

**ANNUAL REPORT of the
CENTRE FOR WILDLIFE ECOLOGY
2002-2003**



**Department of Biological Sciences
Simon Fraser University**

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

Dr. Ron Ydenberg, Director

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, CWE
Tony Williams	Associate Director
David Green	Assistant Professor
Dov Lank	University Research Associate / Adjunct Professor
Dan Esler	University Research Associate
Mark Hipfner	University Research Associate / CWS Biologist
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
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	Guillermo Fernandez	BriAnne Addison	Judy Higham, CWE Admin. Asst.
Elsie Krebs	Silke Nebel	Jeff Ball	Connie Smith, CWE Research Tech.
Ramunas Zydalis	Brent Gurd	Jeanine Bond	Nadine Parker, MAMU Tech.
	Joel Heath	Gwylim Blackburn	Laura McFarlane Tranquilla, MAMU and Triangle Tech.
	Oliver Love	Lily Cesh	Trish Fontaine, Seaduck Tech.
	Silke Nebel	Eric Davies	Sam Iverson, Aquacult. Tech.
	Heidi Regehr	Bart DeFreitas	Debbie Lacroix, Aquacult. Tech.
	Michael Rodway	Kristen Gorman	Molly Kirk, Aquacult. Tech.
	Katrina Salvante	Jamie Kenyon	Tawna Morgan, Res. Asst.
	Bonnie Stout	Sunny LeBourdais	
	Francois Vézina	Tyler Lewis	
		Kim Mathot	
		Christy Morrissey	
		Amanda Niehaus	
		Andrea Pomeroy	
		Dana Seaman	
<i>Moved On</i>	<i>PhD(defended)</i>	<i>MSc (defended)</i>	
Yuri Zharikov	Matt Evans	Harpreet Gill	
	Lesley Evans Ogden	Kate Hagmeier	
		Sam Iverson	

B. Board of Directors

<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	Professor, CWE Assoc. Director (non-voting)	SFU
Ron Ydenberg	Professor, CWE Director (non-voting)	SFU

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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>.

We are now beginning our tenth year, and the second year under our new name, the Centre for Wildlife Ecology (CWE). Dr. Ron Ydenberg is in his second year at the helm of the CWE; he assumed the directorship when Fred Cooke, the Senior Chair from 1993-2002, retired. Tony Williams retains the position of Associate Director. In January 2003 Dr. David Green joined the Centre as a new faculty member. David's interests are in the demography and genetics of bird populations. He is currently initiating a research project on American Dippers.

Dov Lank remains with the CWE as a University Research Associate and Adjunct Professor. Dov is responsible for directing several large-scale projects, including the Marbled Murrelet project. Drs. Dan Esler and Mark Hipfner continue as Research Associates with the CWE, responsible for the waterfowl programs, and the Triangle Island Seabird Research Station, respectively. Since the last Annual Report, two PhD and 3 MSc students have completed their degrees. Several new students have joined the group since the last report and their projects are discussed in upcoming sections. Other new personnel at the CWE are: Elsie Krebs, Post-doctoral Fellow working with the Marbled Murrelet Project; Debbie Lacroix, Project Manager, and Molly Kirk, Research Technician, both working for the Sustainable Shellfish Aquaculture Initiative. Sam Iverson, recent MSc graduate, was hired as a Research Assistant working on several of the sea duck projects. Ramunas Žydelis, a postdoctoral fellow from Lithuania, also will be assisting with sea duck research.

Now in its tenth year, the CWE has proven that it is a strong and enduring institution in its own right. It is thriving under its new structure, continues to attract students and funding, and has diversified scientifically. We look forward to another decade of outstanding research accomplishment.

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 Station was established in 1994 as a center for research devoted to understanding their biology, aimed particularly at identifying and understanding environmental and demographic causes of population changes so as to recommend appropriate conservation options. The Ecological Reserve on Triangle Island supports the largest and most diverse seabird colony in BC, including the world's largest population of Cassin's Auklet, globally significant populations of Rhinoceros Auklet, and BC's largest populations of Tufted Puffin and Common Murre. As part of the Scott Island Group, Triangle Island is recognized as an internationally Important Bird Area (IBA). The ocean region around the Scott Islands is also being considered for status as a Marine Wildlife Area (MWA).

Our ongoing investigations examine breeding propensity and chronology, reproductive performance, nestling diet and development, parental provisioning patterns, attendance patterns, adult survival, and at-sea foraging distributions of seabirds through the application of radio-telemetry. 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.

Dr. Mark Hipfner replaced Dr. Doug Bertram as leader of the station in July 2001, after Doug was assigned by Environment Canada to become Director of the Marbled Murrelet Recovery Team. Mark has extensive experience working on seabirds in Canada and Alaska. His thesis research concentrated on breeding biology of Thick-billed Murres and Razorbills in Labrador and Nunavut, and he co-authored the accounts for both of these species for the American Ornithologists' Union's Birds of North America series. Doug and Mark are among the most experienced young seabird biologists on the continent, and we are fortunate to have been able to attract researchers of this quality to lead the project.

The 2002 season: We opened our research station on Triangle Island for year 9 on 25 March 2002 with continued logistical support from the Canadian Coast Guard. Scientific research was conducted under the direction of Mark Hipfner, John Ryder continued as supervisor of logistical support (until June), and Mark, Kristin Charleton and Laura McFarlane Tranquilla led the field crew. We maintained our time series focus on Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin and Common Murre, coupled with graduate student research (see below). In addition, we used radio telemetry to identify foraging areas of Rhinoceros Auklets to assist with planning for the proposed Scott Islands MPA, with the assistance of Dr. Sean Boyd and Michael Dunn (CWS).

"Nestucca" Trust Fund: Our integrated ecosystem study with Department of Fisheries and Oceans (DFO) collects time series information on temporal and spatial variation in zooplankton communities and ocean properties, coupled with detailed seabird population data. This season marked the final year of our five-year collaborative investigations. Ocean temperatures remained cool in 2002, and in general, reproductive performance was above average in Cassin's Auklets and about average in Rhinoceros Auklets, but after a good start Tufted Puffins once again suffered through a poor breeding season marked by high rates of chick mortality late in the season.

Foraging Distributions: In 2002, we supplemented our three-year study of at-sea foraging distributions of Cassin's Auklets with a single season of radio telemetry work on Rhinoceros Auklets. We deployed radios on 40 breeding birds, and flew aerial surveys to locate birds at-sea in July in a Beaver floatplane. Radioed birds mainly foraged on the shelf edge about 60-80 km north and northwest of Triangle Island. Funding to support this work was obtained from World Wildlife Fund Canada through their Endangered Species Recovery Fund. This information is being used in planning for boundaries for the Scott Islands MWA.

Graduate students: In 2002, Gwyllim Blackburn completed his second year of MSc research on breeding ecology of Tufted Puffins, with a focus on sexual selection and ornamentation as an indicator of parental quality. In addition, Eric Davies began MSc research on the foraging ecology of Triangle's alcids, using stable isotope ratios to assess intra-specific (among individuals and among breeding phases) and inter-specific variation in trophic status.

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.

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 10 years, we have pursued

and aided fieldwork at three breeding sites, several migration locations, and four wintering sites. We have organized seven 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 published a 16-author paper summarizing the differential sex and age distribution of Western Sandpipers during the non-breeding season, and completed several thesis chapters addressing possible causes for the patterns.
- Patrick O'Hara completed and defended his PhD that focused on how primary feather-wear and body-size may influence life-history and migration strategies of birds spending the non-breeding season at different distances from the breeding grounds.
- 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.
- MSc student Amanda Niehaus modeled the timing of southward migration from the breeding grounds, and examined empirical data on sex differences at different stages of migration.
- 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, is examining the feeding modes and feeding opportunities of western sandpipers at a migratory stopover site and at non-breeding grounds along the coast. She has completed her field work at Roberts Bank and California this year, and is organizing her field season in Panama and Mexico this fall/winter.
- Will Stein completed his MSc thesis examining digestive physiology, and Dana Seaman largely completed her "landscape physiology", both detailed further under the "Physiological Ecology" section.
- Numerous publications arising from the project by "alumni" were published, including one in *Nature* that included paternity data from Nome (Brett Sandercock), and papers by James Burns, and Chris Guglielmo. Ron Ydenberg, Dov Lank and Rob Butler continued development of theories and analyses examining how the "predator landscape" may shape migration strategies, habitat use, and the evaluation of shorebird census data, which is critical for the development of shorebird management strategy.

C. The Marbled Murrelet Project

This ground-breaking and high profile project examining the biology of the threatened and elusive marbled murrelet continues for the ninth consecutive year. Dov Lank, Nadine Parker, Laura McFarlane Tranquilla, and Yuri Zharikov continued with the project, and were joined at SFU by Elsie Krebs. Fred Cooke remained in active contact from his retirement home in England. 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. The SFU murrelet research was featured in a segment of the “The Leading Edge” broadcast on BC’s “Knowledge Network” and available on-line.

Dov Lank served 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.

In the summer of 2002, we continued fieldwork at Clayoquot Sound, on Vancouver Island, hiring a full field crew, supervised by Nadine Parker. A major accomplishment of this season was doubling of the number of nests found, bringing the total at this site to 36. This provides us with a sample sufficient to compare these results with those obtained at Desolation Sound, where 121 nests were found through 2001. In a novel addition to previous work, we radio-marked adults and juveniles towards the end of the breeding season to document their post-breeding dispersal and behavior. We searched for radio-tagged birds with fixed-wing aircraft northward up through the coast of Alaska and southward towards Washington State. Juvenile birds moved slowly northward, to Cape Scott, and then disappeared. Adult birds disappeared shortly after completing breeding, with non-breeders and failed breeders preceding successful breeders, who in turn departed prior to juveniles. This information affects the interpretation of murrelet censuses often conducted at this time of year.

Additional funding was obtained through the province’s new Forestry Innovation Investment (FII) research program, in collaboration with Waterhouse and Alan Burger, and from consortia of forest companies, through the provincial Forest Investment Account. The FII funds enabled us to work with Irene Manley, who compared the tree-level attributes of the nests found at both Desolation and Clayoquot Sounds, and Volker Bahn, who used our information on the locations of nests at Clayoquot to test a habitat suitability model previously generated for that area.

The year has been extremely productive in terms of publications and submission of manuscripts. After a lengthy editorial process, Emmanuelle Cam’s multi-authored demography paper was accepted by *Conservation Biology*. Laura McFarlane Tranquilla had three papers accepted and/or published, and submitted 3 others covering and extending work arising from the MSc thesis she completed in 2001. Russ Bradley published a chapter from his MSc thesis and has provisional acceptance of a second by the *Journal of Wildlife Management*. Peggy Yen and Falk Huettmann have a BC-wide analysis of murrelet distributions accepted by the *Journal of Ecological Modeling*. Several publications from previous generations of workers on the project reached final publication, including papers by Cecilia Loughheed and Cindy Hull.

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. 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. These findings confirm preliminary analyses by Russ Bradley and Falk Huettmann et al. in earlier work. This work has substantial implications for murrelet management in British Columbia. As the year closed, these findings were being communicated to interested parties, including presentations at the Pacific Seabird Group meeting in Parksville, in February, and subsequent Murrelet Recovery Team meetings and workshops.

D. The Georgia Basin Ecosystem Initiative

The 2002/03 financial year was the last of Environment Canada's Georgia Basin Ecosystem Initiative (GBEI), under which the CWE received funding for a variety of projects. Projects on the winter and spring ecology of Pacific Black Brant, on Snow Geese, and on the winter ecology of Dunlin were all completed. Work on some of the other projects in this envelope is continuing in other forms: Harlequins (see Harlequin Duck Conservation Research below), Great Blue herons (see Heron Working Group below), scoters (see Sustainable Shellfish Aquaculture Project below), and dippers (see Landscape Ecology of Songbirds section below).

E. The Riske Creek Field Station

CWE research in the Riske Creek area, southwest of William's Lake, is also winding up, as PhD students Matt Evans (defended May 2003) and Brent Gurd (defense planned for March 2004) complete their degrees. Their work focused on waterfowl relationships with wetlands, forest, and rangeland, and how these relationships change with habitat alterations, particularly those related to forestry and water management. We worked in cooperation with Kathy Martin (UBC and CWS) and her "nest web" project, and Sean Boyd (CWS). Long-term funding obtained from Forest Renewal BC in July 1996 ended in 2001. As the CWE winds down its presence at Riske Creek, we turned over management of the field station to Dr. Kathy Martin, whose work at the site is ongoing.

F. 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, the CWE in collaboration with Dr. Leah Bendell-Young 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. Tyler Lewis and Jonathan Whiteley are graduate students working on the project. The CWE component of the research addresses interactions between wintering surf and white-winged scoter populations, 'wild' benthic fauna and shellfish aquaculture. We plan to generate data that will 1) answer questions about basic scoter

biology that will indicate potential mechanisms by which shellfish aquaculture (or other activities) could have population-level effects, (2) directly evaluate relationships of shellfish aquaculture to behaviour, survival, and habitat quality, (3) provide information necessary to set appropriate management goals for scoters, and (4) provide implications for management of shellfish aquaculture optimizing long-term sustainability of both the industry and scoter populations.

Specific research directions include: (1) documenting scoter abundance and distribution in relation to habitat attributes, proximity to shellfish aquaculture, and seasonal and annual variation, based on intensive surveys and habitat sampling; (2) describing movements and foraging behaviour of radio-marked individuals; (3) quantification of survival rates of radio-marked birds; (4) evaluation of various radio-marking packages on scoters; and (5) describing scoter trophic interactions with their primary prey.

Specific activities included:

- Two winters (2001-02 and 2002-03) 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 2 winters, 180 scoters (92 WWSC and 88 SUSC) 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 summer 2002. Nineteen transects, spaced 3 km apart, were sampled with quadrats at 50m intervals from high tide line to low tide. Two-hundred and thirty-seven quadrats were dug, yielding 8852 clams > 10mm.
- 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 winter 2002-03, 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, for-

- aging 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 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 2 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.

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

Related to this work is our project on abalones in Haida Gwaii. Abalone is currently Canada's only marine invertebrate with 'threatened' status, and as such is deserving of some conservation attention. MSc student Bart DeFreitas is investigating why depleted abalone populations seem to have difficulty in re-establishing themselves. Bart is supported by his employer Haida Fisheries, a subvention grant from the Department of Fisheries and Oceans, and by the CWE.

G. 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. Funding is in place to census colonies again in 2003.

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. The Heron Stewardship Program worked with the Waterbird Watch Collective, WBT Wild Bird Trust of BC and Islands Trust Fund on Salt Spring Island to purchase and manage 5.07 ha (12.5 acres) of land supporting one of the largest heron colonies (125 nests) in BC, the McFadden Creek Heronry. The herons abandoned McFadden Creek in 2001 but over 100 pairs returned to nest in the spring of 2002. Agreements to manage lands for herons are also in place or in the works at four other colonies in the region. 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/abouthwg.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.

H. 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 2002-2003 CWE graduate students Heidi Regehr and Michael Rodway continued to write up the results of their research, publishing several papers. Heidi's work addresses dispersal of harlequin ducks and the subsequent implications for population structure and demography. Michael is tackling 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 no new banding of harlequins in the past year, researchers (including Sean Boyd, Ken Wright, Pete Clarkson, John Ashley, Ian Goudie and Mike and Heidi) 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 life history 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.

I. Physiological ecology of reproduction and migration

The main aims of CWE's research in physiological ecology 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 continue to approach these aims through a combination of studies on basic physiology, often using tractable model systems (e.g. zebra finches, starlings), coupled with more applied, and more specific, goal-orientated projects (e.g. addressing current endocrine disrupter and ecotoxicological problems).

1. Reproductive physiology

a. Zebra finches and starlings - model species for reproduction and ecotoxicology studies. We are continuing our studies of basic reproductive physiology in captive-breeding zebra finches (*Taeniopygia guttata*) and nest-box breeding European starlings (*Sturnus vulgaris*). This work focuses on the causes and consequences of individual variation in female reproductive effort (egg size, clutch size and laying date). Individual variation is marked in all these traits but this is unrelated to 'traditional' measures of individual quality (e.g. size, mass or size-adjusted 'condition'). 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. 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. Oliver Love (PhD student) is continuing our work with starlings using hormonal manipulations to investigate the interaction of stress and reproduction. He is also interested in using the hormone corticosterone as a signal for habitat quality. 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).

b. 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 Drs. Tony Williams and 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.

2. *Endocrine disrupters and ecotoxicology*

a. 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. Following a pilot study in 2002, we were successful in obtaining a grant of \$42,000 per year for three years to continue this project (a collaboration between TDW and Drs John Elliott, Kathy Martin, Laurie Wilson and Pierre Mineau of Environment Canada).

b. 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 Lilly 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.

c. Effects of toxic substances on tree swallow breeding at sewage treatment plants. We have been monitoring breeding success of tree swallows at two sites (the Iona Sewage Treatment Plant and a reference site, Serpentine Fen) since 2000 in relation to xenobiotic exposure. The objective of the present study is to investigate the exposure and effect of polybrominated diphenyl ethers, PBDEs (flame retardants), on tree swallows reproduction. Polybrominated diphenyl ethers (PBDEs) are used extensively as flame retardants and in recent years there has been concern regarding the possibility of ecological impacts associated with their release to the environment. This project is a collaboration with Dr John Elliott, Laurie Wilson and Patti Dods at Environment Canada, and the Friends of Semiahoo Bay.

3. *"Landscape physiology" of Western Sandpipers*

With funding from the Marine Ecosystem Health Program (UC Davis), we have been investigating the application of plasma metabolite analysis for the assessment of the relative quality of habitats or sites used by migratory shorebirds. Site-specific variation in fattening rates should be important in determining habitat use which, in turn, is important to consider in land acquisition or stewardship decisions. Dana Seaman (MSc) has been capturing and blood sampling western sandpipers at 6-9 sites in the Puget Sound/Georgia Basin region to determine inter-site variation in fattening rates, based on metabolite analysis. For each site we also obtain information on invertebrate prey availability (from mud cores), diet (from fecal samples), and foraging behaviour. The overall aim is to combine information from three very different approaches (metabolite analysis, invertebrate sampling, and foraging behaviour) to assess variation in the quality of migratory stopover sites. This project is a collaboration between Dr Bob Elner (Canadian Wildlife Service), Dr Chris Guglielmo (U. Montana) and the US Fish & Wildlife Service in Washington State. In collaboration with Drs. Nils Warnock and John Takekawa (with funding from US Fish & Wildlife, California), we are now extending this work to include more southerly wintering/stopover sites.

J. 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 oil spill by the Exxon Valdez 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 is currently conducting her second season of field work 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, is conducting his second field season 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.
- *Courtship and pair formation in Horned and Red-necked Grebes* - Bonnie Stout has completed her field work for her PhD study of Horned and Red-necked Grebes in the Northwest Territories and on the wintering grounds in Boundary Bay. She continues to write up her work and had a paper published in *Waterbirds* this spring. Her work has uncovered a complex array of social patterns in both species that had not been adequately described or explained previously.
- *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 CWE PhD student Joel Heath conducted his first season of field work in the Belcher Islands, Nunavit, to determine how wintering common eiders adjust their foraging behaviour in response to different environmental constraints, and the influence of eider predation on the community structure of benthic invertebrates and fish.
- *Parental care in eiders* - Markus Öst, of the University of Helsinki, made his 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*.

K. Landscape ecology of songbirds

The newest member of the CWE team is Dr. David Green, an avian ecologist with extensive experience studying landbirds in Canada and Australia. His current research focuses on investigating how dispersal and migratory strategies of individuals influence their fitness and the demography and genetic structure of populations. Since arriving in Jan 2003, David has initiated a project that will investigate the migratory behaviour and population demography of American Dippers in BC, while continuing work on a project that examines how habitat fragmentation influences dispersal and the genetic structure of logrunner populations in Queensland Australia. He is currently planning further projects that compare how recent changes to our landscape influence the movement patterns and

viability of populations of resident and migratory landbirds in British Columbia.

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 altitudinal 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 in resident passerines. David and Holly Middleton (research assistant) are using mark-resighting and radiotelemetry data to investigate how variation in dispersal and migratory behaviour influences recruitment, natal philopatry, survival and reproductive success of American dippers. Detailed data on the movement of marked birds will also be used to examine habitat use by juvenile and adults throughout the year and to determine how riparian habitat and water quality affects movement patterns and the structure and dynamics of dipper populations in BC.

2. Effects of habitat fragmentation and brood parasitism in Okanagan songbirds

The objective of this research is to evaluate the effect of habitat fragmentation and inter-specific brood parasitism on nestling and adult condition and breeding productivity in Yellow-breasted Chat (*Icteria virens*) and Grey Catbird (*Dumetella carolinensis*). The Yellow-breasted Chat is a "red listed" species in BC and this project forms part of a broader research effort by Canadian Wildlife Service on passerines in the bio-diverse region of the Okanagan, BC. The objectives of this research proposal are: 1) to identify and describe all potentially suitable chat breeding habitat remaining in the south Okanagan, BC; 2) to determine the current population size of the yellow-breasted chat, nest productivity, and degree of brown-headed cowbird parasitism in chat nests, and 3) for the purposes of habitat restoration, to quantify the habitat characteristics of chat territories and nest patches. In addition DNA will be obtained from red blood cells for genetic analysis of population structure. This is a collaboration with Dr Christine Bishop, Environment Canada; the project is being coordinated by Tawna Morgan (research assistant), with funding from WWF Endangered Species Recovery Fund.

VI. CONFERENCES

A. North American Sea Duck Conference

The first North American Sea Duck Conference and Workshop was held in Victoria BC in November 2002. The CWE took the lead in organizing the conference; Dan Esler was conference coordinator and several CWE members were involved in the scientific and local arrangements committees, including Ron Ydenberg, Sean Boyd, Trish Fontaine, and Jennifer Kormendy. Also, an army of CWE students and research assistants provided help preparing and running the meeting. CWS also contributed personnel, especially

Shelagh Bucknell, and various other forms of support for the conference. Partners in the new North American Sea Duck Joint Venture provided much of the funding.

The conference was very successful, capitalizing on the growing conservation concerns and interest in sea ducks throughout the world. The meeting attracted more than 200 participants from 10 countries. Fifty-eight talks were presented, including plenaries from Stefan Pihl on European sea duck issues and Alexander Kondratyev on Russian sea ducks. In addition, 61 posters were presented. A series of workshops were held, on topics including: survey methods, satellite telemetry, interactions with aquaculture, contaminants and disease, industry relations, diving and foraging ecology, and genetics. The CWE presence was strong in the scientific presentations, along with the organizational aspects. Many members of the CWE also attended a meeting of the Harlequin Duck Working Group on the day after the conference.

B. 30th Pacific Seabird Group Annual Meeting

In February of 2003 the CWE, together with the Canadian Wildlife Service and the US Fish and Wildlife Service, hosted the annual meeting of the Pacific Seabird Group at Tigh Na-Mara Resort in Parksville, BC. Three distinguished speakers, Robert Ricklefs, Helen James, and David Cairns, gave plenary talks to begin each day of the meeting. Two hundred and thirty-nine seabird biologists attended, and a total of 99 papers and 45 posters were presented by authors from more than five countries. Subjects covered many aspects of seabird biology, including breeding biology, foraging ecology, habitat selection, behavioural ecology and sexual selection, seabird monitoring, conservation and management, seabird-fishery interactions, and effects of oil pollution and wind farms. The conference concluded with several field trips designed to give participants a chance to experience BC's seabirds up close and personal. Thanks to the local committee, Doug Bertram, Bob Elner, Ron Ydenberg, Mark Hipfner and Shelagh Bucknell, for all their time and hard work in organizing the conference.

C. 7th Western Sandpiper Workshop

On 17-19 January 2003 the 7th Western Sandpiper Workshop, hosted by the CWE and organized by Dov Lank, Amanda Niehaus and Ron Ydenberg, was held at Simon Fraser University. The theme for the meeting was "The annual routine of shorebirds: non-breeding, migratory and breeding strategies". Tamás Székely (University of Bath, UK), presented a plenary lecture on "Sexual selection and the evolution of breeding systems in shorebirds". Twenty-three papers and six posters were presented by authors from Canada, the US and UK. The conference concluded with a workshop on "Shorebird census declines: A study on the Western Sandpiper". The aim of this workshop was to discuss how the 'western sandpiper research network' that has self-organized over the past nine years might co-ordinate efforts to address this question.

VII. FUNDING**2002/2003 Fiscal Year****1 April 2002 - 31 March 2003**

CWS Annual Chair Funding	125,000
NSERC Contribution to Faculty Salaries	8,920

Support for Doctoral Students

Grad Fellowships Nebel S, Love O, Regehr H, Rodway M, Salvante K, Vézina F	31,200
President's PhD. Research Stipend Regehr H, Evans M	10,000
NSERC PGSB Heath J, Salvante K	25,466
Science Council of BC Great Award Evans, M	5,000
Industrial NSERC Postgrad Scholarship Evans M	18,000
SICB, Best Student Paper Salvante K	152
Travel Grants Evans M, Nebel S, Salvante S	4,270
SFU TAsHips for Ph.D. Students	13,178

Student Support for Masters Students

Grad Fellowships DeFreitas B, Pomeroy A, Seaman D	19,900
National Science Foundation pre doctoral Niehaus A	19,600
NSERC PGSA Mathot K	8,650
SFU TAsHips for M.Sc. Students	21,099

Generated Research Funding

Environment Canada, Science Horizons Youth Program Addison B, Coulter S, Dods P, Mclean A, Newton B	45,000
Ball J Sandpiper Technologies Inc Equipment Grant	3,000
Ball J Northern Scientific Training Program	6,000
Ball J Loon Watch/Sigurd T. Olson Loon Research Award	3,750
<u>Canadian Wildlife Service , PYRC Research Support</u>	
Boyd S Aquaculture Field Work - Sellentin E	3,500
Boyd S Aquaculture - Data Entry - Coulter S	2,111
Boyd S Aquaculture Field Work - Coulter S	4,968

<u>Canadian Wildlife Service , PYRC Research Support (cont'd)</u>		
Pomeroy A, Butler R	Canadian Wildlife Service - Western Sandpipers Data Collection	4,920
Pomeroy A, Butler R	Canadian Wildlife Service - Western Sandpipers Data Collection	4,900
Mathot K	Canadian Wildlife Service - Wintering Distribution of Western Sandpipers	2,260
Elner/Ydenberg		
Evans M, Boyd S	Canadian Wildlife Service - Waterfowl Surveys in the BC Interior	2,136
Addison, B/Butler R	Canadian Wildlife Service - Scoter Mussel Project	1,900
DeFreitas /Ydenberg	Department of Fisheries and Oceans "Measuring Northern Abalone juvenile recruitment using artificial habitats."	15,000
Evans M	North American Bluebird Society	1,500
Fernandez G	Consejo Nacional de Ciencia y Tecnologia (CONACYT, Mexico)	7,750
Fernandez G	International Council for Canadian Studies	3,300
Gurd B	Delta Waterfowl & Wetlands Trust	5,000
Kenyon J, Ydenberg R	Water, Lands, Air Protection (WLAP), Population Research of Coastal Blue Heron Conservation Project	11,600
Salvante K	SICB Society for Integrative and Comparative Biology	1,500
Salvante K	Sigma XI The Scientific Research Society	300
Vézina F	American Ornithologists Union - Egg production	2,826
Vézina F	Sigma XI The Scientific Research Society - Egg production	1,256
Vézina F	SICB Society for Integrative and Comparative Biology - Egg production	1,256
	Canadian Wildlife Service, Georgia Basin Ecosystem Initiative "Ecological research on diving birds, harlequin ducks, and great blue herons to support habitat securement objectives..."	30,000
<u>Aquaculture</u>		
Bendell-Young L	NSERC Strategic Grant "Towards a Sustainable Shellfish Aquaculture Industry"	131,300 (2nd of 5 yrs)
Elner R	Canadian Wildlife Service - Aquaculture Consultation	500
<u>Marbled Murrelets</u>		
Cooke F	NSERC CRD - Demographic and Habitat Studies of Marbled Murrelets	220,500 (3rd of 3 yrs)
Cooke F	Forestry Innovation Investment (Forintek) -"Nesting Habitats Requirements of Marbled Murrelets"	253,115 (1 year)

<u>Marbled Murrelets (cont'd)</u>		
Cooke F	Weyerhaeuser, Western Forest Products Ltd, Interfor "Marbled Murrelet research in Desolation and Clayoquot Sounds"	93,193 (4th of 4 yrs)
Cooke F	NCASI - "Marbled Murrelet Research in Desolation and Clayoquot Sounds"	75,000 (3rd of 3 yrs)
<u>New Marbled Murrelet Projects</u>		
Lank DB	Ministry of Forests "Nesting Habitat Preferences of Marbled Murrelets in fragmented and continuous forests..."	10,368
Lank DB	Western Forest Products Ltd, Terminal Forests Products "Marbled Murrelets Habitat on the Sunshine Coast..."	30,000
Lank DB	Forestry Innovation Investment (Forintek) - "Identification of Nesting Habitat and Population Dispersal of Marbled Murrelets"	149,143
<u>Triangle Island</u>		
Bertram D, Hipfner M	Canadian Wildlife Service PYRC, ATS Receivers	10,000
Hipfner M	Canadian Wildlife Service PYRC, Annual Report	5,000
Hipfner M	Canadian Wildlife Service PYRC - SIMWA Helicopters	3,000
Hipfner M	Canadian Wildlife Service PYRC - SIMWA Telemetry	4,000
Hipfner M	Canadian Wildlife Service PYRC- Rhinoceros Auklet Research World Wildlife Fund – Endangered Species Recovery Fund	1,550
Hipfner M	Radio-telemetry work on Rhinoceros Auklets	25,000
Bertram, Mackas, Welch	Nestucca Trust Fund - "Oil and Seabirds on Coastal Vancouver Island: The Power of Information for Impact Assessment and Response of the Cariboo-Chilcotin	95,000 (4th of 5 yrs)
Esler D	Exxon Valdez Oil Spill Trustee Council, US Geological Survey "Long Term Effects of the Exxon Valdez Oil Spill on Demogra- phy of Harlequin Ducks in Prince William Sound, Alaska"	201,131 (2nd of 3 yrs)
Esler D	US Geological Survey "Evaluating Population Declines in Red Throated Loons"	44,687
Esler D	US Geological Survey "Ecology of Greater Scaup"	28,396
Esler D	US Geological Survey "Common Eiders, Long Tailed Ducks"	19,185
<u>North American Sea Duck Conference and Workshop</u>		
Esler D	Pacific Flyway Council	2,669
Esler D	Ducks Unlimited USA	2,669
Esler D	Ducks Unlimited Canada	2,500
Esler D	CWS Prairie North Region	5,000
Esler D	CWS Atlantic Region	10,000
Esler D	US Fish & Wildlife	23,099
Esler D	Atlantic Flyway Council	2,669
Esler D	US Geological Survey	5,115
Esler D	ACCC Travel Award for Ramunas Zydalis	1,996

NSERC Individual Research Grants

Cooke F	"Demography and Populations Structure of Birds"	90,000 (2nd of 2 yrs)
Lank DB	"Sexual Selection and Genetic Polymorphism"	21,000 (2nd of 3 yrs)
Williams TD	"Physiology of life-histories: egg size and number and costs of reproduction"	43,000 (1st of 4 yrs)
Williams TD Guglielmo C	Marine Ecosystem Health Program (UC Davis) "Assessing habitat or site quality for migrating sandpipers"	61,408 (2nd of 2 yrs)
Ydenberg RC	NSERC Individual Research Grant - "Predation danger and the evolutionary ecology of migrants and provisioners"	51,000
2002/2003 Generated Research Funding		1,884,176

2002/2003 Funding Summary

Student Support - Fellowships, TA Ships, Awards, SFU and external sources	201,515
CWS Core Funding	125,000
Total 2002/2003 Generated Research Funding	1,884,176
NSERC Contribution to Faculty Salaries	8,026
All Funding Sources 2002/2003	2,193,717

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 18 publications in press and 23 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:

- Cam, E., L. Lougheed, R. Bradley and F. Cooke. In press. Demographic assessment of a Marbled Murrelet population from capture-mark-recapture and radio telemetry data. *Conservation Biology*.
- Egeler, O., D. Seaman and T.D. Williams. In press. The influence of diet on fatty acid composition of depot fat in Western Sandpipers, *Calidris mauri*. *Auk*.
- Hakkarainen, H., I. Yli-Tuomi, E. Korpimäki and R.C. Ydenberg. In press. Provisioning response to apparent predation danger by parental pied flycatchers. *Orn. Fenn.*
- 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.*
- Lank, D.B., R.W. Butler, J. Ireland and R.C. Ydenberg. In press. Effects of predation danger on migratory strategies of sandpipers. *Oikos*.
- McFarlane Tranquilla, L., F. Huettmann, C. Lougheed, L.W. Lougheed, N. Parker and G. Kaiser. In press. Sightings of vagrant Pacific alcids in Desolation Sound, British Columbia. *Can. Field Nat.*
- McFarlane Tranquilla, L., T.D. Williams and F. Cooke. In press. Using vitellogenin to identify interannual variation in breeding chronology of Marbled Murrelets. *Auk*.
- Morbey, Y.E. and R.C. Ydenberg. In press. Timing games in the reproductive phenology of female Pacific salmon (*Oncorhynchus* spp.). *Am. Nat.*
- Öst, M., R.C. Ydenberg, K. Lindstrom and M. Kilpi. In press. Condition and coalition formation by brood rearing common eider females. *Behav. Ecol.*
- Rodway, M.S., H.M. Regehr, J. Ashley, P.V. Clarkson, R.I. Goudie, D.E. Hay, C.M. Smith and K.G. Wright. In press. Aggregative response of Harlequin Ducks to herring spawning in the Strait of Georgia, British Columbia. *Can. J. Zool.*
- Rodway, M.S., H.M. Regehr and J.W. Chardine. In press. Status of the largest colony of Atlantic Puffins in North America. *Can. Field Nat.*
- Rodway, R.S., H.M. Regehr and F. Cooke. In press. Sex and age differences in distribution, abundance, and habitat preferences of wintering Harlequin Ducks: implications for conservation and estimating recruitment. *Can. J. Zool.*
- Salvante, K.G. and T.D. Williams. In press. Effects of corticosterone on breeding propensity, reproductive output and yolk precursor levels. *Gen. Comp. Endocrinol.*
- 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.*
- Stein, R.W. and T.D. Williams. In press. Validating the everted sleeve technique for use in migrating Western Sandpipers: captivity effects and tissue damage. *Physiol. Biochem. Zool.*

- Vézina, F. and T.D. Williams. In press. Plasticity in body composition in breeding birds: what drives the metabolic costs of egg production? *Physiol. Biochem. Zool.*
- Wardrop, S.L. and R.C. Ydenberg. In press. Date and parental quality effects in the seasonal decline in Tree Swallow reproductive performance: interpreting results in light of potential experimental bias. *Ibis.*
- Williams, T.D. and J.C. Christians. In press. Experimental dissociation of the effects of diet, age and breeding experience on primary reproductive effort in zebra finches *Taeniopygia guttata*. *J. Avian Biol.*
- Williams, T.D. and M. Miller. In press. Individual and resource-dependent variation in the ability to lay supranormal clutches in response to egg-removal. *Auk.*
- Zharikov, Y. and G.A. Skilleter. In press. Depletion of benthic invertebrates by bar-tailed godwits *Limosa lapponica* in a subtropical estuary. *Mar. Ecol. Prog. Ser.*
- Zharikov, Y. and G.A. Skilleter. In press. Slaves to their stomachs: digestive limitations to the pre-migratory increase in energy intake rate in non-breeding eastern curlews *Numenius madagascariensis*. *Physiol. Biochem. Zool.*

2003:

- Fernandez, G., H. de la Cueva, N. Warnock and D.B. Lank. 2003. Apparent survival rates of Western Sandpipers wintering in northwest Baja California, Mexico. *Auk* 120:55-61.
- Guglielmo, C.G. and T.D. Williams. 2003. Phenotypic flexibility of body composition in relation to migratory state, age and sex in the Western Sandpiper (*Calidris mauri*). *Physiol. Biochem. Zool.* 76:84-98.
- Iverson, S.A., D. Esler and W.S. Boyd. 2003. Plumage characteristics as an indicator of age class in the Surf Scoter. *Waterbirds* 26:56-61.
- Lozano, G.A. and D.B. Lank. 2003. Seasonal trade-offs in cell-mediated immunosenescence in ruffs (*Philomachus pugnax*). *Proc. Royal Soc. Lond. B* 270:1203-1208.
- McFarlane Tranquilla, L.A., R.W. Bradley, D.B. Lank, T.D. Williams, L.W. Loughheed and F. Cooke. 2003. The reliability of brood patches in assessing reproductive status in the Marbled Murrelet: words of caution. *Waterbirds* 26:108-118.
- Regehr, H.M. and M.S. Rodway. 2003. Evaluation of nasal discs and colored leg bands as markers for Harlequin Ducks. *J. Field Ornithol.* 74:129-135.
- Stout, B.E. and F. Cooke. 2003. Timing and location of wing molt in Horned, Red-necked and Western Grebes in North America. *Waterbirds* 26:88-93.

2002:

- Bertram, D.F., T. Golumbia, G.K. Davoren, A. Harfenist and J. Brown. 2002. Short visits reveal consistent patterns of interyear and intercolony variation in seabird nestling diet and performance. *Can. J. Zool.* 80:2190-2199.
- Blomqvist, D., M. Andersson, C. Kupper, I.C. Cuthill, J. Kis, R.B. Lanctot, B.K. Sandercock, T. Szekely, J. Wallander and B. Kempenaers. 2002. Genetic similarity between mates explains extra-pair parentage in three species of waders. *Nature* 419:613-615.
- Burns, J.G. and R.C. Ydenberg. 2002. The effects of wing loading and gender on the escape flights of Least Sandpipers (*Calidris minutilla*) and Western Sandpipers (*Calidris mauri*). *Beh. Ecol. Sociobiol.* 52:128-136.

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B. Papers submitted to refereed journals

23 papers by CWE researchers have been submitted and are currently under review

C. Other Publications

Danemann, G.D., R. Carmona and G. Fernandez. In press. Migratory shorebirds in the Geurrero Negro Saltworks, Baja California Sur, Mexico. *Wader Study Group Bulletin*.

D. Theses

- Evans, M. 2003. Breeding habitat selection by Barrow's Goldeneye and Bufflehead in the Cariboo-Chilcotin region of British Columbia: nest-sites, brood-rearing habitat, and competition. PhD, Simon Fraser University, Burnaby, BC.
- Gill, H. 2003. The effects of p,p'-DDE and other current-use pesticides on reproduction and health in zebra finches (*Taeniopygia guttata*). MSc, University of British Columbia, Vancouver, BC.
- Birmingham, E. 2002. Assessing physiological endpoints in passerines exposed to the environmental estrogen 4-nonylphenol, using a combined laboratory and field approach. MSc, Simon Fraser University, Burnaby, BC. 132 pp.
- Evans Ogden, L.J. 2002. Non-breeding shorebirds in a coastal agricultural landscape: winter habitat use and dietary sources. PhD, Simon Fraser University, Burnaby, BC. 241 pp.
- Hagmeier, K. 2002. Winter and spring migration ecology of Black Brant (*Branta bernicla nigricans*) in the Strait of Georgia. MSc, Simon Fraser University, Burnaby, BC. 110 pp.
- Iverson, S. 2002. Recruitment and the spatial organization of Surf Scoter (*Melanitta perspicillata*) populations during the winter in the Strait of Georgia. MSc, Simon Fraser University, Burnaby, BC. 87 pp.
- Stein, R.W. 2002. Busting a gut: Age-related variation and seasonal modulation of digestive tract structure and function in the Western Sandpiper. MSc, Simon Fraser University, Burnaby, BC. 114 pp.
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