	58.78	36	2.51	57.87	19	2.63	1.58	0.214
Dark-eyed Junco	71.96	25	2.52	69.00	5	1.58	6.27	**0.018**
Pine Siskin	73.29	7	2.21					
Red Crossbill	83.50	1	0.00	84.50	1	0.00		
Red-breasted Sapsucker	127.33	27	3.29	118.47	16	5.46	44.39	**0.000**
Hairy Woodpecker	120.48	4	15.07	123.69	8	1.62	0.39	0.545

DISCUSSION

Mist netting clearly gives a highly selective sample of the birds present in an area. It works best for small birds that regularly move through low cover. In the case of Laskeek Bay, those forest birds that spend most of their time in the canopy were under-represented in our samples, especially Red Crossbill, Pine Siskin and Red-breasted Nuthach, the latter never trapped at all. Conversely, birds like thrushes, wrens and sparrows, which spend most of their time near the ground are likely over-represented. Moreover, the species captured is strongly affected by the exact placement of nets, with sites in conifers more likely to capture kinglets, than sites in salal and sites in grassland more likely to catch Song Sparrows than those in forest with open understory. Hence, numbers of birds trapped cannot be taken to represent their proportion in the bird fauna as a whole. For example, the high proportion of kinglets trapped at East Limestone Island almost certainly related to the fact that most mist net sites on that island were in young conifers.

Despite the forgoing reservations, it seems unlikely that the differences in proportions of species caught at different localities could be attributed solely to differences in the nature of the mist net sites selected. The large numbers of Fox Sparrows trapped at Low and West Skedans islands, although presumably related to the habitat, is unlikely to have been due only to peculiarities in the siting of the nets. It presumably reflects a real tendency for these islands, only lightly affected by deer, to support dense populations of Fox Sparrows. Likewise, the >45% representation of Hermit Thrushes in the small sample netted at Reef Island sites 14 and 15, both under heavy canopy in the center of the island and in the larger sample at Vertical Point, probably reflected the relative abundance of this species in forest interior with open understory.

Inter-year variation in numbers trapped was especially marked for juvenile of Orange-crowned and Townsend's warblers and Golden-crowned Kinglets. These species seem to have bred late and produced few young in the cold summer of 1999, but all did very well in the warm summer of 1998. In general, birds bred later in 1999 than in other years and this seems to have been associated with the cold influence of the La Niña event that year. Further analysis of inter-year variation in age ratios and capture rates is in preparation.

Recapture rates in subsequent years are influenced by the tendency of birds to shift their territories between years, by the proportion of the population in the area that is actually caught in a given year, and by the survival rate of the population. The difference in recapture rates between adults and juveniles must reflect partly the tendency of juvenile birds to disperse away from the area where they were reared. However the difference between the thrushes and the warblers may relate either to a greater tendency for warblers to shift sites, or to our catching a higher proportion of the thrushes in our banding area each year. Irrespective, the recapture of 36% of Swainson's Thrushes and 32% of Hermit Thrushes banded as adults is rather remarkable, given that the former species travels to South America and the latter to the southern US and Mexico in winter (Jones and Donovan 1996). The majority of these birds must return rather precisely to the island where they were reared. The high recapture rate for Varied Thrushes is less surprising, given that they remain in the islands throughout the year.

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NEST SITE SELECTION IN BLACK OYSTERCATCHERS

Suzanne C. Charest
Environmental Science Programme, University of Ottawa, Ottawa K1N 6N5

and

Anthony J. Gaston
National Wildlife Research Centre, 100 Gamelin Blvd. Hull, Quebec K1A 0H3

ABSTRACT

Nest site selection by Black Oystercatchers (*Haematopus bachmani*) was studied in Laskeek Bay, Haida Gwaii, British Columbia in June and July, 2001. Eight islands were included in the study, of which seven were less than 250 ha in area. Black Oystercatcher density was found to decrease with increasing island size. The birds were found to nest only on those islands that were inaccessible to terrestrial predators, such as raccoons (*Procyon lotor*). Compared to randomly selected sites, actual nest sites were situated where there was a more gradual sloping intertidal area, a moderate slope to the high tide line, in closer proximity to low lying shoreline vegetation, further away from the canopy periphery and finally also where a field of vision of less than 180° was available. Nest sites with all these characteristics were shown to exist on Louise Island, the largest island. Hence, the absence of breeding Black Oystercatchers from this island was attributed to the presence of terrestrial predators, namely raccoons.

INTRODUCTION

The Black Oystercatcher (*Haematopus bachmani*) nests along the Pacific Coast of North America from the western Aleutian Islands, Alaska, to Baja, California (Vermeer *et al.* 1989, Andres and Falxa 1995). Its population is estimated at less than 11,000 individuals, with most in Alaska (4,500 - 7,000 individuals) and British Columbia (1,000 - 2,000 individuals) (Andres and Falxa 1995).

Breeding Black Oystercatchers tend to favor solid rocky shorelines and headlands. However, their nesting habitat can also include mixed sand and gravel beaches (Andres and Falxa 1995). Nests, consisting of an open scrape lined mainly with rock chips, pebbles and shell fragments, are also more likely to be found at non-forested sites with gradual shoreline slopes (Andres and Falxa 1995, Andres 1998). They forage almost exclusively in the intertidal zone, mostly during low tide. Prey consists mainly of marine invertebrates, particularly limpets, chitons, mussels, whelks, barnacles, crabs and isopods (Andres and Falxa 1995, Smith 1995, Hazlitt 2001).

Black Oystercatcher eggs and chicks undergo a high rate of predation by both mammalian and avian predators. In British Columbia, these predators include raccoons (*Procyon lotor*), river otters (*Lutra canadensis*), Bald Eagles (*Haliaeetus leucocephalus*), Glaucous-winged Gulls (*Larus glaucescens*), Northwestern Crows (*Corvus caurinus*) and Common Ravens (*Corvus corax*) (Andres and Falxa 1995).

Many studies have been conducted on the breeding and foraging behaviour of Black Oystercatchers, but there have been relatively few concerning their nesting habitat selection. In British Columbia, Vermeer *et al.* (1989, 1992a) carried out several studies on the nesting habitat of Black Oystercatchers around Vancouver Island. The only study of Black Oystercatcher habitat in Haida Gwaii was conducted by Vermeer *et al.* (1992b) in Skidegate Inlet. There has yet to be a nesting habitat study performed on the more isolated islands of the archipelago: those not in close proximity to towns.

In this study we attempt:

(1) to determine the relationship between island size and density of Black Oystercatcher nest sites.

(2) to determine which island characteristics, other than size, are associated with high densities of Black Oystercatchers.

(3) to determine how Black Oystercatchers select their territory and nest site, once they have selected their island.

(4) to determine whether in terms of physical characteristics, there is any reason why Black Oystercatchers should not nest on large islands.

In particular, we wanted to determine why Black Oystercatchers nest mainly on the smaller, isolated islands and why the birds do not breed on the larger islands represented by Louise Island.

STUDY AREA AND METHODS

Study Area

The study was conducted in Laskeek Bay, Haida Gwaii, from 7 June to 21 July 2001. Eight islands were chosen for the study, all of which offered accessible non-forested Black Oystercatcher breeding sites along the rocky shoreline. Seven were less than 250 ha in area and without terrestrial mammalian predators: (Reef Island, 249 ha; East Limestone Island, 48 ha; West Limestone Island, 16 ha; Low Island, 9.6 ha; South Low Island, 4.5 ha; Skedans Islands, 18.9 ha; Lost Islands, 5.3 ha; areas taken from Martin *et al.* [1995]). The eighth island, Louise Island (35,000 ha) was chosen to represent the larger islands of the archipelago. Besides size, Louise Island differs from the other seven islands in being without breeding Black Oystercatchers and in the presence of terrestrial predators: martens and raccoons. Many Black Oystercatcher nest sites were situated on small, non-forested islets neighboring the main islands. Where these islets were connected to the main islands at low tide they were considered a part of the island that they abutted.

Methods

Surveys and Measurements. Three types of sites were studied: (1) actual nest sites, (2) potential nest sites and (3) random sites. Actual nest sites were those where actual scrapes were found and were located on the seven smaller islands. Potential nest sites were situated on Louise Island and were chosen for their resemblance to actual nest sites. These were included in order to determine whether the absence of breeding Black Oystercatchers on the larger islands was caused by a lack of suitable habitat. Each of these sites was selected based on criteria presented in existing literature and on the typical characteristics of Black Oystercatcher nest sites observed in our study. Finally, random sites were selected randomly from areas where measurements could be taken safely along the rocky shore of the seven smaller islands. The general locations of these sites were determined by previous study (Stockton 2002) and the exact site of measurement was randomly determined by the toss of a marker. All sites were visited by boat and on foot. Actual nest sites were located using census data from previous years from the Laskeek Bay Conservation Society records.

Two types of variables were investigated: nest site/territory variables and island variables. Nest site variables were measured for each real, selected or randomly assigned nest site:

(1) distance to the high tide line (distance from the nest site to the barnacle zone or the highest tide wrack, whichever was closest): measured along transects in 3 or 4 directions from the nest site towards the water (depending on whether the site was located on shore or on an islet) and as close to the cardinal points as possible. For analysis, we used only the shortest distance out of the 3 or 4 measured, as this should best capture the threat of nest washout by high tides.

(2) slope to the high tide line: measured using a Silva compass and taken at 3 evenly spaced points along the same transect as the distance to the high tide line.

(3) nest substrate: categorized as large/small rock chips, or as pebbles and/or shell fragments.

(4) arc horizon, an indicator of the bird's field of vision from the nest: estimated as the degree of the view free from vertical rock taller than 20 cm in a 1 m radius around the nest.

(5) total vegetation cover within a 5m radius, an estimate of the degree of exposure of the nest.
(6) distance to the canopy periphery
(7) distance to the nearest tree >3 m tall.
(8) distance to the area of >50% vegetation cover.

Variables 6-8 were all measured to the nearest 10 cm using a 60 m tape. All measurements and data were taken as close to the time of low tide as possible in order to increase the accuracy of the intertidal measurements.

(9) degree of connectivity to the main island: always connected, never connected, or connected only at low tide.
(10) The width of the intertidal (the distance between the high tide line and the low tide mark): measured along transects in 3 or 4 directions (as close to the cardinal points as possible) from the nest site towards the water (depending on whether the site was located on shore or on an islet).
(11) slope of the intertidal: taken at 3 points evenly spaced along the same transect as the width of the intertidal using a Silva compass.
(12) shoreline type: the predominant type within a 30 m radius from the nest, e.g. solid volcanic, limestone, cobbles, pebbles and/or gravel.

Island variables were those variables specific to the island in its entirety.

(1) island area (in ha): taken from Martin *et al*. (1995).
(2) island perimeter: measured using a map measurer and a 1:50,000 chart.
(3) mean intertidal width: estimated by taking the mean intertidal width of each site and then averaging all sites on a given island.
(4) intertidal area: estimated as the product of the mean intertidal width and the island perimeter.
(5) total shoreline area: estimated by multiplying the island perimeter by the mean distance from the high tide line to the area of >50% vegetation cover.
(6) number of Black Oystercatcher pairs (Table 1) and the presence of raccoons (*Procyon lotor*) were recorded using the Laskeek Bay Conservation Society 2001 census data.
(7) density of Black Oystercatchers on each island: estimated by two methods (a) number of pairs/km^2 of shoreline; (b) number of pairs/km length of shoreline.

The average width of the shoreline of an island helps to further quantify the amount of shoreline available for nesting and should therefore be incorporated, along with island perimeter, into the calculation of Oystercatcher density. However, Vermeer *et al.* (1992) calculated Black Oystercatcher density in Skidegate Inlet in relation to shoreline length and to allow comparison between studies, we also used this approach.

Table 1
Number of Black Oystercatcher pairs breeding in Laskeek Bay, Queen Charlotte Islands, British Columbia, 2001

Island	Number of Black Oystercatcher pairs
East Limestone	3
West Limestone	1
Skedans Islands	5
South Low	5
Low	2
Reef and adjacent islets	7
Lost	5
Louise	0

Statistical Analysis. The majority of the statistical analyses performed were designed to test differences between our three site types, particularly between the actual nest sites and the potential nest sites and between the actual nest sites and the random sites. The distribution of each variable was tested for normality using the Kolmogorov-Smirnov test for goodness of fit (Sokal and Rohlf 1969, section 16.2). Only five variables differed significantly from normal, the exceptions being: mean intertidal width, distance to the canopy periphery, distance to the nearest tree > 3 m tall, distance to the area of > 50% vegetation cover and the total percent vegetation cover within a 5 m radius. These five variables were normalized by log-transformation so that they could be used in analyses assuming a normal distribution.

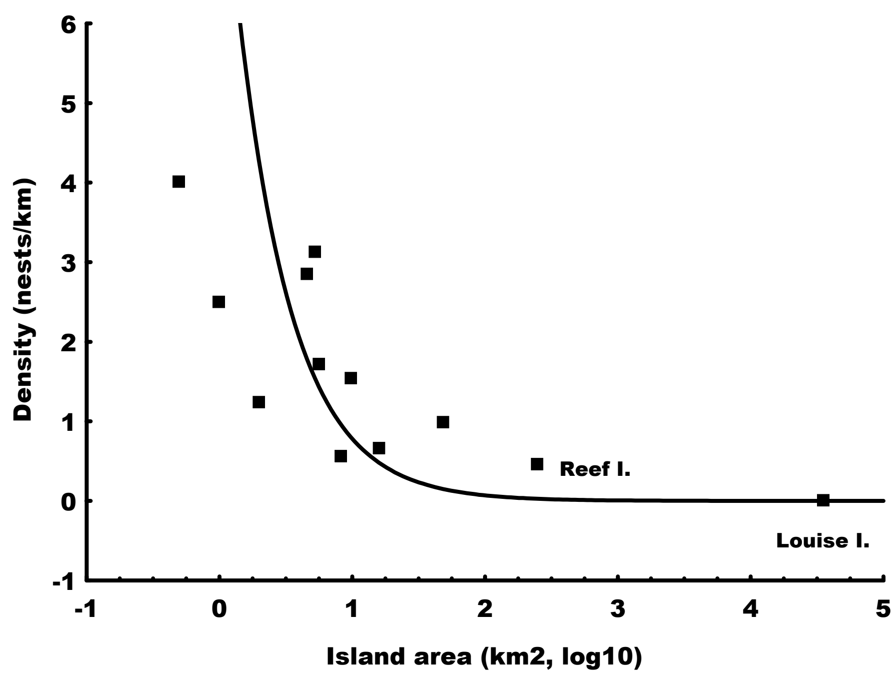
Mann-Whitney U tests were employed to determine which variables differed between site types, i.e. which variables set the actual nest sites apart from the potential nest sites and the random sites. The Mann-Whitney test was used instead of the two sample *t* test because when both tests are applicable, the former is more powerful (Zar 1999). We expected that some of the measured variables would be highly intercorrelated. Consequently, we calculated a correlation matrix involving all the study variables. Where close and significant correlations were found among groups of variables, all but one of the variables involved were removed before multivariate analysis. A discriminant function analysis was then performed using the remaining variables, none of which had inter-correlations > r = 0.30, in order to establish which variables best discriminate between site types and were therefore the best predictors of site type.

RESULTS

Island Habitat

Black Oystercatcher density decreased with increasing island area (Figure 1). There was no significant relationship, however, between Oystercatcher density and mean shoreline width for each island. Birds nested mainly on the smaller islands, i.e. those without terrestrial predators, such as raccoons.

Figure 1
Relationship of Black Oystercatcher nest density to island area in Laskeek Bay



Territory Habitat

Of the 18 actual nest sites studied, 17 were connected to the main study island at all times, and only one was on a separate islet that was never connected. Most of the shorelines on which Black Oystercatchers nested were composed of solid volcanic rock, followed by limestone, cobbles, pebbles and gravel (Figure 2). The width of the intertidal zone adjacent to the actual nest sites averaged 22.4 m and was not significantly different from that of the potential nest sites and the random sites, which averaged 16.2 m and 20.2 m respectively (Table 2). Intertidal slope was also similar between actual nest sites (18.6°) and potential nest sites (21.8°), as well as between actual nest sites and random sites (20.1°). Black Oystercatchers tended to line their scrapes mainly with small rock chips and shell fragments (Figure 3).

Figure 2
Nest substrate for Black Oystercatchers in Laskeek Bay, B.C.

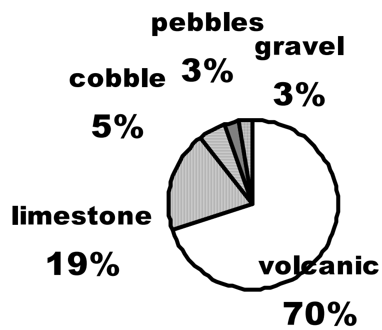


Figure 3
Nest lining used by Black Oystercatchers in Laskeek Bay

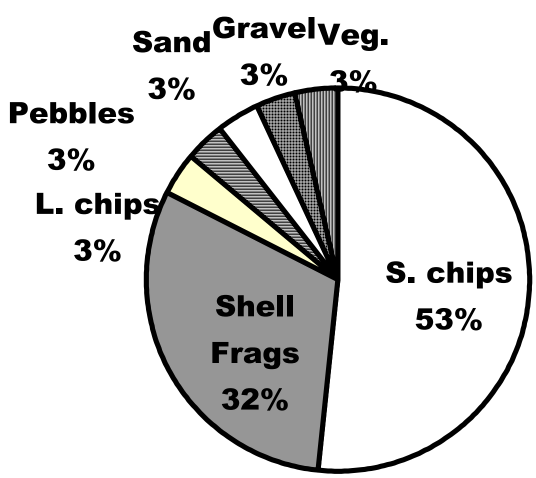


Table 2
Comparison of territory and nesting variables of Black Oystercatchers in Laskeek Bay, Queen Charlotte Islands, British Columbia, 2001

Variable	Actual nest sites n = 17	Potential nest sites n = 15	Random sites n = 15
	Mean ± SD	Mean ± SD	Mean ± SD
Intertidal width (m)	22.4 ± 17.8	16.2 ± 7.7	20.3 ± 12.4
Intertidal slope (°)	19 ± 9	22 ± 9	20 ± 12
Shortest distance to high tide line (m)	17.8 ± 8.2	8.4 ± 3.5	8.9 ± 4.7
Slope to high tide line (°)	23 ± 8	24 ± 8	20 ± 8
Distance to canopy periphery (m)	64.6 ± 84.4	48.2 ± 40.6	28.8 ± 49.7
Distance to nearest tree > 3 m tall (m)	63.2 ± 85.1	51.3 ± 40.8	31.7 ± 49.2
Distance to area > 50% vegetation cover (m)	59.6 ± 87.4	51.0 ± 41.8	28.5 ± 49.9
Arc Horizon (°)	163 ± 93	150 ± 70	232 ± 135
Total vegetation cover within 5 m radius (%)	16 ± 14	12 ± 10	5 ± 12

Nesting Habitat

Nest sites used by breeding Black Oystercatchers tended to be significantly further from the high tide mark than were the potential nest sites and the random sites. These actual nest sites were also significantly further from the canopy periphery and had a significantly greater amount of vegetation within a 5 m radius than did the random sites. The remaining nest site variables, i.e. intertidal width and slope, slope to the high tide line, distance to the nearest tree > 3 m tall, distance to the area of > 50% vegetation cover and arc horizon, were all similar between the three types of sites.

The correlation matrix revealed that the distances to the canopy periphery, to the nearest tree > 3 m tall and to the area of > 50% vegetation cover were all significantly correlated with each other and therefore the last two variables were removed. The mean intertidal width of each nest site was found to correlate significantly with both the mean intertidal slope and the mean slope to the high tide line of each site. The latter two variables, however, did not correlate significantly with each other. Consequently, the mean intertidal width variable was removed and was not included in further applications.

Habitat Selection

From the discriminant function analysis, the following five variables provided the best discrimination between the three categories of Black Oystercatcher nest site and were included in the final model: intertidal slope, slope to the high tide line, the distance to the canopy periphery, the arc horizon and the total amount of vegetation cover within a 5 m radius (Table 3).

Table 3
Summary of discriminant function analysis

Variable	Standardized discriminant function coefficients
Intertidal slope	0.10
Slope to high tide	0.18
Dist. to canopy periphery	0.78
Arc horizon	-0.29
% vegetative cover	0.98

Distances between groups (p-levels significant at p < 0.05)

Site Type	Actual	Potential	Random
Actual	-	0.96	0.00002
Potential	-	-	0.00003
Random	-	-	-

In this study, the birds tended to select nest sites that had a gradually sloping intertidal area, a moderate slope to the high tide line, were away from the forest edge, provided a field of vision less than 180° and had a substantial amount of vegetation within a 5 m radius (Figure 4). The standardized discriminant function coefficients of the vegetation cover surrounding the nest (b = 0.98) and of the distance to the canopy periphery (b = 0.78) suggest that these two variables contributed most to the discrimination between site types. Overall, the final model suggested that the potential nest sites were not significantly different from the actual nest sites ($P = 0.96$). The bivariate plot of the discriminate function shows that potential nest sites formed a subset of the actual nest sites (Figure 5). The model also showed that both the actual nest sites and the potential nest sites differed significantly from the random sites ($P < 0.001$).

DISCUSSION

Island Habitat

The average density of Black Oystercatchers in Laskeek Bay was 0.43 pairs/km^2 shoreline or 0.61 pairs/km of shoreline. An error was noted in Vermeer et al.'s (1992) calculation of the density of Black Oystercatchers at Skidegate Inlet. In the publication, there were 54 Black Oystercatcher pairs occupying 87 km of shoreline. The density was subsequently reported as 1.61 pairs/km of shoreline, instead of 0.62 pairs/km of shoreline. This calculation, however, did not include the shoreline perimeter of non-nesting islands or coasts. When these lengths are included, the shoreline of Skidegate Inlet is 207 km long. The density then becomes 0.26 pairs/km of shoreline, noticeably smaller than that of Laskeek Bay (0.61 pairs/km of shoreline). Skidegate Inlet may have a smaller density of Black Oystercatchers because it is closer to both towns and to islands supporting several terrestrial predators, such as raccoons, or because Skidegate Inlet, having restricted inflow from Hecate Strait, experiences a lower tidal range than the islands of Laskeek Bay.

Figure 4

Variables affecting the situation of Black Oystercatcher nest sites: (a) slope angle from nest to high tide; (b) slope angle of adjacent intertidal; (c) % vegetation cover within 5 m of nest; (d) visibility from nest (degrees of arc horizon); (e) distance to edge of forest canopy (m). Boxes – standard deviation; vertical bars – range

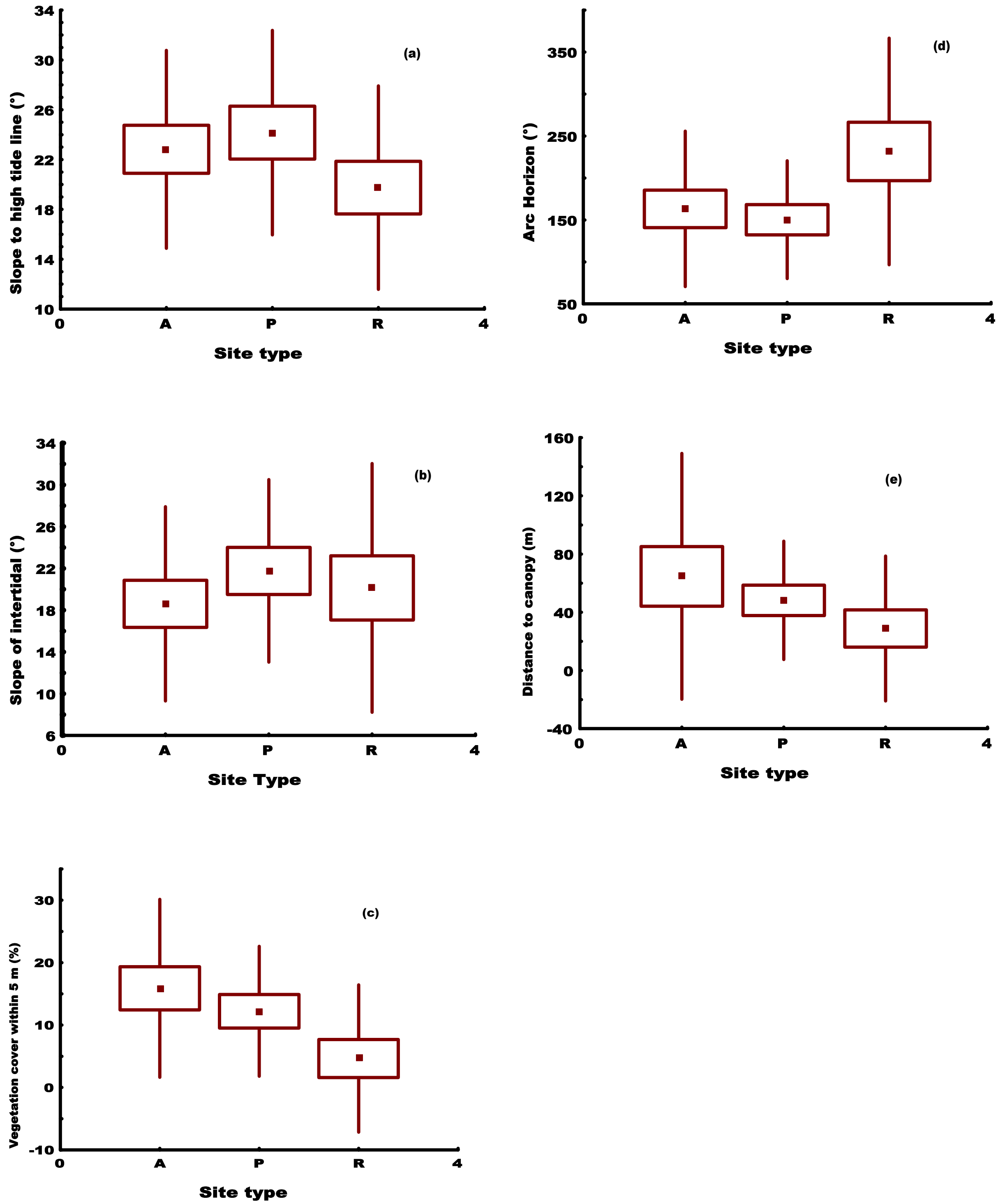
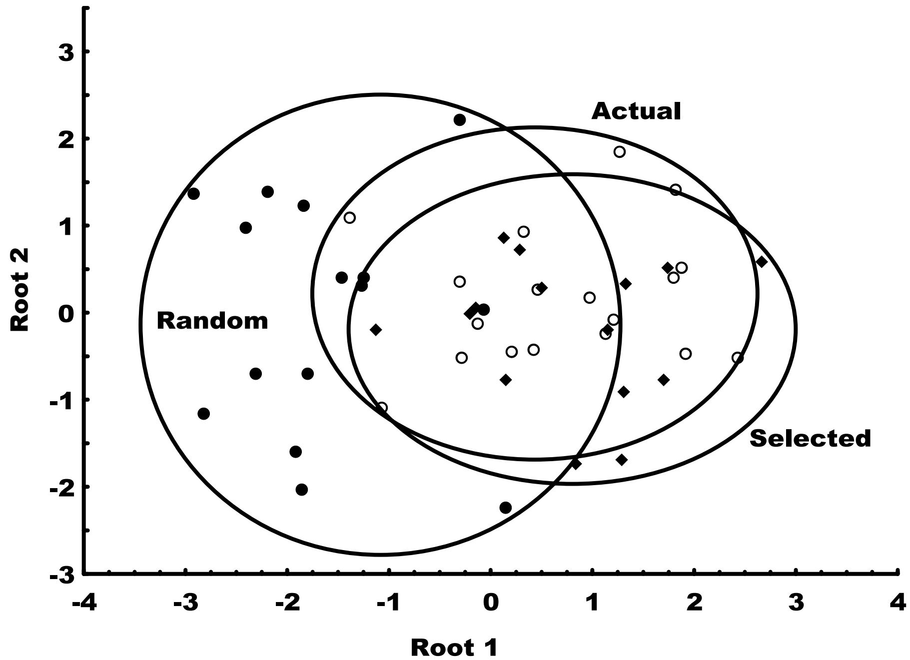


Figure 5
Discriminant function plot comparing actual, random and selected nest sites. Note that actual and selected sites overlap more or less completely, but that random sites include many that fall well outside the scores for actual sites



The islands used by Black Oystercatchers in Skidegate Inlet are considerably smaller (average perimeter = 143 m) than those used in Laskeek Bay (average perimeter = 4564 m). However, when density is plotted against perimeter of shoreline, average density in Skidegate Inlet (average island perimeter = 0.143 km, average no. pairs/island = 1.8) is similar to that predicted by average island perimeter by the relationship of perimeter to density seen in Laskeek Bay (see Figure 1). This suggests that Black Oystercatchers prefer the smallest islands that provide suitable nest security. Because of the greater wave action in Laskeek Bay, islands of the size used by oystercatchers in Skidegate Inlet would not provide security from wave-wash.

Black Oystercatcher density decreased with increasing island area (Figure 1). On Reef Island, the largest of the seven smaller islands, two out of three nests were on islets or headlands that were almost cut off from the main island at low tide. There are many apparently suitable sites on Reef Island and no terrestrial predators. Despite this, the density of Oystercatcher is very low. This fact that oystercatchers tend to avoid this larger island suggests that site selection is based on an innate response to island size, as opposed to an adaptive response to the presence or absence of predators. The fact that they tend to settle on islets suggests an immediate association of island size with predator presence. This interpretation contradicts the assumption made by Vermeer *et al.* (1989) and Vermeer *et al.* (1992b) that the birds recognize and react to the absence of predators and subsequently distance themselves from such threats.

Territory Habitat

With the exceptions of two sites on Reef Island, most actual nest sites studied were connected to the island in question at all times. This differs from Andres' findings in Prince William Sound, Alaska in 1998 where he reported a greater use of islets as breeding Black Oystercatcher territory. Islets may be less important in Laskeek Bay because suitable habitat is abundant on the smaller islands or because islets in Laskeek Bay are less sheltered, making the zone affected by high waves less predictable than in the enclosed waters of Prince William Sound.

The type of shoreline on which the majority of the Black Oystercatchers in Laskeek Bay nested was primarily solid rock. The high use of this form of substrate is most likely due to its abundance rather than intentional selection by the birds. However, the density of Oystercatchers on East Limestone Island, where the shoreline is composed exclusively of limestone, is unusually high. It is possible that the limestone provides additional nutrients and therefore supports a more highly productive foraging area.

The materials used by the Oystercatchers to line their scrapes were mostly rock chips and shell fragments. Small rock chips were used more often most likely because flaky volcanic rock was widely available. Although shells were also quite abundant, particularly from limpets and mussels, it is possible that the birds used more rock chips than shells for camouflage purposes because the lighter colored shells could be seen more easily by predators.

Habitat Selection

To address the essential purpose of this study, i.e. to determine why Oystercatchers nest precisely where they do on the smaller islands, all the variables measured were narrowed down to a select few that seem to best describe those nesting habitat characteristics found most attractive to Black Oystercatchers. In Laskeek Bay, Black Oystercatchers were found to be most attracted to nest sites that (1) have territories with a gradually sloping intertidal area, (2) have a moderate slope to the high tide line, (3) are away from the forest edge, (4) provide a field of vision less than 180° but are therefore still somewhat concealed from approaching predators, (5) have a substantial amount of vegetation within a 5 m radius (Figure 5).

A gradually sloping intertidal area is most likely of greatest importance when the birds are foraging. Not only would a shallower sloping intertidal have a greater surface area and therefore a greater food supply, but it may also facilitate parental provisioning since it would be easier for chicks to accompany parents on feeding excursions (Andres 1998, Hazlitt *et al.* 2002, Hazlitt 1999). A moderately sloping territory (up to the high tide mark) would also facilitate the displacement of chicks, i.e. they could more easily follow their parents around the territory, thereby reducing the risk of predation.

The trend for Oystercatchers to nest away from the forest edge may be a predator avoidance mechanism. Nesting further away from the forest canopy and therefore also from the perches of potential predators may be an attempt to reduce predation by Bald Eagles, Common Ravens and Northwestern Crows. The birds also tended to construct their nests where there was on average 165° of unobstructed view, i.e. free from rock greater than 20 cm tall, the approximate height a brooding Oystercatcher. This degree of rock cover would help to conceal eggs from approaching predators, and at the same time provide a brooding parent with a view of the surrounding territory. Vermeer *et al.* (1989) found similar results in the Gulf islands in that Oystercatchers there tended to nest near elevated logs or rocks. They stressed concealment from predators as the main factor, but also suggested protection from sun and prevailing winds as possible explanations. The amount of vegetation surrounding the nest was found to be substantial, averaging over 17% within a 5m radius. Taller grasses and sedges would likely help to hide eggs and chicks from both avian and terrestrial predators.

In Laskeek Bay, Oystercatchers tended to nest at least 17.8 m from the high tide line, significantly further than the distance of 8.24 m observed by Vermeer, Morgan and Smith (1989). This latter distance was measured on islands in the Gulf Islands without nesting gulls and is even larger than the distance measured on islands with nesting gulls in that study (5.38 m). Differences between the two studies are perhaps a result of the Gulf Islands being more sheltered from large waves.

As all the habitat characteristics of the actual nest sites, with the exception of distance to the high tide line, were similar on the seven smaller islands and on Louise Island, lack of suitable habitat cannot be the sole explanation for the absence of breeding Oystercatchers on Louise Island. The possibility that food may be less abundant on the coast of the larger islands than on the smaller islands, as suggested by Vermeer et al. (1989) for the Gulf Islands, seems unlikely to be the explanation. The major headlands on the larger islands are comprised of the same rocks and receive the same degree of exposure as the smaller islands. Although the presence of factors not measured in the present study cannot be excluded, the presence of mammal predators on the largest islands seems the simplest explanation for the low density of Oystercatchers found there.

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NORTHERN SAW-WHET OWL NEST ON EAST LIMESTONE ISLAND

Charlotte Tarver
Laskeek Bay Conservation Society, Box 867, Queen Charlotte City, BC, V0T 1S0

A Northern Saw-whet Owl (*Aegolius acadicus brooksi*) nest found on East Limestone Island on 27 June 2001 is the first documented record of a nest site for this non-migratory sub-species restricted to the Haida Gwaii archipelago (S. Sealy and Rolf Krahe, personal communication). Although common throughout its range, there may be only a few records of potential nest sites of *A. a. brooksi* on Haida Gwaii (Campbell *et al*. 1990).

The nest was in a Sitka spruce snag (*Picea sitchensis)*, classified as Category 5 under the British Columbia Wildlife Tree Classification System (no bark, decayed heartwood, dead for at least 15 years). The tree was situated alongside a well-traveled trail, next to a small creek and was on the edge of the shore, 15 m from a small cabin. The snag, Wildlife Tree 1 (WT 1) measured 15 m high with a diameter of 130 cm. The nest entrance was 9 m above ground and the hole was 78 mm tall by 74 mm wide. The cavity extended back 18 cm and was 30 cm deep. The cavity was used by Northern Flickers (*Colaptes auratus*) in 1992.

In 2001, saw-whet calls were first heard on 5 May, (about one month later than recorded in previous years) and continued nightly until 15 June. The owl roosted in a tree near the top of Spring Valley, and emitted a constant "advertising" call (*see* Cannings 1993) from dusk to dawn. These calls were clearly audible from North Cove and in the cabin area.

From 2 - 15 June, an owl would frequent the area near the cabin, calling from trees to the south, west, and north sides of the cabin. During the week of 8 to 15 June, on three occasions, we saw a Saw-whet Owl sitting on a small spruce (20 cm diameter) at dusk directly in front of the cabin, only 3 m from the door. The owl would sit on a branch (3.5 m high.) quietly and not appear disturbed by our presence. On several occasions between 15 and 29 June, an owl flew into the cabin area and headed towards WT 1. On the evening of 27 June, an owl flew towards WT 1 and landed below the old Northern Flicker nest cavity (J. Fournier, personal communication). From that date until camp closure on 27 July, WT 1 was observed daily.

Behavior and activities after June 27

Once we determined the location of the nest, we made daily observations of the nest site, recording activities in the evenings and during the day. We observed a male owl coming to the nest with prey, a female calling from within the nest, chicks calling, both adults on the tree, the feeding of a female and chicks, and heard three distinct calls: a visiting call, a female response and a chick begging call.

When the male came into the nest area, he would make a "visiting" call as he approached. A female within the nest would give a "response" call (soft *tsst, tsst, tsst*). The male then would fly to WT 1, often with prey, briefly stick his head inside the cavity, then immediately fly off. On 2 July, the male landed on the nest tree with prey in his talons (possibly a deer mouse) and we heard young chicks peeping inside the cavity. On 3 July, a female was looking out of the nest hole at 2100 h. The next day, the female left the nest at 2230 h, whilst the male was calling nearby. On 7 July, an owl (probably female) left the nest cavity during the late afternoon and flew away into the forest. The next day, 8 July, an owl stuck its head out of the nest, flew out and sat on a nearby tree then returned into the nest hole at 1700 h.

Both male and female owls seemed undisturbed by human presence, as evidenced by several observations of the female watching people walk by, or when the male would perch on the tree in front of the cabin or sit in the regenerated Spruce trees surrounding the nest tree. A chick stuck its head out of the nest on 20 and 21 July. We noticed that whenever the male would sit in the regenerated spruce trees in the early evenings, Hermit Thrush and Winter Wrens would give alarm calls and on 14 July, Winter Wrens were dive-bombing the unfazed owl sitting on a small spruce near the nest site.

Camp closed on 27 July with the chick(s) still remaining in the nest cavity. On 1 August, I returned to Limestone for a short visit, checked the nest and did not hear, or see any owls, eggshells or pellets in the area around the nest tree.

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Appendix 1

Field notes for the activity of the first Northern Saw-whet Owl nest on East Limestone Island, 2001.

Date	Time (h)	Activity Noted
May 5	2200	Calling throughout night from Spring Valley area
May 7-31	2200	"Advertising call" continuous dusk to dawn
June 7 – July 23	Various hours	Calling, visuals and nesting activity in area of cabin
June 12	2100	Adult on spruce tree branch (3.5 m ht.) in front of cabin (3m from door), flew to tree on north side of cabin (2.7 m from cabin)
June 13	2100	Adult on spruce tree branch in front of cabin
June 16	2030	Adult on spruce tree branch in front of cabin
June 20	2100	Adult flying to and from cabin area, some 'visiting' calls
June 22	2115	Adult heard calling near cabin
June 26	2200	Adult flying to and from North side of WT 1
June 27	2130	Female looking out from nest hole on WT 1 (north side) male flew in 3 times, entered hole, prey in talons; gave "visiting" calls as it approached nest area
July 2	2145	Male flew into nest cavity with prey, loud peeping of young inside nest hole, exited and perched on tree with head inside, then flew off
July 3	2100	Female looking out of nest hole
July 4	2215	Male calling softly and gently (visiting call) from regenerating spruce on west side of WT 1; female left nest at 2230
July 5	1745	Male "visiting" call from tree behind cabin, flew onto nest tree with prey, other bird inside took prey
July 7	2100	Adult left nest cavity, flew away to SW of cabin
July 8	1700	Female exited nest, than sat on close by tree, then re-entered cavity
July 12	1630	Female stuck head out of hole and watched JF walk by on trail
July 13	1400	Male left nest (after feeding?), flew over regeneration area, Winter Wren in regeneration, excited, loud alarm calls
July 13	2100	Male in spruce in front of cabin, flew to WT 1 w/prey in talons, head into cavity, then flew to nearby small tree in regeneration area, perched there for 7 minutes, Winter Wren alarm calling and pestered owl by flying at it
July 14	2100	Male perched in spruce in front of cabin with prey, flew to nest hole, then into regenerating spruce and perched on branch overhanging trail at 3m ht., looking at observers and ignoring 2 Winter Wrens "buzzing" him
July 15	2030	Adult and chick calling from within cavity
July 15	2230	Adult "visiting" call as approached nest with prey, flew in to tree, then departed
July 17	1530	Adult at WT 1, then perched in regeneration with Winter Wren and Hermit Thrush alarm calls and diving on owl
July 18	1430	Adult feeding chick(s) within nest cavity
July 19	2100	Chick looking out of nest hole
July 20	1500	Chick looking out of nest hole
July 20	2030	Adult feeding young in nest hole
July 21	1300	Chick looking out of nest hole
July 22	1400	Chick looking out of nest hole
July 23	1100	Adult brought prey to nest and fed chick(s)
July 23	1115	Adult brought prey to nest and fed chick(s) (possibly second adult?)
July 23	2000	Chick looking out of nest hole
July 24	1500	Chick looking out of nest hole
July 24	2230	Adult gave "visiting" call and flew to nest tree with prey, observed feeding chick, chick peeping loudly

For more information, copies of this report, or other publications, please contact us at:

Laskeek Bay Conservation Society
Box 867, Queen Charlotte, B.C., V0T 1S0
(250) 559-2345 ph/fax
laskeek@qcislands.net
www.laskeekbay.org