EAST LIMESTONE ISLAND FIELD STATION

FIELD SEASON REPORT 2017

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Laskeek Bay
CONSERVATION SOCIETY

SUMMARY

This was the Laskeek Bay Conservation Society's 28th field season on East Limestone Island, Laskeek Bay, Haida Gwaii. The season ran from 4 May to 22 July, bringing 34 volunteers and 2 student interns to the island, and 134 visitors including 31 students and 10 teachers/chaperones who came with Project Limestone. Ancient Murrelet chick departures were very low again, similar to last year, and again started much later than normal, on the night of 16 May. We used a combination of manual capture and remote cameras to monitor all Cabin Cove funnels this year. A total of 28 chicks were manually captured or photographed in the Cabin Cove funnels during the standard monitoring time. An additional 4 chicks were photographed after this time, between 03:00 and 04:30 in the morning. Seven chicks were recorded on camera in North Cove. Adult Ancient Murrelet activity again seemed low this season, similar to last year. We conducted a census of the Ancient Murrelet colony in collaboration with the Canadian Wildlife Service to get a better understanding of the population overall. No raccoons were detected on the island during shoreline surveys in early February, or on remote baited cameras used throughout the field season. Black Oystercatcher surveys were conducted only in Laskeek Bay this year, and 17 chicks were banded. The oldest documented black oystercatcher is now at least 19 years old, and is still breeding. Glaucous-winged Gull censuses were conducted at 3 colonies in Laskeek Bay and 233 active nests were found. The Pigeon Guillemot nestbox project was modified this season and remote cameras were used to evaluate why eggs are being abandoned in the boxes. Otters predation seems to be the most likely cause. There were 3 Cassin's Auklet chicks that were measured and weighed in nestboxes; 1 died before fledging. Four near-shore sea surveys were completed and Marbled Murrelet counts were lower than the past few years. One Hecate Strait sea survey was completed. Marine mammal sightings included 22 humpbacks, 2 minke whales, 2 grey whales, 14 harbour porpoises and 10 sightings of groups of killer whales. Fifteen wildlife trees were active, containing 16 nests. A Common Raven nest, two Bald Eagle nests, and the Peregrine Falcon nest were active. The eagles seemed to be unsuccessful this season. We focused our invasive plant removal efforts on East Limestone this season, and removed many large patches of thistles. A new introduced plant was identified this year, sticky chickweed (*Cerastium glomeratum*). We continued to monitor deer on East Limestone, and we set up a small experiment to see if squirrels will predate on large eggs (eg. murrelet eggs). Marine debris was documented and removed from three beaches on Louise Island and one on East Limestone, as well as removed from parts of South Low and the Skedans Islands.

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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 28 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 Lookout Point. They learn about the natural history and geography of the area, and are introduced to the various projects that we run. They assist with the Ancient Murrelet monitoring work from 22:30 to 02:30. The students 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 4 groups from 4 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 31 students from grades 6 to 12, and 10 teachers/ chaperones participated. The first student group was from Port Clements Elementary (Port Clements), on 16 May. On 19 May students from the Living and Learning School (Queen Charlotte) visited, and on 24 May we hosted students from GidGalang Kuuyas Naay Secondary School (Queen Charlotte). The final student group, from Gudangaay Tlaats'gaa Naay Secondary School (Masset), visited on 26 May. Project

Limestone began in 1991, and to date 783 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 help 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 34 volunteers (not including student interns) who contributed 239 volunteer days to projects on Limestone and in other areas of Laskeek Bay. Most volunteers stayed for one week, although one volunteer came for 2 weeks. Six volunteers had visited the island or volunteered on the island previously. Twenty-six volunteers were from British Columbia this year, 1 from Alberta, 1 from Ontario, and 2 from Quebec. We also had international volunteers from Wyoming (1), New Mexico (1) and the Netherlands (1). Ten volunteers were Haida Gwaii residents.

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 did tours with 6 such tour groups who visited us on Limestone: Moresby Explorers on 20 May and 9 June, *Island Roamer* on 22 June, *Island Odyssey* on 26 May, *Atlas* on 3 July and *Maple Leaf* on 4 July. We had a visit from 1 other large group: A Northwest Community College class who camped on Louise Island for a few days, and came for a tour on Limestone on 6 May. We also had visits from kayakers on 2 occasions, and 3 visits from privately owned boats. Our final visitors came to East Limestone for research purposes: In early June, two Canadian Wildlife Service (CWS) staff joined our team for 5 days of Ancient Murrelet work; the students and researchers based on Reef Island came for visits and to conduct research several times; and we also had a team of bryophyte researchers stay on the island for one night in July. See Research Partnerships section below for more details on these 3 projects. In total, there were 93 visitors to the island throughout the field season, 134 including the school groups.

Staff

LBCS staff this year were Vivian Pattison, Lead Biologist/Camp Supervisor; Morgan Davies, Assistant Biologist/Interpreter; Lindsay Seegmiller, Executive Director; and Mahin Omar, Field Season Coordinator.

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 two interns: Kalene Lillico and Maya Meron. Kalene, a student from the University of Victoria, contributed 4 weeks (4 May to 2 June) to projects on Limestone Island and in Laskeek Bay. Maya, a student at the BC Institute of Technology, was in the field for 3 weeks (30 June to 22 July), and in the office in Queen Charlotte for 1 week, assisting with data entry and report writing. In total the interns this season contributed 69 days to field and office work.

RESEARCH AND MONITORING PROGRAMS

Research Partnerships & Special Projects

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 29 June to 20 July. Three principal investigators, Jean-Louis Martin, of the Centre National de la Recherche Scientifique (CNRS; France), Simon Chollet of the University of Rennes (France), and Sue Grayston, of the University of British Columbia, were working with students and one volunteer on projects related to deer impacts on soils and decomposition.

LBCS collaborated with the Canadian Wildlife Service (CWS) for two projects this season. ELI staff and volunteers mounted 8 Automatic Recording Units (ARU) in various locations of the Ancient Murrelet colonies on ELI and Reef Islands. The recordings from the ARUs will be used as part of a project to evaluate the possibility of using them as a method of colony monitoring. Also, ELI field staff and volunteers were joined by 2 CWS staff (Dan Shervill and Glen Keddie) from 28 May to 2 June to conduct a census of the Ancient Murrelet colony on East Limestone. See the Ancient Murrelet section for more details.

Finally, during July, we hosted a bryologist, Karen Golinski, and her 2 assistants for 2 days. She is based at the Smithsonian Institution in Washington, D.C. and was researching rare mosses and assessing their status for COSEWIC. She discovered one rare moss on the limestone cliffs on the island, and will produce an updated inventory of the mosses and liverworts of East Limestone.

Ancient Murrelets *Synthliboramphus antiquus*

Manual Chick Capture

The manual monitoring of chick-capture funnels 5 to 8 in Cabin Cove began on 10 May, while Reconyx wildlife cameras began remotely monitoring for chicks on the standard start

date of 7 May. Funnels were closed on manual monitoring nights to capture departing chicks from 22:30-02:30 for the period of 10-19 May and 23:00-02:30 after 19 May, to compensate for increasing day length. Funnels were checked at regular 15-minute intervals and the date, time, location (funnel number) and mass for each departing chick was 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 2017 the last night of manual capture work was 13 June. This date was used as the final date of monitoring because there had been many nights with zero chicks photographed or captured. Reconyx wildlife cameras were used to continue monitoring until 21 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, but in 2017 we did not have any major new blowdown behind the cabins.

This season the first chick to arrive in the Cabin Cove funnels was on the night of 16 May. The last chick to be manually captured and weighed was captured on the night of 6 June, and the last chick seen on the Reconyx cameras in Cabin Cove was on the night of 10 June, before funnels were taken down for the season on 21 June. Over the course of 26 years of monitoring, the average night of first arrival had been 11 May, with very little variation year-to-year. However, in 2016 and 2017 chicks began arriving much later than in past years, with the first chick arriving almost a week later than average. The highest number of chicks captured in one night was 5, on the night of 20 May. Seventeen chicks were manually captured in funnels 5 to 8, plus an additional 1 chick captured just outside funnel 6, which we now believe had been in the funnel and escaped or was released when the funnel was opened at 2:30. The total sample of chicks captured and weighed was 18.

Camera Monitoring

The 2017 season is the first 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 46 days, and we manually monitored for 18 days over that period. Some limitations we have encountered are the speed that the camera will trigger and take photos (which can be a problem with fast-moving chicks), and in photo analysis it can be challenging to determine the number of chicks if two chicks arrive at the camera at the same time. Camera monitoring also requires dedicated time by staff or volunteers to review images. Benefits of camera monitoring, on the other hand, are that the cameras are monitoring constantly, whether staff and volunteers are available or not, which allows us to monitor for a greater number of days, and for a longer period during the night. With manual monitoring, we end at 02:30, but with cameras we can determine how many chicks leave the colony later than this. This year, the cameras caught 5 chicks departing the colony later than 02:30 in funnels 5-8. These chicks would not have been recorded at all if we had not been using cameras. Cameras can also be used when staff and volunteers are unavailable to manually monitor later in June, for example when away on Oystercatcher surveys or when other daytime project require more staff time.

In 2017, 5 Reconyx PC900 infrared cameras and 5 wooden chutes were set up at funnels 5, 6, 7, and 8, at Cabin Cove (Figure 1). Two cameras and chutes were set on funnel 6; one we labelled “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. A wooden chute was added to funnel 7 to give each funnel a standardized set-up. The cameras were used in conjunction with manual trapping on 18 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 14 chicks that passed by the cameras on manual monitoring nights this season, there was only one chick, in Funnel 7, which passed by the camera without being photographed.

Figure 1. Camera monitoring setup for each of the funnels at Cabin Cove. Top, from left to right: Funnel 5, Funnel 8, Funnel 6A. Bottom, left to right: Funnel 6B, Funnel 7.

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 it was very short. In 2017, a camera was set at the mouth of funnel 4 on 7 May and left in place until 28 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 (Figure 2).

Figure 2. Camera and chute setup at North Cove funnel 4.

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, because camera monitoring is now an integral part of our monitoring method. The Cabin Cove total for 2017 was 28 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 3). The total including chicks that were seen photographed after 02:30 in the morning is 32 (including 4 chicks photographed after 02:30 in the morning). Two chicks were also heard running past funnel 6, but were outside the funnel so did not get manually captured or photographed.

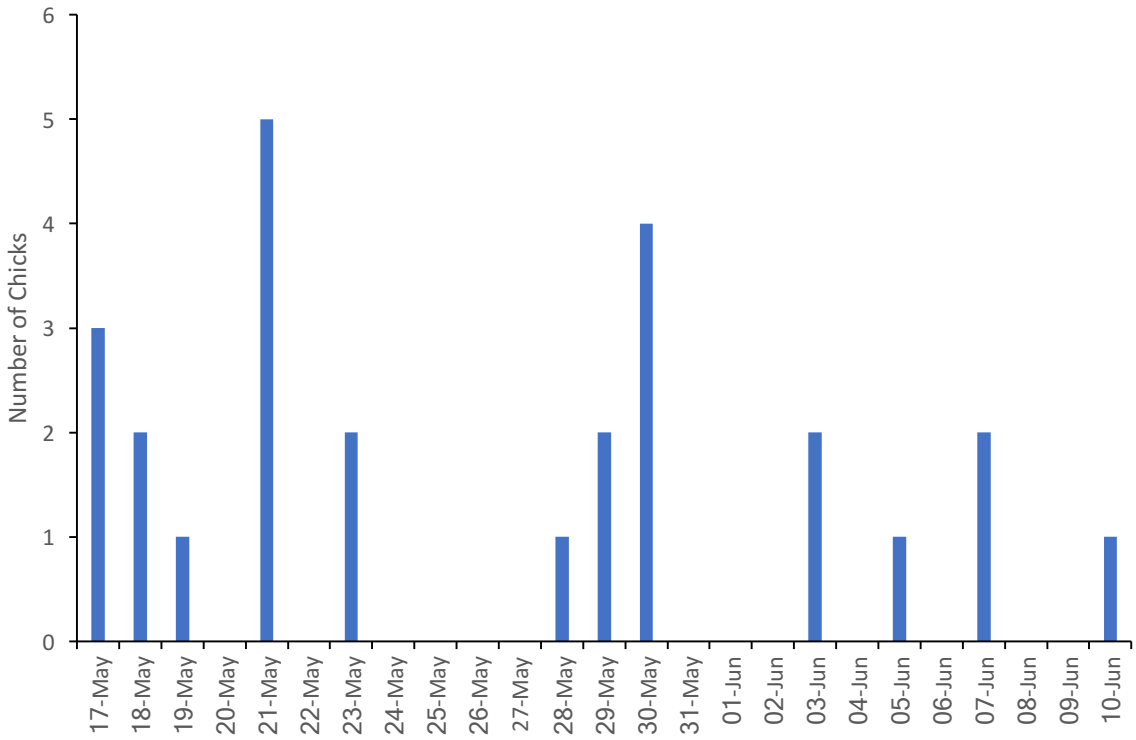

Figure 3. 2017 nightly chick captures, Funnels 5-8. Chicks manually captured or photographed within the funnels before 02:30 are shown here. Date is the date when the monitoring night began, for example, chicks shown on the night of 17 May could have been caught in the early morning of 18 May.

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 high proportion of chicks leaving the colony later than 2:30. This season there were several days in a row when chicks in both Cabin Cove and North Cove all left significantly later than 02:30; from the night of 23 May to the night of 25 May, all 5 chicks left the colony after 02:30, the earliest at 03:13 and the latest at 04:36.

The number of chicks recorded this season in funnels 5-8 was similar to last year: 28 chicks this season compared to 31 in 2016 and 44 in 2015 (Table 1). The decline in 2015 was the largest decline in a single year since we began monitoring. While previous sharp declines have always been associated with raccoon predation, there have not been any raccoons on East Limestone since 2009. Thus, the low number of chicks leaving the Limestone colony from 2015 to 2017 is of significant concern. In 2016 we noticed an apparent drop in adult Ancient Murrelet activity in the colony as well, and we saw a similar lack of adult birds 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 and 2017 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 2017. Chick numbers include only chicks captured or photographed within the funnels, and before 2:30 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

[1]The final night of monitoring in 2016 and 2017 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 28 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 (22 chicks) than funnels 7 and 8 (6 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. As in 2016, funnel 6 had much higher number of chicks (18) than funnel 5 (4 chicks). The total chick number is similar to 2016, and again much lower than previous years (Figure 4). This year, the first chicks arrived in funnels 5 and 6 on 16 May and peak night (5 chicks) occurred on 20 May (Table 2).

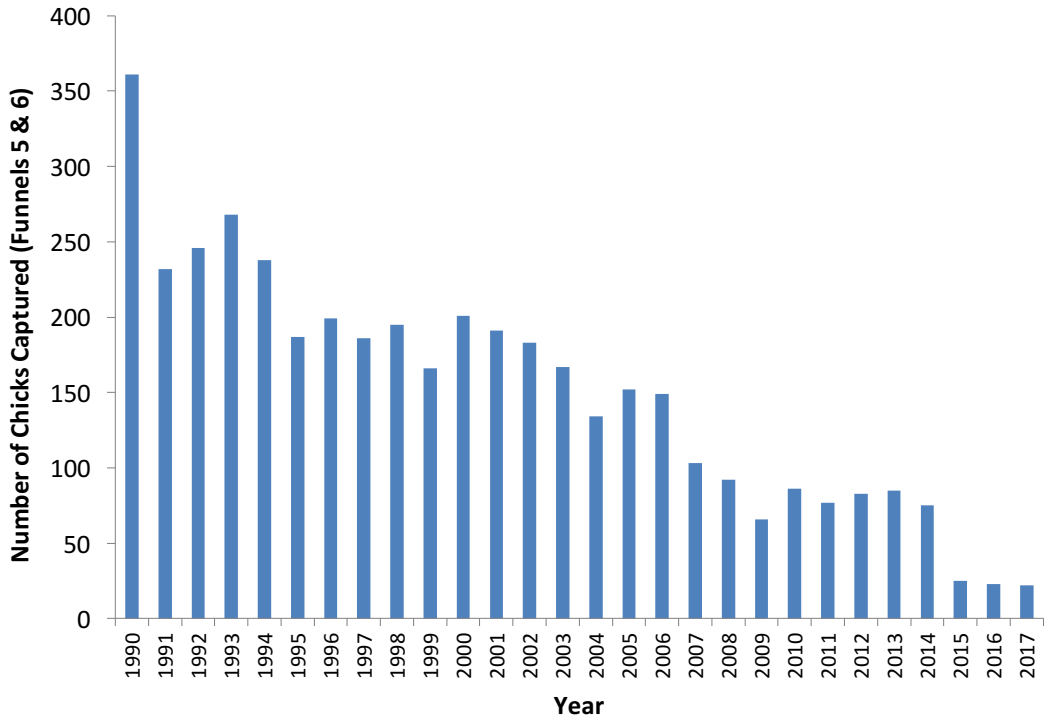

Figure 4. Total Ancient Murrelet chick captures at funnels 5 and 6, 1990-2017. These totals include only chicks captured within the funnels and before 02:30 in the morning.

Table 2. Summary of chick departures, peak nights and totals from funnels 5 and 6 on East Limestone Island, 1990 to 2017.

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
Average ± SD	11-May ± 2.5 days	21-May ± 3.6 days	18 ± 8.7 chicks	6-Jun ± 5.8 days	27 ± 5.3 days	150 ± 82 chicks

[1]The final night of monitoring in 2016 and 2017 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, a total of 7 chicks were recorded between the nights of 19 and 31 May, with peak departure of 2 chicks on the night of 31 May. The total number of chicks is lower than those of the previous 3 years (11 to 13 chicks), and all chicks departed within a short time period (over only 13 nights). The past 4 years have been much lower than 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 some manual monitoring nights for the period of 23 May to 7 June. Point counts were completed on 7 nights in 2017. The maximum number of birds counted was 14, producing 75 calls, on 25 May. The mean number of birds counted this year (±SD) was 5.1 ± 5.1, and the mean number of calls was 18.1 ± 26.3. This is lower than in any of the previous three years with the closest year being 2014 (7 ± 5 birds, 37.7 ± 25.4 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 (2 counts of 5 minutes each). The highest count occurred on 27 May, with a total of 22 birds observed, which is a very low maximum count. 2016 was also a low year for gather ground counts, but the maximum in 2016 was 70 birds. The average gathering ground count in 2017 was 4.6 ± 5.1 Ancient Murrelets, less than 1/3 of the counts over the previous 3 years (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 24 evenings in 2017. It was a relatively stormy year and there were 18 nights when we could not count due to rain, wind or heat shimmer.

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. We also scan feather piles, raven pellets and other predation remains looking for bands. This year on 31 May we found a band on an Ancient Murrelet leg in a feather pile on the Westcoast Trail (near the northwestern point of Limestone). The band number was 1313-85093 and belonged to a bird banded as an adult in 1998 at the flight net in North Cove, several hundred meters from where it was found dead this year.

Predation transects

In previous years we checked for predation remains along 5 fixed, 20m wide transects. These transects were heavily impacted by blow-down 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.

Automatic Recording Units

In 2017 an audio recording project using Automatic Recording Units (ARU; Songmeter SM4) was set up in collaboration with the Canadian Wildlife Service. The project was established

to begin testing whether Ancient Murrelet colonies can be effectively monitored using ARUs, and as a preliminary look at whether and how much Ancient Murrelets are still using the blowdown areas on East Limestone and Reef Islands. At the beginning of May we set up 8 ARUs, four on East Limestone and 4 on Reef Island. On each of the islands we tried to place 2 ARUs in intact forest where murrelet burrows have been found in the past, and 2 ARUs in areas of blown down forest, again within the boundaries of the historic murrelet colony. When we collected the ARUs in mid-July, we also mapped out a 10 m radius plot around each ARU, in which we mapped murrelet burrows, and also any sound barriers (for example, large trees or cliffs). These will then be used by CWS technicians as they review and analyze the audio data.

Social Attraction

The social attraction project that ran from 2011 – 2015 was again paused for the 2017 season.

Summary: Population Trends

The breeding population of Ancient Murrelets on East Limestone has been declining over time (Figure 4). 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 had 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 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 3 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 has stabilized at approximately 75 % lower than 2010.

Due to concern about the declining murrelet population on East Limestone, and especially the recent sharp drop in chick numbers in Cabin Cove, we asked the Canadian Wildlife Service to help us conduct another census of the whole Ancient Murrelet colony on East Limestone. This is the fifth census of the colony on East Limestone, the first being conducted in 1983. The most recent census, in 2006, estimated 509 ± 132 breeding pairs. There has been a decline in estimated population of ANMU on ELI since the first surveys were completed, and we suspect this trend will continue with the most recent census, based on the low number of active burrow we observed during the census. Due to blowdown we were

not able to complete all of the transect that were conducted in the past, but we will continue to work with CWS to see if we can evaluate the breeding population in these areas remotely, for example by using ARUs. LBCS and CWS will be collaborating to analyze the data collected during the 2017 census, and will report on the results once analysis is complete.

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, and the results from the two surveys are summarized below. We have also been conducting extensive surveys in Gwaii Haanas for many years, but this season 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 – 12 June) and again in July (2 – 10 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 survey, all islands were surveyed except for Cumshewa Island and Lost Islands, although we did visit several of the Lost Island territories during the gull survey of the island. During the second survey, all islands were surveyed except for Cumshewa. We also returned to several territories a third time to band chicks that were not big enough during survey 2. We weigh and measure eggs and band and measure chicks at territories where they are present on all islands except for the Lost Islands, because it is within the Gwaii Haanas boundary.

Of the 54 territories visited on foot, 38 were occupied by a territorial adult pair. Of these, 31 were active (warm eggs or live chicks present) during the first survey, and 30 were active during the second survey. During survey 1 we found 29 territories with eggs (53 eggs total, although there were 2 territories 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. During survey 2, we found 11 territories with eggs (19

eggs total) and 19 territories with chicks, with a total of 26 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 43 non-territorial sightings of oystercatchers which totaled to 97 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 have noticed several very worn plastic bands from earlier years, on which the combination is now un-readable. This season, chicks were banded with a single A-N band on the left leg and a dark green plastic band over the metal band on the right leg, as a year identifier in case the alphanumeric combination gets worn off the blue band. We also began gluing the wrap-around plastic bands (the dark green bands), which we hope will help preserve these bands. In total, we banded 17 chicks at 14 different territories this season.

All oystercatchers seen during the season were checked for bands, as this gives us information on their age and dispersal. There were 23 banded individuals sighted in Laskeek Bay (Table 3). We were able to identify several banded birds in Laskeek Bay by photographing the metal band and reading the number from the photos, which resulted in some notable sightings. A breeding adult with an aluminum band was seen at SKE-14 again; this bird has been breeding in the Skedans Islands since it was banded as an adult in 2001. It is now at least 19 years old and is older than any previously reported Black Oystercatchers (Andres and Falxa, 1995, Tessler *et al*. 2014). Another banded bird, seen at Kingsway Rock, is between 18 and 23 years old. An adult with a yellow band which has been breeding on Kingsway Rock was finally identified from photos of its metal band; it had been banded as a chick on Kingsway Rock. Two individuals banded in 2014 were identified, but their alphanumeric band combinations were too worn to read very well. Three individuals banded as chicks last season were sighted with a large group that contained many other young birds identifiable by their shorter brown bills.

Table 3. Banded Black Oystercatchers re-sighted in Laskeek Bay in 2017. Repeat sightings are omitted only if they are definitely the same bird as previously sighted. Band numbers are often read from photos taken during the surveys. Band codes: UB = unbanded (birds can lose bands), M = metal, W = white, Y = Yellow, BR = Brown, AN = unknown alphanumeric combination, white characters on dark blue plastic band, N5 = alphanumeric combination, white characters on dark blue plastic band.

Band combination (L-R)	Band number	Location/ Territory Seen	Year Banded, as Chick or Adult	Banded at Territory	Notes
W-UB/M	-	North ELI	-	-	-
UB-UB/M	0785- _ _04(8?)	SKE-12	2000 Chick	Unknown	Could have been banded in 1994, but much less likely
AI-UB/M	2406-06009	SKE-14	2001 Adult	SKE-6	Seen during both surveys
?-UB/M	-	Skedans Islands	-	-	-
UB-UB/M	-	SKE-10	-	-	-
UB-Y/M	1015-06977	KNG-4	2007 Chick	KNG-1	-
UB-UB/M	0785-357_ _	KNG-3	1994-1999 Chick	Unknown	-
UB-UB/M	-	SLW-8	-	-	-
UB-UB/M	1015-069_ _	REE-1	2004 -2009 Chick	Unknown	-
AN-AN/M	1015-0263 _	SW Reef shoreline	2014 Chick	REE-1 or 12, or ELI-4	AN bands too worn to read, but looks like it contains and “E”, therefore banded in 2014
UB-UB/M	1015-02617	REE-4	2009 Chick	SKE-3	Band number read with binoculars
UB-UB/M	-	REE-11	-	-	-
UB-UB/M	-	LOW-1	-	-	-
W-UB/M	-	ELI-4	-	-	Likely same bird as seen on north ELI shoreline earlier

UB-UB/M	-	LOS-11	-	-	-
AN-AN/M	1015-0263 _	South shoreline Lost Islands	2014 Chick	REE-1 or 12, or ELI-4	Likely same as bird sighted on Reef
UB-W/M	1015-06997 (?)	LOS-14	2009 Chick	LOS-2 (?)	Band number from 2016 but likely same bird
UB-UB/M	-	Low Island shoreline	-	-	-
UB-UB/M	-	SKE-18	-	-	-
UB-UB/M	-	REE-6	-	-	-
A0-UB/M	1015-02632	South-east Reef shore	2014 Chick	REE-13	In group of 4. AN band worn. Band number from photo
UB-UB/M	-	South-east Reef shore	-	-	Joined group of 4
N5-BR/M	1905-20153	South Skedans Bay	2016 Chick	SLW-8	In group of 16
N3-BR/M	1905-20151	South Skedans Bay	2016 Chick	ELI-4	In group of 16
H0-UB/M	1015-02650	South Skedans Bay	2016 Chick	SKE-3	In group of 16

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 2017, prey was collected from 16 unique territories in Laskeek Bay. A new addition to the prey collection project this season was measuring all the pieces of prey, to see if the size of preferred prey differs from place to place, or over time.

Limpets were the primary prey (60.4%), followed by mussels (18.8%), chitons (9.8 %) and abalone (7.5 %; Figure 5). These four prey items made up 96.5 % of the diet. These numbers are fairly consistent with what has been found in past years, although abalone made up a much larger proportion this year than in the past (in 2016 in Laskeek Bay, abalone made up only 1.5 % of the diet).

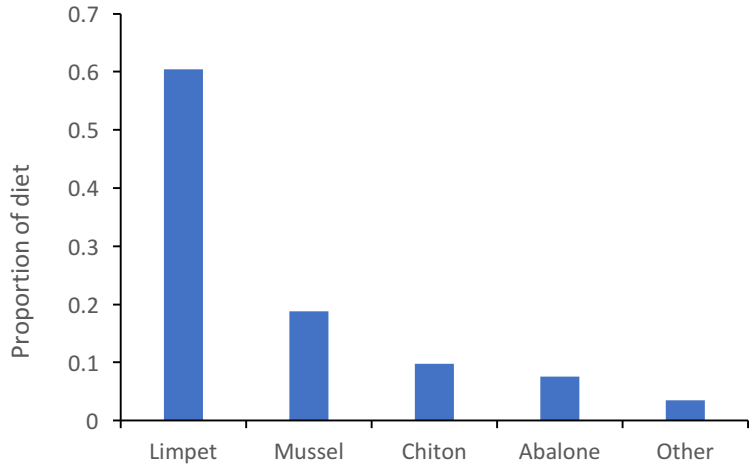

Figure 5. Black Oystercatcher chick diet from prey collections in Laskeek Bay, 2017.

Glaucous-winged Gulls *Larus glaucescens*

Since 1992, LBCS has been censusing gull colonies within Laskeek Bay (Figure 6). This year, we visited the known colonies on Kingsway Rock, Low Island, and Lost Islands. No gulls were seen by boat at the Skedans Islands so the area was not searched on foot to look for nests. Cumshewa Island was not visited this year. Seven adult gulls, and at least 5 nests, were observed on Reef Island by boat during the oystercatcher survey. 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 167 active nests (22 June), followed by Kingsway Rock with 66 nests (17 June). Although several pairs of gulls were seen at Low Island, no active nests were found. In total, we counted 233 active nests on these three colonies. 99.1 % of nests contained only eggs: 1 egg (14.2 % of nests), 2 eggs (27.5 %), or 3 eggs (57.5 %). Only 0.9 % of nests contained chicks (2 nests at the Lost Islands). The total number of active nests counted this season (233), in these 3 colonies, was below the long-term average (±SD) of 264.6 ± 49.3.

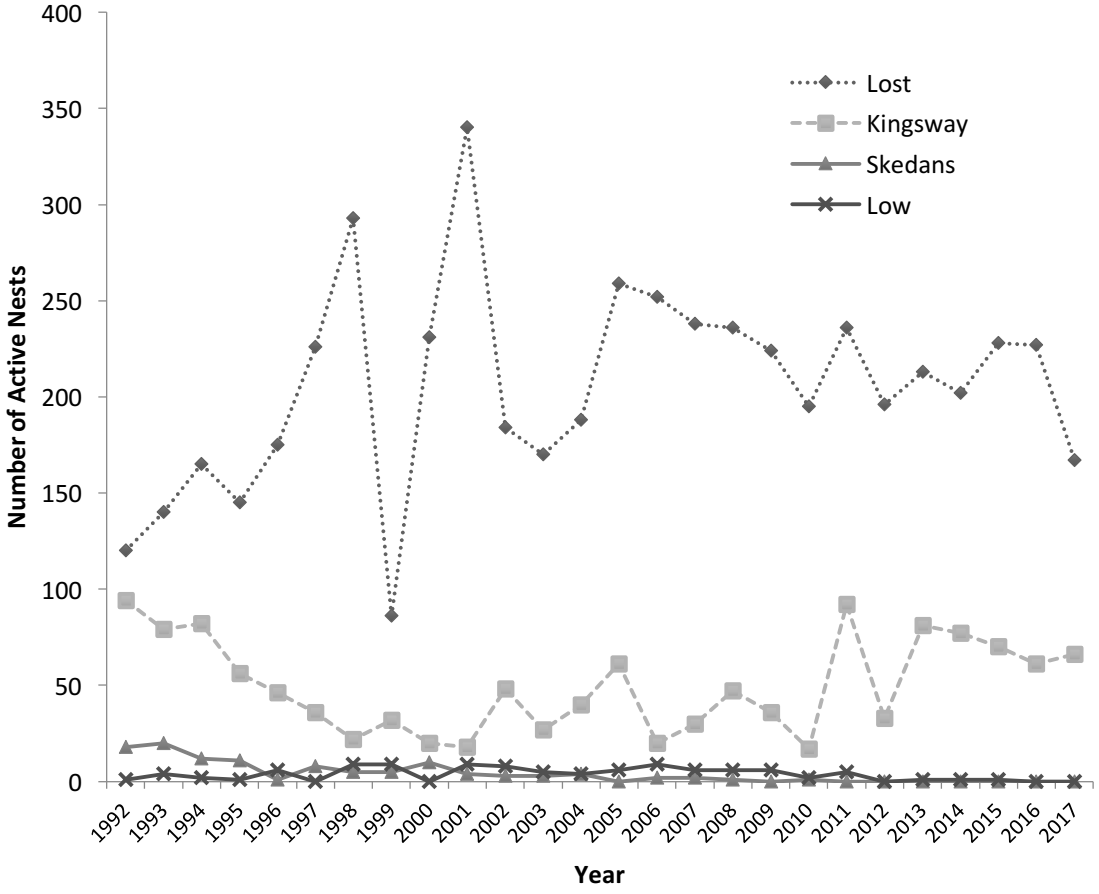

Figure 6. Glaucous-winged Gull nests containing eggs or chicks at four colonies in Laskeek Bay, 1992-2017.

Pigeon Guillemots *Cepphus columba*

Nestboxes

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.

We had to modify our nestbox project this season due to abandonment of eggs for two seasons in a row. We wanted to determine the reason for abandonment, so continued to monitor a sample of the boxes. Last season, due to the speculation that temperature within the boxes may have been a factor, we placed temperature loggers in the boxes, and shaded all the boxes. This season we again put out the temperature loggers, but based on

information gained in 2016 we do not think temperature is the reason for the adult birds abandoning their chicks and eggs.

Last year, we suspected that a predator was the likely cause of abandonment, so this season, beginning in early May, we set up multiple cameras to monitor the area where the boxes are located: two time-lapse cameras (Plotwatcher Pro) and one motion activated infrared camera (Reconyx PC900). We discovered that ravens were visiting the boxes and sticking their heads into the entrances of the boxes, beginning in mid-May, so we decided to close most of the boxes by putting plywood over the entrances or rocks in the entrances. We did leave 9 boxes open: 5 adjacent to one another, so we could continue monitoring activity at the boxes with cameras and try to determine what exactly was happening to deter the adults from returning to the boxes after they had laid eggs, and 4 others that already contained one egg each on the date that we visited the boxes to cover the entrances.

The camera monitoring showed us that, although ravens were visiting the boxes, they were unable to enter them. In mid-June, the cameras captured several sequences of a river otter visiting the boxes, and actually entering the boxes. We now suspect that a small river otter was able to enter the boxes and predate on incubating adult birds, and that the ravens were scavenging in the area due to this predation. We are optimistic that, next year, we can eliminate otter predation from the nestboxes by reducing the size of the box entrances, and possibly by other otter-deterrent methods.

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 (Figure 7). 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 look like Pacific sand lance and a type of reddish-brown blenny.

Figure 7. Examples of photos of Pigeon Guillemots sitting on the water with two different types of fish, that they will eventually deliver to their chicks.

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 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 nestbox 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 nestboxes were monitored again this year at both Lookout Point and at the East Coast plots. Knock-down sticks were placed at the entrances of all nest boxes early in the season and were checked every 4-5 days. 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 with multiple consecutive records of knockdown activity were checked for chicks. In late May, 6 boxes had signs of activity: 4 with Cassin's Auklets (either incubating adults or chicks), one with a cold abandoned auklet egg, and one with an incubating Ancient Murrelet. This was the same box that Ancient Murrelets had successfully hatched chicks in last year and the year before. It was checked again in June and hatched murrelet eggshells were again found. Two auklet chicks successfully fledged this season, and one chick was banded before it fledged. One egg was abandoned before it hatched, and one chick died. We checked all chicks for ticks on their feet this season, in order to contribute any findings to researchers studying ticks on seabirds, but we did not find any ticks on the auklet chicks during any of the checks.

The amount of Fork-tailed storm-petrel activity this season seemed lower than in 2016. Storm-petrels were heard on 18 nights throughout the season. In 2016, they were recorded on 40 nights during the season. This change is partially due to our change in ANMU monitoring protocol this year; because we did not stay up to monitor for ANMU chicks every night, we were not awake as often late at night, when storm-petrels are active in the colony. Last year, storm-petrels were heard frequently at night during the murrelet season, and many were very close to the cabin and in the forest behind ANMU chick funnel 7, but this year we usually heard them farther away, in the areas northeast of funnel 6 and near Lookout Point. A volunteer also heard storm-petrels calling near Boat Cove on one night in May.

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 undertaken this year; 10 May, 28/30 May, 24 June and 16/17 July. On these surveys we counted 22 species: Bald Eagle, Peregrine Falcon, North-western Crow, Common Raven, Tree Swallow, Belted Kingfisher, Marbled Murrelet, Pigeon Guillemot, Ancient Murrelet, Rhinoceros Auklet, Cassin's Auklet, Common Murre, White-winged Scoter, Long-tailed duck, Common Merganser, Pelagic Cormorant, Common Loon, Pacific Loon, Glaucous-winged Gull, Black Oystercatcher, Red-necked Phalarope and Red-necked Grebe.

The highest Marbled Murrelet count was during the 28/30 May survey, when we recorded a total of 79. During the other surveys we counted a total of 33 Marbled Murrelets (10 May), 11 (24/25 June) and 30 (16/17 July). These numbers are quite low compared to last year: 65, 87, and 53 Marbled Murrelets in three surveys. Along with low numbers of Marbled Murrelets, during the surveys we noticed Ancient Murrelets much closer to shore than we normally see them: several groups were seen multiple times in Cumshewa Inlet, and along the Louise Island shoreline transects south of East Limestone Island.

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. We completed one Hecate Strait survey this year, on 6 July. On this survey we recorded 8 Species: Cassin's Auklet, Rhinoceros Auklet, Common Murre, Ancient Murrelet, Pigeon Guillemot, Glaucous-winged Gull, Red-necked Phalarope, and Peregrine Falcon.

Marine Mammals

We kept a daily record of all marine mammal sightings, with the exception of harbour seals (*Phoca vitulina*). Harbour seals and Steller's sea lions (*Eumetopias jubatus*) are counted at specific haulouts 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.

Table 4. Total counts of marine mammals from sea surveys, sea watches, and incidental sightings, 2006-2017†. 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	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006
Northern elephant seal	*Mirounga angustirostris*	0	2	0	0	0	0	0	0	0	0	0	0
California sea Lion	*Zalophus californianus*	0	0	0	4	0	0	1	1	0	0	4	0
Humpback whale	*Megaptera novaeangliae*	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
Grey whale	*Eschrichtius robustus*	2	3	0	0	1	1	1	0	0	0	0	1
Minke whale	*Balaenoptera acutorostrata*	2	9	4	3	6	2	1	0	0	1	3	1
Killer whale	*Orcinus orca*	45-60	47	50	26	16	13	49	11	14	18	26	4
Harbour porpoise	*Phocoena phocoena*	14-15	7	13	31	7	4	19	0	10	0	1	4
Dall's porpoise	*Phocoenoides dalli*	0	0	0	0	0	0	8	0	0	0	0	0
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	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 some years. For example, in 2014, it was not uncommon to count 40 whales during 1 sea watch. This year, we did see humpbacks in the area, but often only single whales or at most 2 or 3 together.

Killer whales

There were 10 sightings of killer whales in Laskeek Bay this season. We were able to take ID photographs during eight of these encounters. Our ID photographs are sent to the killer whale database at the Pacific Biological Station in Nanaimo. We encountered a large group of Orcas on a sea survey in July that were breaching, tail slapping and spyhopping. This group moved from the most northerly of the Skedans Islands to the Kuuna village site. We were able to record 26 minutes of their vocalizations with our hydrophone.

Steller's sea lions

There are several sea lion haulouts in Laskeek Bay. The largest of these is on the east end of Reef Island. There are also smaller haulouts on the Skedans Islands, Cumshewa Rocks, and Helmet Island. We regularly count the number of individuals on the Reef and Skedans haulouts. The maximum number counted this season was 393 individuals at Reef (12 June) and 81 at Skedans Islands (10 May). We had one sighting of a branded sealion (F1019) at Skedans Haulout (17 May). This sealion was marked as a pup in 2001, on Forrester Island, Alaska (NOAA Fisheries, 2017). It is a female, and would now be 16 years old. We also sighted a bull on the outer rock of Reef Island with debris tightly wrapped around its neck. Although sometimes sighted at the haulouts with the Steller's sea lions, no California sea lions were seen this year.

Other species

Three other less-common marine mammal species were sighted this season: minke whales (2 sightings), harbour porpoises (11 sightings of 14-15 individuals) and grey whales (2 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 169 wildlife trees have been identified over the past 28 field seasons.

This year we found a total of 15 active trees, containing 16 nests of 4 different species. Six new trees were identified. Twelve nests were occupied by Red-breasted Sapsuckers (RBSA), one by Chestnut-backed Chickadees, one by Hairy Woodpeckers, and one by Northern Flickers (Table 5). Consistent with last year, a Northern Flicker pair and a Red-breasted Sapsucker pair were found nesting in separate cavities in the same tree (Tree #153). Flickers have nested every year since the blowdown event of 2010/2011, but prior to that were very infrequent. This could indicate a preference for the more open forest, or could indicate an increase in food supply (insects). 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 (12) is the largest since 2011, 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 2017. 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	14-June	17-June
116	CBCH	Ss	16-June	18-June
129	RBSA	Hw	14-June	16-June
131	RBSA	Hw	14-June	17-June
145	RBSA	Ss	18-June	20-June
149	RBSA	Ss	10-June	15-June
150	RBSA	Hw	17-June	19-June
153	NOFL	Ss	27-June	1-July
153	RBSA	Ss	12-June	17-June
156	RBSA	Ss	18-June	19-June
164	HAWO	Hw	1-June	4-June
165	RBSA	Ss	8-June	17-June
166	BRCR	Ss	10-June	12-June
167	RBSA	Ss	21-June	23-June
168	RBSA	Hw	17-June	19-June
169	RBSA	Ss	06-June	12-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 through 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 2 active Bald Eagle nests on East Limestone Island: one at Cassin's Tower (BAEA-5) with one chick, and the other at North Cove (BAEA-10). The chick in BAEA-5 was observed on 30 May, but then was never seen in the nest again, although several thorough hour-long watches of the nest were undertaken. At BAEA-10 at least 1 chick was observed making noise and sitting in the nest. This chick was consistently seen and heard in the nest up until a few days before we left ELI at the end of our season, and was most recently seen and heard on 17 July. Strangely, a few days before we left camp on the 22 July, volunteers watched the nest for over an hour and reported that no chick was seen or heard. We are unsure what would have happened to it because it would likely have been too young to fledge at this point.

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 9 years (1990-1998), an active nest was observed in all years except 1992. During the next 8 years (1998-2006) there was no nesting activity observed. For the next 7 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. We checked the Peregrine Falcon nest on the south cliffs on 24 May, and observed 2-3 downy chicks. We checked the nest again on 19 June, and saw one young falcon almost ready to fledge. Soon after, we often observed 3 falcons flying together above East Limestone.

As in past years, one pair of Common Ravens nested on the island. The nest was in the newest nest site (CORA-3) that has been used since 2013. One chick was observed in the nest on 22 May, and one was observed fledging on 26 May. Soon after (6 June) 3 young birds and 2 adults were observed away from the nest, and for the rest of the season we regularly observed 3 juvenile ravens with the 2 adults.

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 65 species over 77 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 terrestrial species were recorded this year as well, such as Wilson's Warbler, Sharp-shinned Hawk and Tree swallow. Migratory duck species including White-winged and Surf Scoters, Northern Pintail, and Long-tailed Duck were observed, and shorebirds such as Black Turnstones. Some notable sightings were of a huge flock of approximately 150 Whimbrels migrating in "V" formation, a Eurasian Collared Dove (an introduced species that has recently arrived on Haida Gwaii) perched above the cabin in a large spruce tree, and many Red-necked Phalaropes during boat trips.

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 8). 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 8. 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, 2017 (c).

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 (*Anemome multifida*). Showy Jacob's ladder and cut-leafed anemone were found to be blooming in late May, on the cliffs in Boat Cove. A new Richardson's geranium plant was observed at Lookout Point, and was seen blooming on 18 June. Northern starflower (*Trientalis artica*) was again seen blooming in North Cove by the old

banding shed. The 2014 discovery of northern starflower was the first record of this flower in Laskeek Bay. We are attempting to keep better documentation of the location of rare plants found on ELI, so this season we began 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. This season, 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. This season we observed it 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 invasives 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 invasives as possible. We also removed thistles along the Louise Island shoreline where students camp when they come to ELI for Project Limestone.

From 2014 to 2016 staff and volunteers pulled several large patches of bull thistle and removed as many easily accessible thistles as possible along trails. In 2017, we revisited many of the same sites and pulled the two species of thistles and marsh cudweed. They were disposed of by burning or for the largest piles, by wrapping the plants in plastic. We revisited a site where we had used this method in 2014, and determined that wrapping plastic around the plants and allowing them to compost was a successful method of disposal. After four seasons of removal, there seems to be a reduction in the number of thistles on the island, and with continued removal in the future we hope to provide more habitat for the native and rare plant species that grow on East Limestone Island.

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 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 10 February and 6 May. The cameras were moved to Reef Island on 9 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 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 1, 4, 5, 6, 11 and 21 were sighted. The skeleton of deer number 17 was found on the north-west point of ELI; it had likely been dead for quite some time.

On Limestone Island, there are now two deer exclosures, one remaining since the blow-down in 2010 and a new one which was built on 22 March of 2015 (Figure 9). 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 9. Deer exclosure on East Limestone Island, 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 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 10 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 4 May. No raccoons were photographed during this time. On 9 and 10 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, 5 raccoons were sighted (although one was very far away and could have been a deer) and 3 were killed.

Monitoring for raccoons continued throughout the field season, with one or more cameras that were baited and checked regularly. Boat Cove was monitored continuously from 10 February until 17 July, North Cove and Crow Valley from 10 February to 6 May, and Cabin Cove 10 February to 6 May and 3 to 17 July. 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.

This is not the first year that ravens have been attracted to the cameras due to the sardine cans used as bait, but it is the first year that they have managed to pry open the sardine cans and remove the contents. The bait cans at Boat Cove and Cabin Cove were the only ones that were affected. We modified the placement of the sardine can at Boat Cove when we realized this was happening, by placing the holes in the can on the side facing the tree it was nailed to, and by moving the can farther up the trunk of a tree, where ravens could not perch and peck at the can. These modifications were successful, and the ravens were not able to open the cans again.

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. Thirteen squirrel surveys were completed this season.

In 2017, we set up a small experiment in response to concerns about how squirrels may be impacting Ancient Murrelets. There has never been observations of squirrel predation on murrelet eggs, but because it is known that squirrels will predate on small eggs, we decided to set up some camera traps with larger eggs to see if squirrels will attempt to predate on them, or if they are even interested in larger eggs. We used 6 Reconyx cameras, set up in 2 locations with evidence of squirrel activity: near the cabins, along the main trail at ~100 m, and in Crow Valley, along the trail near the beach. At each location there were two cameras pointed at whole chicken eggs, and one camera pointed at an Ancient Murrelet egg. The murrelet eggs had come from a burrow with abandoned eggs, which had been found during the Ancient Murrelet census. This setup was left for a few days, and then we returned and put holes in the eggs, to see if the smell changed the way the squirrels interacted with the eggs.

Unfortunately, ravens took all three eggs at the Cabin Cove location on the first day the experiment was set up. At the Crow Valley location, squirrels were observed passing by the eggs, and in one case sniffing around the area where the egg was placed, but there were not photos of squirrels actually at the eggs, or in any way trying to eat the eggs (Figure 10).

Figure 10. A squirrel passing by a chicken egg left out in the open during an experiment to see if squirrels will try to predate on large eggs.

Marine Debris Removal

In 2016, we began documenting, collecting, and removing marine debris from several beaches in Laskeek Bay. In 2017, we continued this project. We conducted accumulation surveys, based on National Oceanic and Atmospheric Administration (NOAA) protocols, on three beaches on Louise Island and on the Crow Valley beach on East Limestone. These were the same beaches that we had removed debris from in 2016, and we did notice a reduction in debris, although there was still 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. We also collected debris from several locations that were not large beaches. We collected several garbage bags of debris on both South Low Island, in the bay on the east side, and on the east side of the most westerly Skedans Island.

CONCLUSION

This season was our 28th 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 28 chicks in 2017). 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. 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 Limestone Island colony. We are in the process of completing a census of the whole colony to try to determine if it is a very localized decline just in Cabin Cove, and we will continue to work on determining if 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 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. LBCS hopes to continue to implement and incorporate island restoration techniques in future field seasons, such as invasive plant control, raccoon monitoring, and social attraction. We are participating in the development of a bio-security plan to address some of the ongoing issues of introduced species. We are also beginning to discover the possible impacts of changes in climate as warmer oceans change the 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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