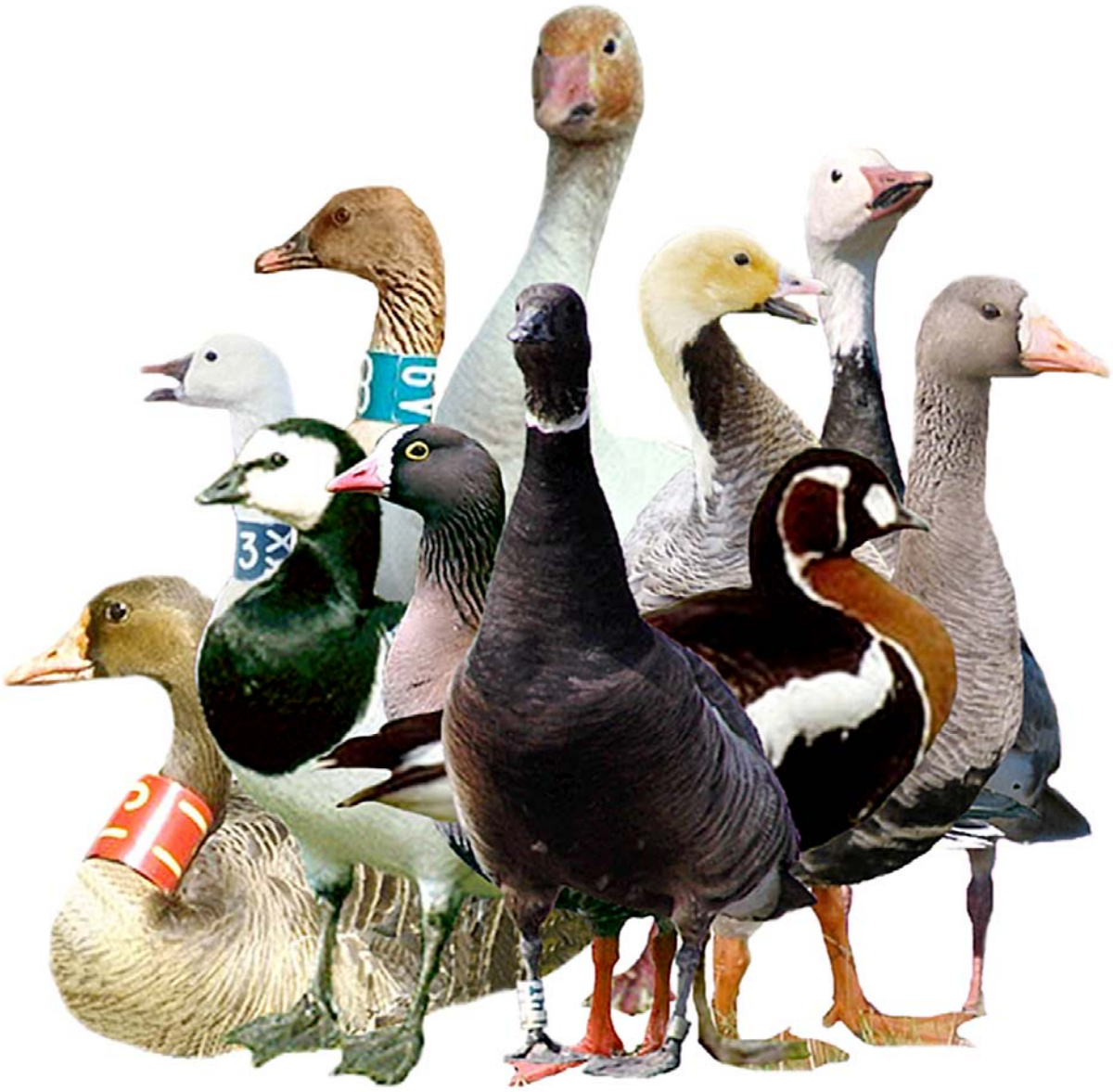
11th North American Arctic Goose Conference and Workshop



January 5 thru January 8, 2005
Reno, Nevada

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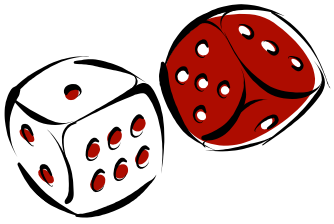

January 5 - 9, 2005

11th Annual North American Arctic Goose Conference and Workshop

Reno, Nevada

The North American Arctic Goose Conference and Workshop for more than thirty years has been the premier meeting for bringing together waterfowl managers, conservationists, students, and researchers with an interest and passion for geese. This conference has grown from a small meeting involving only those with an interest in North American Snow Geese to an international meeting addressing science, conservation and management of geese nesting throughout the arctic. This conference has been unique by providing a venue for interaction between, managers, students, and researchers. Today, a number of conservation issues face waterfowl managers from overabundant stocks of some populations to managing harvest on mixed stocks, some of which require protection. In the face of global climate change, evolving agricultural practices and increased urbanization there is a greater need than ever for fruitful interactions. The North American Arctic Goose conference has provided these interactions in the past and the Eleventh meeting promises to do so as well.

Welcome to Reno!

NAAG 2005 Plenary Speakers

Evan Cooch - Department of Natural Resources, Cornell University **- Adaptive goose harvest management: not just for ducks.**

Tony Fox - Department of Wildlife Ecology and Biodiversity, National Environmental Research Institute, Kalø, Grenåvej 12, DK-8410 Rønde, Denmark - **Recent changes in abundance amongst geese wintering in the Western Palearctic.**

Craig Ely - Alaska Science Center, U. S. Geological Survey - **Influence of breeding chronology, competition, and landscape heterogeneity on growth rates and survival of arctic-nesting geese: a non-colonial perspective.**

Bob Zink - Bell Museum, Univ. of Minnesota - **What, if any, are the taxonomic, evolutionary and conservation roles for subspecies?**

NAAG 2005

Conference Staff

CHAIRPERSON

Jim Sedinger
University of Reno, Nevada

Local Organizers

- Lew Oring - *University of Reno, Nevada*
- Chris Nicolai - *University of Reno, Nevada*
- Patrick Lemons - *University of Reno, Nevada*
- Brad Comstock - *University of Reno, Nevada*
- Bill Henry - *U. S. Fish and Wildlife Service*
- Norm Saake - *Nevada Waterfowl Association*
- Dennis Orthmeyer - *California Waterfowl Association*
- Sylvia Done - *California Waterfowl Association*

International Travel

John Takekawa (Chair) - *USGS*

- Dave Ward - *USGS*

Science Program

Mark Lindberg (Co-Chair)
University of Alaska Fairbanks

Joel Schmutz (Co-Chair)
Alaska Science Center – USGS, Anchorage, AK

- Jim Leafloor - *Canadian Wildlife Service*
- Michael Samuel - *Wisconsin Cooperative Wildlife Research Unit, University of Wisconsin, Madison*
- Dennis Orthmeyer - *California Waterfowl Association*

Student Travel

- Fritz Reid - *Duck Unlimited, Sacramento, CA*
- Joe Fleskes - *Dixon Field Station, USGS, Dixon, CA*

Poster and Presentations

- Bruce Dugger - *Oregon State University*
- Jeff Black - *Humboldt State University*

Don't gamble with the future of Geese. . . .

General Information

Welcome to the 11th North American Arctic Goose Conference and Workshop. The conference staff are here to help you. If you have any questions regarding any aspect of the conference, please do not hesitate to ask one of the staff. The Peppermill staff are also available to assist you.

Registration

Registration will be open outside the Tahoe Room beginning Wednesday, January 5, 2005 at 5:00 P.M and remain open until 8:00 P.M. Additionally, an informational registration table will be outside the Redwood-Pinion-Sequoia Rooms from 7:15 A.M. to 4:00 P.M. January 6, and from 7:45 AM to 4:00 P.M. on January 7 and 8.

Poster Session

The formal poster session is scheduled for the evening of January 7, from 6:30 – 9:00 P.M. It will be held in the Tahoe Grand Ballroom. We would ask that presenter put up their posters 5:30 P.M. and should be taken down by 9:00 P.M.

A special thank you to the Tom and Albert Seeno and the Peppermill for generously hosting tonight's event.

Name Tags and Banquet Tickets

Your name tag is your pass for admittance to all activities at the conference, and must be worn at all times. Your name tag is also your ticket into the banquet. The Banquet is scheduled for Saturday, January 8, in the Tahoe Grand Ballroom.

Event Sponsors

Intermountain West Joint Venture

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Pacific Flyway Council

In Memory

John Taylor

John Paul Taylor Jr., age 49, died Monday, September 27, 2004 at the Albuquerque Regional Medical Center after a massive stroke.

John was a quiet and proud man. He was a husband, father, wildlife biologist, friend, and teacher. In each of these he was respected, loved, and person whom pushed us all to excel. In his love and dedication to wildlife, he had a deep commitment to waterfowl and especially geese. Since 1992, John had attended all of the NAAG conferences. He served as co-chairman for the 8th and as the Mexican biologist liaison for the rest, seeking funding and assuring Mexican biologists were in attendance and at all the NAAG conferences. John understood that there were no borders for migratory birds and worked hard to remove them for biologists as well. In that, John assisted on goose surveys in Mexico for nearly 20 years, as well as traveling to Banks Island to help capture birds in 1997. The biological and especially the goose world have lost one of the preeminent spokesmen for geese and international cooperation. Those of us whom had the opportunity to work with John knew of his commitment to the resource and the enjoyment he had for being in it.

John began his career in July of 1974 as a Coop Student for the DHEW - Office of Education in Wash., DC. He then worked at Crab Orchard NWR as a Biological Science Student Trainee for a few months beginning in January 1978. He then worked for BLM in Las Cruces as a Range Technician for the summer of 1978. He was also attending classes at NMSU during these initial work years. In January 1979 he was a Student Trainee (Biology) at Sherburne NWR, MN for a semester. Then in January 1981 he was placed as the Refuge Manager (Trainee) at Minnesota Valley NWR, MN. He was there until November 1982, when he transferred to the Caribbean Islands NWR - Culebra Island, Puerto Rico as a Refuge Manager. In December 1985, he transferred to the Bosque Del Apache NWR, NM. He had been there since.

John was the first Senior Wildlife Biologist for a Land Management and Research Demonstration Refuge in the U.S. Fish and Wildlife Service. He had earned local, regional, and national honors for his work including the National Wildlife Refuge Employee of the Year in 2003 and was recognized as a Recovery Champion in 2002.

John was born October 13, 1954. He lived in Mesilla, New Mexico until he graduated from New Mexico State University in 1981. At the time of his death, he was pursuing a PhD in Range Management at New Mexico State. John found his doctoral coursework stimulating and he had the most profound regard for his professors. John was deeply loved by his family. His survivors include: his wife Maggie of Escondido, New Mexico, his two children Juan Pablo, a student at New Mexico State University, and Maria Elena, a Rotary Exchange Student in Argentina.

John understood that there were no boarders for migratory birds and worked hard to remove them for biologists as well . . .

Dr. Dennis Raveling developed some of the most important scientific management techniques for waterfowl during his short life. His book:

"Waterfowl of the World" A Comparative Perspective

features his major contributions to Waterfowl Science

Is now available!

Waterfowl of the World: A Comparative Perspective is by Dr. Dennis G. Raveling, who is widely recognized as one of the great minds of waterfowl management. After Raveling's death in 1991, Leigh Fredrickson of the University of Missouri compiled Raveling's final research into the book, which covers the breadth of comparative analysis for waterfowl all over the world. The 213-page soft cover's chapters include "Waterfowl Classification", "the Diversity of Waterfowl," and "Clutch and Egg Size."

The book is available for $29.95 through a custom printing, and proceeds go to the Dennis G. Raveling Scholarship Fund. A bulk copy price of just $25 per copy is available if five or more are purchased. Additional contributions to the fund can be included in your order check.

For your copy of the book, please send the following information

Name: _____

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Mail to:
Dennis G. Raveling Scholarship Fund, c/o Ducks Unlimited Inc.,
3074 Gold Canal Drive, Rancho Cordova CA 95670-6116

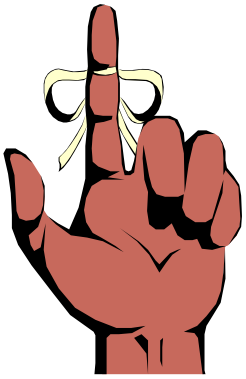
Russian Hosted Scientists

- Alexander V. Kondratyev
- Vasya Baranyuk
- Evgeny Syroechkovskiy

WELCOME!

Mexican Hosted Scientists

- Fabiola Yepez
- Gustavo Quintana
- Alberto Lafon
- Eduardo Carrerra
- Alejandro Perez-Arteaga
- Manuel Ochoa



Announcement

The 2003 International Canada Goose Symposium held in Madison, Wisconsin in March, 2003. The proceedings of the Symposium contain 266 pages of papers and abstracts of 65 delivered presentations. A small number of proceedings (paper or searchable CD) are still available and can be obtained at this meeting for $10.00. Checks should be made out to the Wildlife Management Institute/AGJV. Please see Tim Moser at this conference or if you prefer via mail at:

Tim Moser
USFWS-DMBM
Box 25486-DFC
Denver, CO 80225

11th Annual North American Arctic Goose Conference and Workshop

Plenary
Speaker Information

Tony Fox

Tony cannot remember a time when he was not interested in birds and continues to feel deeply privileged that anyone should employ him to follow his hobby! His research life started with a Ph.D spent up to his waist in peat studying the hydrological budget of a coastal Welsh raised bog. However, after two ornithological expeditions to west Greenland and two years working for the Nature Conservancy Council in the Scottish Highlands, he moved to the (then) Wildfowl Trust at Slimbridge to specialise in waterbird research, a field in which he has concentrated ever since. Although still a member of Council for the Wildfowl & Wetlands Trust, he moved from being Head of Research at WWT to the National Environmental Research Institute of the Ministry of the Environment in Denmark in 1993, where he is currently Research Professor in Wetland Ecology. His current research work is centred upon environmental impact assessment of offshore windfarms, novel applications of remote sensing techniques and population management issues. Although his professional focus continues to be on arctic geese (especially his beloved Greenland Whitefronts!) and migratory ducks in NW Europe, he has been privileged to work in the Canadian Arctic with Hugh Boyd, Bob Bromley and Ray Alisauskas.

Craig Ely

Dr. Craig Ely is a Research Wildlife Biologist for the Alaska Science Center of the USGS. Craig received his PhD (typical 7 year program) from the University of California-Davis, under the exasperation of the late Dr. Dennis Raveling. Only one of his office mates of 7 years at UC Davis claim he learned everything from him, the others all denied knowing him at all. This could explain why he was only able to find work in the Arctic. His work has ranged from genetic variation among White-fronted geese near his tent to analyzing the circumpolar distribution of this species. His 20 years of research on the Yukon Kuskokwim River Delta have explained the early departure times from Alaska and short-stopping of Cacklers in Oregon, and caused the dramatic population decline in white-fronted geese in the mid-1980s. He is considered one the worlds leading authorities on white-fronted geese.

Evan Cooch

Evan Cooch joined the Department of Natural Resources at Cornell University in 1998. He conducts research on the application of theoretical and quantitative methods to the management and conservation of natural resources. He is a population biologist with over 16 years of experience in modeling and analysis of populations. His interests focus primarily on population dynamics, theoretical ecology, parameter estimation, and management under uncertainty. While he currently has research projects ranging from white-tailed deer in NY, to black-legged kittiwake in coastal France, to disease dynamics in introduced passerine species, he has been involved with the long-term study of the breeding biology of snow geese nesting at La Pérouse Bay near Churchill, Manitoba, for his entire professional career. He currently resides at the Department of Natural History, Cornell University, Ithaca, NY 14853

Robert M. Zink

Robert M. Zink is currently a Professor in the Dept. of Ecology, Evolution, and Behavior at the University of Minnesota and the Breckenridge Chair of Ornithology, and Curator of Birds, Bell Museum of Natural History. He received his Ph.D. from the University of California-Berkeley, 1983.

His research interests are evolution, biogeography, and molecular systematics of birds at the population and species level. He feels these are exciting times to be in systematics and evolutionary biology. The integration of molecular methods and phylogenetic principles has revolutionized our ability to reconstruct phylogenetic relationships and understand evolutionary processes. My work involves molecular (DNA) studies both among and within species of birds.

The study of geographic variation, or variation within species across space, has a distinguished history. Darwin recognized the evolution of geographic differentiation as one of the first stages in the origin of species. My work focuses on describing the geography of DNA variation in natural bird populations, as research program termed "phylogeography". After gathering specimens during field expeditions, direct sequencing of mitochondrial and nuclear DNA is used. Although lab work is not always pure fun, the result - the blueprint of heredity, a DNA sequence - is truly awe inspiring. It allows us to understand the recent history of a species, which informs taxonomic, evolutionary and conservation issues.

Our recent work has emphasized phylogeographic comparisons of many species found over the same area. This research program, termed comparative phylogeography allows one to see whether species and communities have responded in concert to common evolutionary events. Most recently, our comparative phylogeographic studies have involved Eurasia. We are finding that species in the current avifauna of Eurasia have not had consistent histories.

I am also interested in the tempo of speciation. Although conventional wisdom suggested that many species alive today originated as a result of isolation caused by the last two major glacial cycles (< 150,000 ybp), our molecular studies suggest that most speciation events among our youngest species are much older. A model showed that it was not possible to distinguish the rate of bird speciation from constant rates of speciation and extinction over the last million years. The use of subspecies in evolutionary and conservation issues has been contentious. I think that the use of subspecies requires major changes, including the abandonment of the category itself.

Meeting Overview

Wednesday	Thursday	Friday	Saturday
5 General Registration ~ Opening Reception **Tahoe Grand Ballroom**	**6** Harvest Derivation Symposium and Paper Session 1 **Redwood-Sequioa-Pinion Ballrooms**	**7** Paper Session 2, 3, and 4 **Redwood-Sequioa-Pinion Ballrooms** ~ Poster Session **Tahoe Grand Ballroom**	**8** Paper Session 5 **Redwood-Sequioa-Pinion Ballrooms** ~ Closing Banquet **Tahoe Grand Ballroom**

Thursday, January 6, 2005 - Morning Session

8:00-8:15 OPENING COMMENTS – Jim Sedinger

HARVEST DERIVATION SYMPOSIUM
Organizers: Kim Scribner, Sandra Talbot and Dirk V. Derksen

8:15–8:25 **Opening Remarks -** Kim Scribner

Part I: Data needs and sources of information
Moderator: Sandra Talbot

8:25-8:40 **James O. Leafloor**. Use of harvest derivation techniques in goose management.

8:40-8:55 **Paul I. Padding, Elwood M. Martin, Daniel J. Nieman and Jack Smith.** What information can waterfowl parts collection surveys provide for goose research and management?

8:55-9:10 **James B. Shaklee, Sewall F. Young, and David J. Teel**. Creating and applying standardized genetic data sets for natural resource management: insights and lessons from the pacific salmon experience.

Part II : Analytical tools and statistical inference

9:10-9:25 **Jerry W. Hupp and Craig R. Ely.** Morphology and plumage as a basis for subspecific and population discrimination.

9:25-9:40 **James D. Nichols and J. Andrew Royle.** Methods for estimating derivation of harvest based on marked individuals.

9:40-9:55 **Keith A. Hobson.** Using stable isotope measurements of feathers to determine origin of molt in north american geese: a review and implications for management.

9:45-10:15 BREAK

Moderator: Dirk V. Derksen

10:15-10:30 **Michele M. Masuda, Jerome J. Pella, and Kim T. Scribner**. Estimating population composition of mixed harvests and individuals' sources from their traits.

10:30-10:45 **William Punch, Kim Scribner, Tim Moser, and Alexander Topchy**
Machine learning methods of individual classification based on continuous and discrete data.

Part III: Empirical data

10:45-11:00 **Craig R. Ely, Judy Gust, and Sandra Talbot.** Intra-specific phenotypic and genetic variation in greater white-fronted geese: population, flyway, and continental variation.

11:00-11:15 **Kim T. Scribner and Rainy I. Shorey.** Variation in snow and Ross's geese at species, subspecies, and population levels across North America.

11:15-11:30 **Sandra L. Talbot, Dave H. Ward, Kathryn Dickson, and Sean Boyd** Phenotypic and genetic variation in nearctic breeding brant: assessment of markers for admixture analysis.

11:30-11:45 **Kim T. Scribner, Rainy I. Shorey, and Sandra L. Talbot. V**ariation in Canada geese at species, subspecies, and population levels across North America.

11:45- 1:15 **LUNCH**

Thursday, January 6, 2005 - Afternoon Session

1:15-1:20 **11TH NORTH AMERICAN ARCTIC GOOSE CONFERENCE**
Comments – Jim Sedinger
Plenary Introduction – Joel Schmutz

1:20-2:20 **PLENARY 1 – Dr. Tony Fox.**
Department of Wildlife Ecology and Biodiversity, National Environmental Research Institute, Kalø, Grenåvej 12, DK-8410 Rønde, Denmark.
Recent changes in abundance amongst geese wintering in the Western Palearctic.

PAPER SESSION 1
MIGRATION AND WINTERING ECOLOGY
Chair: Joe Fleskes USGS Dixon Field Station

2:20-2:40 **Sean Boyd and Kate Hagmeier.** Body condition of Pacific Black Brant using the abdominal profile index (API) as a measure of fat accumulation during spring migration in British Columbia.

2:40-3:00 **Jerry Hupp, Ryan Nielson, and David Safine.** Effects of variable crowberry production on autumn-staging Cackling Geese.

3:00-3:20 **Danielle Mather*, Perry S. Barboza and David Ward.** Body composition dynamics in Pacific Black Brant wintering in Alaska and Baja California.

3:20-3:40 **Kendrew Colhoun, James Robinson, Gudmundur Gudmundsson and Preben Clausen.** Migratory behaviour of Eastern Canadian High Arctic Light-bellied Brent Geese tracked using satellite telemetry.

3:40-4:00 BREAK

4:00-4:20 **Jón Jónsson** and Alan Afton.** Snow geese wintering in southwest Louisiana use two distinct habitats – is there evidence for separate populations?

4:20-4:40 **David Ward, Lee Tibbitts, James Sedinger, Sean Boyd, and Jim Hines.** Population Structure and Migration Chronology of Wintering Brant Black.

4:40-5:00 **Katherine Hagmeier, Barry Smith, and Sean Boyd.** Estimating volumes of Black Brant during spring migration using long-term datasets.

5:00-5:20 **Manuel Ochoa Barraza, Alberto Tarrazas, Rod Drewien*, John Taylor (deceased), Michael Spindler, and Debra Webb.** Winter distribution of Greater White-Fronted Geese in the interior highlands of Mexico.

5:20-5:40 Local committee notes and updates

Friday, January 7, 2005 - Morning Session

8:00-8:05 Announcements – Jim Sedinger
Plenary Introduction – Jim Leafloor

8:05-9:05 **PLENARY 2. Dr. Robert M. Zink**.
Bell Museum, Univ. of Minnesota,
What, if any, are the taxonomic, evolutionary and conservation roles for subspecies?

PAPER SESSION 2 – LIFE HISTORY
Chair: Jim Leafloor - Canadian Wildlife Service

9:05-9:25 **Todd Boonstra* , Mark Clark and Wendy Reed.** Effects of Maternal investments on egg metabolic rates, hatching synchrony and offspring performance in Canada Geese (*Branta canadensis*)

9:25-9:45 **Michael Sertle and Michael Eichholz.** Nesting success, gosling growth, and adult body condition of giant Canada Geese in southern Illinois.

9:45-10:05 **Kiel Drake* and Ray Alisauskas.** Experimental effects of nest success on breeding site fidelity in a capital breeder.

10:05-10:25 **BREAK**

PAPER SESSION 3
GRAZING ECOLOGY
Chair: Jim Leafloor

10:25-10:45 **Richard Inger*, Graeme Ruxton, Stuart Bearhop, and James Robinson.** Factors affecting prey choice in a despotic herbivore: using individuals to predict a population response.

10:45-11:05 **Jeffrey Gleason, Kenneth Abraham, David Ankney, and James Leafloor.** Canada Goose brood-rearing behavior: further evidence of nutrient limitation on Akimiski Island, Nunavut.

11:05-11:25 **Scott McWilliams and James Leafloor.** Effects of elevated CO_2 on keystone herbivores in modern Arctic ecosystems.

11:25-11:45 **Gambling Break**

11:45-1:15 **LUNCH**

Notes:

Friday, January 7, 2005 - Afternoon Session

Announcements – Jim Sedinger
Plenary Introduction - Mark Lindberg

1:15-2:15 **PLENARY 3: Dr. Craig R. Ely,** Alaska Science Center, U. S. Geological Survey. Influence of breeding chronology, competition, and landscape heterogeneity on growth rates and survival of arctic-nesting geese: a non-colonial perspective.

PAPER SESSION 4
BREEDING ECOLOGY
Chair: Mike Samuel - Wisconsin Cooperative Wildlife Research Unit

2:15-2:35 **Frank Baldwin*, James Leafloor, Ray Alisauskas.** Canada geese in a Ross's goose colony; a protective nesting association?

2:35-2:55 **Julien Mainguy*, Gilles Gauthier, Jean-François Giroux, and Joël Bêty.** Long distance brood movements in Greater Snow Geese: effects on gosling growth and survival.

2:55-3:15 **Marie-Hélène Dickey * and Gilles Gauthier .** Effect of climatic variables on the phenology and reproductive success of Greater Snow Geese.

3:15-3:35 **BREAK**

3:35-3:55 **Christopher Nicolai*, James Sedinger, and Jason Schamber.** Consequences of individual choice of brood rearing areas and carryover effects of these decisions on reproductive measures in Black Brant.

3:55-4:15 **Vasiliy V. Baranyuk.** Warming of Arctic and Wrangel Island Snow Goose Population.

4:15-4:35 **Gustaf Samelius*, Ray Alisauskas, Keith Hobson, and Serge Larivière.** Arctic Fox Diets Revealed through Stable Isotopes: the Importance of Cached Foods.

4:35-4:55 **Götz Eichhorn, Vsevolod Afanasyev, Henk van der Jeugd, and Rudi Drent.** Breeding in relation to upstream stopovers in barnacle geese, an individual-based study relying on resightings and geolocators.

Poster Session

The formal poster session is scheduled for the evening of January 7, from 6:30 – 9:00 P.M. It will be held in the Tahoe Grand Ballroom.

We would ask that presenter put up their posters 5:30 P.M. and should be taken down by 9:00 P.M.

A special thank you to the Tom and Albert Seeno for generously hosting tonight's event.

Friday, January 7, 2005 - Evening Poster Session

Breeding Biology

1.	A. A. Mellor and R.F. Rockwell	The pattern of parasite load in lesser snow geese (Chen caerulescens caerulescens) using salt- and freshwater habitat.
2.	Jerry W. Hupp, Joel A. Schmutz, and Craig R. Ely	Migration and the prenesting interval of Emperor Geese
3.	Lecomte, N **, Gauthier, G and JF Giroux	Habitat effects on nest predation risks: the case of the Greater Snow Goose
4.	Drake Larsen**, Christopher Witte and RF Rockwell	The new Ross's goose colony at La Pérouse Bay, Manitoba.
5.	Matthew E. Reiter* and David E. Andersen	Historical trends in lemming abundance and nest success of Canada geese: evidence in support of the "bird-lemming" hypothesis at Cape Churchill, Manitoba
6.	Christopher A. Nicolai[1]** and Amy J. Nicolai[2]	Accuracy in determining laying sequence during incubation in Black Brant.
7.	Gustaf Samelius[1]**, Ray T. Alisauskas, and Serge Larivière	Population Dynamics of Arctic Foxes in Relation to Annual and Seasonal Fluctuation in Foods: the Relative Importance of Small Mammals and Geese
8	Nicolas, Ouellet, J. Larochelle and G. Gauthier	Effect of locomotion on growth in Greater Snow Goose goslings (*Chen caerulescens atlantica*)
9.	Patrick R. Lemons** and James S. Sedinger	Do Geese Manipulate the Sex Ratio of their Offspring?
10	Patrick R. Lemons** and James S. Sedinger	Fitness consequences of conspecific brood parasitism in Black Brant
11.	Joshua J. Traylor**, Ray T. Alisauskas, , Dana K. Kellett, and Stuart M. Slattery	Long-term variation in nest survival of Lesser snow and Ross's geese breeding sympatrically at Karrak Lake, NT.
12.	Harriman, V and R.T. Alisauskas	The Case of the Bloody Egg: Insight into the role of ectoparasites in population regulation
13.	Evgeny V. Syroechkovsky	Egg damping and family structure in the Western Tundra Bean Goose (Anser fabalis rossicus) in Vaigach Island, Russia.

Friday, January 7, 2005 - Evening Poster Session

Grazing Ecology

14. Jeffrey S. Gleason*, Kenneth F. Abraham, James O. Leafloor, and C. Davison Ankney — Comparative Analysis of Gosling Diets on Akimiski Island, Nunavut: early post-hatch overlap and later post-hatch segregation

15. Benoît Audet, Gilles Gauthier and Esther Lévesque — Feeding ecology of Greater Snow Goose (*Chen caerulescens atlantica*) goslings in upland tundra on Bylot Island, Nunavut

16. Kristopher J. Winiarski, Scott McWilliams, Robert R. Rockwell, and Evan Cooch — Using Stable Isotopes to Track Lesser Snow Goose Dispersal and Habitat Use at La Pérouse Bay, Manitoba

17. Susannah Ferson**, Adam Frimodig, Frank Shaughnessy, and Jeffrey M. Black — Eelgrass response to simulated Grazing by Black Brant

18. Kondratyev Alexander V. and Sophia B. Rosenfeld — Food and the feeding ecology of four sympatric geese species on the coastal plains of south Chukotka

19. Kriese, Ken — Habitat use and forage quality by a neotropical grazer: the Orinoco Goose (*Neochen jubata*) in Venezuela.

20. Dominic C. Bachman1** — Field choice of Aleutian Canada geese in relation to food quality and habitat management at Humboldt Bay National Wildlife Refuge.

Population Status

21. Dominic C. Bachman1** — The Aleutian Canada goose story from endangered to exploding

22. Josée Lefebvre and Luc Bélanger — The Greater Snow Goose: a new sustainable and integrated management plan…

23. Michael L. Usai — Evidence of source-sink dynamics in a suburban Canada Goose (*Branta canadensis*) population

24. John Y. Takekawa, Julie L. Yee, and Josh T. Ackerman — Estimating identification error for similar Subspecies: Distinguishing Tule Greater White-fronted Geese in the Pacific Flyway

Friday, January 7, 2005 - Evening Poster Session

25. Maynard Axelson. — Washington Brant Foundation: Preserving Brant Legacy on our Pacific Coast

26. Scribner, Kim — Composition of Canada Goose harvests in Michigan 1998-2002: A genetic analysis over different spatial and temporal scales.

Migration and Wintering

27. Joshua T. Ackerman, John Y. Takekawa, Dennis L. Orthmeyer, Joseph P. Fleskes, Julie L. Yee, and Kammie L. Kruse — Response of Greater white-fronted geese to the Central Valley Joint Venture: Change in wintering ecology over a decade

28. Joshua T. Ackerman, John Y. Takekawa, Kammie L. Kruse2 Dennis L. Orthmeyer, Julie L. Yee, Craig R. Ely, David H. Ward, Karen S. Bollinger, and Daniel M. Mulcahy — Heart rates of Tule Greater White-fronted Geese in response to Human Disturbance Using Radio Telemetry

29. Kyle A. Spragen**, Kaysie K. Logue — Gizzard content as evidence of Black Brant Staging Areas

30. Joel A. Schmutz*, Edward J. Mallek, Paul L. Flint, Dirk V. Derksen, and Carl J. Markon — Spatial and Temporal Patterns of Lake use by molting geese in the Teshekpuk Lake Special Area

31. K. F. Abraham, R. K. Ross, L. R. Walton, J. S. Gleason, and H. G. Lumsden — Brant in Ontario and Western James Bay

32. Mark P. Virtiska and Susan Sullivan — Abundance and distribution of spring-staging Lesser Snow and Ross's Geese in Nebraska's Rainwater Basin

33. Emily R. Bjerre** and Jeffrey M. Black — Optimal Grit Acquisition by Black Brant

34. Jeffery M. Black and D. Lee — Barnacle goose movements and fidelity among sites

Friday, January 7, 2005 - Evening Poster Session

35.	Kevin M. Dawson** and Jeffrey M. Black	Molt Migration In Resident Canada Geese
36.	Jeremy Todoroff **	Flock size and field use of Aleutian Cackling geese during spring staging
37.	A. Pérez-Arteaga, K.J. Gaston, S.F. Jackson, E. Carrera	Priority sites for waterfowl in Mexico
38.	Yépez Rincón and Fabiola D.	History and Current Trends of Grain Sorghum Production and Wintering Geese in Tamaulipas, México.

Saturday, January 8, 2005 - Morning Session

8:00-8:05 Announcements – Jim Sedinger
Plenary Introduction – Rocky Rockwell

8:05-9:05 **PLENARY 4 – Dr. Evan G. Cooch**,
Department of Natural Resources, Cornell University**.**
Adaptive goose harvest management: not just for ducks**.**

PAPER SESSION 5
POPULATION DYNAMICS, STATUS, AND MANAGEMENT
Chair: Mark Lindberg – University of Alaska Fairbanks

9:05-9:25 **Ray Alisauskas, Robert Rockwell, Dale Caswell, Evan Cooch, Kiel L. Drake, Stuart M. Slattery, Dana K. Kellett, James O. Leafloor, and Eric Reed.** Effect of population reduction efforts on survival of mid-continent Lesser Snow Geese.

9:25-9:45 **Gilles Gauthier, Anna Calvert, and Eric Reed.** Impacts of special conservation measures on demographic parameters in Greater Snow Geese.

9:45-10:05 **Ray Alisauskas, Kiel Drake, Stuart Slattery, and Dana Kellett.** Neckbands, harvest, and survival of Ross's geese from Canada's central arctic.

10:05-10:25 **BREAK**

10:25-10:45 **F. Dale Caswell[1] and Katherine M. Meeres[2]**
Lesser Snow Goose population trends across the nesting colonies – An Update.

10:45-11:05 **Joel Schmutz, Bryce Lake, and Julie Morse.**
Harvest and climate influences on annual survival and breeding propensity of Emperor Geese.

11:05-11:25 **David Miller*, James Grand, Thomas Fondell, Martin Drut, and Robert Trost.** Seasonal estimate of survival, detection, and observability for Dusky Canada Geese.

11:25-11:45 **Jason Caswell*, Jim Leafloor, and Ray Alisauskas.** Neckband hunting - can it affect survival estimates?

11:45-1:15 **LUNCH**

Saturday, January 8, 2005 - Afternoon Session

POPULATION DYNAMICS, STATUS, AND MANAGEMENT Continued
Chair: Joel Schmutz - Alaska Science Center - USGS

1:15-1:35 **Paul Conn*, William Kendall, Michael Samuel.** A general model for the analysis of mark-resight, mark-recapture, and band recovery data under tag loss.

1:35-1:55 **Bryce Lake*, Mark Lindberg, Joel Schmutz, Craig Ely, Michael Anthony, William Eldridge, and Fred Broerman.** Spatial and temporal variation in body mass of prefledging Emperor Geese: Effects of interspecific goose densities and grazing lawn availability.

1:55-2:15 **Kiel Drake* and Ray Alisauskas.** Breeding dispersal by Ross's Geese in the Queen Maud Gulf metapopulation.

2:15-2:35 **Nicholas Lecomte*, Gilles Gauthier, Louis Bernatchez, Jean-François Giroux.** Population structure of a Greater Snow Goose colony.

2:35-2:55 **Sandra Talbot, George Sage, Judy Gust, Jolene Rearick, David Ward, Sean Boyd, Kathy Dickson, and James Robinson.** Genetic analysis of North American Brant populations.

2:55-3:15 **Christopher Williams, Michael Samuel, Vasiliy Baranyuk, Evan Cooch, and Don Kraege**. Winter fidelity and apparent survival of Lesser Snow Goose populations in the Pacific Flyway.

3:15-3:35 **BREAK**

3:55-4:15 **Barwolt Ebbinge.** Poor breeding causes persistent decline in Dark-bellied Brent Geese.

4:15-4:35 **Anne Mini* and Jeffery Black.** Expensive management: quantifying the costs of an active hazing program in Aleutian Canada Geese.

4:35-4:55 **Michael Samuel, Diana Goldberg, Daniel Shadduck, William Johnson, and Michael Spindler.** Reservoirs for avian cholera: wetlands vs. birds.

4:55-5:15 **Julie Blanchong, Michael D. Samuel, and Gene Mack.** Multi-species patterns of avian cholera mortality in Nebraska's Rainwater Basin.

Closing Banquet

6:00 – No host cocktails
6:30 – Dinner

- Table Wine
- Caesar Salad
- Slow Roasted Prime Rib
- White and Dark Godiva Chocolate Mouse with Brandied Cherries
- Coffee or Tea

Raveling Scholarship Raffle!

Abstracts

Contributed Papers

Abstracts are arranged in order of Paper Session. Abstracts were reformatted but otherwise printed as provided by authors except for minor editing style and syntax. Information contained herein should NOT be cited without first obtaining author approval.

Recent Changes In Abundance Amongst Geese Wintering In The Western Palearctic

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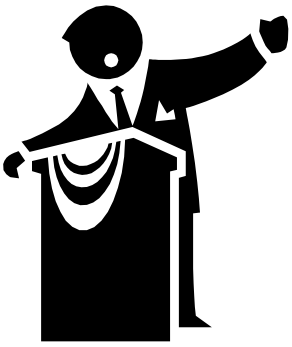
With the exception of the Lesser White-fronted Goose, *Anser erythropus*, all of the 20 naturally occurring (mostly arctic breeding) goose populations of 8 species in the Western Palearctic have generally exhibited favourable conservation status over the last two decades. However, reliable census data extending over more than 20 years exist for only ten of these stocks. Amongst these, all show increases in number of 2-8% per annum, but all demonstrate contrasting population trajectories, dependent in part on their huntable status throughout the annual cycle. None at present show the spectacular increases of snow geese witnessed in North America. Several have shown periods of relative stability interspersed by periods of rapid increase, but others show recent stabilisation or declines in numbers that give some cause for concern for their future status, especially in the face of global climate and agricultural change. Data from regular age sampling in the fall flight show declining production and signs of density dependence in some populations. Some consideration will be given to the effects of inter-specific competition on future goose population trends. Data from various long-term monitoring programmes will be summarised, stressing the need for improved mechanisms to track population changes to enhance our understanding for effective management of these populations.



What, If Any, Are The Taxonomic, Evolutionary And Conservation Roles For Subspecies?

Robert M. Zink

Bell Museum, Univ. Minnesota, St. Paul, MN 55110

Subspecies became prevalent with the adoption of the biological species concept. The subspecies category was used to name entities that differed in some way, usually in phenotypic characteristics, but had not attained reproductive isolation. Review of the subspecies literature shows that often times different taxonomists placed boundaries in different places. This underscores that fact that many subspecies are subjective, arbitrary divisions of single character clines. However, by virtue of having a formal name in the Linnean classification, subspecies are often used by non-taxonomists in ways requiring that the taxon has a real, historical meaning, in the same way that the species category does. Thus, it has been instructive to use recent molecular methods to test whether subspecies of birds are in fact distinct historical entities. Based on mtDNA studies, it was found that less than 5% of subspecies from continentally distributed birds are valid historical entities. Thus, using subspecies as a proxy for an evolutionary significant unit, a distinct population segment, or a management unit, without molecular testing carries a high risk that it will be misleading. In this talk I review recent molecular studies of subspecies of Canada Goose (*Branta canadensis*). Although early work suggested that some subspecies were valid, more recent work suggests otherwise. In contrast the evolutionary split between large-bodied and small-bodied geese is strong evidence of their species status. Lack of genetic distinctiveness of currently defined subspecies indicates that they do not qualify as entities for specific preservation attention. If the traits that were used to define subspecies can arise rapidly and are not especially historically significant (as is body size), then management might be best focused on populations with the highest demographic potential, irrespective of subspecies boundaries. That is, trying to preserve all the apparent subspecific differences might not be in the best long-term interests of the species, given that these differences are not markers of significant evolutionary history.

Influence Of Breeding Chronology, Competition, And Landscape Heterogeneity On Growth Rates And Survival Of Arctic-Nesting Geese: A Non-Colonial Perspective .

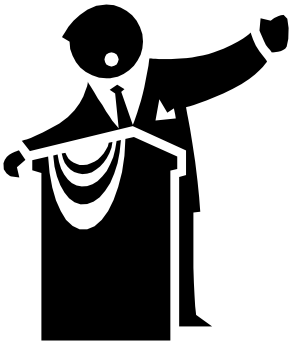
Craig R. Ely

Alaska Science Center, U. S. Geological Survey, 1011 E. Tudor Road, Anchorage, AK 99503

Variation in growth rates of arctic and sub-arctic herbivores has been shown to be mediated by forage availability and quality, and play a role in population regulation by influencing individual survival and breeding propensity. In arctic-nesting geese, selective pressures purportedly favor early breeding, as the nutritional quality of food plants available to goslings generally declines throughout the brood rearing period. Hence, earlier-hatching goslings have been reported to grow more rapidly, attain greater asymptotic body mass, and be more likely to survive to reproductive age than goslings hatching later. However, most studies examining factors influencing gosling growth rates and survival have been based on colonial-nesting species, where intra-specific competition for limited resources is likely greater than in more dispersed nesting species. Indicative of such competition is the extensive post-hatch dispersal exhibited by many colonial breeders; a behavior not necessarily typical of non-colonial species.

I present data examining factors influencing temporal and spatial variation in the growth rate of a non-colonial nesting species, the cackling Canada goose (*Branta canadensis minima*), a tundra-nesting bird that breeds on the outer Yukon-Kuskokwim Delta, Alaska. Over a sixteen-year period we documented growth rates of goslings relative to intra- and inter-seasonal variation in timing of hatch and densities of intra- and inter-specific competitors. During five years of the study we quantified annual, seasonal, and spatial variation in quality and availability of primary forage plants to determine the consistency with which cackling goose goslings hatched relative to the timing of peak nutrient content of their forage plants. We found that annual variation in the timing of nesting and biomass accumulation in forage plants were strongly correlated to environmental variables including temperature and snow cover in May and June. Goslings exhibited significant annual and spatial variation in growth rates related to the quality and availability of forage plants, with forage plant availability being a function of gosling density, which was in turn mediated by overall nesting success. Food abundance during brood rearing was likely greater than for colonial nesting species, as there was little cost incurred in terms of growth rates for late-hatching goslings compared to colonial-nesting geese. Variation in gosling growth rates influenced annual variation in post-fledging survival, but not in all years of study.

Life history characteristics of dispersed-nesting geese can vary markedly from colonial nesting species, with traits influencing demographic parameters being of particular interest. Disperse-nesting geese may be under less-restrictive density-dependent mechanisms during the brood rearing period than their colonial-nesting counterparts, and have a concomitantly altered foraging strategy.



Adaptive Goose Harvest Management: Not Just For Ducks

Evan G. Cooch

Department of Natural Resources, Cornell University

Adaptive management provides a useful framework for making sequential decisions in the presence of uncertainty. To date, most applications of adaptive management to waterfowl harvesting have relied on simple scalar population models; such scalar models assume all individuals in the population have the same responses to environmental stressors. In contrast, goose populations characteristically have significant age structure as a result of relatively high survival rates and significant age-dependent productivity. Application of adaptive harvest management to such structured populations is complicated by relative differences among age- or stage-classes of individuals in their relative contribution to the demography of the population. Moreoever, management objectives for goose populations are increasingly directed at population control. In most cases, the regulatory objective will be not be to maximize yield (as is typically the case for ducks), but rather to at minimum hold the population within the bounds of a stakeholder-determined range, consisting of a maximum and minimum tolerable population size (although the two objectives, maximizing yield, and population control, are not mutually exclusive). Often, this desired range would be significantly below the effective carrying capacity of the ecosystem, such that most significant demographic processes of the population (in particular, adult survival) are not or are only weakly influenced by density-dependence. In such cases, harvest represents the only mechanism regulating (controlling) the dynamics of the population. When populations are structured (either based on age or size), the optimal harvest vector can be described as a set, the elements of which are determined by (i) the number of age- or stage-classes, and (ii) the reproductive value vector at the time of harvest. These dependencies make the optimal control of structured populations complex, for several reasons. First, for geese, precise stage-specific harvest is clearly not possible, and is only under partial control by managers (generally via a vulnerability vector). Second, the equilbrium harvest set is a function of the age- or stage-specific survival and fertility schedule at the time of harvest. Both parameters must be estimated from data from individuals of known age- or stage-class, contributing to uncertainty of the status of the resource at the time of harvest. Finally, the responses of structured populations to harvest is uncertain, both 'mathematically', and demographically. Although specification of the equilibrium harvest set under even simplistic assumptions may be informative under these uncertainties, and may be useful in devising conservative (or minimal) harvest strategies in some cases, much work remains on how best to harvest goose populations when the objective is to control numbers, rather than the simplistic paradigm of 'more is better'; while this may generally be acceptable for ducks, goose overabundance is no longer evidence of 'management success'.

HARVEST DERIVATION SYMPOSIUM

Thursday, January 6

Use of Harvest Derivation Techniques In Goose Management

JAMES O. LEAFLOOR

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Three genera of North American geese (*Anser, Branta, Chen*) are divided into 7 species, 19 subspecies, and 34 populations for management purposes. Harvest is often an important source of adult mortality in geese, and population-specific management allows for greater flexibility and control of hunting regulations across a species' geographic range. Population designations are often based on relatively discrete nesting and/or wintering distributions of a group of geese within a subspecies. However, populations that are not easily distinguishable often overlap geographically during some portions of the annual cycle. This can greatly complicate harvest management, particularly when management objectives differ among closely related populations. Population-specific harvest monitoring requires that harvested birds from these populations can be differentiated from one another. Several techniques have been developed to accomplish this, each having their own limitations, and mainly have been used to estimate harvest composition in areas with multiple sympatric populations. In addition, harvest derivation techniques have been used in assessing relative vulnerability of different populations to harvest, in evaluations of the effectiveness of regulation changes, and in identification of molt migrants during banding operations on northern nesting areas. Future changes in size and distribution of goose populations will likely increase the need for accurate harvest derivation techniques.

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What Information Can Waterfowl Parts Collection Surveys Provide For Goose Research And Management?

PAUL I. PADDING*[1], ELWOOD M. MARTIN[1], DANIEL J. NIEMAN[2] AND JACK SMITH[2]

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For several decades, U. S. and Canadian hunters participating in waterfowl parts collection surveys have provided managers with tail fans from the geese they harvested. These surveys were initially designed to provide species and age composition data derived directly from the tail fans, as well as temporal and geographic distribution data reported by the hunters who submitted the tail fans. Combining these data with estimates of total goose harvest derived from annual questionnaire surveys yields species-specific harvest estimates at the flyway, state and county levels, and/or estimates for early, regular and late seasons. In the U. S., we recently began collecting goose primary feather tips in addition to tail fans, to improve our ability to age geese accurately. The Canadian Wildlife Service and the Mississippi, Central and Pacific Flyways in the U. S. also measure Canada goose (*Branta canadensis*) tail feathers to classify the birds according to size. Along with harvest location data, the tail measurement can be used to identify the subspecies/population of the bird, thereby providing subspecific/population harvest estimates. This enables managers to refine their harvest management regimes for key Canada goose populations. Waterfowl parts collection surveys can also provide researchers with large biological samples of goose feathers, along with reliable harvest location and date data, to help determine harvest derivation.

Creating And Applying Standardized Genetic Data Sets For Natural Resource Management: Insights And Lessons From The Pacific Salmon Experience

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[2]NOAA Fisheries NWFSC Manchester Lab, PO Box 130, Manchester, WA 98535

Population genetic approaches can provide high resolution, cost effective data for discriminating different breeding populations and accurately estimating their contributions to mixed commercial and sport harvests. However, large-scale regional harvest management and conservation programs require the integrated contributions of multiple agencies and laboratories because harvests/impacts: often impact stocks of diverse geographic origins, often span political/national jurisdictions, and are often co-managed by multiple agencies. An informal consortium of genetics labs has worked to develop regional, coast-wide, and Pacific Rim fishery management and conservation approaches for Pacific salmon and other salmonids since 1986. Initial efforts involving up to six laboratories resulted in large, standardized allozyme data sets and mixed-fishery analyses for Chinook (254 populations, 45 loci), chum (273 populations, 20 loci), pink (175 populations, 10 loci), and sockeye salmon (165 populations, 14 loci) and for steelhead (103 populations, 42 loci). Current initiatives are focused on developing microsatellite DNA approaches for Chinook salmon (105 – 250 populations, 15 loci) as well as other species such as sockeye, coho, chum, and bull trout. Because the information content of shared databases is determined by the weakest contributions, inter-lab differences in procedures, instrumentation, infrastructure, and philosophy can limit both power and resolution. Building a large, multi-lab, standardized database is time consuming, expensive, and challenging. Keys to successful genetic approaches include: clearly defined goals and objectives, buy-in by all relevant agencies and laboratories, adequate and representative sampling of baseline populations and mixtures, an agreed-to suite of core loci to be screened, consistent and objective methods of genotyping/allele binning, QA/QC procedures to evaluate and promote data comparability across labs and over time, standardized statistical methods for baseline creation and mixture analysis, and open sharing of methods and data among labs. Flexibility and compromise in the interest of adopting the best approaches and building consensus are essential to success.

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Morphology And Plumage As A Basis For Subspecific And Population Discrimination

JERRY W. HUPP*[1] AND CRAIG R. ELY[1]

[1]Alaska Science Center, U.S. Geological Survey, 1011 E. Tudor Road, Anchorage, Alaska U.S.A.

Phenotypic characteristics have been widely used to discern the breeding origins of harvested geese in admixed migration or winter groups. We review measurement and analysis of geographic variation in anserine morphology and plumage, and discuss how phenotypic characteristics have been used to assess harvest composition. Critical assumptions of such programs are that phenotypic measurements on nesting areas are representative of local populations, and that measurements on harvest areas are adequate to discern breeding origin. Potential sources of error include the presence of molt migrants on nesting areas, undetected clinal variation, hybridization, environmental plasticity in growth, and observer variability in measurements. We discuss in detail geographic variation in morphology and plumage of Pacific Flyway Canada geese and the use of phenotypic characteristics to assess composition of harvest in western Oregon and southwest Washington.

Methods For Estimating Derivation Of Harvest Based On Marked Individuals

JAMES D. NICHOLS*[1] AND J. ANDREW ROYLE[1]

[1]U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, MD 20708

Derivation of the harvest refers to the proportional composition of a specific harvest (e.g., from some specified area of interest) with respect to different source areas (e.g., breeding ground areas). The estimation problem is thus one of trying to estimate the multinomial probabilities of a bird in the harvest of area *a* originating from source areas *b*, *c*, etc. Estimators for these probabilities can be obtained using band recovery data from multiple breeding ground areas. These estimators can be obtained using either traditional capture-recapture thinking or a Bayesian approach. Derivation can also be estimated using a reverse-time capture-recapture approach. We consider recently-developed combination methods that permit estimation using marked animals combined with data on isotopic or genetic signatures that provide additional information about breeding ground origin. Initial models have been based on the assumption of unambiguous signature data, but we show how to develop models permitting misclassification as well. Finally, we emphasize the importance to derivation analyses of abundance information on the breeding ground or source areas.

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Using Stable Isotope Measurements Of Feathers To Determine Origin Of Molt In North American Geese: A Review And Implications For Management

KEITH A. HOBSON

Canadian Wildlife Service, 115 Perimeter Road, Saskatoon, SK, Canada, S7N 0X4

The measurement of naturally occurring isotopes of several elements in bird feathers can yield information on the origin and foodweb associated with feather growth. For example, the measurement of carbon and nitrogen stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) can readily distinguish between terrestrial and marine or boreal vs. grassland biomes and deuterium (δD) measurements can reveal approximate latitude of origin across most of the North American continent. In combination, stable isotope measurements of feathers and other tissues can potentially be used to evaluate structure in goose populations and so provide an important new tool in goose harvest management. In this paper I will review the basic principles of isotopic tracking of wildlife and evaluate specific applications to North American goose management issues. Examples from other species groups will include recent analyses of Sandhill Cranes from the Central Flyway and Lesser Scaup from all major flyways. Emphasis will be placed on consideration of both advantages and disadvantages of the stable isotope approach as a fingerprinting tool.

Estimating Population Composition Of Mixed Harvests And Individuals' Sources From Their Traits

MICHELE M. MASUDA*[1], JEROME J. PELLA[1], AND KIM T. SCRIBNER[2]

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[2]Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824-1222, USA.

Many species of animals, including waterfowl, are comprised of populations that are separated geographically at breeding and have limited genetic exchange. However, their members migrate from the breeding grounds to places where the populations mix. Estimation of the population composition of such mixtures and of the source identities of mixture individuals may be invaluable for scientific studies. In particular, if the species is harvested when occurring in the mixtures, the estimation is vital for management to sustain the separate populations. Traits of the mixture individuals, such as dimensions of their body parts, chemical composition of hard structures and growth patterns on them, or better, their genotypes at multiple loci, can be used for the estimation when the character distributions vary among the populations. The main area of application has been in Pacific salmon fisheries where development of the technique has matured. A review is provided of statistical models and estimation methods, and these are illustrated by applications to genetic microsatellite samples of breeding populations of Richardson's (*B. h. hutchinsii*, $n = 1$), interior (*B. c. interior,* $n = 4$), and giant (*B. c. maxima,* $n = 8$) Canada geese (total $n = 964$ individuals).

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Machine Learning Methods Of Individual Classification Based On Continuous And Discrete Data

WILLIAM PUNCH*[1], KIM SCRIBNER[2], TIM MOSER[3], AND ALEXANDER TOPCHY[1]

[1]Department of Computer Science and Engineering, Michigan State University, East Lansing, MI 48824-1222, USA.
[2]Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824-1222, USA.
[3]U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Lakewood, CO, USA.

Classification is a fundamental activity in systematic biology and has many applications in management of wildlife populations. Classification is performed by measuring traits that occur in different states for different individuals. Classification methods used in machine learning (e.g., artificial neural networks, decision trees, and k-nearest neighbor clustering) are rarely used in avian studies. Using simulated and empirical data representing a wide range of inter-group variance in discrete genetic and continuous morphological characters, we compared different nonparametric machine learning techniques with parametric likelihood and multivariate Gaussian models for purposes of assigning individuals to their population of origin. For genetics data, classification error rates associated with likelihood and neural network classifiers were consistently lower that k-nearest neighbor and decision tree classifiers. The relative performance of each machine learning classifier improved relative to likelihood estimations, suggesting an ability to "learn" and utilize properties of empirical genetic arrays intrinsic to each group. Using morphological data from mid-continent Canada geese (*Branta canadensis interior and B. c. maxima*) k-nearest neighbor, decision trees, and multivariate Gaussian classifiers consistently outperformed univariate and standard multivariate methods. The utility of machine learning methods are discussed in light of known variance across North American goose species, subspecies and geographic populations.

Intra-Specific Phenotypic And Genetic Variation In Greater White-Fronted Geese: Population, Flyway, And Continental Variation

CRAIG R. ELY*, JUDY GUST, AND SANDRA TALBOT

Alaska Science Center, U.S. Geological Survey, 1011 E. Tudor Rd., Anchorage, Alaska 99503, USA

Greater white-fronted geese (*Anser albifrons*) in North America breed nearly continuously across tundra and boreal forest habitats from the Yukon-Kuskokwim Delta and Seward Peninsula in western Alaska to the western shore of northern Hudson Bay. They are currently managed according to flyway boundaries with geese breeding south and west of the Alaska Range in Alaska migrating down the Pacific Flyway, and geese breeding elsewhere in Alaska and across Canada constituting the mid-continent population that migrates down the Central and Mississippi Flyways. All white-fronts within each flyway are generally accorded the same management status, despite analyses of leg-band data identifying within-flyway population differences in migration behavior, distribution, and survival rates. Discrimination among white-front populations has proven difficult because of continuously varying phenotypic traits among sympatric-wintering birds. Implementation of population-specific management practices, particularly as they may relate to harvest of admixed wintering populations, necessitates recognition of population-specific identifiers, no matter the nature of the marker. We present information on phenotypic variation of greater white-fronted geese from across their breeding range in North America, and compare our findings with similar data from Palearctic populations. Genetics data is also presented for geese from 6 breeding areas representing populations from two flyways in North America, as well as Asia and Greenland. Genetics data include information (12 - 30 individuals per population) from mitochondrial DNA (400-600 base pairs of control region and the cytochrome B gene), intron 7 of the nucelar beta fibrinogen gene (307 base pairs) and 7 nuclear microsatellite loci. We interpret our findings relative to individual movement data and potential gene flow, surmised from 5 decades of leg band recovery data.

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Variation In Snow And Ross's Geese At Species, Subspecies And Population Levels Across North America

KIM T. SCRIBNER*[1] AND RAINY I. SHOREY[1]

[1]Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824-1222, USA.

White geese in the genus Chen (*Chen caerulescens and C. rossii*) are among the most numerous species of waterfowl. These species breed across large and discontinuous segments of tundra habitat from Wrangel Island in northeastern Russia to Greenland. Two species and three subspecies are recognized and multiple populations have snow geese have been identified for purposes of management. The abundance and breeding and wintering distributions of Ross's geese and blue and white color phases of lesser snow geese have changed considerably in recent years. Morphological similarity and mixing of Ross's geese with lesser snow geese in western and central North America are impediments to single-species and population-specific management. We highlight background on migration and changes in abundance and distribution in light of known information on phenotypic and genetic differentiation at subspecies and population levels.

Phenotypic And Genetic Variation In Nearctic Breeding Brant: Assessment Of Markers For Admixture Analysis

SANDRA L. TALBOT*[1], DAVE H. WARD[1], KATHRYN DICKSON[2], AND SEAN BOYD[3]

[1]Alaska Science Center, U.S.G.S., 1011 E. Tudor Road, Anchorage, AK, USA 99503
[2]Canadian Wildlife Service, 31 St. Joseph Blvd, Hull, QC, Canada K1A 0H3
[3]Canadian Wildlife Service, RR1- 5421 Robertson Road, Delta, BC, Canada V4K 3N2

Brant (*Branta bernicla*) in North America breed nearly continuously across coastal habitats from the Yukon-Kuskokwim Delta in Alaska to the western shore of northern Ellesmere Island. They are currently managed according to subspecific or stock designations. Brant geese breeding in Alaska, northeastern Russia, northwestern Canada (Black Brant) and western high arctic (WHA brant) migrate south along the Pacific Flyway to winter in lagoons along the North American Pacific coast. Brant geese breeding in northeastern Canada winter either in Ireland (eastern high arctic brant), or along the Atlantic coast of North America (Atlantic Brant). Band returns suggest WHA brant winter in coastal lagoons along northwestern Washington State, admixing with Black Brant from populations in Alaska and northwestern Canada. Discrimination among brant forming admixed wintering populations is difficult because phenotypic traits vary among sympatric-wintering birds. Population-specific management practices, particularly as they may relate to harvest of admixed wintering populations, would benefit from population-specific markers, regardless of the type of marker used. We present information on phenotypic and genetic variation of brant from across several breeding populations in North America. Genetic data include information (16 - 42 individuals per population) from 400 base pairs of the mitochondrial DNA control region, 12 autosomal, and two z-specific nuclear microsatellite loci, and are compared with similar data from populations in Europe (the Netherlands) and Russia (Lena River Delta). We examine the applicability of these markers for determining the source of individuals in admixed populations, and interpret our findings relative to information from mark-resighting data.

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Variation In Canada Geese At Species, Subspecies, And Population Levels Across North America

KIM T. SCRIBNER*[1], RAINY I. SHOREY[1], AND SANDRA L. TALBOT[2]

[1]Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI 48824-1222, USA.
[2]Alaska Science Center, Biological Resource Division, U.S. Geological Survey, 1011 E. Tudor Rd., Anchorage, AK 99503

Two species and eleven subspecies of Canada geese (*Branta canadensis and B. hutchinsii*) breed across the greatest area and greatest diversity of habitats of any goose species in North America. Canada geese are primarily managed on the basis of winter distribution, following Flyway boundaries. Subspecies and breeding populations are recognized within each Flyway and management is pursued at subspecies and breeding population levels. Subspecies and populations co-occur as mixtures at most times during migration and on wintering areas. Recent harvest management efforts have been directed at increasing rates of mortality of abundant resident large-bodied subspecies and populations while ensuring the viability and diversity of other numerically less abundant northern-breeding migratory groups. To accomplish management goals, there exists a tremendous diversity in plumage, morphology, and genetic characters that provide sufficient variation identify breeding location of origin at many spatial and taxonomic levels prescribed by managers. We describe geographic and taxonomic variation in phenotypic and genetic characters across North America. We discuss the mechanisms that have led to observed diversity, and how successfully characters have been used in harvest derivation.

Paper Session One - Migration and Wintering Ecology

Thursday, January 6

Body Condition of Pacific Black Brant (*Branta Bernicla Nigricans*): Using The Abdominal Profile Index (API) As A Measure Of Fat Accumulation During Spring Migration In British Columbia.

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Each spring, roughly 25% of the Pacific Flyway Brant Population (*Branta bernicla nigricans*) stages in the Strait of Georgia, British Columbia. From 1999 to 2004, we used the abdominal profile index (API) as a surrogate of body condition to measure fat accumulation. Mean API scores differed significantly across years for the two most important staging sites in B.C. In the Parksville-Qualicum area, scores were relatively high in 1999 and 2000 and did not differ but scores were significantly lower in each of the following four years (2001-2004 inclusive). On the Fraser River delta, scores in 2001 were significantly lower than in 2000. The lower API scores in the years 2001-2004 could be due to a reduction in food resources or to an increase in disturbance rates.

Each spring, Pacific Herring (*Clupea pallasi*) spawn in the Strait and one of the largest, traditional spawning events occurs near the Parksville-Qualicum area. Brant forage intensively on the eggs when present. However, a preliminary examination of the spawn data suggests that the relationship between spawn biomass and mean API scores is weak or non-existent.

Disturbance rates to Brant in the Strait are among the highest recorded globally for Arctic geese, with the largest single source of disturbance being Bald Eagles (*Haliaeetus leucocephalus*). Eagle numbers have been increasing at 8% per year and both eagle and human disturbance rates have increased over the period 1999-2004.

To manage spring staging Brant in B.C., we need a better understanding of the relationships between: 1) staging variables of individual body condition, timing of migration and length of stay, 2) staging variables and food (eelgrass abundance, herring spawn) availability and rates/sources of disturbance, and finally 3) staging variables and fitness (annual survival and reproductive rates).

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Effects of Variable Crowberry Production on Autumn- Staging Cackling Geese

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We examined the effects of spatial and temporal variation in berry yield of crowberry (*Empetrum nigrum*) on autumn-staging cackling geese (*Branta hutchinsii*) on the Izembek National Wildlife Refuge, Alaska. We measured pre-staging berry abundance at 53-66 randomly located 50 x 50 m plots from 1999-2002. We revisited plots after geese had been on the refuge for approximately six weeks and measured berry offtake and goose fecal densities. Annual pre-staging berry yield ranged from 12 berries/m^2 (SE 3.3) to 205 berries/m^2 (SE 15.6). Berry abundance varied spatially and fecal densities of geese were highest in areas where berry production was also high. Based on relationships between goose fecal density and berry removal, geese consumed up to 45% of the berry crop in years of good berry production. We collected 183 cackling geese over three years and contrasted daily rates of lipid deposition between years of good and poor berry production.

Body Composition Dynamics in Pacific Black Brant, *Branta Bernicla Nigricans,* Wintering in Alaska and Baja California.

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Understanding energetic costs associated with migration distance and wintering location is vital in predicting how birds will respond to changing environmental conditions including, global climate change and habitat destruction. We compared carcass, skin, and pectoralis muscle composition for Brant collected concurrently during fall, winter and spring of 2002-2003 in Alaska and Baja California, Mexico. We measured lipid, protein and ash in body tissues to assess the effects of two divergent wintering strategies: 1) to remain in an unstable and harsh environment or 2) to migrate long distances to a stable and mild environment. Body protein increased over winter for Brant in Alaska and remained stable for birds in Baja California. Protein in the pectoralis muscle and skin remained stable at both sites. Body lipids decreased over winter for Alaskan birds and increased for Mexican birds. Changes in body lipid reflected those of pectoralis muscle, skin, and carcass. The increase in lipid likely fuels long distance migration for Brant wintering in Mexico. Increases in protein may reflect reproductive readiness of Brant wintering in Alaska. The differential deposition of nutrients reflects the magnitude and timing of energetic costs associated with winter location.

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Migratory Behaviour of Eastern Canadian High Arctic Light-Bellied Brent Geese Tracked Using Satellite Telemetry

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Almost the entire breeding population of East Canadian High Arctic Light-bellied Brent Geese *Branta bernicla hrota* winter in Ireland, migrating through Greenland and Iceland. This species remains one of the least studied Western Palaearctic species. Given its conservation importance and relatively small and vulnerable population, a number of flyway initiatives have been undertaken to secure the species' conservation. These include the development on a Single Species Action Plan under the African-Eurasian Waterbird Agreement (AEWA) and an accompanying research programme aimed at developing our understanding of the species in wintering, staging and breeding areas. Here we report on the migration of nine Eastern Canadian High Arctic Light-bellied Brent Geese *Branta bernicla hrota*, tracked in 2002 and 2004 using satellite telemetry. Transmitters were attached in Icelandic spring staging areas and the migration followed to Canadian breeding grounds; the autumn migration to Iceland was followed in 3 birds and 2 on the return to Irish wintering grounds. This paper reports on the migratory routes, use of staging sites and migration phenology of tracked individuals during autumn and spring migrations. The telemetry study has provided important information underpinning the flyway-wide conservation of the species, including the identification of important staging areas. The project also had a enormous impact in raising public awareness about the species and wider wetland/waterfowl conservation.

Snow Geese Wintering In Southwest Louisiana Use Two Distinct Habitats – Is There Evidence For Separate Populations?

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Lesser snow geese wintering in southwest Louisiana historically were only found in coastal marshes, but began inhabiting rice-prairies after the 1940s. Snow geese collected in coastal marshes have larger bills and larger bodies than do snow geese in rice-prairies; thus, individuals in the two habitats possibly are separate populations (Alisauskas 1998). An alternative hypothesis states that snow geese sample and select foraging habitats in relation to their body size (Alisauskas 1998). We tested these hypotheses by neck-banding snow geese in both habitats, and constructing *a priori* models representing both hypotheses in MARK. Candidate models had fixed movement probabilities (Ψ). We also built intermediate models (Ψ: 0.4; 0.5; 0.6), wherein non-movement and movement between the 2 habitats had roughly equal probabilities. We used Akaike's Information Criterion ($\Delta QAIC_c$) to test our models against an unconstrained (global) model. The intermediate model $\Psi=0.4$ fit better to our movement data ($\Delta QAIC_c=9.4$) than did 3 models for habitat selection ($\Psi\geq0.9$) and 3 models for separate populations ($\Psi\leq0.1$), which had $\Delta QAIC_c > 125$ and $\Delta QAIC_c > 39$, respectively. Our results suggest that snow geese in southwest Louisiana comprise one population, and indicate that habitat sampling is common and body size seemingly represents differential competitive abilities.

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Population Structure and Migration Chronology Of Wintering Brant Black

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Understanding population structure at wintering and staging areas is important for effective management of Pacific Black Brant (Branta bernicla nigricans). We used resightings of brant marked in summer at widely separated breeding areas to examine breeding population and age distribution of brant during winter and spring migration. Study sites were spread across the entire nonbreeding range of brant, Alaska to Baja California. Brant that wintered in the north (Oregon to Alaska) were more likely to originate from northern breeding areas (low and high Arctic Canada), whereas wintering birds in the south (Mexico) were more likely to be from southern breeding areas (Western Alaska and Chukotka Peninsula, Russia). Winter distribution of juveniles was also disproportionate among areas. For example, in Mexico, a larger proportion of juveniles were found in the north where habitat conditions are more favorable. During spring migration from Mexico, brant that nested in southern breeding areas were the first to move north, reflecting the earlier nesting phenology of these birds. The slight geographic and temporal variation in distribution of the breeding populations should be considered when managing this species.

Estimating Volumes of Black Brant (*Branta Bernicla Nigricans*) During Spring Migration Using Long-Term Datasets.

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Differences in migration timing and stopover duration among individuals may complicate the estimate of a sub-population's size as it transits a critical staging area. Yet, such estimates are essential since the importance of staging habitats is often measured by the volume of birds using such sites. Estimating volume requires incorporation of estimates of arrival and stopover duration with a time series of abundance assessments for the staging site. Using Program MARK, transition probabilities can be generated conditional upon the arrival time and stopover duration for these transiting populations. These probabilities can then be incorporated with abundance assessments in models designed to estimate volumes and their associated uncertainties.

The Parksville-Qualicum (PQ) area on the East Coast of Vancouver Island, British Columbia, hosts a large annual spring northern migration of Black Brant (*Branta bernicla nigricans*). Here we have used abundance and leg-band observation data collected over 16 years in the PQ area each spring from 1989-2004. Our volume estimates provide a clearer understanding of the importance of this staging area to the Pacific Flyway Brant Population. Researchers and managers will be able to identify trends in the number of Brant using this site to aid in conservation planning for this rapidly changing landscape.

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Winter Distribution of Greater White-Fronted Geese In The Interior Highlands Of Mexico

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Declining abundance of greater white-fronted geese (*Anser albifrons*) that nest in Northwest and Interior Alaska prompted a study of their winter status and ecology in the Interior Highlands of Mexico where many winter. During 5 winters (1998-2002), we surveyed 156 wetland areas in 8 states of the Interior Highlands from the International border at Chihuahua southward $\geq$1,400 km into the states of Jalisco and Michoacan. All wetlands were surveyed one or more times by air and/or ground. Combining various surveys, we recorded white-fronts at 75 wetland areas in 6 states: Chihuahua (19), Durango (14), Zacatecas (31), San Luis Potosi (6), Aguascalientes (1), and Jalisco (4). Only 24 of the 75 areas have been included in traditional Fish and Wildlife Service January aerial waterfowl surveys. During our most extensive survey (Dec 1999), we recorded >27,700 white-fronts at 55 areas in 5 states distributed as follows: Chihuahua-35%, Durango-37%, Zacatecas-21%, San Luis Potosi-5%, and Jalisco-2%. Only 12 areas held >1,000 white-fronts during 1 or more surveys with largest flocks found at Laguna de Santiaguillo, Durango (5,500), Laguna Tejanero (4,975) and Laguna de Babicora (2,250), Chihuahua. Wintering geese from the Pacific Population predominated in northern Chihuahua, whereas western Mid-continent Population geese were mainly found further south in the Highlands. Neck collar observations and band recoveries that we collected revealed >90% originated from Northwest and Interior Alaska.

Paper Session Two - Life History

Friday, January 7

Effects Of Maternal Investments On Egg Metabolic Rates, Hatching Synchrony And Offspring Performance In Canada Geese (*Branta Canadensis*)

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Mechanisms regulating the timing of hatching and embryonic development are not completely known in waterfowl. Understanding how maternal allocations affect the development and performance of a female's offspring is essential to understanding population growth. Maternal allocation of energy may directly affect egg size, constituents or the developmental environment (e.g. location within the nest, time of incubation onset), and these factors may in turn affect offspring development, metabolism, growth and survival. In chick development, an optimal incubation duration must be reached prior to the onset of hatching. Premature hatching (relative to the optimal duration) often results in malformed chicks, while delayed hatching (relative to the optimal duration) may deplete nutrient reserves necessary in the post-hatching environment. Presumably, maternal regulatory mechanisms maximize the number of surviving offspring via differential allocation within the clutch and may favor alternative offspring development. Previous work suggests metabolic rates coordinate offspring development to facilitate synchronous hatching in waterfowl. In this project we will study how yolk steroid levels are represented in the laying sequence, the correlation of steroid levels to metabolic rates within embryo and neonate stages, and the consequence of accelerated development on offspring growth and survival in Canada geese (*Branta canadensis*) breeding in the North Dakota-Minnesota region.

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Nesting Success, Gosling Growth, And Adult Body Condition Of Giant Canada Geese In Southern Illinois

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The giant Canada goose (*Branta canadensis maxima*) is widespread across the Great Lakes states, but nesting density appears to decline in more southern latitudes. Understanding the cause of the relationship between nesting density and latitude will increase our ability to manage resident Canada goose populations. We located nests across southern Illinois and trapped goslings and adults during 2003-2004 to estimate nesting parameters, gosling growth, and adult body condition during brood rearing. The overall nest success for all study sites was 57%. Preliminary results suggest that the morphological measurements of adult male giant Canada geese did not vary between the northern 2/3 and southern 1/3 of Illinois, but the body condition of adult male giant Canada geese was lower in the southern 1/3 of the state. Our results indicate that quality of brood rearing habitat may be limiting productivity of resident Canada geese in more southern latitudes.

Paper Session Three - Grazing Ecology

Friday, January 7

Experimental Effects Of Nest Success On Breeding Site Fidelity In A Capital Breeder.

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We experimentally manipulated nesting success of randomly-chosen female Ross's Geese (*Chen rossii*) nesting at the Karrak Lake breeding colony in Nunavut, Canada, from 2000 to 2003, to evaluate the prior experience hypothesis as an explanation for breeding site fidelity in migratory birds. Previous nest fate influenced dispersal distance; successful nesters generally dispersed shorter distances than birds that experienced nest failure, but, regardless of previous nest fate, our results indicate that fidelity rarely occurs to a previous nest site or territory. Regardless of previous nest success, some breeding dispersal within the colony was asymmetrical movement from areas of below-average to those of above-average nesting density. Contrary to the prediction of the prior experience hypothesis, successful nesters generally returned at lower rates than failed nesters, but this difference was significant during only one year. Using multistate capture-resighting models that incorporate recoveries of dead birds, we found strong evidence that return rates differed as a result of lower survival probability of successful breeders. Although observed differences in dispersal distances were consistent with predictions from the prior experience hypothesis, we suggest that geese are flexible when selecting nest sites to ensure earliest possible nest initiation and that fidelity occurs to the larger landscape-level.

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Factors Affecting Prey Choice In A Despotic Herbivore: Using Individuals To Predict A Population Response

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The spatial distribution of animals is correlated to the location and abundance of food resources. The ability to predict how individuals should distribute themselves has implications for both conservation and our understanding of the ways in which animals make economic decisions. We are using East Canadian High Arctic Light-bellied Brent geese (LBBG) wintering in Ireland in order to gain insights into these processes. LBBG feed on the marine grass *Zostera* spp., grazing by the geese depletes this resource by early winter and they switch to feeding on alternative food sources including agricultural land. Given the despotic nature of Brent geese coupled with their preference for *Zostera* over terrestrial grasses we predict the dominance of larger social groups will influence the timing of diet switching and extent of inland feeding. We are using local gradients in stable carbon and nitrogen isotopes as markers to delineate the extent of terrestrial versus marine feeding in geese (estimated from stable isotope signatures in LBBG blood). We discuss our findings with respect their social / demographic status and present a preliminary individual-based model, allowing us to predict population level responses. Finally, we will discuss the implications of our findings in terms of conservation management decisions relating to this internationally protected population.

Canada Goose Brood-Rearing Behavior: Further Evidence Of Nutrient Limitation On Akimiski Island, Nunavut

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Brood behavior is considered a reasonable measure of habitat quality; therefore a change in behavior indicating decreased feeding time may adversely affect gosling growth and survival, and suggests local resource limitation. We studied behavior of Canada Geese (*Branta canadensis interior*; hereafter CAGO) on Akimiski Island, Nunavut, to determine if behavior differed on two areas differing in goose density, species', and food resources. During 1998-1999, CAGO goslings in an area with Lesser Snow Geese (*Chen caerulescens caerulescens*; hereafter LSGO) spent more time in locomotion and feeding, while those in an area without LSGO spent more time resting. We did not detect a difference in vigilance behavior of adults relative to area. Overall, differences in CAGO brood behavior was likely a function of higher brood densities (CAGO and total broods), reduced habitat integrity, or lower food availability in the mixed-species area. Increased locomotion and feeding by goslings in the mixed-species area suggests that area had lower quantity or quality forage. On Akimiski Island, competition of brood-rearing CAGO is not strictly limited to that with LSGO, rather it is the cumulative effects of all geese (i.e., CAGO, LSGO, and Atlantic Brant) using coastal brood-rearing areas that probably will result in long-term population declines of breeding Akimiski Island CAGO.

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Effects Of Elevated Co_2 On Keystone Herbivores In Modern Arctic Ecosystems

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Elevated atmospheric CO_2 generally decreases plant quality (i.e., lower protein, increased fiber), especially of C_3 plants such as those that dominate arctic ecosystems. Predicting how changes in the quality and distribution of plants will affect higher trophic levels in arctic ecosystems requires knowledge of the reciprocal interactions between keystone herbivores and their food plants. Arctic-nesting geese are good indicators of the health of arctic ecosystems because the ecological limitations associated with being an avian herbivore require them to respond sensitively to changes in plant quality and quantity. Field studies have demonstrated that goslings that grow up in areas with poor habitat quality are smaller as adults and have reduced survival and fitness compared to geese in good quality habitat. Recent captive-rearing experiments with goslings have elucidated some of the important physiological responses of geese to poor quality forage. This work emphasizes the importance of phenotypic flexibility in the digestive system of geese, and of digestive constraints in determining the lowest quality of food eaten by such herbivores. Thus, predicting the effects of elevated atmospheric CO_2 on arctic ecosystems requires understanding the interplay between phenotypic flexibility, adaptation, and migration of the arctic biota.

Notes:

Paper Session Four - Breeding Ecology

Friday, January 7

Canada Geese In A Ross's Goose Colony; A Protective Nesting Association?

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The active association' hypothesis suggests that some birds have higher egg survival and nest success when nesting in association with colonial species than when nesting alone. We sought to determine if nesting Canada geese (*Branta hutchinsii*) occurred in higher density within a Ross's goose (*Chen rossii*) colony than those nesting solitarily outside the colony, and whether they derived reproductive benefits from this association. Canada geese could receive reproductive benefits when nesting in dense areas of the colony because of increased predator detection and deterrence by Ross's geese, or reduced nest detection by predators because of dilution effects.

In 2004, Canada goose nest surveys were conducted within (11.5 km^2) and outside (10 km^2) a Ross's goose colony at McConnell River, Nunavut. We used a distance-based estimator to determine nest densities of Canada geese in each area, and recorded densities of Ross's geese within 30 m of each Canada goose nest. In addition, we monitored 194 Canada goose nests, surrounded by varying densities of nesting Ross's geese, throughout incubation and hatch. We compare Canada goose nest density within and outside the Ross's goose colony, and nest success in relation to the density of neighboring Ross's geese to test the 'active association' hypothesis.

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Long Distance Brood Movements In Greater Snow Geese: Effects On Gosling Growth And Survival

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We studied overland movements of broods the nesting and rearing areas, and the associated costs and benefits in Greater Snow Geese (*Chen caerulescens atlantica*) breeding on Bylot Island, Nunavut. We monitored the movements of 51 radio-marked females between 1997 and 2001, and evaluated if distance moved affected gosling survival and growth by recapturing marked broods shortly before fledging. Movements from nesting to brood-rearing areas were fairly rapid (most $\leq$ 6 d) but their amplitude was highly variable among individuals (range: 2.6–52.5 km). Movements were reduced once broods had settled on a rearing area. Gosling survival was not related to distance moved between nesting and brood-rearing areas but gosling growth differed according to areas used and distance moved. Geese nesting close to the main brood-rearing area generally reared heavier and larger goslings than those that nested at the main colony and made extensive overland movements to the main brood-rearing area (~ 30 km). However, goslings leaving the main nesting colony were heavier than those that stayed there throughout brood rearing in one of two years. Our results suggest that long distance brood movements can be either beneficial or costly for goslings depending on conditions encountered at their hatching site during brood rearing.

Effect Of Climatic Variables On The Phenology And Reproductive Success Of Greater Snow Geese *(Chen Caerulescens Atlantica)*

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Most global climatic models foresee that climate changes will be strongest in Arctic regions. Several studies have already reported some effects of climate changes on boreal and arctic bird species. In this study, we examine the relationship between climatic and reproductive variables in Greater Snow Geese nesting in the High Arctic on Bylot Island, Nunavut. A 16-year database is available to evaluate the relative importance of local and regional climatic variables on the reproduction of geese at different periods of their breeding cycle. Reproductive variables considered are associated with the phenology (laying date, hatching date) and reproductive success (nest density, clutch size, nesting success, brood size at hatch and fledging, and gosling size). Local climatic variables considered include snow cover on the ground, mean, maximum and minimum air temperature, number of frost-free days, solar radiation, wind speed and precipitation calculated on a monthly basis throughout the summer. The Arctic Oscillation is used as an index of regional climatic fluctuations. At our study site, mean summer temperature has increased by 1.8°C over the past 26 years. We predict that climatic effects on goose reproduction will be strongest early in the reproductive cycle.

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Consequences Of Individual Choice Of Brood Rearing Areas And Carryover Effects Of These Decisions On Reproductive Measures In Black Brant.

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Ideal free distribution theory predicts that individuals should make decisions that promote individual fitness in the long term. Previous studies have described variation in forage quality (Person et al. 1998) and gosling size (Herzog and Sedinger 2003, Nicolai et al. in review) among brood rearing areas and across years on brood rearing areas for Black Brant (*Branta bernicla nigricans*) on the Yukon-Kuskokwim Delta, Alaska. Little is known about the effects of selecting these brood rearing areas on attending adult females. Adult female Black Brant are typically at their lowest annual body condition at hatch. We investigated effects of selection and use of these brood rearing areas on adult female body condition by comparing changes in body condition of adult females measured on the day their clutches hatched and again during banding operations approximately 35 days later. Our results indicate substantial variation in changes in body condition among brood rearing areas for female Black Brant during the period of gosling growth and adult remigial molt (Δ residual body mass -300 to 300 grams). We further investigate effects of selecting a brood rearing area in year i and reproductive measures in year $i+1$ utilizing a robust design approach.

Warming Of Arctic And Wrangel Island Snow Goose Population

VASILIY V. BARANYUK.

Wrangel Island Nature Reserve

Currently, on Wrangel Island, there is just one large Snow goose colony located in the Tundra River valley, where at least 90 % of birds of the Wrangel Island Snow Goose (WISG) population nest. In years with low lemming abundance and snowy owls do not breed, snow geese nest just on the main colony. The dynamics of the WISG population, first of all, depends on the nesting success of the geese on the Tundra River colony. A monitoring program for the geese of the Tundra River colony was instituted in 1969. During this period, fluctuations in the number of geese were observed. Snow goose numbers were reduced from 150,000 birds to 56,000 in the 1970's, increased back up to about 100,000 in the 1980's, and fell again to 60,000 in the 1990's. Recently, numbers have increased again, and numbers currently total between 115,000-200,000. During the 36-year monitoring, 19 (53 %) years were classified as having favorable nesting conditions and 13 (36 %) with poor nesting conditions. During the last decade, 7 seasons were classified as having good nesting conditions. The last poor nesting conditions were observed in 1995. As a result, the WISG population has doubled since the early 1990's. Good conditions for breeding are an early spring following a winter with low snow cover. Recently, winters on Wrangel Island have been relatively mild with low snow cover. This may be a manifestation of the global processes being observed in many facets of the Arctic regions. Such changes of a climate, probably, will lead to the further growth of number WISG population.

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Arctic Fox Diets Revealed Through Stable Isotopes: The Importance Of Cached Foods

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Food storing (also termed food hoarding and food caching) is common among many birds and mammals and may be adaptive to avoid food shortage in environments where foods fluctuate greatly; use of stored foods allows animals to remain in familiar areas without having to put on large amounts of body fat and is an alternative strategy to migration, torpor, hibernation, and fat storage. Arctic foxes commonly cache foods when foods are abundant. This behaviour appears to be especially common at large bird colonies where arctic foxes cache >1,000 eggs per fox each nesting season. We examined how arctic foxes used cached foods in fall and spring by comparing stable isotope ratios (δ13C and δ15N) of fox tissues (blood and winter fur) to that of available foods. Mass balance mixing models in Program IsoSource revealed that goose eggs cached in summer made up ca 30-50% and 0-30% of arctic fox diets in fall and spring, respectively. The use of cached eggs appeared to be greater in years of low small mammal abundance. This is the first study to provide an estimate of use of stored foods by any carnivore and illustrates the benefits of stable isotopes in ecological studies.

Breeding In Relation To Upstream Stopovers In Barnacle Geese, An Individual-Based Study Relying On Resightings And Geolocators.

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For successful reproduction, Arctic geese are supposed to rely to a large extent on body stores brought along to the breeding grounds. Body stores are deposited at pre-migratory/ wintering sites and are further accumulated or re-fueled at stopover sites along the migratory route. Beside an adequate breeding condition, the timing of arrival in the breeding colony and subsequent activities plays a major role in determining an individual's reproductive prospects. This study investigates possible relationships between individual performance on the breeding grounds (e.g. timing, condition, clutch size) and preceding migration of barnacle geese belonging to colonies in the Russian Sub-Arctic. While the application of leg-bands is sufficient to gather individually based information of birds on the breeding site as well as to receive a number of re-sights from the wintering area, we rely on a tracking system in order to describe the spatial-temporal pattern of the migratory journey followed by these birds. For this purpose we decided to explore the application of so-called geolocation loggers (Global Location Sensing or GLS logging). Archival tags record light-level data, from which dusk and dawn events are estimated which form the basis to calculate the geographical location twice per day; day length determines the latitude and time of local midday the longitude.

Effect of Population Reduction Efforts On Survival Of Midcontinent Lesser Snow Geese.

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We estimated annual survival probability of midcontinent Lesser Snow Goose (LSG) adults marked with only legbands near Queen Maud Gulf, NU (n > 19,000), and La Pérouse Bay, MB (n > 35,000), from 1989 to 2002. Our objectives in this talk were to (1) review annual harvest of midcontinent Lesser Snow Geese since 1989 both during the regular season and resulting from the conservation order in the U.S. or from spring seasons in Canada, (2) determine whether annual survival was negatively related to annual harvest of lesser snow geese, (3) establish whether probability of annual survival has declined since initiation of such additional harvest opportunities starting in 1998-99, and (4) assess whether survival rate has declined sufficiently to cause population decline. Results to date suggest that increased harvest was insufficient to cause a decline in either survival of most midcontinent LSG, or in population size of either Ross's Geese or midcontinent LSG that nest at Karrak Lake near Queen Maud Gulf. Our findings imply that management objectives for reduction of midcontinent LSG populations with the goal of arresting or reversing deterioration of arctic habitats should be reviewed.

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Impacts Of Special Conservation Measures On Demographic Parameters In Greater Snow Geese (*Chen Caerulescens Atlantica*)

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In order to stop population growth of Greater Snow Geese and protect their natural habitats from overgrazing, special conservation measures were introduced in 1998-1999 in Canada and the US. Hunting regulations were liberalized during regular fall and winter seasons and a new spring conservation harvest was introduced in Québec. Using data from our long-term study on Bylot Island, Nunavut, we evaluated the impact of these measures on demographic parameters by comparing the periods 1990-1998 vs 1998-2003. We calculated adult and juvenile kill rates and survival rates using band-recovery analyses, and also estimated reproductive rates (breeding propensity, laying date, clutch size, nesting success and fall age ratios). Kill rate more than doubled with the new measures for adults, and increased slightly in juveniles. Higher kill rates were due to the new spring harvest and the more liberal regulations in winter in the US, though not due to fall regulations changes in Québec. Annual survival decreased with the new measures in adults (from 83% to 73%) but not in juveniles. The spring harvest had a negative impact on productivity, with fall age-ratios on average 35% lower since its implementation. This was due to a reduced breeding propensity, delayed laying and reduced clutch size. Overall, the special conservation measures had a greater impact on the demography of this population than originally anticipated.

Paper Session Five - Friday, January 7
Population Dynamic Status, & Management

Neckbands, Harvest, And Survival Of Ross's Geese From Canada's Central Arctic.

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We studied harvest of Ross's geese in North America by examining recoveries from 30,774 Ross's geese marked from 1989 to 2001 in Queen Maud Gulf Migratory Bird Sanctuary (QMGMBS), Nunavut, in Canada's central arctic. Continental harvest of Ross's geese began to increase in 1994 due to liberalization of hunting regulations in the Canadian Prairie provinces and the Central and Mississippi Flyways. Harvest from further liberalization of hunting regulations for light geese as part of the U.S. conservation order has accounted for < 17% of continental harvest annually since 1998. Nevertheless, continental increases in harvest of Ross's geese from ~8,000 during the 1989 hunting season to ~90,000 during the 2001 season best accounted for annual variation in adult survival probability. Survival of adults was >0.91 before 1994 but was ~0.80 by 1998-2000 hunting seasons. We found mortality probability of adults marked with neckbands was 1.94 to 2.62 times higher than for adults without neckbands. Adjustment of harvest regulations for Ross's geese in Canada is advised, with the dual objective of reducing mid-continent snow geese while conserving populations of Ross's geese on their traditional winter areas in the Pacific Flyway.

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Lesser Snow Goose Population Trends Across The Nesting Colonies – An Update.

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In 1998, the Arctic Goose Joint Venture outlined a program to monitor population trends at nesting colonies by using photo inventories at five year intervals. Although photo inventories of snow goose colonies have been done since the 1970's, intervals between surveys have ranged from 5 to 20 years at individual colonies. Photo inventories conducted in the western (1995), eastern (1997) and central (1998) arctic not only documented dramatic increases, but also established base line breeding population estimates to assess the success of subsequent management programs intended to reduce the mid-continent population of lesser snow geese. Completed portions of the latest surveys are reported, other types of surveys on various arctic colonies are described, and options for future monitoring are discussed.

Harvest And Climate Influences On Annual Survival And Breeding Propensity Of Emperor Geese

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Numbers of emperor geese have remained depressed for 20 years, as compared to historical numbers. In life histories of geese, perturbations of adult survival have disproportionately large effects on population trends. Thus, to understand the demography contributing to these trends, we estimated the magnitude and variability of annual apparent survival among adult females. We captured, marked, and resighted emperor geese from 1994 to 2004 during nesting in June. Annual survival of geese marked with plastic tarsal bands averaged 80%, with a substantive portion of annual variation being of biological origin (i.e., not sampling error). We examined whether such variation was related to reported levels of spring subsistence harvest and weather during winter (precipitation, wind, and temperature). Winter wind and precipitation were positively associated with survival, whereas models with reported harvest fit poorly. Breeding propensity is one of several variables that collectively constitute annual resighting probability. By using ancillary data and some assumptions, we derived an index of breeding propensity. Breeding propensity appeared to vary across years and a significant fraction of the adult population apparently was not breeding. Overall, these data suggest that large scale climate variations may be contributing to the population stasis of emperor geese.

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Seasonal Estimates Of Survival, Detection, And Observability For Dusky Canada Geese.

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Resighting effort of marked arctic geese commonly occurs on both breeding and wintering areas. It is seldom possible to observe geese throughout breeding or wintering ranges, therefore, some individuals are unobservable during either resighting period. Estimating the probability an individual is observable is important in estimating survival and in determining movements of individuals. We demonstrate novel methods for estimating seasonal survival, detection, and observability for female dusky Canada geese (*Branta canadensis occidentalis*) collared on the Copper River Delta, Alaska from 1997-2004. We employed a seasonal multi-state survival estimator where states related to whether birds were observable during summer and winter resighting periods. We estimated seasonal survival rates of 0.823 from pre-breeding to mid-winter and 0.937 from mid-winter to pre-breeding. We estimated permanent emigration from our study area on the breeding grounds to be 0.015 annually. During winter resighting periods, the probability a bird was observable depended on observability during the previous year. Over the course of the study, birds were more likely to move into the observable state during winter leading to an overall increase in the proportion of birds that were observable. Results concerning the population biology of the Copper River Delta population are discussed.

Neckband Hunting - Can It Affect Survival Estimates?

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Colored neckbands reduce survival rates of geese, but the underlying cause is unknown. We tested the hypothesis that hunters selectively harvest neckbanded geese, thus lowering their survival, by comparing direct recovery rates of adult Ross's geese (*Chen rossii*) marked with various marker types. Direct recovery rates are influenced by reporting rates, so we used $100 reward bands (n=1,997) as a control sample that represented 100% reporting rates. We also marked geese with leg bands only (n=2,775), leg bands and colored neckbands (n=2,806), and leg bands with white/white neckbands (n=1,727). White neckbands were 'invisible' to hunters, but were identical to the colored neckbands in all other respects. Direct recovery rates with only leg bands was 1.4%, with reward bands 2.3%, with colored neckbands 3.6%, and with white/white neckbands 3.8%. These data suggest that (1) hunters did not selectively harvest Ross's geese with colored neckbands, (2) recovery rates of all neckbanded geese were higher than for geese marked with leg bands only, and (3) higher direct recovery rates for neckbanded birds was not caused by higher reporting rates for this marker type. We suggest that increased vulnerability to hunting plays a role in reduced survival rates of neckbanded geese, but not because the markers are visible.

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A General Model For The Analysis Of Mark-Resight, Mark-Recapture, And Band Recovery Data Under Tag Loss.

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Estimates of waterfowl demographic parameters often come from resighting studies. In these studies, birds fit with individually identifiable neck collars are resighted at a distance. Questions have been raised about the effects of collar loss on parameter estimates, and the reliability of extrapolating from collared individuals to the population. Models have been proposed to account for collar loss, but do not allow survival or harvest parameters to depend on neck collar presence or absence. Also, few models have incorporated recent advances in mark-recapture theory that allow for multiple states or auxiliary encounters such as band recoveries. We propose a multi-state model for tag loss in which the presence or absence of a collar is considered a state variable. In this framework, demographic parameters are corrected for tag loss and questions related to collar effects on survival and recovery rates can be addressed. Encounters of individuals between formal sampling periods also can be incorporated in the analysis. We discuss data requirements for answering questions related to tag loss, and sampling designs which lend themselves to this purpose. We illustrate the application of our model using a study of lesser snow geese (*Chen caerulescens caerulescens*).

Spatial And Temporal Variation In Body Mass Of Prefledging Emperor Geese: Effects Of Interspecific Goose Densities And Grazing Lawn Availability

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The abundance of emperor geese has changed little since 1985 and remains at levels below management goals, despite efforts intended to increase this population. Estimates of adult survival obtained during this period show little variation, but estimates of recruitment have declined over the last eight years compared to the previous eleven. Previous research has shown that survival and subsequent recruitment of prefledging geese is influenced by body mass prior to fledging. Body mass of prefledging emperor geese collected at multiple locations on the Yukon-Kuskokwim Delta show both a temporal decline and evidence of spatial variation. We hypothesize that an increase in the numbers of sympatrically nesting goose species (cackling Canada geese and black brant), and subsequent competition for grazing lawn habitat has affected body mass of prefledging emperor geese. To investigate this hypothesis, we used aerial videography to sample grazing lawn habitat in 1999, 2003, and 2004 at six locations across the coastal zone of the Yukon-Kuskokwim Delta. Exclosures deployed in similar locations in 2003 and 2004 were used to estimate apparent offtake in grazing lawns. At these same locations we captured juvenile emperor geese prior to fledging from 1990 – 2004. We describe relationships between spatial and temporal variation in availability of grazing lawn habitat, trends in densities of the composite goose community, and body mass of prefledging emperor geese.

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Breeding Dispersal By Ross's Geese In The Queen Maud Gulf Metapopulation.

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We estimated rates of breeding philopatry and complementary dispersal within the Queen Maud Gulf metapopulation of Ross's Geese (*Chen rossii*). We used multistate modeling of neckband observations made at five breeding colonies, 1999-2003. Probability of philopatry was female-biased, but varied among colonies. Colony-specific dispersal probabilities ranged from 0.023 to 0.344 for females and from 0.122 to 0.376 for males. We applied movement probabilities to colony-specific population estimates and demonstrate that several thousand individuals move among colonies in a given year. Our findings (1) underscore the potential for dispersal to alter breeding distribution, (2) demonstrate that the influence of immigration on colony-specific rates of population growth is nontrivial, and (3) provide behavioral evidence for extensive gene flow. Estimates of apparent survival ranged from 0.631 to 0.682 for females, and from 0.489 to 0.546 for males. Estimates of female apparent survival from this study correspond with true survival estimates from band recovery models and suggest that the probability of permanent emigration by females was close to zero during our study. We propose that sex differences in apparent survival resulted from a combination of higher rates of neckband loss by males, and higher rates of permanent emigration by males from our study area.

Population Structure of A Greater Snow Goose Colony

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Snow geese nest in large colonies but we have little information on the degree of population structuring at the scale of the colony. Females are phylopatric to their nesting area; however, whether or not this translates into genetic differentiation on a small geographic scale is unknown. We examined the genetic structure within a Greater Snow Goose (*Chen caerulescens atlanticus*) colony on Bylot Island (Nunavut, Canada) in 2003. Most geese nest in one colony (>10,000 nests over 100 km^2) but move to distinct brood-rearing areas scattered over the island after hatch. We developed AFLP (Amplified Fragment Length Polymorphism) markers from blood samples to run individual-based population assignment tests to detect cryptic population structure within the colony. Both Bayesian analyses and population allocations tests revealed no genetic differentiation among 3 geographic clusters (n = 20 to 30 nests/cluster) located 3 km apart. However, a sample of 29 individuals scattered throughout the colony but previously marked on the same brood-rearing site were misassigned compared to the rest of the sampled population, which presumably included birds using different brood-rearing sites on the island. We suggest that genetic structuring may exist based on brood-rearing sites used rather than on nesting sites. We collected more samples in 2004 to confirm this pattern.

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Genetic Analysis Of North American Brant (*Branta Bernicla*) Populations

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Uncertainty about subspecific and stock designations for brant (*Branta bernicla*) has the potential to influence management, including harvest. At issue is the relationship among subspecies, among breeding populations within putative subspecies, and links between breeding populations and molting, staging and wintering aggregations. To address these issues, we collected genetic data from brant sampled from representative populations from the eastern Canadian High Arctic (Light-bellied Brant, *B. b. hrota* Müller), western and northern Alaska (Black Brant, *B. b. nigricans* Lawrence), and the western Canadian High Arctic "Grey-bellied Brant". Genetic markers include 12 autosomal and 2 sex-linked microsatellite loci and the mitochondrial DNA (mtDNA) control region and cytochrome b gene. Preliminary results from mtDNA confirm the distinctness of the Grey-bellied Brant and the two nominal subspecies, whereas nuclear microsatellite data suggest connectivity among some populations representing different subspecies or stocks. For example, mtDNA data suggest the Grey-bellied Brant, while distinct, shares more recent ancestry with *B. b. hrota* than with *B. b. nigricans*; however, nuclear markers suggest connectivity with *B. b. nigricans*. These genetic markers appear to be useful in some cases for assessing the breeding source of individuals in admixed groups and help clarify links among breeding, molting, staging and wintering areas.

Winter Fidelity and Apparent Survival Of Lesser Snow Goose Populations In The Pacific Flyway

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The western arctic contains two large populations of lesser snow geese which follow separate migration routes between the breeding areas on Wrangel Island, Russia and Banks Island, Canada to their wintering areas in the Pacific Flyway. The Wrangel Island population is composed of two subpopulations with sympatric breeding areas. The Northern subpopulation winters in the Fraser and Skagit River deltas of British Columbia and Washington and the Southern subpopulation migrates through southern Oregon and northern California and winters in the Central Valley of California where it mixes with the birds breeding on Banks Island. From 1993 to 1996 we neckbanded molting birds at their breeding colonies and resighted birds on the wintering grounds. We used multi-state capture recapture models to evaluate relative survival rates and winter fidelity and potential exchange among these populations. Our results showed similar annual survival rates between subpopulations of Wrangel Island snow geese and lower relative survival for the Banks Island birds. Fidelity to wintering areas was extremely high ($\geq$98%) in all populations with equal movement between northern and southern wintering areas for the Wrangel Island birds. Our results imply that population factors outside the wintering period may be important drivers of trend among these populations.

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Recent Changes In Number And Distribution Of The Taiga Bean Goose *Anser Fabalis Fabalis* In Northwestern Europe.

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The Bean Goose is widely distributed in the arctic and subarctic areas of northern Eurasia from Scandinavia to eastern Russia. In the west it is represented by one tundra form *fabalis rossicus* and one taiga form *fabalis fabalis*. The Taiga Bean Goose breeds in Fennoscandia and northwest Russia and winters around the western part of the Baltic and the North Sea countries. During autumn staging the population is concentrated to a number of sites with approx. 60-75% in Sweden, whereas much smaller numbers migrate through Sweden in spring. As most European goose populations the Taiga Bean Geese increased since the early sixties to a peak of about 110 000 individuals in the late eighties – early nineties, after that in contrast to most other European Goose populations showing a decrease. During the same period there were marked changes in autumn distribution with new staging places established further north and a changed temporary pattern for the migration. The timing of spring migration also changed during the study period. The situation of the species in relation to hunting and exploitation of staging areas will also be discussed.

Poor Breeding Causes Persistent Decline In Dark-Bellied Brent Geese

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After the spectacular recovery in numbers in the 1970s and 1980s Dark-bellied Brent (Branta b. bernicla) wintering in western Europe show a persistent decline in numbers from 314,000 in 1991-92 to less than 197,000 in 2002-03.
The average proportion of first-winter birds over this 11-year period is only 10 %, while the average annual mortality rate is 15 %. The characteristic boom years that coincided with lemming peak years on the Taimyr peninsula in northern Siberia no longer occur.
In 2004 field work in the Russian arctic showed a further increase in the number of breeding birds on small islands in the Pyasina delta, despite the overall population decline. It is hypothesized that increased predation pressure on the mainland tundra leaves these small islands where Brent nest in between Taimyr gulls (Larus heuglini) as a last resort.
Possibly lemming peak years no longer occur because of global warming affecting prolonged snow cover, on which lemmings depend for safety. Therefore nesting within 'safe havens' on the mainland tundra created by nesting Snowy owls could be lost as an option for Dark-bellied Brent to nest.

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Expensive Management: Quantifying The Costs Of An Active Hazing Program In Aleutian Canada Geese

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By minimizing energy expenditure and maximizing caloric intake, spring staging geese can achieve a net surplus of energy necessary for migration and breeding. Surplus energy acquisition is influenced by uninterrupted feeding time and the quality and quantity of available foraging areas. If individuals cannot achieve sufficient reserves, they should move on to more profitable areas. Aleutian Canada geese (*Branta canadensis leucopareia*) may be shifting to more profitable spring staging areas. They have colonized two novel spring staging areas 150 km south of the traditional area where an active hazing program was implemented. We hypothesized that this shift could be due to either 1) a disparity among the traditional and novel areas in foraging opportunity and energy expenditure or 2) a disparity in forage quality and foraging habitat quantity. We calculated foraging opportunity and energy expenditure, taking into account daily time-budgets, disturbances, and commutes from the roost. We calculated the daily energetic costs of staging in each area. We analyzed forage quality from collected grass samples and quantity from GIS map imagery. We found similar foraging opportunity among areas; however, geese in the traditional area had lower abdominal fatness and higher energy expenditure. Forage quality and quantity was not different among areas.

Multi-Species Patterns Of Avian Cholera Mortality In Nebraska's Rainwater Basin

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Nebraska's Rainwater Basin (RWB) is a spring migration area for millions of waterfowl. Avian cholera outbreaks have occurred in the RWB since the 1970s and in some years tens of thousands of waterfowl have died. Lesser snow geese (*Chen caerulescens caerulescens*) have been associated with outbreaks in the RWB and are carriers of *Pasteurella multocida*, the causative agent of avian cholera. We used cumulative mortality curves to characterize patterns of avian cholera mortality in several waterfowl species using the RWB. Mortality patterns changed between the years prior to (1976-1988) and coincident with (1989-1999) dramatic increases in snow goose abundance and mortality. Although snow geese appeared to be disproportionately impacted by avian cholera during 1989-1999, annual mortality in several other waterfowl species was positively correlated with snow goose mortality. Coincident with increased snow goose mortality, was a significantly earlier annual onset and termination of outbreaks compared to 1976-1988. Dense concentrations of snow geese likely facilitate intraspecific disease transmission through bird-to-bird contact and wetland contamination. Rates and mechanisms of interspecific cholera transmission within the waterfowl community are more difficult to determine. Avian cholera outbreaks at spring staging areas provide an ideal system for further research into disease transmission in multi-host communities.

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Reservoirs For Avian Cholera: Wetlands Vs. Birds

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Avian cholera, caused by the bacterium Pasteurella multocida, is the most important infectious disease affecting North American geese. However, the reservoir for the bacteria that causes the disease remains uncertain. We investigated alternative hypotheses that wetlands or waterfowl were the most likely reservoir for P. multocida and thus play an important role in maintaining the disease. Our studies provide the strongest evidence to date that wetlands are not the primary reservoir for P. multocida serotypes that cause avian cholera. In contrast, we found that some goose species, both lesser snow and Ross's geese, were carriers of the disease agent; however, greater white-fronted geese did not appear to be carriers. Serological studies indicate that enzootic avian cholera is likely occurring year-round in snow goose populations. Future research and management on avian cholera should focus on the potential role of different waterfowl species in maintenance and transmission of this disease.

The Pattern Of Parasite Load In Lesser Snow Geese (Chen Caerulescens Caerulescens) Using Salt- And Freshwater Habitat.

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As populations of many bird species increase in number, various factors may become important in limiting further growth. These include limitations of space and food as well as increases in disease agents (Newton, 1998). Gomis et al. (1996) examined the potential involvement of disease agents in the dynamics at the West Hudson Bay colony by comparing the parasite load of pre-fledgling snow geese collected in a degraded coastal portion of the region to that of pre-fledglings collected 15 miles inland in less degraded, freshwater habitat. They found that birds from the degraded, coastal region were smaller, in poorer condition and had higher loads of trichostrongylids, a caecal nematode.In this paper, we further those studies by comparing the load of two different caecal nematodes in pre-fledging lesser snow geese sampled in salt- and freshwater habitat in the La Pérouse Bay and Cape Churchill region. We conclude that several factors, operating at different spatial scales and modified to differing extents by weather and the landscape, are responsible for the pattern. The notion that smaller birds are necessarily more susceptible is not supported without qualification nor is the conclusion that more heavily parasitized birds are smaller..

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Migration And The Prenesting Interval Of Emperor Geese

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We deployed abdominally-implanted satellite or VHF radio transmitters in 136 adult female emperor geese (*Chen canagica*) on the Yukon-Kuskokwim Delta (YKD) in western Alaska from1999-2003. Our objectives were to measure the interval between arrival of females on their nesting area and the onset of egg laying, and to determine relationships between timing of spring arrival and distance females migrated from their wintering sites. We recorded spring arrival dates of 92 radiomarked females on the YKD nesting area and located nests of 32 of those individuals. Distance between the YKD and wintering sites of marked females ranged from 950-3,500 km. However, there was little evidence that migration distance affected arrival date or clutch size. The interval between arrival and nest initiation ranged from 5-17 days. Assuming rapid follicle growth required approximately 12 days, emperor geese exhibited plasticity in timing of RFG. Most females apparently delayed RFG until after arrival on the YKD in a year when timing of breakup was normal, but many females entered RFG prior to arrival in years of early breakup. The proximity of Alaska Peninsula staging areas to the YKD may enable female emperor geese to adjust timing of RFG relative to annual conditions.

Habitat Effects On Nest Predation Risks: The Case Of The Greater Snow Goose

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Nest predation and its avoidance are critical components of an individual's fitness. Predators should affect nesting habitat selection and prey should avoid habitat patches associated with high predation risks. We tested the hypothesis that predation affects nesting habitat selection in a Greater Snow Goose (*Chen caerulescens atlantica*) colony characterized by two nesting habitats: mesic tundra and wetlands. Goose eggs are most vulnerable to predation by foxes and avian predators when incubating females leave their nest to drink. Our observations revealed that females nesting in mesic tundra had to travel a greater distance to find water during incubation recesses in mesic tundra (mean = 32 m, SE=10; n =34) than in wetlands (mean = 10 m, SE=1; n=14). Females nesting in mesic tundra were more likely to surpass the distance threshold (10 m) where predator's attacks lead to efficient egg predation. An artificial nest experiment mimicking snow goose nests suggested that differences in predation risk between habitats were not solely due to the behavioral response of females. Predation on artificial nests was higher in the mesic tundra compare to wetlands, and foxes ate eggs more efficiently in the mesic tundra than in wetlands. Females are apparently sensitive to these differences in predation risks because a higher proportion of marked individuals nested in wetlands compared to their availability in the colony. Further studies need to examine how the difference in predation risk between the two habitats affects nesting success and how this varies in function of predator density.

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The New Ross's Goose Colony At La Pérouse Bay, Manitoba.

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Ross's geese (*Chen rossii*) were rarely found at La Pérouse Bay through the mid-1990's. When they were, it was as males mated to female lesser snow geese (*Chen caerulescens*). In 1996, a pure Ross's goose pair was found nesting approximately 1 km from our base camp. Beginning in 1998, several families of Ross's geese were observed foraging on the central salt marsh. In 2003, the source of these families was found to be an isolated colony of nearly 1000 pairs of Ross's geese located in fresh water habitat 2 km inland from the east coast of La Pérouse Bay and 8.5 km from our base camp. The colony is surrounded by nesting lesser snow geese and is located in an area previously used (and degraded) by lesser snow geese. The colony persisted as an isolated unit and in 2004 contained approximately 1500-2000 pairs of nesting Ross's geese. We present details on the 2004 season including estimates of colony size, nesting density, reproductive success and the frequencies of mixed pairs and hybrids within and adjacent to the Ross's goose colony. We discuss the findings in light of the late 2004 season and the expansion of the Mid-continent population of Ross's geese.

Historical Trends In Lemming Abundance And Nest Success Of Canada Geese: Evidence In Support Of The "Bird-Lemming" Hypothesis At Cape Churchill, Manitoba

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Poster, Keywords: "bird-lemming" hypothesis, EPP Canada geese, nest success

The dynamic interaction of predator, prey, and alternative prey in determining reproductive success in arctic-nesting birds (the "bird-lemming" hypothesis) has been documented. Data collected during annual Eastern Prairie Population (EPP) Canada goose (*Branta canadensis interior*) breeding ground surveys over the last 15 years at Cape Churchill, Manitoba provide adequate estimates of two of three parameters typically used in the analysis of this cyclic pattern, nest success and the proportion of locally active arctic fox (*Alopex lagopus*) dens. A detailed assessment of the third parameter, the annual abundance of lemmings, is lacking. In 2004, we collected and aged 794 willow (*Salix* spp.) stem scars, caused by the gnawing of collared lemmings (*Dicrostonyx richardsoni*), over 300 random points throughout a 48km^2 study area. Scar ages ranged from 0 to 13 years. Correlation in scar age frequency was the strongest in 3-year time lags, $\rho = 0.867$, suggesting 3-year population cycles. Time lag correlation analyses of goose nest data suggest 4-year cycles in nest success. However, a negative correlation between lemming abundance and goose nest success at 1-year time lags ($\rho = -0.285$) provides evidence that lemming cycles influence annual EPP Canada goose nesting success.

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Accuracy In Determining Laying Sequence During Incubation In Black Brant.

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Previous studies have described effects of position in the laying (PILS) sequence on many measures of life history traits and demographics, while other studies fail to detect differences due to PILS. In most waterfowl nesting studies, researchers are unable to visit nests every day during laying to mark eggs in nests as they are laid and therefore, assign PILS by comparing stain color on eggs and assume the darkest stained eggs were laid first. We designed an experiment to test if this method was accurate in determining true laying order in Black Brant. We monitored a sample of 70 Black Brant (*Branta bernicla nigricans*) nests throughout the laying period so that we knew true laying order of eggs within a clutch and had multiple field technicians assign laying order to these clutches during three time periods during incubation. We also allowed observers to assign ties to eggs that were difficult to assign to PILS. Our results indicate that this method is inaccurate in assigning eggs to specific positions within the laying sequence and also when allowed to assign ties. Furthermore, accuracy declined with days of incubation and an increase in clutch size.

Population Dynamics Of Arctic Foxes In Relation To Annual And Seasonal Fluctuation In Foods: The Relative Importance Of Small Mammals And Geese

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Seasonal and annual fluctuations in food availability are common in many northern environments. Fluctuations in food abundance, in turn, affect both the abundance and distribution of animals that feed on them. However, the relative importance of seasonal versus annual fluctuations in food availability is poorly understood. Arctic foxes are opportunistic predators and scavengers that rely heavily on small mammals throughout most of their range. However, other foods such as birds and their eggs can be important in arctic fox diets in some years and parts of the arctic. We examined how large concentrations of geese (i.e. seasonally superabundant foods) and small mammal abundance (i.e. foods that fluctuate over 3-5 years) affected arctic fox abundance, density of breeding foxes, and litter size. Line-transects and den inventories inside and outside the large goose colony at Karrak Lake, Nunavut, showed that (*1*) the abundance of arctic foxes was predominantly affected by abundance of geese (i.e. foxes were more than twice as abundant in the goose colony than outside the colony) whereas (*2*) the density of breeding foxes and litter size was predominantly affected by small mammal abundance.

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Effect Of Locomotion On Growth In Greater Snow Goose Goslings (*Chen Caerulescens Atlantica*)

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Goose families often move to specific brood-rearing areas after hatching. On Bylot Island, Nunavut, Greater Snow Goose goslings can walk over impressive distances soon after hatching (> 30 km) to reach good brood-rearing areas. Despite the potentially high energetic costs associated with walking and the exposure to cold temperatures prevailing in the Arctic, chicks grow very fast. We measured the impact of locomotion and ambient temperature on the growth of young snow geese. We raised 28 goslings hatched from eggs collected on Bylot Island in two controlled temperature chambers (8 and 20°C) in the laboratory. At each temperature, half of the goslings were imposed 6-h periods of walking on a treadmill daily (0.3 m/sec) whereas the other half was used as a control (no walking). At 40 d of age, chicks raised at 8°C were heavier than those raised at 20°C (2072 g vs 1968 g, $p = 0.054$) but goslings who walked 6-h per day had a lower mass than control individuals (1986 g vs 2046 g, $p = 0.057$). However, the difference was less marked for young raised at 8°C. This could be explained by the use of heat produced in muscles during locomotion for thermoregulation.

Do Geese Manipulate The Sex Ratio Of Their Offspring?

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Sex ratio manipulation in birds is highly controversial. One example of this debate occurred in studies of geese. Two factors that may have influenced conclusions of whether sex ratio manipulation occurred within geese were comparisons of primary and secondary sex ratios as well as comparisons within and across individuals. Combining these factors may have lead to confusion when addressing hypotheses associated with sex ratio manipulation. In order to address this debate we examined whether primary sex ratio manipulation occurred within individual black brant (*Branta bernicla nigricans*). Microsatellite analysis was used to determine primary sex ratio within clutches of black brant from 1996-1997 and 2002-2004. The Trivers-Willard hypothesis states that high quality parents will manipulate the sex ratio of their offspring to favor the sex with the greatest variation in reproductive output. Within black brant, juvenile males appear to have lower survival and recruitment than females and consequently are the more variable sex. Therefore we expected that high quality mothers would produce more males than low quality mothers.

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Fitness Consequences Of Conspecific Brood Parasitism In Black Brant.

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Conspecific brood parasitism (hereafter CBP) is an alternative reproductive strategy that may influence fitness of host individuals. Fitness consequences associated with CBP occur on an individual level, however no study to date has directly measured host fitness consequences associated with CBP while controlling for individual quality. We examined direct fitness consequences of CBP by determining changes in reproductive output within individuals as well as potential impacts on host survival. Microsatellite analysis was used to determine occurrence of CBP within nests from 1996-1999 and 2002-2003 within a black brant colony (*Branta bernicla nigricans*). Following, we developed a predictive function based on egg morphology and laying order that enabled us to identify when a parasitic event had taken place across a 20-year data set on the nesting ecology of black brant. By comparing breeding propensity and reproductive success within individuals before and after a parasitic event we determined direct fitness consequences of CBP. We also determined current impacts of CBP on host reproductive success by comparing clutch size, hatching success, brood rearing success, and breeding propensity of young within host's nests. Finally we compared survival of parasitized individuals to that of non-parasitized individuals to determine impacts of CBP on host survival.

Long-Term Variation in Nest Survival Of Lesser Snow And Ross's Geese Breeding Sympatrically At Karrak Lake, Nt.

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Lesser snow (LSGO) and Ross's (ROGO) geese nest sympatrically at Karrak Lake, Nunavut. Historically, LSGO populations at Karrak Lake grew at an annual rate double that of ROGO. Recently, ROGO have grown at a rate twice that of LSGO, offering a unique opportunity to examine why population growth (lambda, λ) differs between two closely-related yet different sized-species. Here, we focus on variation in nest survival. Nest survival is a critical component of productivity and can be affected by numerous biotic and abiotic factors, although the importance of each factor varies annually. Additionally, ROGO are of smaller body size than LSGO and so are confronted with different constraints. For example, body size influences the amount of exogenous reserves an organism can store. In this study, we model long-term (1991-2004) variation in nest survival and influential factors such as spring female condition and body size, weather, nesting densities, and nest initiation date between ROGO and LSGO. By using a comparative approach, we hope to learn how differences in nest survival in these arctic-nesting geese may differentially influence their respective rates of local λ and if life history variation dictates how each responds to annual ambient conditions on arctic breeding grounds.

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The Case Of The Bloody Egg: Insight Into The Role Of Ectoparasites In Population Regulation

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Density-dependent factors regulate many wildlife populations. Overpopulation of arctic-nesting goose species is of interest to biologists because of its impact on sensitive habitat. Lesser snow goose (*Chen caerulescens caerulescens*) and Ross' goose (*Chen rossii*) populations have increased at high annual rates. Food is a regulating factor for goslings on the brooding grounds; however, neither food nor predation in the arctic appears to regulate adult geese. Most parasite-host interactions result in a reduction of host densities, particularly impacting reproductive success and offspring body condition and immunity. Our study focuses on the recent discovery of blood in high prevalence on lesser snow and Ross' goose eggs at Karrak Lake, Nunavut, Canada. Evidence suggests that the blood is a product of flea parasites inhabiting goose nests. Data collected from 2000 to 2004 suggest an increase in frequency of bloody eggs; in addition, blood is linked to decreased nest success. We propose that ectoparasites may be a regulating factor that has arisen in response to increased light goose populations.

Egg Damping And Family Structure In The Western Tundra Bean Goose (Anser Fabalis Rossicus) In Vaigach Island, Russia.

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Egg damping is very common in many species of Arctic Geese. This phenomenon has been most comprehensively described for the Lesser Snow Goose (Anser caerulescens caerulescens) (Syroechkovsky, 1979, Gurtovaja, 1985, Lank et al 1989).The main reason for the egg damping in Arctic colonial geese is believed to be shortage of nesting territories in years with late and cold spring. It seemed logical to think that in non-colonial species of geese that didn't suffer from such a shortage of nesting territories even in the years with late spring the egg damping wouldn't be so widely occurring as in the colonial geese. However our investigations of nesting ecology of the Tundra Bean Goose performed in Vaigach Island (70°15 N 58°47E) in 1986 – 1988 and 1995 – 1997 showed that the egg damping was very common in this species. We used the quantitative method of recognizing of the damped eggs in the geese clutches that we had devised (Syroechkovsky, Baranyuk, 2003) based on differences of egg shape and size in different geese clutches. In total 515 clutches of Bean Geese were investigated. The frequency of nests containing the damped eggs occurred to be unexpectedly high in every year of our investigation - from 17% in 1997 to 33% in 1988 and 1997. So the frequency of egg damping in the non-colonial Bean Goose appeared to be quite comparable with that in the colonial Lesser Snow Goose. However the egg damping in the two species differed in many features. First of all the frequency of egg damping in Bean Goose was not correlated with the type of spring of a given year. It was especially high both in very favorable for geese nesting 1988 and in unfavorable 1997 (33% in both years). Secondly, we did not observe in Vaigach Island any heaps of eggs or solitary eggs lying on the ground even in the years of mass egg damping. It could mean that damping eggs in other bird's nests proceeded there peacefully whereas in a colony of Snow Goose there were usually fights between birds damping eggs and hosts of the nests. Thirdly we never met more than 9 eggs in one nest of Bean Goose. It means that no more than two females damped their eggs in one nest. Finally there were substantial interspecific differences in the form of frequency distribution of clutches of different size in years of mass egg damping. While the distribution curve in Snow Goose was with the upper limit of 15 – 17 eggs thus indicating that eggs had been dumped in all the nests without choice, the curves of distribution in Bean Goose sometimes was bimodal with modes at 3 and 5 or 6 eggs. The modeling of the process of egg dumping showed that such distribution size could emerge only if eggs had been damped predominantly into nests with rather big «own» clutch size. The most logical explanation of this phenomenon is that eggs were damped into the nests of old geese whose clutch size usually is bigger than that of the young birds. Considering the above mentioned differences in egg damping between Snow – and Bean Geese and taking into consideration the fact that pairs of non-nesting geese were observed very often in nesting territories of some geese in Vaigach Island encountering no aggression from the hosts of nests (the Bean Geese are strictly territorial birds) I came to the conclusion that the egg damping in Bean Geese is regulated mostly by family relationships. I suggest that daughters making their first attempt to breed damp their eggs into nests of their mothers.

Comparative analysis of gosling diets on akimiski island, nunavut: early post-hatch overlap and later post-hatch segregation

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Brood-rearing geese should select habitats and plants within habitats in some optimal fashion given morphological and behavioral adaptations. Morphological and behavioral adaptations limit potential for interspecific competition among geese. On Akimiski Island, Nunavut, researchers have argued that competition with an increasing breeding colony of Lesser Snow Geese (hereafter LSGO), may be the cause of poor growth and first-year survival of Canada Goose (hereafter CAGO) goslings. Our objectives were to compare spatial and temporal variation in CAGO gosling food habits and variation in food habits related to goose species in an area where CAGO and LSGO broods were synoptic. We collected 180 goslings (n_{CAGO} = 120, n_{LSGO} = 60) distributed among three sample periods (age classes) and two areas. Preference by CAGO goslings for certain plant foods (i.e., *Festuca rubra*, *Carex subspathacea*, *Puccinellia phryganodes*, and *Triglochin maritima*) was similar between areas, but differed with gosling age. Though differences in diets due to goose species were detected, the relative ranks of plant foods were generally similar between species. Our results are suggestive of competition and we offer that present foraging conditions are insufficient to meet energetic demands of CAGO goslings particularly in the area of syntopy.

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Feeding Ecology Of Greater Snow Goose (*Chen Caerulescens Atlantica*) Goslings In Upland Tundra On Bylot Island, Nunavut

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Although geese prefer wetland habitats during brood-rearing, a significant amount of feeding also occurs in uplands where their feeding ecology has been little studied. We assessed the diet of Greater Snow Goose goslings in upland tundra using two techniques: oesophagi contents of wild goslings (N = 67) and behavioural observations of 16 human-imprinted goslings on Bylot Island. Human-imprinted goslings allowed us to use a rigorous factorial sampling design to assess the impact of plant communities and date of the season on goslings' diet whereas wild goslings were used to validate the diet obtained with captive ones. A total of 35 vascular plant species were found in the diet with about 75% of the items being leaves and the rest mostly flowers. Gramineae were the main food item (48% for captive and 53% for wild goslings). Captive goslings also consumed many Leguminosae in communities where those plants were abundant (39%). Juncaceae (captive 18%, wild 8%), Polygonaceae (captive 4%, wild 16%), Caryophyllaceae and Crucifereae (<5% each) were also eaten. The diet varied seasonally as goslings consumed 5 times more Gramineae in late summer than earlier in the season and the number of plant taxa eaten decreased over time, presumably because goslings gained experience.

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Using Stable Isotopes To Track Lesser Snow Goose Dispersal And Habitat Use At La Perouse Bay, Manitoba

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Although geese are keystone species in arctic ecosystems, habitat selection by geese during brood-rearing is poorly understood. Overpopulation of lesser snow geese (*Chen caerulescens*) in the Hudson Bay region has degraded most preferred salt marsh habitat and this may force geese to use less preferred freshwater marsh habitat during brood-rearing which likely affects their fitness. We used naturally occurring stable isotopes in forage plants and goose tissues to test this hypothesis. During summer 2004, a total of 27 plant species and 130 goslings were collected from salt marsh and freshwater marsh habitat at La Pérouse Bay, Canada. These plant and animal samples were dried, finely ground, and their carbon and nitrogen signatures were measured. Nitrogen but not carbon signatures of freshwater and salt marsh plant species collected at a given site were significantly different, and isotope signatures of two plant species were significantly different between sites. Carbon signatures of liver and leg muscle from goslings collected in freshwater marsh were significantly more enriched than tissues from goslings collected in salt marsh. The difference in carbon signatures of liver and leg muscle from goslings collected in freshwater and salt marsh sites was greater in older goslings compared to younger goslings. Nitrogen signatures of liver and leg muscle from goslings collected in freshwater marsh were similar to those from goslings collected in salt marsh. Nitrogen signatures of liver and leg muscle became significantly more enriched with age of gosling while carbon signatures of these tissues became significantly more depleted. Our results suggest that environmental inputs other than salinity must be important in determining carbon and nitrogen signatures in sub-arctic plants of Hudson Bay, and carbon but not nitrogen signatures of food plants must be different between the two habitats where goslings were collected. Thus, stable isotope signatures of gosling tissues may indicate patterns of habitat use during gosling growth although our understanding of the causes of spatial and temporal variation in isotope signatures in forage plants currently limits our ability to interpret these patterns in gosling tissues.

Eelgrasss Response to Simulated Grazing By Black Brant

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Black brant geese (*Branta bernicla nigricans*) forage almost exclusively on eelgrass (*Zostera marina*) along the Pacific flyway during their spring migration. The abundance and vitality of this resource has an important role in the success of the population. The grazing optimization model predicts an increase in net primary production of leaf biomass with moderate levels of grazing, exceeding that of ungrazed plants. A pilot study in 2003 confirmed that clipped eelgrass in Humboldt Bay, California did overcompensate. I will present results of our current study including above and below ground biomass, shoot primary production, and nitrogen content of leaves from manipulated plots. Plot treatments include simulated grazing, simulated grazing + feces, control, and feces fertilizer. If brant manipulate eelgrass quality and quantity, then grazing will have a positive effect on eelgrass and brant will benefit from foraging on previously grazed eelgrass when regrowth is optimal.

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Food and Feeding Ecology of Four Sympatric Geese Species on The Coastal Plains Of South Chukotka

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Four geese species inhabit coastal plains of South Chukotka with extensive overlap in their main feeding areas. Data on geese feeding ecology have been collected in 3 different sites in 1991-1994 and in 2001. The data were collected separately for the pre-nesting, nesting, brood-rearing and molting periods, droppings were analyzed following the method of Owen (1976).

White-fronted Geese (WFG) showed clear shift from extensively used non-renewable to intensively used renewable food resources in upland habitats from May-June to July-August. But this shift was not so prominent in their coastal populations and in all populations of Emperor Geese (EG). The main feeding habitats of WFG during brood rearing were *A.fulva*, *C.subspathacea* and *E.arvense*, while for the moulting WFG and for EG the important food sources were *C.cryptocarpa* and *P.phryganodes*. In general the diet of EG were wider in compare to WFG, while they were more limited in distribution.

Black Brant showed marked differences in the food composition and the important part of the diet were aquatic plants *C. aquatilis*, *A.fulva*, *R.pallasii* and *P. filiformis*.

The diet of Bean Geese is marked by clear dominance of *E.arvense*, *A.fulva,* and Carex heads, and that was quite close to WFG diet in the upland habitats.

Habitat Use And Forage Quality By A Neotropical Grazer: The Orinoco Goose (*Neochen Jubata*) In Venezuela

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Most geese utilize Arctic habitats with nutrient-rich vegetation (25+% protein) for breeding. In contrast, nutrient-poor soils and plants characterize tropical savannas, suggesting that waterfowl with a goose-like ecology could not inhabit the tropics. Orinoco Geese (*Neochen jubata*), one of eight sheldgeese (*Tadorini*), however, occur in the Neotropics and breed during the dry season, when nutrient levels in most plants are at their lowest. It remains unclear how they have adapted as grazers in a nutrient-poor environment. Using arctic geese for comparison, this project describes habitats utilized by Orinoco Geese in southern Venezuela, assesses forage quality during breeding, and evaluates the impact of grazing on forage quality and availability. Orinoco Geese were observed 90.9% of the time in a short-grass habitat (cespitoso) near open water that comprised only 1.2% of the habitat at my study site. Forage availability declined throughout the study area as the dry season progressed. In contrast, protein content of the three grass species that dominated the habitats where Orinoco Geese were observed grazing was higher (16.6-19.3%) than in similar habitats where geese were absent (8.0-10.5%), suggesting that Orinoco Geese were selecting grazing sites based on forage quality. Grazing by Orinoco Geese and capybara (*Hydrochaeris hydrochaeris*) reduced plant availability but had no effect on plant protein concentrations. Plants that were grazed, however, had lower concentrations of acid-detergent fiber than plants that were not grazed. Conservation efforts to protect populations of Orinoco Geese, therefore, should protect existing cespitoso habitat and establish flooded savannas and permanent water sources that promote the growth of higher-quality forage during the dry season.

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Field Choice of Aleutian Canada Geese In Relation To Food Quality and Habitat Management At Humboldt Bay National Wildlife Refuge.

DOMINIC C. BACHMAN[1]**

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Since the late 1990's Aleutian Canada geese (*Branta canadensis leucopareia*) spring staging in northern California have become agricultural pests by grazing livestock pastures. The most satisfactory solution appears to be the creation of highly managed refuge areas or alternative feeding areas. The Humboldt Bay National Wildlife Refuge is attempting to increase the quality of habitat for goose foraging on the refuge. The work described here was a field experiment to investigate the interaction between food quantity and quality of grass swards, and how this influences their use by Aleutian Canada geese. During February through April 2003-2004 goose grazing intensity was quantified using dropping counts in two treatment areas. One Treatment area was livestock grazed and the other was mechanically hayed. Sward surface height and grass crude protein levels were quantified for each field. Overall use of the cattle grazed areas was much higher than in the mowed areas. Crude protein levels in grass were higher in cattle grazed areas than in mowed areas. Once the sward grew >12 cm geese were no longer seen feeding in those areas. Applications of this research for the management of Aleutian Canada goose refuges are discussed.

The Aleutian Canada Goose Story From Endangered To Exploding

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The Aleutian Canada goose (*Branta canadensis leucopareia*) is a subspecies of the Canada goose that migrates from summer breeding areas in Alaska to major winter foraging areas in California. In 1967 the Aleutian Canada goose population was estimated at only a few hundred individuals. It was one of the first species to be put on the endangered species list and also one of the greatest success stories of the ESA. The U. S. Fish and Wildlife service has been intensively monitoring this goose population since 1975 when the Aleutian Canada goose recovery program began. Throughout the 1990's the Aleutian Canada goose population increased rapidly at an average rate of 20% per year. In 2001 the species was considered recovered and removed from the endangered species list. The spring 2004 population was estimated at more than 70,000 geese. Coastal pastures in Northern California and Southern Oregon serve as feeding grounds for spring staging geese as they prepare for their return to the breeding grounds. The majority of these pastures are in private ownership. Increasing populations of geese using these pastures is currently causing conflicts between local private landowners and geese.

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The Greater Snow Goose: A New Sustainable and Integrated Management Plan.

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The Greater Snow Goose (GSG) spring population has increased from less than 50,000 birds in late 1960's to about 800,000 in 1998, representing at that time, a population growth rate of about 9% per year, due to change in land use on the wintering and staging grounds, and climate warming . It was then predicted that the population would reach more than 1 million birds by 2002 if no management actions were taken. Consequently, on the basis of the recommendations of the AGJV-GSG Habitat Working Group, the Canadian Wildlife Service (Québec region) launched in spring 1999 an Action plan aiming at stopping the growth of the population. A stabilization of the population was observed, the Plan implementation was a success, both in terms of results achieved and of partnerships formed, but overabundance conditions are still present. Therefore, the current issues are 1) to review and refine the management objective, 2) adapt our actions to new circumstances, and 3) implement a new management framework that is not only integrated (ecological integrity of natural marsh habitat, crop damages, economic impact of hunters and bird observations, etc.) but sustainable. The basics conditions of this new sustainable and integrated management plan is to maintain a healthy GSG population, with an clear objective population that is recognized by all, based on a adaptive population management, with a target population that lean on biological and social carrying capacities, an optimal management of natural habitat and preventive crop damage programs.

Evidence of Source-Sink Dynamics In A Suburban Canada Goose (*Branta Canadensis*) Population

MICHAEL L. USAI

City University of New York Ph.D. Program in Biology

To study population structure and dispersal, Canada Goose goslings were banded between 2000 and 2004 with red tarsal bands in Rockland County, New York. A matrix of dispersal probabilities where 95% of dispersal events occurred (subpopulations) was created showing seven subpopulations. There is a high level of movement within subpopulations and low-levels of immigration and emigration. The Hackensack River Population (HRP) is within the Town of Clarkestown, which has an active management program. Lethal takes in the past have eliminated local goose flocks and the egg addling program has been highly successful in reducing gosling production. The HRP has the lowest gosling production, highest immigration and low emigration rates, while subpopulations with high gosling production have higher emigration and low immigration. Despite the management program, the population in the HRP has remained stable since the lethal takes. Management in HRP has created a sink into which birds are dispersing. A metapopulation model is being developed to predict the effects of a source-sink system on the countywide goose population and to determine the feasibility of using these dynamics to manage geese at a regional level.

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Estimating Identification Error for Similar Subspecies: Distinguishing Tule Greater White-Fronted Geese In The Pacific Flyway

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Identification error is a source of bias for estimating population sizes of similar subspecies. We estimated identification error for Tule greater white-fronted geese (*Anser albifrons elgasi*) with a double-observer survey. We used a Bayesian approach adapted from medical research to compare results from two observers examining the same geese. We estimated probabilities of an observer correctly classifying a greater white-fronted goose as a Tule or Pacific (*A. a. frontalis*) subspecies. The approach uses a multinomial distribution with cell probabilities corresponding to rates of correct and incorrect identification. We used the WinBUGS program to conduct Markov Chain Monte Carlo simulations to estimate these rates. Bayes' rule was applied to estimate correct identification conditional on the observers' classification. We had observers with limited experience conduct field tests along Tule survey routes in the Central Valley in the early spring of 2004. Among birds classified as Tule geese, the analysis indicated that 87% (SE = 11%) of birds were likely Tule geese. Among birds classified as Pacific geese by both observers, an estimated 8.4% (SE=8.9%) were likely Tule geese. These estimates may be improved by including observer experience levels and another classification level (birds with "intermediate" characteristics) in a multidimensional model.

Washington Brant Foundation: Preserving Brant Legacy on Our Pacific Coast

MAYNARD AXELSON

Washington Brant Foundation, 15758 Fir Island Road, Mount Vernon, WA 98273

Washington Brant Foundation is a non-profit organization involved in education, research, and habitat enhancement programs for marine waterfowl. Our focus is brant due to their singular dependence on specific dwindling estuarine areas along the Pacific Coast. In April 2005, we will host our third annual Brant Festival near Blaine, WA to mark spring migration through this important staging area. Presentations at local schools, conservation groups, and the Padilla Bay Estuarine Reserve have been ongoing. Since 2002 WBF's website has received more than five thousand visits. Future goals include specific research, as well as habitat preservation or enhancement projects here in Puget Sound. The Foundation board believes heightened awareness of brant needs will lead to less degradation, disturbance, and loss of habitat for them and other marine species. Please consider joining our quest to preserve and perhaps enhance this distinctive part of our marine heritage.

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Composition of Canada Goose Harvests In Michigan 1998-2002: A Genetic Analysis Over Different Spatial And Temporal Scales

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Harvest management for Canada geese (*Branta canadensis* and *B. hutchinsii*) attempts to meet species, population, and resource user goals by maintaining viable breeding populations that allow for sustained harvests. We demonstrate the utility of joint use of standardized parts collections and genetic-based analyses for harvest derivations in states and provinces across North America and elsewhere, where genetically differentiated subspecies and populations co-occur during migration and harvest. We utilized tail fan samples collected through the U. S. Fish and Wildlife Service Parts Survey and maximum likelihood methods to estimate proportional contributions of subspecies and breeding populations of Canada geese to five annual harvests (1998-2002) in Michigan. We genetically characterized breeding populations of Richardson's (*B. h. hutchinsii*, $n = 1$), interior (*B. c. interior,* $n = 4$), and giant (*B. c. maxima,* $n = 8$) Canada geese (total $n = 964$ individuals), and a large sample of geese harvested throughout Michigan ($n = 2272$ over 5 annual harvests). Harvests of different subspecies and population varied significantly among years, among time periods within a year, and spatially among different management zones. Data provide estimates of migratory timing and of differential susceptibility to harvest on spatial and temporal scales necessary for management.

Response of Greater White-Fronted Geese To The Central Valley Joint Venture: Change In Wintering Ecology Over A Decade

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We investigated the response of Greater White-fronted Geese (*Anser albifrons frontalis*) to the Central Valley Joint Venture by comparing goose movements, distribution, and habitat use during the winters of 1987–1990, before major habitat changes occurred, and 1998–2000, after a decade of habitat change. Using radio telemetry, we tracked 192 female geese and recorded 4,516 locations. Geese traveled shorter distances between roosting and feeding sites during 1998–2000 (24.2±2.2 km) than during 1987–1990 (32.5±3.4 km). Population range size was more concentrated during 1998–2000 (3,367 km^2) than during 1987–1990 (5,145 km^2), despite a 2.2-fold increase in population size. Distributions of geese differed between decades; geese shifted into basins with the greatest increases in rice production (American Basin) and out of other basins (Delta Basin). Use of rice fields for roosting (1987–1990: 40%, 1998–2000: 54%) and feeding (1987–1990: 57%, 1998–2000: 72%) increased between decades, whereas use of wetlands declined. Within post-harvested rice fields, geese roosted and fed primarily within burned rice fields during 1987–1990 (roost: 43%, feed: 34%) whereas they used flooded rice fields during 1998–2000 (roost: 78%, feed: 64%). Our results indicate that geese have altered their spatial use of California's Central Valley in response to recent habitat changes related to the Central Valley Joint Venture and current agricultural practices.

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Heart Rates of Tule Greater White-Fronted Geese In Response To Human Disturbance Using Radio Telemetry

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We monitored the heart rates of free-living Tule Greater White-fronted Geese (*Anser albifrons elgasi*) during human disturbances on their wintering range in the Sacramento Valley of California during 1997. We used implanted radio transmitters to record the heart rates of geese as an observer experimentally approached them at a constant walking speed. Change point regression was used to identify the point in time when heart rate abruptly increased prior to flushing and when heart rate began to level off in flight after flushing. Heart rate increased as the observer approached the radio-marked goose, from 114.1±6.6 beats/min during the observer's initial approach to 154.8±7.4 beats/min just prior to flushing at the first change point. On average, goose heart rates began to increase most rapidly 5 sec prior to taking flight, and continued to increase rapidly for 4 sec after flushing until they reached flight speed. Heart rate was 456.2±8.4 beats/min at the second change point, which occurred immediately after flushing, and 448.3±9.5 beats/min a minute later during flight. Although heart rates of geese increased as an observer approached, the largest physiological change occurred during a 9-sec period (range: 1.0–15.7 sec) immediately before and after flushing when heart rates nearly tripled.

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Gizzard Content as Evidence Of Black Brant Staging Areas

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Black brant (*Branta bernicla nigricans*) migrate every year from their breeding grounds in Alaska, south to the bays of Mexico, and then stage within bays along the coast of California, Oregon, Washington, and British Columbia on their return migration north. At each of these locations brant feed primarily on eelgrass (*Zostera marina*) and use specific sites to ingest grit to aid in digestion. The rate of passage of grit may be frequent, but residual rock and mineral material will yield evidence of previous staging areas visited by a particular Black brant. The objectives of this study are to 1) create a baseline reference of rock and mineral composition for confirmed grit ingestion sites at known Black brant staging bays, 2) analyze gizzard content of Black brant obtained from Humboldt Bay for residual rock and mineral fragments to compare to other bays, and 3) conduct band observations to find how many resightings could be obtained for potential future studies that would involve comparison of gizzard content of brant that have been in Humboldt for a known duration of time.

Spatial and Temporal Patterns Of Lake Use By Molting Geese In The Teshekpuk Lake Special Area

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The Teshekpuk Lake Special Area (TLSA) in northern Alaska contains approximately 200 lakes used annually during wing molt by up to 100,000 geese representing 4 species. Aerial surveys of these lakes during July were conducted during 1976-1978 and 1982-2004. High annual variability in counts exists as migration to the TLSA for wing molt is dependent on reproductive success in other areas, particularly for Black Brant. Despite such variability, notable patterns emerge in goose use of the TLSA. Black Brant are distributed more in the eastern portion of the TLSA, Greater White-fronted Geese in the western portion, and Canada Geese evenly distributed throughout. Coincident with a large increase in numbers of white-fronted geese (7-fold), the distribution of brant is shifting more easterly. Canada Geese and Black Brant have remained relatively stable throughout the survey, and Snow Geese occur in very small numbers, but have begun an exponential increase. Habitats are changing due to water level fluctuations, coastline erosion, and salt-water intrusion into drained lake basins. In 2004, we initiated studies of how habitats are changing and its correspondence with goose distribution. In particular, we are assessing whether distributional changes in Black Brant are related to competitive exclusion by White-fronted Geese or shifts in optimal foraging habitat.

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Brant in Ontario and Western James Bay

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A significant proportion of the Atlantic Brant (*Branta bernicla hrota*) population uses western James Bay enroute between the US Atlantic coast and the eastern Canadian Arctic. One-day spring surveys counted up to 24,000 birds, mostly in salt marshes. Peak numbers occur from mid May to mid June. Historically, brant use offshore eel grass habitats in fall. Fall aerial surveys in the 1970s and 1980s, although not designed to count brant offshore, regularly tallied more than 10,000 birds; one-day ground count of migrants yielded an estimate of 40,000. Brant arrive as early as the third week of August and stay until late October. South of James Bay in Ontario, migration is often nocturnal and relatively small numbers are seen regularly in Lake Ontario, Lake Erie, the Ottawa Valley, and Lake Temiskaming, from mid April to late May and from mid October to early November. In exceptional years, brant are more widely dispersed throughout Ontario, possibly related to food or weather events. Brant are not established as a breeder in this region. The objective of this presentation is to provide a synthesis of the information available on the occurrence and status of brant in Ontario and western James Bay since the 1950s.

Abundance and Distribution of Spring-Staging Lesser Snow and Ross's Geese in Nebraska's Rainwater Basin

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[1]Nebraska game and parks commission, wildlife division, Lincoln, NE

The number of lesser snow (*Chen caerulescens*) and Ross's (*Chen rossii*) geese (hereinafter light geese) staging during spring in the Rainwater Basin (RWB) region of southcentral Nebraska has dramatically increased since the late 1980s. However, there has been no documentation as to abundance or distribution of light geese across the RWB and the relationship of distribution to conservation order activities. We used aerial transect surveys and distance sampling methodology to estimate abundance and distribution of light geese in the RWB in springs 2001-2003. In 2001 at peak migration, we estimated approximately 7.3 million light geese to be in the RWB. There were approximately 1.2 and 1.6 million light geese at peak migration in 2002 and 2003, respectively. Distribution did not appear to change in relation to conservation order activities. However, there was an increased use of the Platte River Valley during 2002 and 2003 due to drought. The RWB has become a major spring staging area for light geese. Abundance and distribution appears to be related to water conditions and migration chronology.

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Optimal Grit Acquisition by Black Brant

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Brant (*Branta bernicla nigricans*) arriving at spring stopover areas are under energetic demands to build-up endogenous nutrient reserves for migration and breeding efforts. To understand how brant meet these demands, research has focused on questions relating to foraging efficiency, feeding site selection, and disturbance. Little attention has been given to the importance of gritting sites at staging areas. Grit facilitates the mechanical breakdown of ingested plant materials, aiding efficient digestion and potentially playing a significant role in the daily energy budget decisions made by brant. We investigated whether brant obtained grit in an optimal manner at the primary gritting site in Humboldt Bay, CA. We will present comparisons of brant attendance, distribution, and flock behaviors with GIS-interpolated values of sand grain size and percent calcium carbonate of grit at the site.

Barnacle Goose Movements and Fidelity Among Sites

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Relative fighting ability or social status may influence the distribution of unequal competitors. In goose societies, dominant birds may experience enhanced foraging opportunities, resulting in improved reproductive success. As arctic-breeding geese migrate towards their breeding grounds, spring staging areas provide feeding opportunities that are crucially important to reproductive success. We studied spring staging site fidelity and movement of barnacle geese (*Branta leucopsis*) on three islands of differing habitat quality. Yearlings and young-adults had the highest movement probabilities in every case, with movements being least likely in adults. Site fidelity probabilities varied, with the New (high quality) site having the highest site fidelity probabilities, while Degraded and Control sites had much lower fidelity for all age classes. The probability of changing spring staging site decreased with age, body size, and reproductive success in the previous season. Our results show that young geese are most likely to cause the shift in distribution when habitat quality deteriorates, while older geese tend to remain in traditionally used sites.

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Flock Size And Field Use Of Aleutian Cackling Geese During Spring Staging

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The Aleutian cackling goose (*Branta hutchinsii leucopareia*) (Aleutians from here on) is one of four living races of cackling geese. Aleutians have extended their traditional spring staging area to Loleta, CA and Arcata, CA(40°53'N, 124°07'W). A total of 31 days were spent collecting data between 9 February and the 11 April 2004. Flock size and locations at sunrise, midday, and sunset were recorded every other day while the geese were present at the study site. Average flock size for sunrise, midday, and sunset time periods were 260, 126, and 436 respectively. There was significance difference between sunrise and midday time periods ($df = 2$, $p < 0.01$, and $F = 7.72$), sunset and sunrise time periods ($df = 2$, $p < 0.01$, and $F = 7.72$), and midday and sunset time periods ($df = 2$, $p < 0.01$, and $F = 7.72$). Total number of fields used peaked in the midday time period with 180 fields. Significance was found between the sunrise and midday time periods ($df = 2$, $t = 8.14$, and $p = 0.015$), and sunset and midday time periods ($df = 2$, $t = 8.14$, and $p < 0.01$). This study suggests that with the rapid increase in Aleutian population numbers any available habitat needs to be set aside under a CRP type program for their continued growth.

Priority Sites For Waterfowl In Mexico

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A set of priority sites for waterfowl conservation in Mexico was determined using contemporary count data (1991-2000) from the U.S. Fish & Wildlife Service mid-winter surveys. We used a complimentarily approach implemented through linear integer programming that addresses particular conservation concerns for every species included in the analysis and large fluctuations in numbers through time. A set of 31 priority sites was identified, which held more than 69% of the mid-winter count total in Mexico during all surveyed years. Six sites were in the northern highlands, 12 in the central highlands, six on the Gulf of Mexico coast, and seven on the upper Pacific coast. Twenty-two sites from the priority set have previously been identified as qualifying for designation as wetlands of international importance under the Ramsar Convention and 20 sites are classified as Important Areas for Bird Conservation in Mexico. We also present population trends of 24 waterfowl species in Mexico. The information presented here provides an accountable, spatially-explicit, numerical basis for ongoing conservation planning efforts in Mexico, which can be used to improve existing waterfowl conservation networks in the country, and can also be useful for conservation planning exercises elsewhere.

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History and Current Trends Of Grain Sorghum Production And Wintering Geese In Tamaulipas, México.

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Universidad Autónoma de Tamaulipas

Tamaulipas, Mexico contains important North American wintering habitats for a large population of Snow Geese (*Chen caerulescens*) and White-fronted Geese (*Anser albifrons*), and also ranks first in sorghum production within the country. This agricultural activity, coupled with associated irrigation and construction of reservoirs, supports this wintering goose population. This study was held from October 2001 to March 2002 in 3 study areas of 900 Km^2 each, located in north, central and southern Tamaulipas. [1] It determined seasonal and land tenancy availability of waste sorghum. [2] The study also document and evaluate the agricultural history, goose population density and land-use practices of the state and [3] finally estimated goose numbers in association with sampling of waste sorghum fields. Results indicated that there was a difference in waste sorghum among the study areas. The relationship between goose numbers and the total area of harvested sorghum during the same period was significant, and adding the area of harvested corn was higher significant. There was no difference in waste sorghum based on land tenancy, but there was an interaction of land tenancy and study area. A historical comparison of goose populations in Tamaulipas revealed that the change began in 1970s which is related also to the increasing grain crop area in the state. Overall, policy and management of natural resources in Mexico have affected the future of winter habitats for waterfowl, and especially affected goose wintering habitats in Tamaulipas.

Acknowledgments to G .A. Baldassarre (SUNY-ESF), W. D. Eldridge and J. Haskins (FWS), M.A Lara and A.Carreón (Universidad Autónoma de Tamaulipas) and The Wildlife Management Institute.

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