EAST LIMESTONE ISLAND FIELD STATION

FIELD SEASON REPORT 2018

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Laskeek Bay
CONSERVATION SOCIETY

SUMMARY

This was the Laskeek Bay Conservation Society's 29th field season on East Limestone Island, Laskeek Bay, Haida Gwaii. The season ran from 4 May to 20 July, bringing to the island 25 volunteers, 3 student-interns and 116 visitors, including 47 students and 13 teachers and chaperones that were part of Project Limestone. Ancient Murrelet chick departures began on 11 May. The departing chick numbers were low again this year. However, they were higher than in 2017. A combination of manual capture and remote camera recording was used to monitor the Cabin Cove funnels, while a remote camera was used to monitor Funnel 4 in North Cove. A total of 45 chicks were captured in Cabin Cove, two of which were recorded on camera after the standard monitoring time (02:30). One chick was recorded on camera in North Cove. No raccoons were detected on the island during shoreline surveys in February, April or on remote baited cameras used throughout the field season. Black Oystercatcher surveys were conducted in Laskeek Bay and Gwaii Haanas this year. In Laskeek Bay, 12 chicks were recorded in survey one, and 24 chicks in survey two. Glaucous-winged Gull surveys were conducted at 2 colonies in Laskeek Bay; 149 active nests were found, as well as 57 inactive nests. Ten Pigeon Guillemot nest boxes were fitted with smaller entrances and landing platforms in an attempt to prevent predation and increase nest box use. Out of the 10 modified nest boxes, 5 were found to be active. The Cassin's Auklet nest boxes this year showed little activity; one contained a dead egg and another a dead chick. Four near-shore sea surveys were completed this season, during which 141 Marbled Murrelets were sighted. Marine mammal sightings included 36 Humpback Whales, 1 Grey Whale, 2 Minke Whales, 36 Killer Whales, 27 Harbour Porpoises, and 13 Pacific White-sided Dolphins. Thirteen wildlife trees were recorded as active this season, as well as 4 raptor nests: 1 Common Raven nest, 2 Bald Eagle nests and 1 Peregrine Falcon nest. The Common Raven and Peregrine Falcon nests were both successful and the two Bald Eagle nests were still active with one chick in each nest when we departed East Limestone Island at the end of the field season. Invasive plant removal efforts were focused on East Limestone this season; invasive plots created in 2016 and 2017 were revisited and removal was again conducted. Marine debris was documented and removed from 3 beaches this season: Crow Valley Beach, Vertical Point Beach, and Louise 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 29 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 grade-school students to Limestone Island to learn about natural history and participate in Ancient Murrelet research. The students are led on an interpretive tour, which crosses the island and ends at Cabin cove. During this tour they learn about the natural history and geography of the area, and are introduced to the various projects that we run. Students are also provided with the opportunity to assist with the Ancient Murrelet monitoring work from 22:30 to 02:30. They learn about Ancient Murrelet life history as they help to capture, weigh, and release chicks. Along with participating in Ancient Murrelet night work, the students have time to observe and learn about the birds and introduced species on Limestone Island, scan Laskeek Bay for marine mammals, and sometimes help check Cassin's Auklet nest boxes for activity.

This year we had five school group visits to East Limestone Island, from four different schools. Approximately 47 students and 13 teachers and chaperones participated. Four

of the school groups spent one night in the research camp to participate in the Ancient Murrelet chick monitoring and returned to their camp on Louise Island the next morning. The first group visited on 8 May and was from Northwest Community College (Prince Rupert). Two groups from GidGalang Kuuyas Naay Secondary School (Queen Charlotte) visited on 22 May and 26 May and a group from Agnes L. Mathers Elementary School (Sandspit) visited on 28 May. One group from Gudangaay Tlaats'gaa Naay Secondary School (Masset) visited during the day on 9 June, and participated in raptor nest and wildlife tree monitoring. Project Limestone began in 1991, and to date 830 students have visited the island as part of this program, some multiple times.

Volunteers

Volunteers play an important role in the operation of the field camp on Limestone Island. They generally stay for one week, and assist staff with research and monitoring projects, camp maintenance, and daily chores. Volunteer contributions of time and energy are essential to keep the field camp going and to continue long-term data collection. 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 21 volunteers (not including student interns) who contributed 126 volunteer days to projects on Limestone, other areas in Laskeek Bay, and Gwaii Haanas. All the volunteers stayed for one week. Five volunteers had volunteered or visited the island previously, three of which were LBCS directors. Eighteen volunteers were from British Columbia, one from Alberta, and two were from the Yukon. Eight volunteers were Haida Gwaii Residents.

Boat Drivers

This year three boat drivers worked consecutively throughout the season. These boat drivers worked mainly for Sonya Pastran, a master's student working out of the Laskeek Bay research station (see research partnerships – p. 8), but also contributed an estimated 10 volunteer days to the Laskeek Bay Conservation Society over the field season.

Visitors

The LBCS visitor program provides an opportunity for tour groups to visit Limestone Island and participate in an interpretive tour of the island with a staff member. While visitors walk across the island, they are introduced to the natural history of the area and to the monitoring and research projects that we conduct. We aim to bring about greater understanding of the natural world and increased awareness of local conservation issues through the visitor program.

Generally, visitor groups who stop on Limestone Island are taking part in ecotourism excursions into Gwaii Haanas. We provided tours for six of the groups who visited us on Limestone Island: Moresby Explorers on 24 May, Bluewater on 25 May, two Botany BC groups on 20 and 26 June, and the Passing Cloud on 18 July (accompanied by past LBCS biologist Vivian Pattison). We also had a visit from two kayakers on one occasion, as well as the Kuuna watchmen and the RGIS crew on two other separate occasions. In total there were 74 visitors, 134 including Project Limestone.

Staff

LBCS staff this year were Neil Pilgrim, Lead Biologist/Camp Supervisor; Sonja Panozzo, Assistant Biologist/Interpreter; and Jamie Mcdonald, 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: Sara Yeomans, Christarin Dilkumar, and Emma Duggan. Sara, a student from the British Columbia Institute of Technology (BCIT), contributed five weeks, from 4 May – 8 June. Christarin, a student from the University of Guelph, contributed four weeks, from 1-29 June. Emma Duggan, a student from Simon Fraser University, contributed four weeks from 29 June to 27 July. In total the student interns contributed 91 days.

RESEARCH AND MONITORING PROGRAMS

Research Partnerships & Special Projects

Research Group on Introduced Species

LBCS assists with other research and monitoring projects in Laskeek Bay and the surrounding area. LBCS has been working with the Research Group on Introduced Species (RGIS) for many years to support their research on introduced species, such as the impacts of deer on native flora and fauna, and deer behaviour in the absence of predators. RGIS was again active in Laskeek Bay this year, based in the Reef Island camp from 30 June to 22 July. Those involved were Jean-Louis Martin, of the Centre National de la Recherche Scientifique (CNRS; France), Simon Chollet, of the University of Rennes (France), Morgane Maillard, a Ph.D. student from the University of British Columbia and Juliane Schoerghuber. The group worked on projects related to decomposition and deer impacts on soil ecology.

LBCS received suggestions and advice this year from RGIS on plans for vegetation monitoring in the blowdown area on East Limestone Island. They also offered to share any data they have of vegetation plots in the area.

Master's student

This season was the first 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 various annual and inter annual local abundance and distribution, as well as to define hot- and cold spots of common seabird species; (2) use static and dynamic variables from existing online environmental data to examine their relationships to sea usage; and (3) analyze fine-scale distributional relationships using additional marine and various seabird data collected in 2018 and 2019 along the at-sea survey transects.

During the 2018 field season she ran transects laid out by Laskeek Bay Conservation Society to record bird sightings on the water, replicating the methods the society has followed since 1997. While running the sea-surveys she collected additional fine-scale data along these transect lines; she measured salinity and temperature every 1 km at 5, 10 and 15-meter depths. In addition to this, she used sonar to record general prey abundance and availability, as well as to collect fine scale depth readings. A second component she completed during this field season involved the experimental tests she ran to examine the effects of potential avian predators on the Marbled Murrelet. By posting 10 eagle and peregrine falcon kites (decoys that emulate the birds in flight) on 10 km of shoreline along Louise Island, she assessed whether the habitat usage was altered by the presence or absence of these avian predators.

Ancient Murrelets (*Synthliboramphus antiquus)*

Manual Chick Capture

The manual monitoring of chick-capture funnels 5 to 8 in Cabin Cove began on the night of 7 May, while monitoring with Reconyx wildlife cameras began on the night of 9 May. Funnels were closed on manual monitoring nights from 22:30-02:30 from 7 May to 19 May, and from 23:00-02:30 from 20 May onwards to compensate for increasing daylight hours. Funnels were checked at regular 20-minute intervals, and the date, time, location (funnel number) and mass for each departing chick were recorded. Funnel protocol is kept constant across years so that the number of chicks departing gives a consistent index of the overall breeding population in the same geographic area of the colony. Prior to 2016, capture work has always ended after two consecutive nights with no chick captures in any of the funnels. In 2018 the last night of manual capture work was 12 June. This date was chosen as the final date of monitoring because there had been multiple nights with zero chicks photographed or captured prior to the 12 June. Reconyx wildlife cameras were used to continue monitoring until 17 June.

Although the funnel location has not changed, the forest in the Cabin Cove area has changed dramatically in the last few years due to a large blowdown event in 2010/2011. There was significant blowdown in the area within funnels 5 and 7, while funnels 6 and 8 were much less affected. Due to instability in the remaining forest behind the cabins, trees continue to fall down most winters; in 2016 the North arm of funnel 5 became slightly shorter due to the location of fallen trees. In 2018 we did not have any major new blowdown behind the cabins.

This season the first chick to arrive in the Cabin Cove funnels was captured manually in funnel 6. Over the past 26 years of monitoring, the night of first arrival has not varied much from its 11 May average. This year the first night of arrival was once again May 11th. The last chick seen on camera was on 7 June, in funnel 6. The last chick to be captured manually and weighed was on 12 June in funnel 6 (this chick was caught above the camera, therefore it was not captured in a picture), before the funnels were taken down on 17 June. This season, the night with the highest number of chicks captured in one night was 6 chicks on 17 May. A total sample of 26 chicks were manually captured and weighed in funnels 5 to 8, plus 4 that were captured outside of the funnels. Three chicks were manually captured in funnel 5, 11 in funnel 6, 10 in funnel 7, and 2 in funnel 8.

Camera Monitoring

The 2018 season is the second year we have used remote camera monitoring as one of the primary methods of monitoring for Ancient Murrelet chicks departing from Limestone Island. We began using Reconyx PC900 infrared cameras in 2013 for monitoring in North Cove, where manual monitoring was no longer possible after heavy blowdown. We initiated camera use at several of the Cabin Cove funnels in 2014, along with manual capture, so we could test the effectiveness of using cameras to count the number of chicks departing the colony. After the 2016 season, we decided that cameras were an effective method of counting chicks, although we wanted to continue manual capture for several reasons: to continue to get a sample of chick weights, to make sure the cameras were working as expected, and to allow volunteers and visiting students the experience of monitoring in the Ancient Murrelet colony at night.

Although camera monitoring has limitations, this season we relied on the cameras for monitoring for more than half the nights of the chick departure season. Cameras were set up in Cabin Cove for 41 days, and we manually monitored for 20 days over that period. The benefit of combining camera monitoring with manual monitoring is that chicks departing after 02:30 (when the manual monitoring ends) can still be recorded. This year we captured two chicks on camera departing after 02:30.

In 2017, five Reconyx PC900 infrared cameras and five wooden chutes were set up at funnels 5, 6, 7, and 8, at Cabin Cove. Two cameras and chutes were set on funnel 6; one we labeled “A” and one at a new opening “B”, where a dip in the plastic tends to catch chicks. A and B totals were added together for all funnel 6 reporting. The cameras

were used in conjunction with manual trapping on 20 nights; the chicks pass by the cameras and we then catch and weight them in the funnels. By comparing the number of chicks recorded manually to the number photographed, we can then assess the accuracy of using only cameras for monitoring chick departure numbers at funnels, as we are doing presently in North Cove. Of the 21 chicks that passed by the cameras on manual monitoring nights this season, there were three chicks, in Funnel 7, which passed by the camera without being photographed.

North Cove funnels 1-4 were heavily impacted by the blowdown events of 2010/2011. Only funnel 4 and a small portion of funnel 3 remained intact. Starting in 2013 we monitored funnels 3 and 4 using Reconyx cameras. In 2014, we discontinued monitoring funnel 3 due to limited camera availability and because the funnel was very short. As done in 2017, in 2018 a camera was set up at the mouth of funnel on 6 May, and left in place until 17 June. A wooden chute, designed to direct the chicks towards the camera and slow them down, was again installed at the funnel mouth in front of the camera.

Chick Capture Trends

Trends in chick numbers are now calculated by combining numbers of chicks that are manually captured and numbers of chicks recorded by camera (Figure 1), because camera monitoring is now an integral part of our monitoring method. The Cabin cove total for 2018 was 39 chicks, which excludes those captured after 02:30 and outside the funnels, to be consistent with previous years. Four chicks were captured outside of the funnels, making the total chicks captured within the Cabin Cove funnels, before 02:30, 43. The total including two chicks that were captured after 02:30 is 45.

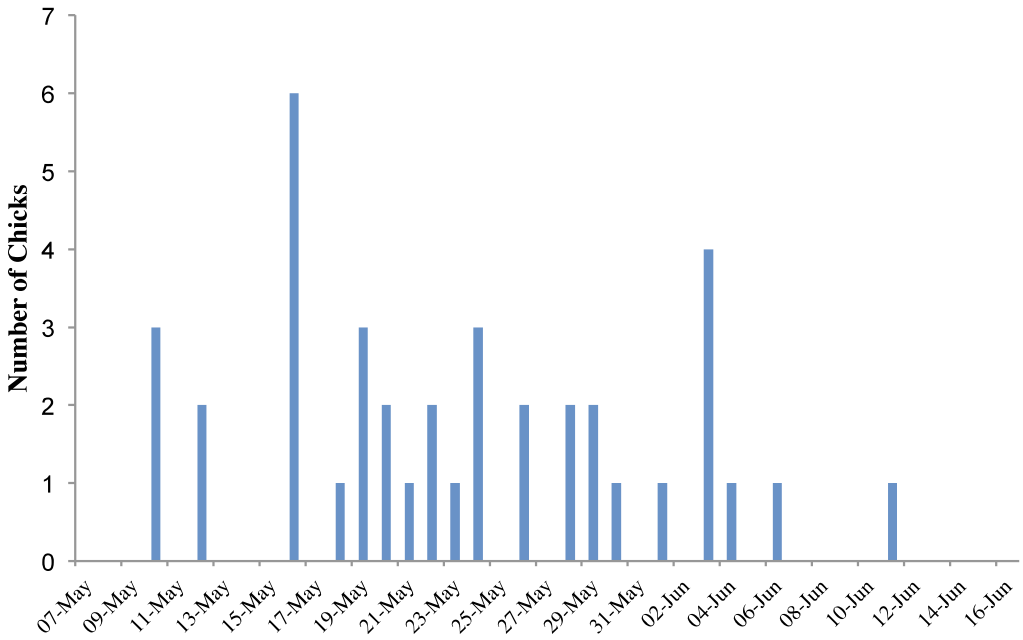

Figure 1. 2018 nightly chick captures, funnels 5-8. Chicks manually captured or photographed within the funnels before 02:30 are shown here. The date refers to when the monitoring night began, even if chicks were caught in the early morning of the next day.

In the early years of monitoring, it was determined that most chicks would leave the colony before 02:30. We are now noticing that with small numbers of chicks departing, and because we can now record later departures with the cameras, there is a proportion of chicks that leave the colony later than 02:30. This season two chicks departed after 02:30 on 29 May: one at 02:44 and the other at 04:23.

The number of chicks recorded this season in funnels 5-8 was higher than last year: 39 chicks this season compared to 28 during last season (Table 1). This is the first year that we have recorded an increase in chicks since 2013. The number of chicks departing, though higher this season, is still a low number when compared to historical numbers and remains of significant concern. In 2016 we noticed an apparent drop in adult Ancient Murrelet activity in the colony and a similar lack of adult birds was recorded in the colony this season. In 2015, observations and point counts indicated that there were still many adult birds in the colony, while in 2016, 2017 and 2018 general observations and point counts indicated much less activity in the colony most nights, and the gathering ground counts were also lower.

Table 1. Summary of chick departures, peak nights and totals for funnels 5 to 8 on East Limestone Island, 2006 to 2018. Chick numbers include only chicks captured or photographed within the funnels, and before 02:30 in the morning.

Year	*First night with chicks*	*Peak night*	*Peak count*	*Last night*	*Total nights*	*Total chicks*
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[1]	32	36
2017	16-May	20-May	5	10-June[1]	26	28
2018	11-May	17-May	6	17-June[1]	37	39

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

Funnels 5 and 6

As of this season, funnels 5 and 6 have been monitored continuously for 29 years, and are the primary means of assessing the long-term population trend in the Cabin Cove colony area (Figure 2, Table 2). Funnels 7 and 8 were installed in 2006 flanking funnels 5 and 6 to see if the colony area had shifted. This year more chicks were recorded in funnels 5 and 6 (24 chicks) than funnels 7 and 8 (13 chicks), which is consistent with past trends, suggesting that the densest part of the colony is still being captured by funnels 5 and 6. As in 2016 and 2017, funnel 6 had a much higher number of chicks (19 chicks) than funnel 5 (5 chicks). The total chick number is slightly higher than 2017 and 2016, but still lower than 2015 and significantly lower than all prior years. This year the first chicks arrived in funnels 5 and 6 on 11 May (funnel 6), and peak night (6 chicks) occurred on 17 May.

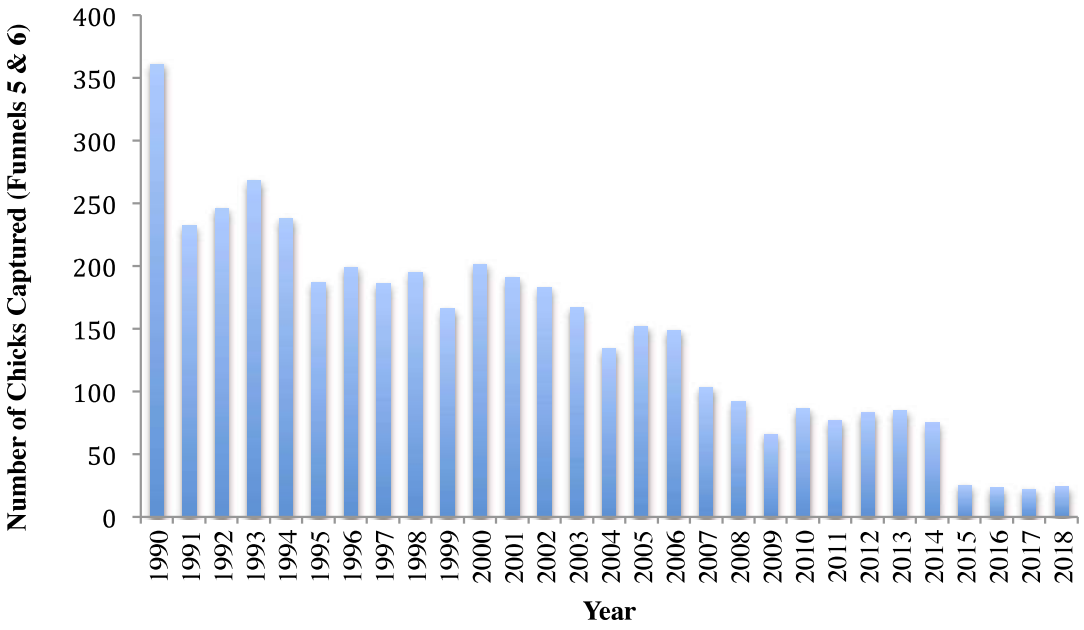

Figure 2. Total Ancient Murrelet chick captures at funnels 5 and 6, 1990-2018. These totals include only chicks captured within the funnels and before 02:30 in the morning.

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
Average ± SD	11-May ± 2.4 days	21-May ± 3.7 days	17 ± 9.0 chicks	6-Jun ± 6.1 days	27 ± 6.0 days	145 ± 83.5 chicks

[1]The final night of monitoring in 2016, 2017, and 2018 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

In funnel 4 in North Cove only one chick was recorded this season, on 24 May. This is a lower number compared to the previous four years (7 to 13 chicks). This year shows a significant decrease from 2013 (41 chicks), the first year that a camera was used for the full Ancient Murrelet departure period at funnel 4.

Other ANMU monitoring

Point counts

We conduct point counts 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 all manual monitoring nights for the period of 8 May to 12 June. Point counts were completed on 20 nights in 2018. The maximum number of birds counted was 10, producing 31 calls, on 17 May. The mean number of birds counted this year (±SD) was 3.85 ± 3.08, and the mean number of calls was 17.35 ± 15.55. The mean number of birds and calls this year was lower than any of the past four years, with the closest year being 2017 (5.1± 5.1 birds, 18.1 ± 26.3 calls)

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 6 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 25 May, with a total of 51 Ancient Murrelets observed, which is a low maximum count. The maximum this year was higher than the maximum in 2017 (22 birds), but lower than the maximum in 2016 (70 birds). The average gathering ground count in 2018 was 4.2 ±10.0 Ancient Murrelets, lower than last year (4.6 ± 5.1), and less than 1/3 of the average counts of the 3 years prior (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 44 evenings this season, they could not be completed on two nights (7 and 9 May).

Band Recoveries & Recaptures

Recapture of adult Ancient Murrelets on Limestone Island ended in 2003. However, we still opportunistically inspect adult birds for bands if we have to handle them (for example, removing a bird that is trapped in a funnel). No adult birds were inspected for bands this year.

Predation transects

In previous years we checked for predation remains along five fixed, 20m wide transects. These transects were heavily impacted by blowdown and have not been monitored since 2011. See the 'Raccoons' section below for a description of the use of cameras to detect the presence of raccoons.

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) and 2017 (13% decline from 2015) is concerning. In 2018, chick numbers increased slightly from recent years (4% decline from 2015), but this is still a low number. In 2015, we 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 three 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.

The number of chicks exiting the colony in the North Cove funnel 4 area has declined dramatically since it was last manually monitored in 2010, suggesting breeding birds are moving elsewhere, possibly due to the extreme blowdown that took place in North Cove. In 2013, the second year after the blowdown, chick numbers based on wildlife camera monitoring, had only declined by ~20% since 2010, but now the number is approximately 70% lower than 2010.

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 in Laskeek Bay and Gwaii Haanas this year, and the results from Laskeek Bay are summarized below. The results from Gwaii Haanas are detailed in the Gwaii Haanas Black Oystercather Survey report. We have been conducting extensive surveys in Gwaii Haanas for many years; in 2016 we switched to a cycle of conducting surveys in Gwaii Haanas every other year. Methodology for shoreline surveys and territory visits are detailed in the Gwaii Haanas Black Oystercather 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.

Site occupancy and reproductive success

Oystercatcher territories were visited in Laskeek Bay in the first half of June (9 – 16 June) and again in late June and early July (30 June – 2 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 on foot. 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. During the first and second surveys, all islands were surveyed. We weigh and measure eggs and chicks at territories where they are present on all islands except for the Lost Islands, because they are within the Gwaii Haanas boundary.

Of the 49 territories visited on foot, 39 were occupied by a territorial adult pair. Of these, 30 were active (warm eggs or live chicks present) during the first survey, and 34 were active during the second survey. During survey 1 we found 24 territories with eggs (57 eggs total, although there was 1 territory where the adult bird would not get off the nest, suggesting there was at least one egg, but we are uncertain exactly how many). There were 9 territories with chicks during survey 1. During survey 2, we found 12 territories with eggs (21 eggs total) and 16 territories with chicks, with a total of 24 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 1 new territory in Laskeek Bay, and had 23 non-territorial sightings of oystercatchers that totaled to 55 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 2018, no banding of birds took place.

All oystercatchers observed during the season were checked for bands, as this can give us information on their age and dispersal. In Laskeek Bay, 13 banded birds were re-sighted during the two surveys conducted (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. Only two birds with colour or alphanumeric bands

were re-sighted in Laskeek Bay this year. One bird, observed at territory REE-5, had a white colour band; it was banded either in 1994 or 2009. However, most likely this bird was banded in 2009, since being banded in 1994 would make it 24 years old. The other banded bird, with a (A-N) band reading TO-G/M, was banded as a chick in 2017 at territory REE-10, and was re-sighted as a non-territorial bird in Breaker Bay.

Table 3. Banded Black Oystercatchers re-sighted in Laskeek Bay in 2018.

Band Combination (Left – Right)[1]	Location seen / Nest site	Year Banded	Banded as Adult or Chick
UB-UB/M	REE-4	2009	Chick
UB-W/M	REE-5	1994 or 2009	Unknown
UB-UB/M	REE-11	Unknown	Unknown
UB-UB/M	REE-1	Unknown	Unknown
UB-UB/M	KNG-4	Unknown	Unknown
TO-G/M	Breaker Bay, Louise Island	2017	Chick
UB-UB/M	ELI-4	Unknown	Unknown
UB-UB/M	SKE-12	Unknown	Unknown
UB-UB/M	SKE-17	Unknown	Unknown
UB-UB/M	SLW-8	Unknown	Unknown
M-UB/M	SKE-14	Unknown	Unknown
UB-UB/M	Skedans Islands	Unknown	Unknown
UB-UB/M	South Low Island	Unknown	Unknown

[1]Band 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.

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 2018, prey was collected from 21 unique territories in Laskeek Bay.

Limpets were the primary prey (68.7%), followed by mussels (15.7%), chitons (11.7%) and abalone (3.2%) (Figure 3). These four prey items made up 99.2% of the diet. These numbers are fairly consistent with what has been found in past years.

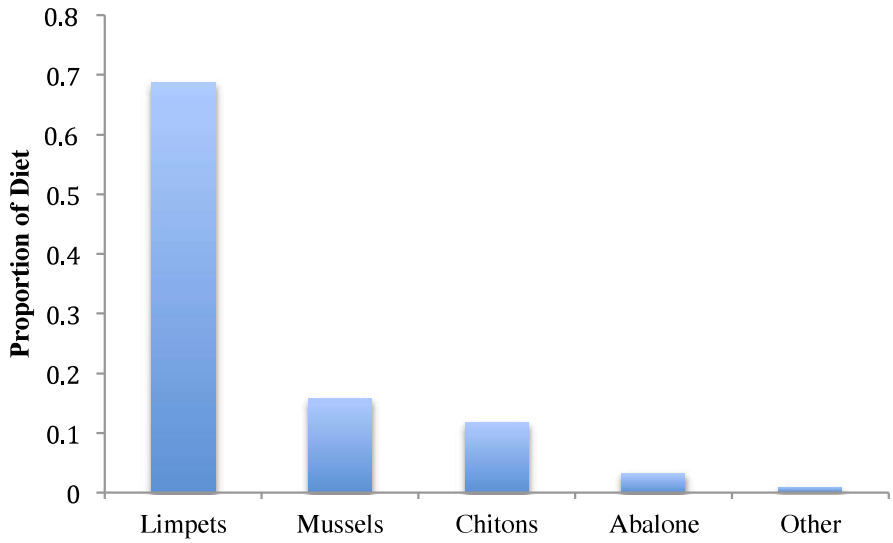

Figure 3. Black Oystercatcher chick diet from prey collections in Laskeek Bay, 2018.

Glaucous-winged Gulls (*Larus glaucescens)*

Since 1992, LBCS has been conducting a census of gull colonies within Laskeek Bay (Figure 4). This year, we visited the known colonies on Kingsway Rock, Low Island, Lost Islands and Cumshewa Island. No gulls were observed from the water at the Skedans Islands so the area was not searched on foot to look for nests. 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. Lost Island, the largest colony in the area, had a total of 102 active nests (20 June), followed by Kingsway Rock with 47 nests (17 June). Although several pairs of gulls were seen at Low Island, no active nests were found. In total, we counted 149 active nests on these three colonies. 100% of nests contained only eggs: 1 egg (22.1% of nests), 2 eggs (30.2%), or 3 eggs (47.7%). The total number of active nests counted this season (149), in these 3 colonies, was below the long-term average (±SD) of 254.7 ± 54.2.

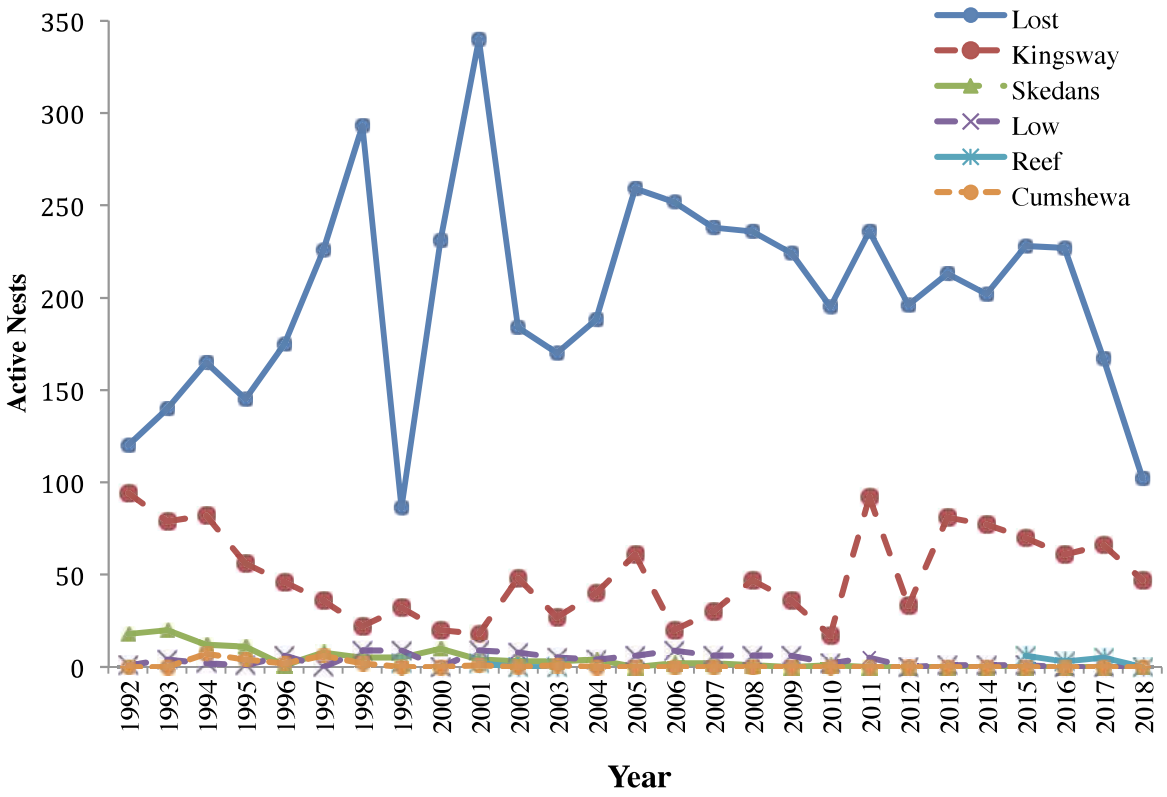

Figure 4. Glaucous-winged Gull nests containing eggs or chicks at four colonies in Laskeek Bay, 1992-2018.

Pigeon Guillemots *Cepphus columba*

Nest boxes

There are 27 Pigeon Guillemot (PIGU) nest boxes at Lookout Point. Boxes #1-10 were installed in 2001 and boxes #11-28 in 2010. Nest box #3 went missing during the winter of 2013. The boxes were put in place to establish a sample of breeding PIGU that could be studied more easily in the future. In the past, chicks and eggs were weighed and measured before the end of our field season in mid-July. We also banded any chicks that were large enough at that time.

In 2017, cameras captured several sequences of a river otter visiting the boxes, and actually entering the boxes. We suspected that a small river otter was able to enter the boxes and predate on incubating adult birds. This year, we eliminated otter predation from the nest boxes by reducing the size of the box entrances, as well as adding a small ledge for the birds to land on. We also moved the entrances of the boxes close to, or over, the edge of the rock ledges. This was successful as we found that five of the ten nest boxes were occupied; two of the nest boxes had chicks, one with two chicks and the other with one chick (Figure 5). Of the three other occupied boxes, two had adults incubating, and the last contained an egg but not adult.

Figure 5. A chick from the 2018 Pigeon Guillemot boxes

PIGU foraging project

In 2016 we began opportunistically photographing Pigeon Guillemots with fish in their bills. PIGU 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. We continued this project this season and put more time and concerted effort into finding PIGU with fish and photographing them. Over time, we will be able to catalogue the type and size of fish that PIGU in Laskeek Bay are foraging on, and could potentially see changes in the fish they are foraging on over time. We have not identified the types of fish yet, or measured the sizes, but we have seen them taking what we suspect may be Pacific Sand Lance and a type of Reddish-brown Blenny.

Cassin's Auklets and Fork-tailed Storm Petrels

(Ptychoramphus aleuticus and *Oceanodroma furcate)*

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 recent years. In 2015, we completed a natural burrow census on Limestone Island and found 101 Cassin's Auklet burrows that appeared to be active. Most burrows were located on Cassin's Tower, at Lookout Point, and at the East Coast nest box plots, although there were lower densities of burrows interspersed between these locations.

The next complete burrow census will be carried out in 2019 to monitor long-term Cassin's Auklet activity on East Limestone.

Cassin's Auklet nest boxes were monitored again this year at both Lookout Point and at the East Coast plots. Knockdown sticks were placed at the entrances of all nest boxes early in the season and were checked every 4-5 days. A total of 46 nest boxes were monitored at the East Coast plots (North and South), and 25 at Lookout Point. In late May, nest boxes with multiple consecutive records of knockdown activity were checked for chicks. In late May, 3 boxes had signs of activity: one with an adult with at least one egg, one with only an egg and no adult present, and one with an adult Ancient Murrelet incubating. The boxes were checked again in June and the Ancient Murrelet egg had hatched and the adult had departed the nest. The egg with without adult present never hatched and the egg with the adult present hatched, however, the chick had died.

The amount of Fork-tailed Storm-petrel activity this season was again lower than previous years but only slightly lower than 2017. Storm-petrels were heard on 16 nights throughout the season. In 2017, they were heard on 18 nights and in 2016 on 40 nights. This year the ANMU were again only monitored every other night, a change made in the 2017 season, which suggests a reason for the lower numbers in observed storm-petrel activity. The storm-petrels are most active in the colony late at night and by only staying up late to monitor the ANMU every other night storm-petrels were not heard as often. They were heard most often during the first month of the field season while the ANMU were monitored and then infrequently during the remainder of the season when the ANMU monitoring was not taking place.

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 Cumshewa Island and south to Haswell Island. Four near-shore surveys were completed this year: 7 May, 19 May, 30 May, and 21 June. On these surveys we counted 20 species: Ancient Murrelet, Black Oystercatcher, Cassin's Auklet, Common Goldeneye, Common Loon, Common

Murre, Glaucous-winged Gull, Harlequin Duck, Herring Gull, Long-tailed Duck, Marbled Murrelet, Pacific Loon, Pelagic Cormorant, Pigeon Guillemot, Rhinoceros Auklet, Red-necked Grebe, Red-necked Phalarope, Sooty Shearwater, White-winged Scoter, and Yellow-billed Loon.

The highest Marbled Murrelet count was during the 7 May survey, when we recorded a total of 80. During the other surveys we counted a total of 61 Marbled Murrelets; 23 on 19 May, 0 on 30 May and 38 on 21 June. These numbers are similar when compared to the 2017 season: 79, 33, 11 and 30 Marbled Murrelets in four surveys.

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 had to modify 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 no Hecate Strait surveys were completed.

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.

This year 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, 2006-2018†. Data since 2014 include 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	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Northern elephant seal	*Mirounga angustirostris*	0	0	2	0	0	0	0	0	0	0	0	0	0
California sea Lion	*Zalophus californianus*	0	0	0	0	4	0	0	1	1	0	0	4	0
Humpback whale	*Megaptera novaeangliae*	36	22	112	13	347	12	14	193	86	102	261	203	91
Fin whale	*Balaenoptera physalis*	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey whale	*Eschrichtius robustus*	1	2	3	0	0	1	1	1	0	0	0	0	1
Minke whale	*Balaenoptera acutorostrata*	2	2	9	4	3	6	2	1	0	0	1	3	1
Killer whale	*Orcinus orca*	36	45-60	47	50	26	16	13	49	11	14	18	26	4
Harbour porpoise	*Phocoena phocoena*	27	14-15	7	13	31	7	4	19	0	10	0	1	4
Dall's porpoise	*Phocoenoides dalli*	0	0	0	0	0	0	0	8	0	0	0	0	0
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	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 not many Humpback sightings this year in Laskeek Bay, compared to other years. For example, in 2014, it was not uncommon to count 40 whales during a single sea watch. This year, we did see Humpbacks in the area, but often only single whales or 2 or 3 together at most.

Killer Whales

There were eight sightings of Killer Whales in Laskeek bay this season. We were able to take ID photographs during five of these encounters. Our ID photographs are sent to the Killer Whale database at the Pacific Biological Station in Nanaimo. One encounter of note was a group of 6 Orcas, ~ 100 meters east of Cabin cove, on 16 June that appeared to be in the process of hunting for food. This group moved to South Low Island where we observed them capture and subsequently feed on a Harbour Seal.

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 244 individuals at Reef (19 May) and 75 at Skedans (5 May). California Sea Lions were heard on the Reef rocks on 19 May, but could not be differentiated from among the large group of Steller's Sea Lions in the same area.

Other species

Other less-common marine mammal species that were sighted this season: Minke Whales (2 sightings), Harbour Porpoises (27 individuals in 15 sightings), Pacific White-sided Dolphins (13 individuals in 2 sightings) and Grey Whales (1 sighting).

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 173 wildlife trees have been identified over the past 29 field seasons.

This year we found a total of 13 active trees, containing 14 different nests of 3 different species. Four new trees were identified. Twelve nests were occupied by Red-breasted Sapsuckers (RBSA), one by Chestnut-backed Chickadees (CBCH), and one by Northern Flickers (NOFL) (Table 5). The Chestnut-backed Chickadee pair and the Northern Flicker pair nested in separate cavities in wildlife tree #153, however the Northern Flicker nest failed. Wildlife tree #98 is currently the oldest active tree (first active in 2004), which has been used intermittently by Red-breasted Sapsuckers and Hairy Woodpeckers. The number of Red-breasted Sapsucker nests (12) is the same as last year, which was the largest number since 2011. This is still 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 2018. 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	Fledge Date (min)	Fledge date (max)
98	RBSA	Ss	7-June	8-June
109	RBSA	Ss	15-June	18-June
118	RBSA	Ss	11-June	18-June
145	RBSA	Ss	12-June	16-June
150	RBSA	Hw	13-June	16-June
153	CBCH	Ss	13-June	15-June
156	RBSA	Ss	22-June	24-June
165	RBSA	Ss	13-June	16-June
168	RBSA	Hw	20-June	22-June
170	RBSA	Ss	29-June	1-July
171	RBSA	Ss	11-June	15-June
172	RBSA	Ss	3-July	5-July
173	RBSA	Dr	15-June	18-June

[1]RBSA = Red-breasted Sapsucker, NOFL = Northern Flicker, HAWO = Hairy Woodpecker, CBCH = Chestnut-backed Chickadee, Ss = Sitka spruce, Hw = Western hemlock.

Raptors and Corvids

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

This year we had two active Bald Eagle nests on East Limestone Island: one at Cassin's Tower (BAEA-5) and the other at North Cove (BAEA-10). There was one chick in each nest and neither had fledged by the end of the field season on the 19 July. The chick in BAEA-5 was first seen on the 24 May and the chick in BAEA-10 was first seen on the 18 June. The chicks were then consistently seen and heard in the two nests for the remainder of the season. BAEA-5 was last seen from the skiff on the 16 July and BAEA-10 was last seen on the 6 July. When BAEA-10's chick was last seen it was observed with brown plumage and was no longer downy thus suggesting that it was gaining its flight feathers.

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, there were abandoned eggs observed in the nest, but no young. In 2016, there was one young falcon and an abandoned egg in the nest. In 2017, one young falcon was observed and later sighted flying. The Peregrine Falcon nest was first checked on the 24 May, and was observed with 2 or possibly 3 young chicks. The nest, when checked on 8 June, was found to be empty. Then, on June 23, three falcons (2 parents and 1 fledgling) were seen near the nest. Later this group was observed flying near Lookout Point and over other areas other island.

As in past years, one pair of Common Ravens nested on the island. The nest this year was at a new nest site (CORA 4). One young was visible in the nest on 13 May when the nest was found. The fledge date of the chick was between 18 May and 24 May. On June 8, 2 juvenile birds were observed near Boat Cove on a spruce tree calling. The two juveniles, with the adults, were seen and heard regularly for the rest of the season.

Daily Bird Checklist

Throughout the field season, we keep a daily record of all bird species observed or heard within Laskeek Bay. We recorded a total of 63 species over 70 days. Many species were recorded almost daily, for example: Pelagic Cormorants, Black Oystercatcher, Glaucous-winged Gull, Pigeon Guillemot, Bald Eagle, Red-Breasted Sapsucker, Hairy Woodpecker, Pacific-Slope Flycatcher, Northwestern Crow, Common Raven, Pacific Wren, Hermit Thrush and Townsends Warbler. Many less frequently observed species were recorded this year as well, such as Tree Swallow, Barn Swallow, Double-crested Cormorant, Long-tailed Duck, White-winged Scoter, Herring Gull, Cassin's Auklet, Red-breasted Nuthatch, Brown Creeper, Belted Kingfisher, Fox Sparrow, Red Crossbill and Pine Siskin. Migratory duck species we observed included Green-winged Teal, Long-tailed Duck and White-winged Scoters. Some notable sightings were 500 Ancient Murrelets in the Reef Island gathering ground area on 9 June, 300 Rhinos in Cumshewa Inlet on 21 June, a Sooty grouse with three chicks on the Main Trail of East Limestone Island was spotted several times between June 9-20, a Northern Saw-whet Owl on the Main Trail on 2 July, a Yellow-billed Loon near Skedans Islands on 7 May, a Northern Fulmar on 20 June on route to lost island, as well as ~200 Pacific Loons just East of Cabin Cove in mid-May. Pacific Loons were also seen frequently and in larger numbers than normal from early May until late June.

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 6). 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.

(a)

(b)

c)

Figure 6. Photos taken looking west along the Main Trail, in 2011 (a), the first field season after the blowdown events, five years later in 2016 (b) and again this year, 2018 (c).

Rare Plants

There are relatively few wildflowers and berry bushes left on East 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, Hairy Rockcress (*Arabis hirsute eschscholtziana*), Spreading Stonecrop (*Sedum divergens*), Salal (*Gaultheria shallon*), Shore Blue-eyed Grass (*Sisyrinchium littorale*), Northern Rice-root (*Fritillaria camschatcensis occidentalis*), Purple-leaved Willowherb (*Epilobium ciliatum*).

A number of rare plants are present on East 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 (*Anemome multifida*). Showy Jacob's Ladder and Cut-leafed Anemone were found to be blooming in late May on the cliffs in Boat Cove.

In 2017 an attempt to document the location of rare plants found on East Limestone Island was made and in 2018 we continued systematically recording the locations of the rare or significant plants using GPS waypoints.

CONSERVATION

Invasive Plants

Invasive plants are plants that have been introduced to an area from elsewhere, and that 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*), and Wall Lettuce (*Lactuca muralis*). Marsh Cudweed (*Gnaphalium uliginosum*) was first detected on the island in 2013 near Cassin's Tower, and is now spreading to other parts of the island. In 2017, a new introduced plant was confirmed on East Limestone, Sticky Chickweed (*Cerastium glomeratum*), growing along the Main Trail near the junction to the Deer Trail. It has been observed for a few seasons now, but we had not identified it in the past. In 2018, it was again observed in many of the locations where thistles were growing, especially in the blowdown areas in the centre of the island.

In 2016 we began a 3-year project to continue documenting invasive plants on various islands in Laskeek Bay, and to remove invasive plants from East Limestone Island. This project built on the initial invasive plant work done in 2009/2010 (See report "A study of invasive alien plant distribution in Laskeek Bay", Laskeek Bay Research #16). In 2016, surveys were undertaken along selected portions of shorelines of the Skedans Islands, Low Island, South Low Island, Kingsway Rock, East Limestone, Reef and Louis Islands. In 2017, we focused our effort on surveying more on East Limestone Island, and trying to remove as many invasive plants as possible. We also removed thistles along the Louise Island shoreline where students camp when they come to East Limestone Island for Project Limestone. In 2018, we re-surveyed all sites on East Limestone Island and removed the vast majority of invasive plants from these areas. It has become evident that the removal of invasive plants from many areas is not achieving the desired effect, so a rethink of the present approach is needed.
In the 2019 season a more concerted effort on removing invasive plants from areas of refugia for native plants may be more beneficial than continually removing them from areas where they have less of an effect of the local flora.

Introduced Mammals

Sitka Black-tailed Deer (*Odocoileus hemionus)*

Deer were intentionally introduced to Haida Gwaii in 1878, and on several other occasions 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 recently finished a four-year program; project BAMBI (Behavioral Adjustments to Mitigate Biodiversity loss). This study 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 15 February and 6 May. These pictures were sent to RGIS for analysis. The cameras were then moved to Reef Island on 12 May and retrieved in late July. The pictures were sent to RGIS for analysis.

Although project BAMBI is over, we continue to record deer sightings on East Limestone Island for RGIS. The date/time, location, tag colour/number, and sex were recorded along with any behavioural notes. This year, deer with ear tags numbered 5 and 21 were sighted.

On East Limestone Island, there are now two deer exclosures, one remaining since the blowdown in 2010 and a new one that was built in March 2015 (Figure 7). The older deer 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 exclosure is almost entirely absent from areas that deer can access. The new exclosure is close to the Main Trail, in the blowdown at the centre of the island. The difference in growth within this exclosure to the area adjacent is already quite apparent, with many small Huckleberry bushes, wildflowers, and healthy Spruce saplings growing within the exclosure. We are also noticing that a consequence of the blowdown is the creation of many small refugia for plants on top of upturned roots.

Figure 7. Deer exclosure on East Limestone Island (2018), built in 2015, demonstrates the change in vegetation, even in a short amount of time, when deer are removed.

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 East Limestone Island since 2009.

Due to the large raccoon population on Louise Island it seems likely that raccoons will continue to disperse to East Limestone Island 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 15 Febuary, 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 East Limestone Island 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 4 May. No raccoons were photographed during this time. On 15 and 16 February, a crew conducted two nights of spotlight surveying of the shoreline of East Limestone Island, West Limestone Island 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, 6 raccoons were sighted and 3 were killed. On 16 and 17 April, two nights of spotlight surveying were conducted along the same shorelines. During these surveys, there were no sightings on East or West Limestone Island. Five raccoons were sighted and two were killed on the shoreline of Louise Island.

Monitoring for raccoons continued throughout the field season, with one camera that was baited and checked regularly. Boat cove was monitoring continuously from 15 February to 17 July, North Cove and Crow Valley from 15 February to 6 May, and Cabin Cove 15 February to 6 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 confident they were not present on East Limestone Island 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 East Limestone Island 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. There were 15 squirrel surveys completed this season.

Marine Debris Removal

In 2016, we began documenting, collecting, and removing marine debris from several beaches in Laskeek Bay. In 2018, we continued this project. We conducted accumulation surveys, based on National Oceanic and Atmospheric Administration (NOAA) protocols, on Crow valley beach, Vertical point beach and Louise Island campground beach. Debris was removed from these same beaches in 2016 and 2017, and when comparing records a reduction in debris could be seen. Nevertheless, we still collected a lot of plastic fragments, foam and polystyrene fragments, and plastic waterbottles. Large debris items were also found, such as tires, and many fishing floats.

CONCLUSION

This season was our 29th 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 with 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 39 chicks in 2018). This year, we observed an increase from 2017 (28) but the 2018 numbers are still much lower then those recorded historically. 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. The results of the completed census in 2017 will allow us to determine if the decline is localized to just Cabin Cove.

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. We will also continue to research the possibilities of other restoration, such as social attraction techniques that have been shown to be effective in other colonies, to possibly assist the recovery of the East Limestone Island colony. Further efforts will also be made to attempt to determine whether the blowdown has had an impact on the number of Ancient Murrelet breeding on Limestone Island.

The lessons that we learn from our research on East Limestone Island are of great importance when considering the prospects of other colonies threatened by introduced raccoons and rats as they continue to disperse throughout the many islands of Haida Gwaii. Laskeek Bay Conservation Society hopes to continue to implement and incorporate island restoration techniques in future field seasons. We are participating in the development of a bio-security plan to address some of the ongoing issues of introduced species. With the warming of the climate and increase in ocean temperatures, we are also beginning to discover the possible impacts of these changes on the behaviour patterns of marine species. We hope that continuing our core long-term monitoring programs will help to document and understand these broader scale changes.

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