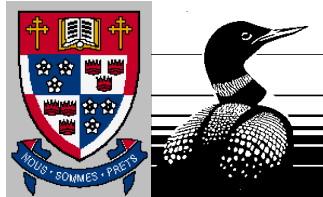


**ANNUAL REPORT of the  
CENTRE FOR WILDLIFE ECOLOGY  
2004-2005**



**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
Mark Hipfner	University Research Associate / CWS Biologist
Doug Bertram	CWS Biologist / Adjunct Professor
Christine Bishop	CWS Research Scientist / Adjunct Professor
Sean Boyd	CWS Research Scientist / Adjunct Professor
Rob Butler	CWS Research Scientist / Adjunct Professor
Bob Elner	CWS Research Scientist / Adjunct Professor
John Elliott	CWS Research Scientist / Adjunct Professor
Barry Smith	CWS Research Scientist / Adjunct Professor
Fred Cooke (retired)	Emeritus Chairholder

##### *2. Research Group*

<b><i>Postdoctoral Fellow</i></b>	<b><i>PhD (in progress)</i></b>	<b><i>MSc (in progress)</i></b>	<b><i>Staff</i></b>
James Dale	Guillermo Fernandez	Courtney Albert	Judy Higham, CWE Admin. Asst.
Liz Gillis	Brent Gurd	Jeanine Bond	Sam Iverson, Aquacult. Tech.
Elsie Krebs	Joel Heath	Lily Cesh (MET)	Glen Keddie, Res. Assist.
Tomohiro Kuwae	Sarah Jamieson	Eric Davies	Debbie Lacroix, Aquacult. Tech.
Caz Taylor	Oliver Love	Bart DeFreitas	Laura McFarlane Tranquilla, MAMU and Triangle Tech
Ramunas Žydelis	Andrea Pomeroy	Kristen Gorman	Connie Smith, CWE Research Tech
	Katrina Salvante	Iain Jones	
		Peter Katinic	
		Jamie Kenyon	
		Molly Kirk	
		Sunny LeBourdais	
		Tyler Lewis	
		Erika Lok	
		Josh Malt	
		Kim Mathot	
		Holly Middleton	
		Emily Wagner	
		Jonathan Whiteley	
	<b><i>PhD( defended)</i></b>	<b><i>MSc (defended)</i></b>	
		BriAnne Addison	
		Jeff Ball	
		Gwylim Blackburn	

**B. Steering Committee**

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

## 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).

The past year has been 'steady as she goes' for the CWE. All our major projects continued, and we have sharpened the focus of our efforts on issues of strategic importance to Environment Canada. Several of our projects are moving into their final phases, enabling us to plan new initiatives. An ongoing occupation is of course the ongoing concern about declining populations of migratory birds, the historical mandate of the Canadian Wildlife Service. An addition to our major projects that address this issue is the NSERC-funded "**Network on avian reproduction and environmental change: integrating ecology and physiology**", a grant won under the leadership of Tony Williams. NSERC funding is supporting a Canadian component of, and Canadian participation in, this international network, with partners in the USA and Europe, funded by NSF and ESF respectively. The network will organise annual workshops (including one in Vancouver in 2006) and technical meetings, and fund student/post-doctoral laboratory exchanges. The main aim of this Network is to foster interdisciplinary discussion and collaborative research bringing together physiologists/endocrinologists with ecologists and evolutionary biologists to address issues in avian reproduction within the context of environmental change (e.g. climate change). Tony's physiological contributions have been key to the success of many of the CWE's projects.

It was a distinct pleasure for me as Director to be able to attend the annual meeting of our east coast sister, ACWERN in November 2004. Aside from exposure to the research work undertaken by ACWERN, I was able to attend their Director's meeting. As a result, I've decided to increase the emphasis given to oversight of the CWE by our Steering Committee. A more detailed and timely Annual Reporting process and a meeting of the SC will help to meet these objectives.

## 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 below. The personnel can also be contacted via the website.

### A. The Triangle Island Seabird Research Station

Coastal British Columbia is home to large populations of seabirds, for which the Canadian Wildlife Service has 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 for marine wildlife. 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 provisioning patterns, attendance patterns, and adult survival. 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 2004 season: We opened our research station on Triangle Island for year 11 on 26 March 2004, with continued logistical support from the Canadian Coast Guard. Scientific research was conducted under the direction of Mark Hipfner, with Laura MacFarlane Tranquilla again acting as supervisor of logistical support. Mark and Laura led the field crew at various times in the summer. 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).

All of the species that we monitored bred successfully at Triangle Island in 2004. For example, Cassin's Auklets enjoyed their best season yet since the CWE research program was initiated in 1994, and Rhinoceros Auklets fared almost as well. Of note, both species bred much more successfully than predicted from spring sea surface temperatures; in fact, the ocean was quite warm in 2004, so the successful season was unexpected.

#### **Graduate students:**

In 2004, Eric Davies continued work on his MSc at SFU, investigating the foraging ecology of Triangle's alcids using stable isotope analysis. In addition, Jessica Beaubier began an MSc project investigating linkages between ocean climate, forage fish ecology, and seabird breeding success. Jessica is based in Dr. Jamie Smith's lab at UBC.

### **B. The Western Sandpiper Research Network**

Shorebirds are among the most highly migratory of all birds. Populations of many species 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 the western sandpiper intensively to understand these apparent declines better.

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.

Since its inception, the CWE has nurtured the development of the Western Sandpiper Research Network ten years as a platform for research on a hemispheric scale that can address this issue. CWS staffers Rob Butler, Bob Elner, and Barry Smith are active in this group. 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. 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. For the past 11 years, we have pursued and aided fieldwork at three breeding sites, several migration locations, and four wintering sites. We have organized nine workshops to help keep researchers in touch, and we run a list-server for this purpose. As a result of our work, the Western Sandpiper is now the best-studied shorebird in the Western Hemisphere.

The ninth **Western Sandpiper Research Network workshop** was held 23 January, 2005 in Portland, Oregon (in conjunction with the Pacific Seabird Group meeting) to consider the broad outlines of a hemispheric research project aimed at understanding causes for declining shorebird census numbers. We decided to form the Shorebird Research Group of the Americas, and set up a committee to organize the founding conference at the first good opportunity in the next two years.

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

This ground-breaking and high profile project examining the biology of the threatened and elusive marbled murrelet continues for its eleventh year. Dov Lank, Elsie Krebs, and Josh Malt continued with the project throughout the year. Nadine Parker moved on in July to a position with CWS, while Laura McFarlane Tranquilla to leave in December to reproduce. Alumnus Falk Huettmann also worked towards publication of results. The team worked closely with Louise Waterhouse from the BC Ministry of Forests and other murrelet researchers in government, industry, and academia, including Peter Arcese (UBC) and Alan Burger (UVic).

Dov Lank continued to serve on the Canadian Marbled Murrelet Recovery Team, which is headed by former CWE staff member Doug Bertram. This participation enables the results of this research to be rapidly assimilated into evolving policy guidelines for management of this threatened species, which falls under the protection of the federal Species at Risk Act. The rewritten provincial "Identified Wildlife Management Strategy", which sets policies for management of the species nesting habitat by forest companies and others, was finally signed off on by government, incorporating our findings into its policy recommendations. Lank also participated in development of a B.C. province-wide radar monitoring plan, a process led by Peter Arcese at UBC.

M.Sc. student Josh Malt conducted a strenuous and successful first field season, running an experimental study to examine the magnitude of "edge effects" on the probability of nest survivorship, a topic that has remained controversial in BC. PDF Elsie Krebs provided GIS and



other support for this work. Additional habitat fieldwork was conducted to supplement the sample size of “random plots” available for comparison with nest sites at Desolation Sound.

This has been a productive year in terms of publications. Yuri Zharikov’s analysis of nest distributions and success with respect to patch sizes and landscape features was accepted for publication in *Landscape Ecology*. Falk Huettmann submitted his revised habitat selection paper to *Wildlife Monographs*; we are fund raising to cover the potentially steep cost of publication in this outlet. Both papers conclude that murrelets are not particularly sensitive to forest stand patch size, and that nesting success is not poorer in small patches, as has been previously suggested. This work has substantial implications for murrelet management in British Columbia. Laura McFarlane Tranquilla was the lead author on three papers published or in press, with a fourth submitted. Russ Bradley published a major thesis chapter in the *Journal of Wildlife Management*. Nadine Parker *et al.* published a paper analyzing post-fledging survival rates of murrelets at Desolation Sound, and prepared a MS on the 2002 dispersal study from Clayoquot Sound. Elsie Krebs has prepared a manuscript marine home ranges and nesting locations and performance, for both Desolation and Clayoquot Sound. Finally, three published papers by American researchers included SFU co-authors because they utilized either the Williams/McFarlane vitellogenin technique and/or information from our radioed birds.

The SFU group’s literature review produced last year was cited prominently in the US Fish and Wildlife Service’s 5-year status review of the species’ status in northern California, Oregon and Washington. Ironically, the passage of SARA in Canada may result in the downlisting of the species further south, where it is in fact substantially more threatened.

As the year closed, these findings were being communicated to interested parties, including presentations at the Pacific Seabird Group meeting in Portland, and funding was obtained from the provincial Forest Science Program and from industry to continue another season of field work, focusing on the relationship between landscape structure and the risk of nest predation. As of the end of March 2005, we were awaiting a final decision on matching NSERC funds in support of both this work and a marine component.

## **D. Shellfish and Scoter Ecology along the British Columbia Coast**

### *1. Baynes Sound Sustainable Shellfish Aquaculture Initiative*

In response to the planned expansion of shellfish aquaculture along the British Columbia coast, Dr. Leah Bendell-Young in collaboration with the CWE, initiated in 2001/02 a study of ecological implications of shellfish aquaculture. Funded by a NSERC Strategic Grant obtained by Dr. Bendell-Young, the CWE and CWS, the project is centered in Baynes Sound, and is a collaborative venture with an array of agency, university and industry partners. CWE personnel working on the project include Ron Ydenberg, Rob Butler, Dan Esler, Sean Boyd, Sam Iverson, Deb Lacroix, and Ramunas Žydelis. The research addresses interactions between wintering surf and white-winged scoter populations, ‘wild’ benthic fauna and shellfish aquaculture. The basic project is fully described in the 2002-03 Annual Report.

This project has just finished its fourth year, the last year of field data collection. Following the five-year plan for the project, the work continued at Baynes Sound and expanded to Barkley and

Desolation Sounds. The field work of graduate student Tyler Lewis was completed, and graduate student Jonathan Whiteley will defend his thesis in April 2005. NSERC-USRA undergraduate student Ian Giesbrecht completed his thesis on the interactions between shorebirds and shellfish aquaculture. Analyses of the many data collected, and comparisons with such historical data as we could find are well underway.

The work on scoters has grown into a large, collaborative program involving CWE, CWS, and an array of other agency, university, and industry partners across the continent. This research addresses interactions between wintering surf and white-winged scoter populations and shellfish aquaculture, which are concentrated in similar areas and require similar resources. To address this issue, we need to understand the processes by which scoters choose foraging patches, the attributes of habitat patches that influence scoter foraging decisions, the scale over which scoters forage, the effects of scoter foraging on shellfish resources, the effects of variation in prey densities and types on scoter foraging and distribution, and the population-level demographic consequences of these interactions. In turn, this will generate data that will (1) indicate the mechanisms by which conflicts or benefits of the shellfish industry could occur, (2) evaluate the population-level effects of the shellfish industry, and (3) predict effects of current and projected levels of shellfish industry activity.

In the coming year we will wind this project up. Specific activities to be conducted include a final public meeting, with all interested parties invited to attend. We have tentatively set the date for this in late October or early November of 2005. We will present our final results. We feel that we have successfully convinced our industry and public partners that the project is non-threatening to their interests, and that the results will in the longer run benefit the industry as well as the environment.

Specific activities of the scoter studies include:

- Four winters (2001-02, 2002-03, 2003-04, and 2004-05) of data collection have been completed. Intensive surveys have been conducted at all 3 study sites with the intent of describing changes in numbers and distribution between and within years. These data also will be compared to historical CWS data (from winter 1980-81) in Baynes Sound to provide insight into longer-term changes. The survey data also will be used in analyses of habitat associations, with the goal of determining the relationships between habitat attributes, including aquaculture, and scoter densities. A post-doctoral research associate, Ramunas Žydelis, will be leading the habitat association work.
- A major component of the project involves radio-telemetry, which we are using to answer questions about survival, movements, habitat associations, and foraging behavior. Over the last 4 winters, nearly 400 scoters have been marked with conventional VHF transmitters. These have been tracked by vehicle or boat regularly from December through April. We have found that scoters in Baynes Sound show strong fidelity to feeding areas, they forage almost exclusively on clams in intertidal habitats, they almost never forage at night, and their winter survival is high. In Desolation Sound, the data suggest that surf scoters move much more than in Baynes Sound, sequentially exploiting shellfish farms with naturally recruited mussels.
- Diet of captured scoters was inferred from analysis of shell fragments in fecal samples; varnish clams (*Nuttallia obscurata*) and manila clams (*Venerupis philippinarum*) were the taxa most abundant in the fecal samples from Baynes Sound. Scoters feed primarily

on mussels in Desolation Sound, although their diet apparently diversifies later in the season, as mussels on aquaculture structures are depleted.

- Clams were sampled throughout Baynes Sound during summers 2002 and 2003. These data will be used to quantify abundance and distribution of prey, for use in several aspects of the study. These data are difficult and labor-intensive to collect, but allow clearer understanding of the effects of varying food supply on scoter wintering biology.
- Tyler Lewis, MSc student, is quantifying the behavioural responses of scoters to temporal and spatial variation in bivalve prey. Results from this work will indicate behavioural consequences of variation in bivalve prey that occur due to aquaculture operations. In each of the winters 2002-03 and 2003-04, six plots were intensively sampled for clam density and distribution. At each of the six plots, foraging radio-marked scoters were monitored to determine the amount of time devoted to feeding. These data will be compared between sites with different clam densities and distributions, as well as over time as prey resources are depleted. In addition, foraging success (proportion of dives in which a prey item was brought to the surface) was documented for both radio-marked and non-marked scoters at each plot. Tyler will defend his thesis during the 05-06 fiscal year.
- Molly Kirk, MSc student, is finishing data collection for her component of the project, which focuses on movements and behaviour of scoters in different habitats: the soft-bottomed, clam-dominated Baynes Sound and the rocky, mussel-dominated habitat in Desolation Sound. She will consider how aspects of winter foraging ecology are mediated by dramatically different prey landscapes.

These results are preliminary as data preparation and analysis is currently underway. However, we are confident that the data gathered over the past 3 winters will be valuable for understanding scoter interactions with aquaculture (and other forms of habitat change), as well as lending new insight into wintering biology of these poorly known species.

The work on shellfish aquaculture has also led to other project directions, addressing the distributional, behavioural, and physiological responses of scoters to herring spawn in the Strait of Georgia. Also, CWE is involved in satellite telemetry marking of scoters from the Strait of Georgia, with the intent of understanding migration ecology, breeding area affiliations, molting sites, and winter site fidelity.

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## *2. The status of Abalone populations in Haida Gwaii*

Northern Abalone is Canada's only marine invertebrate with 'threatened' status, and as such the species is deserving of some conservation attention. M.Sc. student Bart DeFreitas is supported by his employer Haida Fisheries, a subvention grant from the Department of Fisheries and Oceans, and by the CWE, and is investigating why depleted abalone populations seem to have difficulty in re-establishing themselves. Bart will defend his thesis in April 2005. The first results were previously published (DeFreitas 2003). His 'Baby Abalone Recruitment Traps' (acronym BART) showed that many small abalones are present in the waters around Haida Gwaii. Therefore, the depressed numbers do not seem to be due to a failure of spawning, as some have claimed. The growth of wild abalones also lies well within the reported range. It seems therefore that most individuals are unable to reach sizes large enough to enter the fishery, perhaps because the depredation rate is high.

## **E. Heron Working Group**

The Great Blue Heron, the largest heron of North America, is widely distributed in Canada but the estimated 1500 pairs of coastal British Columbia Great Blue Heron are distinct from herons elsewhere in Canada. The coastal birds are non-migratory and remain isolated year round from heron populations that migrate. This isolation has led to adaptations with among other features a darker plumage and subspecies classification, *Ardea herodias fannini*. This subspecies, which is currently blue-listed by the British Columbia Ministry of Sustainable Resource Management, has been investigated by a team of researchers from the CWE and CWS for several years.

In 2004/2005 CWS scientists Rob Butler and Barry Smith and students from the CWE continued to investigate the response of herons to eagle predators at their nests and the food supplies. It has been observed that the overall reproductive success of Great Blue Herons in the Georgia Basin has decreased over the last decade and a high level of colony abandonment, thought to be due to predation, occurs. Fieldwork has suggested that once a colony has abandoned, it frequently fractures into a number of smaller colonies around the same foraging site. In April 2005, CWE MSc student Jamie Kenyon will defend his MSc thesis which examines the role these different sized colonies may play in the overall population dynamics of this species. A new MSc student, Iain Jones, is beginning a study of the relationship between eagle nests and heron colony locations. Paradoxically, it seems that herons may be choosing to locate their colonies near an eagle nest. Iain is quantifying the territorial response of nesting eagles to other eagles intruding on their territory. The hypothesis is that herons may benefit from being near one eagle nest by gaining protection from other intruding eagles.

## **F. Harlequin Duck Conservation Research**

CWE and CWS have had long-standing conservation concerns and research interest regarding harlequin ducks in the Strait of Georgia. Past studies have resulted in an unprecedented understanding of ecology and demography of a seaduck

Although there was little banding of harlequins in the past year (some were banded as part of studies described below), researchers (including Sean Boyd, and Pete Clarkson) continued to make observations of colour banded birds at several locations in the Strait of Georgia in the fall and spring, concentrating on birds at White Rock and at the herring spawn at Hornby Island, augmenting the database of information on individual birds. The objectives are to understand survival, migration and recruitment patterns of this population in order to characterize critical habitats and demographic processes of harlequin ducks.

Over the past 2 summers (2003 and 2004) we have conducted studies of harlequin ducks breeding on streams in the southern Coast Mountains, funded in part by BC Hydro's Bridge-Coastal Fish and Wildlife Restoration Program. Led by Dan Esler and Ron Ydenberg, and involving MSc students Jeanine Bond and Sunny LeBourdais, this research is designed to determine factors related to distribution and productivity. For the first time, we are collecting data to evaluate the relationship between harlequin duck abundance and habitat attributes at a broad, regional scale. This approach will allow a broad inference for predicting and mitigating effects of human activities on streams in the region. We also are looking more closely at two mechanisms by which productivity might be affected. The first considers the interactions between fish, harlequin ducks, and their prey, aquatic invertebrates. We speculate that there may

be direct and indirect effects of fish that have implications for abundance of harlequin duck prey and subsequent productivity. Also, we are using a stable isotope approach to determine whether nutrients for clutch formation are derived primarily from marine wintering areas or from freshwater breeding streams. Field work for this project is complete and Jeanine and Sunny are in the process of analyzing data and preparing their theses.

### **G. 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 endocrine disrupter and ecotoxicological problems). The techniques we have developed and utilised for this basic research, and the basic information generated on reproductive physiology have been invaluable in contributing to, and facilitating, our more applied work. One good example of this linkage is our work on development of indirect, physiological techniques to assess reproductive state and breeding chronology in rare or cryptic species (Vanderkist *et al.* 1999, 2000; McFarlane Tranquilla *et al.* 2003). The following projects are on-going in the William's lab at present:

1. **Corticosterone, reproduction and environmental stress:** Oliver Love (PhD student) is continuing our work with starlings using hormonal manipulations to investigate the interaction between stress and reproduction. Specifically, he is examining the adaptive role of corticosterone in mediating reproductive 'decisions' in females and the consequences of this on offspring phenotype. Maternal corticosterone transferred to the yolk may act as a hormonal cue of maternal condition to the developing embryo enabling mothers to fine-tune the quantity and quality of offspring to prevailing environments.

2. **Role of lipid dynamics in reproduction:** Katrina Salvante (PhD student) is working on a potential mechanism underlying "costs of reproduction": the conflict between the mother meeting her own energy needs (for maintenance etc) and those of provisioning the egg. In particular she is looking at the dynamics of lipoprotein metabolism in relation to reproduction under 'normal' and stressful conditions (e.g. low ambient temperature), and the hormonal basis of this relationship.

3. **Anemia and reproductive effort:** Female birds routinely become anemic, i.e. they have reduced red blood cell number, during egg-laying. Emily Wagner (new M.Sc. student) will be investigating the relationship between the extent of anemia and a bird's ability to lay eggs and/or rear chicks. Since anemia can be a common symptom associated with disease or toxicological challenge this work will also be of applied interest.

4. **Costs of social signalling:** Dr. James Dale (NSERC PDF) is investigating the relationship between social dominance, potential social signals (e.g. bill colour) and immune function. He is

also interested in assessing the utility of applying studies of social behaviour and sexual signals as measures of bird health in applied issues such as ecotoxicology.

**5. Timing of nesting and reproductive physiology of Greater scaup:** Continental scaup populations have declined in recent years, and lowered productivity has been suggested as an important contributing factor in this decline. Kristen Gorman (MSc, co-supervised by TDW and Dr Dan Esler) is investigating physiological and nutritional attributes that influence timing of clutch formation in female greater scaup (*Aythya marila*). This work has three components: 1) assessment of nutrient reserve dynamics (lipid, protein) during egg formation using more traditional methods of body composition analysis; 2) use of stable isotope analysis to determine the sources and relative contributions of nutrient reserves used in egg formation; and 3) validation of the use of an indirect, physiological method (plasma yolk precursor analysis) to determine reproductive state in free-living ducks. This project is funded by the US geological Survey in collaboration with Dr Paul Flint (USGS).

**6. Impact of use of MSMA (monosodium methanearsonate) for bark beetle control on cavity-nesting birds in B.C. forests.** Bark beetles are considered among the most damaging of forest insect pests in western North America. Use of MSMA provides an alternative to direct harvesting in reducing losses to bark beetles. Typically pheromone baits are used to attract beetles to specific trees, and these infested trees are then treated with MSMA. This project will investigate a) the potential for secondary exposure to arsenic from MSMA in woodpeckers and other insectivorous forest birds, and b) possible relationships between AS exposure and health and reproductive success of birds using zebra finches as a model species (MSc student, Courtney Alberts; a collaboration between TDW and Drs John Elliott, Kathy Martin, Laurie Wilson and Pierre Mineau of Environment Canada).

**7. Monitoring of chlorinated hydrocarbons and effects in bald eagles on the British Columbia coast.** This is a collaborative project with Dr John Elliott of Environment Canada, involving Lily Cesh an MET student (supervised by TDW). The aim of the project is to assess the impact of chlorinated hydrocarbon concentrations on nestling bald eagles from the Lower Fraser Valley and reference sites in the Georgia Basin. The objectives of the study are: (1) to revisit eagle nests sampled in the early 1990s to assess burdens of pulp mill related contaminants (dioxins, furans), (2) to sample those same sites for "newer" chemicals such as polybrominated diphenyl ethers (flame retardents) and look for correlative evidence of impairment of thyroid hormone processes. Long term trend monitoring of persistent contaminants in local marine and estuarine food chains is valuable to a variety of agencies and NGOs in assessing chemical risks to ecosystems. Data from study of bald eagle populations has proven to be extremely valuable in previous assessment of health of ecosystems such as the Strait of Georgia. The polybrominated diphenyl ether results and associated biological effects will be communicated to the Canadian and international agencies reviewing the use of this chemical, and be used in assessing its environmental risk. The data will also be used in the region to assess the risk posed by this specific chemical to local ecosystem health.

**8. "Landscape physiology" - plasma metabolites in migrating birds:** We have continued to extend the application of plasma metabolite analysis for the assessment of fattening rate and the relative quality of habitats or sites used by migratory birds, at a number of geographical scales: a) habitat use over the whole migratory route in western sandpipers (a collaboration with Drs. Nils Warnock, Guillermo Fernández Aceves and John Takekawa, with funding from US Fish &

Wildlife, California), and b) habitat use in pre-migratory staging areas in Alaska ( a collaboration with Dr. Abby Powell and Audrey Taylor, University of Alaska Fairbanks, AK and Dr. Richard Lanctot, U.S. Fish and Wildlife Service, Anchorage, AK) and c) altitudinal habitat use in migratory passerines in the Lower Mainland (Lesley Evans-Ogden, NSERC PDF at UBC).

**9. NSERC-funded Network on avian reproduction and environmental change: integrating ecology and physiology.** NSERC funding is supporting a Canadian component of, and Canadian participation in, this international network, with partners in the USA and Europe funded by NSF and ESF respectively. The network will organise annual workshops (including one in Vancouver in 2006) and technical meetings, and funds student/post-doctoral laboratory exchanges. The main aim of this Network is to foster interdisciplinary discussion and collaborative research bringing together physiologists/endocrinologists with ecologists and evolutionary biologists to address issues in avian reproduction within the context of environmental change (e.g. climate change).

## **H. Waterbirds in the North**

Under the direction of Dan Esler and Ron Ydenberg, several studies are underway that address conservation issues concerning waterbirds in arctic and subarctic habitats. These projects were initiated because of the well-founded concerns about long-term (three decade) population declines of northern waterbirds such as many seaducks and some loon species. The projects, which are often collaborative with various agencies and colleagues, are outlined briefly below:

- *Population change in seaducks in Prince William Sound* - Dan Esler continues his involvement with a project initiated in 1995 addressing population-level responses of sea ducks (particularly Harlequin Ducks and Barrow's Goldeneyes) to the 1989 Exxon Valdez oil spill in Alaska. Field work continued through March 2005 and analysis and writing is ongoing. In collaboration with a research team of agency and university partners, Dan has documented that these sea ducks continued to be exposed to residual oil for more than a decade following the spill. Further, Harlequin Ducks have shown long-term demographic consequences of the oil spill, in contrast to the conventional wisdom that oil spill effects are short-lived for bird populations.
- *Timing of reproduction in Greater Scaup* - Another project initiated in collaboration with the U.S. Geological Survey addresses the relationships of nutrition and physiology to timing of reproduction by greater scaup in coastal Alaska. MSc student Kristen Gorman is defending her thesis in April 2005. Her work, also described under the physiological studies section, has led to novel insights into how waterfowl manage their nutrient reserves in support of reproduction.
- *Foraging ecology of breeding Red-throated Loons* - Numbers of red-throated loons have declined by over 50% in recent decades. Jeff Ball, MSc student defended his thesis in fall 2004, which evaluated underlying causes of this population change by addressing the hypothesis that changes in forage fish quantity or quality have constrained the ability of parents to adequately provision chicks, resulting in subsequent depression of recruitment. In collaboration with Dr. Joel Schmutz, USGS, Jeff documented variation in provisioning by Red-throated loons, and subsequent effects on chick growth, survival, and behaviour.
- *Staging Habitats of Spring-migrating Surf Scoters* – We have recently received funding from the Sea Duck Joint Venture to initiate a study identifying important spring-staging areas for surf scoters, and quantifying habitat attributes of those sites. This work relies on collabora-

tion across the Pacific coast from researchers in Baja California, Mexico, San Francisco Bay, Puget Sound, and our own work in the Strait of Georgia. We will be tracking birds with VHF radios and satellite transmitters during migration, particularly in northern BC and southeastern Alaska. Erika Lok is a new MSc student who will be participating in the project.

- *Foraging Strategies of Arctic Wintering Sea Ducks* - Changing environmental conditions in the Canadian North associated with global climate change pose a serious risk to the integrity of sea ice ecosystems within Hudson Bay. In 2002 and 2003 CWE PhD student Joel Heath conducted field work in the Belcher Islands, Nunavit, to determine how wintering common eiders adjust their foraging behaviour in response to different environmental constraints, and the influence of eider predation on the community structure of benthic invertebrates and fish.
- *Parental care in eiders* - Markus Öst, of the University of Helsinki, made his third winter migration to the CWE in February 2005. He was continuing work begun in 2002 with Ron Ydenberg on a project modeling the evolution of cooperative parental care in eiders. A paper resulting from this collaboration was published in *Behavioural Ecology* in 2004.

## **I. Landscape ecology of songbirds**

CWE's research on the landscape ecology of songbirds investigates how natural and anthropogenic modification of the landscape influences avian populations. Currently projects coordinated by David Green focus on how dispersal and migratory strategies of individual birds influence their fitness and the demography and genetic structure of populations. Projects underway include a study on migration and demography of American dippers, a songbird dependent on pristine rivers and streams, a study investigating the long-term declines of warbler species in BC and a study examining how habitat fragmentation influences the genetic structure of logrunner populations in Queensland, Australia. We briefly outline the BC studies below:

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

The Dipper project builds on research initiated by Christy Morrissey (CWE PhD student) on the population ecology of the American Dipper in the Chilliwack River Valley, BC. 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. Little is known about what factors influence altitudinal migration or the consequences of altitudinal migration for subsequent survival or reproductive success. We are currently using morphometric data, mark-recapture analysis and radiotelemetry to investigate whether migratory/sedentary behaviour is associated with distinct morphological and physiological traits, and examine how variation in migratory behaviour influences natal philopatry, recruitment, survival and reproductive success of American dippers. Preliminary analysis of the long-term data set conducted by Elizabeth Gillis (post-doc) suggests that sedentary individuals have higher reproductive success and similar survival rates to migratory individuals. Despite this, Holly Middleton (in press) has found that migratory dippers are equally faithful to their breeding sites. Work conducted in 2004/5 by Amber Taylor and Elissa Drake (undergraduates) found no differences in the wing shape or body size of migratory and sedentary dippers suggesting that morphological differences do not limit the ability of migratory individuals to switch strategies. We are therefore examining whether food or nest sites limit the number of individuals that can be sedentary. Holly Middleton also initiated her MSc in 2004 and is currently examining how



variation in post-fledging behaviour and dispersal strategies in juvenile dippers influences survival and recruitment.

*Population declines in migratory warblers of BC*

Long term declines in populations of many migratory songbirds have been documented both in Canada and the United States by the Breeding Bird Survey (BBS). In BC, Yellow and Wilson's warbler populations have declined consistently (ca. 2% per year and 3.4% per year respectively) over the last 30 years. However, American Redstart populations are relatively stable and Orange-crowned warbler populations are thought to have increased in abundance over the same time period. In order to investigate the causes of the observed population trends of these four neotropical migrants we have initiated a project to compare their demography and migratory behaviour. A pilot project funded by BC Hydro and a Science Horizons Youth Internship to Christine Croton was conducted in 2004 to assess the utility of current survey methods to determine breeding productivity of warbler species and establish marked populations of Yellow warblers and American Redstarts at two sites in Revelstoke, BC. Future research will use Yellow warblers as a focal species and relate spatial patterns in vital rates to local and landscape level habitat characteristics, including those associated with management of water levels in the Columbia River. Funding has been obtained from BC Hydro for Sam Quinlan (MSc) to examine age-specific migratory strategies of Yellow warblers and evaluate how the use of riparian habitat by migratory birds in the fall influences adult and juvenile Yellow warblers that have not yet left their breeding territories. In addition we plan to use radioisotope analysis to document temporal patterns in movement of the four warbler species during spring and fall migration and investigate the connectivity of warbler populations on breeding and wintering grounds. This work is a collaboration with Wendy Easton of the Wildlife Service and migratory bird monitoring stations in Revelstoke and Mackenzie, BC.

## VI. CONFERENCES

The CWE organized the ninth **Western Sandpiper Research Network workshop** (held 23 January 2005 in Portland, Oregon in conjunction with the Pacific Seabird Group meeting). We decided to form the Shorebird Research Group of the Americas, and set up a committee to organize the founding conference at the first good opportunity in the next two years. The highlight of the workshop was a brilliant historical overview of work on the western sandpiper by Dov Lank, that made clear to all how far we have come in understanding this long-distance migrant.



Attendees at the Western Sandpiper Research Network workshop, 23 January 2005

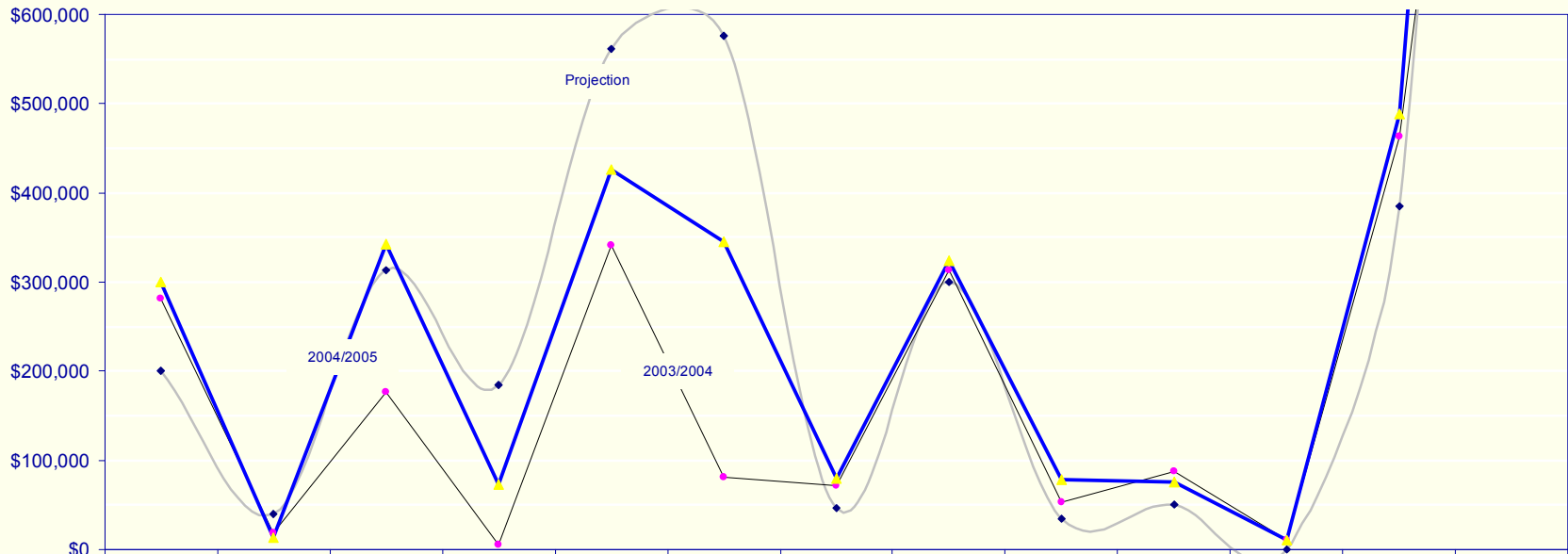
## VII FUNDING

### Budget

1 April 2004 to 31 March 2005 is the second year of the current five-year agreement between Simon Fraser University (the Centre for Wildlife Ecology) and Environment Canada (the Canadian Wildlife Service PYRC). This Contribution Agreement provides \$200,000 annually 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.

### 2004/2005 Annual Report CWS Centre for Wildlife Ecology Fiscal Funding Sources Simon Fraser University



	EC/CWS	Other Federal	Provincial	Industry	NSERC	International	Misc. Awards	SFU Faculty	SFU TAs/hips	SFU Fellowships	SFU Other	SFU Total	Grand Total
◆ Projection	\$200,000	\$40,000	\$313,115	\$183,898	\$561,181	\$576,141	\$47,000	\$300,000	\$35,000	\$50,000	\$0	\$385,000	\$2,306,335
■ 2003/2004	\$281,500	\$19,195	\$176,110	\$4,733	\$340,846	\$81,611	\$72,143	\$313,242	\$53,130	\$87,500	\$10,000	\$463,872	\$1,440,010
▲ 2004/2005	\$299,459	\$13,373	\$342,025	\$72,750	\$426,332	\$345,550	\$79,600	\$323,250	\$78,242	\$76,000	\$11,000	\$488,492	\$2,067,581

## Centre for Wildlife Ecology Annual Financial Report

2004/2005 Fiscal Year

1 April 2004 - 31 March 2005

EC/CWS Annual Chair Funding 1 April 04 to 31 March 05 \$200,000

### Grad Research Fellowships

Ph.D: Heath J, Love O, Salvante K	\$18,000
President's Fellowship, Salvante K	\$6,000
NSERC PGSB Jamieson, S	\$21,000
NSTP Research Award, Jamieson S	\$3,373
M.Sc: Albert C, Bond J, Gorman K, Kenyon J, Klein V, Mathot K, Whiteley J	\$48,000
NSERC PGSA Mathot K, Kirk M	\$18,000
NSERC Industrial Postgraduate Scholarship (M Sc) Malt, J	\$14,000
Canfor Industrial Contribution (Matching NSERC IPS) Malt, J	\$6,000
NSERC Undergrad Research Award: Chin E, Rowland E	\$11,250
J. Abbott/M. Fretwell Grad Fellowship - Katinic P	\$4,000

**SFU Student TAs** \$78,242

### Travel Grants

NSERC Grad Student Conference Support Fernandez G, Heath J, Love O, Mathot K, Pomeroy A, Salvante K	\$3,136
SICB Grant in Aid of Research - Love O	\$1,300
E Bird NSERC-funded Network Travel Award - Love O, Salvante K, Addison B,	\$4,961

### Generated Research Funding

Green DJ	BC Hydro: Migratory behaviour and demography of declining songbirds in BC	\$5,000
Boyd S, Esler D	CWS: Ecological interaction between shellfish aquaculture operations and the foraging behaviour of Scoters in Baynes Sound, B.C.: Lewis T	\$23,000 (2nd of 2 years)
Esler D, Ydenberg RC	Whispering Pines Clinton Band: LeBourdais S	\$25,600 (2nd of 3 years)
Ost M, Ydenberg RC	Barrows Goldeneye Riske Creek Project	\$9,995 (1st of 2 years)
Smith B, Green DJ	CWS: Population Dynamics and Conservation Ecology of the Yellow Warbler of the Upper Arrow Reservoir near Revelstoke, BC. Quinlan S	\$6,500

Boyd S, Esler D	CWS: Clam Measurement at SFU. Gorman K	\$6,000
EC/ CWS BCCF Contributions:		
Elnor R, Ydenberg RC	Mathot K	\$2,000
Elliott J, Williams TD	Cesh L	\$5,000
Boyd S, Esler D	Iverson S	\$15,000
Esler D, Ydenberg RC	CWS: Abundance and Distribution of Marine Birds on the West Coast of Vancouver Island	\$5,000
<u>Environment Canada - 6 Science Horizons Projects</u>		
Hipfner MJ, Ydenberg RC	Demography of common murrelets breeding at Triangle Island, BC	\$9,000
Boyd S, Esler D	Scoter populations wintering in coastal BC: how do environ- mentally-mediated movement patterns affect conservation strategies	\$9,000
Boyd S, Edler D	Factors affecting harlequin duck productivity: interactions among ducks, fish, and their shared invertebrate prey	\$9,000
Easton W, Green DJ	Migratory behaviour and the demography of a declining neotropical migrant, the Wilson's Warbler	\$9,000
Elliott J, Williams TD	Study of bark beetle control agent on cavity nesting birds in BC	\$9,000
Butler R, Ydenberg RC	Minimizing the effect of predators in population declines of COSEWIC-Listed great blue herons	\$9,000
Esler D, Ydenberg RC	BC Hydro Bridge Coastal Restoration Program Variation in Harlequin Duck Distribution and Productivity: The Roles of Habitat, Competition, and Nutrient Acquisition"	\$81,000 (2nd of 3 years)
Esler D, Ydenberg RC	Exxon Valdez Oil Spill Trustee Council, US Geological Survey "Long Term Effects of the Exxon Valdez Oil Spill on Demography of Harlequin Ducks and Sea Otters in Prince William Sound, Alaska"	\$53,889 (4th of 5 years)
Esler D, Ydenberg RC	US Geological Survey "Evaluating Population Declines in Red Throated Loons"	\$6,150 (4th of 4 years)
Esler D, Ydenberg RC	Ducks Unlimited, IWWR: Movements of Wintering Surf Scoters...Kirk	\$10,000
Esler D, Ydenberg RC	MEHP/ U. Wyoming - The Role of herring spawning grounds as marine protected areas for scoters in the Pudget Sound - Georgia Basin	\$18,871

Williams TD	NSERC Individual Research Grant - "Physiology of life-histories: egg size and number and costs of reproduction"	\$43,000 (3rd of 4 yrs)
Williams TD	NSERC Special Research Opportunity Program (SRO) "Avian reproduction and environmental change: integrating ecology and physiology"	\$29,200 (1st of 3 yrs)
Ydenberg RC	NSERC Individual Research Grant - "Predation danger and the evolutionary ecology of migrants and provisioners"	\$51,000 (4th of 4 yrs)
Hill E, Green DJ	BC Hydro Columbia Basin Generation: Migratory behaviour and demography of declining songbirds in BC	\$5,000
Green DJ	NSERC Individual Research Grant - Dispersal and migration behaviour of birds in natural and modified landscapes	\$22,000 (1st of 5 years)
Lank DB	NSERC Individual Research Grant - Maintaining variation in ecologically significant traits in birds	\$24,000 (2nd of 4 years)
Green DJ	NSERC Equip Grant for Truck	\$33,000
Williams TD, Elliott J	Canadian Wildlife Service: "Ecotoxicology of halogenated organic contaminants in bald eagles in the Strait of Georgia"	\$2,000
Williams TD	NSERC Equipment Grant	\$20,285
	CWS Equipment - Bird Trapping Noosemats, Scope	\$7,959
<b><u>Aquaculture</u></b>		
Bendell-Young L	NSERC Strategic Grant "Towards a Sustainable Shellfish Aquaculture Industry"	\$131,500 (3rd of 5 yrs)
Powell AN, Williams TD	Institute of Arctic Biology, University of Alaska, Fairbanks AK: Pre-migratory movements and physiology of shorebirds staging on Alaska's North Slope - External Funding	\$150,813  (1st of 3 years)
<b><u>Marbled Murrelet Program</u></b>		
Bertram D, Lank DB	CWS North Coast Radar Survey 1997, Marbled Murrelets	\$2,000
Ydenberg RC, Lank DB	Forest Science Program - Mamu - Edge Effects	\$94,110

Ydenberg RC, Lank DB	Forest Science Program - Mamu - Critical Habitat	\$77,848
Lank DB	International Forest Products Ltd. - Helicopters	\$26,750
Lank DB	Canadian Forest Products - Effects of Fragmentation on Nesting Success of Marbled Murrelets	\$20,000
Lank DB	Western Forest Products: Effects of terrestrial and marine habitat on nesting performance of Marbled Murrelets	\$20,000

#### Triangle Island

Bertram D, Hipfner JM	MELP Nestucca Trust Fund - Oil and Seabirds - Integrated Ecosystem Investigation -Triangle Island	\$40,000
Hipfner JM	MELP Nestucca Trust Fund - Re-Survey of seabird colonies at Langara Island, haida Gwaii, to assess population level responses of Ancient Murrelets and Cassin's Auklets to rat removal	\$25,000
Bertram D/Hipfner JM	EC/CWS Nestucca Papers and Database Project	\$10,000
Hipfner JM, Iverson S	EC/CWS Seabird Colony Surveys in Englefield Bay, Haida Gwaii	\$4,067
Williams TD, Elliott J	CWS: MSMA Toxicological Effects from avian exposure  (1st of 2 years)	\$20,000
Williams TD	Discovery Parks: Avian Reproduction and environmental change: integrating ecology and physiology	\$6,000
Ydenberg RC	Discovery Parks Research Admin Program	\$5,000

#### Western Sandpipers

Baird P, Ydenberg RC	US Army Corps of Engineers: Multinational Study of Neotropical Migrants: The Western Sandpiper as model.	\$104,532
Butler R, Ydenberg RC	CWS: Western Sandpipers - Radio Transmitters/Receivers	\$5,000
SFU	SFU Contribution to Faculty Salaries Ydenberg Williams Green	\$323,250

Grand Total \$2,067,581

## VIII. 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 17 publications in press and 21 submitted. 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. The listing also includes these produced by graduate students in our group at SFU.

### A. Papers in Refereed Journals

#### In press:

- Chin, E.H., O.P. Love and T.D. Williams. In press. Year-dependent sex specific association between nestling immunocompetence and brood size in a sexually-size dimorphic bird. *J. Avian Biol.*
- Gaston, A.J., H.G. Gilchrist and J.M. Hipfner. In press. Climate change, ice conditions and reproduction in an arctic-nesting marine bird: Brunnich's Guillemot (*Uria lomvia L.*). *J. Anim. Ecol.*
- Gaston, A.J. and J.M. Hipfner. In press. Adult Brunnich's Guillemots balance body condition and investment in chick growth. *Ibis*
- Gaston, A.J. and J.M. Hipfner. In press. Body mass changes in breeding Brunnich's Guillemots in relation to age and breeding stage. *J. Avian Biol.*
- Lank, D.B. and S. Nebel. In press. Cross-cutting research on a flyway scale - beyond monitoring. *Intern. Wader Stud.* 16:
- McCutchen, N.A. and R.C. Ydenberg. In press. Harlequin duck distribution and stonefly nymph availability in the Maligne Valley watershed. *Wildfowl.*
- McFarlane Tranquilla, L., N.R. Parker, R.W. Bradley, D.B. Lank, E.A. Krebs, L. Lougheed and C. Lougheed. In press. Breeding chronology of Marbled Murrelets varies between coastal and inshore sites in southern British Columbia. *J. Field Ornithol.*
- Middleton, H.A., C.A. Morrissey and D.J. Green. In press. Breeding site fidelity in a partial migrant, the American Dipper (*Cinclus mexicanus*). *J. Avian Biol.*
- Morrissey, C.A. In press. American dipper predates tailed frog larvae (*Ascaphus truei*). *Can. Field Nat.*
- Nebel, S. In press. Latitudinal clines in bill length and sex ratio in a migratory shorebird: a case of resource partitioning? *Act. Oecolog.*
- Nebel, S., D.L. Jackson and R.W. Elner. In press. Functional association of bill morphology and foraging behaviour in Calidrid sandpipers. *Anim. Biol.*
- Nebel, S. and G.J. Thompson. In press. Foraging behaviour of Western Sandpipers changes with sediment temperature: Implications for their hemispheric distribution. *Ecol. Res.*
- O'Hara, P.D., G. Fernandez, F. Becerril, H. de la Cueva and D.B. Lank. In press. Life history varies with migratory distance in Western Sandpipers (*Calidris mauri*). *J. Avian Biol.*
- Stein, R.W., A.R. Place, T. Lacourse, C.G. Guglielmo and T.D. Williams. In press. Digestive organ sizes and enzyme activities of refueling western sandpipers (*Calidris mauri*): contrasting effects of season and age. *Physiol. Biochem. Zool.*
- Vézina, F. and T.D. Williams. In press. Interaction between organ mass and citrate synthase activity as an indicator of tissue maximal oxidative capacity in breeding European starlings: implications for metabolic rate and organ mass relationships. *Funct. Ecol.*
- Zharikov, Y., D.B. Lank, F. Huettmann, R.W. Bradley, N. Parker, P.P.-W. Yen, L.A. McFarlane



Tranquilla and F. Cooke. In press. Habitat selection and breeding success in a forest-nesting Alcid, the marbled murrelet, in two landscapes with different degrees of forest fragmentation. *Landscape Ecol.*

Žydelis, R. and D. Esler. In press. Response of wintering Steller's Eiders to herring spawn. *Waterbirds* 28:

### **Submitted**

- Addison, B., R.C. Ydenberg and B.D. Smith. Submitted. Tufted puffins respond to predation danger during colony approach flights. *Auk*.
- Dods, P.L., E. Birmingham, T.D. Williams, M.G. Ikononou, D.T. Bennie and J.E. Elliott. Submitted. Exposure of breeding tree swallows (*Tachycineta bicolor*) to nonylphenol in the vicinity of a wastewater treatment plant. *Env.Tox. Chem.*
- Fernandez, G. and D.B. Lank. Submitted. Variation in the wing morphology of western sandpipers (*Calidris mauri*) in relation to sex, age and annual cycle. *Auk*.
- Gill, H., J.E. Elliott, C.A. Bishop and T.D. Williams. Submitted. Effects of p,p'-DDE and current-use pesticides on egg production and yolk precursor levels in the Zebra Finch (*Taeniopygia guttata*). *Env.Tox. Chem.*
- Gurd, D.B. Submitted. Filter-feeding ducks (*Anas*) can actively select particles by size. *Condor*.
- Gurd, D.B. Submitted. Increased extirpation rates and variation in provincial richness explain variation in species losses from islands. *Ecol Appl.*
- Hipfner, J.M. Submitted. Population status and morphometric variation of the Common Murre in British Columbia. *Marine Ornithol.*
- Hipfner, J.M., A.J. Gaston and H.G. Gilchrist. Submitted. Variability of egg size and laying date in Thick-billed Murre populations breeding in the low arctic and high arctic. *Condor*.
- Hipfner, J.M., A.J. Gaston and B.D. Smith. Submitted. Regulation of provisioning under variable feeding conditions in Thick-billed Murres. *Can. J. Zool.*
- Huettmann, F., E. Cam, D.B. Lank, R.W. Bradley, L. Lougheed, L. McFarlane Tranquilla, C. Lougheed, Y. Zharikov, P.P.-W. Yen, N.R. Parker and F. Cooke. Submitted. Breeding habitat selectivity for regional-scale habitat features by Marbled Murrelets in fragmented and virgin old-growth forest landscapes. *Wildl. Monogr.*
- Iverson, S.A. and D. Esler. Submitted. Site fidelity and the demographic implications of winter movements by a migratory bird, the harlequin duck. *J. Avian Biol.*
- Lacroix, D.L., W.S. Boyd, D. Esler, M. Kirk, T. Lewis and S. Lipovsky. Submitted. Surf scoters aggregate and forage on ephemeral abundant polychaetes. *Marine Ornithol.*
- Lewis, T.L., D. Esler, W.S. Boyd and R. Žydelis. Submitted. Nocturnal foraging behaviour of wintering surf scoters and white-winged scoters. *Condor*.
- Morrissey, C.A., L.I. Bendell-Young and J.E. Elliott. Submitted. Food chain biomagnification of persistent organic contaminants in mountain streams of southwestern British Columbia, Canada. *Env. Sci. Technol.*
- Nebel, S. and G.A. Fernandez. Submitted. Latitudinal clines in sex ratio, bill and wing length in a migratory shorebird. *J. Field Ornithol.*
- Nebel, S. and R.C. Ydenberg. Submitted. Differential predator escape performance contributes to a latitudinal sex ratio cline in a migratory shorebird. *Beh. Ecol. Sociobiol.*
- O'Hara, P.D., G. Fernandez, B. Haase, H. de la Cueva and D.B. Lank. Submitted. Differential migration of Western Sandpipers (*Calidris mauri*) with respect to body size and wing length. *Condor*.
- Robson, T.E., A. Goldizen and D.J. Green. Submitted. The multiple signals assessed by female satin bowerbirds: do they select mates based on chemical as well as visual and auditory cues? *Biol. Letters*.

- Seaman, D.A.A., C.G. Guglielmo, R.W. Elner and T.D. Williams. Submitted. Landscape physiology: site differences in refueling rates as indicated by plasma metabolite analysis in free-living, migratory sandpipers. *Funct. Ecol.*
- Ydenberg, R.C., A.C. Niehaus and D.B. Lank. Submitted. Interannual differences in southward migration timing between male and female western sandpipers (*Calidris mauri*). *Naturwissenschaften.*
- Zimmerman, K. and J.M. Hipfner. Submitted. Egg size, eggshell porosity and incubation period in the marine bird family Alcidae. *Auk.*

## **2005**

- Bennett, K., T.D. Williams, J.E. Smits, M. Wayland, S. Trudeau and L.I. Bendell-Young. 2005. Impact of oil sands based wetlands on the growth of mallard (*Anas platyrhynchos*) ducklings. *Env.Tox. Chem.* 24:457-463.
- Ganter, B., W.S. Boyd, V. Baranyuk and F. Cooke. 2005. First pairing in Snow Geese *Anser caerulescens*: at what age and at what time of year does it occur? *Ibis* 147:57-66.
- Gill, H., T.D. Williams, C.A. Bishop, K.M. Cheng and J.E. Elliott. 2005. Effects of azinphos-methyl on cholinergic responses and general health in zebra finches (*Taeniopygia guttata*) following prior treatment with p,p'-DDE. *Arch. Envir. Contam. Toxicol.* 48:119-127.
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