ANNUAL REPORT of the
CENTRE FOR WILDLIFE ECOLOGY

2012-2013

Department of Biological Sciences
Simon Fraser University

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

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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 Fellows	***PhD (in progress)***	***MSc (in progress)***	***Staff***
Margaret Eng	Marie-Hélène Burle	Jason Brogan	Monica Court, CWE Admin. Asst.
Melinda Fowler	Heidi Currier	Allison Cornell	Connie Smith, CWE Research Tech
Cailin Xu	Anna Drake	Danielle Dagenais	Jenn Barrett, MAMU/Sea Duck Tech
	Philina English	Annie Ellison	
	Kristen Gorman	Willow English	
	David Hope	Tim Forrester	
	Emily McAuley	Martha Fronstin	
	Holly Middleton	Matthew Hepp	
	Marinde Out	Richard Johnston	
	Birgit Schwarz	Elly Knight	
	Simon Valdez	Michaela Martin	
		Calen Ryan	
		Sarah Thomsen	
		Brian Uher-Koch	
		Maria Yu (MET)	
Visitors	***PhD(defended)***	***MSc (defended)***	
Pat Baird	Margaret Eng	Mikaela Davis	
Florian Reurink	Lindsay Farrell	Rachel Gardiner	
Mathilde Tissier	Samantha Franks	Nathan Hentze	
	Ariam Jiménez	Eric Palm	
		Christopher St. Clair	
		Dominique Wagner	

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 Environment Canada has an important 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 throughout 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 2012 season: We opened our research station on Triangle Island for year 19 on 27 May 2012. Scientific research was conducted under the direction of Mark Hipfner. We maintained our time series focus on Cassin's Auklets, Rhinoceros Auklets, Glaucous-winged Gulls and Black Oystercatchers.

The 2012 season continued the recent string of years (since 2007-2008, but excluding 2010) characterized by cold ocean conditions. This again created favourable conditions for breeding by Black Oystercatchers, which bred at high density, and for Cassin's Auklets, whose phenology was well matched to that of their most important prey, the copepod *Neocalanus cristatus*.

However, Rhinoceros Auklets had a poor breeding season due to the scarcity of juvenile sand lance.

In 2012 we also completed the fifth year of a project to band Rhinoceros Auklets at the large colonies at Pine Island (central coast) and Lucy Island (north coast). The objectives of the work are to obtain estimates of adult survival rates at these colonies to enable us to assess the potential effects of mortality in gill-net fisheries on local populations; to quantify geographic and yearly variation in this species' diet and productivity; to quantify spatial and temporal variation in diets of Pacific sandlance, a key prey species for Rhinoceros Auklets at all BC colonies. And finally, in 2012 we began a collaborative project with scientists from the Department of Fisheries and Oceans to quantify the consumption of salmon, especially Fraser River sockeye, by seabirds. Of interest, with juvenile sand lance relatively scarce, Rhinoceros Auklets delivered unusually large amounts of salmon to nestlings on Triangle and Pine islands.

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, contributes information useful for Environment Canada's environmental assessments as Port of Vancouver and ferry operations continue and expand.

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, EC's 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. We are now cooperating with Mark Drever, recently hired by CWS to address shorebird issues. The CWE maintains substantial science capacity for this group of birds. 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 these long-distance Neotropical migrants. We have pursued and aided fieldwork at three breeding sites, several migration locations, and five wintering sites. We have organized twelve 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? How do changes in environmental danger and food availability affect migration and stopover strategies? Of direct conservation concern is the consequence of the removal or deterioration of one or more locations on survival and reproduc-

tion.

Highlights from 2012:

Fraser River Delta issues: PhD student Ariam Jiménez concluded detailed work with sandpiper usage of biofilm on Robert's Bank and elsewhere in the Delta, 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, and he defended his PhD early in 2013.

Florian Reurink, a visiting graduate student from Wageningen University in the Netherlands, conducted a study supervised by Ydenberg of interpatch foraging flight speeds, as part of a broader effort to characterize variation in shorebird habitat quality within the Delta.

MSc student David Hope published the major chapter from his MSc thesis addressing migration strategies of Western Sandpipers through the Fraser River Delta with respect to changing schedules of predation risk, and submitted a second chapter looking at changes in stopover behaviour throughout the summer as predation danger changed. Hope is returning to the CWE in 2013 to start as a PhD student, working on shorebird distribution questions.

MSc student Rachel Gardiner completed her MSc. on Least Sandpipers, the third common local migrant shorebird, in April 2012. She related aspects of their intertidal habitat usage at different sites to measures of fattening rates and predation danger, and contrasted these with habitat usage and migration strategies of Western sandpipers. Her analyses utilize both currently acquired data and historical data available from previous work by EC scientists and the CWE.

MSc student Nathan Hentze completed his thesis in Sept 2012, exploring patterns and costs of high-tide 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. Hentze quantified temporal, special, and environmental factors fostering or curtailing these flights, and showed that the costs of flight during over0ocean flocking were lower than those of commuting flights.

Dunlin feeding habitat usage at the Skagit estuary in Washington State was described using radio-tracking and stable isotope approaches in a study by Lank, EC-S&T's Keith Hobson (Saskatoon), MSc student Gardiner and Gary Slater, of the Ecostudies Institute and Ruth Milner, Washington Fish and Wildlife. As in the Fraser Delta, wintering dunlin utilize a mixture of agricultural and intertidal resources that shifts through the season.

Shorebird Breeding Biology:

Lank co-supervised the third field season of a 4-5 year project to support demographic research on nesting shorebirds with respect to environmental factors, near Nome Alaska, together with collaborator Brett Sandercock, a CWE alumnus who is now a professor at Kansas State University, funded by NSF and the Alaska Department of Fish and Game. Several CWE current graduate students participated in the third year of this study, which focuses on the demography of Western and Semipalmated sandpipers, and how this may have changed since Sandercock's PhD work at the site in the 1990s. CWE MSc student Willow English conducted her second field season focusing on consequences of uniparental care, working with red-necked phalaropes. The

site contributes towards an arctic-wide collaborative program dubbed the Arctic Shorebird Demographic Network, which includes a dozen sites in Alaska and arctic Canada utilizing comparable protocols.

Sarah Jamieson (PhD CWE 2009) published thesis papers on dunlin breeding biology; one remaining publication with Ydenberg and Lank, relating the duration of parental care to migration strategies of sympatric dunlin and Western sandpipers, was refined for journal submission.

Migratory Connectivity Project: The Western Sandpiper migratory connectivity project 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, is being completed. This international project involved 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. PhD student Samantha Franks defended her PhD thesis in spring 2012. The thesis covers stable isotope analyses of western sandpiper feathers collected throughout their annual cycle, and the major migratory connectivity paper from this work was published in the Journal of Avian Biology. Birgit Schwarz, a second PhD student originally supported by German graduate fellowships, is addressing population structure using genetic analyses and song, co-supervised by Darren Irwin at UBC. Schwarz should complete her thesis in 2013.

As part of the breeding study at Nome, a geolocator was recovered from a Western sandpiper, demonstrating a non-stop flight from Alaska to, and wintering at, the Fraser River delta. Three geolocators were recovered from semipalmated sandpipers, showing southwesterly migration and wintering sites in Colombia and Panama. Approximately 20 additional tags were placed on each species during the summer of 2012.

Population Biology:

Ydenberg and Lank worked with CWE associate Jenn Barrett examining long-term population and distributional changes in Pacific dunlin, as assessed by Christmas Bird Count data encompassing most of the species' winter range, and those of Canadian-breeding hudsonica dunlin that winter on the US south and east coasts. An EC-funded post-doctoral fellow, Cailin Xu, started with the CWE in January 2013 to pursue analyses of factors affecting shorebird populations, including these dunlin and semipalmated sandpipers.

Helped plan and finance 5th Western Hemisphere Shorebird Group Meeting: Lank and Ydenberg organized the 4th biennial meeting of the Western Hemisphere Shorebird Group meeting, held at SFU in August 2011. In 2012, we provided input for those planning the 5th meeting, to be held in Colombia in September 2013, and will transfer residual funding from in support of this meeting. Our support is facilitated because we have taken on Richard Johnson as a new graduate student, a Colombia student who is playing a central role in organizing the meeting. Johnson started as a new graduate student with the CWE in January 2013, and will work on non-breeding distributions of shorebirds in Colombia.

Tuamotu Sandpiper Conservation: The CWE is lending its expertise in shorebird biology to support a conservation project on the highly endangered Tuamotu Sandpiper, in partnership with the USF&WS (Rick Lanctot, Alaska region), Island Conservation, the French Polynesian

Regional Division for the Environment (DIREN), a local ornithological NGO (the Society of Polynesian Ornithologists, SOP-MANU), and the Critical Ecosystems Partnership Fund (CEPF), administered by Conservation International.

Once widespread across the South Pacific, this species is now found on only 4 atolls, with a world population of ca. 1200 individuals. PhD student Marie-Hélène Burle has now >15 months conducting the first study of the species' biology, including 5 months during 2012. 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.

C. The Marbled Murrelet Project

SFU's research on threatened Marbled Murrelets continues to address issues of direct conservation concern for this listed species. This ground-breaking and high profile project examining the biology of the threatened and elusive marbled murrelet, started by CWE chair emeritus Fred Cooke, continued for its eighteenth year lead by Dov Lank, addressing evolving questions of management interest for this threatened species.
Following the completion of student projects in 2011, in 2012 Lank and CWE technician Jenn Barrett continued data analyses of the extensive radar traffic rate data sets that 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. This work will be completed in 2013.

Lank continued to serve on the Canadian Marbled Murrelet Recovery Team and participated in calls with the Habitat Implementation Group. After several years of reduced activity, the CMMRT has become reanimated following the Federal government's response to lawsuits regarding its failure to post a recovery strategy completed by the CMMRT three years ago, and apparent decision not to alter major provisions of SARA. The radar-habitat work feeds directly into decisions defining critical habitat under SARA.

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 evaluates population recovery of sea ducks (harlequin ducks and Barrow's goldeneye) from the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska. We continue to collect new data on the degree and duration of oil exposure that sea ducks are experiencing, with most recent data collection in March 2013 and plans for continued analysis and sample collection. This body of work has important implications with regard to considerations of oil and gas development and transportation in British Columbia.

2. Winter and Spring-migration Ecology of Surf and White-winged Scoters – Our research group has been studying various aspects of scoter winter and migration ecology since 2001, as part of a flyway-wide collaboration including Environment Canada, U.S. federal agencies, and Washington Department of Fish and Wildlife. 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. Field work is complete and efforts are now focused entirely on analysis and write-up of findings. The last graduate student on the project, MSc candidate Brian Uher-Koch, has completed his thesis addressing variation in winter survival of surf scoters at a continental scale and will defend summer 2013. In addition to nearly 20 papers that have been published from this work, several new papers are in journal review, or in preparation for submission. Collectively, our work has led to significant advances in understanding of scoter wintering and spring migration ecology, and identifies habitat and demographic features that may influence population dynamics.

3. Barrow's Goldeneye Population Delineation – In collaboration with Sean Boyd of Environment Canada, we are using satellite telemetry to evaluate population structure, movements, site fidelity, and habitat use of Barrow's goldeneyes in western North America. Goldeneyes have been marked at a breeding site (Riske Creek, BC), 4 wintering sites (Indian Arm, BC; Prince William Sound, Alaska; Juneau, Alaska; and Kachemak Bay, 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.

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 discovered in northwestern Alberta. In collaboration with Jonathan Thompson of Ducks Unlimited Canada and Sean Boyd of EC, we documented moulting strategies of Barrow's goldeneyes. Led by Danica Hogan, who recently received her MSc, this work quantified 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. Four papers from this project have been published; also, results from this work have been presented to agencies in BC and Alberta.

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. We also conducted directed field work, using funding from NRCAN, Environment Canada, and the industrial proponent, addressing trophic interactions and energetics of long-tailed ducks white-winged scoters. This work provided perspective on the habitat function of the proposed wind farm site, including comparisons to other areas within the province. The work resulted in a thesis by MSc student Eric Palm, as well as 3 published papers.

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 conducted a project addressing ecology of surf and white-winged scoters during the wing moult phase of the annual cycle. This work was conducted in southeast Alaska and in the Strait of Georgia/Puget Sound, providing a flyway-wide assessment of wing molt. This work, led by recent MSc graduate Rian Dickson, addressed a variety of basic and applied questions, including energetics, movements and habitat use, and demography (survival). Field work has been completed, and data analysis and write-up are underway, with 2 papers in press.

7. Western Grebe Population Structure and Dynamics – Although not taxonomically a sea duck, the CWE has engaged in studies of western grebes in collaboration with Environment Canada and the University of British Columbia, to address dramatic declines in numbers wintering in coastal British Columbia. A research plan was formulated to consider the roles of redistribution of birds and declines in demographic attributes of birds that winter in BC, employing a number of different tools to address the issue. Field work was conducted in 2012, which included capture and marking efforts throughout prairie Canada, and surveys of western grebe distributions throughout their wintering range from BC to Baja. Reports with recommendations for conservation are being prepared.

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) successfully defended his Masters thesis in Spring 2012 on this project, using physiological assessment of fattening rates and condition (plasma metabolites, corticosterone) to determine effects of reservoir water management strategies, on four species of neo-tropical migrants (Common Yellowthroat, Yellow Warbler, Orange-Crowned Warbler, Wilson's Warbler) in Revelstoke, BC. Two papers are currently in preparation from this work. No further fieldwork was conducted in 2012 but our collaborators on this BC Hydro-funded project (John Cooper, Manning Beauschene and Associates Ltd.) have indicated that they wish to continue this project in 2013, with sampling from multiple sites that will likely be differentially affected by variation in water levels from dam operations (with David Green).

b) **Altitudinal differences in fattening rates in neo-tropical migrants using high- and low-altitude sites in the Lower Mainland, BC.** A paper on this collaborative study (with Kathy

Martin, Lesley Evens Ogden) was published in *The Auk* in January 2013. Main results were that three frugivorous species (Fox Sparrow, Golden-crowned Sparrow and Hermit Thrush) had 37% to 65% higher fattening rates at higher altitude sites. In contrast, the largely insectivorous Orange-crowned Warbler had higher fattening rates at low altitude sites. This study shows that high elevation sites can represent high quality stopover habitats for migrants, and thus should be given consideration for protection for songbird management and conservation. Moreover, these patterns were only evident using plasma metabolites analysis, not with more "traditional" analysis of body mass or fat score, highlighting the value of these physiological approaches.

2. **Ecotoxicology projects**

a) **Anthropogenic maternal effects: long-term effects of early (in ovo or natal) exposure to xenobiotics in birds.** We continue this long-term and highly productive collaboration with Dr. John Elliott, S & T, largely funded via non-CWE grants or agreements. Early life stages in birds are sensitive to environmental conditions, and factors such as hormones and pollutants can have long-term (permanent) effects on the resulting phenotypes at concentrations much lower than those required to affect adults. We have developed an integrated model system using lab-based studies of breeding zebra finches and field-based studies of European starlings. This combines various methods of exposure of embryos or chicks during early development (egg injection, exposure via maternal transfer, etc), assessment of long-term effects of contaminants when these chicks reach adulthood (mating and courtship behaviour, breeding success), and potential intergenerational effects on the offspring of birds exposed as chicks. More recently we have incorporated *in vitro* (cell-based and molecular) assays of potential endocrine disrupting effects before we start *in vivo* testing using physiological, neurobiological, behavioural and reproductive endpoints (with Dr. Tim Beischlag, Faculty of Health Sciences). We have now used this system to test to test a series of "priority" chemicals identified by colleagues at NWRC, Ottawa (Drs. Crump, Fernie, Letcher), under EC's Chemical Management Plan (CMP):

a) Viktoria Khamzina (MET, 2011) published two papers in 2012 from her Masters on development and validation of methods for *in ovo* exposure (egg injection) in zebra finches and use of this method to assess multi-generational effects of the flame retardant BDE-99 on chick growth, development,

b) Margaret Eng (PhD) successfully defended her thesis in January 2013 having completed a range of studies using our integrated starling/zebra finch system to investigate effects of BDE-99. This included effects of developmental exposure to BDE-99 on the song-control system, mating behavior, physiology, growth and reproduction in zebra finches and starlings (Eng et al. 2013a,b); assessment of concentrations and effects of organohalogen contaminants in free-living European starlings, in an ecological context; and how individual variation in body burden, lipid status and reproductive investment affect maternal transfer of BDE-99 to eggs in the zebra finch (Eng et al. 2013c). Margaret is continuing as a post-doc with CWE involving a project on assessment of exposure, bioaccumulation, and possible effects on birds of CMP2/CMP3 priority organic flame retardants (e.g. TBEP, TEP).

c) Heidi Scherr (PhD) completed one manuscript on molecular action and physiological effects of a new "priority" chemical, TBECH, and a second manuscript on long-term, multigenerational effects of *in ovo* exposure to another flame retardant, BDE-47. In 2012 she conducted a detailed field study of breeding ecology, physiology and toxicology of European starlings comparing the Delta landfill (a location with know, high levels of PBDEs) with control sites in the Fraser valley (Langley).

d) we initiated a new project on developmental neurotoxicity of mercury in birds; this involves Margaret Eng (post-doc) and new MET student, Maria Yu.

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). We continued to provide eggs, other samples, and breeding data, for this monitoring from our two main starling study sites. A paper on bioaccumulative flame retardants at sites across Canada, including the Delta landfill, was published in *Environmental Science & Technology* using these data (Chen et al. 2013).

c) **Relationship between foraging, diet and potential for contaminant exposure in the Glaucous-winged gull.** Mikaela Davis (MSc) successfully defended her Masters thesis on this project in Spring 2012, a) investigating Glaucous-winged gull diets across three historically-used breeding colonies off the coast of Vancouver Island, and b) comparing findings with those of similar studies conducted 27-37 years ago. This study provided essential information for the interpretation of contaminant monitoring data and use of the Glaucous-winged gull as a suitable monitoring species for marine contaminants on the Canadian West coast, under EC's Chemical Management Plan.

3. **Reproductive ecology and physiology**

We completed an 11th field season (2002-2012) investigating the ecological physiology of European starlings at two sites in the Fraser Valley: Langley (140 nest boxes) and Glen Valley (60 nest boxes); funded largely from sources outside of CWE. We shifted our focus somewhat to consider the broader ecological and agricultural context of reproduction, initiating studies of prey (*Tipulid* sp.) density in fields, prey composition of diet, and foraging (using radio tracking) in relation to breeding success and physiological condition. We also completed an initial analysis of effects of climate change and temperature on timing of breeding using the long-term data set. This work will continue over the next few years with a new MSc student (Allison Cornell) and a new post-doc (Melinda Fowler).

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 currently being assessed by examining how winter habitat use and migration distance influence the life history and demography of yellow warblers that over-winter in Mexico and breed in Revelstoke, B.C. and Inuvik, N.W.T. Secondly, we are interested in how anthropogenic changes to the landscape influence habitat selection, breeding performance and survival of threatened or declining landbirds in Canada. 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 orchards and wineries adjacent to remnant shrub-steppe habitat influence the predator and grassland songbird community in the Okanagan, and a study evaluating hypotheses for the decline of whip-poor-wills in Ontario. We briefly describe these studies below:

Winter habitat use, migration and the demography of Yellow warblers

Previous work using stable isotope signatures in feathers indicates that individuals

breeding in the NWT and BC overwinter along the Pacific and Gulf coasts of Mexico (Boulet et al. 2006). Michaela Martin (MSc, defending April 2013) evaluated how migration distance influences the life history of this broadly distributed species by comparing the reproduction and survival of yellow warbler populations spanning a latitudinal gradient from 68 to 0^{o}N. She showed that populations migrating to the Arctic laid larger clutches, had higher nest success and produced more young during a shortened breeding season than populations migrating to temperate regions. Annual survival of birds breeding in the Arctic was, in contrast, lower than the annual survival of birds breeding in BC.

Anna Drake (PhD, defending April 2013 studied the breeding population in Revelstoke and Inuvik and examined winter habitat use of Yellow warblers in Mexico from 2009-2012. She found that riparian habitat in Mexico is occupied primarily by older males, coastal shrub/mangrove is occupied primarily by females and agricultural habitat contains a similar number of birds of all sex/age-classes. She demonstrated that the winter habitat occupied by an individual did not have a large effect on their subsequent reproductive. Carryover effects of winter habitat only influenced the productivity of yearling females in Revelstoke; carryover effects of winter habitat had no effect on the productivity of any birds (female- yearlings or older, males- yearlings or older) in Inuvik. Intriguingly, Anna found that annual variation in climatic conditions (wind speed) during migration had large effects on the arrival dates, productivity and annual survival of yellow warblers breeding in Revelstoke. This work indicates the importance of conditions during fall migration for the population dynamics of Neotropical migrants using the western flyway.

Simon Valdez (PhD candidate) has now initiated work examining whether the natal origins of yellow warblers influences winter habitat use in Mexico, and is evaluating how winter habitat (riparian habitat, agricultural habitat and coastal scrub/mangroves) influences the territorial behavior, condition, departure dates and winter survival of Yellow warblers in Jalisco, Mexico. This project that encompasses work on the breeding grounds, wintering grounds and on migration is conducted in collaboration with Elsie Krebs (EC) and Jorge Rivera (UNAM, Mexico).

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. We have shown that riparian habitat impacted by reservoir operations on the Columbia River do not function as an ecological trap for yellow warblers, a species identified by Partners in Flight as a focal species for riparian habitat. Yellow warblers prefer territories with more riparian shrub/tree habitat and build nests at sites with more willow stems; these habitat selection decisions increase annual productivity (Quinlan and Green 2012). Flooding of nests due to reservoir operations leads to the loss of between 0 and 18% of nests per year. Productivity is further reduced by cowbird parasitism that can influence the productivity of both yearling and older females (Rock, MSc thesis 2011). Matt Hepp (MSc candidate) is currently developing an individual based model using our detailed data on arrival dates, clutch and brood sizes, daily nest survival, and re-nesting probabilities to examine how different reservoir water use decisions influence productivity on the breeding grounds. He will combine this with data on age-specific annual survival estimates to determine how reservoir operations impact the population dynamics of Yellow warblers. This project is conducted in collaboration with Cooper-Beauchesne Associates with funding and support from BC Hydro.

Fragmentation, edge effects of orchards and vineyards and the distribution and abundance of songbirds in shrub-steppe habitat in the Okanagan.

Habitat loss alters the configuration of the remaining habitat patches, increasing the ratio of edge:core habitat, and alters the composition of the landscape surrounding remnant patches. The relative importance of habitat change at a local (patch) and landscape level are debated. Elly Knight (MSc, defending April 2013) examined how loss of habitat in the Okanagan due to agricultural and urban development influences the composition of the avian community within shrub-steppe habitat adjacent to orchards and vineyards and evaluated the relative importance of vegetation characteristics at a patch scale, the predator community within patches, land use at a landscape scale in explaining variation in the distribution, abundance and nest success of grassland songbirds in edge and core shrubbe-steppe habitat in the Okanagan. She found that bird communities differed in edge and core habitat primarily due the presence of generalist species that used adjacent agricultural habitat. Shrubsteppe songbird nest densities were also lower in edge than interior habitat. Nest success, however, was only lower in edge habitat adjacent to orchards. Differences in nest success in orchard edge habitat and vineyard edge habitat and interior habitat was not due to differences in the abundance of the major predators - identified as snakes using nest cameras or differences in the vegetation. Further work is required to assess how competition and the use of pesticides in vineyards and orchards that could reduce food availability influence nest success. This project was conducted in collaboration with Nancy Mahony (EC-Wildlife Division).

The role of diet, land use change on breeding grounds and wintering location in population declines of eastern whip-poor-wills

Populations of aerial insectivores in eastern North America are argued to be declining at a faster rate than populations of other avian guilds. Philina English, a PhD candidate co-supervised by Dr Joe Nocera (Ontario Ministry of Natural Resources), has initiated a project to investigate hypotheses for population declines in eastern whip-poor-wills in Ontario. She will combine data on whip-poor-will distributions collected for the first and second Ontario Breeding Bird Atlas, land use classification data for the 1980's and 2000's, and habitat specific insect abundance data to evaluate whether changes to land use and prey abundance on breeding grounds can explain changes in the distribution of whip-poor-wills. Philina, in collaboration with Dr Joe Nocera and Dr Mike Cadman (CWS) has also attached light-logging geolocators to whip-poor-will breeding at three sites, (QUBS in the Frontenac arch, Torrance Barrens Dark Sky Reserve in the southern Muskoka, and Long Point on Lake Erie). Data from geolocators removed from birds returning to these sites in 2012 provided the first information on the wintering location of eastern whip-poor-wills. Further fieldwork will be conducted in 2013 to examine whether food abundance can explain changes in the distribution of whip-poor-wills across Ontario, assess the role of food in determining local abundance at a territory scale, and retrieve additional geolocators.

VI FUNDING

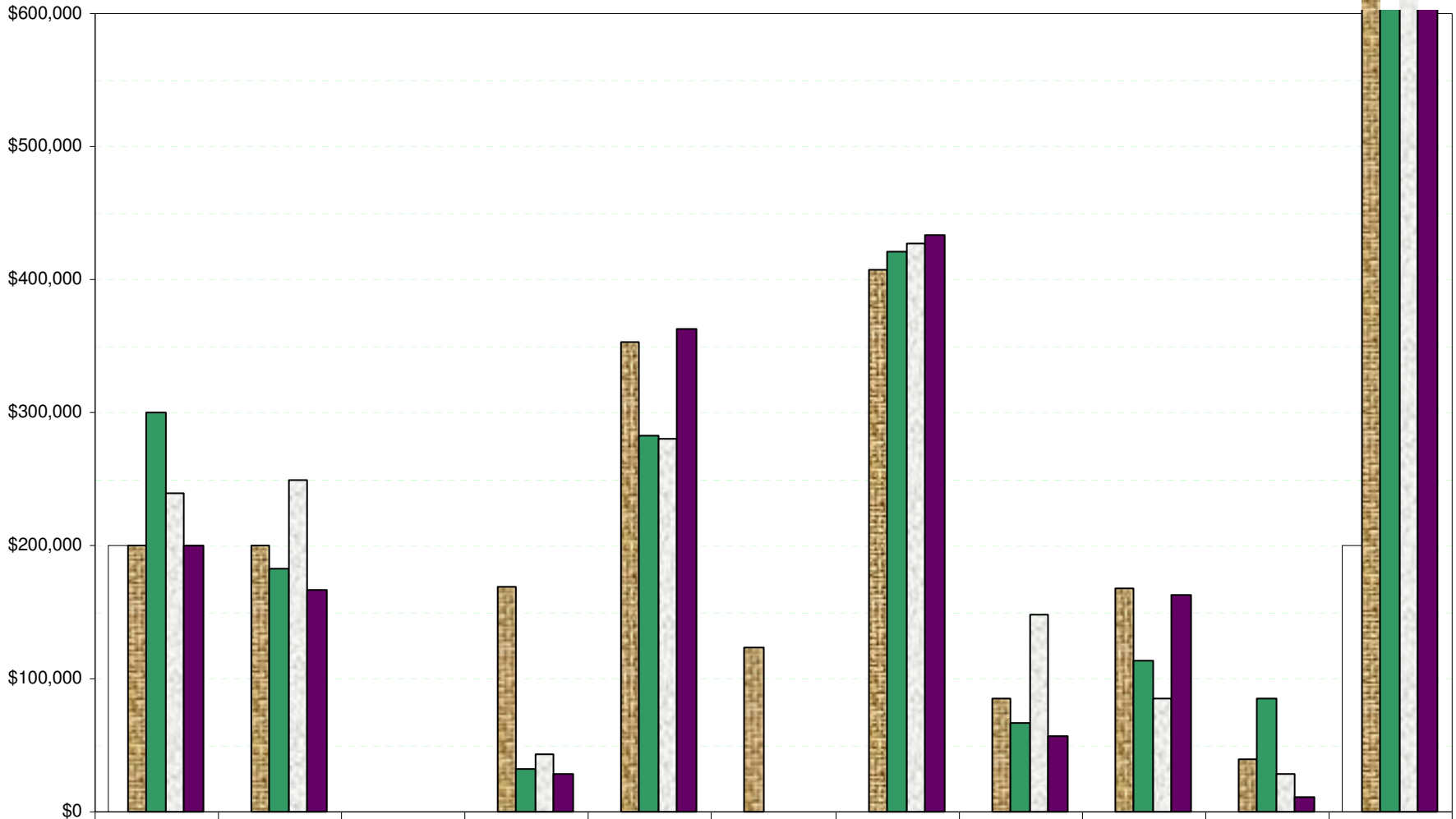
2012-2013 is the fourth and final year of the Simon Fraser University (Centre for Wildlife Ecology) and Environment Canada (Science and Technology Division) funding agreement that provides $200,000 annually as core support for the research activities of the Centre for Wildlife Ecology.

The chart compares revenue projections (formulated for this agreement) to actual revenue from Environment Canada, SFU and other industrial, provincial, federal and international sectors.

2012/2013 Annual Report

CWS Centre for Wildlife Ecology Fiscal Funding Sources

Simon Fraser University



	EC/Core	Other EC	Other Fed Gov't	Prov Gov't	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	406,812	85,350	167,865	40,109	1,745,887
2010/2011	300,000	182,340	0	32,186	282,974	0	420,655	66,389	114,189	85,351	1,484,084
2011/2012	240,000	249,400	0	43,336	280,365	0	426,775	147,901	85,132	27,889	1,500,798
2012/2013	200,000	167,000		28,347	363,321		433,718	57,348	$163,110	11,462	1,424,306

Category for Chart

Centre for Wildlife Ecology Annual Financial Report

1 April 2012 - 31 March 2013

Scholarships, Fellowships, Grants for Students

PhD

NSERC		Holly Middleton (IPS)	$7,000
NSERC		David Hope (IPS)	$15,000
SFU Fellowships etc		Birgit Schwarz (TA + GF)	$7,550
SFU Fellowships etc		Marinde Out TA + GF + Graduate Intl' research travel award	$18,888
SFU Fellowships etc		Kristen Gorman (GF)	6250
International		Marinde Out SBP Funds (The Nether-lands)	$3,900
International		Simon Valdez - CONACYT and Provost International Fellowship	$23,215
International		Kristen Gorman (Antarctic Science Bursary + SCAR Open science bursary NSF travel award +SCAR student registration waiver	$6,875
International		Sarah Thomsen - Montrose Trustee Council	$43,500
Other		David Hope - Bird Studies Canada	$6,000

M Sc

NSERC		Danielle Dagenais (IPS)	$21,000
NSERC		Elly Knight (CGSM)	$1,346
SFU Fellowships etc		Matthew Hepp (TA)	$5,474
SFU Fellowships etc		Anne Ellison - Graduate Open Bursary (Fall + Spring)	$3,238
SFU Fellowships etc		Willow English (Fall GF)	$6,250
SFU Fellowships etc		Elly Knight (Travel Award + TA +GTA/M1 Masters Assoc. Scholarship)	$4,699

General Funding for CWE

EC/Core		EC Annual Chair Funding (4th of 4 yrs)	$200,000
SFU	SFU	SFU Contribution to Faculty Salaries (Ydenberg Williams Green)	$433,718
SFU	Ydenberg RC	SFU - VPR: Contribution to Centre for Wildlife Ecology	$5,000

Generated Research Funding

Other EC	Ydenberg RC/Elliott J	Science Horizon - Effects of persistent organic pollutants in a top predator, the Cooper's Hawk, (*Accipiter cooperii)* in the Lower Mainland)	$12,000

Waterbirds

Other EC	Esler D/Ydenberg R	Western Grebes (2nd of 2 years)	$50,000

Land Birds

Provincial	Green DJ	BC Hydro/ Cooper Beauchesne and Associates Ltd.	$8,950
Provincial	Green DJ	Ontario Ministry of Natural Resources	$19,397
Other EC	Green DJ	Population trends and threats to migratory birds in the south Okanagan valley, BC, Canada (2nd of 2 years)	$15,000

Triangle Island

Other EC	Hipfner MJ	Species at Risk and Migratory Birds	
Other EC	Hipfner MJ	Scott Islands MWA $84,000 direct support to Hipfner	

Physiological Ecology

Other EC	Williams TD	Investigating priority chemicals using avian lab and field models (2nd of 3 years)	$40,000
Other EC	Williams TC/Elliott J	Research on developmental neurotoxicity of methyl mercury in birds (1st of 5 years)	$25,000
International	Williams TD	Polar Oceans Research Groups (NSF-LTER) - Climate-dependent changes in penguin population biology, physiology and nutrition (4th of 4 years)	$12,050

Shorebirds

Other	W. English	NSTP - field expenses and assistant	$5,462
Other EC	RC Ydenberg	Postdoctoral Contribution (year 1 of 3)	$25,000
International	Lank D/Ydenberg RC/B Sandercock	Kansas State University (year 2 of 3)	$24,422

Tuamotu

International	Lank D/Ydenberg RC	Critical Ecosystem Partnership Fund	$49,148

NSERC

NSERC	Green DJ	NSERC Individual Research Grant - Dispersal and migration behaviour of birds in natural and modified landscapes (4th of 5 years)	$29,000
NSERC	Ydenberg RC	NSERC Individual Research Grant - "Predation danger and the annual cycle of migrants (3rd of 5 yrs)	$50,000
NSERC	Lank D	NSERC Individual Research Grant - RGPIN171290-2008 (5th of 5 years)	$25,610
NSERC	Williams TD	NSERC Individual Research Grant- RGPIN/155395-200	$60,000
NSERC	Williams TD	NSERC T-RGPAS 429387	$40,000
NSERC	Williams TD/Zanette/Western U	NSERC RTI - Equipment Grant - "Very large outdoor aviaries"	$89,365
NSERC	Elliott J	NSERC Individual Research Grant - RGPIN/402344-2011 (2nd of 5 years)	$25,000
		Grand Total	$1,424,306
		SFU In-Kind	$120,000

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 17 publications out in 2013 through April, 12 publications in press and 9 submitted. A publication highlight this year was the well-reviewed book by Dr. Tony Williams, "*Physiological adaptations for breeding in birds*". We had a bumper year for graduates in 2012 – 2013, with 4 PhD and 6 MSc students supervised by CWE faculty successfully defending 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. Book

Williams, T.D. 2012. *Physiological adaptations for breeding in birds*. Princeton: Princeton University Press. 344 p.

B. Papers in Refereed Journals or Books

In press:

Beaubier, J.E. and J.M. Hipfner. In press. Proximate composition and energy density of forage fish delivered by Rhinoceros Auklets to nestlings at Triangle Island, British Columbia. Marine Orni-

thol.
Drake, A.E.G., C. Rock, S.P. Quinlan and D. Green. In press. Yellow Warblers (*Setophaga petechia*) show age-sex-specific carry-over effects in western North America. J. Avian Biol.
Eng, M.L., T.D. Williams and J.E. Elliott. In press. Developmental exposure to a brominated flame retardant: an assessment of effects on physiology, growth, and reproduction in a songbird, the zebra finch. Env. Poll.
Hipfner, J.M. and M. Galbraith. In press. Spatial and temporal variation in the diet of the Pacific sand lance *Ammodytes hexapterus* in waters off the coast of British Columbia, Canada. J. Fish Biol.
Hobson, K.A., G.L. Slater, D.B. Lank, R.L. Milner and R. Gardiner. In press. Agricultural lands subsidize winter diet of Pacific dunlin *Calidris alpina pacifica* at two major estuaries. Condor.
Hogan, D., D. Esler and J.E. Thompson. In press. Variation in body mass and foraging effort of Barrow's Goldeneyes during remigial molt. Auk.
Palm, E.C., D. Esler, E.M. Anderson, T.D. Williams, O.P. Love and M.T. Wilson. In press. Baseline corticosterone in wintering marine birds: methodological considerations and ecological patterns. Physiol. Biochem. Zool.
Palm, E.C., D. Esler, E.M. Anderson, T.D. Williams and M.T. Wilson. In press. Variation in physiology and energy management of wintering white-winged scoters in relation to local habitat conditions. Condor.
Rodway, M.S., K.R. Summers, J.M. Hipfner, J. van Rooyen and R.W. Campbell. In press. Changes in abundance and distribution of Pelagic Cormorants nesting on Triangle Island, British Columbia, Canada, 1949-2010. Wildlife Afield 8.
Singh, A.D., S. Wong, C.P. Ryan and S. Whyard. In press. Oral delivery of double-stranded RNA in larvae of the yellow fever mosquito, *Aedes aegypti*: implications for pest mosquito control. J. Insect Sci.
Stein, R.W. and T.D. Williams. In press. Extreme intraclutch egg-size dimorphism in Eudyptes penguins, an evolutionary response to clutch-size maladaptation. Amer. Nat.
Zanette, L.Y., K.A. Hobson, M. Clinchy, M. Travers and T.D. Williams. In press. Food use by songbirds is affected by the experience of nest predation: implications for indirect predator effects on clutch size. Oecologia.

2013

Crespi, E.J., T.D. Williams, T.S. Jessop and B. Delehanty. 2013. Life history and the ecology of stress: how do glucocorticoid hormones influence life-history variation in animals? Funct. Ecol. 27**:** 93106.
Dekker, D. 2013. High-tide flight by wintering Dunlin (Calidris alpina): a weather-dependent trade-off between energy loss and predation risk. Can. J. Zool. 91**:** 25-29.
Eng, M.L., J.E. Elliott, R.J. Letcher and T.D. Williams. 2013. Individual variation in body burden, lipid status and reproductive investment affects maternal transfer of a brominated diphenyl ether (BDE-99) to eggs in the zebra finch. Env.Tox. Chem. 32**:** 345-352.
Evans Ogden, L.J., K. Martin and T.D. Williams. 2013. Elevational differences in estimated fattening rates suggest that high-elevation sites are high-quality habitats for fall migrants. Auk 130**:** 98-106.
Hipfner, J.M., B.A. Addison and M.R. Charéte. 2013. Dietary segregation between two cohabiting species of sparrows revealed with stable isotope analysis. Can. J. Zool. 91**:** 37-40.
Hipfner, J.M. and R.W. Elner. 2013. Sea-surface temperature affects breeding density of an avian rocky intertidal predator, the Black Oystercatcher *Haematopus bachmani*. J. Exp. Marine Biol. Ecol. 440**:** 29-34.
Hipfner, J.M., L.A. McFarlane-Tranquilla, B. Addison and K.A. Hobson. 2013. Trophic responses to the hatching of offspring in a central-place foraging seabird. J. Ornithol. DOI**:** 10.1007/s10336-013-0962-3.

Hogan, D., J.E. Thompson and D. Esler. 2013. Survival of Barrow's Goldeneyes during remigial molt and fall staging. J. Wildl. Manage. 77**:** 701-706.

J.M. Hipfner, B.A., M.R. Charette. 2013. Dietary segregation between two cohabiting species of sparrows revealed with stable isotope analysis. Can. J. Zool. 91**:** 37-40.

Jaatinen, K., M. Öst, P. Gienapp and J. Merilä. 2013. Facultative sex allocation and sex-specific offspring survival in Barrow's Goldeneye. Ethol. 119**:** 146-155.

Kouwenberg, A.-L., J.M. Hipfner, D.W. McKay and A.E. Storey. 2013. Corticosterone and stable nitrogen isotopes in feathers predict egg size in Atlantic Puffins *Fratercula arctica*. Ibis 155**:** 413-418.

Lozano, G.A., D.B. Lank and B. Addison. 2013. Immune and oxidative stress trade-offs in four classes of ruffs (*Philomachus pugnax*) with different reproductive strategies. Can. J. Zool. 91**:** 212-218.

Major, H.L., A.L. Bond, I.L. Jones and C.J. Eggleston. 2013. Stability of a seabird population in the presence of an introduced predator. Avian Cons. Ecol. 8**:** 2.

Nebel, S., D.M. Buehler, S. Kubli, D.B. Lank and C.G. Guglielmo. 2013. Does innate immune function decline with age in captive ruffs *Philomachus pugnax*? Anim. Biol. 63**:** 233-240.

Ryan, C.P. and B.J. Crespi. 2013. Androgen receptor polyglutamine repeat tract length: models of selection and disease susceptibility. Evol. Appl. 6**:** 180-196.

Winter, V., J.E. Elliott, R.J. Letcher and T.D. Williams. 2013. Validation of an egg-injection method for embryotoxicity studies in a small, model songbird, the zebra finch (*Taeniopygia guttata*). Chemosphere 90**:** 125-131.

Winter, V., T.D. Williams and J.E. Elliott. 2013. A three-generational study of in ovo exposure to PBDE-99 in the zebra finch. Env.Tox. Chem. 32**:** 562-568.

2012

Agüero, M.L., P.G. Borboroglu and D. Esler. 2012. Distribution and abundance of Chubut steamer-ducks: an endemic species to central Patagonia, Argentina. Bird Conserv. Internat. 22**:** 307-315.

Anderson, E.M., D. Esler, W.S. Boyd, J.R. Evenson, D.R. Nysewander, D.H. Ward, R.D. Dickson, B.D. Uher-Koch, C.S. VanStratt and J.W. Hupp. 2012. Predation rates, timing, and predator composition for scoters in marine habitats. Can. J. Zool. 90**:** 42-50.

Crossin, G.T., A. Dawson, R.A. Phillips, P.N. Trathan, S. Adlard, K.B. Gorman and T.D. Williams. 2012. Seasonal patterns of prolactin and corticosterone secretion in an Antarctic seabird that molts during reproduction. Gen. Comp. Endocrinol. 175**:** 74-81.

Crossin, G.T., R.A. Phillips, P.N. Trathan, D.S. Fox, A. Dawson, K.E. Wynne-Edwards and T.D. Williams. 2012. Migratory carryover effects and endocrinological correlates of reproductive decisions and reproductive success in female albatrosses. Gen. Comp. Endocrinol. 176**:** 151-157.

Crossin, G.T., M. Poisbleau, L. Demongin, O. Chastel, T.D. Williams, M. Eens and P. Quillfeldt. 2012. Migratory constraints on yolk precursors limit yolk androgen deposition and underlie a brood reduction strategy in rockhopper penguins. Biol. Let. 8**:** 1055-1058.

Crossin, G.T., P.N. Trathan, R.A. Phillips, K.B. Gorman, A. Dawson, K.Q. Sakamoto and T.D. Williams. 2012. Corticosterone predicts foraging behavior and parental care in macaroni penguins. Amer. Nat. 180**:** E31-E41.

Crossin, G.T., P.N. Trathan and T.D. Williams. 2012. Potential mode of clutch size determination and follicle development in Eudyptes penguins. Polar Biology 35**:** 313-317.

Dekker, D., M. Out, M. Tabak and R. Ydenberg. 2012. The effect of kleptoparasitic Bald Eagles and Gyrfalcons on the kill rate of Peregrine Falcons hunting Dunlins wintering in British Columbia. Condor 114**:** 290-294.

Dickson, R.D., D. Esler, J.W. Hupp, E.M. Anderson, J.R. Evenson and J. Barrett. 2012. Phenology and

duration of remigial molt in Surf Scoters (*Melanitta perspicillata*) and White-winged Scoters (*M. fusca*) on the Pacific coast of North America. Can. J. Zool. 90**:** 932-944.

Dietrich, M., F. Kempf, E. Gómez-Díaz, A.S. Kitaysky, J.M. Hipfner, T. Boulinier and K.D. McCoy. 2012. Inter-ocean variation in patterns of host-associated divergence in a seabird ectoparasite. J. Biogeog. 39**:** 545-555.

Draheim, H.M., P. Baird and S.M. Haig. 2012. Temporal analysis of mtDNA variation reveals decreased genetic diversity in Least Terns. Condor 114**:** 145-154.

Ekblom, R., L.L. Farrell, D.B. Lank and T. Burke. 2012. Gene expression divergence and nucleotide differentiation between males of different colour morphs and mating strategies in the ruff. Ecol. Evol. 2**:** 2485-2505.

Eng, M.L., J.E. Elliott, S. MacDougall-Shackleton, R.J. Letcher and T.D. Williams. 2012. Early exposure to 2,2',4,4',5-pe-pentabromodiphenyl ether (BDE-99) affects mating behavior of zebra finches. Toxicol. Sci. 127**:** 269-276.

Evans Ogden, L.J., M. Martin and K. Martin. 2012. Mating and breeding success decline with elevation for the Pacific Wren (*Troglodytes pacificus*) in coastal mountain forests. Wilson J. Ornithol. 124**:** 270-276.

Farrell, L.L., D.A. Dawson, G.J. Horsburgh, T. Burke and D.B. Lank. 2012. Isolation, characterization and predicted genome locations of ruff (*Philomachus pugnax*, AVES) microsatellite loci. Cons. Gen. Res. 4**:** 763-771.

Federer, R., T.E. Hollmén, D. Esler and M.J. Wooller. 2012. Stable carbon and nitrogen isotope discrimination factors for quantifying Spectacled Eider nutrient allocation to egg production. Condor 114**:** 726-732.

Fernández, G.J. and D.B. Lank. 2012. Territorial behavior of Western Sandpipers on their non-breeding grounds: effect of sex and foraging interference. J. Field Ornithol. 83**:** 272-281.

Franks, S.E., D.R. Norris, T.K. Kyser, G. Fernández, B. Schwarz, R. Carmona, M.A. Colwell, J.C. Sandoval, A. Dondua, H.R. Gates, B. Haase, D.J. Hodkinson, A. Jiménez, R.B. Lanctot, B. Ortego, B.K. Sandercock, F. Sanders, J.Y. Takekawa, N. Warnock, R.C. Ydenberg and D.B. Lank. 2012. Range-wide patterns of migratory connectivity in the western sandpiper *Calidris mauri*. J. Avian Biol. 43**:** 155-167.

Garcia-Lau, I., A. González, A. Jiménez, M. Acosta and L. Mugica. 2012. Razón de sexos y morfometria de *Calidris minutilla* en Cuba: un análisis a partir de especimenes en colecciones cientificas. Anim. Biodivers. Conserv. 35**:** 51-58.

Gratto-Trevor, C.L., R.I.G. Morrison, D. Mizrahi, D.B. Lank, P. Hicklin and S. A.L. 2012. Migratory connectivity of Semipalmated sandpipers: Winter distribution and migration routes of breeding populations. Waterbirds 35**:** 83-95.

Heath, J.P., W.A. Montevecchi and D. Esler. 2012. A method for quantifiying consistency in animal distributions using survey data. PLoS One 7**:** e44353.doi:10.137/journal.pone.0044353.

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Hipfner, J.M. 2012. Effects of sea-surface temperature on egg size and clutch size of the Glaucous-winged Gull. Waterbirds 35**:** 430-436.

Hipfner, J.M., L.K. Blight, R.W. Lowe, S.I. Wilhelm, G.J. Robertson, R.T. Barrett, T. Anker-Nilssen and T.P. Good. 2012. Unintended consequences: How the recovery of sea-eagle *Haliaeetus* spp. populations in the northern hemisphere is affecting seabirds. Marine Ornithol. 40**:** 39-52.

Hipfner, J.M., K.M. Morrison and A.-L. Kouwenberg. 2012. Biology of Black Oystercatchers breeding on Triangle Island, British Columbia, Canada 2003-2011. Northwest. Natur. 93**:** 145-153.

Jamieson, S.E. 2012. Body mass dynamics during incubation and duration of parental care in Pacific Dunlin *Calidris alpina pacifica*: a test of the differential parental capacity hypothesis. Ibis 154**:**

838-845.
Jonker, R.M., R.H.J.M. Kurvers, A. van de Bilt, M. Faber, S.E. Van Wieren, H.H.T. Prins and R.C. Ydenberg. 2012. Rapid adaptive adjustment of parental care coincident with altered migratory behaviour. Evol. Ecol. 26**:** 657-667.
Kraus, R.H.S., H.H.D. Kerstens, P. van Hooft, H.-J. Megens, J. Elmberg, A. Tsvey, D. Sartakov, S.A. Soloviev, R.P.M.A. Crooijmans, M.A.M. Groenen, R.C. Ydenberg and H.H.T. Prins. 2012. Widespread horizontal genomic exchange does not erode species barriers among sympatric ducks. BMC Evolutionary Biology 12**:** 45.
Kraus, R.H.S., P. van Hooft, H.-J. Megens, A. Tsvey, S.Y. Fokin, R.C. Ydenberg and H.H.T. Prins. 2012. Global lack of flyway structure in a cosmopolitan bird revealed by a genome wide survey of single nucleotide polymorphisms. Molec. Ecol. doi**:** 10.1111/mec.12098.
Kurvers, R.H.J.M., B.A. Nolet, H.H.T. Prins, R.C. Ydenberg and K. van Oers. 2012. Boldness affects foraging decisions in barnacle geese: an experimental approach. Behav. Ecol. 23**:** 1155-1161.
Kurvers, R.H.J.M., S.I. van Santen de Hoog, S.E. van Wieren, R.C. Ydenberg and H.H.T. Prins. 2012. No evidence for negative frequency–dependent feeding performance in relation to personality. Behav. Ecol. 23**:** 51-57.
Kuwae, T., E. Miyoshi, S. Hosokawa, K. Ichimi, J. Hosoya, T. Amano, T. Moriya, M. Kondoh, R.C. Ydenberg and R. Elner. 2012. Variable and complex food web structures revealed by exploring missing trophic links between birds and biofilm. Ecol. Letters 15**:** 347-356.
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. 2012. Spatiotemporal associations between Pacific herring spawn and surf scoter spring migration: evaluating a "silver wave" hypothesis. Mar. Ecol. Prog. Ser. 457**:** 139-150.
Major, H.L. and A. Chubaty. 2012. Estimating colony and breeding population size for nocturnal burrow-nesting seabirds. Mar. Ecol. Prog. Ser. 454**:** 83-90.
Major, H.L., M.J.F. Lemon and J.M. Hipfner. 2012. Habitat as a potential factor limiting the recovery of a population of nocturnal seabirds. J. Wildl. Manage. 76**:** 793-799.
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