ANNUAL REPORT of the
CENTRE FOR WILDLIFE ECOLOGY

2009-2010

Department of Biological Sciences
Simon Fraser University

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

Dr. Ronald C. 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 Environment Canada (Canadian Wildlife Service, CWS, and Science and Technology, S&T) 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, Associate Professor
Dov Lank	University Research Associate / Adjunct Professor
Dan Esler	University Research Associate / Adjunct Professor
Mark Hipfner	EC Research Scientist / Adjunct Professor
Doug Bertram	EC Research Scientist
Christine Bishop	EC Research Scientist / Adjunct Professor
Sean Boyd	EC Research Scientist / Adjunct Professor
Rob Butler	EC Research Scientist Emeritus / Adjunct Professor
Bob Elner	EC Research Scientist Emeritus/Adjunct Professor
John Elliott	EC Research Scientist / Adjunct Professor
Barry Smith	EC Wildlife Research Head / Adjunct Professor
Fred Cooke (retired)	Emeritus Chairholder

2. *Research Group*

Postdoctoral Fellow	***PhD (in progress)***	***MSc (in progress)***	***Staff***
Eric Anderson	Anna Drake	Marie-Hélène Burle	Monica Court, CWE Admin. Asst.
Glenn Crossin	Margaret Eng	Lana Cortese (REM)	Connie Smith, CWE Research Tech
	Lindsay Farrell	Mikaela Davis	Jenn Barrett, MAMU/Sea Duck Tech
	Samantha Franks	Rian Dickson	Corinna Lichota, BSc Asst
	Raime Fronstin	Martha Fronstin	Sam Quinlan, Sea Duck Tech
	Kristen Gorman	Rachel Gardiner	Melanie Wilson, Sea Duck Tech
	Ariam Jiménez	Nathan Hentze	
	Heather Major	Danica Hogan	
	Heidi Scherr	Viktoria Khamzina,MET	
	Birgit Schwarz	Michaela Martin	
		Eric Palm	
		Christine Rock	
		Corey VanStratt	
		Dominique Wagner	
Visitors	***PhD(defended)***	***MSc (defended)***	
Pat Baird	Sarah Jamieson	Sofi Hindmarch	
Michel Faber		David Hope	
Rudy Jonker		Iain Jones	
Marinde Out		Peter Katinic	
Diane Tracy		Michael Silvergieter	
		Marc Travers	
		Kirsten Webster	

B. Steering Committee

Name	*Position*	*Affiliation*
Elizabeth Elle	Assistant Professor	*SFU*
Arne Mooers	Assistant Professor	*SFU*
Robert Elner	Emeritus Scientist	*EC*
David Green	CWE faculty (non-voting)	*SFU*
Paul Kluckner	Regional Director, ECB PYR	*EC*
Barry Smith	Wildlife Research, Head	*EC*
Tony Williams	CWE faculty (non-voting)	*SFU*
Ron Ydenberg	CWE Director (non-voting)	*SFU*

IV. INTRODUCTION

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

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

or contact Ron Ydenberg at ydenberg@sfu.ca.

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). Publications and theses are listed at the end of this report. The personnel also can be contacted via the website.

A. The Triangle Island Seabird Research Station

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

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

The 2009 season: We opened our research station on Triangle Island for year 16 on 14 May 2009, with continued logistical support from the Canadian Coast Guard. Scientific research was conducted under the direction of Mark Hipfner, while Kristin Charleton, Moira Lemon and Mark led the field crew at various times in the summer. We maintained our time series focus on Cassin's Auklet, Rhinoceros Auklet, Tufted Puffin, Common Murre, Pelagic Cormorants, Glaucous-winged Gulls and Black Oystercatchers. In addition, a crew from the Canadian Wildlife Service (Moira Lemon and 2 former CWEers, Heidi Regehr and Michael Rodway)

visited Triangle in late July and early August to recheck the permanent monitoring plots established in 1989. This project is undertaken at 5- year intervals.

The 2009 season was fairly typical for a cold-water year in terms of the seabirds' phenology (slightly late), diet (lots of *Neocalanus cristatus* in Cassin's Auklet nestling diets) and breeding success (generally good). But it was also the second consecutive year in which Common Murres failed completely, due to constant harassment and predation by Bald Eagles and Glaucous-winged Gulls in the absence of a protective pair of Peregrine Falcons.

In addition, in 2009 we completed the second year of a project to band Rhinoceros Auklets at the large colonies at Pine Island (central coast) and Lucy Island (north coast). We also banded on SGang Gwayy, in Haida Gwaii in 2009. We plan to continue this project for several more years, in order to (1) obtain estimates of adult survival rates at these important colonies to enable us to assess the potential effects of mortality in gill-net fisheries on local Rhinoceros Auklet populations, (2) to quantify the extent of population genetic structuring in Rhinoceros Auklet colonies in BC and elsewhere, so as to identify management units for conservation; (3) to quantify geographic and intercolony variation in this species' diet and productivity, and (4) to quantify geographic and interannual variation in diets of Pacific sandlance, a key prey species for Rhinoceros Auklets at all BC colonies.

Graduate students:

Kyle Morrison defended his M.Sc. thesis in May 2009.

B. Integrated Shorebird Research

Populations of many species of shorebirds travel half the globe in the course of their annual migrations. Great concern has been raised about apparent population declines of many species over the past two decades. The CWE is studying small calidrid sandpipers - Western and Least sandpipers, and Dunlin - to better understand the causes of these apparent declines.

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

Since its inception in 1993, the CWE has nurtured the development of the Western Sandpiper Research Network, including current CWE staff Ron Ydenberg, Dov Lank, and Tony Williams, and EC-S&T staff Barry Smith, and recent retirees Bob Elner and Rob Butler, as a platform for research on a hemispheric scale that can address migratory bird issues. The CWE maintains substantial science capacity for this group of birds in the Pacific region. Our multifaceted

research is documenting and modeling the factors controlling the population size, migratory routes and timing, ecological relationships with predators and prey, habitat use, and physiological ecology of this long-distance Neotropical migrant. We have pursued and aided fieldwork at three breeding sites, several migration locations, and five wintering sites. We have organized eleven workshops to help keep researchers in touch, and we run a list-server for this purpose. Our integrated approach allows us to examine how factors at one location affect events at another. How do events in the wintering grounds, migration sites, and breeding grounds interconnect? Where are population bottlenecks? Of direct conservation concern is the consequence of the removal or deterioration of one or more locations on survival and reproduction. As a result of our work, the Western Sandpiper is now the best-studied sandpiper in the Western Hemisphere.

Highlights from the past year:

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

Direct evidence of migratory connectivity comes from radio-tracking studies. Research Collaborator Pat Baird has wrapped up her five-year study on migration of western sandpipers, radio-tagging them on their wintering grounds in Panama, and following them to Alaska over a four-year period. She presented a paper on this research at the Waterbirds meeting in Cape May, N.J. in November 2009. We continue to collaborate with researchers at SFU, Panama Audubon, and the Universidad Nacional Autonoma de Mexico.

Postdoctoral researcher Caz Taylor and colleagues continued work on an individual-based model of Western Sandpiper migration. She progressed on gathering data sets and estimates to parameterize a general demographic model for the species. Results from the connectivity work will help determine the final structure of the population models, and a paper published by PhD student Franks et al., on using isotope ratios to produce more accurate age ratios, will also contribute towards this effort. Taylor, Lank, and Brett Sandercock developed and submitted a

paper on methods to correct estimates of local survivorship and mate fidelity for biases due to dispersal. Taylor published several papers on migration theory with collaborator Ryan Norris.

The year closed with the start of a new initiative: Lank and collaborator Brett Sandercock, a CWE alumnus who is now a professor at Kansas State University, obtained 3 years of funding to support demographic research on nesting shorebirds near Nome Alaska. Several CWE current graduate students will participate in the first year of this study.

Fraser River Delta issues: MSc student David Hope defended his MSc thesis addressing migration strategies of Western Sandpipers through the Fraser River Delta with respect to changing schedules of predation risk. Two papers from his thesis are being prepared for journal submission. PhD student Ariam Jiménez continued detailed work with sandpiper usage of biofilm on Robert's Bank, guided by EC-CWS's Bob Elner and CWE's Ydenberg, and contrasted finding here with those on the wintering grounds in Cuba. His work includes on-the-ground and remote sensing, and direct observation and "poop counts" as indirect indices of habitat usage. MSc student Rachel Gardiner samples Least Sandpipers, the third common local migrant shorebird, and is relating aspects of their intertidal habitat usage at different sites to measures of fattening rates and predation danger. Her analyses utilize both currently acquired data and historical data available from previous work by the CWS and CWE.

In the autumn, new MSc student Nathan Hentze conducted a radar surveillance project quantifying the timing of over-ocean flocking by Dunlin over Boundary Bay. This occurs throughout the winter, largely during diurnal high tides, and we interpret it as an anti-predator "roosting" tactic. A paper outlining the history of this intriguing phenomenon, and interpreting it with respect to changes in falcon populations, was published by Ydenberg et al. Dr. Dick Dekker spend several weeks at Boundary Bay working with Hentze, and intensively with visiting student Marinde Out, from the Netherlands, who was completing a research term focused on predator-prey interactions as part of her program at Wageningen University, in the Netherlands where CWE Director Ydenberg holds a part-time appointment.

Dunlin: PhD student Sarah Jamieson defended her PhD thesis on the breeding biology of Pacific Dunlin. Her papers consider aspects of female reproductive strategies, both physiological and behavioral, with respect to egg formation, breeding strategy, and provision of parental care; and breeding and migration strategies of different populations with respect to predator landscapes.

Dov Lank and Yuri Zharikov continued a collaboration with a radio-tracking study of habitat use by Pacific Dunlin in the Skagit Delta in Washington State, initiated by Gary Slater, from the Ecostudies Institute and Ruth Milner, Washington Fish and Wildlife. The study borrows approaches used in the Fraser River delta by earlier CWE students, and involves EC-S&T's Keith Hobson, Saskatoon.

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

Once widespread across the South Pacific, this species is now found on only 4 atolls, with a

world population of ca. 1200 individuals. Master's student Marie-Hélène Burle spent 5 months conducting the first study of the species' biology on the atoll of Tahanea, including the transition from the non-breeding to the breeding season. The information on habitat usage, diet, and social behaviour is being used to support reintroduction planning for the species onto atolls where rats have or will be removed. Burle presented papers at the Wader Study Group meeting, in the Netherlands, and the 2010 SCO-AOU-COS meeting in San Diego.

Least Terns: CWE Research Associate Pat Baird conducted a one-year study to compare foraging areas and prey types of California least terns in San Diego in 2009, with the same types of data gathered in the late 1990's. She presented a paper on this research at the Pacific Seabird Group meeting in February 2010 at Long Beach, California. Researchers from UBC, the University of North Texas, and the U.S. Fish and Wildlife Service were collaborators on this project.

C. The Marbled Murrelet Project

SFU's research on threatened Marbled Murrelets continues to address issues of direct conservation concern for this listed species. Under Lank's leadership, this ground-breaking and high profile project examining the biology of the threatened and elusive marbled murrelet continues for its sixteenth year, addressing new questions of significant management interest for this threatened species. Six papers on aspects of habitat usage, classification and the effectiveness of management approaches were published or submitted with provincial Ministry of Forests and Range collaborator Louise Waterhouse, and with Alan Burger (UVic) and others.

MSc student Mike Silvergeiter defended his MSc thesis focusing on stand-level habitat characteristics of nest sites, utilizing data collected in previous years, including some he gathered while working as an undergraduate two years ago. He is also collaborating with Alan Burger on models predicting nest site availability. Three papers from his thesis have been submitted for journal publication.

The focus of ongoing CWE activity on this species was the analysis of the extensive radar traffic rate data sets which have been gathered in BC to address (1) the utility of several methods of habitat suitability classification, and (2) the magnitude of fragmentation effects on local breeding population size. CWE graduate Jenn Barrett worked closely with SFU REM student Lana Cortese in creating appropriate predictor variables, generating analysis strategies, and interacting with collaborators to achieve consensus on methodological issues. This work has been funded by the BC Forest Science program, but due to Provincial fiscal difficulties, there is some uncertainty regarding the final year's (2010-11) planned support for its completion. The team is nonetheless continuing with the analysis.

Dov Lank continued to serve on the Canadian Marbled Murrelet Recovery Team. EC-S&T's Doug Bertram, a CWE alumnus, stepped down as leader of this team, a role which now falls to CWS staff. Nonetheless, Lank's participation enables the results of the CWE's research to be rapidly assimilated into evolving policy guidelines for management of this threatened species, under the protection of the federal Species at Risk Act and Provincial Identified Wildlife Management Strategy. Through the Recovery Team, Lank participated in the never-ending rewriting the federal recovery strategy, which should be approved by the Minster quite soon, and action plans which will follow on the plan's approval.

D. Sea Duck Ecology

The sea duck research group, led by Dan Esler, conducts a broad range of studies addressing factors affecting population dynamics of sea ducks along the Pacific coast. All studies are collaborative ventures with federal agencies, including the Canadian Wildlife Service, U.S. Geological Survey, and the U.S. Fish and Wildlife Service. We also collaborate with numerous universities and other partners throughout North America.

1. Chronic Effects of the Exxon Valdez Oil Spill on Sea Ducks – This long-term program continues to evaluate the progress of population recovery of sea ducks (harlequin ducks and Barrow's goldeneye) from the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. At this stage, most efforts are directed towards analysis and publication of data collected over the 15 years of the project. However, we continue to collect new data on the degree and duration of oil exposure that sea ducks are experiencing. In addition, we recently published a population model evaluating the relative effects of acute mortalities immediately after the spill and mortalities related to chronic exposure to oil over the subsequent 20 years.

2. Winter and Spring-migration Ecology of Surf and White-winged Scoters – Our research group has been studying various aspects of scoter wintering ecology since 2001. This has included specific evaluations of local anthropogenic effects such as shellfish aquaculture, as well as flyway-wide considerations of factors related to winter site selection and spring migration strategies. Sub-projects under this broad heading are at various stages of completion, with some generating journal publications and others in the data collection phase. Current CWE MSc candidates Corey VanStratt and Brian Uher-Koch are leading ongoing work on wintering ecology of surf scoters in Southeast Alaska.

As an example of the results of our work, we are gaining insights into factors driving winter distributions of surf scoters. Studies in Southeast Alaska have identified specific habitat features that are associated with presence and abundance of scoters. At a broader scale, our research has demonstrated that age and sex ratios of surf scoters vary latitudinally, with higher proportions of females and juveniles at lower latitudes. Further, our data are revealing patterns in foraging effort and survival that indicate underlying mechanisms leading to observed distributions. In sum, understanding why scoter winter where they do will provide managers with information necessary to preserve, restore, or enhance wintering habitat.

We have taken a similar approach to addressing spring migration ecology of surf scoters, through flyway scale data collection and collaboration. Using a combination of satellite telemetry (from throughout the Pacific wintering range, including Baja California Mexico, San Francisco Bay, Puget Sound, and British Columbia), radio-telemetry, aerial surveys, and existing GIS habitat data we have identified specific sites that are important to spring-migrating surf scoters, as well as the habitat features that are common to these sites.

A specific habitat feature that influences both winter and migration ecology of scoters is Pacific herring spawn. We have documented distributional, physiological, and behavioural responses of scoters to herring spawn; much of this work has been published recently. We have found that surf scoters show a particularly strong response, and evidence indicates that this pulse of easily obtained food may be a particularly important source of nutrients and energy during late-winter and spring migration for this species.

3. Barrow's Goldeneye Population Delineation – In collaboration with Sean Boyd of the Canadian Wildlife Service, we are using satellite telemetry to evaluate population structure, movements, site fidelity, and habitat use of Barrow's goldeneyes in British Columbia. Goldeneyes have been marked at a breeding site (Riske Creek, BC), 2 wintering sites (Indian Arm, BC and Prince William Sound, Alaska), and a molt site (Cardinal Lake, Alberta). This work will have important implications for understanding population level effects of factors at different annual cycle stages (e.g., oil pollution on coastal wintering areas, changes to interior breeding areas) and will provide the first insights into migratory connectivity for the species. To date, we have learned that breeding males undergo extensive northward molt migrations, some as far north as the Beaufort Sea. Also, wintering areas of these males range from southeast Alaska to the Strait of Georgia, suggesting that local breeding populations are constituted from birds from numerous wintering sites.

4. Barrow's Goldeneye Wing Moult and Staging in Alberta – As a result, in part, of satellite telemetry work described above, an important molting and staging site was recently discovered in northwestern Alberta. In collaboration with Jonathan Thompson of Ducks Unlimited Canada and Sean Boyd of EC, we are documenting moulting strategies of Barrow's goldeneyes. Led by MSc candidate Danica Hogan, this work quantifies body mass variation, feather growth rates, foraging effort, and survival of goldeneyes through the moult and staging periods, which for males can constitute up to one-third of their annual cycle. Results to date indicate that molt strategies are variable, and are responsive to local conditions. A second season of field work is planned for 2010.

5. Offshore Wind Farms and Effects on Sea Ducks – The CWE has been identified as a collaborator and national lead on research efforts by Environment Canada to evaluate effects of offshore wind turbine arrays on wintering and migrating sea ducks. To date, the only offshore wind farm proposed for Canada is in Hecate Strait near Haida Gwaii (Queen Charlotte Islands). Since 2005, we have laid the groundwork for research in the region by hosting workshops, conducting extensive literature reviews, interacting with European researchers with experience in this area, visiting the site to meet with local interests, interacting with the proponent, and collaborating with the U.S. Fish and Wildlife Service to conduct aerial surveys. Within the last year, we have generated funding from NRCAN, Environment Canada, and the industrial proponent, and have initiated field studies of trophic interactions and energetics of long-tailed ducks. This work is intended to provide perspective on the habitat function of the proposed wind farm site, including comparisons to other areas within the province. This effort includes CWE personnel Eric Palm (MSc candidate), Eric Anderson (Post-doc), and Jenn Barrett (Research Assistant).

6. Molting Ecology of Pacific Scoters – Thanks to funding and collaboration from the Sea Duck Joint Venture, U.S. Geological Survey, Washington Department of Fish and Wildlife, and the U.S. Fish and Wildlife Service, we are conducting a project addressing ecology of surf and white-winged scoters during the wing moult phase of the annual cycle. This work is being conducted in southeast Alaska and in the Strait of Georgia/Puget Sound, providing a flyway-wide assessment of wing molt. This work, led by MSc student Rian Dickson, will be addressing a variety of basic and applied questions, including energetics, movements and habitat use, and demography (survival). CWE Post-doc Eric Anderson is also a PI on the work, and collaborators include Joe Evenson (WDFW) and Jerry Hupp (USGS). Field work has been completed, and data analysis and write-up are underway.

E. Ecological physiology

The main aims of CWE's research in ecological physiology are three-fold: 1) to obtain a better understanding of the fundamental mechanisms underlying individual and population-level variation in physiological traits in order to provide a solid basis for predicting how animals might respond to environmental change, 2) to determine more meaningful intra-specific measures of body condition, quality and individual health for birds, and 3) to develop and apply new physiological approaches and techniques to conservation biology and ecotoxicology. We approach these aims through a combination of studies on basic physiology, often using tractable model systems (e.g. zebra finches) as well as free-living birds (starlings, western sandpiper), coupled with more applied, and more specific, goal-orientated projects (e.g. addressing current ecotoxicological problems). The following projects are on-going in the Williams' lab at present:

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

a) **Arrow Lakes Reservoir Neotropical Migrant use of the Drawdown Zone: use of physiological indicators for assessment of habitat quality.** Dominique Wagner (MSc student) is coordinating the physiology components of this collaborative BC Hydro-funded project (with John Cooper, Manning Beauschene and Associates Ltd., and David Green). This project aims to discern effects of habitat quality, and various reservoir water management strategies, on four species of neo-tropical migrants (Common Yellowthroat, Yellow Warbler, Orange-Crowned Warbler, Wilson's Warbler). Specifically we are measuring plasma metabolites (triglyceride, glycerol, and beta-hydroxybutyrate) as indices of fattening rate, and plasma corticosterone as a general indicator of "stress". Physiological data will be combined with banding station data and information of feather stable isotopes. We completed the second year of this project in 2009

b) **Other collaborations.** We have continued to extend the application of plasma metabolite analysis for the assessment of fattening rate, general condition, and the relative quality of habitats or sites used by migratory birds, in a wide variety of on-going collaborative studies: a) yolk precursors, breeding and migration in sea ducks with Dr. John Takekawa (USGS) and Dr. David Safine (Alaska Science Center); and d) yolk precursors as markers of breeding status in the endangered Kittlitz's Murrelet (with Michelle Kissling, US Fish & Wildlife, Alaska). Several of Dr. Esler's projects are also utilizing these analytical techniques as described in the Sea Duck section.

2. **Ecotoxicology projects**

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

in the eggs and mothers, 3) determine if the pattern of transfer from mother to egg differs between hormones and contaminants, and if hormone transfer is affected by contaminants, 4) measure levels of contaminants and hormones in avian wildlife, and 5) investigate the long term effects of early exposure to contaminants in a free-living species. This project is funded by EC's Chemical Management Plan, in collaboration with Drs. John Elliott (S & T), Drs. Rob Letcher and Tony Scheuhammer (NWRC) and Dr. Scott MacDougall-Shackleton (UWO). In 2009 we had two students working on different aspects of this project: Margaret Eng (PhD) conducted lab work with zebra finches and initiated field studies with starlings; and Viktoria Khamzina (MET) developed and validated methods for in ovo exposure.

b) **Surveillance and monitoring of CMP priority compounds in key bio-indicator species.** In 2008 EC selected the European starling (*Sturnus vulgaris*) as the "terrestrial" indicator species to monitor new contaminants in biota to provide early warning support to ongoing risk assessment (under the Chemical Management Plan). Nest box 'trails' (25 boxes/site) have been established in four urban centers (Halifax, Montreal, Toronto, Vancouver). Lower Mainland sites include the Delta landfill, Burnaby/Surrey, Abbotsford and our new study site at Langley. Nest boxes will be checked daily throughout the breeding season (April – June) to monitor timing of breeding and obtain data on egg and clutch size. Eggs were collected from all locations in 2009 and measured for contaminant concentrations at the NWRC laboratories, Ottawa. Project leader Dr. Laird Shutt (NWRC) and Dr. John Elliott.

c) **Determining the relationship between brodifacoum exposure and prothrombin time in California quail and estimation of barn owl exposure to anticoagulants.** Kirstin Webster (MET student) defended her Masters thesis on the anticoagulant rodenticide brodifacoum in relation to risk of secondary poisoning, in collaboration with John Elliott, Kim Cheng (UBC), and Dr Harr, Idexx, Vancouver. She determined the relationship between anticoagulant exposure, prothrombin time (PT) and liver residues of brodifacoum in laboratory California quail, and estimated the oral anticoagulant exposure from the prothrombin time of barn owl plasma samples obtained from a previous study. This laboratory correlation will also be useful for continued monitoring of birds brought to wildlife centres due to abnormal behavior or bleeding.

d) **Relationship between foraging, diet and potential for contaminant exposure in the Glaucous-winged gull.** Mikaela Davis (MSc) initiated a project to establish a current baseline of Glaucous-winged gull diets across three historically-used breeding colonies off the coast of Vancouver Island, and compare findings with those of similar studies conducted 27-37 years ago. We hope to determine if there is an emphasis on marine or terrestrial food items and further demonstrate whether the diet and trophic level are reflective of a high level trophic predator in the local marine environment. Results from the project are necessary to interpret contaminant monitoring data and assess whether the Glaucous-winged gull is a feasible monitoring species for marine contaminants on the Canadian West coast.

3. **Reproductive ecology and physiology**

Raime Fronstin (PhD) started a PhD study on causes and consequences of reproductive anemia in European starlings. This represents the 8th year of data collection at this study site and we are currently collating long-term data to look at breeding phenology and reproductive performance in the context of climate change. We also initiated two studies integrating physiology, foraging, oceanographic conditions and climate change in seabirds (penguins, albatross, and petrels), one

on the Antarctic Peninsula (Kristen Gorman, PhD, in collaboration with Dr. Bill Fraser, Polar Oceans Research Group, MT, USA) and one at Bird Island, South Georgia (Glenn Crossin, post-doctoral fellow, in collaboration with the British Antarctic Survey). The latter study will lead to comparative work based on Triangle Island in 2010.

F. Population ecology of landbirds

CWE's research on landbirds is coordinated by David Green and addresses two key questions in avian ecology and conservation. Firstly, we are interested in how migratory strategies of individual birds influence their fitness and the demography of populations. This question is addressed using two model systems; American dippers within the Chilliwack River watershed, and yellow warblers that breed in Revelstoke but overwinter in the neotropics. Secondly, we are interested in how anthropogenic changes to the landscape influence habitat selection, breeding performance and survival of threatened landbirds in British Columbia. Current projects with this focus include a study examining how water use decisions by BC Hydro influence the breeding performance and survival of Yellow warblers in riparian habitat, a study examining how changes in agricultural practices in the Fraser Valley influence the foraging ecology productivity and survival of barn owls, and a study examining how grazing induced changes to grasslands influence productivity of Vespers sparrow. We briefly describe these studies below:

Migratory behaviour and population demography of American dippers

We have studied dippers in the Chilliwack River Valley, BC since 1999. The majority of dippers, in this and other populations, make seasonal movements between low elevation wintering grounds on large rivers and breeding grounds on higher elevation tributaries. However some individuals do not undergo this seasonal migration and remain on permanent territories year round. We have used morphometric data, mark-recapture analysis and radiotelemetry to investigate whether migratory/sedentary behaviour is associated with distinct morphological and physiological traits, and to examine how variation in migratory behaviour influences the demography of American dippers. Migratory and sedentary dippers do not differ morphologically (Green et al. 2009). However, sedentary individuals consistently have higher reproductive success and lower survival than migrants (Gillis et al. 2008). Renae Mackas (NSERC undergrad) has shown that sedentary individuals also produce offspring of higher quality (Mackas et al. 2010). Ivy Whitehorne (MSc defended 2009) has demonstrated that differences in reproductive success do not arise because of differences in the age structure of the sedentary and migratory population. She has also found that the higher survival of migrants does not result because they expend less effort and are in better condition at the end of the breeding season.

Migratory behaviour and reproduction in Yellow warblers

We have studied the breeding biology of Yellow warblers, a declining songbird dependant on riparian habit, in Revelstoke since 2004. Sam Quinlan (MSc defended 2009), showed Yellow warblers moult some feathers on their wintering ground (Quinlan and Green in revision) and that stable isotope analysis can therefore provide information on winter habitat use. Anna Drake is using C and N stable isotopes to examine how winter habitat use influences the arrival dates and subsequent reproductive success of birds that return to their breeding grounds in Revelstoke and Inuvik, NWT. Logistic support for this work is provided by CWS (Pacific and Yukon Region and Prairie and Northern Region). This research will provide insight into

migratory connectivity of Yellow warblers and the importance of carry-over effects during the winter period on subsequent productivity.

Water use decisions and the demography of a riparian dependant songbird

Human activities have caused a dramatic loss in the amount of riparian habitat in North America and this habitat loss is linked to population declines of many riparian dependant songbirds. Prevention of further declines will require an understanding of how to minimize human impacts on these bird populations along with informed restoration efforts. Yellow warblers have been identified by Partners in Flight as a focal species that could be used to evaluate the health of riparian habitat within BC. We established a marked population of Yellow warblers in three riparian habitat types within the drawdown zone of Upper Arrows Lake Reservoir, near Revelstoke, in 2004. We have shown that Yellow warblers prefer territories containing a high proportion of willow habitat, and that this cue predicts subsequent productivity (Quinlan and Green 2006, Green and Quinlan 2007). We have also shown that current water use decisions have limited impact on productivity and survival of yellow warblers, but that advancing when water levels rise by as little as two weeks would triple nest mortality (6 vs. 18%; Green and Quinlan 2007, 2008, Green and Rock 2009). Christine Rock (MSc) examined how water-use and cowbirds influence the demography of yellow warblers in Revelstoke in 2008 and 2009. She will defend her MSc in 2010. Her work will help determine whether the habitat in Revelstoke Reach functions as a source or a sink.

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

Land used for agriculture provides habitat for a diversity of wildlife. However, the intensification of agricultural practises, increased use of pesticides and encroachment of urban centres have been linked to the widespread decline of many species associated with agricultural land in Europe. Less is known about the extent to which recent changes to agricultural land use and practices in the Fraser Valley have impacted wildlife. Sofi Hindmarch (MSc defended in 2009) with Elsie Krebs of the Canadian Wildlife Service, and Markus Merkens of Delta Farmland and Wildlife Trust investigated how land use patterns influence the distribution of barn owls. She found that the most important factor influencing change in barn occupancy since the 1990's and current barn occupancy is traffic volume and the length of major highway in the $3km^2$ surrounding a barn. However, the major factor influencing the productivity of barn owls was the amount of urban development surrounding breeding sites. She, along with John Elliott (Environment Canada), is currently extending this work by examining how barn owl foraging behaviour influences their exposure to rodenticides.

Impacts of grazing induced changes to rangeland on grassland birds.

Native grasslands are one of the most threatened ecosystems in the province and cattle have been shown to have a profound impact on the vegetation community. This may have significant impacts on the bird community; 60% of bird species native to North American rangelands have declining population trends. We conducted a research project, in collaboration with Nancy Mahony of Environment Canada, funded by FIA-FSP to assess how grazing induced changes to rangeland influences habitat use and productivity of grassland birds. We found that grazing results in changes in the structure and composition of grasslands in the in the Chilcotin – Cariboo but that grazing-induced changes to the vegetation had both positive (less bare ground) and negative effects (shorter vegetation) on the abundance of Vespers sparrow and western meadowlark such that the overall abundance of these species did not differ in grazed and

ungrazed sites (Harrison et al. in revision). Similarly, grazing induced changes to the vegetation had both positive (increased cover of species promoted by grazing) and negative effects (shorter vegetation) on nest survival of Vespers sparrows (Harrison et al. submitted) such that productivity did not differ in grazed and ungrazed sites. We also examined how grazing influenced vegetation and the avifauna in Douglas fir forest of the Cariboo Chilcotin. We found that grazing reduced ground vegetation height and reduced grass cover but led to increased numbers of shrub cover and saplings, but these changes had few impacts on the bird community (Whitehorne et al. in prep). Overall, this project suggests that rangeland can sustain grazing of the intensity currently observed in the Cariboo-Chilcotin since this level of grazing has limited impact on birds of the intermountain region of BC. However, grazed sites had a lower abundance of aerial insectivores than ungrazed sites (Whitehorne et al. in prep). This result warrants further attention given the observed declines of this avian guild.

VI FUNDING

Budget

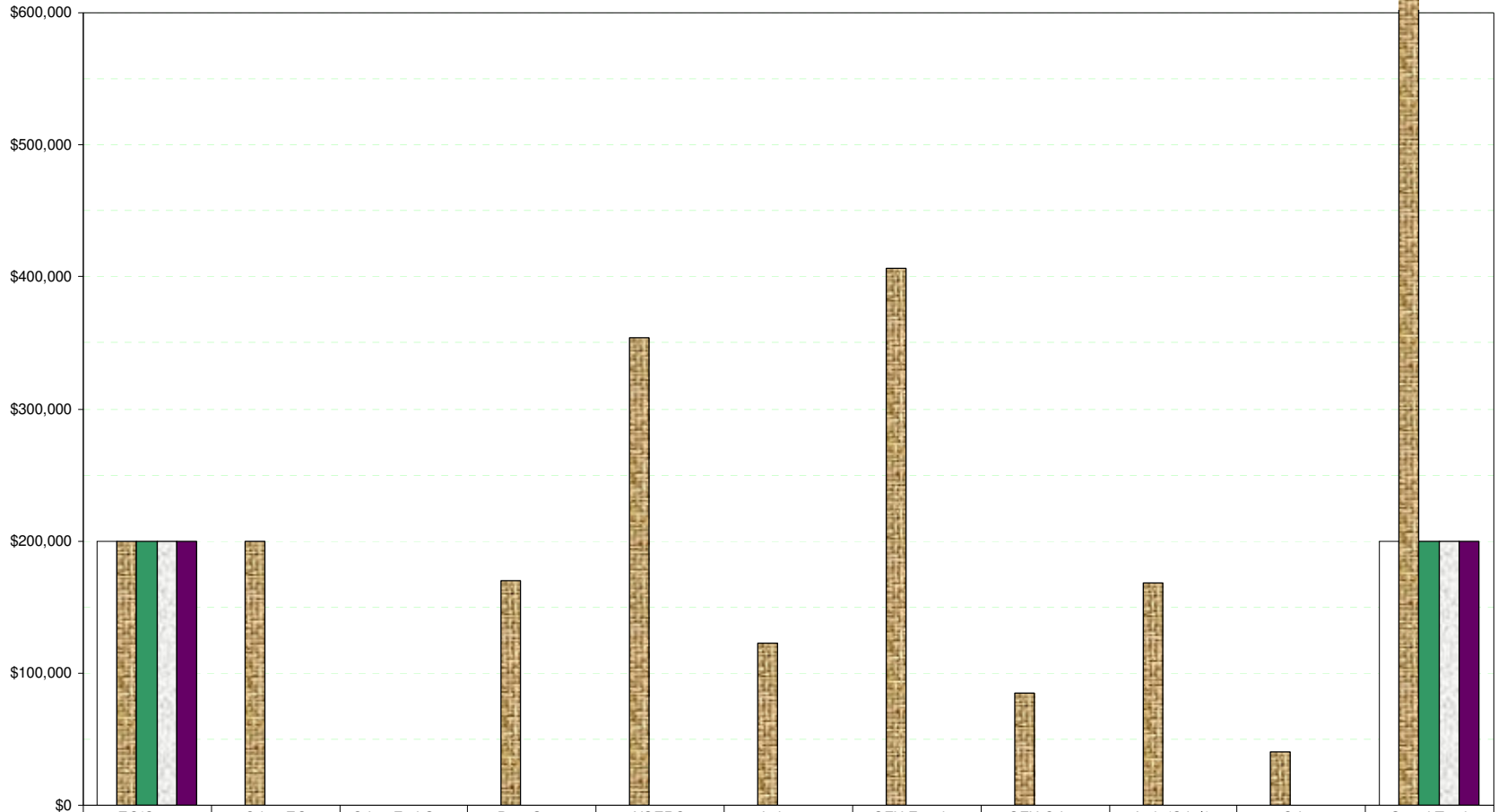
During this fiscal year, 1 April 2009 to 31 March 2010, Simon Fraser University (the Centre for Wildlife Ecology) and Environment Canada (Science and Technology Division) signed a contract for a four year funding agreement. This Contribution Agreement, which was only finalized in March 2010, provided $200,000 as core support for the research activities of the Centre for Wildlife Ecology this year, and will contribute the same amount for the next three years, 2010-2013.

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

2009/2010 Annual Report

CWS Centre for Wildlife Ecology Fiscal Funding Sources

Simon Fraser University



	EC/Core	Other EC	Other Fed Govt	Prov Govt	NSERC	Industry	SFU Faculty	SFU Other	Int'l (Cdn$)	Other	Grand Total
Projections	200,000										200,000
2009/2010	200,000	199,460		169,722	353,629	122,940	406,813	85,350	167,865	40,109	1,745,887
2010/2011	200,000										200,000
2011/2012	200,000										200,000
2012/2013	200,000										200,000

Category for Chart

Centre for Wildlife Ecology Annual Financial Report

2009/2010

1 April 2009 - 31 March 2010

Scholarships, Fellowships, Grants for Students

		PhD	
Emerging Leaders in the Americas Program		Ariam Jimenez	$10,000
NSERC		Samantha Franks, Holly Middleton, Lindsay Farrell	$63,000
SFU Fellowships etc		Lindsay Farrell - President's Research Award	$6,250
SFU Fellowships etc		Birgit Schwarz - Dept of Biological Sciences - Travel and Research Award	$350
International		Birgit Schwarz - German Academic Exchange Service	$10,180
International		Birgit Schwarz - Daimler Benz Foundation	$7,020
Provincial		Birgit Schwarz - Pacific Century Graduate Scholarship	$10,000
		M Sc	
SFU Fellowships etc		Danica Hogan - Graduate Entrance Scholar-ship	$12,000
NSERC CGS-M		Danica Hogan	$15,817
Ducks Unlimited		Danica Hogan	$3,000
SFU Fellowships etc		Rachel Gardiner - GF	$6,250
SFU Fellowships etc		Christine Rock - GF	$6,250
IPS NSERC		Christine Rock - Summer and Fall	$13,924
SFU Fellowships etc		Eric Palm - Special Graduate Entrance Scholarship - Fall and Spring	$9,000
SFU Fellowships etc		Corey VanStratt - GF	$6,250
SFU Fellowships etc		Martha Fronstin - Special Targeted Entrance Scholarship - Fall and Spring	$9,000
Society of Canadian Ornithologists		Marie-Helene Burle - The Fred Cooke Award	$10,000
NSERC CGS		Michaela Martin	$10,208
		General Funding for CWE	
EC/Core		EC/CWS Annual Chair Funding (1st of 4 yrs)	$200,000
SFU	Ydenberg RC	SFU - VPR: Contribution to Centre for Wildlife Ecology (Lump sum for 2006 through 2011)	$30,000

SFU	SFU	SFU Contribution to Faculty Salaries (Ydenberg Williams Green)	$406,813
		Generated Research Funding	
Other EC	Ydenberg RC / Middleton H	Science Horizon - Effects of intensive land use on use of Agricultural fields by Wintering American Wigeon	$12,000
Other EC	Esler D	Science Horizon - Molting Ecology of Barrows Goldeneyes	$12,000
Other EC	Esler D	Science Horizon - Pacific Coast Scoter	$12,000
Other	Lank D / Whitehorne I	Student Summer Works	$1,960
		Sea Ducks	
International	Esler D	US Fish & Wildlife: Sea Duck Joint Venture - Population Delineation and wintering ecology of Surf Scoters in SE Alaska (1st of 3 years)	$27,442
International	Esler D	US Fish & Wildlife: Sea Duck Joint Venture - Molting ecology of Surf and White-winged Scoters in SE Alaska	$30,775
International	Esler D / Anderson E	US Fish & Wildlife	$26,162
Industry	Esler D	Naikun Wind Dev. Inc.	$122,940
Other	Esler D / Dickson R	Ducks Unlimited	$17,000
Other EC	Esler D	Wind Farms	$23,000
Other EC	Esler D, Boyd S	EC: Marine Bird Conservation (5th of 5 years)	$35,000
		Marbled Murrelet	
Provincial	Ydenberg R/Lank D	Forest Science Program - Testing relation-ships between habitat quality indices, forest configuration and Marbled Murrelet local population size	$33,764
		Land Birds	
Provincial	Green DJ	Forest Science Program - Determining thresholds of habitat quality for breeding birds in rangeland ecosystems in the Cariboo Region	$42,533

Provincial	Green DJ	BC Hydro/ Cooper Beauchesne and Associates Ltd.	$73,425
Other EC	Green DJ	Effects of priority pesticides on Wildlife - Owls	$23,760
Other	Drake A / Green DJ	Northern Scientific Training Program	$3,604
		Triangle Island	
Other EC	Hipfner JM	Environment Canada - Science Horizons: "Seabird field conservation programs at Langara and Triangle Islands, BC"	$12,000
		Physiological Ecology	
Other EC	Williams TD	Effects of Chemical Management Plan priority on wildlife – Glaucous-winged Gulls	$16,500
Other EC	Williams TD	Development and validation of an integrated avian laboratory and field model system using Zebra Finch and Starling (2nd of 4 years)	$53,200
International	Williams TD	Polar Oceans Research Groups (NSF-LTER) - Climate-dependent changes in penguin population biology, physiology and nutrition (2nd of 4 years)	$16,250
		Western Sandpipers	
International	Ydenberg R/Lank D	US Fish and Wildlife Service - Using Intrinsic Markers to aid migratory bird conservation (2nd of 2 years)	$50,036
NSERC	Lank D/ Ydenberg R	Estuary Management for migratory Birds and Sustainable Development (2nd of 2 years)	$99,919
Other	Hope D. / Lank D	Northern Scientific Training Program	$2,437
Other	Somjee U / Lank D	Northern Scientific Training Program	$2,108
		NSERC	
NSERC	Green DJ	NSERC Individual Research Grant - Dispersal and migration behaviour of birds in natural and modified landscapes (1st of 5 years)	$29,000
NSERC	Ydenberg RC	NSERC Individual Research Grant - "Predation danger and the annual cycle of migrants (5th of 5 yrs)	$51,300
NSERC	Lank D	NSERC Individual Research Grant - RGPIN171290-2008 (2nd of 5 years)	$25,610
NSERC	Williams TD	NSERC Individual Research Grant- RGPIN/155395-200	$44,850

Grand Total	$1,745,887
SFU In-Kind	$116,678

VII. PUBLICATIONS

This list reflects those publications produced since our last report (publications that were "in press" or "submitted" for the last report are included and have been updated). We continue to publish very actively with 16 publications out in 2010 through March, 20 publications in press and 16 submitted. Over the past year six MSc students, one MET (Master of Environmental Toxicology), and one PhD student supervised by CWE faculty successfully defended their theses. Most of our publications relate to the research carried out in the main CWE programs and most refer to work carried out in the Pacific Northwest. We are however interacting with scientists throughout Canada and beyond and some of our publications reflect this.

A. Papers in Refereed Journals or Books

In press:

Agüero, M.L., P.G. Borboroglu and D. Esler. In press. Breeding habitat attributes and nest site selection of Chubut steamerducks in Patagonia, Argentina. Emu.

Blight, L.K., D.F. Bertram, T.D. Williams and L. Cowen. In press. Interannual variation in egg neglect and incubation routine of the rhinoceros auklet (*Cerorhinca monocerata*) during the 1998/1999 El Nino/La Nina event. Marine Ornithol.

Burger, A.E., R.A. Ronconi, M.P. Silvergieter, C. Conroy, V. Bahn, I.A. Manley, A. Cober and D.B. Lank. In press. Factors affecting the availability of thick epiphyte mats and other potential nest platforms for Marbled Murrelets in British Columbia. Can. J. For. Res.

Crossin, G.T., P.N. Trathan, R.A. Phillips, A. Dawson, F. Le Bouard and T.D. Williams. In press. A carry-over effect of migration underlies individual variation in reproductive readiness and extreme egg-size dimorphism in macaroni penguins. Amer. Nat.

Esler, D. and S.A. Iverson. In press. Female harlequin duck winter survival 11 to 14 years after the Exxon Valdez oil spill. J. Wildl. Manage. 74.

Esler, D., K.A. Trust, B.E. Ballachey, S.A. Iverson, T.L. Lewis, D.J. Rizzolo, D.M. Mulcahy, A.K. Miles, B.R. Woodin, J.J. Stegeman, J.D. Henderson and W. B.W. In press. Cytochrome P4501A biomarker indication of oil exposure in harlequin ducks up to 20 years after the Exxon Valdez oil spill. Env.Tox. Chem.

Gutowsky, S., M.H. Janssen, P. Arcese, T.K. Kyser, D. Ethier, M.B. Wunder, D.F. Bertram, L. McFarlane Tranquilla, C. Lougheed and D.R. Norris. In press. Concurrent declines in nestling diet quality and reproductive success in a threatened seabird over 150 years. Endang. Species. Res.

Heath, J.P., G. Gilchrist and R.C. Ydenberg. In press. Interactions between rate processes with different time scales explain counter-intuitive foraging patterns of arctic wintering eiders. Proc. Roy. Soc. B.

Hipfner, J.M., J. Dale and K.J. McGraw. In press. Yolk carotenoid and stable isotopes reveal links among foraging behavior, environment and seabird breeding success. Oecologia.

Iverson, S.A. and D. Esler. In press. Harlequin duck population dynamics following the 1989

Exxon Valdez oil spill: assessing injury and projecting a timeline to recovery. Ecol. Appl.
Jaatinen, K., A. Lehikoinen and D.B. Lank. In press. Female-biased sex ratios and the proportion of cryptic male morphs of migrant juvenile ruffs (*Philomachus pugnax*) in Finland. Orn. Fenn.
Kurvers, R., K. van Oers, B. Nolet, R. Jonker, S. Wieren, H. Prins and R. Ydenberg. In press. Personality predicts the use of social information. Ecol. Letters.
Lok, E.K., D. Esler, J.Y. Takekawa, S.W. De La Cruz, W.S. Boyd, D.R. Nyeswander, J.R. Evenson and D.H. Ward. In press. Stopover habitats of spring migrating surf scoters in south-east Alaska. J. Wildl. Manage.
Ricca, M.A., A.K. Miles, B.E. Ballachey, J.L. Bodkin, D. Esler and K.A. Trust. In press. PCB exposure in sea otters and harlequin ducks in relation to history of contamination by the *Exxon Valdez* oil spill. Mar. Pollut. Bull.
Salvante, K.G., F. Vézina and T.D. Williams. In press. Evidence for within-individual energy reallocation in cold-challenged, egg-producing birds. J. Exp. Biol.
Sheehy, J., C.M. Taylor, K.S. McCann and D.R. Norris. In press. Optimal conservation of migratory animals: integrating demographic information across seasons. Conservation Letters.
Stoskopf, M., D.M. Mulcahy and D. Esler. In press. Evaluation of a portable automated serum chemistry analyzer for field assessment of harlequin ducks, *Histrionicus histrionicus*. Vet. Med. Internal.
Taylor, C.M. and D.R. Norris. In press. Population Dynamics of Migratory Networks. Theoretical Ecology.
Travers, M., M.L. Clinchy, R. Boonstra, L. Zanette and T.D. Williams. In press. Indirect predator effects on clutch size and the cost of egg production. Ecol. Letters.
Whitehorne, I. In press. Wintering behavior, physiology and site fidelity in a partial migrant, the American Dipper (*Cinclus mexicanus*). Waterbirds.

Submitted:

Beaubier, J.E. and J.M. Hipfner. Submitted. Proximate composition and energy density of forage fish delivered to rhinoceros auklet nestlings at Triangle Island, British Columbia. Can. J. Zool.
Esler, D., B.E. Ballachey, K.A. Trust, S.A. Iverson, J.A. Reed, A.K. Miles, J.D. Henderson, B.W. Wilson, B.R. Woodin, J.R. Stegeman, M. McAdie and D.M. Mulcahy. Submitted. Cytochrome P4501A biomarker indication of the timeline of chronic exposure of Barrow's goldeneye to residual Exxon Valdez oil. Mar. Pollut. Bull.
Federer, R., T. Hollmén, D. Esler, M.J. Wooller and S.W. Wang. Submitted. Stable carbon and nitrogen isotope discrimination factors from diet to blood plasma, cellular blood, feathers, and adipose fatty acids in Spectacled Eiders (*Somateria fischeri*). Can. J. Zool.
Harrison, M.L., N.A. Mahony, P. Robinson, A. Newbury and D.J. Green. Submitted. Nest-site selection and productivity of Vesper Sparrows breeding in grazed habitats. J. Field Ornithol.
Harrison, M.L., N.A. Mahony, P. Robinson, A. Newbury and D.J. Green. Submitted. Vesper Sparrows and Western Meadowlarks show a mixed response to cattle grazing in the Intermountain region of British Columbia. Avian Cons. Ecol.
Hipfner, J.M., B. Addison and M.R. Charete. Submitted. Could dietary differences facilitate the coexistence of island populations of Fox Sparrows and Song Sparrows? Wilson J. Ornithol.
Hipfner, J.M., K.W. Morrison and R. Darvill. Submitted. How a single pair of Peregrine Falcons changed the lives of thousands of colonial seabirds. Waterbirds.
Lindstrom, Ã., R.E. Gill, S.E. Jamieson, B. McCaffery, L. Wennerberg, M. Wikelski and M. Klaassen. Submitted. A puzzling migratory detour: Are fuelling conditions driving the movement of juvenile Sharp-tailed Sandpipers in Alaska? Condor.
Lok, E.K., D. Esler, J.Y. Takekawa, S.W. De La Cruz, W.S. Boyd, D.R. Nyeswander, J.R. Evenson and D.H. Ward. Submitted. Spatiotemporal associations between Pacific herring

spawn and surf scoter spring migration: evaluating a "silver wave" hypothesis. Mar. Ecol. Prog. Ser.

Morrison, K.W., J.M. Hipfner, G. Blackburn and D.J. Green. Submitted. Demographic consequences of extreme climate events for three North Pacific seabird species. J. Anim. Ecol.

Mulcahy, D.M. and D. Esler. Submitted. Survival of captive and free-ranging harlequin ducks (Histrionicus histrionicus) following surgical liver biopsy. J. Wildl. Diseases.

Pavlacky Jr, D.C., H.P. Possingham, A.J. Lowe, P.J. Prentis, D.J. Green and A.W. Goldizen. Submitted. Habitat loss influences local extinction and asymmetric dispersal in a rainforest bird metapopulation: empirical evidence for the rescue effect. Amer. Nat.

Quinlan, S.P. and D.J. Green. Submitted. Variation in deuterium (□D) signatures of yellow warbler feathers grown on breeding and wintering grounds. J. Ornithol.

Silvergieter, M.P. and D.B. Lank. Submitted. Marbled Murrelets select distinctive nest trees within old growth forest patches. Condor.

Taylor, C.M., D. Lank and B. Sandercock. Submitted. Using local dispersal data to improve estimates of survivorship and mate fidelity. Condor.

Whitehorne, I.B.J., D.J. Green and S. Bourgeon. Submitted. Migratory strategy does not affect physiological state at the end of breeding in American dippers. Auk.

2010

Esler, D. and J.C. Bond. 2010. Cross-seasonal body mass dynamics of male Harlequin Ducks: a strategy for meeting costs of reproduction. Can. J. Zool. 88**:** 224-230.

Fernández, G. and D.B. Lank. 2010. Do sex and habitat differences in anti-predator behavior of Western Sandpipers *Calidris mauri* reflect cumulative or compensatory processes? J. Ornithol. 151:665–672.

Harrison, M.L. and D.J. Green. 2010. Vegetation influences patch occupancy but not settlement and dispersal decisions in a declining migratory songbird. Can. J. Zool. 88**:** 148-160.

Heath, J.P. and H.G. Gilchrist. 2010. When foraging becomes unprofitable: energetics of diving in tidal currents by common eiders wintering in the Arctic. Mar. Ecol. Prog. Ser. 403**:** 279-290.

Hipfner, J.M., K.A. Hobson, J. Dale and K.J. McGraw. 2010. Stable isotopes link diet to avian yolk carotenoid allocation: a comparative study of five auk species (Charadriiformes: Alcidae). Physiol. Biochem. Zool. 83**:** 481-489.

Hipfner, J.M., M.J.F. Lemon and M.S. Rodway. 2010. Introduced mammals, vegetation changes, and seabird conservation on the Scott Islands, British Columbia. Bird Conservation International. Bird Conserv. Internat. 20**:** doi:10.1017/S0959270910000043.

Hipfner, J.M., L.A. McFarlane-Tranquilla and B. Addison. 2010. Experimental evidence that both timing and parental quality affect breeding success in a zooplanktivorous seabird. Auk 127**:** 195-203.

Kordonowy, L.L., J.P. McMurtry and T.D. Williams. 2010. Variation in plasma leptin-like immunoreactivity in free-living European starlings (*Sturnus vulgaris*). Gen. Comp. Endocrinol. 166**:** 47-53.

Kurvers, R.H.J.M., H.H.T. Prins, S.E. van Wieren, K. van Oers, B.A. Nolet and R.C. Ydenberg. 2010. The effect of personality on social foraging: shy barnacle geese scrounge more. Proc. Roy. Soc. B 277**:** 601-608.

Mackas, R.H., D.J. Green, I.B.J. Whitehorne, E.N. Fairhurst, H.A. Middleton and C.A. Morrissey. 2010. Altitudinal migration in American Dippers (*Cinclus mexicanus*): Do migrants produce higher quality offspring? Can. J. Zool. 88**:** 369-377.

Sorensen, M.C., J.M. Hipfner, T.K. Kyser and D.R. Norris. 2010. Pre-breeding diet influences

ornament size in the Rhinoceros Auklet *Cerorhinca monocerata*. Ibis 152**:** 29-37.
Vennesland, R.G. 2010. Risk perception of nesting Great Blue Herons: experimental evidence of habituation. Can. J. Zool. 88**:** 81-89.
Waterhouse, F.L., A.E. Burger, P.K. Ott, A. Donaldson and D.B. Lank. 2010. Does interpretation of Marbled Murrelet habitat change with different classification methods? BC J. Ecosys. Manag. 10**:** 20-34.
Willie, J., M. Travers and T.D. Williams. 2010. Female zebra finches (*Taeniopygia guttata*) are chronically, but not cumulatively, 'anemic' during repeated egg-laying in response to experimental nest predation. Physiol. Biochem. Zool. 83**:** 119-126.
Ydenberg, R.C. 2010. Decision theory. In: *Evolutionary Behavioural Ecology*, Westneat, D.F.and C.W. Fox, eds., pp. 131-147. Oxford: Oxford University Press.
Ydenberg, R.C., D. Dekker, G. Kaiser, P.C.F. Shepherd, L. Evans Ogden, K. Rickards and D.B. Lank. 2010. Winter body mass and over-ocean flocking as components of danger management by Pacific dunlins. BMC Ecol. 10**:** 1doi:10.1186/1472-6785-10-1.

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Anderson, E.M., J.R. Lovvorn, D. Esler, W.S. Boyd and K.C. Stick. 2009. Using predator distributions, diet, and condition to evaluate seasonal foraging sites: sea ducks and herring spawn. Mar. Ecol. Prog. Ser. 386**:** 287-302.
Bertram, D.F., A. Harfenist and A. Hedd. 2009. Seabird nestling diets reflect latitudinal temperature-dependent variation in availability of key zooplankton prey populations. Mar. Ecol. Prog. Ser. 393**:** 199-210.
Bertram, D.F., N.E. Philips and R.R. Strathmann. 2009. Evolutionary and experimental change in egg volume, heterochrony of larval body and juvenile rudiment, and evolutionary reversibility in pluteus form. Evol. and Develop. 11**:** 728-739.
Blackburn, G.S., J.M. Hipfner and R.C. Ydenberg. 2009. Evidence that tufted puffins *Fratercula cirrhata* use colony overflights to reduce kleptoparasitism risk. J. Avian Biol. 40**:** 412-418.
Bond, J.C., S.A. Iverson, N.B. MacCallum, C.M. Smith, H.J. Bruner and D. Esler. 2009. Variation in breeding season survival of adult female harlequin ducks. J. Wildl. Manage. 73**:** 965-972.
Burger, A.E., F.L. Waterhouse, A. Donaldson, C. Whittaker and D.B. Lank. 2009. Applications of new methods for assessing nesting habitat of Marbled Murrelets in coastal forests: air photo interpretation and low-level aerial surveys. BC J. Ecosys. Manag. 10**:** 4-14.
Davies, W.E., J.M. Hipfner, K.A. Hobson and R.C. Ydenberg. 2009. Seabird seasonal trophodynamics: isotopic patterns in a community of Pacific alcids. Mar. Ecol. Prog. Ser. 382**:** 211-219.
De La Cruz, S.E.W., J.Y. Takekawa, M.T. Wilson, D.R. Nyeswander, J.R. Evenson, D. Esler, W.S. Boyd and D.H. Ward. 2009. Surf scoter (*Melanitta perspicillata*) spring migration routes and chronology: a synthesis of Pacific coast studies. Can. J. Zool. 87**:** 1069-1086.
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C. Theses

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