

**ANNUAL REPORT of the  
CENTRE FOR WILDLIFE ECOLOGY  
2008-2009**



**Department of Biological Sciences  
Simon Fraser University**

<http://www.sfu.ca/biology/wildberg/index.html>

**Dr. Ron Ydenberg, Director**

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## **I. HISTORY**

Under the Migratory Birds Convention and Canada Wildlife Acts, the mandate of the Canadian Wildlife Service is to protect and conserve migratory bird populations. In the 21st century, this historical mandate is broadening to encompass other environmental concerns such as species at risk, biodiversity, sustainability and endangered habitats. To meet these broad and varied responsibilities, Environment Canada depends on sound science, and participates in cooperative ventures. In 1993, the Natural Sciences and Engineering Research Council of Canada, Simon Fraser University, and Environment Canada signed a ten year agreement to create the NSERC/CWS Chair in Wildlife Ecology at SFU. The Centre for Wildlife Ecology (CWE) described here is a revised administrative structure based on the Chair, formed after the retirement in 2002 of the original chairholder, Professor Fred Cooke.

## **II. MISSION STATEMENT**

The mission of the Centre for Wildlife Ecology (CWE) is to foster high quality graduate training and research, conduct basic and applied research in wildlife ecology, and to provide knowledge and personnel that will help Environment Canada and other agencies meet the challenges of conservation in the 21st century. The central concept is to foster synergy between the mission-oriented research and management policies of the Canadian Wildlife Service (CWS) and the basic research agenda of the University. Information, ideas, expertise, resources and opportunity flow back and forth across this interface, giving government agencies access to a broad base of science capability that helps inform policy and decision making, while the university and its faculty and students benefit from enhanced opportunities for research and application of the ideas their disciplines generate.

### III. PERSONNEL

#### A. Research Team

##### *1. Faculty and Research Associates*

| <i>Name</i>          | <i>Position</i>                                    |
|----------------------|--|
| Ron Ydenberg         | Director, Professor                                |
| Tony Williams        | Professor  |
| David Green          | Associate Director, Assistant Professor            |
| Dov Lank             | University Research Associate / Adjunct Professor  |
| Dan Esler            | University Research Associate / Adjunct Professor  |
| Mark Hipfner         | EC Biologist / Adjunct Professor                   |
| Doug Bertram         | EC Biologist                                       |
| Hide                 | EC Research Scientist / Adjunct Professor          |
| Christine Bishop     | EC Research Scientist / Adjunct Professor          |
| Rob Butler           | EC Research Scientist Emeritus / Adjunct Professor |
| Bob Elner            | EC Research Scientist Emeritus/Adjunct Professor   |
| John Elliott         | EC Research Scientist / Adjunct Professor          |
| Barry Smith          | EC Research Scientist / Adjunct Professor          |
| Fred Cooke (retired) | Emeritus Chairholder                               |

##### *2. Research Group*

| <i>Postdoctoral Fellow</i> | <i>PhD (in progress)</i> | <i>MSc (in progress)</i> | <i>Staff</i>                    |
|----------------------------|--------------------------|--------------------------|---------------------------------|
| Caz Taylor                 | Marie-Hélène Burle       | Lana Cortese             | Monica Court, CWE Admin. Asst.  |
|                            | Anna Drake               | Rian Dickson             | Connie Smith, CWE Research Tech |
|                            | Margaret Eng             | Rachel Gardiner          | Vanessa Richard, Seabird Tech   |
|                            | Lindsay Farrell          | Sofi Hindmarch           | Karen Rickards, NSERC USRA      |
|                            | Samantha Franks          | David Hope               | Jason Von Roosen, BSc Asst.     |
|                            | Raime Fronstin           | Iain Jones               | Allison Patterson, Seaduck Tech |
|                            | Kristen Gorman           | Peter Katinic            |                                 |
|                            | Sarah Jamieson           | Christine Rock           |                                 |
|                            | Ariam Jiménez            | Michael Silvergieter     |                                 |
|                            | Heather Major            | Marc Travers             |                                 |
|                            | Birgit Schwarz           | Corey VanStratt          |                                 |
|                            |                          | Dominique Wagner         |                                 |
|                            |                          | Kirsten Webster          |                                 |
| <i>Visitors</i>            | <i>PhD( defended)</i>    | <i>MSc (defended)</i>    |                                 |
| Pat Baird                  |                          | Jenn Barrett             |                                 |
| Laura McFarlane            |                          | Dan Guertin              |                                 |
| Tranquilla                 |                          |                          |                                 |
| Mieke van Opheusden        |                          | Dong Han                 |                                 |
|                            |                          | Megan Harrison           |                                 |
|                            |                          | Lauren Kordowny          |                                 |
|                            |                          | Sam Quinlan              |                                 |
|                            |                          | Dora Repard              |                                 |
|                            |                          | Kyle Morrison            |                                 |
|                            |                          | Ivy Whitehorne           |                                 |

## **B. Steering Committee**

| <i>Name</i>    | <i>Position</i>                    | <i>Affiliation</i> |
|----------------|------------------------------------|--------------------|
| Elizabeth Elle | Assistant Professor                | <i>SFU</i>         |
| Arne Mooers    | Assistant Professor                | <i>SFU</i>         |
| Robert Elner   | Head, Migratory Birds Conservation | <i>CWS</i>         |
| David Green    | CWE faculty (non-voting)           | <i>SFU</i>         |
| Paul Kluckner  | Regional Director, ECB PYR         | <i>CWS</i>         |
| Barry Smith    | Research Scientist                 | <i>CWS</i>         |
| Tony Williams  | CWE faculty (non-voting)           | <i>SFU</i>         |
| Ron Ydenberg   | CWE Director (non-voting)          | <i>SFU</i>         |

## IV. INTRODUCTION

The aim of this Annual Report is to give an overview of our activities, outline the progress on new and continuing projects, describe the personnel involved, and to give some indication of our scientific and community involvement. Previous Annual Reports are available from the CWE. Contact us via our website

<http://www.sfu.ca/biology/wildberg/index.html>

or contact Ron Ydenberg at [ydenberg@sfu.ca](mailto:ydenberg@sfu.ca).

## V. THE CWE IN ACTION

The accounts that follow give brief overviews of the major projects run by the CWE. More detail is available on our website (<http://www.sfu.ca/biology/wildberg/index.html>). Publications and theses are listed at the end of this report. The personnel also can be contacted via the website.

### **A. The Triangle Island Seabird Research Station**

Coastal British Columbia supports large populations of many species of seabirds, for which the Pacific and Yukon Region of the Canadian Wildlife Service has stewardship responsibility. The Triangle Island Seabird Research and Monitoring Station was established in 1994 as a centre for research devoted to understanding seabird biology, aimed particularly at identifying and understanding environmental and demographic causes of population change so as to recommend appropriate conservation actions. The Anne Vallée Ecological Reserve on Triangle Island supports the largest and most diverse seabird colony in BC, including the world's largest population of Cassin's Auklets, BC's largest populations of Tufted Puffins and Common Murres, and a large population of Rhinoceros Auklets, among others. As part of the Scott Island Group, Triangle Island is recognized as an Important Bird Area (IBA). Moreover, waters around the Scott Islands are being developed as a Marine Wildlife Area (MWA) under the Canada Wildlife Act, to protect critical habitat for the millions of seabirds that depend on these waters through the year.

Our ongoing investigations examine breeding propensity and chronology, reproductive performance, nestling diet and development, parental foraging and provisioning patterns, attendance patterns, and adult survival, among other topics. Of particular interest is the issue of how climate-induced fluctuations in the timing and availability of marine prey populations affect seabird reproduction and survival.

The 2008 season: We opened our research station on Triangle Island for year 16 on 21 May 2008, with continued logistical support from the Canadian Coast Guard. Scientific research was conducted under the direction of Mark Hipfner, while Kyle Morrison and Mark led the field crew at various times in the summer. And Connie finally made it out to the island this year! We maintained our time series focus on Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin, Common Murre, Pelagic Cormorants, Glaucous-winged Gulls and Black Oystercatchers, coupled with graduate student research (see below).

The 2008 season was remarkable for the strong breeding season experienced by Rhinoceros Auklets and Tufted Puffins – the best in the 16 year time series. Cassin’s Auklets also had a good season, which was poor only for Common Murres and Pelagic Cormorants. But this had nothing to do with the cold ocean conditions that prevailed; rather, it was due to constant harassment and predation by Bald Eagles who were free to invade the area of the colony because the protective pair of Peregrine Falcons failed to breed this year.

### **Graduate students:**

Kyle Morrison, who began his MSc at SFU in September 2006 co-supervised by David Green and Mark, spent part of summer 2008 conducting field work on Triangle Island. Kyle’s thesis, completed and defended in March 2009, investigates survival and colony attendance patterns in Tufted Puffins in relation to age and gender.

## **B. Integrated Shorebird Research**

Populations of many species of shorebirds travel half the globe in the course of their annual migrations. The Canadian Wildlife Service has an historical, mandated responsibility for the conservation of migratory birds. Great concern has been raised about apparent population declines of many species over the past two decades. The CWE is studying two small calidrid sandpipers - western sandpipers and dunlin - to better understand these apparent declines.

The majority of the world’s 3.5 – 4.0 million Western Sandpipers stop briefly to refuel in Boundary Bay or on Robert’s Bank during their annual northward migration, providing a thrilling sight for local residents. A good fraction of the species population also stops over on southward migration, following a flight over the Gulf of Alaska. Because of this, the species is ranked in the highest priority class in the draft BC-Yukon region CWS Shorebird Management Plan. Each winter, the Fraser River Delta (FRD) hosts the most northerly wintering population of Pacific Dunlin – some 30,000-50,000. Local information on shorebird habitat usage, including western sandpipers and dunlin, contributed towards Environment Canada’s submission in response to proposals to enlarge the Coal Port facility on Robert’s Bank, and will be of substantial value with respect to environmental assessment as port operations continue and planning for the next phase of port expansion continues.

Since its inception in 1993, the CWE has nurtured the development of the Western Sandpiper Research Network, including CWE staff Ron Ydenberg, Dov Lank, and Tony Williams, and CWS staff Bob Elner, Barry Smith, and recent retiree Rob Butler, as a platform for research on a hemispheric scale that can address migratory bird issues. Our multifaceted research is documenting and modeling the factors controlling the population size, migratory routes and timing, ecological relationships with predators and prey, habitat use, and physiological ecology of this long-distance Neotropical migrant. We have pursued and aided fieldwork at three breeding sites, several migration locations, and five wintering sites. We have organized eleven workshops to help keep researchers in touch, and we run a list-server for this purpose. Our integrated approach allows us to examine how factors at one location affect events at another. How do events in the wintering grounds, migration sites, and breeding grounds interconnect? Where are population bottlenecks? Of direct conservation concern is the consequence of the removal or deterioration

of one or more locations on survival and reproduction. As a result of our work, the Western Sandpiper is now the best-studied sandpiper in the Western Hemisphere.

### Highlights from the past year:

Three particularly significant publications came out last year. First, the quantitative level of diet derived from biofilm feeding by shorebirds, a long-time interest of EC biologist and CWE collaborator Bob Elner, was published in *Ecology* (Kuwae et al. 2008). The article and its associated videos attracted considerable media attention across Canada. Second, a model of winter habitat usage by dunlin on Robert's Bank was published by former CWE postdoctoral fellow Yuri Zharikov, who was based at the PWRC in Delta (Zharikov et al 2009). Finally, a set of papers by graduated student Evans Ogden addressing shorebird usage of agricultural fields were published. In addition to their general significance, all these pieces of work are of management significance with respect to Roberts Bank, heavily used by sandpipers, the operation and potential expansion of Vancouver Port facilities, and land use policies in the FRD.

Migratory Connectivity Project: The shorebird program was given a boost when Dov Lank received two substantial grants – a two year NSERC Strategic Supplemental Competition grant, and a USF&WS Neotropical Migratory Bird Conservation Act grant – in support of work on migratory connectivity of Western Sandpipers and of local shorebird usage of the FRD. Prior support for the work came largely from Ydenberg's NSERC Discovery grant, which emphasized danger management by sandpipers. This ongoing support allowed us to take on two new students and for Samantha Franks to switch from the MSc to the PhD program.

The migratory connectivity project is designed to develop the use of intrinsic markers – information present in the body of the bird – as tools for establishing the connections among the suite of sites utilized by migrants. This international project involves Environment Canada-CWS as a partner, plus faculty from UBC (Darrin Irwin), Queen's (Kurt Kyser) and Guelph (D Ryan Norris), three universities in Mexico, Kansas State University, and the Point Reyes Bird Observatory, with additional cooperators in Alaska, Texas, Florida, South Carolina, Puerto Rico, Panama and Ecuador. Samples collected throughout the species' range will be analysed for stable isotope signatures, genetic composition, trace element composition, and morphology. We will create statistical which combine information from all four intrinsic "markers" to produce population assignments. Samantha Franks became a PhD student, taking responsibility for a portion of the migratory connectivity project, including sample collection and stable isotope analyses of western sandpiper feathers collected throughout their annual cycle. Birgit Schwarz, a PhD student supported by German graduate fellowships, will take responsibility for sample collection and genetic analyses, working with Dr. Darren Irwin, at UBC. These two students organized fieldwork in the FRD during both northward and southward migration, collecting data for the migratory connectivity project. Lank organized sampling from four sites in Alaska and one in Siberia; MSc student Dave Hope did some of this fieldwork in between completion of his own MSc studies of predation danger management by migrant Western Sandpipers in the FRD.

Postdoctoral researcher Caz Taylor and colleagues continued work on an individual-based model of Western Sandpiper migration. One application of the model was published, considering how changes in habitat usage could measure changing effects of predation risk. Taylor published several papers on migration theory, with Ryan Norris, and progressed on gathering data sets and

estimates to parameterize a general demographic model for the species. Results from the connectivity work will help determine the final structure of the population models.

Fraser River Delta issues:

PhD student Ariam Jiménez pursued detailed work with sandpiper usage of biofilm on Robert's Bank, guided by CWS's Bob Elner and CWE's Ydenberg. His work includes on-the-ground and remote sensing, and direct observation and "poop counts" as indirect indices of habitat usage. Undergraduate Karen Rickards documented detailed movements of migrants on the bank throughout the tidal cycle. In autumn, MSc student Rachel Gardiner joined the team, with a mandate to consider broad patterns of habitat usage by shorebirds in the FRD.

Other studies:

PhD student Sarah Jamieson returned from a term in the Netherlands doing collaborative lab work on Dunlin egg production, and completed analyses and writing for her thesis on Pacific Dunlin breeding biology, which she will defend in mid-2009.

We continued to collaborate with radio-tracking studies organized by Dr. Pat Baird, who received her fourth year of funding from the U.S. government for a project investigating the southern portion of the migration route, in Panama and Mexico. She has discovered new migratory paths for the westerns from the southern overwintering area in Panama that were previously unknown.

Dov Lank and Yuri Zharikov continued a collaboration with a radio-tracking study of habitat use by dunlin in the Skagit Delta in Washington State, initiated by Gary Slater, from the Ecostudies Institute and Ruth Milner, Washington Fish and Wildlife. The study borrows approaches used in the Fraser River delta by earlier CWE students, and involves CWS' Keith Hobson, Saskatoon.

Collaborator Dick Dekker became a PhD student at the Wageningen University, in the Netherlands, where CWE Director Ydenberg holds a part-time appointment.

Additional collaborators of note include: former CWE PhD students Guillermo Fernández, now at the Universidad Nacional Autónoma de México in Mazatlan, and Brett Sandercock, Kansas State University.

Tuamotu Sandpiper Conservation: In partnership with the USF&WS (Rick Lanctot, Alaska region), the CWE is lending its expertise in shorebird biology to support a conservation project on the highly endangered Tuamotu Sandpiper. The work is supported by the French Polynesian Regional Division for the Environment (DIREN), with logistical help from a local ornithological NGO (the Society of Polynesian Ornithologists, SOP-MANU).

Once widespread across the South Pacific, this species is now found on only 4 atolls, with a world population of ca. 1200 individuals. Master's student Marie-Hélène Burle spent 5 months conducting the first study of the species' biology on the atoll of Tahanea, including the transition from the non-breeding to the breeding season. The information on diet, habitat usage, and social system will be used to support reintroduction of the species onto atolls where rats have been removed.

## **C. The Marbled Murrelet Project**

SFU's research on threatened Marbled Murrelets continues to address issues of direct conservation concern for this listed species.

This ground-breaking and high profile project examining the biology of the threatened and elusive marbled murrelet continues for its fifteenth year, addressing new questions of significant management interest for this threatened species. Dov Lank, Josh Malt, Mike Silvergeiter, recent MREM graduate Jenn Barrett and current MREM student Lana Cortese continued their work. The SFU team worked closely with EC staff Doug Bertram, who chairs the Canadian Marbled Murrelet Recovery team, with Louise Waterhouse from the BC Ministry of Forests, and with other murrelet researchers in government, industry, and academia, including Peter Arcese (UBC), Alan Burger (UVic), and John Deal (Western Forest Products Inc.). Joint publications and reports were again produced with Louise Waterhouse, BC Ministry of Forests, to evaluate current methodology for classifying murrelet nesting habitat.

Malt and Lank have now published, in *Ecological Applications*, their major paper addressing the probability of nest predation with respect to forest edge type and landscape composition. The study demonstrates that higher predation rates at newly-formed hard edged decay over time, and that large amounts of regenerating forest depress nest predation rates in adjacent old forest patches. These countervailing processes need to be incorporated into long-term assessment of murrelet population persistence in BC landscapes.

Jenn Barrett, following her completion of her MREM degree, which included a research paper jointly modeling marine and terrestrial effects on habitat usage and nesting success, following up on work begun by former CWE research associate Elsie Krebs, who now works for EC-CWS.

Last year, Dov Lank brought together private and government researchers as a consortium to use the extensive radar traffic rate data sets which have been gathered in BC to address (1) the utility of several methods of habitat suitability classification, and (2) the magnitude of fragmentation effects on local breeding population size. Josh Malt helped to start the project, but left to take a job with the BC Ministry of the Environment, and was replaced by Jenn Barrett and Lana Cortese. We have now brought together all of the relevant data and are starting the analyses. This work is being funded by the BC Forest Science program and will continue for the coming two years.

MSc student Mike Silvergeiter is scheduled to defend his MSc thesis in April 2009, focusing on stand-level habitat characteristics of nest sites, utilizing data collected in previous years, including some he gathered while working as an undergraduate two years ago. He is also collaborating with Alan Burger on models predicting nest site availability.

While we have continued to utilize the nest data gathered in previous years, marine survey data from Desolation Sound 1994-2001 are also proving valuable. A manuscript by UBC's Peter Arcese, Ryan Norris and others utilizes these to address effects of marine diet on annual reproductive success.

Dov Lank continued to serve on the Canadian Marbled Murrelet Recovery Team, headed by former CWE staff member Doug Bertram. This participation enables the results of the CWE's research to be rapidly assimilated into evolving policy guidelines for management of this

threatened species, under the protection of the federal Species at Risk Act and Provincial Identified Wildlife Management Strategy. Through the Recovery Team, Lank participated in the never-ending rewriting the federal recovery strategy, which should be approved by the Minister quite soon, and action plans which will follow on the plan's approval.

## **D. Sea Duck Ecology**

The sea duck research group, led by Dan Esler, conducts a broad range of studies addressing factors affecting population dynamics of sea ducks. Much of the work is conducted along the Pacific coast from Alaska to Mexico, including a concentration in British Columbia. All studies are collaborative ventures with federal agencies, including the Canadian Wildlife Service, U.S. Geological Survey, and the U.S. Fish and Wildlife Service. We also collaborate with universities and other partners throughout North America. Details of each project are presented in an updated web site (<http://www.sfu.ca/biology/wildberg/CWESeaducksfolder/CWESeaducks/index.html>) and are described in brief below.

*1. Chronic Effects of the Exxon Valdez Oil Spill on Sea Ducks* – This long-term program continues to evaluate the progress of population recovery of sea ducks (harlequin ducks and Barrow's goldeneye) from the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. At this stage, most efforts are directed towards analysis and publication of data collected over the 13 years of the project. However, we continue to collect new data on the degree and duration of oil exposure that sea ducks are experiencing. In addition, we have constructed a population model evaluating the relative effects of acute mortalities immediately after the spill and mortalities related to chronic exposure to oil over the subsequent 18 years. Collaborators on the project include U.S. Geological Survey, U.S. Fish and Wildlife Service, and Oregon State University.

*2. Scoter Interactions with Shellfish Aquaculture in Coastal British Columbia* – This work, part of the Sustainable Shellfish Aquaculture Initiative, was conducted in close collaboration with the Canadian Wildlife Service. The research was designed to evaluate mechanisms by which shellfish aquaculture might affect, positively or negatively, wintering surf and white-winged scoters. Funding was provided by an NSERC Strategic Grant to Leah Bendell-Young et al., the Canadian Wildlife Service, Ducks Unlimited, and the Sea Duck Joint Venture. Many CWE personnel were involved in this multi-faceted project, including Dan Esler, Sean Boyd, Ron Ydenberg, Ramūnas Žydelis, Sam Iverson, Deb Lacroix, and graduate students Tyler Lewis and Molly Kirk.

Data collection for this project was completed in 2005 and we continue to analyze and write-up data, with 15 papers already published and many others in review or preparation. Both Tyler and Molly have graduated and have done a great job getting their work into the primary literature.

The findings of this project have been encouraging from the perspective of scoter conservation. Using a suite of metrics (habitat use, changes in abundance, survival, foraging behaviour, and habitat quality), we determined that shellfish aquaculture had either neutral or beneficial effects on scoters, depending on the location, type of aquaculture, and prey type. These findings have been used by the industry and regulators to help chart a sustainable course for BC's coastal environments.

3. Behavioural, Distributional, and Physiological Responses of Scoters to Herring Spawn –

Many birds are known to aggregate at sites where Pacific herring spawn in the spring. However, the importance of this phenomenon, in terms of the numbers of species and individuals that use this ephemeral food resource and in terms of the benefits conferred by foraging on spawn, has not previously been addressed. In direct collaboration with the Canadian Wildlife Service and the University of Wyoming, we have been collecting data to address these issues. We have found that the largest and most predictable herring spawn sites in the Strait of Georgia are used by hundreds of thousands of individuals of many species. Surf scoters show a particularly strong response; CWE MSc students Molly Kirk and Erika Lok have used radio and satellite telemetry to show that nearly all surf scoters that winter or migrate through coastal BC utilize herring spawn. Collaborator and PhD candidate (UWyo) Eric Anderson has been tracking changes in mass and condition of scoters in association with herring spawn, using stable isotopes and fatty acids to determine sources of lipid reserves. CWE MSc student Tyler Lewis demonstrated that surf and white-winged scoters dramatically decreased their foraging effort during herring spawn, suggesting that they were easily able to meet maintenance and lipid acquisition costs when foraging on the abundant spawn.

4. Staging Habitats of Spring-migrating Surf Scoters – As part of a collaborative project investigating Surf Scoter spring migration ecology, Erika Lok (CWE MSc student) used a combination of satellite telemetry, radio-telemetry, aerial surveys, and existing GIS habitat data to investigate habitat use of Surf Scoters along the northern BC coast and southeast Alaska during spring. Funded by the Sea Duck Joint Venture (U.S. Fish and Wildlife Service) and working with research partners from Canadian Wildlife Service, U.S. Geological Survey, and the Washington Department of Fish and Wildlife, Erika identified important spring habitats based on the location of marked scoters from throughout the Pacific wintering range, including Baja California Mexico, San Francisco Bay, Puget Sound, and British Columbia. Satellite telemetry, VHF telemetry and survey data collected during springs of 2005 and 2006 indicated that Surf Scoters use specific staging sites within Southeast Alaska during migration, and that herring spawn events are an important habitat attribute of these sites. Erika graduated in 2008 and has one paper in press, and two others ready for submission.

5. Habitat Use by Sea Ducks in SE Alaska – This project (funded by the Sea Duck Joint Venture, the U.S. Geological Survey, and U.S. Fish and Wildlife Service) uses aerial survey data collected throughout southeast Alaska to analyze distribution and habitat use by wintering sea ducks. Combining the spatially explicit survey data with habitat attributes in GIS is allowing us to evaluate species-habitat relationships at a broad scale. This work is being done by SFU (REM) MSc candidate Dora Repard in collaboration with Kris Rothley (SFU-REM), U.S. Geological Survey researchers (Jerry Hupp), and U.S. Fish and Wildlife biologists (Jack Hodges, Debbie Groves, and Bruce Conant).

6. Harlequin Duck Conservation Research - The CWE and Canadian Wildlife Service have had long-standing conservation concerns and research interests regarding harlequin ducks in the Strait of Georgia. Past studies have resulted in an unprecedented understanding of ecology and demography of a seaduck.

During the summers of 2003 and 2004, we conducted studies of harlequin ducks breeding on streams in the southern Coast Mountains of British Columbia, and we are now finishing write-up

of reports and papers. This project was funded in part by BC Hydro's Bridge-Coastal Fish and Wildlife Restoration Program and was led by Dan Esler and Ron Ydenberg. CWE MSc students Jeanine Bond, who completed her degree in December 2005, and Sunny LeBourdais, who graduated in summer 2006, were the workhorses on the project. This research was designed to determine factors affecting distribution and productivity, including abiotic habitat features, presence of fish and invertebrates, and strategies of nutrient acquisition and allocation by females for egg production. Our results indicate that some abiotic features (e.g., slope) are important predictors of harlequin duck occurrence and density, and that fish may have a negative influence, perhaps as a result of their influence on behaviour (and subsequently availability to ducks) of aquatic insects. Female harlequin ducks acquire egg resources entirely from breeding streams, although nutrients acquired on coastal wintering sites may be important for other reproductive stages. Final results of this work have been summarized in a final report for BC Hydro and also are available in the theses of Jeanine Bond and Sunny LeBourdais. This project has generated 5 journal publications, with more in the works.

***7. Black Scoter Reproductive Energetics*** – In collaboration with the U.S. Geological Survey (Paul Flint and Jason Schamber), we are addressing nutrient acquisition and allocation strategies of female black scoters for meeting costs of reproduction. Despite clear declines in numbers of Black Scoters breeding in tundra habitats of Alaska, the mechanisms underlying population change are uncertain. Waterfowl ecologists and managers increasingly recognize the influence of spring energy management strategies on productivity, and ultimately population dynamics, of waterfowl. Therefore, we are quantifying the timing and locations at which female black scoters acquire nutrients and energy for subsequent investment into reproduction, with the intention of identifying habitats and annual cycle stages that are particularly important for management consideration. Field collections for this work have been completed, as have body composition and stable isotope analyses. Data analysis and writing are underway.

***8. Latitudinal Variation in Wintering Ecology of Surf Scoters*** – Tens of thousands of surf scoters winter along the west coast of Baja California, which represents the southern extent of their wintering range, yet we know very little about their wintering ecology (e.g., movements, foods, habitats used) in the region. In contrast to more northern wintering sites, our preliminary observations indicate that Surf Scoters in Mexico appear to have a different diet, exert greater foraging effort, and have a disproportionately higher number of females and juveniles in the population. We are using telemetry to study the ecology of Surf Scoters wintering in Baja California and gain a more complete delineation of the winter population structure, specific migration routes and patterns, and breeding distribution of scoters in the Pacific Flyway. In February 2006, November 2006, and November/December 2007, we captured Surf Scoters in Bahia San Quintin and Bahia Ojo de Libre, Baja California, Mexico and deployed both satellite and radio transmitters to obtain spatial and temporal movement patterns of this wintering population, foraging effort information, habitat use, survival, and population delineation. This effort is led by CWE researcher Kathy Brodhead, in collaboration with U.S. Geological Survey (David Ward) and local universities.

***9. Barrow's Goldeneye Population Delineation*** – In collaboration with Sean Boyd of the Canadian Wildlife Service, we are using satellite telemetry to evaluate population structure, movements, site fidelity, and habitat use of Barrow's goldeneyes in British Columbia. Twenty males were marked at Riske Creek in May 2006, 10 in May 2007, and ten males and ten females were marked in Indian Arm on the coast during December 2006. We intend to deploy more radios over the next 2 years, to mark all age and sex cohorts at different annual cycle stages.

This work will have important implications for understanding population level effects of factors at different annual cycle stages (e.g., oil pollution on coastal wintering areas, changes to interior breeding areas) and will provide the first insights into migratory connectivity for the species. To date, we have learned that males from Riske Creek undergo extensive northward molt migrations, some as far north as the Beaufort Sea. Also, wintering areas of these males range from southeast Alaska to the Strait of Georgia, suggesting that local breeding populations are constituted from birds from numerous wintering sites.

**10. Offshore Wind Farms and Effects on Sea Ducks** – The CWE has been identified as a collaborator and national lead on research efforts by the Canadian Wildlife Service to evaluate effects of offshore wind turbine arrays on wintering and migrating sea ducks. To date, the only offshore wind farm proposed for Canada is in Hecate Strait near Haida Gwaii (Queen Charlotte Islands). We have laid the groundwork for participating in research in the region by hosting workshops, conducting extensive literature reviews, interacting with European researchers with experience in this area, visiting the site to meet with local interests, interacting with the proponent, and collaborating with the U.S. Fish and Wildlife Service to conduct aerial surveys. We are working with the agency and the industry to initiate a large research program.

**11. Molting and Wintering Ecology of Scoters in Southeast Alaska** – Thanks to funding and collaboration from the Sea Duck Joint Venture, U.S. Geological Survey, and the U.S. Fish and Wildlife Service, we are initiating new projects addressing nonbreeding ecology of surf and white-winged scoters in southeast Alaska. This region is known to host substantial proportions of the continental populations of these species during nonbreeding periods (especially wing molt) but studies of their ecology have never been tackled. The molting work, led by MSc student Rian Dickson, will be addressing a variety of basic and applied questions, including energetics, movements and habitat use, and demography (survival). MSc student Corey VanStratt will lead the winter studies, which will provide a continental perspective on wintering biology of surf scoters, in conjunction with our previous and ongoing studies in BC and Mexico.

**12. Foraging Strategies of Arctic Wintering Common Eiders** - Sea ice conditions in Hudson Bay are important to the winter ecology of Common Eiders. CWE PhD student Joel Heath has conducted field work in the Belcher Islands, Nunavut, to determine how wintering common eiders adjust their foraging behaviour in response to different environmental and physiological constraints, in order to balance their energy budgets in mid-winter. These results indicate the importance of considering factors operating across multiple time scales, and provide insight into potential impacts of environmental change in sea ice habitats. This project was conducted in collaboration with Grant Gilchrist of the Canadian Wildlife Service and the Sanikiluaq Hunters and Trappers Association and provides important information to facilitate informed co-management strategies. Joel has graduated and continues to produce manuscripts from the project.

## **E. Ecological physiology**

The main aims of CWE's research in ecological physiology are three-fold: 1) to obtain a better understanding of the fundamental mechanisms underlying individual and population-level variation in physiological traits in order to provide a solid basis for predicting how animals might respond to environmental change, 2) to determine more meaningful intra-specific measures of body condition, quality and individual health for birds, and 3) to develop and apply new

physiological approaches and techniques to conservation biology and ecotoxicology. We approach these aims through a combination of studies on basic physiology, often using tractable model systems (e.g. zebra finches) as well as free-living birds (starlings, western sandpiper), coupled with more applied, and more specific, goal-orientated projects (e.g. addressing current ecotoxicological problems). The following projects are on-going in the Williams' lab at present:

## 1. Plasma metabolites as indicators of physiological state, condition and habitat quality

a) **Arrow Lakes Reservoir Neotropical Migrant use of the Drawdown Zone: use of physiological indicators for assessment of habitat quality.** Dominique Wagner (MSc student) is coordinating the physiology components of this collaborative BC Hydro-funded project (with John Cooper, Manning Cooper and Associates Ltd., and David Green). This project aims to discern effects of habitat quality, and various reservoir water management strategies, on four species of neotropical migrants (Common Yellowthroat, Yellow Warbler, Orange-Crowned Warbler, Wilson's Warbler). Specifically we will measure plasma metabolites (triglyceride, glycerol, and beta-hydroxybutyrate) as indices of fattening rate, and plasma corticosterone as a general indicator of "stress". Physiological data will be combined with banding station data and information of feather stable isotopes.

b) **Other collaborations.** We have continued to extend the application of plasma metabolite analysis for the assessment of fattening rate, general condition, and the relative quality of habitats or sites used by migratory birds, in a wide variety of on-going collaborative studies: a) habitat use in pre-migratory staging areas for shorebirds in Alaska in relation to oil and gas development (with Audrey Taylor and Drs. Abby Powell and Rick Lanctot, University of Alaska Fairbanks); b) altitudinal habitat use in migratory passerines in the Lower Mainland (with Drs. Lesley Evans-Ogden, NSERC PDF at UBC and Kathy Martin); c) yolk precursor analysis in relation to stable isotope signatures in marbled murrelets (with Drs. Ryan Norris, University of Guelph); f) yolk precursors, breeding and migration in sea ducks with Dr. John Takekawa (USGS) and Dr. David Safine (Alaska Science Center); and d) yolk precursors as markers of breeding status in the endangered Kittlitz's Murrelet (with Michelle Kissling, US Fish & Wildlife, Alaska).

## 2. Ecotoxicology projects

a) **Anthropogenic maternal effects: long-term effects of early (in ovo or natal) exposure to xenobiotics in birds.** Early life stages in birds are sensitive to environmental conditions, and factors such as hormones and pollutants can have permanent effects on the resulting phenotypes at concentrations much lower than those required to affect adults. The level of in ovo and post-hatch exposure to hormones and xenobiotic contaminants can be influenced by the mother, potentially resulting in maternal effects (non-genetic modifications of offspring phenotype caused by the conditions provided by the mother during development). Polybrominated diphenyl ethers (PBDEs) are a class of brominated flame retardants that have become ubiquitous in the environment, yet their long-term effects on avian wildlife are poorly understood. We are using a combination of captive (Zebra finch) and wild (European starling) studies to 1) investigate the long term effects on avian development of early exposure to environmentally relevant, sublethal levels of PBDEs, 2) determine what factors affect the relationship between PBDE concentrations in the eggs and mothers, 3) determine if the pattern of transfer from mother to egg differs between hormones and contaminants, and if hormone transfer is affected by contaminants, 4) measure levels of contaminants and hormones in avian wildlife, and 5) investigate the long term effects of early exposure to contaminants in a free-living species. This project is funded by ECs

Chemical Management Plan, in collaboration with Drs. John Elliott (S & T), Drs. Rob Letcher and Tony Scheuhammer (NWRC) and Dr. Scott MacDougall-Shackleton (UWO).

**b) Surveillance and monitoring of CMP priority compounds in key bio-indicator species.** In 2008 EC selected the European starling (*Sturnus vulgaris*) as the “terrestrial” indicator species to monitor new contaminants in biota to provide early warning support to ongoing risk assessment (under the Chemical Management Plan). Nest box ‘trails’ (25 boxes/site) have been established in four urban centers (Halifax, Montreal, Toronto, Vancouver). Lower Mainland sites include the Delta landfill, Burnaby/Surrey, Abbotsford and our new study site at Langley. Nest boxes will be checked daily throughout the breeding season (April – June) to monitor timing of breeding and obtain data on egg and clutch size. Eggs will be collected from all locations and measured for contaminant concentrations at the NWRC laboratories, Ottawa. Project leader Dr. Laird Shutt (NWRC) and Dr. John Elliott.

**c) Determining the relationship between brodifacoum exposure and prothrombin time in California quail and estimation of barn owl exposure to anticoagulants.** The anticoagulant rodenticide brodifacoum has incredible efficiency in eradicating invasive rats causing harm to many bird species, however it has also been linked to the deaths of several raptors, including owls. This project will be conducted by Kirstin Webster (MET student) in collaboration with John Elliott, Kim Cheng (UBC), and Dr Harr, Idexx, Vancouver, and will attempt to determine the relationship between anticoagulant exposure, prothrombin time (PT) and liver residues of brodifacoum in laboratory California quail. The relationship will then be used to estimate the oral anticoagulant exposure from the prothrombin time of barn owl plasma samples obtained from a previous study. This laboratory correlation will also be useful for continued monitoring of birds brought to wildlife centres due to abnormal behavior or bleeding.

### **3. Reproductive ecology and physiology**

Three MSc students successfully defended their theses early in 2009: a) Lauren Kordonowy, ‘Plasma leptin in relation to breeding stage, season, estrogen and photoperiod in female European starlings (*Sturnus vulgaris*)’; b) Marc Travers, ‘Nest predation, clutch size, and physiological costs of egg production in the song sparrow (*Melospiza melodia*)’, and c) Dong Han, ‘Molecular approaches to understanding variation in reproductive phenotype in female zebra finches (*Taeniopygia guttata*)’. A new PhD student, Raime Fronstin, has started a PhD study on causes and consequences of reproductive anemia in European starlings. Finally, we have initiated two studies integrating physiology, foraging, oceanographic conditions and climate change in seabirds (penguins, albatross, and petrels), one on the Antarctic Peninsula (Kristen Gorman, PhD, in collaboration with Dr. Bill Fraser, Polar Oceans Research Group, MT, USA) and one at Bird Island, South Georgia (Glenn Crossin, post-doctoral fellow, in collaboration with the British Antarctic Survey).

### **F. Population ecology of landbirds**

CWE’s research on landbirds is coordinated by David Green and addresses two key questions in avian ecology and conservation. Firstly, we are interested in how migratory strategies of individual birds influence their fitness and the demography of populations. This question is addressed using two model systems; American dippers within the Chilliwack River watershed,

and yellow warblers that breed in Revelstoke but overwinter in the neotropics. Secondly, we are interested in how anthropogenic changes to the landscape influence habitat selection, breeding performance and survival of threatened landbirds in British Columbia. Projects with this focus include a study examining how water use decisions by BC Hydro influence the breeding performance and survival of Yellow warblers in riparian habitat, a study examining habitat selection and reproductive success in the provincially threatened Brewer's sparrow, a study examining how changes in agricultural practices in the Fraser Valley influence the foraging ecology productivity and survival of barn owls, and a study examining how grazing induced changes to grasslands influence productivity of Vespers sparrow. We briefly describe these studies below:

#### *Migratory behaviour and population demography of American dippers*

We have studied dippers in the Chilliwack River Valley, BC since 1999. The majority of dippers, in this and other populations, make seasonal movements between low elevation wintering grounds on large rivers and breeding grounds on higher elevation tributaries. However some individuals do not undergo this seasonal migration and remain on permanent territories year round. We have used morphometric data, mark-recapture analysis and radiotelemetry to investigate whether migratory/sedentary behaviour is associated with distinct morphological and physiological traits, and to examine how variation in migratory behaviour influences natal philopatry, recruitment, survival and reproductive success of American dippers. Migratory and sedentary dippers do not differ morphologically (Green et al. 2009). However, sedentary individuals consistently have higher reproductive success and lower survival than migrants (Gillis et al. 2008). Ivy Whitehorse (MSc) has demonstrated that differences in reproductive success do not arise because of differences in the age structure of the sedentary and migratory population. She has also found that the higher survival of migrants does not result because they expend less effort and are in better condition at the end of the breeding season. Her work instead suggests that not having to defend a breeding territory in the winter improves their ability to deal with fluctuations in prey availability. Ivy defended her thesis in Spring 2009.

#### *Migratory behaviour and reproduction in Yellow warblers*

We have studied the breeding biology of Yellow warblers, a declining songbird dependent on riparian habit, in Revelstoke since 2004. Sam Quinlan, an NSERC Industrial student supported by BC Hydro, has used information that can be obtained from hydrogen isotope ratios in feathers to determine where yellow warblers molt and over-winter. He defended his MSc thesis in Spring 2009. His research will provide a platform for a new NSERC funded PhD student, Anna Drake, who will examines how molt and migratory strategies influence the survival and subsequent reproductive success of birds that return to their breeding grounds in Revelstoke and Inuvik, NWT.. This work will provide considerable insight into migratory connectivity of Yellow warblers and the importance of carry-over effects during the winter period on subsequent productivity.

#### *Water use decisions and the demography of a riparian dependant songbird*

Human activities have caused a dramatic loss in the amount of riparian habitat in North America and this habitat loss is linked to population declines of many riparian dependant songbirds. Prevention of further declines will require an understanding of how to minimize human impacts on these bird populations along with informed restoration efforts. Yellow warblers have been identified by Partners in Flight as a focal species that could be used to evaluate the health of riparian habitat within BC. We established a marked population of Yellow warblers in three riparian habitat types within the drawdown zone of Upper Arrows Lake

Reservoir, near Revelstoke, in 2004. We have shown that Yellow warblers prefer territories containing a high proportion of willow habitat, and that this cue predicts subsequent productivity (Quinlan and Green 2006, Green and Quinlan 2007). We have also shown that current water use decisions have limited impact on productivity and survival of yellow warblers, but that advancing when water levels rise by as little as two weeks would triple nest mortality (6 vs 18%; Green and Quinlan 2007, 2008, Green and Rock 2009). Christine Rock (MSc) initiated a project in 2008 to examine how water-use and cowbirds influence the demography of yellow warblers in Revelstoke. She will use Program Mark to estimate juvenile and adult survival and develop a population model to determine whether the habitat in Revelstoke Reach functions as a source or a sink.

#### *Habitat selection mechanisms in Brewer's sparrow*

The Brewer's sparrow is a provincially red-listed species that is restricted to the sagebrush steppe, an ecosystem type that is under intense pressure from agricultural and residential development. Research on Brewer's sparrows was initiated by the Canadian Wildlife Service (Pam Krannitz, Nancy Mahony, and Kathy Martin) in 1997 and extended to include multiple sites within the Okanagan in 2003. Megan Harrison (MSc) examined how habitat characteristics and conspecifics influence settlement decisions in 2007 and 2008. She found that habitat characteristics have only a small effect on habitat occupancy and the order in which territories are settled. However a large scale playback experiment demonstrated that the conspecific song can attract birds to areas of unoccupied sagebrush habitat. Megan defended her thesis in Fall 2008.

#### *Impacts of changing agricultural land use on the distribution and breeding performance of barn owls*

Land used for agriculture provides habitat for a diversity of wildlife. However, the intensification of agricultural practises, increased use of pesticides and encroachment of urban centres have been linked to the widespread decline of many species associated with agricultural land in Europe. Less is known about the extent to which recent changes to agricultural land use and practices in the Fraser Valley have impacted wildlife. Sofi Hindmarch (MSc) with Elsie Krebs and John Elliott of the Canadian Wildlife Service, and Markus Merkens of Delta Farmland and Wildlife Trust has investigated how land use patterns influence the distribution of barn owls. She has found that the most important factor influencing change in barn occupancy since the 1990's and current barn occupancy is the traffic volume and the length of major highway in the 3km<sup>2</sup> surrounding a barn. She is currently investigating how land use influences barn owl diet, nestling growth rates and productivity. She will defend her thesis in the Fall 2009.

#### *Impacts of grazing induced changes to rangeland on grassland birds.*

Native grasslands are one of the most threatened ecosystems in the province and cattle have been shown to have a profound impact on the vegetation community. This may have significant impacts on the bird community; 60% of bird species native to North American rangelands have declining population trends. We have therefore initiated a research project, in collaboration with Nancy Mahony of the Canadian Wildlife Service, to assess how grazing induced changes to rangeland influences habitat use and productivity of grassland birds. Preliminary analysis of data from 2007 suggests that grazing induced modification of the grassland community influences western meadowlarks. The likelihood that western meadowlarks were present at point count stations increased as the amount of cover made up of species sensitive to grazing increased. In contrast, however, the presence of another grassland bird, the Vespers sparrow varied with total grass cover. Fieldwork in 2009 will focus on how grazing induced

changes to the grassland influence nest success and productivity. This project is intended to inform rangeland management decisions in the Cariboo region of BC.

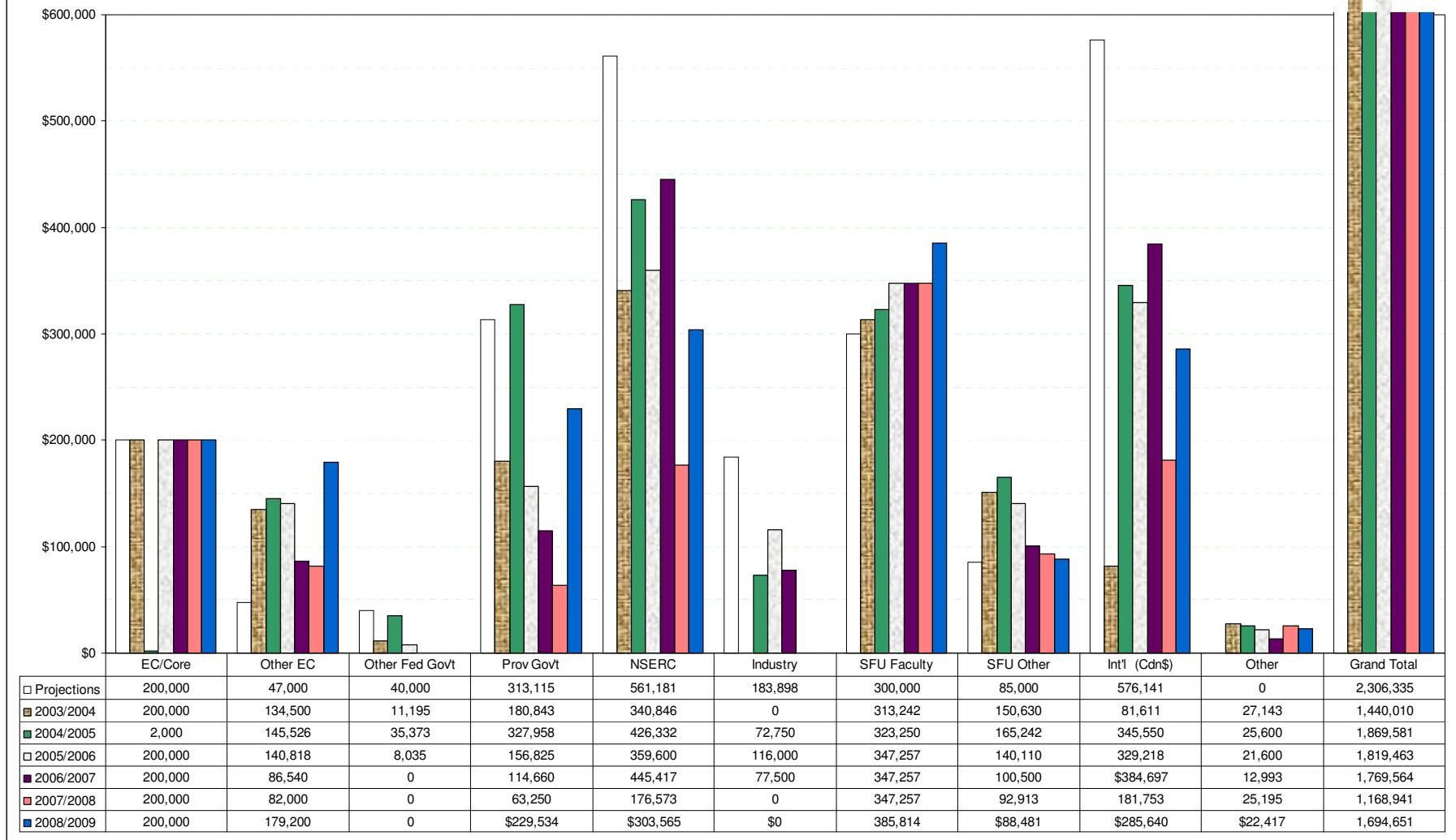
## **VI FUNDING**

### **Budget**

During this fiscal year, 1 April 2008 to 31 March 2009, Simon Fraser University (the Centre for Wildlife Ecology) and Environment Canada (the Canadian Wildlife Service PYRC) had a one year funding agreement that was only finalized in October 2008. . This Contribution Agreement provided \$200,000 as core support for the research activities of the Centre for Wildlife Ecology.

The chart has been revised from the format of previous years to compare revenue projections (formulated for this third agreement) to actual revenue from Environment Canada, SFU and other industrial, provincial, federal and international sectors.

2008/2009 Annual Report  
**CWS Centre for Wildlife Ecology Fiscal Funding Sources**  
 Simon Fraser University



## Centre for Wildlife Ecology Annual Financial Report

2008/2009 Fiscal Year  
1 April 2008 - 31 March 2009

### Scholarships, Fellowships, Grants for Students

#### PhD

|  |   |            |
|--|---|------------|
| SFU Fellowships etc                                      | Heather Major (GF Spring/Fall); Sarah Jamieson (President's PhD Stipend - Summer; GF - Fall); Samantha Franks (GF - Fall) | \$31,250   |
| Departmental travel grant                                | Sarah Jamieson; Lindsay Farrell; Heather Major, Margaret Eng, Samantha Franks   | \$3,872    |
| Western Hemisphere Group Travel Award                    | Sarah Jamieson  | \$750      |
| Intl Society of Behavioural Ecology travel award         | Sarah Jamieson  | \$550      |
| NSERC  | Lindsay Farrell; Samantha Franks; Margaret Eng  | \$48,187   |
| Robert Russell Family First Nation Award                 | Lindsay Farrell   | \$5,250    |
| National Aboriginal Achievement Foundation International | Lindsay Farrell   | \$2,350.00 |
|  | Birgit Schwarz  | \$16,074   |

#### M Sc

|                                     |  |                     |
|-------------------------------------|--|---------------------|
| SFU Fellowships etc                 | Kyle Morrison - GF - Fall  | \$6,250             |
| NSERC CGS-M                         | Kyle Morrison  | \$11,666            |
| SFU Fellowships etc                 | Ivy Whitehorne (TA Fall & Spring - Dept scholarship and top up)                            | \$10,993            |
| SFU Fellowships etc                 | Marie- Helene Burle (GF - Fall))   | \$6,250             |
| PCGF                                | Provincial   | Marie- Helene Burle |
| Graduate International Travel Award | Marie- Helene Burle  | \$6,250             |
| SFU Fellowships etc                 | Rian Dickson (Pacific Century Graduate Fellowship - Special Graduate Entrance Scholarship) | \$12,666            |
| SFU Fellowships etc                 | Corey VanStratt (Pacific Century Graduate Fellowship)                                      | \$10,000            |
| SFU Fellowships etc                 | Kristen Gorman (Fall 2008 Grad Fellowship)   | \$6,250             |

|                     |             |  |          |
|---------------------|-------------|--|----------|
| SFU Fellowships etc |             | Kristen Gorman (Spring 2009 - Glen Gee Scholarship)  | \$950    |
| Provincial          | Green DJ    | Forest Science Program - Graduate Student Pilot Project - Awarded to Megan Harrison - Defining breeding habitat selection mechanisms for red-listed sagebrush Brewer's sparrow | \$20,000 |
| Other               | Green DJ    | Brink-McLean Grassland Conservation Fund - Awarded to Megan Harrison - Defining breeding habitat selection mechanisms for the red-listed sagebrush Brewer's sparrow            | \$3,000  |
| Other               | Ydenberg RC | NSTP - WESA project in Alaska  | \$852    |

**General Funding for CWE**

|          |                 |   |           |
|----------|-----------------|---|-----------|
| EC/Core  |                 | EC/CWS Annual Chair Funding Oct 1/08 to March 31/09                             | \$200,000 |
| SFU      | Ydenberg RC     | SFU Dean of Science: Contribution to Centre for Wildlife Ecology (3rd of 5 yrs) | \$0       |
| SFU      | SFU             | SFU Contribution to Faculty Salaries (Ydenberg Williams Green)                  | \$385,814 |
| Other EC | Esler D         | Wind Farms (3rd of 3 years)   | \$23,000  |
| Other EC | Esler D, Boyd S | EC: Marine Bird Conservation (4th of 5 years)                                   | \$35,000  |

**Generated Research Funding**

|          |                      |  |         |
|----------|----------------------|--|---------|
| Other    | H. Major             | Mewaldt King Award   | \$1,000 |
| Other    | H. Major             | Northern Scientific Training Program   | \$2,142 |
| Other EC | R. Ydenberg/H. Major | EC - Using Audio Clues and Artificial Burrows to enhance Ancient Murrelet Recovery at Langara Island | \$8,000 |

**Sea Ducks**

|               |         |   |          |
|---------------|---------|---|----------|
| International | Esler D | US Fish & Wildlife: Sea Duck Joint Venture (3rd of 3 years) | \$34,606 |
| International | Esler D | USGS - Female Black Scoters (2nd of 2 years)                |          |
| International | Esler D | SDJV - Sea Duck Habitat                                     | \$14,682 |
| International | Esler D | USGS - Exxon - Harlequin Duck                               | \$23,203 |
| International | Esler D | USGS - Southeast Alaska                                     | \$7,590  |

|               |         |   |          |
|---------------|---------|---|----------|
| International | Esler D | US Fish & Wildlife: Sea Duck Joint Venture - Population Delineation and wintering ecology of Surf Scoters in SE Alaska( 1st of 3 years) | \$38,670 |
| International | Esler D | US Fish & Wildlife: Sea Duck Joint Venture - Molting ecology of Surf and White-winged Scoters in SE Alaska                              | \$30,470 |
| International | Esler D | US Fish & Wildlife: Sea Duck Joint Venture - Molting ecology of Surf and White-winged Scoters in SE Alaska (1st of 3 years)             | \$11,000 |
| Other         | Esler D | Ducks Unlimited   | \$2,000  |
| Other         | Esler D | College Educacentre   | \$5,074  |
| Other EC      | Esler D | Science Horizon - Demography of Sea Ducks   | \$12,000 |
| Other EC      | Esler D | Science Horizon - Nonbreeding Ecology of Surf Scoters in the North Pacific  | \$12,000 |

#### **Marbled Murrelet**

|            |                   |   |          |
|------------|-------------------|---|----------|
| Provincial | Ydenberg R/Lank D | Forest Science Program - Testing relationships between habitat quality indices, forest configuration and Marbled Murrelet local population size | \$40,252 |
| Provincial | Lank D            | FSP - Nest-site re-use and management of nest habitat of Marbled Murrelets in coastal forests   | \$6,000  |

#### **Land Birds**

|            |          |  |          |
|------------|----------|--|----------|
| Provincial | Green DJ | BC Hydro Columbia Basin Fish & Wildlife contribution Program: Reservoir operation impacts on nesting success and survival of Yellow Warblers in the Revelstoke Research Wetlands, BC | \$9,900  |
| Provincial | Green DJ | Forest Science Program - Determining thresholds of habitat quality for breeding birds in rangeland ecosystems in the Cariboo Region  | \$69,279 |
| Provincial | Green DJ | BC Hydro/Manning Cooper Associates - Kinbasket and Arrow Lake Reservoir. Nest mortality of Migratory Birds   | \$5,679  |
| Other EC   | Green DJ | Science Horizon - Assessing the impact of dam operations and cowbird parasitism in Yellow Warbler population dynamics  | \$12,000 |

|                              |                         |   |          |
|------------------------------|-------------------------|---|----------|
| <b>Triangle Island</b>       |                         |   |          |
| Other EC                     | Hipfner MJ              | Environment Canada - Science Horizons:<br>"Seabird field conservation programs at Langara<br>and Triangle Islands, BC"                                | \$12,000 |
| <b>Physiological Ecology</b> |                         |   |          |
| International                | Williams TD             | USGS - Triglyceride/glycerol/VTG analysis for<br>233 plasma samples for Western Sandpipers  | \$1,500  |
| International                | Williams TD             | US Fish and Wildlife Service - Assay 60 plasma<br>samples for Kittlitz Murrelets  | \$1,320  |
| Other EC                     | Williams TD             | Development and validation of an integrated<br>avian laboratory and field model system using<br>Zebra Finch and Starling (1st of 4 years)             | \$53,200 |
| International                | Williams TD             | Polar Oceans Research Groups (NSF-LTER) -<br>Climate-dependent changes in penguin<br>population biology, physiology and nutrition (1st<br>of 4 years) | \$16,250 |
| Provincial                   | Williams<br>TD/Green DJ | BC Hydro/Manning Cooper and Associates Ltd. -<br>Arrow Lakes Reservoir Neotropical Migrant use<br>of the Drawdown Zone (1st of 3 years)               | \$73,425 |
| Other EC                     | Williams TD             | Science Horizon - Maternal transfer and long-<br>term effects of early exposure to PBDE-99  | \$12,000 |
| <b>Western Sandpipers</b>    |                         |   |          |
| International                | Ydenberg RC,<br>Baird P | US Army Corps of Engineers: Multinational<br>Study of Neotropical Migrants: The Western<br>Sandpiper as model.  | \$3,487  |
| International                | Lank D                  | Government of French Polynesia - The biology of<br>the Tuamotu Sandpiper  | \$20,000 |
| International                | Ydenberg<br>R/Lank D    | US Fish and Wildlife Service - Using Intrinsic<br>Markers to aid migratory bird conservation (1st of<br>2 years)                                      | \$59,988 |
| NSERC                        | Lank D/<br>Ydenberg R   | Estuary Management for migratory Birds and<br>Sustainable Development (1st of 2 years)  | \$99,952 |
| <b>NSERC</b>                 |                         |   |          |
| NSERC                        | Green DJ                | NSERC Individual Research Grant - Dispersal<br>and migration behaviour of birds in natural and<br>modified landscapes (5th of 5 years)                | \$22,000 |

|             |             |   |             |
|-------------|-------------|---|-------------|
| NSERC       | Ydenberg RC | NSERC Individual Research Grant - "Predation danger and the annual cycle of migrants (4th of 5 yrs) | \$51,300    |
| NSERC       | Lank D      | NSERC Individual Research Grant - RGPIN171290-2008 (1st of 5 years)                                 | \$25,610    |
| NSERC       | Williams TD | NSERC Individual Research Grant- RGPIN/155395-200   | \$44,850    |
| Grand Total |             |   | \$1,694,651 |
| SFU In-Kind |             |   | \$116,678   |

## VII. PUBLICATIONS

This list reflects those publications produced since our last report (publications that were “in press” or “submitted” for the last report are included and have been updated). We continue to publish very actively with 12 publications out in 2009 through March, 12 publications in press and 7 submitted. Over the past year seven MSc students and two MREM students who were supervised by CWE faculty successfully defended their theses. Most of our publications relate to the research carried out in the main CWE programs and most refer to work carried out in the Pacific Northwest. We are however interacting with scientists throughout Canada and beyond and some of our publications reflect this.

### A. Papers in Refereed Journals

#### In press:

Blackburn, G.S., J.M. Hipfner and R.C. Ydenberg. In press. Evidence that tufted puffins use colony overflights to reduce kleptoparasitism risk. *J. Avian Biol.* 40.

Burger, A.E., I.A. Manley, M. Silvergieter, D.B. Lank, K.M. Jordan, T.D. Bloxton and M.G. Raphael. In press. Re-use of nest sites by Marbled Murrelet (*Brachyramphus marmoratus*) in British Columbia. *Northw. Natur.*

Burger, A.E., F.L. Waterhouse, A. Donaldson, C. Whittaker and D.B. Lank. In press. Applications of new methods for assessing nesting habitat of Marbled Murrelets in coastal forests: air photo interpretation and low-level aerial surveys. *BC J. Ecosys. Manag.*

Davies, W.E., J.M. Hipfner, K.A. Hobson and R.C. Ydenberg. In press. Seabird seasonal trophodynamics: Isotopic patterns in a community of Pacific alcids. *Mar. Ecol. Prog. Ser.*

Han, D., N.H. Haunerland and T.D. Williams. In press. Variation in yolk precursor receptor mRNA expression is a key determinant of reproductive phenotype in the zebra finch (*Taeniopygia guttata*). *J. Exp. Biol.*

Janssen, M.H., P. Arce, T.K. Kyser, D.F. Bertram, T.D. Williams, L. McFarlane Tranquilla and D.R. Norris. In press. Pre-breeding diet quality and timing of breeding in a threatened seabird, the Marbled Murrelet. *Marine Ornithol.*

Love, O.P., G. Gilchrist, J. Béty, K.E. Wynne-Edwards, L. Berzins and T.D. Williams. In press.

Using life-histories to predict and interpret variability in yolk hormones. *Gen. Comp. Endocrinol.*

Malt, J.M. and D.B. Lank. In press. Marbled Murrelet nest predation risk in managed forest landscapes: dynamic fragmentation effects at multiple scales. *Ecol. Appl.*

Ronconi, R.A. and J.M. Hipfner. In press. Egg neglect under risk of predation in the seabird Cassin's auklet *Ptychoramphus aleuticus*. *Can. J. Zool.*

Takekawa, J.Y., S.W. De La Cruz, M.T. Wilson, E.C. Palm, J. Yee, D.R. Nyeswander, J.R. Evenson, J.M. Eadie, D. Esler, W.S. Boyd and D.H. Ward. In press. Breeding synchrony, sympatry, and nesting areas of Pacific coast surf scoters (*Melanitta perspicillata*) in the northern boreal forest. *Studies in Avian Biology*.

Vézina, F., O.P. Love, M. Lessard and T.D. Williams. In press. Shifts in metabolic demands in growing European starlings: from tissue development to function. *Physiological and Biochemical Zoology*.

Wada, H., K.G. Salvante, E. Wagner, T.D. Williams and C.W. Breuner. In press. Ontogeny and individual variation in the adrenocortical response of zebra finch (*Taeniopygia guttata*) nestlings. *Physiological and Biochemical Zoology*.

**Submitted:**

Hipfner, J.M. Submitted. Euphausiids in the diet of a zooplanktivorous, north Pacific seabird: Annual, seasonal and age-related patterns of variation. *Mar. Ecol. Prog. Ser.*

Hipfner, J.M., K.B. Gorman, R.A. Vos and J.B. Joy. Submitted. Evolution of the embryonic developmental period in the marine bird family Alcidae: roles for nutrition and predation? *BMC Evolutionary Biology*.

Hipfner, J.M. and J.L. Greenwood. Submitted. Timing and success of Pelagic Cormorant breeding at Triangle Island, British Columbia, 2003-2008. *Northwestern Naturalist*.

Hipfner, J.M., M.J.F. Lemon and M.S. Rodway. Submitted. Introduced mammals, vegetation changes, and seabird conservation on the Scott Islands, British Columbia. *Bird Conservation International*. *Bird Conserv. Internat.*

Hipfner, J.M., L.A. McFarlane Tranquilla and B. Addison. Submitted. Experimental evidence that both timing and parental quality affect breeding success in a zooplanktivorous seabird. *Auk*.

Morrison, K.W., J.M. Hipfner, C. Gjerdrum and D.J. Green. Submitted. Wing length and mass at fledging influence juvenile survival and age at first return to the breeding colony in the Tufted Puffin *Fratercula cirrhata*. *Condor*.

Sorensen, M.C., J.M. Hipfner, T.K. Kyser and D.R. Norris. Submitted. Pre-breeding diet quality and ornament size in a Pacific seabird, the rhinoceros auklet (*Cerorhinca monocerata*). *Ibis*.

**2009**

Caro, S.P., A. Charmantier, M.M. Lambrechts, J. Blondel, J. Balthazard and T.D. Williams. 2009. Local adaptation of timing of reproduction: females are in the driver's seat. *Funct. Ecol.* 23: 172-179.

Chin, E.H., O.P. Love, J.J. Verspoor, T.D. Williams, K. Rowley and G. Burness. 2009. Juveniles exposed to embryonic corticosterone have enhanced flight performance. *Proc. Roy. Soc. B* 276: 499-505.

Franks, S.E., D.B. Lank, D.R. Norris, B.K. Sandercock, C.M. Taylor and T.K. Kyser. 2009. Feather isotope analysis discriminates age-classes of Western, Least, and Semipalmated sandpipers when plumage methods are unreliable. *J. Field Ornithol.* 80: 51-63.

Gorman, K.B., D. Esler, R.L. Walzem and T.D. Williams. 2009. Plasma yolk precursor dynamics during egg production by female Greater Scaup (*Aythya marila*): characterization and indices of reproductive state. *Physiological and Biochemical Zoology* 82: doi: 10.1086/589726.

Green, D.J., I.B. Whitehorne, A. Taylor and E.L. Drake. 2009. Wing morphology varies with age but not migratory habit in American Dippers. *Wilson Journal of Ornithology* 121: 141-147.

Schamber, J.L., D. Esler and P.L. Flint. 2009. Evaluating the validity of using unverified indices of body condition. *J. Avian Biol.* 40: 49-56.

Sorensen, M.C., J.M. Hipfner, T.K. Kyser and D.R. Norris. 2009. Carry-over effects in a Pacific seabird: stable isotopic evidence that pre-breeding diet quality influences reproductive success. *J. Anim. Ecol.* 78: 460-467.

Waterhouse, F.L., A.E. Burger, D.B. Lank, P.K. Ott, E.A. Krebs and N. Parker. 2009. Using the low-level aerial survey method to identify nesting habitat of Marbled Murrelets (*Brachyramphus marmoratus*). *BC J. Ecosys. Manag.* 10: 80-96.

Williams, T.D., F. Vezina and J.R. Speakman. 2009. Individually-variable energy management during egg production is repeatable across breeding attempts. *J. Exp. Biol.* 212: 1101-1105.

Wolf, S.G., W.J. Sydeman, J.M. Hipfner, C.L. Abraham, B.R. Tershy and D.A. Croll. 2009. Range-wide reproductive consequences of ocean climate variability for the seabird Cassin's Auklet. *Ecology* 90: 742-753.

Žydelis, R., D. Esler, M. Kirk and W.S. Boyd. 2009. Effects of off-bottom shellfish aquaculture on winter habitat use by molluscivorous sea ducks. *Aqua. Conserv.* 19: 34-42.

Zharikov, Y., R.W. Elner, P.C.F. Shepherd and D.B. Lank. 2009. Interplay between physical and predator landscapes affects transferability of shorebird distribution models. *Landscape Ecol.* 24: 129-144.

## **2008**

Addison, B., Z.M. Benowitz-Fredricks, J.M. Hipfner and A.S. Kitaysky. 2008. Are yolk androgens adjusted to environmental conditions? A test in two seabirds that lay single-egg clutches. *Gen. Comp. Endocrinol.* 158: 5-9.

Addison, B., A.S. Kitaysky and J.M. Hipfner. 2008. Sex allocation in a monomorphic seabird with a single-egg clutch: test of environment, mate quality and female condition hypotheses. *Beh. Ecol. Sociobiol.* 63: 135-141.

Bentzen, R.L., A.N. Powell, T.D. Williams and A.S. Kitaysky. 2008. Characterizing the nutritional strategy of incubating king eiders *Somateria spectabilis* in northern Alaska. *J. Avian Biol.* 39: 683-690.

Bond, J.C. and D. Esler. 2008. Bill entanglement in subcutaneously-anchored radio transmitters on Harlequin ducks. *Wilson Journal of Ornithology* 120: 599-602.

Bond, J.C., D. Esler and T.D. Williams. 2008. Breeding propensity of female harlequin ducks. *J. Wildl. Manage.* 72: 1388-1393.

Cesh, L.S., T.D. Williams, D.K. Garcelon and J.E. Elliott. 2008. Patterns and trends of chlorinated hydrocarbons in nestling Bald Eagle (*Haliaeetus leucocephalus*) plasma in British Columbia and southern California. *Arch. Environ. Contam. Toxicol.* 55: 496-502.

Elliott, J.E., D.A. Guertin and J.M.E. Balke. 2008. Chlorinated hydrocarbon contaminants in feces of river otters from the southern Pacific coast of Canada, 1998-2004. *Sci. Total Environ.* 397: 58-71.

Evans Ogden, L.J., D.B. Lank and S. Bittmann. 2008. A review of agricultural land use by shorebirds with special reference to habitat conservation in the Fraser River Delta, British

Columbia. Can. J. Plant. Sci. 87: 1-13.

Fernández, G.J. and D.B. Lank. 2008. Foraging behaviour of non-breeding Western Sandpipers *Calidris mauri* as a function of sex, habitat and flocking. Ibis 150: 518-526.

Gorman, K.B., D. Esler, P.L. Flint and T.D. Williams. 2008. Nutrient-reserve dynamics during egg production by female Greater Scaup (*Aythya marila*): relationships with timing of reproduction. Auk 125: 384-394.

Hagmeier, K.R., B.D. Smith and W.S. Boyd. 2008. Estimating numbers of black brant using two sequential spring-staging sites. J. Wildl. Manage. 72: 1342-1351.

Heard, D.J., D.M. Mulcahy, S.A. Iverson, D.J. Rizzolo, E.C. Greiner, J. Hall, H. Ip and D. Esler. 2008. A blood survey of elements, viral antibodies, and hemoparasites in wintering Harlequin Ducks (*Histrionicus histrionicus*) and Barrow's Goldeneyes (*Bucephala islandica*). J. Wildl. Diseases 44: 486-493.

Hipfner, J.M. 2008. Matches and mismatches? Ocean climate, prey phenology and breeding success in a zooplanktivorous seabird. Mar. Ecol. Prog. Ser. 368: 295-304.

Hipfner, J.M. and J.L. Greenwood. 2008. Breeding biology of the Common Murre at Triangle Island, British Columbia, Canada, 2002-2007. Northwestern Naturalist 89: 76-84.

Hipfner, J.M., L.A. McFarlane Tranquilla and B. Addison. 2008. Do marine birds use environmental cues to optimize egg production? An experimental test based on relaying propensity. J. Avian Biol. 39: 611-618.

Lok, E.K., M. Kirk, D. Esler and W.S. Boyd. 2008. Movements of pre-migratory surf and white-winged scoters in response to Pacific herring spawn. Waterbirds 31: 385-393.

Love, O.P., K.G. Salvante, J. Dale and T.D. Williams. 2008. Specific variability in the immune system across life-history stages. Amer. Nat. 172: E99-E112.

Love, O.P. and T.D. Williams. 2008. The adaptive value of stress-induced phenotypes: Effects of maternally derived corticosterone on sex-biased investment, cost of reproduction and maternal fitness. Amer. Nat. 172: E135-E149.

Love, O.P., K.E. Wynne-Edwards, L. Bond and T.D. Williams. 2008. Determinants of within- and among-clutch variation in levels of yolk corticosterone in the European starling. Hormones and Behavior 53: 104-111.

Middleton, H.A. and D.J. Green. 2008. Correlates of postfledging survival, the timing of dispersal, and local recruitment in American Dippers. Can. J. Zool. 86: 875-881.

Pomeroy, A.C., D.A. Acevedo Seaman, R.W. Butler, R.W. Elner, T.D. Williams and R.C. Ydenberg. 2008. Feeding-danger tradeoffs underlie stopover site selection by migrants. ACE-ECO 3: 7. [online] URL: <http://www.ace-eco.org/vol3/iss1/art7>.

Stein, R.W., G.J. Fernández, H. de la Cueva and R.W. Elner. 2008. Disproportionate bill length dimorphism and niche differentiation in wintering western sandpipers (*Calidris mauri*). Can. J. Zool. 86: 601-609.

Taylor, C.M., D.B. Lank, A.C. Pomeroy and R.C. Ydenberg. 2008. Relationship between stopover site choice of migrating sandpipers, their population status, and environmental stressors. Israel Journal of Ecology and Evolution 53: 245-261.

Thayer, J.A., D.F. Bertram, S.A. Hatch, J.M. Hipfner, L. Slater, W.J. Sydeman and Y. Watanuki. 2008. Forage fish of the Pacific Rim as revealed by diet of a piscivorous seabird: synchrony and relationships with sea surface temperature. Can. J. Fish. Aquat. Sci. 65: 1610-1622.

Wagner, E.C., C.A. Stables and T.D. Williams. 2008. Hematological changes associated with egg production: direct evidence for changes in erythropoiesis but a lack of resource-dependence? J. Exp. Biol. 211: 2960-2968.

## B. Other Publications

Butler, R. 2008. Peregrine Fear. In: *BirdWatch Canada*, pp. 4-7.

Green, D.J. and C. Rock. 2009. Monitoring breeding performance and return rates of Yellow Warblers in the Revelstoke Reach Wetlands, BC. Report to: Columbia Basin Fish and Wildlife Compensation Program.

Fernández, G., N. Warnock, D.B. Lank and J.B. Buchanan. 2008. Conservation plan for the Western Sandpiper. Report to: Manomet Center for Conservation Science. 44 pp.

Green, D.J. and S. Quinlan. 2008. Reservoir operation impacts on survival of yellow warblers in the Revelstoke Reach Wetlands, BC. Report to: Columbia Basin Fish and Wildlife Compensation Program, BC.

## C. Theses

Guertin, D.A. 2009. Assessment of contaminant exposure, diet, and population metrics of river otters (*Lontra canadensis*) along the coast of southern Vancouver Island. MSc, Simon Fraser University, Burnaby.

Morrison, K.W. 2009. Demographic consequences of early development and extreme climate events for alcids on Triangle Island, BC. MSc, Simon Fraser University, Burnaby.

Quinlan, S.P. 2009. Habitat selection and migratory connectivity of a Neotropical songbird. MSc, Simon Fraser University, Burnaby.

Repard, D. 2009. MREM

Whitehorne, I.B. 2009. Migratory strategy, reproduction and survival of the American dipper, *Cinclus mexicanus*. MSc, Simon Fraser University, Burnaby.

Barrett, J. 2008. MREM.

Han, D. 2008. Molecular approaches to understanding variation in reproductive phenotype of female zebra finches (*Taeniopygia guttata*). MSc, Simon Fraser University, Burnaby.

Harrison, M.L. 2008. Habitat selection of the Sagebrush Brewer's Sparrow *Spizella breweri breweri* in British Columbia. MSc, Simon Fraser University, Burnaby.

Kordonowy, L. 2008. Plasma leptin in relation to breeding stage, season, estrogen and photoperiod in female European starlings (*Sturnus vulgaris*). MSc, Simon Fraser University, Burnaby.