

**EAST LIMESTONE ISLAND FIELD STATION
FIELD SEASON REPORT 2019**



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Laskeek Bay
CONSERVATION SOCIETY

Summary

This was the Laskeek Bay Conservation Society's 30th field season on East Limestone Island (ELI), Laskeek Bay, Haida Gwaii. The season ran from 3 May to 18 July, bringing 17 volunteers and 3 student interns to the island, as well as 91 visitors including 36 students and 9 teachers/chaperones who came with Project Limestone. Ancient Murrelet (ANMU) chick departures were very low again, similar to last year, and started on the night of 11 May. Remote cameras were used to monitor all ANMU funnels this year. A total of 34 chicks were photographed in the Cabin Cove funnels during the standard monitoring time. An additional 8 chicks were photographed after the standard end to monitoring time of 02:30. Adult Ancient Murrelet activity seemed low this season, similar to last year. No raccoons were detected on the island during shoreline surveys in February and March, or on remote baited cameras used throughout the field season. Black Oystercatcher surveys were conducted only in Laskeek Bay this year, and 26 chicks were banded. Glaucous-winged Gull censuses were conducted at 3 colonies in Laskeek Bay and 184 active nests were found. The Pigeon Guillemot (PIGU) nestbox project was operating fully this season, 30 boxes were open for use. 16 boxes (53%) were active and produced 18 chicks that were weighted and measured. We also, in conjunction with the Canadian Wildlife Service (CWS), put 15 geolocators on to adult PIGU's. There were 3 Cassin's Auklet chicks that were measured and weighed in nestboxes; 1 disappeared before fledging, 2 were banded and then fledged. Five near-shore sea surveys were completed and Marbled Murrelet counts were high, there were a total of 681 sightings during all surveys. Two Hecate Strait surveys were completed. Marine mammal sightings included 122 humpback whales, 2 minke whales, 5 grey whales, 16 harbour porpoises and 8 sightings of groups of orcas. Thirteen wildlife trees were active, containing 14 nests. A program to monitor sapsucker sapwells was initiated this season; 98 person hours were spent monitoring, interactions between Red-breasted Sapsuckers (RBSA) and squirrels were observed and there were 41 hummingbird sightings at the sapwells. A Common Raven nest, two Bald Eagle nests, and the Peregrine Falcon nest were active. We initiated a vegetation restoration plan, centered on the reduction of Deer numbers on the island, and various monitoring programs were begun in anticipation of the first deer population control (intended for October 2019); vegetation plots, songbird point counts, tree growth monitoring and invasive plant monitoring. We continued to monitor deer on East Limestone. Marine debris was documented and removed from one beach on Reef Island (Reef South Beach) and one on East Limestone (Crow Valley Beach).

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Introduction

Laskeek Bay Conservation Society (LBCS) is a non-profit organization committed to increasing appreciation and understanding of the natural environment through biological research, interpretive programs and public involvement in science. The field station at East Limestone Island has been in operation for 30 consecutive field seasons and over this period LBCS has developed diverse long-term monitoring and public education projects in Laskeek Bay, Haida Gwaii. Volunteers assist researchers with data collection in order to study the abundance, distribution, and life history of wildlife in Laskeek Bay. This information helps us understand the fluctuations in marine and terrestrial ecosystems and gives a baseline against which we can describe changes in the future due to introduced species, marine pollution, global climate change, extreme weather events, and other threats to coastal ecosystems.

Education and interpretation program

LBCS provides opportunities for public involvement in research and monitoring activities through Project Limestone (our school program), our volunteer program, and interpretive tours. Students, volunteers, and visitors come to our field camp and participate in the projects that are occurring throughout the season. By bringing people to our camp and encouraging participation in research activities, we hope to increase public awareness of local conservation issues, and increase public knowledge of the natural history of Haida Gwaii.

Project Limestone

Project Limestone brings local students, grade school and college, to Limestone Island to learn about natural history and participate in Ancient Murrelet research. The students are led on an interpretive tour that crosses the island and ends at Lookout Point. They learn about the natural history and geography of the area, and are introduced to various research projects. They assist with Ancient Murrelet monitoring work and learn about Ancient Murrelet life history as they observe the capturing, weighing, and releasing of chicks. Along with participating in Ancient Murrelet night work, the students have time to observe and learn about native and introduced wildlife on Limestone Island and the Laskeek Bay area.

This year 4 groups from 3 different schools camped on Louise Island, opposite West Limestone Island, spent one night in the research camp on East Limestone Island, and returned to their camp the next morning. A total of 36 students and 9 teachers/chaperones participated. The first and second student groups were from Coast Mountain College, on 7 May and 14 May. On 24 May students from GidGalang Kuuyas Naay

Secondary School (Queen Charlotte) visited, and on 26 May we hosted students from the Living and Learning school. Project Limestone began in 1991, and to date 866 students have visited the island as part of this program, some multiple times.

Volunteers

Volunteers play an important role in the operation of the LBCS field camp. They generally stay for one week, and help staff with research, monitoring projects, camp maintenance, and daily chores. Volunteer contributions of time and energy are essential and help ensure our ability to continue the long-term collection of data. LBCS provides a unique opportunity for the general public to be involved in long-term research in a remote field camp.

This year we had 17 volunteers (not including student interns) who contributed 128 volunteer days to projects on Limestone and in other areas of Laskeek Bay. Most volunteers stayed for one week, although two volunteers came for 2 weeks. Volunteers this season came from BC, Quebec, Ontario, Alberta, Washington State, and Australia. Of the 17 volunteers, three full-time and two seasonal Haida Gwaii Residents were among them

Visitors

The LBCS visitor program provides an opportunity for private and commercial groups to visit Limestone Island and participate in an interpretive tour. While visitors walk across the island, they are introduced to the natural history of the area and to our monitoring and research projects. Our aim is to bring about greater understanding of the natural world and increase awareness of local conservation issues.

Generally, visitor groups who stop on Limestone Island are taking part in ecotourism excursions into Gwaii Haanas. We did tours with 5 such tour groups who visited us on Limestone: *Island Bay* on 21 May, *Island Solitude* on 24 May and June 1, *Atlas* on 3 June and *Island Solitude* on 10 July. One private vessel, *Soul Star*, visited the island on 20 May. There were no visits by Kayakers this season. In total, there were 46 visitors to the island throughout the field season, 91 including the school groups.

Staff

LBCS staff this year were Neil Pilgrim, Lead Biologist/Camp Supervisor; Sonja Panozzo, Assistant Biologist/Interpreter; and Aggie Cangardel, Executive Director.

Student Interns

In 1998, LBCS began a program that provides students in biology or environmental studies with an opportunity to gain valuable hands-on field experience as an intern on Limestone for a four to six week period. This year we had three interns: Brendan Carswell, Tori Harrison and Natalie Benoit. Brendan, a student from the University of Northern British Columbia, contributed 4 weeks (3 May to 1 June), Tori, a former student at the University of Calgary, was in the field for 4 weeks (1 June to 28 June), and Natalie, a University of British Columbia student, spent three weeks in the field and one week in the office in Skidegate. In total the interns this season contributed 84 days to field and office work.

Research and monitoring programs

Research Partnerships & Special Projects

LBCS assists other researchers and organizations with various projects in the Laskeek Bay area and other areas of Haida Gwaii. This year LBCS collaborated with the Canadian Wildlife Service on research into the annual movement of Pigeon Guillemots. See the PIGU section for more details.

Master's student

This season was the second field season of a two-year partnership with a Master's student at Simon Fraser University, Sonya Pastran. Sonya's objectives are to (1) map the local abundance and distribution of Marbled Murrelets to define important feeding areas and to assess inter-year variability; (2) use static and dynamic variables from existing online environmental data to examine their relationships with Murrelet distributions; and (3) analyze fine-scale distributional relationships using additional marine and Murrelet data collected in 2018 and 2019 along the at-sea survey transects.

During the 2019 field season, data collection was continued on the waters of Laskeek Bay with the additional goal of mapping sea-floor composition. Sea-surveys were completed along linear transects, replicating methods created by Laskeek Bay Conservation Society, but with additional fine-scale measurements: salinity and temperatures at 5, 10 and 15-meter depths were measured every 1.5 km along transects. In addition, sonar was used to record prey abundance and availability. In addition to the regular sea-surveys, Sonya continued the avian predation experiment, begun in 2018, using Eagle-like kites to replicate the presence of hunting predators along the shoreline. The motivation for this is to assess whether their presence would alter the distribution and abundance of the seabirds along the transect routes. Work to map out the ocean bottom composition was also completed, using a Petite Ponar grab lowered to a maximum depth

of 60 meters to collect whatever sediment existed on the bottom. This was done at 1 km intervals along the sea-survey transect routes. The data collected from the last two fields seasons will be used to gain a better understanding of what determines the distribution of Marbled Murrelets in Laskeek Bay.

Ancient Murrelets *Synthliboramphus antiquus*

In 2017, remote camera monitoring became one of the primary methods of monitoring for Ancient Murrelet (ANMU) chicks departing from Limestone Island. In 2017 and 2018 the cameras were used throughout the ANMU season with manual monitoring being conducted every second night. Given the success of camera monitoring in 2017 and 2018, in 2019, manual monitoring was discontinued and camera monitoring became the sole means of monitoring chick departure. This freed up staff and volunteers to undertake other activities. The camera monitoring was conducted on Cabin Cove funnels 5,6,7 and 8. Funnel 4, the last remaining funnel in North cove, was not erected in 2019.

In 2019, the first chick to arrive in the Cabin Cove funnels was on the night of 11 May and the last chick was seen on the night 5 June. The highest number of chicks to be monitored on one night was 6, on the night of 19 May.

Chick Capture Trends

The Cabin Cove total for 2019 was 34 chicks, including only chicks captured on camera during the time when we would normally be monitoring (22:30 to 02:30), to be consistent with previous years (Figure 1). The total including chicks that were seen photographed after 02:30 in the morning is 42.

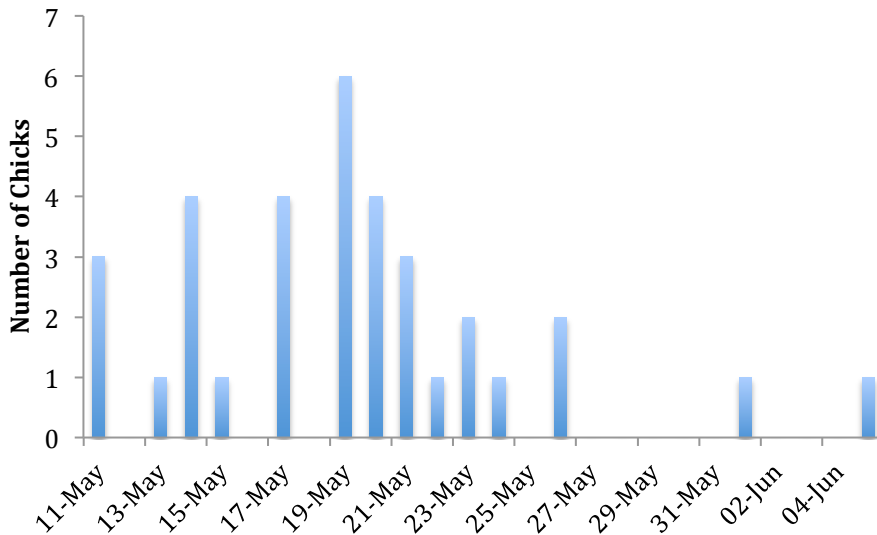


Figure 1. 2019 nightly chick captures, funnels 5-8. Chicks manually captured or photographed within the funnels before 02:30 are shown here. The date refers to when the monitoring night began, even if chicks were caught in the early morning of the next day.

The number of chicks recorded this season in funnels 5-8 was lower than last year: 34 chicks this season compared to 39 during last season (Table 1). The number of chicks departing is low when compared to historical numbers and is of significant concern.

Table 1. Summary of chick departures, peak nights and totals for funnels 5 to 8 on East Limestone Island, 2006 to 2019. Chick numbers include only chicks captured or photographed within the funnels, and before 02:30 in the morning.

<i>Year</i>	<i>First night with chicks</i>	<i>Peak night</i>	<i>Peak count</i>	<i>Last night</i>	<i>Total nights</i>	<i>Total chicks</i>
2006	10-May	21-May	24	30-May	21	197
2007	15-May	4-Jun	16	12-Jun	29	166
2008	12-May	14-May	13	3-Jun	23	125
2009	10-May	18-May	16	29-May	20	104
2010	8-May	21-May	19	2-June	26	121
2011	11-May	15-May	11	9-June	30	106
2012	12-May	17, 22-May	14	31-May	20	110
2013	13-May	21-May	15	1-June	20	136
2014	11-May	18, 19-May	15	2-June	23	110
2015	11-May	20-May	7	6-June	27	44
2016	18-May	25, 29-May	5	19-June	32	36
2017	16-May	20-May	5	10-June	26	28
2018	11-May	17-May	6	17-June	37	39
2019	11-May	19-May	6	11-June	36	34

Funnels 5 and 6

As of this season, funnels 5 and 6 have been monitored continuously for 30 years, and are the primary means of assessing the long-term population trend in the Cabin Cove colony area. Funnels 7 and 8 were installed in 2006 flanking funnels 5 and 6 to see if the colony area had shifted. This year there were more chicks in funnels 5 and 6 (25 chicks) than funnels 7 and 8 (9 chicks), which is consistent with past trends, suggesting that the densest part of the Cabin Cove colony is still being captured by funnels 5 and 6. Similar to the past three years, funnel 6 had a much higher number of chicks (21) than funnel 5 (4). The total chick number is similar to the past four years, and much lower than years previous to that (Figure 2). This year, the first chicks arrived in funnels 5 and 6 on 11 May and peak night (6 chicks) occurred on 19 May (Table 2).

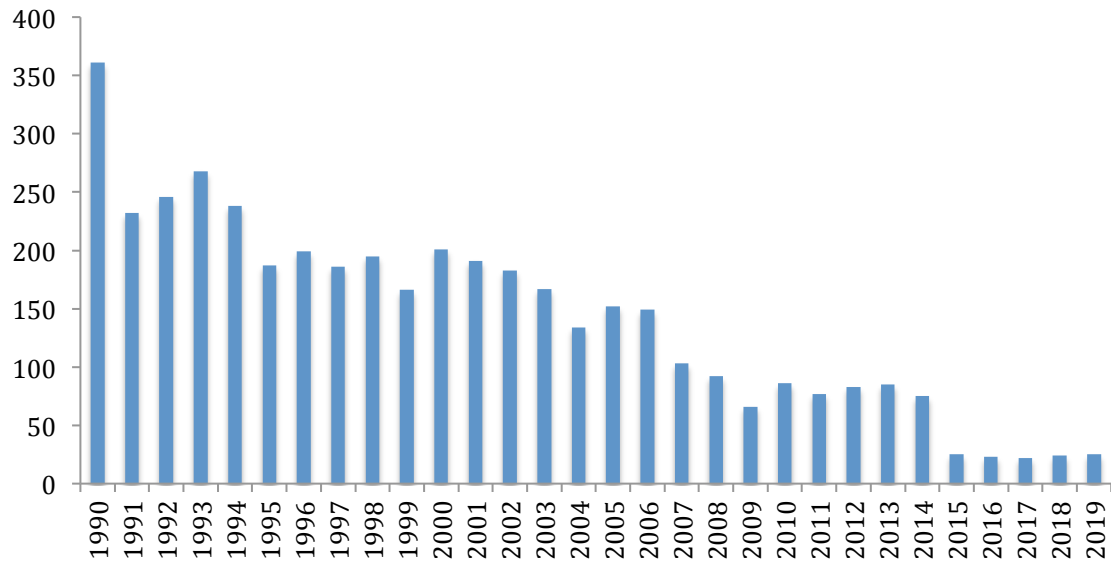


Figure 2. Total Ancient Murrelet chick captures at funnels 5 and 6, 1990-2019. These totals include only chicks captured within the funnels and before 02:30 in the morning.

Table 2. Summary of chick departures, peak nights and totals from funnels 5 and 6 on East Limestone Island, 1990 to 2018.

Year	1st night with chicks	Peak night	Peak count	Last night	Total days	Total chicks
1990	13-May	20-May	28	15-Jun	34	361
1991	10-May	25-May	22	05-Jun	27	232
1992	14-May	22-May	29	02-Jun	20	246
1993	12-May	18-May	39	04-Jun	24	268
1994	08-May	20-May	29	06-Jun	30	238
1995	11-May	23-May	18	12-Jun	33	187
1996	11-May	18-May	17	07-Jun	28	199
1997	13-May	28-May	22	05-Jun	24	186
1998	11-May	20-May	23	20-Jun	41	195
1999	11-May	21-May	22	09-Jun	30	166
2000	11-May	21-May	22	06-Jun	27	201
2001	11-May	19-May	21	15-Jun	36	191
2002	09-May	21-May	33	01-Jun	24	183
2003	11-May	21-May	19	03-Jun	24	167
2004	08-May	16, 17-May	15	01-Jun	25	134
2005	07-May	19, 23-May	12	05-Jun	30	152
2006	10-May	21-May	20	31-May	22	149
2007	15-May	04-Jun	16	12-Jun	29	103
2008	13-May	20, 22, 23-May	8	03-Jun	22	92
2009	12-May	18,19-May	10	29-May	20	66
2010	8-May	21-May	16	2-June	25	86

2011	11-May	21-May	9	9-June	30	77
2012	13-May	22-May	12	31-May	19	83
2013	13-May	22-May	11	1-June	20	85
2014	11-May	18-May	12	02-Jun	23	75
2015	11-May	17, 24 - May	4	06-Jun	27	25
2016	18-May	25-May	5	19-Jun ¹	32	23
2017	16-May	20-May	5	10-Jun ¹	26	22
2018	11-May	17-May	6	17-Jun ¹	37	24
2019	11-May	19-May	6	11-Jun ¹	36	25
Average ± SD	11-May ± 2.4 days	21-May ± 3.7 days	17 ± 9.0 chicks	6-Jun ± 6.0 days	28 ± 5.6 days	141 ± 84.9 chicks

¹The final night of monitoring in 2016, 2017, 2018 and 2019 was obtained using a different method from previous years, due to low chick numbers and use of cameras for monitoring. See text for details.

North Cove

Due to the low numbers of chicks recorded in funnel 4 in 2018, the last remaining funnel in North Cove was discontinued.

Other ANMU monitoring

Point counts

In past years, point counts were conducted in the colony area to monitor the activity of adult birds in the forest at night; five-minute counts were conducted in Cabin Cove at approximately 02:30 on some manual monitoring nights. In 2019, an automated recording unit (ARU) was set-up in the same location where the point counts were conducted. This allowed the collection of ANMU calls from 23:00 to 04:00 on 45 nights, from May 7 to June 21. These recording will be analyzed during the winter of 2019/2020.

Gathering grounds

Ancient Murrelets enter and leave the breeding colony only at night. In late afternoon and evening the birds gather on the water in areas called gathering grounds, where they wait until it is sufficiently dark before entering the colony. Both breeding and non-breeding birds are thought to gather in these areas and engage in important social interactions. The Limestone Island gathering ground is located between Low Island and Limestone Island. Between 4 May and 20 June, we conducted standardized 10-minute counts of birds on the gathering grounds (two counts of 5 minutes each). The highest count occurred on 15 May, with a total of 104 Ancient Murrelets observed. The maximum this year was higher than the maximum in 2018 (51 birds), 2017 (22 birds), and 2016 (70 birds). The average gathering ground count in 2019 was 6.7 ± 15.6 Ancient Murrelets, higher than last year (4.2 ± 10.0) and 2017 (4.6 ± 5.1), but less than the three years prior to that (14.5 ± 15.7 in 2016, 30.3 ± 31.8 in 2015 and 20.7 ± 23.0 in 2014). Gathering ground counts were

completed on 46 evenings this season, they could not be completed on one night (17 May).

Summary: Population Trends

The breeding population of Ancient Murrelets on East Limestone has been declining over time. The number of departing chicks in funnels 5 and 6 declined by 56% between 2006 and 2009, likely due to the presence of raccoons in 2007 and 2009. Chick numbers increased slightly since 2009 and seemed to have stabilized in these two funnels, up until the 2015 season when there was a 67% decline in chick numbers from the previous year. The continued low number of chicks in 2016 (8% decline from 2015), 2017 (13% decline from 2015), 2018 (4% decline from 2015) is concerning. In 2019, the low number of chicks continued with no decline from 2015 but no increase either. The chick numbers remain low. In 2015, it was speculated that the dramatic decline from 2014 to 2015 could have been a temporary poor breeding year due to high sea surface temperatures throughout the previous winter. With five years of very low chick numbers we are concerned that the combination of poor feeding conditions, changes in habitat on Limestone Island due to blowdown, and sporadic raccoon predation in the past, have worked together to decrease recruitment of new breeders to the Limestone Island colony, and we are now seeing the result as a rapidly declining population on this island.

Black Oystercatchers *Haematopus bachmani*

Oystercatchers are large, conspicuous shorebirds that are easily studied because of the relative ease with which nesting sites can be located. Because they are entirely dependent on the intertidal system, these birds are also thought to be a good indicator species for this ecosystem. LBCS has been monitoring the breeding population of Black Oystercatchers in Laskeek Bay annually (except for 2011) since 1992.

LBCS conducted Black Oystercatcher surveys only in Laskeek Bay this year (Figure 3), and the results from the two surveys are summarized below. We have also been conducting extensive surveys in Gwaii Haanas for many years, but the surveys in Gwaii Haanas occur every other year and were not conducted this year. Methodology for shoreline surveys and territory visits are detailed in the Gwaii Haanas Black Oystercatcher Survey reports, and will not be repeated here. Survey maps of the Laskeek Bay area are produced by Gwaii Haanas and included as an appendix in the Gwaii Haanas reports.

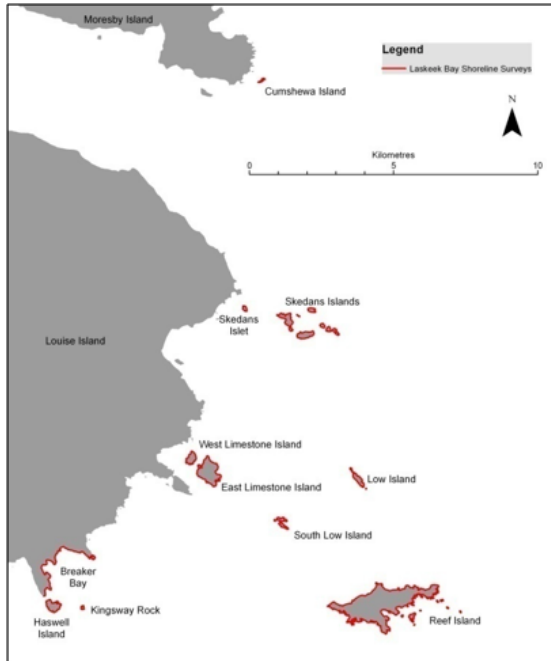


Figure 3. All shorelines outlined in red represent surveyed shoreline segments.

Site occupancy and reproductive success

Oystercatcher territories were visited in Laskeek Bay in the early June (1 – 5 June) and again in late June and early July (30 June – 5 July). We visited and searched on foot all territories occupied by breeding pairs in the last three survey years. Territories not active in the last three survey years were scanned during shoreline surveys, but not visited unless activity was observed. Shoreline surveys followed the same protocol developed for the Gwaii Haanas surveys and involved scanning shoreline areas from ~50m offshore at 11 km/hr (2500rpm) to search for new territories and for non-territorial birds. The islands that we survey every year are Cumshewa Island, Lost Islands, East and West Limestone, Reef, Low and South Low, Skedans Islands (including the small islet in front of the village site), Kingsway Rock, Haswell Island, and a section of the Louise Island shoreline between Haswell Island and Nelson Point. All islands were visited during both the first and second surveys. We weighed and measured eggs and banded and measured chicks at territories where they were present.

Of the 56 territories visited on foot, a territorial adult pair occupied 41. Of these, 33 were active (warm eggs or live chicks present) during the first survey, and 28 were active during the second survey. During survey 1 we found 30 territories with eggs (66 eggs total, although there was 1 territory where the adult bird would not get off the nest, indicating there was at least one egg, but we are uncertain exactly how many). There were 2 territories with 2 chicks each during survey 1 and 2 territories with three chicks. During survey 2, we found 13 territories with eggs (19 eggs total) and 18 territories with chicks, with a total of 32 chicks. We also survey the shoreline of islands to search for new territories and non-territorial birds (birds that are away from their territory or non-breeders). We found 2 new territories in Laskeek Bay, and had 26 non-territorial

sightings of oystercatchers comprising 53 birds (some of which could be the same birds sighted multiple times).

Banding and re-sighted oystercatchers

All birds are banded with one metal band on the right leg that carries a unique number. Oystercatchers banded in the years before 2013 have a combination of colour-bands on the left and right leg that indicates the year of banding as well as the general location where the bird was banded. Metal bands are permanent, while the plastic bands seem to be lost over time. In 2013, we began banding chicks with field-readable alphanumeric (A-N) codes on plastic bands, instead of colour combinations, because the unique code allows identification of the individual bird from a distance. The A-N bands have white characters on a dark blue background. In 2017, we tried using a new type of A-N plastic band, because we noticed several very worn plastic bands from earlier years, on which the combination is now un-readable. This season, it was decided to discontinue using the A-N bands as the new bands selected in 2017 have already become mostly unreadable. In 2019, all chicks that were large enough were banded with a red colour band over a metal band on the right leg. The first four chicks were also banded with blue alphanumeric bands on the left leg. The total number of chicks banded in 2019 was 26.

All oystercatchers observed during the season were checked for bands, as this gives us information on their age and dispersal. In Laskeek Bay, there were 18 banded birds re-sighted during the two 2019 surveys (Table 3). Banded individuals at breeding territories were assumed to be the same individuals on subsequent visits and repeated sightings are not included in the table. There were only four birds with colour or alphanumeric bands that were re-sighted in Laskeek Bay this year. One bird, observed at territory SLW-8, had an alphanumeric band on the left leg, and a brown colour band over a metal band on the right leg. While we were unable to read the alphanumeric band, the brown colour band indicates that the bird was banded in 2016 as a chick. By taking photographs we were able to decipher the numbers of some metal bands that did not have field-readable alphanumeric bands. One of these birds, observed in the Skedans islands, was banded in 2001 as a breeding adult and hence is a minimum of 21 years old (assuming age at first breeding is not less than 3).

Table 3. Banded Black Oystercatchers re-sighted in Laskeek Bay in 2019.

Band Combination (Left – Right)¹	Location seen / Nest site	Year Banded
UB-UB/M (1015-026__)	REE-4	2013 or 2014 ²
UB-UB/M	REE-1	Unknown
UB-UB/M	52.90866067°N - 131.53251252°W	Unknown
UB-UB/M	52.95780603°N - 131.57423026°W	Unknown

UB-UB/M (1015 - 06---)	SKE-17	2004-2008 ²
H?-R/M	SLW-5	Unknown
UB-UB/M	LOS-14	Unknown
UB-UB/M (1015-____)	LOS-11	Unknown
UB-UB/M	SLW-8	Unknown
UB-UB/M (1015-06973)	ELI-4	2007 (REE-3) ²
UB-UB/M	52.90919049°N -131.53308978°W	Unknown
AN (N-) - Br/M (1905-___)	SLW-8	2016 ²
UB-UB/M	52.89641663°N -131.57456847°W	Unknown
UB-UB/M (2406-060--)	REE-11	2003 or 2004 ²
UB-UB/M (1015-_-69--) band USD	KNG-3	2004-2008 ²
AN -UB/M (1015_- ----9)	KNG-2	Unknown
AN-UB/M	Cumshewa	Unknown
AL-UB/M (2406-06009)	52.95829478°N -131.56962465°W	2001 (SKE-6) ³

¹Band codes: UB = unbanded (birds can lose bands), M = metal, Or = orange, W = white, LG = Light Green, R = Red, Bk = Black, Br = Brown, Y = Yellow, DB = dark blue, AL = Aluminum.

²Banded as a chick.

³Banded as a breeding adult.

Oystercatcher Chick Diet

Oystercatchers feed their chicks hard-shelled invertebrates, which they bring intact to the breeding territory. In order to quantify average diet composition fed to chicks, we collect a sample of fresh prey remains where they are present. In 2019, prey was collected from 16 unique territories in Laskeek Bay.

Limpets were the primary prey (70.4%), followed by mussels (16.7%), chitons (7.4%) and abalone (4.5%) (Figure 4). These four prey items made up 99.0% of the diet. These numbers are fairly consistent with what has been found in past years; in 2018 these four prey items made up 99.2% of the diet.

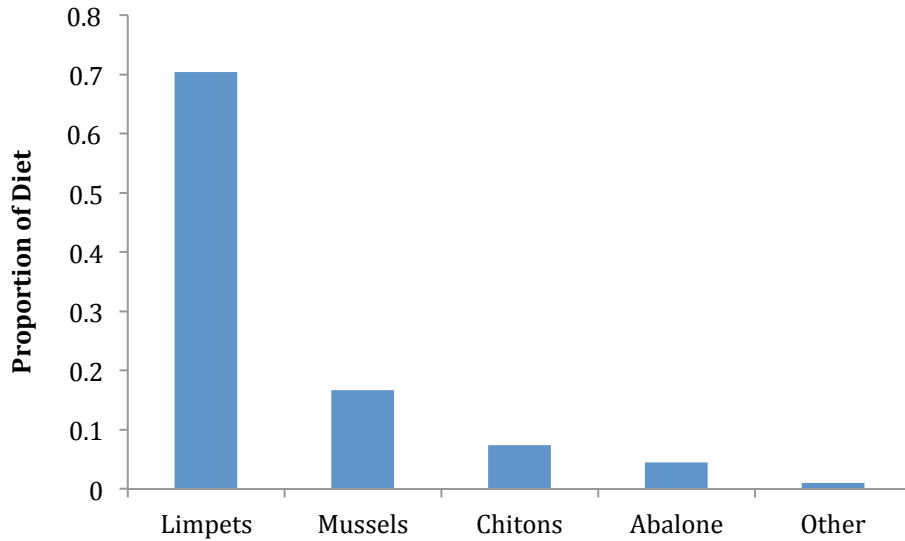


Figure 4. Black Oystercatcher chick diet from prey collections in Laskeek Bay, 2019.

Glaucous-winged Gulls *Larus glaucescens*

LBCS has been censusing gull colonies within Laskeek Bay since 1992 (Figure 5). This year, we visited the known colonies on Kingsway Rock, Low Island, Cumshewa Island, Skedans Islands and Lost Islands. At each of the colonies visited the number of active nests (those containing either eggs or chicks) was recorded, as well as the number of empty nests. No nests and very few gulls were seen on Skedans Islands, Low Island and Cumshewa Islands. Lost Island, the largest colony in the area, had a total of 147 active nests (15 June), followed by Kingsway Rock with 37 nests (16 June). In total, we counted 184 active nests on these two colonies. All nests contained only eggs: 1 egg (9 % of nests), 2 eggs (16 %), or 3 eggs (75 %). The total number of active nests counted this season (184), in these 2 colonies, was below the long-term average (\pm SD) of 248.6 ± 54.0 .

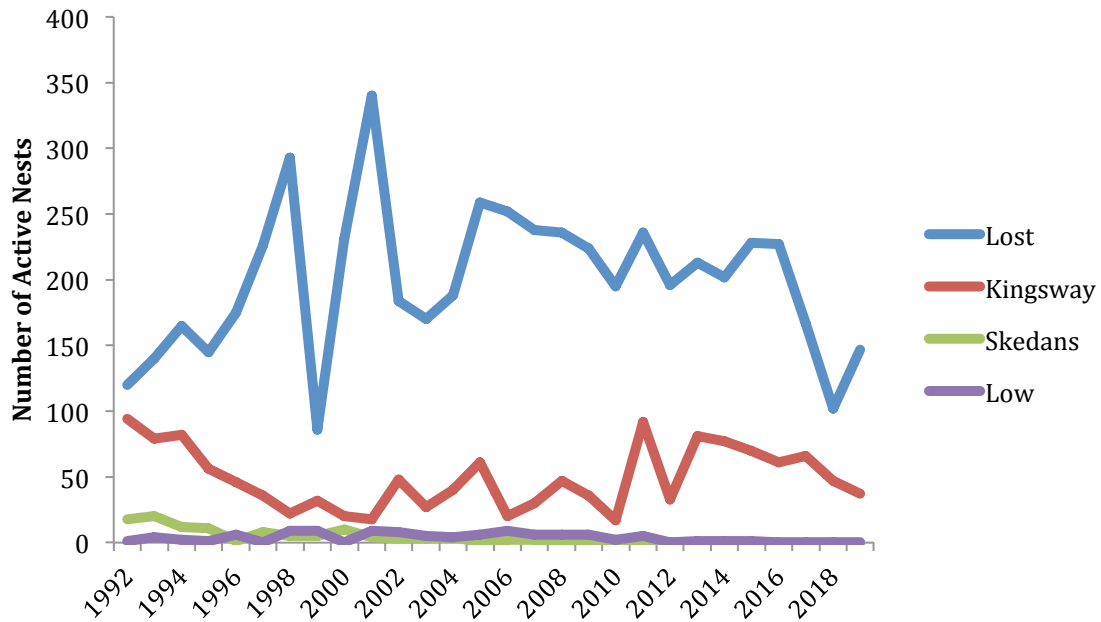


Figure 5. Glaucous-winged Gull nests containing eggs or chicks at four colonies in Laskeek Bay, 1992-2019

Pigeon Guillemots *Cepphus columba*

There are 30 Pigeon Guillemot (PIGU) nest boxes at Lookout Point on the east side of East Limestone Island. Ten boxes were initially installed in 2001 with another 18 boxes being added in 2010. This field season 10 new boxes were brought into the area. These boxes replaced others, which were in need of replacement, as well as increasing our nest box number to 30.

After the temporary suspension of our PIGU nest box program, due to an Otter causing problems, the 2019 season saw the program come back in full swing. This season 16 (53%) of our nestboxes were active (eggs or chicks), the boxes contained a total of 18 chicks and 12 eggs. Fifteen of the chicks were banded with a metal band on their right leg. Four of our new boxes were active, a surprisingly high number, given that new nestboxes are typically inactive in their first season.

Geolocator Project

In 2019 LBCS collaborated with the Canadian Wildlife Service (CWS) on research into the annual movement of Pigeon Guillemots. The CWS contracted us to attach 15

geolocators to adult PIGU as well as to retrieve them in the 2020 field season. These birds were also banded.

The nest boxes, on Lookout Point, provide the PIGU with a reliable nest site that can be used, often by the same birds, year after year. This gives the LBCS staff the opportunity to recapture birds, which have had a geolocator attached in 2019, in 2020 and remove the geolocators.

Geolocators (also known as GLS tags or geologgers) are miniature archival light level loggers for tracking birds. They record ambient daylight over very long periods. From this information, the location of the animal each day can be determined.

To retrieve the data, birds must be recaptured, the tags removed and the data archive downloaded. The accuracy of light level geolocation is appreciably less than provided by GPS tags and is usually assumed to have an error of about 150 km. However, it can be enough to provide useful timing and movement data, allowing the identification of important wintering and stopover areas. Currently, we have no data on where Pigeon Guillemots breeding in Haida Gwaii spend the winter, so we are keenly looking forward to recapturing our birds next year.

PIGU foraging project

In 2016 we began opportunistically photographing Pigeon Guillemots with fish in their bills. The guillemots tend to sit on the water before they enter their nest sites to feed their chicks, which gives us a great opportunity to photograph the fish they are carrying to their chicks (Figure 6). We continued this project this season and put more time and concerted effort into finding and photographing guillemots with fish. Over time, we will be able to catalogue the type and size of fish that PIGU in Laskeek Bay are foraging on, and may be able to track changes in the fish they are foraging on over time.



Figure 6. Pigeon Guillemots with prey items

Cassin's Auklets and Fork-tailed Storm Petrels

Ptychoramphus aleuticus and *Oceanodroma furcata*

Small populations of Cassin's Auklets and storm petrels breed on Limestone Island. Like Ancient Murrelets, these species are burrow nesters and are only active in the colony at night. Breeding activity on the island has fluctuated over the years, which is partly attributed to predation by introduced raccoons. In previous seasons we monitored several locations on the island for breeding activity and noted increasing activity. In 2019, we completed a natural burrow census on Limestone Island and found 91 Cassin's Auklet burrows that appeared to be active. Most burrows were located on Cassin's Tower, Lookout Point, and in the area of the East Coast nestbox plots, although there were lower densities of burrows interspersed between these locations. This is a decrease (10%) from the census completed in 2015 (101).

Cassin's Auklet nestboxes were checked for occupancy again this year at both Lookout Point and at the East Coast plots, although in 2019 Knockdown sticks were not placed at the entrances of all nest boxes early in the season, as in previous years. It was decided at the strategic planning meeting in late 2018 that, due to the lack of success in the boxes, this project would be scaled back. A total of 41 nest boxes were monitored at the East Coast plots (North and South), and 24 at Lookout Point. In late May, nestboxes were checked for chicks: 4 boxes had signs of activity: 3 with Cassin's Auklets (either incubating adults or chicks) and one with a broken abandoned auklet egg. Two auklet chicks successfully fledged this season, and both chicks were banded before they fledged. The other chick disappeared before it would have fledged; this chick was, most likely, predated.

The amount of Fork-tailed storm-petrel activity this season has yet to be determined. In 2019, the ANMU point counts were not manually conducted. These were replaced with the ARU that recorded the ANMU colony acoustics. These recordings will be analyzed and the level of Fork-tailed storm-petrel activity will be determined and published in a future report.

Sea Surveys

Boat surveys are conducted throughout the season to monitor the distribution and abundance of marine birds and mammals encountered along pre-determined 100m wide strip-transects in Laskeek Bay. The objective of these surveys is to develop a strong baseline data-set for marine wildlife in the Laskeek Bay area as well as to specifically monitor the abundance and distribution of Marbled Murrelets (*Brachyramphus marmoratus*), a forest canopy nesting seabird that is provincially red listed and designated as threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). These surveys have been conducted since 1991 and represent a very important Marbled Murrelet dataset within the province.

Near-shore surveys

Near-shore surveys cover the inshore waters as far north as Cumsheewa Island and south to Haswell Island. Five near-shore surveys were completed this year: 6 May, 16 May, 28 May, 8 June, and 24 June. On these surveys, we counted 20 species: Ancient Murrelet, Black Oystercatcher, Cassin's Auklet, Common Loon, Common Murre, Glaucous-winged Gull, Green-winged Teal, Harlequin Duck, Long-tailed Duck, Marbled Murrelet, Northern Shoveler, Pacific Loon, Pelagic Cormorant, Pigeon Guillemot, Rhinoceros Auklet, Red-breasted Merganser, Red-necked Grebe, Surf Scoter, White-winged Scoter, and Yellow-billed Loon.

The highest Marbled Murrelet count was during the 8 June survey, when we recorded 274. During the other surveys we counted a total of 407 Marbled Murrelets; 120 on 6 May, 111 on 16 May, 131 on 28 May and 45 on 24 June. These numbers are higher than those recorded in four 2018 surveys: 80, 23, 0 and 38.

Hecate Strait surveys

This survey takes us due east from Reef Island into Hecate Strait, and then back towards the Skedans Islands. It allows us to record species that tend to stay farther from shore. In 2017 we modified the survey to reduce the distance we were travelling from shore: this season we travelled 6 km east of Reef Island, and 8.5 km east of the most eastern Skedans Island point. This year two Hecate Strait surveys were completed, on 7 and 20 May. On these surveys we counted 12 species: Ancient Murrelet, Black-legged Kittiwake, Cassin's Auklet, Common Loon, Common Murre, Glaucous-winged Gull, Pacific Loon, Pelagic Cormorant, Pigeon Guillemot, Rhinoceros Auklet, Red-necked Phalarope, and Sooty Shearwater.

Marine Mammals

We kept a daily record of all marine mammal sightings, with the exception of Harbour Seals (*Phoca vitulina*) and Steller's Sea Lions (*Eumetopias jubatus*). Harbour Seals and Steller's Sea Lions are counted at specific haul-outs during sea surveys in order to keep an index of population trends.

Along with recording incidental sightings, we do standardized surveys of marine mammals during sea watches from Lookout Point, during at-sea surveys, and by doing a 5-minute scan and count of marine mammals from Cabin Cove each evening approximately two hours before sunset. The evening 5-minute count was initiated in 2014, and ends on 20 June, when the ANMU gathering ground count ends. The results of this season's total sightings are summarized in Table 4.

In 2018, an attempt to standardize sea watch times was made; we scheduled sea watches 3 times per week, from 07:00-08:00. These three hours per week were coupled with another one or two one-hour sea watch sessions that were completed opportunistically. This allowed us to complete four to five hours of sea watches each week.

Table 4. Total counts of marine mammals from sea surveys, sea watches, and incidental sightings, 2006-2019[†]. Data since 2014 includes sightings during the 5-minute evening count. Numbers do not necessarily reflect number of individuals, as individuals may be recorded more than once.

Common name	Scientific name	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Northern elephant seal	<i>Mirounga angustirostris</i>	0	0	0	2	0	0	0	0	0	0	0	0	0	0
California sea Lion	<i>Zalophus californianus</i>	1	0	0	0	0	4	0	0	1	1	0	0	4	0
Humpback whale	<i>Megaptera novaeangliae</i>	122	36	22	112	13	347	12	14	193	86	102	261	203	91
Fin whale	<i>Balaenoptera physalis</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey whale	<i>Eschrichtius robustus</i>	5	1	2	3	0	0	1	1	1	0	0	0	0	1
Minke whale	<i>Balaenoptera acutorostrata</i>	2	2	2	9	4	3	6	2	1	0	0	1	3	1
Killer whale	<i>Orcinus orca</i>	36	36	45-60	47	50	26	16	13	49	11	14	18	26	4
Harbour porpoise	<i>Phocoena phocoena</i>	16	27	14-15	7	13	31	7	4	19	0	10	0	1	4
Dall's porpoise	<i>Phocoenoides dalli</i>	0	0	0	0	0	0	0	0	8	0	0	0	0	0
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	0	13	0	30	0	0	0	0	0	46	334	0	81	365

[†]Harbour seal *Phoca vitulina* and Steller's sea lion *Eumetopias jubatus* sightings are not reported here.

Humpback Whales

There were many more Humpback whale sightings this year in Laskeek Bay, than in 2018. The majority of the Humpbacks were seen earlier in the season; of the total 122 seen this season, 119 were seen in May. The sea watch with the highest count of Humpback whales was on 5 May, with 18 Humpbacks spotted during the 1-hour morning watch.

Orca

There were eight sightings of Killer Whales in Laskeek Bay this season. We were able to take ID photographs during four of these encounters. Our ID photographs are sent to the Killer Whale database at the Pacific Biological Station in Nanaimo.

Steller's Sea Lions

There are several sea lion haul-outs in Laskeek Bay. The largest of these is on the east end of Reef Island. There are also smaller haul-outs on the Skedans Islands, Cumshewa Rocks, and Helmet Island. We regularly count the number of individuals on the Reef and Skedans haul-outs. The maximum number counted this season was 297 individuals at Reef (12 June) and 115 at Skedans (5 May). One California Sea Lion was identified (by sight and sound) at the Skedans haul-out on 5 May.

Other species

Other less-common marine mammal species that were sighted this season: Minke Whales (2 individuals in 2 sightings), Harbour Porpoises (16 individuals in 10 sightings), and Grey Whales (5 individuals in 5 sightings).

Wildlife Trees

LBCS has been monitoring cavity-nesting birds on Limestone Island since 1990. Wildlife trees (dead standing snags used by cavity nesting birds) were monitored opportunistically from 1990-1994, and since 1995 there has been a systematic effort each year to cover the island thoroughly, looking for active trees. Through this monitoring program, LBCS has amassed a long-term data set on tree use across many years, showing the importance of these trees as habitat for cavity nesting species. A total of 178 wildlife trees have been identified over the past 30 field seasons.

This year we found a total of 13 active trees, containing 14 nests of 4 different species. Five new trees were identified. Ten nests were occupied by Red-breasted Sapsuckers (RBSA), two by Chestnut-backed Chickadees (CBCH), one by Hairy Woodpeckers (HAWO), and one by Northern Flickers (NOFL; Table 5). A Chestnut-backed Chickadee pair and a Red-breasted Sapsucker pair were found nesting in separate cavities in the same tree (Tree #150). Wildlife tree #98 is the oldest active tree currently (first active in 2004), which has been used intermittently by Red-breasted Sapsuckers and Hairy Woodpeckers. The number of Red-breasted sapsucker nests (10) is high, but less than in some previous years when up to 22 active RBSA trees were found.

Table 5. Wildlife tree activity on East Limestone Island in 2019. Minimum fledge date is the last day activity was observed at the nest, maximum fledge date is the first day that no activity was observed in a half-hour continuous watch of the nest.

Tree #	Cavity Nester ¹	Tree Species ²	Fledge Date (earliest)	Fledge date (latest)
98	RBSA	Ss	13-June	15-June
118	RBSA	Ss	12-June	13-June
145	CBCH	Ss	13-June	15-June
149	RBSA	Ss	15-June	17-June
150	RBSA	Hw	9-June	11-June
150	CBCH	Hw	13-June	15-June
151	RBSA	Ss	13-June	15-June
153	RBSA	Ss	13-June	15-June
170	RBSA	Ss	1-June	3-June
174	HAWO	Ss	25-May	27-May
175	RBSA	Hw	13-June	15-June
176	NOFL	Ss	21-May	23-May
177	RBSA	Hw	9-June	11-June
178	RBSA	Ss	11-June	13-June

¹RBSA = Red-breasted Sapsucker, NOFL = Northern Flicker, HAWO = Hairy Woodpecker, CBCH = Chestnut-backed Chickadee.

²Ss = Sitka spruce, Hw = Western hemlock.

Sapwell Monitoring

In 2019, we started to make observations at Red-breasted Sapsucker sapwells. Sapwells were found opportunistically while the staff and volunteers travelled around the island during other projects, mainly the wildlife tree monitoring program. While monitoring wildlife trees, we noted where the sapsuckers went after leaving the nest. When we searched the area to which the birds departed we often found a sapwell tree, which was marked, and mapped.

Twenty-one active sapwell trees were located, marked and watched for one or more one-hour periods. The majority of the monitoring took place in May, though periods of monitoring took place in June and July. Most active sapwell trees that were monitored were Western Hemlock (95%), the only other tree species being used was Red Alder (5%). Average DBH (diameter at breast height) was 48 cm (max 120 cm, min 17 cm) and the average height was 22.1 m (max 45.8 m, min 7.4 m).

A total of 98 person hours were spent monitoring sapwell trees. During these sessions, 39 squirrels were seen at the sapwells, 13 of which interacted with sapsuckers, with the sapsucker driving off the squirrel 11 times and the squirrel driving off the sapsucker twice. Rufous Hummingbird was the only other bird seen using sapwells, being seen 41 times during the monitoring sessions.

Raptors and Corvids

Every season, as with cavity-nesting birds, we make a concerted effort to keep track of other nesting birds on Limestone Island, including Bald Eagles, Peregrine Falcons, Common Ravens and Northwestern Crows.

This year we had 2 active Bald Eagle (BAEA) nests on East Limestone Island; in the NW section of the island (BAEA-10) there was one chick and at Cassin's Tower (BAEA-5) there were two chicks. The chicks in BAEA-5 and BAEA-10 were seen and heard throughout the season and were looking very developed at the time of our departure from ELI. The chicks did not fledge before our departure.

Peregrine Falcons have nested on Limestone Island discontinuously since research began in 1990. The nest has always been on the south cliffs, although the position has shifted somewhat between years. During the first nine years (1990-1998), an active nest was observed in all years except 1992. During the next eight years (1998-2006) there was no nesting activity observed. For the next seven years (2007-2013) there was an active nest every year, generally with 2-3 young observed. In 2014 and 2015, eggs were observed in the nest, but no young and in 2016, 2017 and 2018 chicks were observed in the nest and fledglings were later seen. In 2019, 2 or 3 chicks were observed in the nest, on 31 May. On 14 June, no chicks could be seen, though one of the parents showed alarm. On 21 June, no chicks could be seen and no adults were present. This could indicate that the chicks had fledged, but no young birds were seen flying around the island as has been seen in previous years. This may indicate that the chicks did not survive, but no confirmation could be obtained.

As in past years, one pair of Common Ravens (CORA) nested on the island. The nest was at site (CORA-3) that has been used since 2013, with the exception of 2018 (CORA-4). One chick was observed in the nest on 11 May, and three were observed near the nest, fledged, on 19 May. Soon after 3 juveniles and 2 adults were observed in Boat cove, and for the rest of the season we regularly observed them around the island.

Daily Bird Checklist

Throughout the field season, we keep a daily record of all bird species seen or heard within Laskeek Bay. We recorded a total of 71 species over 76 days. Many species were recorded almost every day, for example: Common Raven, Black Oystercatcher, Bald Eagle, Pigeon Guillemot, Red-breasted Sapsucker, Pacific-slope Flycatcher, Golden-crowned Kinglet, Hermit Thrush, and Pacific Wren. Many less frequently observed species were recorded this year as well, such as the Tufted Puffin, Yellow-billed Loon, Red-necked Phalarope, Black-legged Kittiwake, Spotted Sandpiper, Northern Fulmar, Semi-palmated Plover, and large groups of Sooty Shearwaters.

Blowdown

Since 2011, when winter winds blew down a significant portion of the forest on East Limestone Island, we have been monitoring the regeneration of the forest in these blowdown areas by taking photos from the same locations each year (Figure 7). We have established 6 photopoints, mostly in the north and central part of the island, but including one directly behind the camp in Cabin Cove.

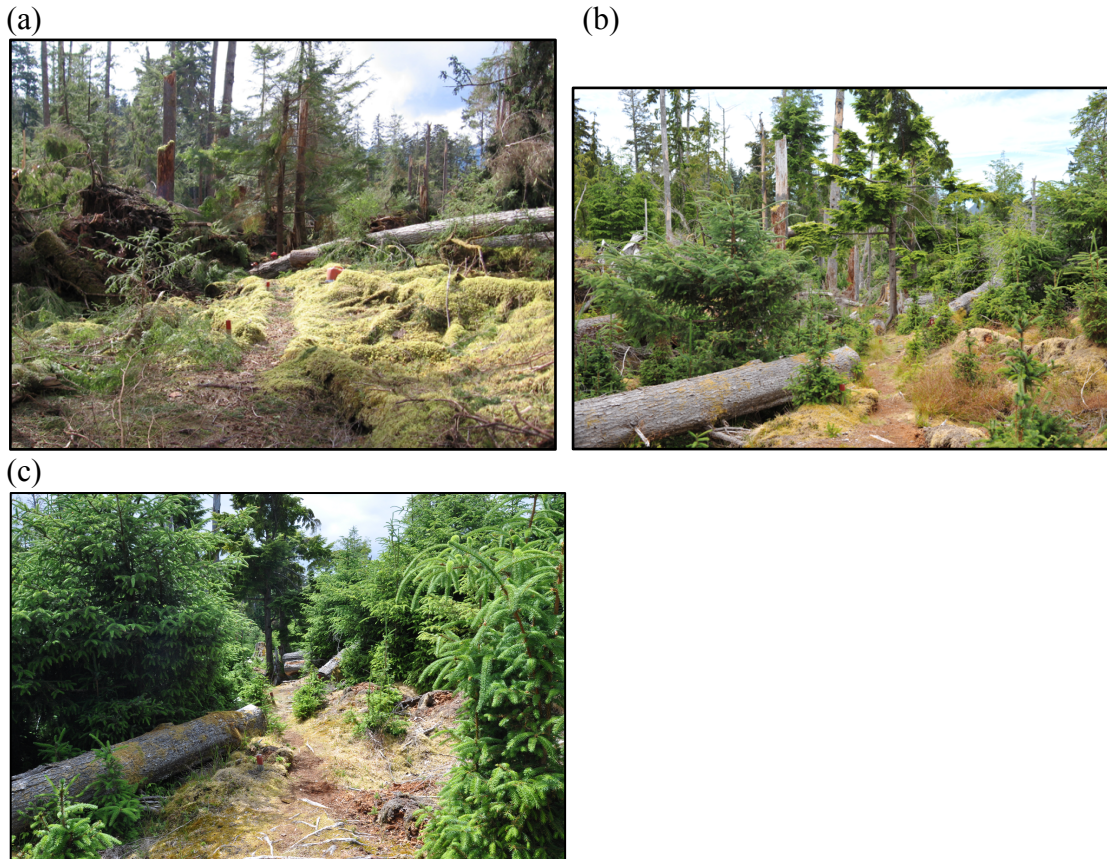


Figure 7. Photos taken looking west along the main trail, in 2011 (a), the first field season after the blowdown events, (b) five years later in 2016 and (c) this year, 2019.

Rare Plants

There are relatively few wildflowers and berry bushes left on Limestone Island as a result of heavy browsing by introduced deer. Most flowering plants are now found restricted to cliff areas where the deer cannot reach them or the top of uprooted tree stumps, above the deer's grazing height. Throughout the season we keep a record of the dates on which particular species are first observed in bloom. For example, this year we recorded sightings of blooming northern rice-root (*Fritillaria camschatcensis occidentalis*), salal

(*Gaultheria shallon*), monkey flower (*Mimulus guttatus*), and red columbine (*Aquilegia formosa*); these species tend to be common in areas with no deer, but are only seen on inaccessible cliff locations on Limestone Island.

A number of rare plants are present on Limestone Island due to the unique limestone geology that is uncommon on the rest of Haida Gwaii. These plants are showy Jacob's ladder (*Polemonium pulcherrimum*), Richardson's geranium (*Geranium richardsonii*), and cut-leafed anemone (*Anemone multifida*). Showy Jacob's ladder and cut-leafed anemone were found to be blooming in late May, on the cliffs in Boat Cove.

CONSERVATION

Restoration Project

In 2019, LBCS has begun a restoration project that will help East Limestone Island return to a state approaching a pre-deer era (based on what is seen on deer free islands). A central plank in this plan is to cull the deer population of East Limestone Island regularly, with the aim to substantially lower browsing pressure. Once deer culling has commenced, we should be able to document accurately the anticipated return of the native vegetation on East Limestone Island, creating an increase in biodiversity and a more resilient ecosystem.

The main aspects of the monitoring program were implemented in the 2019 field season prior to the first culling of the Deer population on East Limestone Island, which will occur in the autumn of 2019. The culling of the deer will become an annual event with the objective to maintain hunting pressure on the Deer, not complete eradication.

This plan will create an effective monitoring program for native vegetation, the browsing effects of Deer, and songbird richness and abundance, as well as monitor the distribution and density of invasive alien plants.

Vegetation Plots

East Limestone Island contains habitat suitable for many types of grasses, forbs, ferns, shrubs and trees. This vegetation has changed over time due to the presence of the invasive Sitka Black-tailed Deer. In order to capture change in the vegetation structure as the deer control operation takes place, we have begun to record every plant species present, as well as estimate abundance and cover in 11 vegetation plots around the island; vegetation plots are located strategically in different areas of the island: Sitka Spruce/Western Hemlock forest (2 plots), Shoreline (4 plots—N, S, E, W), Alder forest

East (1 plot), Alder forest South (1 plot), Cedar forest (1 plot) and blowdown (2 plots). The plots have a 10-meter radius (large plot) with a subplot (using the same center point as the large plot) of 3.6 m. The large plot will be used to measure species richness and the subplot used to estimate abundance and cover. The information will be recorded annually into the foreseeable future.

Course woody debris is an important part of the of coastal old growth forests and is a factor that is used to characterize them. CWD surveys were conducted in five of the 11 vegetation plots with the remaining 6 to be completed in 2020. CWD surveys were conducted using the standard methods of the B.C government with adjustments made to suit the size of our vegetation plots.

Songbird Point Counts

Many species of songbirds are found on East Limestone Island with different species occupying various habitats on the island. The introduced deer has negatively affected the abundance and distribution of flowering plants, limiting both foraging and nesting habitats for many songbirds. We are now recording the presence, location and abundance of various species of songbirds on the island, in order to monitor change in songbird distribution and abundance as a deer control operation takes place.

In the 2019 field season, three point counts were conducted in each vegetation plot. Each point count was administered over a two-day period between 06:00 and 08:30. The dates of the point counts were: May 16-17, May 30-31 and June 12-13.

Tree Growth

Sitka Black-tailed Deer have a marked effect on tree growth on East Limestone Island and it can take much longer for a tree on ELI to escape the browsing limit of the deer, compared to a place where deer are less abundant. In order to monitor and record the growth rate of trees that are within the browsing limit (<1.5m) of the deer, ten trees of three common tree species (Sitka Spruce, Western Hemlock, Western Red Cedar) on ELI, located in areas around the island that have full exposure to light, were selected. The total height of the tree and the longest lateral branch below 1.5 meters were measured.

Invasive Plant Monitoring

Invasive plants are plants that have been introduced to an area from elsewhere and have the ability to reproduce rapidly. They often quickly take over habitat that would otherwise be available to native plant species. Invasive plants that have become established on Limestone Island include Bull Thistle (*Cirsium vulgare*), Canada Thistle

(*Cirsium arvense*), Prickly Sow-thistle (*Sonchus asper*), Wall Lettuce (*Lactuca muralis*) and Marsh Cudweed (*Gnaphalium uliginosum*).

After a three-year removal project of invasive plants on ELI, it was found that the effort exerted did not provide the desired rewards. During the removal program, a number of plots were selected for invasive removal. During the 2019 season the monitoring of ten of these plots was conducted in order to track the change that would occur without further removal (with some exceptions: seed heads of *Cirsium* species were clipped and *Lactuca* was pulled). The ten plots that were selected were the ones that had the most consistent removal in the past three years, as well as containing the most troublesome invasive plants on ELI.

Introduced Mammals

Sitka Black-tailed Deer* *Odocoileus hemionus

Deer were intentionally introduced to Haida Gwaii in 1878 and in several years between 1911 and 1925 to provide game meat for local people (Gaston *et al.* 2008). Because they have no major predators on the islands, the deer population has reached very high density and has dramatically impacted plant communities, particularly in the forest understory. LBCS is a partner in the Research Group on Introduced Species (RGIS), which has carried out extensive research on this topic in Laskeek Bay as well as on the rest of Haida Gwaii.

RGIS has completed a four-year program, project BAMBI (Behavioral Adjustments to Mitigate Biodiversity loss), a study that looked at how the deer of Haida Gwaii have adapted to life in the absence of predators, and the role that fearless behaviour plays in helping deer maintain high densities on islands with severely browsed understories. This season infrared and motion-activated cameras were used to remotely track deer on Limestone and Reef Islands. On Limestone, 12 cameras were set up around the island between 18 February and 5 May. The cameras were moved to Reef Island on 13 May and retrieved on 6 July. The pictures were sent to RGIS for analysis.

Although project BAMBI is over, we continue to record deer sightings on Limestone Island for RGIS. The date/time, location, tag colour/number, and sex were recorded along with any behavioral notes. This year, the only deer sighted with ear tags was number 5. This deer is now nine years old; it was captured and tagged in July 2011 as a yearling buck.

On Limestone Island, there are now two deer exclosures, one that was built several years prior to the blow-down in 2010 and a new one that was built in March of 2015. The older exclosure, having survived the blowdown with only minor damage, contains vegetation that was established prior to the blowdown. This exclosure did not receive any further damage in the last winter and it is full of shrubs, saplings, and ferns, continuing to

highlight the contrast between browsed and unbrowsed areas. The understory vegetation (huckleberry, salal, ferns, and young trees) inside this enclosure is almost entirely absent from areas that deer can access. The new enclosure is close to the main trail, in the blowdown at the centre of the island. The difference in growth within this enclosure to the area adjacent is already quite apparent, with many huckleberry bushes, wildflowers, and healthy spruce, hemlock and cedar saplings growing within the enclosure. We are also noticing that a consequence of the blowdown is the creation of many small refugia for plants on top of upturned roots.

Raccoons Procyon lotor

Raccoons were introduced in the early 1940s to provide local trappers with a source of employment (Gaston *et al.* 2008). Raccoons (as well as rats) are one of the largest threats to ground and burrow nesting seabirds on Haida Gwaii. With few defenses against mammalian predators, birds such as Ancient Murrelets, Cassin's Auklets and Fork-tailed Storm Petrels are very vulnerable to raccoon predation and typically experience rapid declines where these predators become established in colonies.

Raccoon predation is an ongoing concern on Limestone Island and drops in Ancient Murrelet numbers have been closely correlated with raccoon presence. During 1990 and 1991 there was considerable raccoon presence on the island and very high rates of predation. Based on predation rates observed during earlier visits to the island, it is reasonable to assume high levels of predation for the period of 1983-1989 as well (see LBCS Science Report #3 for further discussion). Raccoons were removed from the colony in 1992 and predation rates dropped dramatically. Raccoons were again present in 1993, 1994 and were suspected in 1995 and 2001. More recently a raccoon was removed from the island in 2007, and raccoon presence was confirmed again in 2009. No raccoons have been confirmed present on Limestone since 2009.

Due to the large raccoon population on Louise Island it seems likely that raccoons will continue to disperse to Limestone in future years. It is therefore very important to continue undertaking spring surveys for raccoons to eliminate them from the colony before birds begin breeding in early April. By the time field camp opens in early May, a raccoon could have already had a considerable impact on the colony.

This year, cameras were set up and surveys took place early in the year. On 18 Feb, a crew set up four infrared cameras baited with cans of sardines. They were set up in Boat Cove, Cabin Cove, North Cove and Crow Valley. Anemone Cove and Boat Cove are likely spots where raccoons crossing to Limestone from Vertical Point could be intercepted, and Cabin Cove is within the known Ancient Murrelet colony. The cameras were in place continuously until the staff arrived to begin nighttime Ancient Murrelet work on 3 May. No raccoons were photographed during this time.

On 18 and 19 February, a crew conducted two nights of spotlight surveying of the shoreline of East Limestone, West Limestone and the adjacent shoreline of Louise Island. During this approximately three-hour survey, no raccoons were sighted on East or West Limestone. On Louise Island, 2 raccoons were sighted. On 20 March another raccoon survey was conducted, no raccoons were sighted.

Monitoring for raccoons continued throughout the field season, with one camera that was baited and checked regularly. Boat Cove was monitored continuously from 18 February until 6 July, and North Cove, Cabin cove and Crow Valley from 18 February to 3 May. Based on experiments with baited cameras in locations where raccoons are present, they are attracted to the baited cameras for an extended period of time. However, we did not record any photographs of raccoons at the wildlife cameras so we are almost certain they were not present on East Limestone this season.

Red Squirrels *Sciurus vulgaris*

Squirrels were introduced to Haida Gwaii in 1950 to aid in cone gathering for the forest industry (Gaston *et al.* 2008). Squirrels may have been introduced to Limestone directly at this time. Squirrels are now well established on Limestone and are known to be a nest predator on various songbird species (Martin and Joron, 2003).

Since 2007, we have been conducting squirrel surveys on Limestone to measure the annual abundance of squirrels. Over time we hope to describe population cycles of this introduced species and gain a better understanding of the consequences of squirrel presence. Fourteen squirrel surveys were completed this season.

Marine Debris Removal

In 2016, we began documenting, collecting, and removing marine debris from several beaches in Laskeek Bay. In 2019, two beaches were selected to become long-term monitoring sites. We conducted accumulation surveys, based on National Oceanic and Atmospheric Administration (NOAA) protocols, on the south beach on Reef Island and on the Crow Valley beach on East Limestone. The Crow valley beach has had debris removed annually since 2016, and we did notice a reduction in debris, although there were still a lot of plastic fragments, foam and polystyrene fragments, and plastic water bottles. Large debris items, mainly fishing buoys, were also found. This is the first year of removal on the South beach on Reef Island and large amounts of plastic and other debris was found; for example, 654 pieces of plastic (this includes water bottles, other jugs or containers and various other plastic products)

CONCLUSION

This season was our 30th year of research, monitoring, and environmental education in Laskeek Bay. Since 1990, LBCS has focused on developing baselines and long-term data sets for the marine and terrestrial ecosystems of Laskeek Bay, as well as providing volunteers, students and visitors the chance to visit our research camp. The society remains dedicated to long-term monitoring and engaging the public in addressing local conservation issues.

Between the years 2006-2009 we documented a very serious decline in Ancient Murrelet numbers on East Limestone Island. Since 2015 we have again experienced another major decline in chick numbers in the Cabin Cove area (from 110 chicks in 2014 to 34 chicks in 2019). What brought on this change is not clear: changes in sea surface temperatures which in turn modify food sources, loss of habitat or degradation of habitat in the remaining forest due to blowdown, and increased predation are all plausible explanations. Since raccoons are detrimental to Ancient Murrelet colonies, we will continue to monitor for and remove raccoons from the area as our main restoration initiative. In 2019, we decided to discontinue manual monitoring and move to complete automation of ANMU monitoring. This has allowed us to be less invasive with the ANMU, as well as giving us the ability to direct more person hours to other projects.

Invasive plants and animals are degrading the various habitats on ELI. These same problems are evident on many islands in the Haida Gwaii Archipelago. The restoration plan begun in 2019 will help to give us a better understanding of these effects and how controlling the deer population can effect change, as well as hopefully, a return to what the island would have been like in pre-deer era.

The lessons that we learn from our research on Limestone Island are of great importance. In every monitoring program LBCS conducts we are collecting quantifiable data that will allow us, and others, to conduct analysis that will produce information that can inform managers, researchers and the general public. We hope that continuing our core long-term monitoring programs will help to document and understand broader scale changes.

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