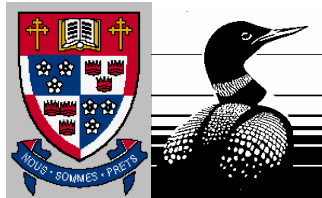


**ANNUAL REPORT of the  
CENTRE FOR WILDLIFE ECOLOGY  
2005-2006**



**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	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

<i>Postdoctoral Fellow</i>	<i>PhD (in progress)</i>	<i>MSc (in progress)</i>	<i>Staff</i>
James Dale	Kathy Brodhead	Courtney Albert	Judy Higham, CWE Admin. Asst.
Liz Gillis	Joel Heath	Eric Davies	Connie Smith, CWE Research Tech
Elsie Krebs	Sarah Jamieson	Dan Guertin	Jeanine Bond, MAMU Res. Asst.
Tomohiro Kuwae	Oliver Love	Iain Jones	Sam Iverson, Seaduck Res. Asst.
Caz Taylor	Heather Major	Peter Katinic	Glen Keddie, Res. Assist.
Yuri Zharikov	Andrea Pomeroy	Vera Klein	Debbie Lacroix, Seaduck Res. Asst.
Ramunas Žydelis		Molly Kirk	
		Sunny LeBourdais	
		Erika Lok	
		Josh Malt	
		Holly Middleton	
		Sam Quinlan	
		Michael Silvergieter	
		Emily Wagner	
		Ivy Whitehorne	
<i>Visitors</i>	<i>PhD( defended)</i>	<i>MSc (defended)</i>	
Sue McRae	Guillermo Fernandez	Jeanine Bond	
	Brent Gurd	Lily Cesh (MET)	
	Katrina Salvante	Bart DeFreitas	
		Kristen Gorman	
		Jamie Kenyon	
		Tyler Lewis	
		Kim Mathot	
		Jonathan Whiteley	

**B. Steering Committee**

<i>Name</i>	<i>Position</i>	<i>Affiliation</i>
Elizabeth Elle	Assistant Professor	SFU
Arne Mooers	Assistant Professor	SFU
Robert Elner	Head, Migratory Birds Conservation	CWS
David Green	CWE faculty (non-voting)	SFU
Kristina Rothley (SFU alternate)	Assistant 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 seen a number of changes for the CWE. The biggest was the retirement of our Administrative Assistant, Judy Higham, in March 2006. Judy has been a tremendous pillar of support to everyone at the CWE for the past four years. We thank her for all of her hard work, and wish her all the best in her well deserved "life of leisure", and with her photography. We welcomed Monica Court in April 2006 as the new Administrative Assistant to the CWE, and she is getting settled in and learning the ropes.

Once again this year, the CWE had to relocate its main office, which houses the majority of the graduate students and staff. Due to "Space Wars" at SFU, Applied Science wanted to reclaim the office in the Kinesiology wing that we had called home for two years. We have returned to our roots in the old "Cooke Lab" in Biology, which we are now sharing with grad students from the Behavioural Ecology Research Group. We hope to move to new, permanent quarters when the TASC II building is completed and Biology completes its reshuffling sometime in 2007.

We have had a record number of "fledglings" from our group this year. In April 2005 alone, we had seven students defend their theses! Their accomplishments are detailed in the project updates below, as well as the research plans for several new students who have been recruited. Dr. Yuri Zharikov joined the Western Sandpiper research group as a post-doctoral research fellow, and Dr. Sue McRae from East Carolina University began an eight month visit with the CWE in January 2006.

Most of our major projects continued, and we focused on issues of strategic importance to Environment Canada. A highlight of the past year was the international workshop on Environmental Change and Individual Variability, organized by Tony Williams and hosted by CWE in March 2006. This was the third in a series of conferences organized under the auspices of the "Network on avian reproduction and environmental change: integrating ecology and physiology" grant, funded by NSERC in Canada, with partners in the USA and Europe, funded by NSF and ESF respectively. (See details in the Conference section.)

One of our long-term projects, the Sustainable Shellfish Aquaculture Initiative, is winding up. A final public meeting was held in November 2005 to present results to interested parties, which included many shellfish growers, provincial and federal officials, landowners and research scientists from academic and public interest groups. Although the SSAI is wrapping up after 5 years, our research on Scoters continues, and is expanding to include work all along the migration route, including Mexico.

Mid-way through its third 5 year term, the CWE is an active, productive institution, conducting high quality research, attracting students and funding, and publishing in well-regarded journals.

## 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 can also 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. 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 2005 season: We opened our research station on Triangle Island for year 12 on 23 March 2005, with continued logistical support from the Canadian Coast Guard. Scientific research was conducted under the direction of Mark Hipfner. Mark, Glen Keddie, and BriAnne Addison 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).

The 2005 season was unusual for the severity of seabird breeding failures throughout the oceanic region influenced by the California Current. At Triangle Island, several species, notably Cassin's Auklets and Pelagic Cormorants, experienced their least successful breeding seasons since the inception of the CWE research program in 1994. However, all species were affected to at least some degree, including Rhinoceros Auklets, Tufted Puffins and Common Murres.

#### **Graduate students:**

In 2005, Eric Davies continued to write his MSc thesis at SFU, investigating the foraging ecology of Triangle's alcids using stable isotope analysis. In addition, Jessica Beaubier continued to write her MSc thesis investigating linkages between ocean climate, forage fish energetics, and seabird breeding success. Jessica is based in Dr. Jamie Smith's lab at UBC.

## **B. Integrated Shorebird Research**

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 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. Local information on shorebird usage, both western sandpipers and dunlin, contributed towards Environment Canada's submission in response to recent proposals to enlarge the Coal Port facility on Robert's Bank. 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, which includes CWE staff Ron Ydenberg, Dov Lank, and Tony Williams. 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 12 years, we have pursued and aided fieldwork at three breeding sites, several migration locations, and four wintering sites. We have organized ten 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 sandpiper in the Western Hemisphere.

Kim Mathot completed her MSc and Guillermo Fernández his PhD on wintering WESA. Guillermo went on to a position in shorebird conservation with the Manomet Centre for Conservation Sciences. PhD students Andrea Pomeroy (western sandpiper behaviour at stopovers) and Sarah Jamieson (breeding dunlin in Alaska) continued their research. Postdoctoral researchers Caz Taylor and Yuri Zharikov joined the CWE team in 2006. Dr. Taylor is creating an individual-based model of Western Sandpiper migration, which may be expanded to more of the annual cycle. Dr. Zharikov, who is based at the PWRC in Delta, is studying the winter ecology of shorebird use, particularly dunlin, on Robert's Bank. We continued to collaborate with radio-tracking studies organized by Dr. Pat Baird (California State University at Long Beach) and Dr. Nils Warnock (PRBO Conservation Sciences). Additional collaborators included: Dr. Ryan Norris, a postdoctoral fellow at UBC, who is testing novel approaches towards identifying winter locations based on feather composition; Dr. Abby Powell and Audrey Taylor, at the University of Alaska, who are looking at physiological measures associated with migrant habitat use; and Dick Dekker, who is examining local raptor-dunlin interactions. The past year was exceedingly productive from a publication point of view, with over 17 papers published or in press.



### **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 twelfth year. Dov Lank and Josh Malt continued with the project throughout the year. Elsie Krebs moved on in July to a position with CWS. Dr. Kris Rothley and her MREM graduate student Jenn Barrett joined the project in September. At the end of the year, MSc student Michael Silvergieter started as a graduate student within the murrelet program. The SFU 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 the CWE's research to be rapidly assimilated into evolving policy guidelines for management of this threatened species, which now falls under the protection of the federal Species at Risk Act. Lank participated in rewriting the federal recovery strategy and action plans, and in reviewing a proposal for a B.C. province-wide radar monitoring plan.

MSc student Josh Malt conducted a strenuous and successful second field season on northern Vancouver Island, running an experimental study to examine the magnitude of "edge effects" on the probability of nest survivorship. This topic remains controversial in BC, and has substantial management implications. Dr. Kris Rothley, and MREM student Jenn Barrett, from the Resource Management Department at SFU, joined the "edge effects" project to help model the results from Josh's fieldwork, plus the data to be gathered from two additional regions of British Columbia in the summer of 2006, at the landscape level. Final additional habitat fieldwork was conducted to supplement the sample size of "random plots" available for comparison with nest sites at Desolation Sound.

Yuri Zharikov's analysis of Marbled Murrelet nest distribution with respect to landscape variables, including patch size, was published in "Landscape Ecology". Laura McFarlane Tranquilla and colleagues published a paper comparing the phenology of breeding between Vancouver Island and the mainland, with implications for the design of census and monitoring schemes. Elsie Krebs completed a manuscript examining marine usage of areas by radioed birds with respect to nesting locations and stage of breeding.

As the year closed, our findings were being communicated to interested parties, including presentations at the Pacific Seabird Group meeting in Alaska. Funding for the past and future years has come from the Provincial Forest Science Program, four forest companies, and from an NSERC-CRD grant awarded at the close of 2005.

### **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 collabora-

tive 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, Ramunas Žydelis and graduate students Tyler Lewis, Jonathan Whiteley and Molly Kirk. 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 is in its fifth and final year. All field data collection is complete and the analysis and reporting phase of the project is in progress. Graduate student Jonathan Whiteley defended his Master's thesis "Macroinvertebrate community responses to clam aquaculture practices" in April 2005. Tyler Lewis followed in September 2005 by successfully defending his thesis "Clam predation and foraging behaviors of wintering Surf Scoters and White-winged Scoters". 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 work generated data that (1) indicates the mechanisms by which conflicts or benefits of the shellfish industry could occur, (2) evaluates the population-level effects of the shellfish industry, and (3) predicts effects of current and projected levels of shellfish industry activity.

As the project is nearing completion, a final public meeting was held in Nanaimo on November 14, 2005. Interested parties in attendance included many shellfish growers, provincial and federal officials, landowners and research scientists from academic and public interest groups. An overview of the major finding of all components of the project was presented. The results of the Scoter Project were presented by Dr. Dan Esler and he reviewed all aspects of the scoter studies (summarized below). Overall, we found the interactions between scoters and shellfish farming practices are largely neutral in Baynes Sound and neutral or beneficial in Desolation Sound.

Specific activities of the scoter studies include:

- Four winters (2001-02, 2002-03, 2003-04, and 2004-05) of survey 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 were compared to historical CWS data (from winter 1980-81) in Baynes Sound to provide insight into longer-term changes. We documented a significant increase in scoter densities, particularly in the Comox Harbour area and suggest this may be due to the invasion and expansion of the Varnish clam (*Nuttallia obscurata*), a preferred prey for scoters and not directly related to aquaculture activities.
- The survey data also are 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, led the habitat association work that will be published in the Journal of Wildlife Management in spring 2006. This

work found scoter abundance and distribution highly correlated with prey density in both Baynes Sound and Desolation Sound.

- 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 both Baynes Sound and Desolation Sound have high winter survival. The longevity of the transmitter batteries allowed us to determine that scoters show winter site fidelity in Baynes Sound as the inter-annual return rates here comparatively high.
- 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 the mussels that recruit on to aquaculture structures (representing highly attractive prey) are depleted.
- Clams and mussels have been intensively and extensively sampled in Baynes Sound and Desolation Sound. These data are 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. Prey samples were also collected for laboratory analysis of tissue mass, caloric content and heavy metal contaminant tests.
- Tyler Lewis, MSc student, quantified the behavioural responses of scoters to temporal and spatial variation in bivalve prey. One goal of his work was to document any behavioural consequences of variation in bivalve prey that occur due to aquaculture operations. Six plots were intensively sampled for clam density and distribution and foraging radio-marked scoters were monitored to determine the amount of time devoted to feeding. Despite predation by scoters, densities of manila and varnish clams, their primary prey items, decreased by only 27% and 13%, respectively. Clam capture success of both scoter species and foraging effort of Surf Scoters were unrelated to variation in clam density, while White-winged Scoter foraging effort was only slightly, negatively related to clam density. Observed clam densities were apparently high enough to not elicit strong behavioral shifts in foraging scoters. Further, scoters rarely foraged at night, sufficiently meeting energetic requirements during diurnal hours. These combined results suggest that Baynes Sound constituted high quality winter habitat in which scoters were not limited by food supplies.
- Molly Kirk, MSc student, is in the analysis and writing phase of preparing her thesis, 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. Baynes Sound surf scoters show high site fidelity both within and between winters and thus have small foraging ranges. In contrast, in Desolation Sound, scoters foraging on mussels, display high levels of movement, low fidelity to foraging sites and large winter ranges. Prey sampling data suggests that the Baynes Sound clam resource is relatively stable throughout the season while mussels are rapidly exhausted. She will consider how aspects of winter foraging ecology are mediated by these two dramatically different prey landscapes. Molly will defend in the 06-07 fiscal year.

While data analysis and reporting is currently underway, we are confident that the data gathered over the past 4 winters has greatly increased our understanding scoter interactions with aquacul-

ture (and other forms of habitat change), as well as lent new insight into wintering biology of these poorly known seaduck 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.

## 2. Staging Habitats of Spring-migrating Surf Scoters –

As part of a collaborative project investigating Surf Scoter spring migration ecology, Erika Lok (MSc student) is using 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. Working with research partners from CWS, USGS, and the Washington Department of Fish and Wildlife, Erika is identifying 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 spring 2005 indicates that Surf Scoters are using specific staging sites within Southeast Alaska during migration, and that herring spawn events are likely an important habitat attribute of these sites. Field data collection will continue in Southeast Alaska in spring 2006 and further GIS and habitat analysis is in progress.

## **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 the adaptation of several unique features such as a darker plumage pattern. Due to these differences the local Pacific Great Blue Heron has been given a unique subspecies classification, *Ardea herodias fannini*. This subspecies, which is currently blue-listed by the British Columbia Ministry of Environment, has been investigated by a team of researchers from the CWE and CWS for several years.

In 2005/2006 CWS scientists Rob Butler and Barry Smith and students from the CWE continued to investigate local heron nesting strategies, habitat use and population dynamics. It has been observed that the overall reproductive success and number of Great Blue Herons in the Georgia Basin has decreased over the last decade and a high level of colony abandonment has occurred. This trend is thought to be the result of a combination of predation by bald eagles and human disturbance at colonial nest sites. Pacific Great Blue herons utilize a number of nesting strategies in Coastal British Columbia. Many pairs choose to nest in large colonies, some nest in small colonies, and many others choose to nest individually. In April 2005, CWE MSc student Jamie Kenyon successfully defended his thesis which, through ecological modeling, examined the possible role of foraging site quality and predation risk in determining the population dynamics of coastal herons in BC. In addition, Jamie's thesis pioneered a methodology for identifying colony locations from foraging ground observations that increased the number of known colonies and the overall population estimates in the study area.

Iain Jones, an MSc student in the CWE, is continuing work examining the role that predation risk

plays in determining colony site selection by closely studying the relationship between coastal herons and their primary predator, the bald eagle. Paradoxically, it seems that a large proportion of herons are choosing to nest colonially near active eagle nests. The working hypothesis is that herons may benefit from being near one eagle nest by gaining territorial protection from other intruding eagles. In utilizing this strategy herons may manage their predation risk as bald eagle populations continue to recover from previous lows. Very little is known about eagle territoriality or foraging ecology on the B.C. coast. Therefore, in addition to examining the correlation of habitat use and reproductive success between these two species, Iain is attempting to shed light on this hypothesis by quantifying local eagle territoriality and diet preference through a combination of field observations and experiments.

## **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.

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 coming to the final stages of making conclusions and drawing inferences from this research. 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. MSc students Jeanine Bond, who completed her degree in December 2005, and Sunny LeBourdais, who will be completing this spring, were also involved. This research was designed to determine factors related to distribution and productivity. For the first time, data were collected to evaluate the relationship between harlequin duck abundance and habitat attributes at a broad, regional scale. The analysis of these data are in the final steps and the results will allow a broad inference for predicting and mitigating effects of human activities on streams in the region. We also looked more closely at two mechanisms by which productivity might be affected. The first considered abiotic and biotic influences on food availability, especially with respect to environmental effects and the interactions between fish, harlequin ducks, and their prey, aquatic invertebrates. We found evidence to suggest that stream flow variability affects invertebrate abundance and that there may be indirect effects of fish that have implications for abundance of harlequin duck prey and subsequent productivity. The second mechanism considered nutrient acquisition and allocation for clutch formation and we used a stable isotope approach to determine whether nutrients for clutch formation were derived primarily from marine wintering areas or from freshwater breeding streams. The results of this work showed that females allocate entirely freshwater resources to their eggs and we conclude that aquatic invertebrate availability on streams is important for egg production in this species. Final results of this work will be summarized in a final report for BC Hydro and is also available in the theses of Jeanine Bond and Sunny LeBourdais.

Although the CWE did not band any harlequins in 2005, 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 wintering near White Rock and those that congregate 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.

## **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; Peery *et al.* 2004). 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) successfully defended her thesis in March 2006 on a potential mechanism underlying "costs of reproduction", and the effects of temperature on resource allocation during reproduction. In particular she investigated 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 MSc 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. **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) successfully defended her thesis in 2005 which investigated 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).

**5. 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 is investigating, 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 and Christy Petersen of Environment Canada, and Dr. William Cullen, UBC).

**6. Monitoring of chlorinated hydrocarbons and effects in bald eagles on the British Columbia coast.** Lilly Cesh an MET student (supervised by TDW, in a collaborative project with Dr John Elliott of Environment Canada) successfully defended her thesis in 2005. Lilly's project assessed 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 were: (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 retardants) 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.

**7. "Landscape physiology" - plasma metabolites as indicators of fattening rate 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, Mary Ann Bishop and John Takekawa), 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), c) altitudinal habitat use in migratory passerines in the Lower Mainland (with Lesley Evans-Ogden, NSERC PDF at UBC and Kathy Martin), and d) during incubation in king eiders (with Rebecca McGuire and DR. Abby Powell, University of Alaska, Fairbanks).

**8. E-Bird, an NSERC-funded Network on avian reproduction and environmental change: integrating ecology and physiology.** NSERC funding (to TDW) is supporting a Canadian component of, and Canadian participation in, this international research network, with partners in the USA and Europe funded by NSF and ESF respectively <http://www.sfu.ca/biology/faculty/williams/ebird/>. The main aim of this Network is to foster interdisciplinary discussion and collaborative research bringing together physiologists and endocrinologists with ecologists and evolutionary biologists to address issues in avian reproduc-

tion within the context of environmental change (e.g. climate change). Funding supported attendance of eight Canadian researchers at the 2<sup>nd</sup> E-Bird workshop on “maternal effects” in Seattle in October 2005. The 3<sup>rd</sup> E-Bird meeting was organised and held in Vancouver in March 2006 (see Conferences Section for details). In addition, funding supported 13 Canadian PhD or MSc students – including four CWE students - to attend the workshops or to undertake lab exchanges to other Universities in Canada, the US, and Europe.

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

*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 are indicating the importance of considering factors operating across multiple time scales, and are providing insight into potential impacts of environmental change in sea ice habitats, and elucidating recent mortality events. This project is being conducted in collaboration with the Sanikiluaq Hunters and Trappers Association and will provide important information to facilitate informed co-management strategies.

*Chronic Effects of the Exxon Valdez Oil Spill on Sea Ducks* – This long-term program continues under the direction of Dan Esler, and is designed 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 10 years of the project. However, we collected new data this year that demonstrated that both harlequin ducks and Barrow’s goldeneyes continue to be exposed to oil – a finding that is remarkable given the time since the spill.

## **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 graduate) 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 to examine how variation in migratory behaviour influences natal philopatry, recruitment, survival and reproductive success of American dippers. Analysis of the long-term data set conducted by Elizabeth Gillis (post-doc) suggests that sedentary individuals have higher reproductive success than migrants. Despite this, Holly Middleton (2006) has found that migratory dippers are equally faithful to their breeding sites. This does not appear to be due to morphological differences that limit the ability of migratory individuals to switch strategies. 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. However, Elizabeth Gillis (in prep) has found that migratory individuals have higher survival than sedentary individuals that may partially offset their lower reproductive success. Ivy Whitehorne has therefore initiated an MSc examining why migratory individuals have higher survival. Holly Middleton, whose MSc research examines how variation in post-fledging behaviour and dispersal strategies in juvenile dippers influences survival and recruitment, will defend her thesis in 2006.

#### *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 warblers have declined consistently (ca. 2% per year) over the last 30 years. In order to investigate the causes of this decline we initiated a project examining how riparian habitat structure influences the demography of this neotropical migrant. A pilot project funded by BC Hydro and a Science Horizons Youth Internship to Christine Croton conducted in 2004 assessed the utility of current survey methods to determine breeding productivity of warbler species and established marked populations of Yellow warblers at two sites in Revelstoke, BC. In 2005, with the aid of funding from the Columbia Basin Fish and Wildlife program, we examined how local and landscape level habitat characteristics, including those associated with management of water levels in the Columbia River, influence habitat selection and breeding performance of Yellow Warblers. Results of this study will be used to inform re-vegetation plans for the drawdown zone of Arrow Lakes Reservoir. Sam Quinlan, who conducted this research, also initiated an MSc examining how molt and migratory strategies of Yellow warblers influence survival and subsequent reproductive success. He is funded by an NSERC Industrial Scholarship supported by BC Hydro. In addition we have initiated a project using radioisotope analysis to document temporal patterns in movement of 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**

*E-Bird, avian reproduction and environmental change.* The 3<sup>rd</sup> E-Bird meeting, part of the NSERC-funded Network on avian reproduction and environmental change: integrating ecology and physiology, was organised by Dr. Tony Williams and the CWE and held in Vancouver in March 2006. Over 70 participants discussing twin themes: a) effects of environmental change on Canadian birds and mammals, and b) individual variability.

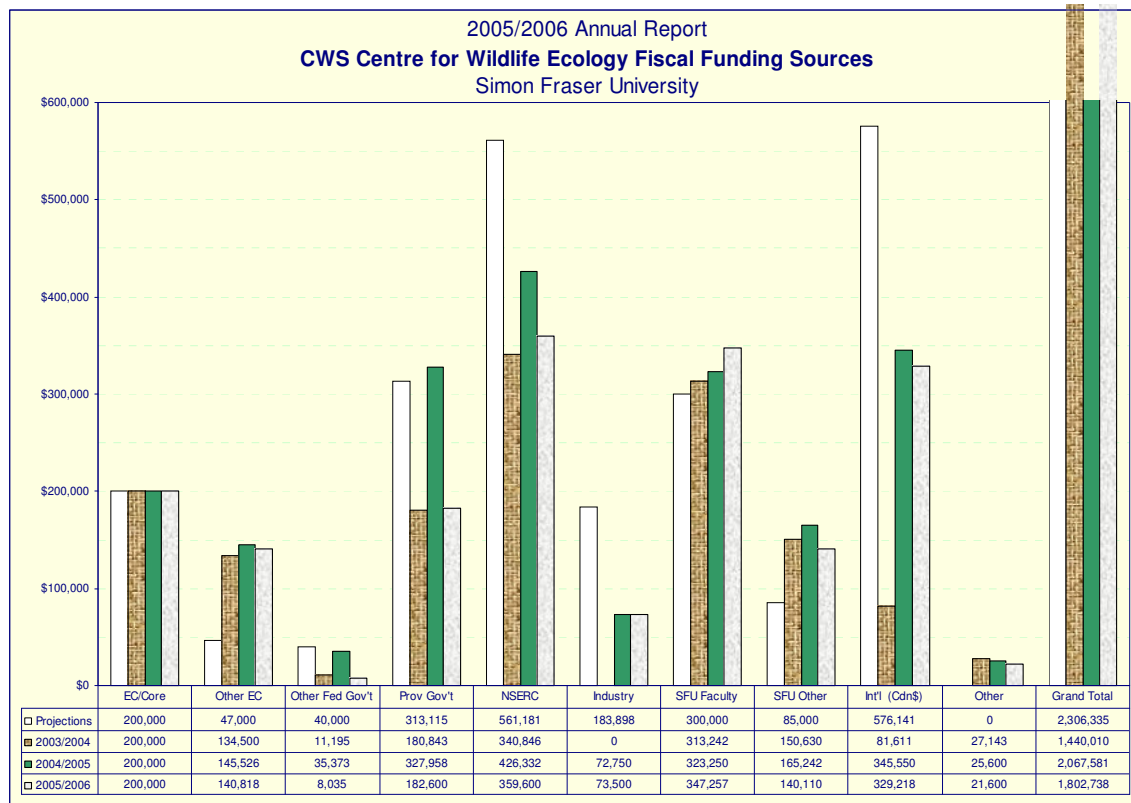
*Western Hemisphere Shorebird Science* - Dov Lank organized a symposium session on Western Sandpipers at the first “Western Hemisphere Shorebird Science” meeting, held in Boulder CO at the end of February 2006. In part, this meeting of nearly 200 scientists grew out of the nine previous Western Sandpiper Research Network workshops organized by the CWE since 1994. CWE members at the meeting participated in further organizational discussions for the Shorebird Research Group of the Americans and a potentially broader Western Hemisphere Shorebird Group.

## **VII FUNDING**

### **Budget**

1 April 2005 to 31 March 2006 was the third 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.



**Centre for Wildlife Ecology Annual Financial Report**

2005/2006 Fiscal Year  
1 April 2005 - 31 March 2006

**Scholarships, Fellowships, Grants for Students**PhD

PhD: Heath J, Jamieson S, Major H, Love O, Pomeroy A, Salvante K,	\$30,000
NSERC PGSB Jamieson, S	\$14,000
Glen Geen Graduate Scholarship - Heath J	\$906

M Sc

Jones I, Middleton H	\$12,000
NSERC Canada Grad Scholarship M - Whitehorne I	\$4,375
NSERC PGSM - Kirk M	\$17,300
NSERC Industrial Postgraduate Scholarship Quinlan S	\$21,000
NSERC Industrial Postgraduate Scholarship Malt J	\$14,000
Intn'l Forest Products: Industrial Contribution (Matching NSERC IPS) Malt, J	\$3,000
Timberwest Forest Co.: Industrial Contribution (Matching NSERC IPS) Malt, J	\$3,000
Garfield Weston Marine Science - Katinic P	\$19,084
Coastal Zone Canada (BC) Assn - Katinic P	\$858
Whispering Pines Clinton Band: LeBourdais S (3rd of 3 years)	\$21,600

Undergrads

NSERC Undergrad Research Award: Stables C	\$5,625
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SFU TAs

\$41,262

Travel Grants

Pacific Seabird Group Travel Award	\$118
E-Bird Network Travel Grant - Jamieson S	\$1,800
NSTP Travel Grant - Jamieson S	\$1,185

**General Funding for CWE**

EC/CWS Annual Chair Funding 1 April 05 to 31 March 06	\$200,000
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Ydenberg RC	SFU Dean of Science: Contribution to Centre for Wildlife Ecology (1st of 5 yrs)	\$30,000
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SFU	SFU Contribution to Faculty Salaries (Ydenberg Williams Green)	\$347,257
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**Generated Research Funding**

<b>Aquaculture</b>		
Bendell-Young L	NSERC Strategic Grant "Towards a Sustainable Shellfish Aquaculture Industry" (4th of 5 yrs)	\$112,000
<b>Barrows Goldeneye</b>		
Ydenberg RC, Ost M	Riske Creek Project (2nd of 3 years)	\$12,986
<b>Ducks</b>		
Esler D	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" (5th of 5 years)	\$83,480
Esler D	BC Hydro Bridge Coastal Restoration Program: Variation in Harlequin Duck Distribution and Productivity (3rd of 3 years)	\$30,970
Esler D	US Fish & Wildlife: Sea Duck Joint Venture (1st of 3 years)	\$58,343
Esler D, Boyd S	EC: Marine Bird Conservation (1st of 5 years)	\$35,000
Esler D	Environment Canada - Science Horizons: "Spring Migration of Surf Scoters Along the Pacific Coast: Important Habitats and Energetic Implications"	\$10,670
<b>Land Birds</b>		
Green DJ	BC Hydro Columbia Basin Fish & Wildlife contribution Program: Evaluating the health of riparian habitats: The role of habitat structure in nest site selection and breeding success of yellow warblers in the Revelstoke Reach, BC	\$20,000
Green DJ	Environment Canada - Science Horizons: Migratory behaviour and breeding performance of the American Dipper, an indicator species for freshwater stream conditions	\$10,670
<b>Marbled Murrelets</b>		
Lank DB	BC Forest Service - Marbled Murrelets Habitat Project	\$3,800

Lank DB	Forest Science Program - Marbled Murrelets - Edge Effects	\$75,000
Lank DB	Forest Science Program - Marbled Murrelets - Critical Habitat	\$43,500
Lank DB	Canadian Forest Products Ltd.: Effects of fragmentation on nesting success of Marbled Murrelets	\$10,000
Lank DB	Western Forest Products: Effects of terrestrial and marine habitat on nesting performance of Marbled Murrelets (2nd of 3 years)	\$20,000
Lank DB	Weyerhaeuser Canada: Effects of terrestrial and marine habitat on nesting performance of Marbled Murrelets	\$25,000
Lank DB	Island Timberlands: Effects of terrestrial and marine habitat on nesting performance of Marbled Murrelets	\$12,500
Lank DB	HDRC Summer Career Placement - Ruffs	\$2,400
Lank DB	HDRC Summer Career Placement - Marbled Murrelets	\$4,450
<b>Physiological Ecology</b>		
Williams TD, Elliott J	CWS: MSMA Toxicological Effects from avian exposure (2nd of 2 years)	\$49,500
Williams TD	SFU Dean of Science: Avian Reproduction and environmental change: integrating ecology and physiology	\$6,000
Williams TD	NSERC Special Research Opportunity Program (SRO) : "Avian reproduction and environmental change: integrating ecology and physiology" (2nd of 3 yrs)	\$29,200
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 (2nd of 3 years)	\$146,568
Williams TD	Environment Canada - Science Horizons: "Exposure and effects of MSMA pesticide applications (pine beetle control) to forest birds"	\$10,670

**Triangle Island**

Hipfner MJ	Environment Canada - Science Horizons: "Development of better techniques to estimate population size of Tufted Puffins"	\$10,670
Hipfner MJ	Nestucca Trust Funds	\$9,330
Hipfner MJ	EC/CWS Coast Guard Support	\$8,638

**Western Sandpipers**

Ydenberg RC, Baird P	US Army Corps of Engineers: Multinational Study of Neotropical Migrants: The Western Sandpiper as model.	\$27,723
Ydenberg RC, Butler R	CWS: Western Sandpipers Equipment: Nanotags	\$5,000

**NSERC**

Green DJ	NSERC Individual Research Grant - Dispersal and migration behaviour of birds in natural and modified landscapes (2nd of 5 years)	\$22,000
Lank DB	NSERC Individual Research Grant - Maintaining variation in ecologically significant traits in birds (3rd of 4 years)	\$24,000
Williams TD	NSERC Individual Research Grant- "Physiology of life-histories: egg size and number and costs of reproduction" (4th of 4 yrs)	\$43,000
Ydenberg RC	NSERC Individual Research Grant - "Predation danger and the annual cycle of migrants (1st of 5 yrs)	\$51,300

Grand Total	\$1,802,738
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SFU In-Kind	\$116,678
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## 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 23 publications in press and 29 submitted. In addition, 2005 was a bumper year for graduate students completing their theses, with 8 Masters and 2 Doctoral students graduating. 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 theses produced by graduate students in our group at SFU.

### A. Papers in Refereed Journals

#### In press:

- Acevado Seaman, D.A., C.G. Guglielmo, R.W. Elner and T.D. Williams. In press. Landscape-scale physiology: site differences in refueling rates as indicated by plasma metabolite analysis in free-living, migratory sandpipers. *Auk*.
- Addison, B., R.C. Ydenberg and B.D. Smith. In press. Tufted puffins respond to predation danger during colony approach flights. *Auk*.
- Breuner, C.W., S.E. Lynn, G.E. Julian, J.M. Cornelius, B.J. Heidinger, O.P. Love, R.S. Sprague, H. Wada and B.A. Whitman. In press. Plasma binding globulins and the acute stress response. *Horm. Met. Res.*
- Esler, D., S.A. Iverson and D.J. Rizzolo. In press. Genetic and demographic criteria for defining population units for conservation: the value of clear messages. *Condor* 108.
- Falk, K., F.R. Merkel, K. Kampp and S.E. Jamieson. In press. Embedded lead shot and infliction rates of Common and King Eiders wintering in Southwest Greenland. *Wildl. Biol.*
- Gjerdrum, C., G.M. Yanega and D.F. Bertram. In press. Bill harnesses on nestling Tufted Puffins influence adult provisioning behavior. *J. Field Ornithol.*
- Gurd, D.B. In press. Filter-feeding ducks (*Anas*) can actively select particles by size. *Zool.*
- Hipfner, J.M., A.J. Gaston and B.D. Smith. In press. Regulation of provisioning in the Thick-billed Murre (*Uria lomvia*). *Can. J. Zool.*
- Iverson, S.A., W.S. Boyd, D. Esler, D.M. Mulcahy and T.D. Bowman. In press. Comparison of the effects and performance of four radio transmitter types for use with scoters. *Wildl. Soc. Bull.*
- Iverson, S.A. and D. Esler. In press. Site fidelity and the demographic implications of winter movements by a migratory bird, the harlequin duck. *J. Avian Biol.*
- Jamieson, S.E., H.G. Gilchrist, F.R. Merkel, A.W. Diamond and K. Falk. In press. Endogenous reserve dynamics of Northern Common Eiders wintering in Greenland. *Polar Biology.*
- Jamieson, S.E., H.G. Gilchrist, F.R. Merkel, K. Falk and A.W. Diamond. In press. An evaluation of methods used to estimate carcass composition of Common Eiders. *Wildl. Biol.*
- Jamieson, S.E., H.G. Gilchrist, F.R. Merkel, K. Falk and A.W. Diamond. In press. An evaluation of methods used to estimate carcass composition of Common Eiders. *Wildl. Biol.*
- Kenyon, J.K. In press. Use of vanishing bearings to locate new wading bird colonies. *Waterbirds.*
- Lacroix, D.L., W.S. Boyd, D. Esler, M. Kirk, T.L. Lewis and S. Pipovsky. In press. Surf scoters aggregate in association with ephemerally abundant polychaetes. *Marine Ornithol.*
- Merkel, F.R., K. Falk and S.E. Jamieson. In press. Impact on body condition of embedded lead shot in Common Eiders *Somateria mollissima*. *J. Wildl. Manage.*
- Merkel, F.R., K. Falk and S.E. Jamieson. In press. Impact on body condition of embedded lead shot in Common Eiders *Somateria mollissima*. *J. Wildl. Manage.*
- Merkel, F.R., S.E. Jamieson, K. Falk and A. Mosbech. In press. The diet of Common Eiders



- wintering in Nuuk, southwest Greenland. *Polar Biology*.
- Mulcahy, D.M., K.A. Burek and D. Esler. In press. Histology of fabric collars from percutaneous antennas on intracoelomic radio transmitters implanted in harlequin ducks. *Journal of Avian Medicine and Surgery* 19.
- Niehaus, A.C. and R.C. Ydenberg. In press. Ecological factors associated with the migratory phenology of high-latitude breeding Western Sandpipers. *Polar Biology*.
- Salvante, K.G. In press. Techniques for the study of integrated immune function in birds. *Auk*.
- Stein, R.W. and T.D. Williams. In press. Causes and consequences of a post-growth age-dependent difference in small intestine size in a migratory sandpiper (*Calidris mauri*, Western sandpiper). *Funct. Ecol.*
- Sydeman, W.J., R.W. Bradley, P. Warzybok, V. Jahncke, C.L. Abraham, V. Kouskie, J.M. Hipfner and M.D. Ohman. In press. Krill and krill predators: response of planktivorous auklets *Ptychoramphus aleuticus* to the anomaly of 2005. *Geophysical Research Letters*.
- Zimmerman, K. and J.M. Hipfner. In press. Egg size, eggshell porosity, and incubation period in the marine bird family Alcidae. *Auk*.
- Žydelis, R., D. Esler, W.S. Boyd, D. Lacroix and M. Kirk. In press. Habitat use by wintering surf and white-winged scoters: effects of environmental attributes and shellfish aquaculture. *J. Wildl. Manage.*

### **Submitted**

- Arcese, P., A.E. Burger, C.L. Staudhammer, J.P. Gibbs, E. Selak, G.D. Sutherland, J.D. Steven-ton, S.A. Fall, D.F. Bertram, I.A. Manley, S.E. Runyan, W.L. Harper, A. Harfenist, B.K. Schroeder, D.B. Lank, S.A. Cullen, J.A. Deal, L. D. and G. Jones. Submitted. Monitoring designs to detect population declines and identify their cause for the Marbled Murrelet. *Can. J. Zool.*
- Ball, J.R., D. Esler and J.A. Schmutz. Submitted. Proximate composition, energetic value, and relative abundance of prey fish from the inshore eastern Bering Sea: implications for piscivorous predators. *Polar Biology*.
- Ball, J.R., J.A. Schmutz and D. Esler. Submitted. Effects of energy consumption and parental attendance on survival of pre-fledging Red-throated Loons: a potential mechanism for declining numbers in Alaska. *Condor*.
- Bond, J.C. and D. Esler. Submitted. Nutrient acquisition by female harlequin ducks prior to migration and reproduction: evidence for body mass optimization. *Can. J. Zool.*
- Bond, J.C., D. Esler and K.A. Hobson. Submitted. Isotopic evidence for sources of nutrients allocated to clutch formation by harlequin ducks. *Funct. Ecol.*
- Bond, J.C., D. Esler and T.D. Williams. Submitted. Breeding propensity of harlequin ducks *Histrionicus histrionicus* estimated using yolk precursors and radio telemetry. *J. Avian Biol.*
- 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*.
- Gurd, D.B., D. Kinakin, D. Siu, J. Chandler and M. Mo. Submitted. Estimating local species richness from historical range maps: how robust are methods to errors in species' distributions? *Global Ecol. Biogeogr.*
- Heath, J.P., H.G. Gilchrist and R.C. Ydenberg. Submitted. Regulation of stroke pattern and swim speed across a range of current velocities: diving by Common Eiders wintering in polynyas in the Canadian Arctic. *J. Exp. Biol.*
- Hipfner, J.M., M.R. Charete and G.S. Blackburn. Submitted. Subcolony variation in breeding success in Tufted Puffins, its association with provisioning, and its implications. *Auk*.
- Hipfner, J.M., C. Gjerdrum and B.D. Smith. Submitted. Post-fledging survival in two Tufted Puffin cohorts in relation to date and body condition at nest departure. *Condor*.

- Hipfner, J.M., L.A. McFarlane Tranquilla and B.A. Addison. Submitted. Do pelagic seabirds use early-season environmental cues to make optimal breeding decisions? *Behav. Ecol.*
- Kenyon, J.K., B.D. Smith and R.W. Butler. Submitted. Can redistribution of breeding colonies on a landscape mitigate changing predation danger? *J. Avian Biol.*
- Lewis, T.L., D. Esler and W.S. Boyd. Submitted. Foraging behaviours of Surf and White-winged Scoters in relation to clam density: inferring food availability and habitat quality. *Auk.*
- Lewis, T.L., D. Esler and W.S. Boyd. Submitted. Foraging behaviours of surf scoters and white-winged scoters at spawning sites of Pacific herring. *Condor.*
- Lewis, T.L., D. Esler and W.S. Boyd. Submitted. Sea ducks are significant predators in soft-bottom intertidal habitats: effects of predation by wintering Surf Scoters and White-winged Scoters on clam abundance. *Mar. Ecol. Prog. Ser.*
- Merkel, F.R., A. Mosbech, C. Sonne, A. Flagstad, K. Falk and S.E. Jamieson. Submitted. Local movements, home ranges and body condition of Common Eiders wintering in Southwest Greenland. *Ardea.*
- Miller, E.H., J. Williams, S.E. Jamieson, H.G. Gilchrist and M.L. Mallory. Submitted. Allometry and variation of the vocal tract in Common Eiders (*Somateria mollissima*) and King Eiders (*S. spectabilis*). *J. Avian Biol.*
- Nilsson, P.B., T.E. Hollmen, S. Atkinson, K.L. Mashburn, P.A. Tuomi, D. Esler, D.M. Mulcahy and D.J. Rizzolo. Submitted. Effects of ACTH, capture, and short term confinement on corticosterone concentrations in harlequin ducks (*Histrionicus histrionicus*). *Comparative Biochemistry and Physiology Part A.*
- Öst, M., C.W. Clark, M. Kilpi and R. Ydenberg. Submitted. Parental effort and reproductive skew in coalitions of brood-rearing female common eiders. *Am. Nat.*
- Pomeroy, A.C., R.W. Butler and R.C. Ydenberg. Submitted. Experimental evidence that migrants adjust usage at a stopover site to trade off food and danger. *Behav. Ecol.*
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