# Pacific Great Blue Heron Population and Monitoring

# Vancouver Island and the Gulf Islands

# 2013 - 2015

By
Trudy Chatwin,
Travis Heckford,
and Emily Barnewall

Prepared for Ministry of Forests, Lands and Natural Resource Operations
and the Heron Working Group
Nanaimo, British Columbia

Wildlife Working Report No. WR-124
March 2017

*Wildlife Working Reports frequently contain preliminary data, so conclusions based on these may be subject to change. Working Reports receive little review. They may be cited in publications, but their manuscript status should be noted. Copies may be obtained on-line from http://www.env.gov.bc.ca/wld/ or from the Ministry of Forests, Lands and Natural Resource Operations, Ecosystems Branch, P.O. Box 9338 Stn. Prov. Govt., Victoria, B.C. V8W 9M1.*

© Province of British Columbia 2017

ISBN: ISBN 978-0-7726-7003-8

Date: March 2017
British Columbia Ministry of Forests, Lands and Natural Resource Operations
Pacific Great Blue Heron population and monitoring, Vancouver Island and the Gulf Islands 2013-2015 [electronic resource]

Cover photo
Pacific Great Blue Heron by Bill Pennell

CITATION

Chatwin, T.A., T. Heckford, and E. Barnewall. 2017. Pacific Great Blue Heron Population and Monitoring Vancouver Island and the Gulf Islands 2013 – 2015. B.C. Minist. For., Lands and Nat. Resour. Operations. Wildl. Working Rep No. WR-124. Nanaimo, BC. 36pp.

## ACKNOWLEDGMENTS

This project could not have been be completed without the help of the many volunteers that provided updates for their local colonies, including Tseycum Band, Aziza Cooper, David Manning, Thomas Munson, Bruce Obee, Vance Rosling, Roland and Halina Rocchini, Kristen Bill, Tania Tripp, Barbara Steffler and Gary Wick, Vaughan Blackman, Dave Lindsay, Dan Bose, Jenna Cragg, Erica McClaren, Honica Zylstra, Laura Matthias, Kerri and Roger Talbot, Rose and Joe Drixler, Liz Ciocea, Mrs. Knighton, Liz Hammond Kaarremaa, Heather McCubbin, Rob Kernachan, Ted Perry, Sandra Gray, Kaitlyn Girard, Steve Gower/Elaine Thompson, Jeff Shatford, Sue Powell, Connie Haist, Jim Halvorsen, Barbara Cornman, Marcus Smith, Maj Birch and volunteers with the Mountainaire Avian Rescue Society, Robert Argull, Claire Guest, Mac Willing, Sharon Godkin, Molly Hudson, Ronald and Reanna Shelling, Michael Berti, Heather Kellerhalls, Frank Sheran, Anthony Smitherton, Ron Dixon, Holly Clermont, Deborah Sunberg, Betty Russell, Ann Cobas, Sabina and Dennis Mense, Anne Marie Koch, Robin and Dorothy Budd, Wendy Kotilla, Chris Chutter, Sharon Ringel, Brian Mews, Jeff Whetter, Wendy Tyrell, Terry Morrison, Katy Fulton, and Olive Pool.

Ruth Joy provided the R script that was used in previous heron reports and aided in the statistics for this report.

Thank you to Ron Diederichs, Janice Anderson and Brendan Anderson for reviewing the report.

## SUMMARY

The Pacific or Great Blue Heron *fannini* subspecies winters and breeds on Vancouver Island, within 10 km of the marine shoreline. Its visibility and close connection to the Salish Sea make it an important conservation species, and it is listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as a Species of Special Concern due to population concerns and threats associated with urban development. The Province of B.C. has coordinated monitoring of Pacific Great Blue Heron colonies on Vancouver Island and the adjacent Gulf Islands from 1997 through 2015. We trained volunteer stewards and technicians to follow a standardized methodology for locating and assessing heron colonies and counting active nests. We follow a sample of visible nests to determine nest success and productivity of young herons (those that lived until fledgling-age). The data are housed at the B.C. Ministry of Environment Wildlife Species Inventory website and are provided to local governments and interested parties to support conservation bylaws and urban planning.

Each breeding season, we assessed between 19 and 37 colonies and analyzed the population variables to provide indications of Pacific Great Blue Heron population viability. This report focuses on the survey results from the 2013–2015 Pacific Great Blue Heron breeding season. Long-term trends from 2002 to 2015 are also included. From 2002 to 2015, overall colony success rate ranged from a low of 43% in 2008 to 90% in 2010 with an average of 66 ± 7%. The number of active nests in the study area does not show a significant trend with a mean of 540 ± 26 active nests annually. Nest success in sampled nests ranged from a low of 30% in 2005 to 100% in 2015 with an overall average of 65% ± 11%. Vennesland and Butler (2008 COSEWIC report) estimated that at least 63% of active nests would need to fledge young to maintain Pacific Great Blue Heron populations. This occurred in 9 of 14 years analysed. As well, the average annual productivity on Vancouver Island was 1.4 chicks per sampled nest. In only three years (2006, 2010 and 2012), the productivity exceeded the 1.9 chicks per nest population maintenance threshold estimated by Henny and Bethers (1971). Immigration of breeding adults from large colonies on the Fraser Delta could be helping to maintain Pacific Great Blue Heron populations on Vancouver Island.

Bald Eagle predation on chicks and adults appears to be responsible for lower productivity and nest success and colony failures. Another factor in the annual variation of nesting success appears to be cool wet springs, which affect egg production and timing of nesting. Pacific Great Blue Heron colonies on Vancouver Island appear to be locating closer to urban centres possibly to deter Bald Eagle predation, but this poses vulnerabilities due to disturbance from noise, tree cutting and various development pressures. We recommend continuing monitoring of Pacific Great Blue Herons on Vancouver Island and Gulf Islands and working with local governments to encourage conservation. Public support could be encouraged through installation of a heron webcam at either the Beacon Hill Park or Cowichan Bay heron colonies. More research on Pacific Great Blue Heron life history is recommended in order to provide valuable population parameters and provide direction for management.

# TABLE OF CONTENTS

1.0 INTRODUCTION ..... 1
2.0 METHODS ..... 2
2.1 Study Area ..... 2
2.2 Nest Site Inventory and Monitoring ..... 2
2.3 Nest and Colony Activity ..... 3
2.4 Data Analysis ..... 4
2.4.1 Colony Success Rate, Nest Success and Productivity ..... 5
3.0 RESULTS ..... 5
3.1 Pacific Great Blue Heron Colony Maps ..... 6
3.2 Annual Colony Summary Data Table ..... 9
3.3 Active Nests, Colony Activity, and Colony Success Rates ..... 10
3.4 Sampled Nest Site Success Rate and Productivity ..... 12
4.0 DISCUSSION ..... 13
4.1 Active Nests and Colonies ..... 13
4.2 Sampled Nests and Fledgling Productivity ..... 14
4.3 Predation ..... 14
4.4 Stewardship ..... 15
4.5 Management ..... 15
5.0 RECOMMENDATIONS ..... 17
6.0 REFERENCES CITED ..... 17
7.0 APPENDICES ..... 20
Appendix A. 2013– 2015 Inventory Photos ..... 20
Appendix B. 2013 – 2015 Inventory Data ..... 28
Appendix C. Sample Data Form ..... 32
Appendix D. Diagrams for Aging Herons ..... 33
Appendix E. Article from the Times Colonist to illustrate some of the issues surrounding Pacific Great Blue Heron Colonies ..... 34
Appendix F. Marine foraging areas in estuaries and shallow beaches, bays along with cumulative nest locations for Pacific Great Blue Herons up until 2002 ..... 35

## List of Tables

Table 1. Pacific Great Blue Heron annual colony summary data from 2002 to 2015. ..... 9

## List of Figures

Figure 1. Pacific Great Blue Heron 2013 colony inventory showing colony status on Vancouver Island and Gulf Islands. ..... 6
Figure 2. Pacific Great Blue Heron 2014 colony inventory showing colony status on Vancouver Island and Gulf Islands. ..... 7
Figure 3. Pacific Great Blue Heron 2015 colony inventory showing colony status on Vancouver Island and Gulf Islands. ..... 8
Figure 4. Number of active nests and active colonies per year from 2002 to 2015. ..... 10
Figure 5. Colony success rate by year from 2002 to 2015 ..... 11
Figure 6. Success rate of sampled Pacific Great Blue Heron active nests by year from 2002 to 2015 ..... 12
Figure 7. Mean productivity of sampled Pacific Great Blue Heron nests by year from 2002 to 2015 ..... 13

# 1.0 INTRODUCTION

The Great Blue Heron (*Ardea herodias)* is one of the largest of the North America wading birds (Butler 1997). Up to five subspecies of Great Blue Heron are recognized, of which two subspecies are found in British Columbia. This report focuses on the field data collected from monitoring *Ardea herodias fannini*, the Pacific Great Blue Heron[1] on Vancouver Island and the Gulf Islands in the years 2013 - 2015.

Pacific Great Blue Heron populations are threatened by loss of nesting habitat through forest harvesting, urban development and degradation of marine foraging habitat (Butler 1997; Gebauer and Moul 2001). The increasing Bald Eagle (*Haliaeetus leucocephalus*) population (Elliott and Harris 2001; Pendergast 2004) on Vancouver Island appears to be linked to high predation rates on heron young and adults at breeding colonies and foraging grounds (Butler 1997; Gebauer and Moul 2001; Vennesland and Butler 2004; McClaren 2005; Chatwin *et al.* 2016). In marine foraging grounds, heron indirectly ingest contaminants from air and waste pollution through the fish they consume. Herons feeding in estuaries in close proximity to wood-processing mills and urban areas are particularly affected by persistent organic contaminants, such as polychlorinated biphenyls (PCBs) (Nichol *et al.* 2000). Due to these threats and concern over population parameters (including low productivity, a decrease in wintering herons (Crewe *et al*. 2012) and Christmas Bird Counts (D. Preikshot, pers. comm.), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has maintained the Pacific Great Blue Heron as a species of Special Concern since 1997 (COSEWIC 2008). This subspecies is on the provincial Blue list in British Columbia (B.C. Conservation Data Centre 2016).

The Great Blue Heron, along with its nests, eggs, and young, are protected under the legislation of both the federal *Migratory Birds Convention Act* and the provincial *Wildlife Act*. Section 34 of the British Columbia *Wildlife Act* also protects the nest tree of the Great Blue Heron. The *Forest and Range Practices Act* allows for the protection of Wildlife Habitat Areas for Pacific Great Blue Herons on Provincial Forest Land (there is one existing Wildlife Habitat Area at Sointula, on Malcolm Island.) In addition to this provincial and federal legislation, many municipalities and regional districts have bylaws requiring development permit areas to protect the natural environment, its ecosystems and biological diversity. For example, the Cowichan Valley Regional District has Bylaw 3083 Section 13.6 Habitat Protection Development Permit Area for the Cowichan Bay heron colony (Cowichan Valley Regional District 2008). Development permit areas consider Pacific Great Blue Heron colonies by requiring non-disturbance buffers be retained around a colony with the intention of maintaining habitat around the nest sites and separating the colony from potential disturbances during the sensitive nesting period.

Population trends for the Pacific Great Blue Herons are somewhat challenging to determine precisely. Before 2002, historical data on colony size, nesting success, breeding activity, and productivity were collected using non-standardized methods and variable effort (Dodd and Murphy 1995; Gebauer and Moul 2001). However, recent tracking of the heron populations, and the shifting locations of their colonies, has been successful largely due to high interest from the public and consistent provincial data gathering and coordination. Staff from the B.C. Ministry of Environment, Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) and B.C. Conservation Foundation (BCCF), in addition to

[1] The Pacific Great Blue Heron is not migratory in winter, as compared to *Ardea herodias* (the inland continental subspecies).

trained volunteers[2], have been conducting standardized Pacific Great Blue Heron monitoring since 2002. This monitoring program provides long-term data and trends on colony size, location, productivity, and evidence of predation in order to inform conservation priorities and management planning. Data are provided to the B.C. Ministry of Environment Wildlife Species Inventory, the B.C. Conservation Data Centre and local governments to ensure protection of data and to promote legal conservation and stewardship around known nesting colonies by municipal and regional governments.

This report focuses on the 2013 to 2015 Pacific Great Blue Heron inventory program on Vancouver Island and the neighbouring Gulf Islands (the study area). Long-term trend data on colony activity, colony success, nest success, and productivity from 2002 to 2015 monitoring information are also included. It is part of a series of Wildlife Working Reports on this long-term heron monitoring program (Chatwin *et al.* 2006; Chatwin *et al.* 2007; Chatwin *et al.* 2009; Chatwin *et al.* 2016).

The objectives of the project are to:

- locate and track Pacific Great Blue Heron colonies on Vancouver Island and the Gulf Islands within the West Coast Region, Ministry of Forests, Lands and Natural Resource Operations.
- obtain measures of Pacific Great Blue Heron population viability including colony success, number of active nests, nest success, and fledgling numbers as a measure of productivity.
- examine long-term trends in numbers of active nests, numbers of colonies, colony success, nest success and productivity.
- work with Provincial agencies, landowners, municipal and regional governments, developers, non-profit organizations, and First Nations to promote stewardship of Pacific Great Blue Herons, nesting and foraging habitat through education and public involvement in the project.

# 2.0 METHODS

## 2.1 Study Area

Data were collected from Pacific Great Blue Heron colonies located on Vancouver Island and the Gulf Islands in MFLNRO's West Coast Region (formerly Ministry of Environment's Region 1) of British Columbia.

## 2.2 Nest Site Inventory and Monitoring

Data were collected from 2002 to 2015 using standardized methodologies, as described by the Resources Information Standards Committee (RISC 1998) and Vennesland and Norman (2006). We surveyed volunteer nest stewards by phone in early spring (March and April) rather than visit colonies to check for early nesting season activity as some colonies are sensitive to disturbance during courtship and incubation. The phone survey included local heron nest stewards of colonies that had been active anytime in the previous three years. Heron nest stewards are generally members of the public that keep an eye on their local heron colony and report to the Ministry on the activity status of the colony. Some colonies were located through tips from the public or when a neighbour reported disturbance to a colony. Field

[2] Trudy Chatwin with B.C. Ministry of Forests, Lands and Natural Resource Operations, Karen Morrison (former B.C. Ministry of Environment biologist), Erica McClaren (B.C. Parks), Ross Vennesland, and British Columbia Conservation Foundation field technicians.

surveys were conducted of nesting sites that appeared to be active during the late incubation to the chick-rearing stage in May through September. Permission from landowners was obtained for colonies located on private land. Each colony was visited at least once, with some colonies visited up to five times during the breeding season to sample nest productivity and success. Colonies sampled for productivity had to have visible nests, be relatively accessible, and be habituated to anthropogenic disturbance. Volunteer nest stewards at Mystic Pond visited sites weekly to observe and collect information on sample nests during the nesting season to assess productivity and predation. "Heron wanted" posters were put up in public places in areas where nesting information was lacking (i.e., where the previous year's heron colony site was abandoned and could not be located in the current survey year) in hopes that someone seeing the poster would have information on the current heron colony location and contact the Ministry.

During the 2013 to 2015 survey period, Trudy Chatwin (MFLNRO Species-at-Risk Biologist), BCCF conservation technicians, and volunteers trained using the RISC standards survey protocol (RISC 1998) conducted surveys. BCCF conservation technicians include Travis Heckford, Katie Bell, and Emily Barnewall. Heron nest stewards and trained volunteers include Tseycum Band, Aziza Cooper, David Manning, Thomas Munson, Bruce Obee, Vance Rosling, Roland and Halina Rocchini, Kristen Bill, Tania Tripp, Barbara Steffler and Gary Wick, Vaughan Blackman, Dave Lindsay, Dan Bose, Jenna Cragg, Erica McClaren, Honica Zylstra, Laura Matthias, Kerri and Roger Talbot, Rose and Joe Drixler, Liz Ciocea, Mrs. Knighton, Liz Hammond Kaarremaa, Heather McCubbin, Rob Kernachan, Ted Perry, Sandra Gray, Kaitlyn Girard, Steve Gower/Elaine Thompson, Jeff Shatford, Sue Powell, Connie Haist, Jim Halvorsen, Barbara Cornman, Marcus Smith, Maj Birch, and volunteers with the Mountainaire Avian Rescue Society, Robert Argull, Claire Guest, Mac Willing, Sharon Godkin, Molly Hudson, Ronald and Reanna Shelling, Michael Berti, Heather Kellerhalls, Frank Sheran, Anthony Smitherton, Ron Dixon, Holly Clermont, Deborah Sunberg, Betty Russell, Ann Cobas, Sabina and Dennis Mense, Anne Marie Koch, Robin and Dorothy Budd, Wendy Kotilla, Chris Chutter, Sharon Ringel, Brian Mews, Jeff Whetter, Wendy Tyrell, Terry Morrison, Katy Fulton, and Olive Pool.

## 2.3 Nest and Colony Activity

Data collected during nesting site surveys included colony location, the total number of nests, the number of active nests, presence/type of activity in the nest, the number of failed nests, the number of young, age of young, number of young at fledgling age, the number of successful nests and evidence of predation (Appendix C).

Generally, field visits were made to colonies that were reported to be active (from phone surveys of volunteer nest stewards). Where practical, all active colonies were assessed, and some sites that lacked concrete information on activity were also visited. For the more remote colonies such as Stories Beach, Port Hardy, nest stewards provided information on nesting activity.

A colony was considered **active** if one or more of the following criteria were met: adults were seen incubating; young were observed within the nest; large amounts of excrement were observed on the ground or on the nest, and/or fresh eggshells were found below a nest when a colony was not occupied. Active colonies were further classified as successful or failed. An **active successful** (**AS**) colony had, at least one nest that fledged young (young aged 6-8 weeks) (McClaren 2005) while an **active failed** (**AF**) colony had activity confirmed during the survey year but did not fledge young. If the fate of an active colony was unknown, it was classified as an **active and not determined** colony (**A/ND**) while colonies that had no evidence of breeding were classified **not active** (**NA**). To facilitate counts of active nests,

nesting trees were marked with flagging tape and numbered with a tree number for that colony along with the year. Nest counts were completed in late June through to August when nesting herons are less sensitive to disturbance.

**Predation** evidence included anecdotal reports and evidence of Bald Eagles, other avian predators, raccoons attacking the colony, observations of destroyed eggs, large piles of feathers and dead young or adults found below nests.

**Productivity** was determined by selecting colonies that had visible nests, were easy to access and familiar with anthropogenic disturbance, could be visited at least twice during the breeding period, and were visited when chicks were at least 6-8 weeks old (fledgling). It is difficult to determine accurate productivity estimates at most sites due to the low number of visits, lack of nest - content visibility, and chick movement if field assessments occurred late in the breeding season. Not all nests and nest contents can be observed in a colony; only nests with reliable visibility were used for estimating productivity. These active nests are called **sample nests**. For the sampled nests, the stage, age of the young and the number of fledgling-aged birds were used to determine the **success** of the active nest (determined by having fledgling-age young of at least six weeks). A failed nest is an initiated nest that had either abandoned or did not have young during a visit during the pre-fledgling stage.

All Pacific Great Blue Heron data, including exact locations and annual colony counts, resides in the Province of B.C.'s Wildlife Species Inventory database (http://a100.gov.bc.ca/pub/siwe/details.do?id=4872) and the B.C. Conservation Data Centre (http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre).

## 2.4 Data Analysis

Summary statistics for colony success, nest success, productivity, and comparisons of colony activity and colony success were calculated in R (R Development Core Team 2016). Long-term trend data includes data from 2002 to 2015, when standardized data collection methods were used. A generalized linear model with Poisson distribution or Quasipoisson in cases of overdispersion (Quinn and Keough 2002) was conducted for trend analysis using the count data. Proportion data was analyzed using Quasibinomial distribution (Crawley 2007). Results are stated in means ± 95% confidence intervals.

### 2.4.1 Colony Success Rate, Nest Success and Productivity

The rate of annual colony success was calculated as the proportion of active colonies that were successful per year. Nest success in sampled colonies was determined by calculating the sum of successful nests divided by the sum of nests sampled ($\sum \frac{Successful\ Nests}{Sampled\ Nests}$) by year (breeding season).

The sum of fledglings per sampled active nest was divided by the total number of sampled active nests in a colony to determine the mean number of fledglings per active sampled nest (sampled colony productivity).

The annual mean productivity is the mean of the sampled colony productivity per year.

## 3.0 RESULTS

Maps from 2013 to 2015 with the general colony locations and their status (active successful, active failed, and active not determined) are found in Figures 1-3.

## 3.1 Pacific Great Blue Heron Colony Maps

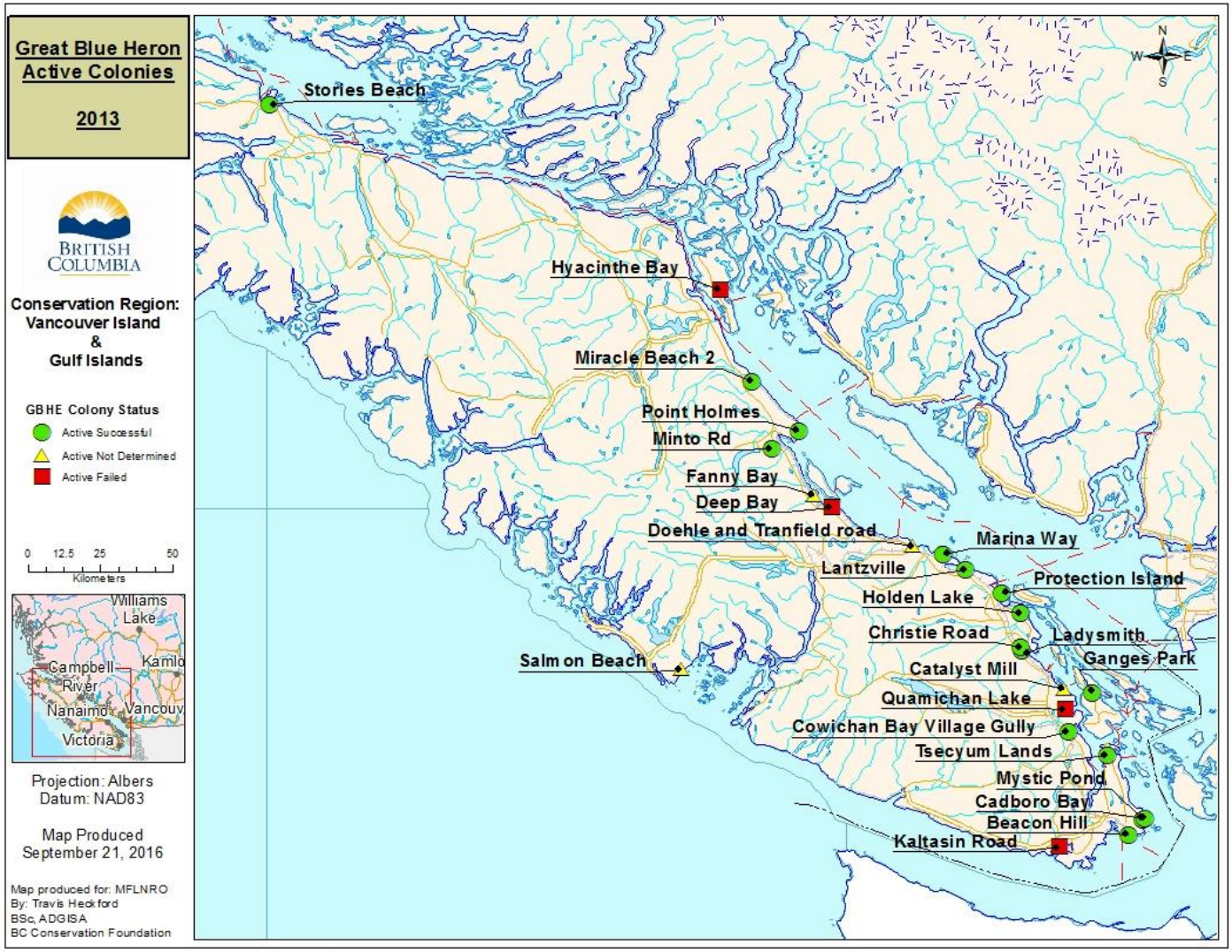



**Figure 1. Pacific Great Blue Heron 2013 colony inventory showing colony status on Vancouver Island and Gulf Islands.**

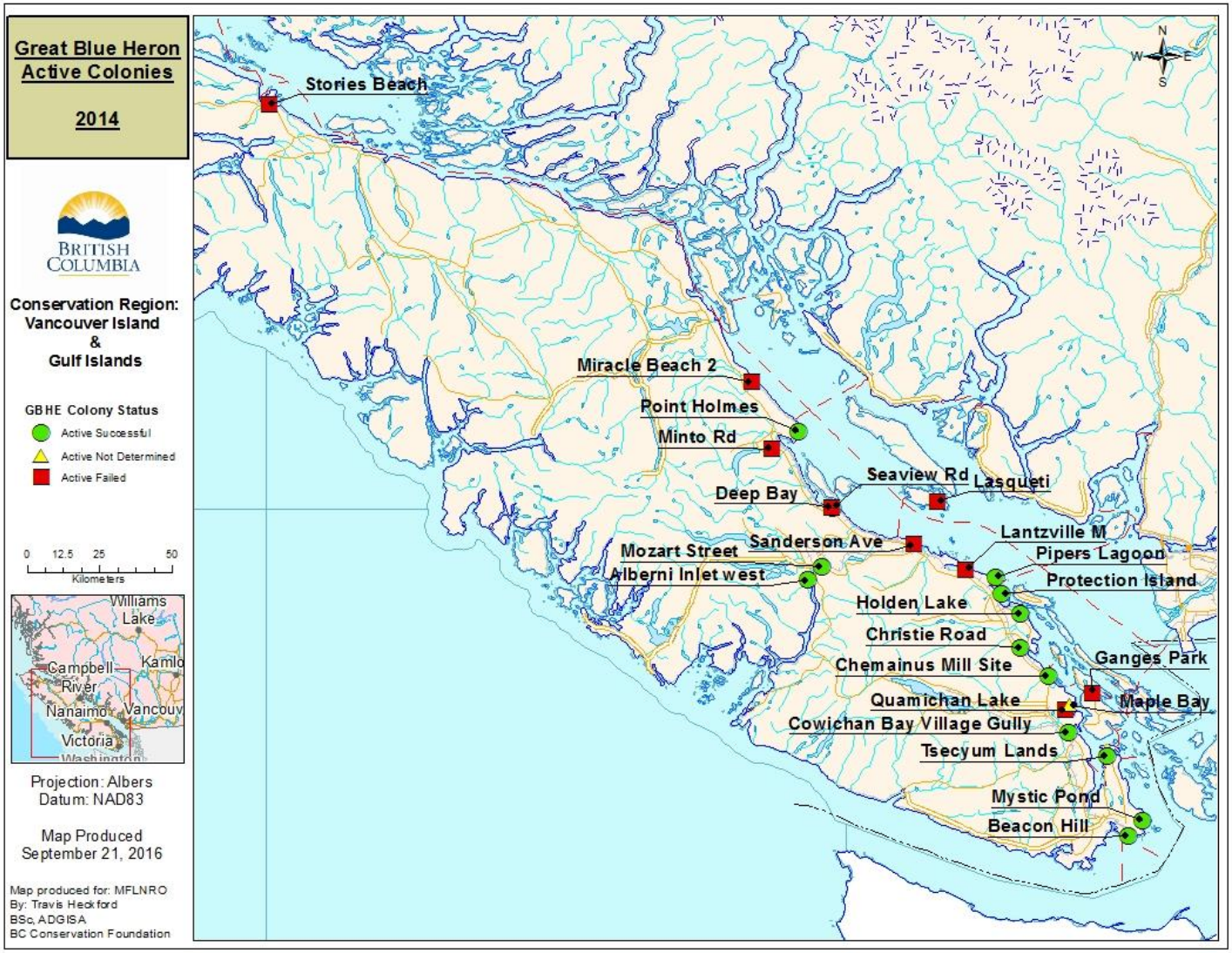



**Figure 2. Pacific Great Blue Heron 2014 colony inventory showing colony status on Vancouver Island and Gulf Islands.**

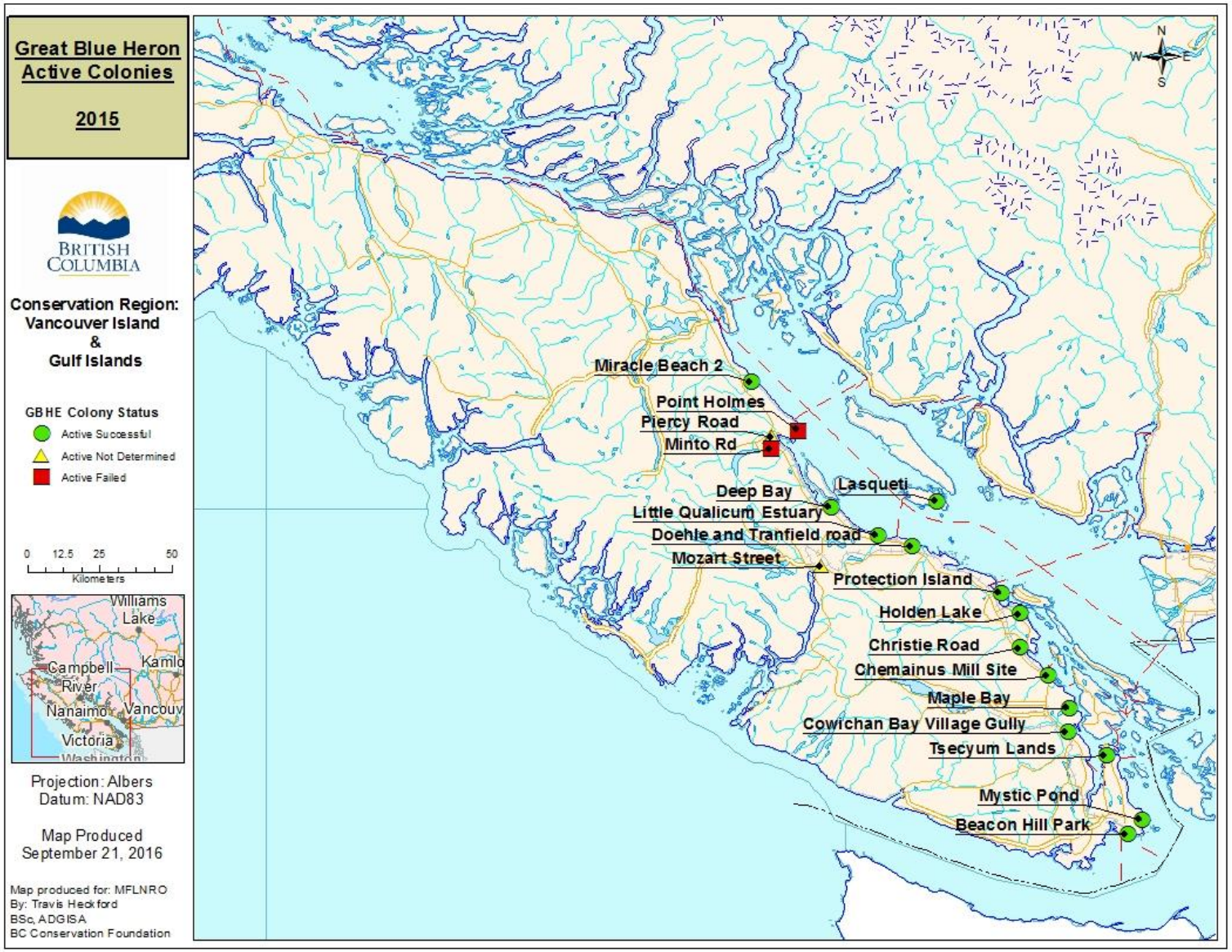



**Figure 3. Pacific Great Blue Heron 2015 colony inventory showing colony status on Vancouver Island and Gulf Islands.**

## 3.2 Annual Colony Summary Data Table

The annual colony summary (Table 1) shows the measures of number of active colonies, active successful colonies, active failed colonies, active status not determined, colony success rate, active nests, sampled nests, nest success rates for sampled nests, and productivity of sampled nests for the years 2002 to 2015. Appendix B reports inventory information on individual colonies by year for the years (2013 to 2015) and previous reports (Chatwin *et al.* 2006; Chatwin *et al.* 2007; Chatwin *et al.*2009; Chatwin *et al.* 2016; McClaren 2005) contain this information from 2004 to 2012.

**Table 1. Pacific Great Blue Heron annual colony summary data from 2002 to 2015.**

| Year | Active colonies | Active successful colonies | Active failed colonies | Active and status not determined | Colony success rate* | Active nests | Sampled nests | Nest success rate | Productivity (chicks/active sampled nest) |
|---|---|---|---|---|---|---|---|---|---|
| 2002 | 36 | 20 | 6 | 10 | 77% | 509 | 225 | 46% | 1.29 |
| 2003 | 27 | 15 | 11 | 1 | 58% | 478 | 382 | 40% | 1.04 |
| 2004 | 24 | 11 | 9 | 4 | 55% | 531 | 379 | 74% | 0.92 |
| 2005 | 37 | 16 | 17 | 5 | 48% | 668 | 448 | 30% | 0.66 |
| 2006 | 37 | 23 | 11 | 3 | 68% | 569 | 69 | 71% | 2.10 |
| 2007 | 33 | 17 | 8 | 8 | 68% | 606 | 67 | 79% | 1.70 |
| 2008 | 31 | 12 | 16 | 3 | 43% | 506 | 117 | 38% | 1.07 |
| 2009 | 26 | 15 | 10 | 1 | 60% | 500 | 149 | 66% | 1.17 |
| 2010 | 22 | 18 | 2 | 2 | 90% | 538 | 125 | 82% | 1.89 |
| 2011 | 24 | 12 | 9 | 3 | 57% | 529 | 132 | 51% | 0.88 |
| 2012 | 22 | 13 | 7 | 2 | 65% | 500 | 36 | 92% | 2.13 |
| 2013 | 24 | 16 | 4 | 4 | 80% | 533 | 60 | 65% | 1.19 |
| 2014 | 24 | 14 | 9 | 1 | 61% | 546 | 86 | 81% | 1.68 |
| 2015 | 19 | 14 | 2 | 3 | 88% | 548 | 29 | 100% | 1.51 |
| Avg | 27.6±3.18 | 15.4±1.73 | 8.6±2.33 | 3.6±1.37 | 66%±7% | 540±25.6 | 164.6±73.1 | 65%±11% | 1.37±0.24 |

*Colony success rate = Active Successful Colonies / (Active Failed Colonies + Active Successful Colonies). Note: this calculation does not include Active and Not Determined Colonies.

### 3.3 Active Nests, Colony Activity, and Colony Success Rates

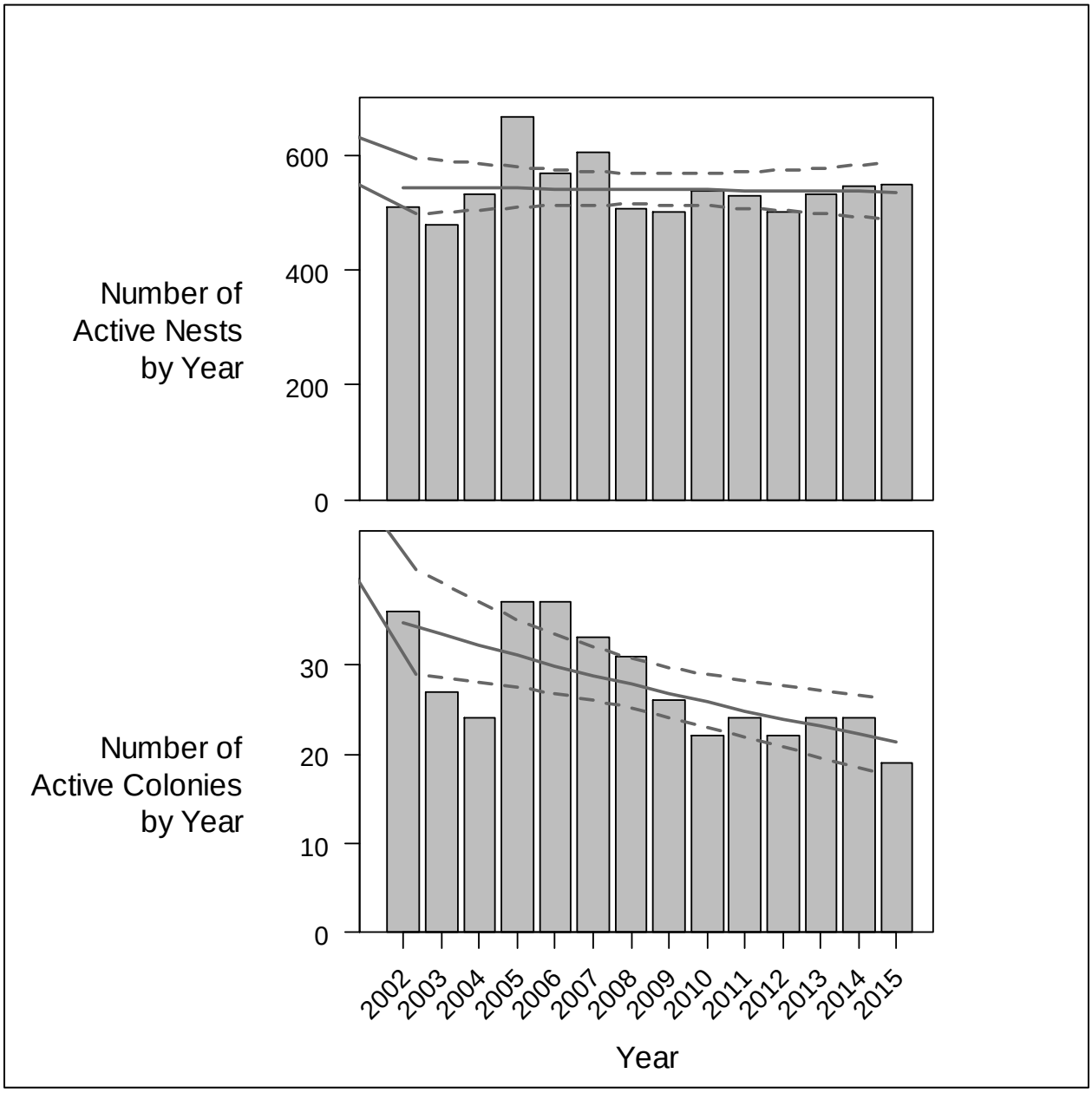



**Figure 4. Number of active nests and active colonies per year from 2002 to 2015.**

In 2013, 30 colonies were assessed for activity, of which 24 were active. Of the 566 nests observed, 533 were determined to be active. In 2014, 31 colonies were assessed, of which 24 were active. A total of 547 nests were active out of a total of 577 nests surveyed. In 2015, 20 colonies were assessed for activity, of which 19 were given an active status. A total of 548 nests were determined to be active out of 603 nests evaluated. Long-term trends show that the number of active nests remains relatively stable ($y = 8.85 – 0.0012x$, $t = -0.205$, $p = 0.841$) while the number of active colonies by year is decreasing ($y = 77.6 – 0.037x$, $t = -2.996$, $p = 0.00274$) (Table 1, Figure 4).

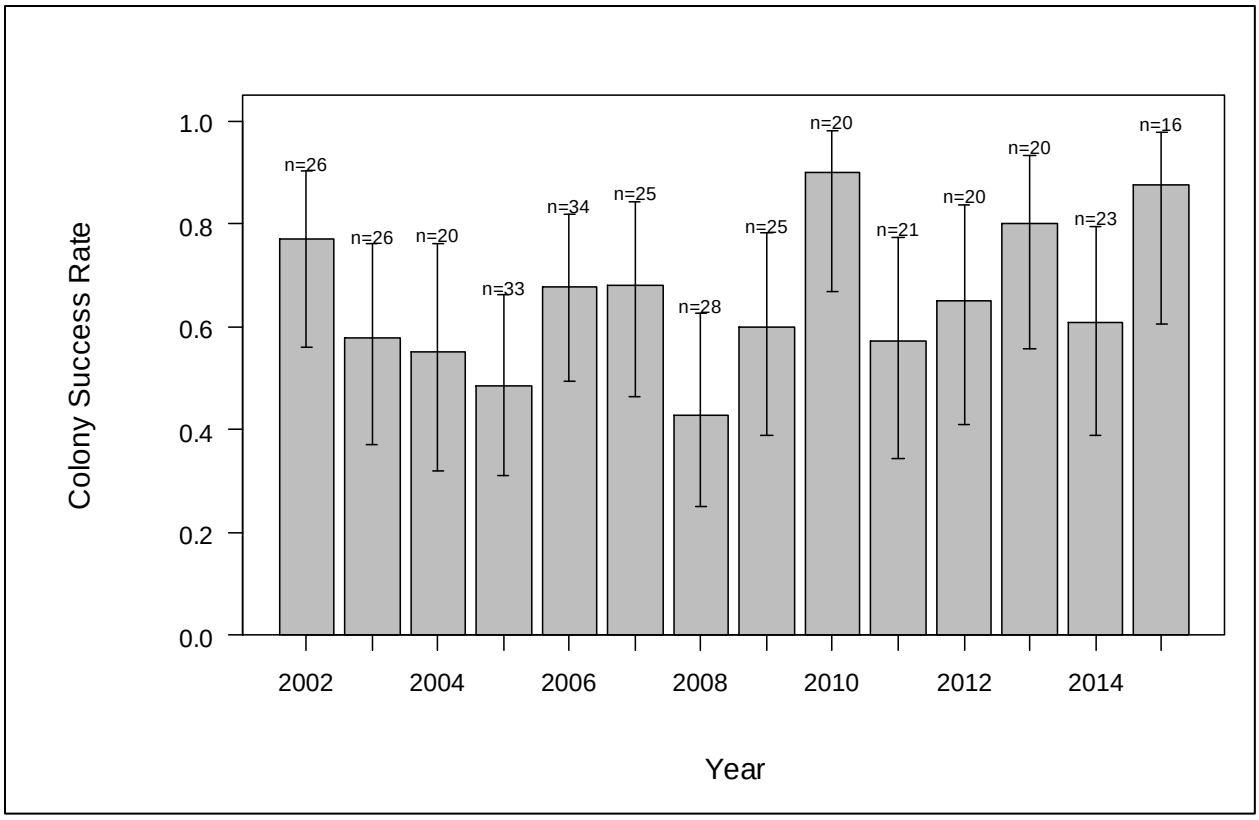



**Figure 5. Colony success rate by year from 2002 to 2015, with 95% confidence intervals and number of active colonies (active successful and active failed colonies).**

In 2013, the colony success rate was determined to be 80% with 16 active successful colonies, 4 active not determined, 4 active failed, and 6 not active. In 2014, the colony success rate was 61%. The range of colony status for 2014 includes: 14 active successful, 1 active not determined, 9 active failed, and 8 not active. In 2015, the colony success rate was 88 % with 14 active successful colonies, 3 active not determined, 2 active failed and 2 not active (Table 1, Figure 5). Long-term trends from 2002 to 2015 show that the colony success rate is stable ($y = -107.27 + 0.05x$, $t = 1.311$, $p = 0.214$). Colony success rate is not significantly different by year ($F = 1.733$, $p = 0.208$).

## 3.4 Sampled Nest Site Success Rate and Productivity

In 2013, 39 sampled nests produced fledglings (chicks 6-8 weeks old) out of the 60 sampled nests for a nest success rate of 65%. In 2014, 70 nests were successful and produced fledglings out of the 86 sampled nests for a nest success rate of 81%. There were 29 nests that produced fledglings out of the 29 sampled nests for a nest success rate of 100% in 2015 (Table 1, Figure 6). From 2002 to 2015, the nest success rate is increasing over time (y = -295.62 + 0.15x, $t$ = 2.539, p = 0.03). Nest success rate is significantly different by year ($F$ = 7.5, p = 0.018).

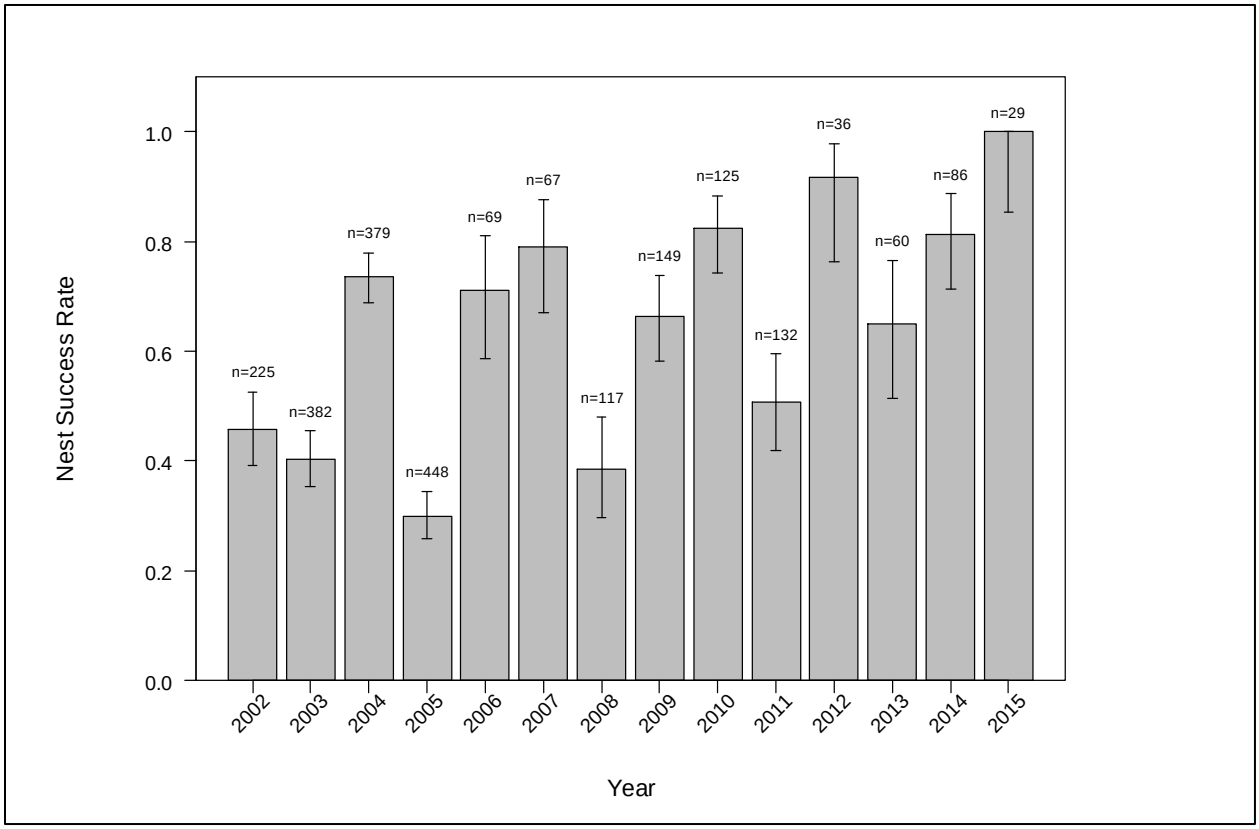



**Figure 6. Success rate of sampled Pacific Great Blue Heron active nests by year from 2002 to 2015 with 95% confidence intervals and number of sampled nests.**

In 2013, sample fledgling productivity counts were conducted at three colonies with a nest productivity of 1.19 fledglings. In 2014, five colonies were sampled for fledgling productivity counts with a resulting nest productivity of 1.68. In 2015, sample fledgling counts were only completed at two colonies and the resultant nest productivity was 1.51 (Table 1, Figure 7). Productivity remains stable from 2002 to 2015 (y = -55.07 + 0.03x, $z$ = 0.486, p = 0.627). Fledgling productivity was significantly different between years ($F$ = 1.82, p = 0.046).

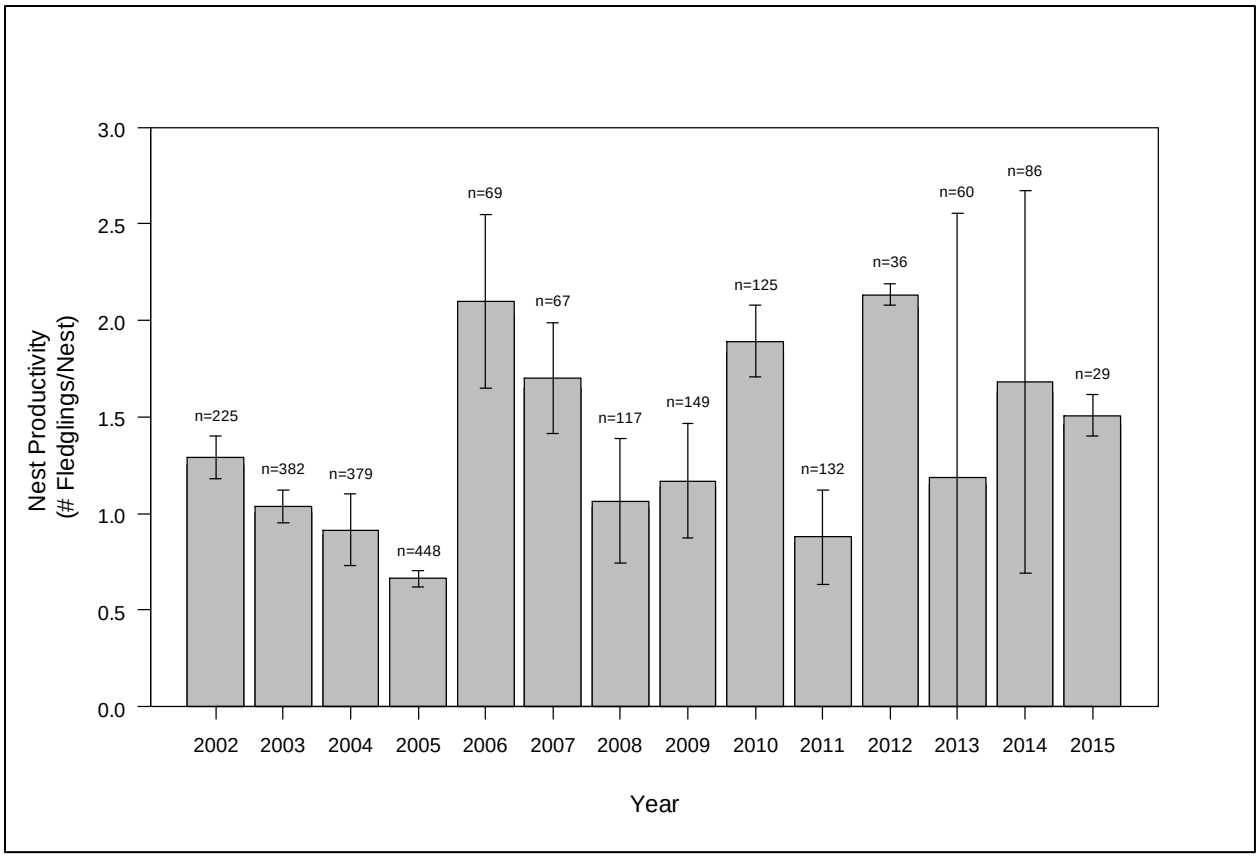



**Figure 7. Mean productivity of sampled Pacific Great Blue Heron nests by year from 2002 to 2015, with 95% confidence intervals and number of sampled nests.**

# 4.0 DISCUSSION

## 4.1 Active Nests and Colonies

Although the odd small colony may escape detection, the annual parameter of number of active nests seems to be a relatively robust indication of Pacific Great Blue Heron populations due to the consistent strong effort in conducting the active nest counts at all colonies. A comparison of the number of active nests per year in the study period 2013-2015 does not show a significant increasing or decreasing trend, with an average of 540 ± 25.6 nests annually. We conducted a linear regression analysis in 2008 (Chatwin *et al.* 2009), using the number of total active nests 2002-2008, and found no significant trend. Since the following years had very similar numbers, the level trend continues into 2015. This is a surprising finding, given the colony predation events at large colonies, low productivity observed in some years (productivity of less than two chicks per year may not replace adults lost) and the loss of most colonies on both the northern (Hornby, Denman, Quadra, Cortez and Broughton Archipelago Islands) and southern (Salt Spring, Galiano, Pender, Gabriola) Gulf Islands. Ross Vennesland (pers. comm.) believes that herons from larger colonies on the Lower Mainland possibly immigrate to Vancouver Island and keep the Vancouver Island population from showing declining numbers of active nests (see also COSEWIC 2008).

There is a decreasing trend in the number of active colonies (Figure 4). This suggests that there are more nests in each colony, as the number of active nests remains relatively stable. In past years, large colonies that failed broke into smaller colonies that same year or the following year. This occurred in 2015 when

the Point Holmes colony failed. The large colony relocated to Piercy Road and Tull Ave colonies in Courtenay. Since nesting failure is more prevalent in small colonies (Butler *et al.* 1995; Vennesland and Butler 2004) than large colonies, when a colony breaks up into smaller colonies, this would negatively affect productivity.

Colony success rates, although quite variable, show a slight upward trend (Figure 5). This could be due to some favourable spring weather periods in 2010 and 2015 (Irvine and Crawford 2013) that warmed surface waters and increased Shiner Perch productivity, which in turn had a positive effect on heron nesting productivity (Butler 1997).

## 4.2 Sampled Nests and Fledgling Productivity

The number of available colonies and stewards for productivity studies is dwindling. To be included in the productivity sample, colonies must be accessible and have good views of nests (to make accurate counts of chicks), visited at least twice, and the birds must be accustomed to some disturbance. It is increasingly difficult to find volunteer nest stewards who are willing to take the time to conduct productivity samples and who can age heron chicks (see diagrams useful for aging chicks in Appendix D). After the sampled heron colonies have been abandoned, new nesting colonies, if located, may not be suitable for productivity surveys (e.g., Protection Island, Cuthbert Holmes Park). Although the nest success rate of sampled heron nests appears to be increasing, it must be noted that due to the small sample size (i.e., five colonies or less were assessed for productivity in 2013 to 2015) the numbers may not be reliable.

An average productivity of 1.9 chicks per active sampled nests is required to keep Pacific Great Blue Heron populations stable (Henny and Bethers 1971). Average productivity over the study period on Vancouver Island (2013 to 2015) is 1.46 ± 0.28 fledglings per nest, which is less than that required to maintain heron populations. Fledgling productivity remains stable over the long-term (2002 to 2015) with an average productivity of 1.37 ± 0.24 (Table 1, Figure 7). As the number of active nests remains stable, despite the low productivity, it is possible that immigration of breeding herons from large colonies on the Fraser River estuary is helping to stabilize populations on Vancouver Island (R. Vennesland, pers. comm.). It may also be possible that winter survival could be greater on Vancouver Island than in Henny and Bether's (1971) study in Western Oregon. More current studies of Pacific Great Blue Heron life history and survival rates through marking herons are necessary to provide better information for evaluating productivity rates and the relationship to the annual number of active nests.

## 4.3 Predation

Bald Eagle predation is likely the main contributor to heron colony abandonment (Vennesland and Butler 2004) (see photos of Bald Eagle predation events in Appendix A). Bald Eagles have been observed feeding on both adults and chicks. Bald Eagle attacks over colonies are very loud as adult herons scream and puff feathers. When herons finally abandon a site, the entire adult colony flies up and circle silently, before flying off.

Nest stewards who hear heron alarm cries during a predation event can become quite concerned. Some nest stewards try various methods to deter Bald Eagle attacks such as banging pots and pans. This seems to deter the Bald Eagles and the herons seem to tolerate the noise. For example, this technique has worked successfully at the Protection Island and the Ladysmith colonies. However, not all interactions with Bald

Eagles have negative consequences. Iain Jones (2013) studied Pacific Great Blue Herons at the large Tsawwassen colony (approximately 400 nests) in Boundary Bay. He concluded that colonies that lie within 250 m of a Bald Eagle nest have been provided with some "predator protection", where the nesting Bald Eagles actively defend their nesting territory from other juvenile Bald Eagles that may be trying to attack the heron colony. Predator protection may increase fledging productivity by 0.5 - 0.7 fledglings per nest (Jones *et al.* 2013). Note that this phenomenon has not been observed on the Vancouver Island colonies. The Piper's Lagoon colony and an older Crofton colony had nesting Bald Eagles but both of these colonies failed. On Vancouver Island, Bald Eagle predation may be driving colony movement to sites closer to human settlement and development where herons feel safer (Lima and Dill 1990). However, urban heron colony locations inevitably have human disturbance- and development pressure-related conflicts (See Appendix E for newspaper article).

## 4.4 Stewardship

Engagement of heron stewards is an important aspect of heron management on Vancouver Island and the Gulf Islands. Heron stewards tend to take an active role in protecting their heron colonies by defending colonies against Bald Eagle attacks, delivering injured herons to rehabilitation facilities and reporting development conflicts or nest tree cutting to the local governments. Public outreach campaigns (i.e., putting up 'Heron wanted' posters in areas where heron colony information is lacking) have been a useful tool in reporting heron colonies and in educating the public about herons. Landowners with heron colonies on their property have been provided with stewardship recommendations and information about local by-laws surrounding nest trees where applicable.

## 4.5 Management

As Pacific Great Blue Herons live in the most highly populated part of British Columbia and nest within 10 kilometers of the Salish Sea foraging grounds (Moul 2002; COSEWIC 2008; Moul and Birch 2013; Knight *et al.* 2016) (Appendix F), there are many and varied challenges to conserving herons and their habitat. The main issues have been heron nest tree cutting permits, development pressures and loud noises (e.g., fireworks). Usually the resolution of issues requires working with landowners, municipal and/or regional district governments, conservation or by-law officers and qualified environmental biologists. Knowledge and up-to-date familiarity with the nesting sites and their importance to the heron population is critical to effective responses and decisions. The heron colony management issues have been summarized in previous working reports and continue into 2015 (Chatwin *et al.* 2006; Chatwin *et al.* 2007; Chatwin *et al.* 2009; Chatwin *et al.* 2016).

Local governments including District of Comox, Cowichan Valley Regional District, and City of Nanaimo have been working on including heron nesting trees in Develop Permit Area bylaws. Cooperation with wildlife biologists, local governments and the continued monitoring of heron colonies is very important in order to maintain confidence in guidelines and having the public report infractions of the *Wildlife Act*. The B.C. Ministry of Environment has developed a factsheet for local governments and the public about laws regarding development near heron colonies (B.C. Ministry of Environment 2012): http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare/Fact-Sheet-11-herons.pdf

In 2013, neighbours reported landowners cutting trees very close to the Holden Lake heron colony and the Nanaimo Regional District became involved with regulating this development. However, by far the biggest issue was a new airspace requirement around airports that affected trees around the Wireless Road

and Point Holmes colonies near Comox Airport. Trees near these colonies needed felling and cutting to meet the new requirements. This caused concern to residents and had conservation implications. As well, subdivision of a lot near Cape Lazo prompted review and evaluation of the Great Blue Heron Develop with Care guidelines (B.C. Ministry of Environment 2012) and their applicability to the situation.

In 2014, the construction of "The Cannery" in Cowichan Bay continued into the nesting period of the herons (see news article in Appendix E). This site, located at the mouth of a small creek going into Cowichan Bay is only 30 meters from the heron colony. Since it is such an important colony and heron stewards keep close watch on the birds, this development generated much controversy. MFLNRO staff met with the construction company, environmental consultants and the Cowichan Valley Regional District to develop several recommendations. These include noise reduction guidelines, and a disturbance monitoring protocol for the colony and housing development with the proviso of ability of consultants or the Province to issue a "stop work order" if disturbance was noted. Fortunately, the herons nested successfully and were not significantly disturbed. Cowichan Bay continues to be the largest colony on Vancouver Island.

City of Nanaimo needed to make sewer upgrades near the Protection Island heron colony. Trudy Chatwin, MFLNRO, provided recommendations for timing for this project. The recommended measures involved leaving the upgrade work near the heron colony until late in the season and hiring an environmental consultant to monitor while the noisy excavator worked. In the same year, a landowner with heron nests adjacent to his property wanted to upgrade his cottage and waterlines. Separate recommendations were made to have the work done outside the nesting period.

Tree trimming near hydro lines at Minto Road colony near Royston caused some controversy with the heron steward. This led BC Hydro to obtain all current heron colony location information from the Conservation Data Centre to avoid future issues.

One of the few heron nest sites on the west coast of Vancouver Island, at Salmon Beach, became controversial when an adjacent landowner reported a heron nest in the area slated for timber cutting. This issue was resolved through working with the forester and Alberni Regional District to amend the cutting plan.

In 2015**,** tree-cutting permits associated with the Comox Airport and heron colonies in the vicinity continued. On another site, residents of Parksville notified MFLNRO regarding a proposed shopping center near the Doehle and Tranfield Road heron colony. Before the neighbors' calls, the location of this small colony was unknown. The colony has been mapped, and the Nanaimo Regional District is now aware of the colony and can take appropriate protection measures for the colony.

The Point Holmes (near Comox) heron colony abandonment was presumed due to Bald Eagle attacks, despite landowner attempts to protect the herons. In June 2015, MFLNRO received reports of herons nesting in a subdivision near downtown Courtney (likely a second nesting attempt by the Point Holmes herons). Some neighbours liked to watch the herons nesting, but others did not like the noise, guano and Bald Eagle attacks. Trudy Chatwin worked with the City of Courtney to provide neighborhood information to alleviate this situation.

One of the long-time stable colonies in Cadboro Bay, Victoria, had development issues in the winter of 2015/16. Neighbouring houses were being constructed during the sensitive early nesting period. Environmental monitoring for disturbance was recommended and the herons returned to nest successfully.

# 5.0 RECOMMENDATIONS

1. Continue the heron monitoring program, focusing on the collection of information on location and active nest counts. Information on productivity of specific heron colonies can be gathered with help from the public (landowners, municipal and regional governments, developers, non-profit organizations and First Nations).

2. Continue the distribution of data to regional districts and municipalities to help them protect existing and establishing colonies.

3. Install a heron webcam for educational outreach as well as research monitoring at either the Beacon Hill or Cowichan Bay heron colonies. These colonies are well established and are perfect locations to educate the public about this species at risk. A webcam with a wide field of view could also be used to monitor and quantify bald eagle predation rates.

4. Investigate Pacific Great Blue Heron survival rates so that population parameters including productivity and nest success can provide better comparisons and indications of Pacific Great Blue Heron population trends.

# 6.0 REFERENCES CITED

British Columbia Conservation Data Centre. 2016. Conservation status report: *Ardea herodias fannini*. B.C. Minist. Environ. Available: http://a100.gov.bc.ca/pub/eswp/ [Accessed 27 Sept 2016].

British Columbia Ministry of Environment. 2012. Fact sheet #11: Great Blue Herons. *In* Develop with care: environmental guidelines for urban and rural land development in British Columbia. B.C. Minist. Environ., Ecosystems Branch, Victoria, BC. http://www.env.gov.bc.ca/wld/documents/bmp/devwithcare/Fact-Sheet-11-herons.pdf [Accessed 19 Jan 2014].

Butler, R.W. 1997. The Great Blue Heron. UBC Press, Univ. B.C., Vancouver, BC.

Butler, R.W., P.E. Whitehead, A.M. Breault, and I.E. Moul. 1995. Colony effects on fledging success of great blue herons (*Ardea herodias*) in British Columbia. Colonial Waterbirds. 18(2):159-165.

Chatwin, T.A., E. Barnewall, R. Joy, S. Ringel, and H. McCubbin. 2016. Pacific Great Blue Heron Population and Monitoring Vancouver Island and the Gulf Islands 2009 – 2012. Prepared for B.C. Minist. For. Lands Nat. Resour. Operations. Wildl. Working Rep. No WR-121. Nanaimo, BC.

Chatwin, T.A., S. Bonar, and M. Kissinger. 2006. Pacific Great Blue Heron Population Monitoring Vancouver Island and the Gulf Islands 2005. Prepared for B.C. Minist. Environ. and the Heron Working Group. B.C. Minist. Environ., Wildl. Working Rep. No. WR-110. Nanaimo, BC.

Chatwin, T.A., L. Cortese, and R. Joy. 2007. Pacific Great Blue Heron population and monitoring Vancouver Island and the Gulf Islands 2006. B.C. Minist. Environ., Wildl. Working Rep. No. WR-118. Victoria, BC.

Chatwin, T.A., T. Dunlop, and R. Joy. 2009. Pacific Great Blue Heron population and monitoring: Vancouver Island and the Gulf Islands 2007 and 2008. B.C. Minist. Environ. Wildl. Working Rep. No WR-119. Victoria, B.C.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2008. COSEWIC assessment and update status report on the Great Blue Heron *fannini* subspecies *Ardea herodias fannini* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON. vii+39 pp.

Cowichan Valley Regional District. 2008. Bylaw No. 3083. A Bylaw for The Purpose Of Amending Official Settlement Plan Bylaw No. 925, Applicable to Electoral Area D – Cowichan Bay. Available: http://www.cvrd.bc.ca/DocumentCenter/View/5059 [Accessed: 7 December 2016].

Crawley, M.J. 2007. The R Book. John Wiley and Sons, Ltd, England. 942pp.

Crewe, T., K. Barry, P. Davidson, and D. Lepage. 2012. Coastal Waterbird Population Trends in the Strait of Georgia 1999-2011: Results from the first 12 years of the British Columbia Coastal Waterbird Survey. B.C. Birds. 22:8-35. Available: http://www.bsc-eoc.org/volunteer/bccws/Resources/BCCWSresults2012.pdf [Accessed: 29 November 2016].

Dodd, M.G., and R.M. Murphy. 1995. Accuracy and precision of techniques for counting Great Blue Heron nests. J. Wildl. Manage. 59:667–673.

Elliott, J.E., and M.L. Harris. 2001. An ecotoxicological assessment of chlorinated hydrocarbon effects on Bald Eagle populations. Rev. Toxicol. 4:1–60.

Gebauer, M.B., and I.E. Moul. 2001. Status of the Great Blue Heron in British Columbia. Wildl. Working Rep. No. WR-102, B.C. Minist. Environ., Wildl. Branch, Victoria, BC.

Henny, C.J., and M.R. Bethers. 1971. Population ecology of the Great Blue Heron, with special reference to western Oregon. Can. Field Nat. 85:205–209.

Irvine, J.R., and W.R. Crawford. 2013. State of physical, biological and selected fishery resources of Pacific Canadian marine ecosystems in 2012. Appendix 2.2: SalishSea. Department of Fisheries and Oceans Canadian Science Advisory Secretariat Research Document 2013/032 vii+140pp. Available: http://waves-vagues.dfo-mpo.gc.ca/Library/348746.pdf (Accessed: 17 February 2017).

Jones, I.M., R.W. Butler, and R.C. Ydenberg. 2013. Recent switch by the Great Blue Heron *Ardea herodias fannini* in the Pacific northwest to associative nesting with Bald Eagles (*Haliaeetus leucocephalus*) to gain predator protection. Can. J. Zool. 91:489-495

Knight, E.C., R.G. Vennesland, and N.N. Winchester. 2016. Importance of Proximity to Foraging Areas for the Pacific Blue Heron (*Ardea herodias fannini*) Nesting in a Developed Landscape. Waterbirds. 39(2):165-174.

Lima, S.L., and L.M. Dill. 1990. Behavioural decisions made under the risk of predation: A review and prospectus. Can. J. Zoo. 68:619-640.

McClaren, E.L. 2005. Pacific Great Blue Heron population inventory and monitoring Strait of Georgia, British Columbia, 2004. B.C. Minist. Environ., Victoria, BC.

Moul, I.E. 2002. Habitat Conservation Trust Fund Coastal Great Blue Heron Monitoring and Management Program, Final Report, 2001 Breeding Season. Unpubl. rept.

Moul, I.E., and M.J. Birch. 2013. Great Blue Heron Foraging Study, Comox Valley and Oyster Bay 2013. Unpubl. rept. 23pp.

Nichol, L., L. Wilson, and J. Elliott. 2000. Marine and estuarine birds of the Georgia Basin. Can. Wildl. Serv. Pac. Wildl. Res. Centre, Delta, BC.

Pendergast, C. 2004. Bald Eagle Occupancy and Productivity Surveys on Vancouver Island. Report prepared for Nestucca Oil Spill Trust Fund. 15 pgs. Available: http://www.env.gov.bc.ca/wildlife/wsi/reports/4198_WSI_4198_RPT.PDF [Accessed 27 Sept 2016].

Quinn, G.P., and M.J. Keough. 2002. Experimental Design and Analysis for Biologists. Cambridge Univ. Press. Cambridge, U.K. 537pp.

R Development Core Team. 2016. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. ISBN 3-900051-07-0. Available: http://www.R-project.org. [Accessed September 2015].

Resources Information Standards Committee (RISC). 1998. Inventory methods for colonial-nesting freshwater birds: Eared Grebe, Red-necked Grebe, Western Grebe, American White Pelican, and Great Blue Heron. Standard for components of British Columbia's biodiversity No. 8, Ver. 2. B.C. Minist. Sustainable Resour. Manage., Victoria, BC.

Vennesland, R.G., and R.W. Butler. 2004. Factors influencing Great Blue Heron nesting productivity on the Pacific Coast of Canada from 1998 to 1999. Waterbirds 27:289–296.

Vennesland, R.G., and R.W. Butler. 2011. Great Blue Heron (*Ardea herodias*). *In* A. Poole, ed. Birds of North America Online. Cornell Laboratory of Ornithology. Ithaca, NY. Available: https://birdsna.org/Species-Account/bna/species/grbher3/introduction [accessed on 27 Sept 2016].

Vennesland, R.G., and D. Norman. 2006. Survey protocol for measurement of nesting productivity at Pacific Great Blue Heron breeding colonies. Heron Working Group. Unpubl. rept. Available: http://www.sccp.ca/sites/default/files/species-habitat/documents/survey%20protocol%20measuring%20productivity%20gbh%20nesting%20sites%20Vennesland%20and%20Norman%202006.pdf [accessed 27 Sept 2016].

**Personal Communications**

Ross Vennesland, Species-at-Risk Biologist, Parks Canada

David Preikshot, Fisheries Scientist, Fisheries and Oceans Canada

# 7.0 APPENDICES

## Appendix A. 2013– 2015 Inventory Photos

Photos are by Trudy A. Chatwin unless stated otherwise.

### Beacon Hill Park, Victoria

(Left) Two Pacific Great Blue Heron chicks in a pine tree in Beacon Hill Park, Victoria, B.C.

(Right) Dead chick found at Beacon Hill Park, Victoria, B.C. Even though there were some predation pressures in 2013-2015, the herons continued to return to nest. This colony is viewed and photographed by hundreds of people. City of Victoria Park staff assist monitoring the colony and we work together to manage landscaping and signage near the colony.

### Cowichan Bay Village Gully

(Left) Adult Pacific Great Blue Heron with three chicks in the nest at Cowichan Bay Village Gully in 2013. Cowichan Bay has Vancouver Island's largest heron colony and contributes many fledglings to the population.

(Right) Adult incubating egg(s) in a nest at Cowichan Bay. Despite development of "The Cannery", a multi-family housing development, herons nested successfully at this site. Madrone Consultants developed a monitoring method to coordinate with construction crews on disturbance issues.


(Left) Adult coming in to feed chicks at the Cowichan Bay colony in 2014. Note the plumes and bright orange bill of the adult. Photo by Rachel Penny.

(Right) Temporary signage posted at the Cowichan Bay colony during construction of "The Cannery" in 2013.

## Holden Lake, Cedar

(Left) Emily Barnewall marking a Pacific Great Blue Heron nest tree at the Holden Lake colony in Cedar in 2015. This colony re-established on the site in 2011 after abandoning it in 2005 due to Bald Eagle attacks.

(Right) A field of whitewash under two nest trees at the Holden Lake colony in Cedar in 2015.

## Ladysmith

(Left) Trudy Chatwin standing beside a well-used nest tree at the Ladysmith heron colony in 2013. This tree has been used for at least six years based on the number of pieces of flagging tape around the tree trunk. Note the white wash on the surrounding foliage, which is characteristic of an active heron nest.

(Right) It is not uncommon for herons to make multiple nests in a nest tree. Here is an example of two active nests in one tree from the Ladysmith colony in 2014. The Drixler family have been stewards for this colony for over 12 years.

(Left) A 6-week old Pacific Great Blue Heron chick with the head feathers sticking straight up standing beside a lopsided nest at the Ladysmith colony.

(Right) Four chicks around 8 weeks of age exploring their tree-top home. Wandering heron chicks can make accurate nest counts difficult when trying to conduct productivity assessments.

**Point Holmes, Comox**

View of the Point Holmes colony in Comox from Lazo Road in 2013. Note the Pacific Great Blue Herons occupying nests.

(Left) Triplets waiting for their next meal at the Point Holmes Road colony in 2013.

(Right) Some heron colonies become habituated to disturbances such as a helicopter flying over the Point Holmes colony during the 2013 survey. This colony failed in 2015, likely due to Bald Eagle predation. Some of the herons re-nested in a sub-division in Courtney (Tull Road and Piercy Road).

## Piper's Lagoon, Nanaimo

(Left) Nest in Douglas-fir. This is a small colony with only three nests. A Bald Eagle nest is nearby.

(Right) Adult Pacific Great Blue Heron in a tree overlooking Piper's Lagoon.

## Protection Island, Nanaimo

(Left) Pacific Great Blue Heron perched in an Arbutus tree at the Protection Island colony in 2014.

(Right) Seven Pacific Great Blue Heron nests of various sizes in a dying Arbutus tree on Protection Island in 2015. Some of these nests fell when heavy chicks and wind broke branches. This colony is adjacent to the busiest place on Protection Island. Nests straddle Pirates Park and private land.

(Left) Three Pacific Great Blue Heron chicks approximately 4-6 weeks old at the Protection Island colony.

(Right) An approximately 8-week old Pacific Great Blue Heron chick out on a limb at the Protection Island colony.

## Salt Spring Island

The heron colony in Ganges Park was active up until 2015. Nests were in big-leaf maples and alders. Local school children “adopted” this colony and have learned much about the natural history of Pacific Great Blue Herons and their habitat. This colony suffered high Bald Eagle Predation during the 2012, 2013 and 2014 breeding seasons. We were unable to find an active colony on Salt Spring Island in 2015.

## Tsecyum First Nation

Pacific Great Blue Heron check siting in a nest in a trembling aspen at Tsecyum Lands. Note the whitewash on the branches and leaves encircling the nest.

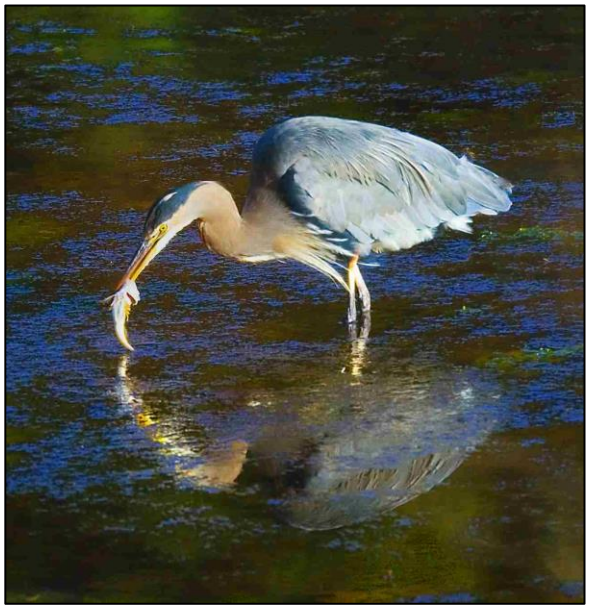
## Heron Predation

(Left) Bald Eagle flying off with a Pacific Great Blue Heron Chick while a Northwestern Crow flies in the background at Beacon Hill Park in Victoria in 2013. Photo by Jim Chapmans.

(Right) Bald Eagle feasting on a Pacific Great Blue Heron chick at Beacon Hill Park in Victoria in 2013. Photo by Jim Chapmans.

## Herons Feeding

Four Pacific Great Blue Herons feeding in the shallow waters off Lazo Road in Comox in 2013.



(Left) Pacific Great Blue Heron feeding on a tide pool sculpin. In the breeding season, Pacific Great Blue Herons feed mainly on Shiner Perch gunnels, Starry Flounders and other shallow water marine fish. In fall, we observed herons at many freshwater locations taking frogs and fish.

(Right) Adult Pacific Great Blue Heron roosting on a post with Purple Martin nest boxes on Quadra Island.

## Appendix B. 2013 – 2015 Inventory Data

Region 1 Pacific Great Blue Heron breeding colonies inventory data for 2013 to 2015. Status of colony: ND = not determined; AS = Active successful (at least one nest fledged a chick that was 6-8 weeks old); AF = Active failed; NA = Not Active; A/ND = Active, success not determined. Evidence of predation at a colony is indicated by number 1.

## 2013 Pacific Great Blue Heron Inventory Data

| Colony ID | Colony Name | Colony Status | Number of Total Nests | Number of Active Nests | Number of Sampled Nests | Number of Successful Nests | Number of Fledglings from Sampled Nests | Productivity of Sampled Nests | Evidience of Predation |
|---|---|---|---|---|---|---|---|---|---|
| H101-001 | Beacon Hill | AS | 51 | 51 | | | | | 1 |
| H101-010 | Mystic Pond | AS | 10 | 8 | 8 | 6 | 14 | 1.8 | |
| H101-026B | Saanichton - Pullock Road | NA | | 0 | | | | | |
| H101-031 | Vance Island | NA | 3 | 0 | | | | | |
| H101-032 | Clamshell Road | NA | 5 | 0 | | | | | |
| H101-035 | Tsecyum Lands | AS | 35 | 35 | | | | | 1 |
| H101-049 | Ganges Park | AS | 31 | 29 | 29 | 11 | 18 | 0.6 | 1 |
| H101-052 | Cadboro Bay | AS | 9 | 9 | | | | | 1 |
| H102-001B | Kaltasin Road | AF | 5 | 5 | | | | | 1 |
| H102-009B | Cowichan Bay Village Gully | AS | 74 | 73 | | | | | |
| H104-001B | Quamichan Lake | AF | 6 | 6 | | | | | |
| H105-001B | Catalyst Mill trees | A/ND | 23 | 23 | | | | | |
| H105-002 | Holden Lake | AS | 47 | 47 | | | | | |
| H105-007 | Protection Island | AS | 23 | 23 | 23 | 22 | | 0.0 | |
| H105-008B | Marina Way | AS | 17 | 17 | | | | | |
| H105-011 | Ladysmith | AS | 12 | 12 | | | | | 1 |
| H105-015 | Nanoose | NA | 3 | 0 | | | | | |
| H105-033 | Christie Road | AS | 62 | 61 | | | | | 1 |
| H105-041B | Doehle and Tranfield road | A/ND | 1 | 1 | | | | | |
| H105-042 | Lantzville M | AS | 20 | 20 | | | | | |
| H105-043 | Chemainus Mill Site | NA | 8 | 0 | | | | | 1 |
| H106-009 | Fanny Bay | A/ND | 6 | 5 | | | | | |
| H106-032C | Deep Bay 2 - Hembourgh rd. | AF | 16 | 16 | | | | | 1 |
| H106-033C | Miracle Beach 2 | AS | 6 | 5 | | | | | 1 |
| H106-041A | Point Holmes | AS | 59 | 59 | | | | | 1 |
| H106-046 | Minto Rd | AS | 11 | 11 | | | | | |
| H106-048 | Wireless Road | NA | | 0 | | | | | |
| H107-006 | Salmon Beach | A/ND | 1 | 1 | | | | | |
| H113-002 | Stories Beach | AS | 9 | 3 | | | | | |
| H115-006 | Hyacinthe Bay | AF | 13 | 13 | | | | | 1 |

## 2014 Pacific Great Blue Heron Inventory Data

| Colony ID | Colony Name | Colony Status | Number of Total Nests | Number of Active Nests | Number of Sampled Nests | Number of Successful Nests | Number of Fledglings from Sampled Nests | Productivity of Sampled Nests | Evidience of Predation |
|---|---|---|---|---|---|---|---|---|---|
| H101-001 | Beacon Hill | AS | 54 | 54 | | | | | 1 |
| H101-010 | Mystic Pond | AS | 26 | 26 | 15 | 15 | 35 | 2.3 | 1 |
| H101-026B | Saanichton - Pullock Road | NA | | | | | | | |
| H101-035 | Tsecyum Lands | AS | 49 | 49 | | | | | 1 |
| H101-049 | Ganges Park | AF | 25 | 24 | | | | | 1 |
| H101-052 | Cadboro Bay | NA | | | | | | | 1 |
| H102-009B | Cowichan Bay Village Gully | AS | 91 | 89 | 52 | 51 | 140 | 2.7 | 1 |
| H104-001B | Quamichan Lake | AF | 1 | 1 | | | | | |
| H104-010A | Maple Bay Van Island | A/ND | 4 | 4 | | | | | |
| H105-001 | Shoal Island | NA | 16 | 0 | | | | | |
| H105-002 | Holden Lake | AS | 56 | 56 | | | | | 1 |
| H105-007 | Protection Island | AS | 26 | 26 | | | | | |
| H105-009 | Cottle Creek | NA | | | | | | | |
| H105-033 | Christie Road | AS | 65 | 65 | | | | | 1 |
| H105-040 | Little Qualicum Estuary | NA | | | | | | | |
| H105-041 | Sanderson Ave | AF | 6 | 6 | | | | | 1 |
| H105-042 | Lantzville M | AF | 7 | 7 | | | | | 1 |
| H105-043 | Chemainus Mill Site | AS | 33 | 33 | | | | | 1 |
| H105-044A | Pipers Lagoon | AS | 4 | 4 | | | | | 1 |
| H105-045 | Lasqueti | AF | 1 | 1 | | | | | |
| H106-032B | Seaview Rd | AS | 13 | 13 | | | | | 1 |
| H106-032C | Deep Bay 2 - Hembourgh rd. | AF | 10 | 1 | | | | | |
| H106-033C | Miracle Beach 2 | AF | 7 | 7 | | | | | 1 |
| H106-041A | Point Holmes | AS | 51 | 49 | 13 | 3 | 5 | 0.4 | 1 |
| H106-046 | Minto Rd | AF | 5 | 5 | 5 | | 0 | 0.0 | 1 |
| H107-002 | Alberni Inlet west | AS | 1 | 1 | 1 | 1 | 3 | 3.0 | |
| H107-006 | Salmon Beach | NA | 1 | 1 | | | | | |
| H107-008 | Mozart Street | AS | 1 | 1 | | | | | |
| H110-007 | Storey Creek | NA | 0 | | | | | | |
| H113-002 | Stories Beach | AF | 4 | 4 | | | | | 1 |
| H114-003 | Jackson Bay camp | AS | 20 | 20 | | | | | |

## 2015 Pacific Great Blue Heron Inventory Data

| Colony ID | Colony Name | Colony Status | Number of Total Nests | Number of Active Nests | Number of Sampled Nests | Number of Successful Nests | Number of Fledglings from Sampled Nests | Productivity of Sampled Nests | Evidience of Predation |
|---|---|---|---|---|---|---|---|---|---|
| H101-001B | Beacon Hill Park | AS | 56 | 52 | | | | | 1 |
| H101-010 | Mystic Pond | AS | 23 | 23 | 9 | 9 | 15 | 1.7 | |
| H101-035 | Tsecyum Lands | AS | 61 | 56 | | | | | |
| H102-009B | Cowichan Bay Village Gully | AS | 96 | 94 | | | | | 1 |
| H104-010A | Maple Bay Van Island | AS | 9 | 9 | | | | | 1 |
| H105-002 | Holden Lake | AS | 88 | 87 | | | | | 1 |
| H105-007 | Protection Island | AS | 21 | 20 | 20 | 20 | 27 | 1.4 | 1 |
| H105-008B | Marina Way | NA | 19 | 0 | | | | | |
| H105-033 | Christie Road | AS | 62 | 62 | | | | | 1 |
| H105-040 | Little Qualicum Estuary | AS | 4 | 3 | | | | | 1 |
| H105-041B | Doehle and Tranfield road | AS | 6 | 6 | | | | | 1 |
| H105-043 | Chemainus Mill Site | AS | 41 | 41 | | | | | 1 |
| H105-045 | Lasqueti | AS | 2 | 2 | | | | | 1 |
| H106-032C | Deep Bay | AS | 23 | 20 | | | | | |
| H106-033C | Miracle Beach 2 | AS | 13 | 13 | | | | | 1 |
| H106-041A | Point Holmes | AF | 40 | 35 | | | | | 1 |
| H106-046 | Minto Rd | AF | 6 | 5 | | | | | 1 |
| H106-052 | Tull Ave | A/ND | 12 | 12 | | | | | 1 |
| H106-053 | Piercy Road | A/ND | 4 | 4 | | | | | |
| H107-008 | Mozart Street | A/ND | 5 | 4 | | | | | 1 |
| H113-002 | Stories Beach | NA | 12 | 0 | | | | | |

## Appendix C. Sample Data Form

**Great Blue Heron Data Sheet #4 - Colony Reproductive Productivity**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Colony Name: | | | Colony Code: | | | | | | | |
| Date: | | Visit No: | Previous Visit Date: | | | | | | | |
| Arrival Time: | | | Departure Time: | | | | | | | |
| Observers: | | | | | | | | | | |
| Weather: | | | | | | | | | | |
| Comments: | | | | | | | | | | |

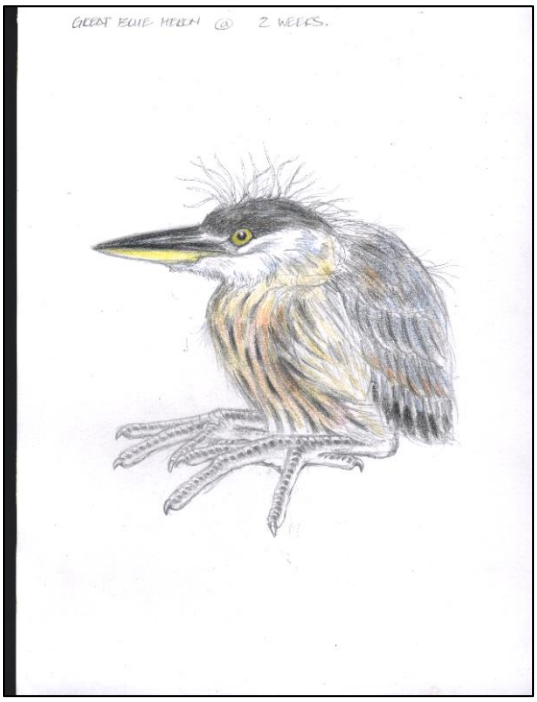
| Nest Status Codes | Nest Activity Code eg's |
|---|---|
| **STD** - adult standing | **1AS/2AS** – 1 or 2 adult stand |
| **INC** – incubation | **ASN** – adult stand near |
| **YNG** - young in nest | **EX** – adult exchange |
| **NV** – not visible | **COP** – copulatory behaviour |
| **FN** – failed nest | **STICK** - stick brought to nest |

| Young Age Codes | |
|---|---|
| **1** – 1 to 2 wks old | **3** – 4 to 6 wks old |
| **2** – 2 to 4 wks old | **4** – 6 to 8 wks old |

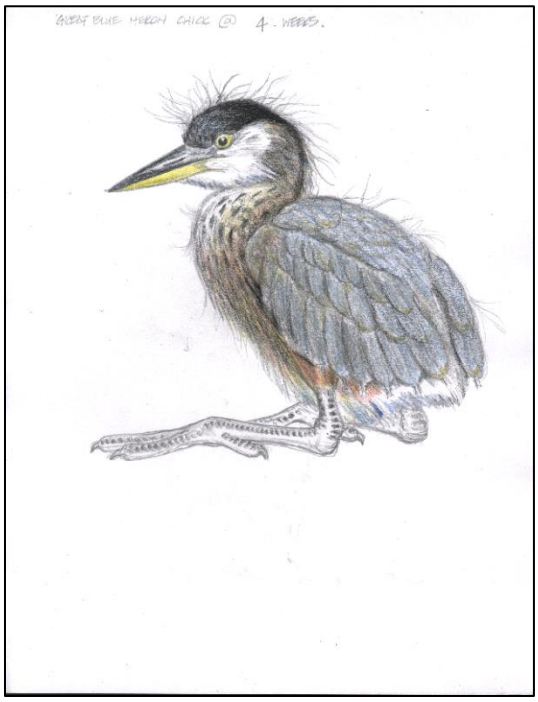
| Observer Location | Tree No. | Nest No. | Nest Location | Nest Active? (Y/N) | Nest Status | No. Adults | No. Young | Age of Young | Nest Activities | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

## Appendix D. Diagrams for Aging Herons

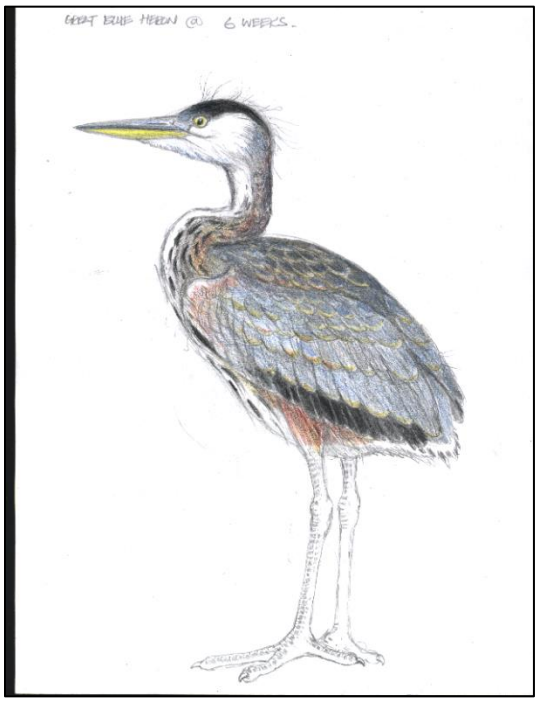
Sketches by Donald Gunn.




(Left) Sketch of a 2-week old heron chick.




(Right) Sketch of a 4-week old heron chick.




(Left) Sketch of a 6-week old heron chick.


(Right) Sketch of an 8-week old heron chick.

**Appendix E. Article from the Times Colonist to illustrate some of the issues surrounding Pacific Great Blue Heron Colonies.**

# HERONS AT CENTRE OF COWICHAN BAY DEBATE

DEBRA BRASH, TIMES COLONIST

A heron carries nesting material to its home in a ravine near the abandoned rookery in Cowichan Bay. Vancouver Island's largest heron colony is under threat from development, but the Cowichan Valley Regional District's effort to protect nesting sites is being met by threats of a lawsuit. "Residents have really got up in arms, they love their herons," said Trudy Chatwin, provincial endangered-species biologist. Story, page A3.

**Appendix F. Marine foraging areas in estuaries and shallow beaches, bays along with cumulative nest locations for Pacific Great Blue Herons up until 2002. Source: Moul 2002.**