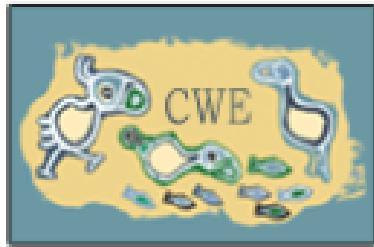


**ANNUAL REPORT of the  
CENTRE FOR WILDLIFE ECOLOGY  
2003-2004**



**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

Name	Position
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

Postdoctoral Fellow	PhD (in progress)	MSc (in progress)	Staff
Joël Béty	Guillermo Fernandez	BriAnne Addison	Blake Bartzen, Res. Assist
James Dale	Brent Gurd	Courtney Albert	Kristen Charleton, Res. Asst.
Elsie Krebs	Joel Heath	Jeff Ball	Cait Henderson, Res. Assist
Ramunas Zydelis	Sarah Jamieson	Jeanine Bond	Judy Higham, CWE Admin. Asst.
	Oliver Love	Gwylim Blackburn	Sam Iverson, Aquacult. Tech.
	Andrea Pomeroy	Lily Cesh (MET)	Glen Keddie, Res. Assist.
	Katrina Salvante	Eric Davies	Molly Kirk, Aquacult. Tech.
	Bonnie Stout	Bart DeFreitas	Debbie Lacroix, Aquacult.Tech.
		Kristen Gorman	Leisha LeClaire, Res. Asst.
		Jamie Kenyon	Rocky Lis, Res. Asst.
		Sunny LeBourdais	Darren Lissimore, Res. Asst.
		Tyler Lewis	Laura McFarlane Tranquilla, MAMU and Triangle Tech
		Josh Malt	Holly Middleton, Res. Asst.
		Kim Mathot	Tawna Morgan, Res. Asst.
		Jonathan Whiteley	Nadine Parker, MAMU Tech.
			Judith Shapiro, SciHor Res. Assist
			Connie Smith, CWE Research Tech
PhD( defended)	MSc (defended)		
Christy Morrissey	Amanda Niehaus		
Silke Nebel	Dana Seaman		
Heidi Regehr			
Michael Rodway			
François Vézina			

**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
Rick McKelvey (CWS alternate)	Manager, CWS PWRC	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>.

The last year has seen only minor staffing changes. Dr. Tony Williams assumed the Chairship of the Department of Biological sciences, a demanding position leaving little time for the duties of Associate Director of the CWE. Dr. David Green has replaced him in that role.

Dov Lank continues with the CWE as a University Research Associate and Adjunct Professor, directing the Marbled Murrelet project. Dr. Dan Esler retains responsibility for the waterbird program, and Dr. Mark Hipfner continues to lead the Triangle Island Seabird Research Station. Students graduating and new students joining the group since the last Annual Report are listed on p. 3. Judy Higham and Connie Smith continue to provide outstanding service in their administrative roles.

The largest visible change of the past year took place when the CWE left its long-term quarters (the ‘Cooke’ lab, in B7217) and moved to new digs in K8501. The move was made at the behest of then-Dean Dr. Willie Davidson, and the then-chair of Biology, Dr. Norbert Haunerland, who were seeking a solution for a space crisis in the old science wing. We agonized over this decision: the new quarters offered some advantages, but also drawbacks, and there was no clear overall net gain. However, the promise of ‘future considerations’ tipped the balance, and we agreed to the move. (Unfortunately, the Dean unexpectedly resigned shortly afterwards.)

In this Annual Report we would like to draw attention to the productive relationship we enjoy with our Research Scientist colleagues at CWS, many of whom are also Adjunct Faculty in the Department of Biological Sciences. They take an active role in supervising, supporting and working with students. Our Mission Statement declares that “Information, ideas, expertise, resources and opportunity flow back and forth across [the academia-government] interface ....”, a goal met in full measure in this relationship.

Finally, we note that September 2003 marked the completion of a full decade of operations for the CWE, an event we celebrated September 12/13 with a conference and party. Last year, the Annual Report declared that the CWE has proven itself an enduring institution, thriving, diversifying and continuing to attract students and funding. We have continued that record in the past year.

## 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 center 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 2003 season: We opened our research station on Triangle Island for year 10 on 26 March 2003, 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 and Common Murre, coupled with graduate student research (see below). We also initiated small research projects in 2003 on Pelagic Cormorants, Glaucous-winged Gulls, and Black Oystercatchers.

After several years of cold ocean conditions following the regime shift that began in 1998-1999, sea surface temperatures were quite high during summer 2003 (described as "El Nino Lite" by researchers working at the Farallon Islands in California). Not surprisingly, seabirds suffered through a season of relatively poor breeding success at Triangle in 2003. Success was low to average in Cassin's and Rhinoceros auklets, and very close to values predicted from spring sea surface temperatures. Tufted Puffins had a very bad year; many birds succeeded in hatching eggs, but adult birds suddenly stopped feeding their chicks on the first of August and the chicks perished. In fact, the adult birds largely abandoned the colony. Only Common Murres enjoyed good breeding success in 2003.

**Graduate students:** In 2003, Gwylim Blackburn completed field work for his MSc research on breeding ecology of Tufted Puffins, with a focus on sexual selection and ornamentation as indicators of parental quality. In addition, Eric Davies continued work on his MSc at SFU, investigating at foraging ecology of Triangle's alcids.

## **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 has nurtured the development of the Western Sandpiper Research Network over the past 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.

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. 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 eight 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.

Specific activities during the past year include:

- Silke Nebel completed her PhD thesis examining the sex and age distribution of Western Sandpipers during the non-breeding season, and submitted for publication several papers addressing possible causes for the patterns.
- Amanda Niehaus completed her MSc thesis and submitted several papers, modeling the timing of southward migration from the breeding grounds, and examining empirical data on sex differences at different stages of migration.
- Dana Seaman completed her MSc thesis, with Tony Williams, looking at the “landscape physiology” of migrant western sandpipers (see physiological ecology section).
- Four essays on future directions in shorebird research were published by members of the WESA network in the 100<sup>th</sup> issue of the Wader Study Group Bulletin. One

by Silke Nebel and D. Lank reviewed the WESA network program, Bob Elner and Dana Seaman focused on foraging ecology, Rob Butler et al. discussed influences of changes in the predator landscape on migrant shorebirds, and Shepherd et al. discussed integrating marine and terrestrial components into shorebird conservation planning. These essays resulted in an invitation for Silke Nebel to give a plenary paper on the group's work at the Global Flyways Conference in Edinburgh, 4-7 April 2004.

- Lank et al. published a paper on effects of predator landscapes on aspects of migration strategies, arising from a workshop in Lund, Sweden in 2002.
- Guillermo Fernández continued progress towards completing his Ph.D., examining sex and age distributions at a local scale at a large non-breeding site in western Mexico, and published the final paper from his MSc, and presented a symposium paper on life history differences in Western Sandpipers at the Neotropical Ornithological Congress.
- Patrick O'Hara, SFU and network alumni, submitted papers from his PhD thesis focusing on body size and life history differences in relationship to non-breeding latitude.
- Andrea Pomeroy examined migrant western sandpipers' usage of stopover sites near Vancouver with respect to the availability of food and predation danger as part of her MSc work.
- Kim Mathot, working with Bob Elner examined the feeding modes and feeding opportunities of western sandpipers at migratory stopover sites and at non-breeding grounds along the coast. She completed field work in Panama and Mexico this past fall/winter.
- Ydenberg et al. obtained acceptance for publication in Proceedings of the Royal Society of London B of a paper documenting the 15 year change in census numbers, body mass, length of stay (modeled by Barry Smith, CWS), and predation danger for migrant sandpipers in southern BC, and drew attention to the conservation planning implications of their findings
- The year concluded with a February workshop at SFU which brought together persons to help put together a major proposal to test hypotheses about factors responsible for apparent changes in many shorebird populations over the past 30 years. This project will be conducted in association with the Shorebird Research Group of the Americas, which was formed recently by an international group including Rob Butler, in part to address this question.

### **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 tenth year. Dov Lank, Nadine Parker, Laura McFarlane Tranquilla, and Elsie Krebs continued with the project, and were joined at SFU by entering M.Sc. student Josh Malt. Alumni Falk Huettmann, Emmanuelle Cam, Peggy Yen, and Russ Bradley 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.

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 newly passed federal Species at Risk Act. The provincial “Identified Wildlife Management Strategy”, which sets policies for management of the species nesting habitat by forest companies and others, was substantially re-written over the past year, incorporating our findings into its policy recommendations. In addition, Louise Waterhouse et al. completed a publication creating guidelines for air photo interpretation of potential murrelet habitat that relied heavily on known nest sites identified by the project in earlier years.

The year has been extremely productive in terms of publications and submission of manuscripts. Emmanuelle Cam’s multi-authored demography paper was published in Conservation Biology. Laura McFarlane Tranquilla was the lead author on 5 papers published or in press, with a sixth submitted. Russ Bradley has a major thesis chapter in press as a paper in the Journal of Wildlife Management. Peggy Yen and Falk Huettmann published a BC-wide analysis of murrelet distributions in the Journal of Ecological Modeling.

Nadine Parker *et al.* obtained acceptance of 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 taken on the challenge of synthesizing information on marine home ranges and nesting locations and performance, for both Desolation and Clayoquot Sound. Yuri Zharikov integrated several sources of information on landscape variables to produce a rigorous analysis of nest distributions and success with respect to patch sizes and landscape features, which was submitted for publication. Falk Huettmann completed reanalysis and rewriting of his habitat selection paper, designed to be submitted as a Wildlife Monograph. We 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.

The SFU group produced a major literature review of population dynamics, geographical distribution, and habitat selection by Marbled Murrelets, which was submitted to the US Fish and Wildlife Service as part of their mandated 5-year review of the species’ status in northern California, Oregon and Washington.

As the year closed, these findings were being communicated to interested parties, including presentations at the Pacific Seabird Group meeting in La Paz, Mexico, and funding was obtained to continue another season of field work, focusing on the relationship between landscape structure and the risk of nest predation.

## **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. This project is now in its third year, and is led by Leah Bendell-Young, Ron Ydenberg, Rob Butler, Dan Esler, and Sean Boyd. 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 last year’s Annual Report.

We made progress on the project as follows over the past year: Following our five-year plan for the project, the work expanded to Barkley and Desolation Sounds. Tyler Lewis and Jonathan Whiteley are graduate students working on the project. A sub-project was initiated with USRA student Ian Giesbrecht on the interactions between shorebirds and shellfish aquaculture. We have begun initial analyses of the many data collected, and made comparisons with such historical data as we could find. And in November, 2003, we held another public meeting in Nanaimo, inviting all interested parties to attend. We presented some initial results, continued our dialogue with the industry. We feel that we are slowly but surely convincing them 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 included:

- Three winters (2001-02, 2002-03, and 2003-04) of data collection have been completed, with activities focused in Baynes Sound. Intensive surveys have been conducted 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) 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 Zydelis, 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 3 winters, 254 scoters have been marked with conventional VHF transmitters. These are tracked by vehicle regularly from December through April. We have found that scoters in Baynes Sound show strong fidelity to feeding areas, they forage almost exclusively in intertidal habitats, they almost never forage at night, and their winter survival is 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.
- Clams were sampled throughout Baynes Sound during summers 2002 and 2003. These data will be used to quantify abundance and distribution of prey.
- 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.

- Finally, during winter 2002-03 and 2003-04 we have conducted surveys in Desolation and Barkley Sounds to quantify scoter use of the area and prepare for more intensive work in the future.

These results are preliminary as data preparation and rigorous analysis have not been applied. 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.

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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's thesis work is nearing completion, and the first results have been 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, is being investigated by a team of researchers from the CWE and CWS. Barry Smith, Ross Vennesland and Rob Butler are working on a paper on the status and population trends of herons. It is likely that the status of this subspecies will change to the red list in light of these analyses.

The majority of these herons, about four-fifths of them, nest in five large colonies each with well over 100 breeding pairs. They include the Point Roberts, University of British Columbia, Chilliwack, Mary Hill, Alouette Lake and Salt Spring colonies. The large colonies have existed for many years and even decades, although heron colonies are not static and may shift location from time to time. The remaining BC coastal herons nest in small colonies or as solitary pairs and typically relocate their nesting sites every few years. The number of herons nesting in colonies is positively related to the area of

eelgrass on nearby beaches. Large beaches at the mouth of the Fraser River estuary support hundreds of pairs of herons, whereas the smaller areas of eelgrass on Vancouver Island beaches support only a few hundred herons in total.

Environment Canada's Canadian Wildlife Service has formed a partnership with the British Columbia Ministry of Water, Land and Air Protection, and the Wild Bird Trust (WBT) of British Columbia to establish the Heron Stewardship Program. The objective of this program is to reduce the impact of humans at nesting colonies and important heron feeding areas. In 2001, the Heron Stewardship Program in BC expanded to include government and non-government groups and individuals in Washington State into the Heron Working Group. The Working Group collaborates on designing research and census protocols, conservation advice, seeking funding support and providing a web site forum for information (<http://www.sfu.ca/biology/wildberg/hwg/aboutwg.html>).

Canadian Wildlife Service scientists are working with students from the Centre for Wildlife Ecology at Simon Fraser University to understand 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. CWE MSc student Jamie Kenyon is examining the role these different sized colonies may play in the overall population dynamics of this species. This is accomplished by analyzing size, quality, and use of foraging sites throughout the Georgia Basin as well as differences in age structure between these foraging sites. A model is being developed that will aid in the understanding of the role predation plays in colony formation.

## **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. In 2003 CWE graduate students Heidi Regehr and Michael Rodway completed and defended their doctoral dissertations and each published several papers. Heidi's work addressed dispersal of harlequin ducks and the subsequent implications for population structure and demography. Michael tackled the subject of timing of pairing in harlequin ducks and factors that influence timing, including the process of mate selection and associated constraints, spacing behaviour, and the role of herring spawn.

Although there was little banding of harlequins in the past year (some were banded during wing molt at White Rock), 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 which habitats are most favorable for harlequin ducks.

A new study was initiated in summer 2003 on harlequin ducks breeding on streams in the

southern Coast Mountains. 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.

## **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 my 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. Metabolic costs of egg production:** François Vézina (PhD student) has been investigating energetic costs of reproduction and, specifically, egg formation using respirometry (for BMR) and the doubly-labeled water technique (for DEE), and the relationship between body composition and energy expenditure. He is focusing on variability in the strategies individual birds can utilise to meet elevated energy demands during laying.

**3. 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.

**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. Physiological mechanisms underlying timing of breeding and clutch size in birds:** Dr. Joël Béty (NSERC PDF) works in the Canadian Arctic (Southampton Island, Nunavut) and is currently focusing on the reproductive strategies of the Common Eider (*Somateria mollissima*). The project involves field experimental manipulations (prelaying body condition, clutch size and incubation costs), use of physiological method (e.g. plasma yolk precursor) to determine reproductive state, use of stable isotopes to trace nutrients invested in egg production, and long-term monitoring of marked individuals. The outcomes of this project are not only of academic interest but contribute to the conservation and management of arctic-nesting eiders. This is a collaborative project with Dr Grant Gilchrist of Environment Canada (CWS, National Wildlife Research Centre).

**7. 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).

## **8. 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 a new 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 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.

**9. "Landscape physiology" - plasma metabolites in migrating birds:** Dana Seaman (MSc) completed her thesis investigating the application of plasma metabolite analysis for the assessment of fattening rate and the relative quality of habitats or sites used by migratory shorebirds of Western Sandpipers (funded by the Marine Ecosystem Health Program, UC Davis). We are now extending this work to a number of other scales, or different systems, e.g. 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 passerines in the Lower Mainland (Lesley Evans-Ogden, NSERC PDF at UBC).

## **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. Although field work is completed, analysis and writing up 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 has completed two field seasons on this project; specific project details are described under the physiological studies section.
- *Foraging ecology of breeding Red-throated Loons* - Numbers of red-throated loons have declined by over 50% in recent decades. Jeff Ball, MSc student, has conducted two field seasons of research into the 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 is documenting variation in provisioning by Red-throated loons, and the subsequent effects on chick growth, survival, and behaviour.
- *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, Nunavut, 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 second visit to the CWE in February and March 2003. 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 is now accepted in *Behavioural Ecology*.

## **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:

### 1. 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 recruitment, natal philopatry, survival and reproductive success of American dippers. Holly Middleton (research assistant) who coordinates the fieldwork is also quantifying variation in juvenile dispersal behaviour and examining factors that influence site fidelity in dippers. Amber Taylor (undergraduate) is investigating the wing morphology of sedentary and migratory dippers.

## 2. 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, Wilson's and Yellow warbler populations have declined consistently (ca. 3.4% per year and 2% 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. Research will be conducted in Revelstoke (starting spring 2004) and Mackenzie (starting spring 2005) where banding stations have monitored the movement of migratory landbirds since 1998. The initial aims of this project are to: assess the accuracy of current survey methods used to determine population trends, compare the breeding performance and annual survival of the four warbler species that show high variation in population trend, 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. In addition we will use radioisotope analysis to investigate the connectivity of warbler populations on breeding and wintering grounds and document temporal patterns in movement of warblers during spring and fall migration. This work is a collaboration with Wendy Easton and Christa DeGroot of the Wildlife Service and John Woods at Parks Canada in Revelstoke, fieldwork in the pilot year will be coordinated by Christine Croton (research assistant) with support from Science Horizons Youth Internship Program.

## VI. CONFERENCES

Each year the CWE hosts a number of scientific meetings built around one or more of its main projects. On November 17, 2003, the **Sustainable Shellfish Aquaculture Project** hosted a meeting at The Coast Bastion Hotel in Nanaimo, to consult with the shellfish aquaculture industry, environmental groups, government, other scientists and the public about our progress on the project. This was the third such meeting we have organized. We reported on the various components of our project, interacted with attendees, and had an informative open discussion about various aspects of the project. We feel that further progress was made in getting industry 'on side' with our project.

The CWE hosted the eighth **Western Sandpiper Research Network workshop** (February 20/21, 2004) to consider the broad outlines of a hemispheric research project

aimed at understanding causes for declining shorebird census numbers. Relevant portions of the Summary Document (March 30 draft) of the workshop are copied below. We thank the Discovery Parks Major Research Project Application Preparation fund at Simon Fraser University for financial support. The summary document briefly summarizes the discussions held at that workshop.

## **DRAFT (March 30/04) SUMMARY DOCUMENT**

**SHOREBIRD RESEARCH GROUP OF THE AMERICAS  
PROJECT PLANNING WORKSHOP  
CENTRE FOR WILDLIFE ECOLOGY  
SIMON FRASER UNIVERSITY  
FEBRUARY 20/21 2004**

### ***BACKGROUND***

Recent analyses of shorebird census data in North America indicate widespread ongoing declining trends, giving ample reason for concern about the population health of many species. The analyses are based on statistical evaluation of trends in two large data sets of censuses at migratory stopover sites (see Morrison et al. 1994, Wilson Bulletin 106: p 431; Morrison et al. 2001, Wader Study Group Bulletin 94: p 39). A recent report based on counts at non-breeding areas (Morrison et al. 2004, Condor 106: p 60) supports these conclusions for red knots (*Calidris canuta rufa*).

Conservation plans for shorebirds have been completed in both the USA and in Canada and a national initiative for Mexico is in its final stages of completion. Implementation of these plans is intended to address all aspects of shorebird conservation. One of the largest new initiatives to come from them is the Program for Regional and International Shorebird Monitoring which aims to coordinate monitoring efforts on a hemispheric scale to give accurate indications of population distribution, size and trend. Though essential, monitoring programs generally give few solid leads about which of the possible causative agents of population decline is involved. In order to decide on effective conservation policy and action, some research is needed to elucidate which factors might be operating. One approach is to challenge hypotheses based on suspected causative agents with the extensive data on some shorebird species built up over the past thirty or so years. In combination with specific newly-acquired information, this offers a science-based way to evaluate which of the several plausible causes are most likely involved.

In 2002, the Shorebird Research Group of the Americas (SRGA) was formed to create a platform from which to coordinate priority shorebird research on a hemispheric scale. The first initiative of this group will be to launch a major multi-year hemisphere wide research project, using this approach to investigate the causes for these declining population trends. This idea was endorsed in principle by the CWS Shorebird Technical Committee in Quebec City in October 2002 and by the US Shorebird Council in LaCrosse, WI in November 2002 (Donaldson et al. 2000, Brown et al. 2000). These Working Groups report to national councils of the North American Bird Conservation Initiative (NABCI) that facilitates all bird conservation in Canada, the USA and Mexico.

The next step for The Shorebird Research Group of the Americas is to complete a

detailed research plan for this project, and this exercise is now underway.

## **PROJECT PLANNING WORKSHOP SUMMARY**

### ***General features***

The attendees agreed that as the matter is pressing, any project must have attainable goals within a reasonable timeframe. We agreed to structure the project around tests of seven general hypotheses (see below) that might explain part or all of the reported declines, in some or all of the species. We agreed that searching for and making best use of existing data is invaluable, and that co-ordinating activities across the hemisphere would greatly increase the extent and power of the work.

We agreed to focus on western sandpipers initially (*Calidris mauri*), because there is an existing network (see <http://www.sfu.ca/biology/wildberg/>). This network has held seven workshops on western sandpipers since 1994, so this species has been well-studied.

Repeated stopover censuses in British Columbia indicate an estimated 18% annual rate of decline since 1992. The western sandpiper network has developed extensive links to biologists throughout the range of these birds, and has unearthed many historical data. Our objective is to use this network and existing knowledge base to develop technologies and procedures that will provide guidance as we seek to expand the study to additional networks to determine causative factors of declines in other species.

### ***Seven general hypotheses***

There are several widely-touted possible causes for the declines. Bearing in mind that the same causes need not apply to all the species, and that more than one may be affecting any single species, these are (1) habitat loss or change; (2) toxic chemicals and pollutants; (3) increasing predator populations; (4) human disturbance; and (5) climate change. To this list we decided to add a hypothesis that explicitly considers (6) interactions among two or more of these factors. A final hypothesis is that (7) declines are apparent rather than real, resulting from changes in behaviour of migrants that affect the number tallied. We found at the workshop that opinions on the importance of some of these factors varied widely.

### ***Basic plan***

The workshop was able to generate a list of up to 12 sites in the non-breeding range, including 8 Latin American sites for which some historical data on western sandpipers are available. For about half of these sites the data are extensive and of high quality. There are a further 12 (at least) migratory sites in North America that offer historical data, some of which are also extensive and of high quality. Some of the work will involve visits to these sites to collect current information, and to evaluate the historical data.

Comparisons of the census data among these sites will permit evaluation of most of the hypotheses. For example, a prediction of hypothesis 7 is that declines should be registered at migratory sites, but not at non-breeding sites. Hypothesis 1 predicts a correlation between measures of habitat change at these sites and changes in the non-breeding census. Many other plausible predictions were discussed.

### ***Next steps***

The workshop provided enough time only to hammer out the rudiments of the above plan. The next tasks are (1) recruit additional expertise, especially in the toxics and GIS areas; (2) to develop detailed predictions; and (3) to seek funding. We are actively working on these at the moment.

### ***Funding***

We estimate the cost of the project at about CDN\$400,000 per year for 5 years. We're aiming for funding from a variety of sources.

### ***Future meeting***

An active point of discussion was how the Shorebird Research Group of the Americas should develop. All agreed that its scope should be greater than a single project aimed at western sandpipers, and a variety of scenarios for its future were discussed.

We agreed to meet again next year to discuss the SRGA further. A joint meeting of the Pacific Seabird Group and the Waterbird Society to be held in Portland, Oregon, January 19-22, 2005, provides a convenient opportunity. Katie O'Reilly, organizer of this event, has kindly agreed to help with arrangements to accommodate our meeting at that conference. We have tentatively agreed with her that our group will hold a satellite meeting on Sunday, January 23, 2005. Details will follow as we plan this event. Please direct inquiries about the satellite meeting to Ron Ydenberg ([ydenberg@sfu.ca](mailto:ydenberg@sfu.ca)) rather than to Dr. O'Reilly, the PSG, or the WS.

## **REFERENCES**

### ***Analyses of shorebird census data***

R.I.G. Morrison, C. Downes, B. Collins, B. Wilson Bull. 106, 431 (1994).

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### ***Shorebird conservation plans***

S. Brown, C. Hickey, B. Harrington, R. Gill, Eds. The U.S. Shorebird Conservation Plan, 2nd edition. Manomet Center for Conservation Sciences, Manomet, MA, 2001).

G.M. Donaldson, C. Hyslop, R.I.G. Morrison, H.L. Dickson, I. Davidson, Eds. Canadian Shorebird Conservation Plan. Canadian Wildlife Service Special Publication. Published by Authority of the Minister of Environment, Canadian Wildlife Service. Minister of Public Works and Government Services Canada, 2000. Catalogue No. CW69-15/5-2000E. ISBN 0-662-29112-3.

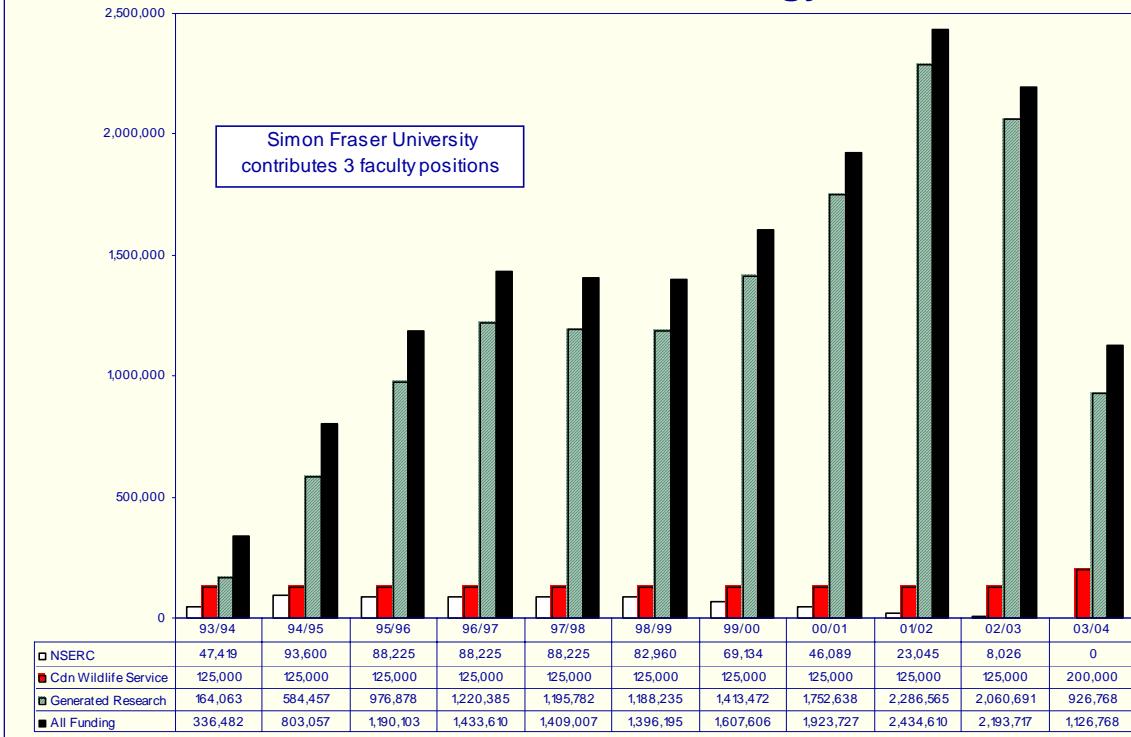
## VII FUNDING

### Budget

1 April 2003 marked the beginning of a third successive 5-year MOU between Environment Canada and Simon Fraser University to provide the core support for the CWE. Minister David Anderson visited SFU on 23 September 2003 to make the announcement. Simon Fraser University provides the salary for three faculty positions, as well as facilities, while EC makes an annual contribution of \$200,000. These form the base from which is generated all of the other research funding each year.



## **2003/2004 Annual Report Centre for Wildlife Ecology**



# **Centre for Wildlife Ecology**

## **Annual Financial Report**

**1 April 2003 - 31 March 2004**

CWS Annual Chair Funding	200,000
<b><u>Support for Doctoral Students</u></b>	
PhD Grad Fellowships	29,200
Heath, J; Morrissey, C; Nebel, S; Love, O; Salvante, K	
<b><u>Dean of Grad Studies Travel Grants</u></b>	
Guillermo Fernandez Aceves; Kristin Gorman	1,400
Oliver Love, Katrina Salvante, Francois Vézina	1,700
American Ornithologists Union: Katrina Salvante	2,376
TAships for Ph.D. Students	27,176
<b><u>Support for Masters Students</u></b>	

	SFU TAships for M.Sc. Students	25,954
	<u>Travel Grants</u>	
	Canadian Wildlife Service: Pacific Seabird Group 2004 Conference	3,463
	<u>Support for Undergraduate Students</u>	
	NSERC Undergrad Research Award: Ames, C; Chin, E; Giesbrecht, I	13,500
	<u>Generated Research Funding</u>	
	President's PhD. Research Stipend Fernandez Aceves, G; Morrissey, C	11,200
	NSERC PGSB - Heath J; Jamieson S	20,596
	National Science Foundation Graduate Fellowship Niehaus A	6,800
	NSERC PGSA - Mathot, K	17,500
	NSERC Industrial Postgraduate Scholarship: Malt, J	5,250
	NSERC Northern Research Supplement: Béty, J NSERC Postdoctoral Fellowship: Béty, J	5,000 10,000
	Garfield Weston Marine Science: Whiteley, J	20,000
	Environment Canada, Science Horizons Youth Program Cesh L, Charleton K, Mathot K, Middleton H, Shapiro J	45,000
	Canadian Wildlife Service Miscellaneous Research Expenses	800
Ball J, Heath J	Northern Scientific Training Program	11,195
Fernandez G	International Council for Canadian Studies	13,200
Bendell-Young L	<u>Aquaculture</u>	
	NSERC Strategic Grant "Towards a Sustainable Shellfish Aquaculture Industry"	151,000 (2nd of 5 yrs)
Esler D, Boyd S	Canadian Wildlife Service: Ecological interaction between shellfish aquaculture operations and the foraging behaviour of Scoters in Baynes Sound, B.C.( Lewis, T)	23,000 (1st of 2 years)
Esler D	Whispering Pines Clinton Band: LeBourdais, SV	27,143 (1st of 3 years)

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"	<i>fully reported in the last two fiscal years</i>
Esler D	US Geological Survey "Evaluating Population Declines in Red Throated Loons"	<i>fully reported in the last two fiscal years</i>
Esler D	US Geological Survey "Ecology of Greater Scaup"	<i>fully reported in the last two fiscal years</i>
Esler D	US Geological Survey "Common Eiders, Long Tailed Ducks"	<i>fully reported in the last two fiscal years</i>
Esler D	BC Hydro Bridge Coastal Restoration Program Variation in Harlequin Duck Distribution and Productivity: The Roles of Habitat, Competition, and Nutrient Acquisition"	71,550 (1st of 3 years)
Esler D	Canadian Wildlife Service: Abundance and Distribution of Marine Birds on the West Coast of Vancouver Island	10,000
Lank, DB	<u>Marbled Murrelets</u> Ministry of Forests: Identification of critical habitat and testing methods of population assessment for breeding marbled murrelets	96,560
Lank, DB	O & C "Review of Marbled Murrelets"	19,800
Lank DB, Arcese P	University of BC: "Marbled Murrelet Radar Analysis"	4,733
Lank DB, Bertram D	Canadian Wildlife Service: North Coast Radar Survey	3,569
Hipfner M	<u>Triangle Island</u> Canadian Wildlife Service - Helicopters	6,668
Williams TD, Bishop CA	Canadian Wildlife Service: Reproductive Biology and Habitat use by the Yellow-Breasted Chat in British Columbia	9,000
Williams TD, Bishop CA	World Wildlife Fund Canada (ESRF): Reproductive Biology and Habitat use by the Yellow-Breasted Chat in British Columbia	8,000
Williams TD,	Canadian Wildlife Service: "Ecotoxicology of halogenated	10,000

Elliott J

organic contaminants in bald eagles in the Strait of Georgia"

Williams TD, Elliott J	Canadian Wildlife Service: "Zebra Finches"	6,000
<b><u>Blue Heron Conservation Project - Kenyon, J</u></b>		
Ydenberg RC, Smith B Chatwin T	Water, Lands, Air Protection (WLAP), Population Research of Coastal Great Blue Heron Conservation Project	8,000
Ydenberg RC, Smith B	Canadian Wildlife Service: Great Blue Heron Conservation Concerns	9,000
<b><u>Western Sandpipers</u></b>		
Ydenberg RC, Baird P	US Army Corps of Engineers: Multinational Study of Neotropical Migrants: The Western Sandpiper as model.	39,435
Ydenberg, RC	SFU Discovery Parks Major Grant Preparation Administration Grant: WESA	5,000
Ydenberg RC	SFU Discovery Parks Administration Grant	5,000
Lank DB	NSERC Individual Research Grant: Sexual Selection and Genetic Polymorphism	24,000 (1st of 4 yrs)
Williams TD	NSERC Individual Research Grant: "Physiology of life-histories: egg size and number and costs of reproduction"	43,000 (2nd of 4 yrs)
Ydenberg RC	NSERC Individual Research Grant - "Predation danger and the evolutionary ecology of migrants and provisioners"	51,000 (3rd of 4 yrs)
2003/2004 Generated Research Funding		<u>797,999</u>

**2003/2004 Funding Summary**

Student Support - Fellowships, TA Ships, Awards, SFU and external sources	128,769
Total 2003/2004 OTHER Generated Research Funding	<u>797,999</u>
	<u>926,768</u>
Canadian Wildlife Service / Environment Canada Core Funding	200,000
All Funding Sources 2003/2004	<u><u>1,126,768</u></u>

## 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 19 publications in press and 13 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 theses produced by graduate students in our group at SFU.

### A. Papers in Refereed Journals

#### In press:

- Bennett, K., T.D. Williams, J.E. Smits, M. Wayland, S. Trudeau and L.I. Bendell-Young. In press. Impact of oil sands based wetlands on the growth of mallard (*Anas platyrhynchos*) ducklings. *Envir. Toxicol. Chem.*
- Dekker, D. and R.C. Ydenberg. In press. Raptor predation on wintering dunlins in relation to the tidal cycle. *Condor*
- Fernandez, G., P.D. O'Hara and D.B. Lank. In press. Tropical and subtropical Western Sandpipers (*Calidris mauri*) differ in life history strategies. *Ornit. Neotrop.*
- Hipfner, J.M., K. Charleston and W.E. Davies. In press. Rates and consequences of relaying in Cassin's and Rhinoceros auklets breeding in a seasonal environment. *J. Avian Biol.*
- Iverson, S.A., D. Esler and D.J. Rizzolo. In press. Philopatry of harlequin ducks molting and wintering in Prince William Sound, Alaska. *Condor*
- Love, O.P., C.W. Breuner, F. Vézina and T.D. Williams. In press. Mediation of a corticosterone-induced reproductive conflict. *Hormones and Behavior*
- McFarlane Tranquilla, L., P.P.-W. Yen, R.W. Bradley, B. Vanderkist, D.B. Lank, M. Drever, G. Kaiser, L. Lougheed and T.D. Williams. In press. Do two Marbled Murres make a pair? Breeding status and behaviour of Marbled Murrelet twosomes captured at-sea. *Wilson Bull.* 115
- Morrissey, C.A. In press. American dipper predaes tailed frog larvae (*Ascaphus truei*). *Can. Field Nat.*
- Morrissey, C.A. In press. Effect of altitudinal migration within a watershed on the reproductive success of American dippers. *Can. J. Zool.*
- Morrissey, C.A., L.I. Bendell-Young and J.E. Elliott. In press. Linking contaminant profiles to the diet and breeding location of American dippers using stable isotopes. *J. Appl. Ecol.*
- Mulcahy, D.M., K.A. Burek and D. Esler. In press. History of fabric collars from percutaneous antennas on intracoelomic radio transmitters implanted in harlequin ducks. *J. Avian Surg. Med.*
- 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.*
- Parker, N., E. Cam, D.B. Lank and F. Cooke. In press. Post-fledging survival of juvenile Marbled Murres as determined by radio-telemetry in Desolation Sound, British Columbia. *Marine Ornithol.*
- Peery, M.Z., S.R. Beissinger, S.H. Newman, E.B. Burkett and T.D. Williams. In press. Applying the declining population paradigm: diagnosing causes of low reproductive

- success in Marbled Murrelets. *Conservation Biology*  
Peery, Z., S.R. Beissinger, S.H. Newman, B.H. Becker, E.B. Burkett and T.D. Williams.  
In press. Monitoring marbled murrelet populations using inland surveys: implications  
from radio telemetry. *Condor*  
Pomeroy, A.C. and R.W. Butler. In press. Colour infrared photography is not a good  
predictor of macro invertebrate abundance on mudflats used by shorebirds. *Waterbirds*  
Schamel, D., D.M. Tracy and D.B. Lank. In press. Male mate choice, male availability  
and egg production as limitations on polyandry in the Red-necked Phalarope. *Anim.*  
*Behav.*  
Williams, T.D., W.O. Challenger, J.K. Christians, M. Evanson, O. Love and F. Vézina. In  
press. What causes the decrease in hematocrit during egg production? *Funct. Ecol.*  
Ydenberg, R.C., R.W. Butler, D.B. Lank, B.D. Smith and J. Ireland. In press. Western  
sandpipers alter migration tactics to mitigate danger from recovering peregrine falcon  
populations. *Proc. Roy. Soc. Lond. B.*

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- Bradley, R.W., F. Cooke, L.W. Lougheed and W.S. Boyd. 2004. Inferring breeding  
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331.  
Evans Ogden, L.J., K.A. Hobson and D.B. Lank. 2004. Blood isotopic ( $d^{13}\text{C}$  and  $d^{15}\text{N}$ )  
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*pacifica*). *Auk* 121:170-177.  
Nebel, S., A. Cloutier and G.J. Thompson. 2004. Molecular sexing of prey remains  
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## B. Papers submitted to refereed journals

- Evans Ogden, L.J., K.A. Hobson and D.B. Lank. Submitted. Using stable isotope analysis to establish the contribution of agricultural fields to the diet of wintering shorebirds. *J. Anim. Ecol.*
- Gurd, D.B. Submitted. Ecomorphology of dabbling ducks: what are the trade-offs and predictions? *Oikos*
- Iverson, S.A., B.D. Smith and F. Cooke. Submitted. Assessing age and sex distributions of wintering surf scoters: implications for the use of age ratios as an index of recruitment. *Condor*
- Lozano, G.A. and D.B. Lank. Submitted. Immunocompetence and testosterone-dependent condition traits in male ruffs (*Philomachus pugnax*). *Anim. Biol.*
- McFarlane Tranquilla, L.A. Submitted. Stress response to capture in Marbled Murres. *Can. J. Zool.*
- Morrissey, C.A., L.I. Bendell-Young and J.E. Elliott. Submitted. Assessing exposure to trace metals in mountain streams using the diet, feathers and feces of the American dipper. *Env. Tox. Chem.*
- Morrissey, C.A., L.I. Bendell-Young and J.E. Elliott. Submitted. Contributions from atmospheric deposition to food chain biomagnification in the Chilliwack watershed of British Columbia, Canada. *Env. Sci. Technol.*
- Morrissey, C.A., L.I. Bendell-Young and J.E. Elliott. Submitted. Seasonal trends in population density, distribution and movement of American dippers within a watershed of southwestern British Columbia, Canada. *Condor*
- Nebel, S. Submitted. Intraspecific feeding niche divergence and a latitudinal cline in sex ratio in a migratory shorebird. *Oikos*
- Nebel, S. and G. Fernandez. Submitted. Latitudinal cline in sex ratio and bill length in non-breeding least sandpipers. *Condor*
- 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. *Auk*  
 Pomeroy, A.C. and R.W. Butler. Submitted. The usefulness of colour infrared photography to estimate primary productivity of intertidal mudflats used by shorebirds. *Waterbirds*  
 Schamel, D., D.M. Tracy, D.B. Lank and D.F. Westneat. Submitted. Copulation strategies and extra-pair fertilization rates in the sex-role reversed, socially polyandrous Red-necked Phalarope *Phalaropus lobatus*. *Beh. Ecol. Sociobiol.*

### C. Other Publications

- Elner, R.W. and D. Seaman. 2003. Calidrid conservation: unrequired needs. *Wader Study Group Bulletin* 100: 30-34.  
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### D. Theses

- Nebel, S. 2003. Ecological factors underlying the non-breeding distribution of western sandpipers. Ph.D., Simon Fraser University, Burnaby. 96 pp.  
 Niehaus, A.C. 2003. Ecology of migratory timing by southbound male and female western sandpipers (*Calidris mauri*). MSc, Simon Fraser University, Burnaby. 127 pp.  
 Regehr, H.M. 2003. Movement patterns and population structure of Harlequin Ducks wintering in the Strait of Georgia. Ph.D., Simon Fraser University, Burnaby, BC. 136 pp.  
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